TELEVISION

SERVICING · CONSTRUCTION · COLOUR · DEVELOPMENTS

25p

JANUARY
1975

VIDEO CIRCUITS & FAULTS part 1

Clear up these picture faults and enjoy a good clean picture!

Also:~

REMOTE CONTROL SYSTEM
FAST-ACTING AGC CIRCUIT
BRC 950 LINE TIMEBASE FAULTS
FORGESTONE COLOUR RECEIVER REVIEW

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OB2	0·40
OZ4	0·47
1A3	0·45
1A5GT	0·50
1A7GT	0·65
1B3GT	0·50
1D5	0·60
1D6	0·60
1G6	1·00
1H5GT	0·60
1L4	0·28
1LD5	0·60
1LN5	0·60
1N5GT	0·65
1R5	0·45
1S4	0·33
1S5	0·30
1U4	0·60
1U5	0·75
2D21	0·45
2X2	0·60
2GK5	0·55
6AM8A	0·55
6AN8	0·70
6AQ5	0·45
6AR5	0·60
6AR6	1·00
6AT6	0·45
6AU6	0·30
6AV6	0·45
6AW8A	0·95
6AX4	0·75
6B8G	0·30
6BA6	0·28
6BC8	0·60
6BE6	0·35
6BG6G	1·05
6BH6	0·60
6BJ6	0·55
6BK7A	0·60
6BQ5	0·31
6BQ7A	0·55
6BR7	1·00
6BR8	1·50
6F13	0·70
6F14	0.75
6F15	0·65
6F18	0·55
6F23	0·80
6F24	0·85
6F25	1·00
6F28	0·67
6F32	0·50
6G6G	0·50
6GH8A	0·75
6GK5	0·65
6GU7	0·75
6H6GT	0·25
6J5GT	0·45
6J6	0·30
6J7G	0·30
6J7(M)	0·45
6JU8A	0·75
6K7G	0·30
6K8G	0·45
6L1	2·00
6Y6G	0·60
6Y7G	1·00
7A7	1·00
7B6	0·75
7B7	0·70
7C7	1·00
7F8	1·50
7H7	0·75
7R7	0·80
7V7	1·50
7Y4	0·75
7Z4	0·80
9BW6	0·75
9D7	0·65
10C2	0 65
10DE7	0·75
10F1	0·75
10F9	0·65
10F18	0·55
10LD11	·70
10P13	0·75
10P14	2·00
12SQ7GT	·65
12SR7	0·75
14H7	0·55
14S7	0·80
19AQ5	0·50
19G6	6·00
19H1	2·00
20D1	0·60
20D4	2·00
20F2	0·75
20L1	1·10
20P1	. 0·55
20P3	0·80
20P4	1·00
20P5	1·30
25A6G	0·60
25L6GT	·60
25Y5	0·80
25Y5G	0·70
25Z5	0·80
25Z6GT	·70
28D7	1·00
35W4	0·50
35Z3	0·75
35Z4GT	·70
35Z5GT	·75
42	0·50
50B5	0·85
50C5	0·60
50CD6G	1·25
50EH5	0·75
50L6GT	·65
72	0·60
77	0·53
85A2	0·60
85A3	0·60
90AG	2·50
90CG	2·40
90CV	2·40
90C1	0·75
150B2	0·75
807	0·59
4033X	6·00
BL63	2·00
CL33	1·60
CV6	0·53
CV63	0·75
CY1C	1·00
CY31	0·50
D63	0·25
DAF96	0·50
DC90	0·60
DD4	1·00
DF91	0·30
DF96	0·50
DH63	0·50
DH77	0·45
DH81	0·75
DK40	0·70
DK92	0·70
DK96	0·60
DL96	0·55
DM70	0·60
DM71	1·50
DW4/500	£1
EB91	0·20
EBC41	0·75
EBC81	0·35
EBC90	0·45
EBC91	0·45
EBF80	0·39
EBF83	0·43
EBF89	0·32
EBL21	2·00
EC52	1·00
EC53	1·00
EC54	1·00
EC86	0·70
EC88	0·70
EC92	0·45
ECC32	1·50
ECC33	1·50
ECC35	0·95
ECC40	1·00
ECC81	0·34
ECC82	0·34
ECC83	0·33
ECC84	0·30
ECC85	0·40
ECC86	0·85
ECC88	0·44
ECC189	·65
ECC804	·80
ECF80	0·45
ECF82	0·45
ECF86	0·75
EF83	1·00
EF85	0·34
EF86	0·45
EF89	0·27
EF91	0·37
EF92	0·50
EF97	0·80
EF98	0·80
EF183	0·30
EF184	0·35
EF804	1·25
EFP60	2·00
EH90	0·55
EL32	0·50
EL34	1·00
EL35	2·50
EL37	2·50
EL41	0·90
EL81	0·60
EL83	0·55
EL84	0·31
EL85	0·44
EL86	0·38
EL91	0·50
EL360	1·20
EL506	0·90
ELL80	1·25
EM80	0·45
EM81	0·65
EM83	0·55
EM84	0·40
GY501	0·70
GZ30	0·45
GZ32	0·50
GZ33	1·25
GZ34	0·60
GZ37	1·00
HABC80	0·60
HL23	0·60
HL23DD	·75
HL41	1·00
HL41DD	£2
HL42DD	£2
HN309	1·50
HVR2	1·00
HVR2A	£1
IW4/350	£1
IW4/500	£1
KT2	0·75
KT8	2·50
KT41	1·00
KT44	1·00
KT63	0·50
KT66	2·50
KT81	2·00
KTW61	1·50
KTW62	1·50
KTW63	1·00
M8162	1·00
MHL4	0·75
MHLD6	£1
PCF86	0·60
PCF801	·50
PCF802	·50
PCF805	·80
PCF806	·50
PCF808	·78
PCH200	·80
PCL82	0·38
PCL83	0·50
PCL84	0·45
PCL85/805	0·55
PCL86	0·47
PCL88	1·10
PEN4DD	2·00
PEN45	0·80
PEN45DD	0·80
PEN46	0·50
PEN453DD	2·00
PENA4	1·00
PEN/DD/4020	2·00
PFL200	·70
PL33	0·50
PL36	0·60
PL81	0·50
PL81A	0·55
PL82	0·37
PY800	0·40
PY801	0·40
PZ30	0·48
QQV03/10	1·75
QS75/20	1·00
QS95/10	1·00
QS150/15	1·50
QVO4/7	1·00
R16	1·75
R17	0·88
R18	0·70
R19	0·60
R20	0·66
R52	0·45
RK34	1·00
TH4B	1·00
TH233	1·00
TP22	1·00
TP25	1·00
TP2620	1·00
UABC80	0·40
UAF42	0·60
UBC41	0·60
UBC81	0·45
UBF80	0·40
UBF89	0·40
UBL21	0·77
UR1C	1·00
UU5	1·00
UU12	0·29
UY41	0·45
UY85	0·35
U10	1·00
U12/14	1·00
U16	1·00
U17	0·75
U18/20	1·00
U19	2·50
U22	0·75
U25	0·85
U26	0·66
U31	0·40
U33	1·50
U35	1·50
U37	1·75
U45	1·00
U50	0·45
U76	0·70
U78	0·40
U81	0·80
U191	0·75
U193	0·40
U251	0·80
U281	0·90
U282	0·55
U301	0·65
U403	0·75
U404	0·55

VALVES ALSO REQUIRED FOR CASH. LOOSE OR BOXED, BUT MUST BE NEW. OFFERS MADE BY RETURN.

3A4	0·50
3B7	0·45
3D6	0·40
3Q4	0·60
3Q5GT	0·55
3S4	0·40
3V4	0·70
4CB6	0·55
5CG8	0·55
5R4GY	0·80
5T4	0·40
5U4G	0·40
5V4G	0·50
5Y3GT	0·45
5Z3	0·75
5Z4G	0·45
5Z4GT	0·45
6/30L2	0·80
6A8G	1·25
6AC7	0·49
6AG5	0·27
6AH6	0·60
6AJ5	0·65
6AK5	0·40
6AK6	0·60
6BS7	1·40
6BW6	0·80
6BW7	0·70
6BZ6	0·49
6C4	0·35
6C5G	0·50
6C6	0·40
6C9	1·00
6C12	0·33
6C17	2·00
6CB6A	0·40
6CD6G	1·25
6CG8A	0·75
6CL6	0·65
6CL8A	0·80
6CM7	0·75
6CU5	0·75
6CW4	1·00
6D3	0·60
6DE7	0·75
6DT6A	0·75
6EW6	0·75
6E5	1·00
6F1	0·75
6F6G	0·50
6L6GT	0·58
6L7	0·50
6L18	0·55
6L19	2·00
6LD20	0·75
6N7GT	0·60
6P15	0·31
6Q7G	0·50
6Q7(M)	0·55
6Q7GT	0·50
6R7	0·75
6R7G	0·60
6SA7	0·44
6SC7GT	·33
6SG7	0·44
6SH7	0·44
6SJ7	0·55
6SK7GT	·44
6SQ7GT	·45
6U4GT	0·70
6U7G	0·45
6V6G	0·17
6V6GT	0·45
6X4	0·40
6X5GT	0·45
12A6	1·00
12AC6	0·70
12AD6	0·65
12AE6	0·65
12AT6	0·40
12AT7	0·34
12AU6	0·45
12AU7	0·33
12AV6	0·50
12AX7	0·33
12BA6	0·45
12BE6	0·50
12BH7	0·50
12E1	3·00
12J5GT	·33
12J7GT	·60
12K5	1·00
12K7GT	·50
12Q7GT	·45
12SA7GT	·55
12SC7	0·50
12SG7	0·40
12SH7	0·35
12SJ7	0·44
12SN7	0·60
30A5	0·65
30C1	0·40
30C15	0·80
30C17	0·80
30F5	0·80
30FL1	0·67
30FL2	0·67
30FL13	·55
30FL14	·78
30L1	0·40
30L15	0·75
30L17	0·70
30P4MR	1·00
30P12	0·80
30P19/30P4	0·75
30PL1	0·85
30PL12	·38
30PL13	·95
30PL14	1·10
30PL15	·90
35A3	0·65
35D5	0·75
35L6GT	·75
5702	1·00
6057	1·00
6060	1·00
6067	1·00
7193	0·63
7475	1·00
9002	0·50
9006	0·30
A1834	1·00
A2134	1·00
A3042	1·00
AC2/PEN	1·00
AC6/PEN	60
AC2/PEN/DD	1·00
AC/PEN(7)	1·00
AC/TH1	1·00
AL60	1·00
ARP3	0·60
ATP4	0·50
AZ1	0·25
AZ31	0·60
AZ41	0·25
DY87/6	0·35
DY802	0·35
E80CC	2·20
E80F	1·40
E83F	1·30
E88CC	0·75
E92CC	0·60
E180CC	·70
E180F	1·00
E182CC	1·25
E1148	0·53
EA50	0·27
EA76	1·00
EABC80	·38
EAC91	0·75
EAF42	0·75
EAF801	·75
EB34	0·25
ECF804	2·25
ECH21	2·00
ECH35	1·25
ECH42	0·70
ECH81	0·33
ECH83	0·44
ECH84	0·44
ECL80	0·55
ECL82	0·34
ECL83	0·70
ECL84	0·60
ECL85	0·60
ECL86	0·40
EF22	1·50
EF40	0·75
EF41	0·70
EF42	0·70
EF80	0·26
EM85	1·00
EM87	0·70
EMM803	2-00
EY51	0·40
EY83	0·54
EY84	0·70
EY87	0·33
EY88	0·40
EY91	0·58
EZ40	0·50
EZ41	0·55
EZ80	0·28
EZ81	0·29
FC4	1·00
FW4/500	1·00
FW4/800	£1
N339	1·10
P61	0·50
PABC80	·38
PC86	0·60
PC88	0·60
PC95	0·60
PC97	0·38
PC900	0·48
PCC84	0·40
PCC85	0·44
PCC88	0·60
PCC89	0·50
PCC189	0·57
PCC805	0·75
PCC806	0·70
PCF80	0·40
PCF82	0·35
PCF84	0·59
PL83	0·45
PL84	0·40
PL504/500	0·75
PL505	1·45
PL508	0·90
PL509	1·45
PL802	0·95
PM84	0·65
PY33/2	·50
PY80	0·40
PY81	0·35
PY82	0·35
PY83	0·38
PY88	0·40
PY301	0·75
PY500	0·95
PY500A	·95
UC92	0·45
UCC84	0·75
UCC85	0·45
UCF80	0·70
UCH21	2·00
UCH42	0·75
UCH81	0·40
UCL82	0·38
UCL83	0·55
UF41	0·70
UF42	0·70
UF80	0·35
UF85	0·44
UF86	1·00
UF89	0·40
UL41	0·75
UL84	0·42
UM80	0·44
U801	0·85
U4020	0·60
VP13C	0·60
VP23	0·75
VP41	0·75
VR105	0·50
VT61A	0·65
VU111	0·80
VU120	£1
VU120A	£1
VU133	0·80
W107	1·00
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PLEASE NOTE:

- ALL TUBES GUARANTEED
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All sets with guaranteed tubes and guaranteed complete from **£55.00**

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2. WE DO **NOT** SELL RUBBISH
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6. ALL PRICES SUBJECT TO V.A.T. and DELIVERY
7. NO CONNECTION WITH ANY OTHER COMPANY

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Working	*Untested but guaranteed complete*
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All plus p. & p., V.A.T.—£1.50
All tubes guaranteed

TUBES

19"—**£3.00**
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(in makers' cartons—fully guaranteed—less batteries)

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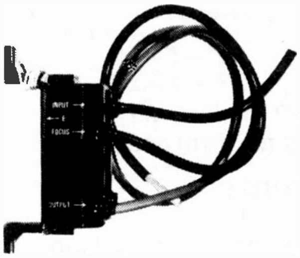

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PYE CT72 SERIES 691, 693, EKCO CT103, CT120, CT105, CT125, CT121, CT122. GEC 2028, 2029, 2030 SOBELL 1028, 1029, TS25, 11TAZ	£3.00+24p V.A.T.
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PYE TRANSISTOR TUNER UNITS VHF, UHF. *No* push button assembly	£1.50+12p V.A.T.
PHILIPS UHF UNIT	£1.50+12p V.A.T.
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22 MFD, 315V/W Condensers 25 MFD, 300V/W, 470MFD 35 V/W 10 MFD, 250 V/W. 1000 PF 8Kv	10p+1p V.A.T.
200+100 MFD, 325 V/W	30p+2p V.A.T.
200+200+100, 325 V/W	40p+3p V.A.T.
200+100+50+100	40p+3p V.A.T.
300+200+100 MFD, 350 V/W	50p+4p V.A.T.
200+200+100 MFD, 350 V/W	50p+4p V.A.T.
100 W/W Resistor	£1.00+8p V.A.T.
300 Mixed Condensers	£1.00+8p V.A.T.
350 Mixed Resistors	£1.00+8p V.A.T.
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MANUFACTURERS DISCARDED MATERIALS

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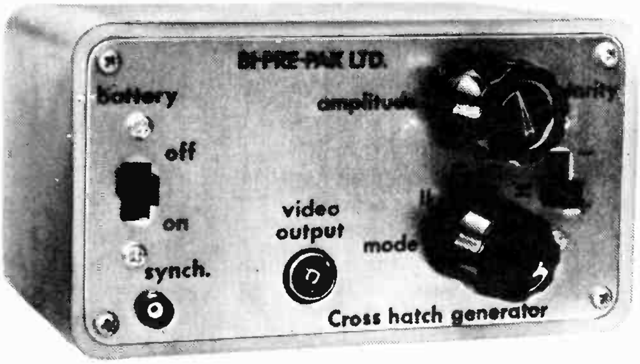

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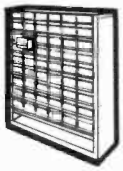

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AC152	0.25
AC153K	0.28
AC154	0.20
AC176	0.25
AC187	0.25
AC187K	0.25
AC188	0.25
AC188K	0.26
AC193K	0.30
AC194K	0.32
ACY28	0.25
ACY39	0.68
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AD142	0.52
AD143	0.51
AD149	0.50
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AD162	0.48
AF114	0.25
AF115	0.25
AF116	0.25
AF117	0.20
AF118	0.50
AF121	0.30
AF124	0.25
AF125	0.20
AF126	0.20
AF127	0.20
AF139	0.35
AF147	0.35
AF149	0.45
AF178	0.55
AF179	0.60
AF180	0.55
AF181	0.50
AF186	0.40
AF239	0.40
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AL102	1.10
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BC107	0.12
BC107A	0.13
BC107B	0.14
BC108	0.12
BC108B	0.13
BC109	0.13
BC109C	0.14
BC113	0.13
BC114	0.20
BC115	0.20
BC116	0.20
BC117	0.20
BC119	0.29
BC125	0.22
BC125B	0.25
BC126	0.20
BC132	0.15
BC134	0.20
BC135	0.15
BC136	0.20
BC137	0.20
BC138	0.20
BC142	0.30
BC143	0.35
BC147B	0.13
BC148	0.12
BC149	0.14
BC152	0.25
BC153	0.20
BC154	0.20
BC157	0.15
BC158	0.13
BC159	0.15
BC161	0.48
BC167B	0.15
BC168B	0.13
BC169C	0.13
BC170	0.15
BC171	0.15
BC172	0.14
BC173	0.20
BC176	0.22
BC177	0.20
BC178	0.22
BC178B	0.22
BC179	0.20
BC179B	0.21
BC182L	0.11
BC183	0.11
BC183K	0.12
BC183L	0.11
BC184L	0.13
BC186	0.25
BC187	0.25
BC208	0.12
BC212L	0.12
BC213L	0.12
BC214L	0.15
BC238	0.10
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BC262A	0.18
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BC267	0.16
BC268C	0.14
BC294	0.27
BC300	0.58
BC301	0.35
BC303	0.60
BC307B	0.12
BC308A	0.10
BC309	0.15
BC323	0.38
BC377	0.22
BC441	1.10
BC461	1.58
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BCY42	0.16
BCY71	0.22
BCY88	2.42
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BD132	0.50
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BD137	0.48
BD138	0.50
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BD144	2.19
BD145	0.75
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BD234	0.75
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BD520	0.76
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BF121	0.25
BF123	0.28
BF125	0.25
BF127	0.30
BF158	0.25
BF159	0.27
BF160	0.22
BF161	0.45
BF162	0.45
BF163	0.45
BF167	0.25
BF173	0.25
BF177	0.30
BF178	0.33
BF179	0.33
BF180	0.35
BF181	0.33
BF182	0.44
BF183	0.44
BF184	0.26
BF185	0.26
BF194	0.15
BF195	0.15
BF196	0.15
BF197	0.17
BF198	0.20
BF199	0.25
BF200	0.35
BF218	0.35
BF222	1.08
BF224J	0.15
BF240	0.20
BF241	0.20
BF244	0.18
BF254	0.45
BF255	0.45
BF256	0.45
BF257	0.49
BF258	0.66
BF259	0.93
BF262	0.70
BF263	0.70
BF273	0.16
BF336	0.35
BF337	0.35
BF458	0.46
BF459	0.57
BF596	0.70
BF597	0.15
BFR41	0.30
BFR61	0.30
BFT43	0.55
BFW10	0.55
BFW11	0.55
BFW16A	1.70
BFW30	1.38
BFW59	0.19
BFW60	0.20
BFW90	0.28
BFX16	2.25
BFX29	0.30
BFX30	0.35
BFX84	0.25
BFX85	0.26
BFX86	0.26
BFX87	0.28
BFX88	0.24
BFY18	0.53
BFY40	0.40
BFY41	0.43
BFY50	0.25
BFY51	0.23
BFY52	0.23
BFY57	0.32
BFY64	0.42
BFY72	0.31
BFY90	0.70
BLY15A	0.79
BPX25	1.65
BPX29	1.60
BPX52	1.90
BRC4443	0.60
BRY39	0.42
BR101	0.35
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BSX20	0.19
BSX76	0.15
BSX82	0.52
BSY19	0.52
BSY41	0.22
BSY54	0.50
BSY56	0.80
BSY65	0.15
BSY78	0.40
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BUY78	2.55
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E1222	0.55
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MJE340	0.68
MJE341	0.72
MJE370	0.65
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MJE521	0.95
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MJE3055	0.74
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MPF102	0.40
MPS6566	0.21
MPSA05	0.47
MPSA55	0.50
MPSU05	0.66
MPSU06	0.76
MPSU55	1.26
OC26	0.38
OC28	0.65
OC35	0.50
OC36	0.55
OC42	0.35
OC44	0.15
OC45	0.15
OC70	0.15
OC71	0.15
OC72	0.15
OC73	0.51
OC75	0.25
OC81	0.25
OC81D	0.30
OC139	0.28
OC140	0.30
OC170	0.25
OC171	0.30
OCP71	0.43
ON188	2.19
ON236A	0.65
ORP12	0.55
R2008B	2.05
R2010B	2.10
TAG3/ 400	1.54
TIC44	0.29
TIC46	0.44
TIC47	0.58
TIP29A	0.49
TIP30A	0.58
TIP31A	0.65
TIP32A	0.67
TIP33A	0.99
TIP34A	1.73
TIP41A	0.80
TIP42A	0.91
TIS43	0.30
TIS73	1.36
ZTX109	0.12
ZTX300	0.16
ZTX304	0.22
ZTX310	0.10
ZTX313	0.12
ZTX500	0.17
ZTX502	0.17
ZTX504	0.42
ZTX602	0.24
2N525	0.86
2N696	0.23
2N697	0.15
2N706	0.12
2N706A	0.15
2N708	0.35
2N744	0.30
2N914	0.19
2N916	0.20
2N918	0.42
2N930	0.35
2N1304	0.21
2N1305	0.21
2N1306	0.31
2N1307	0.22
2N1308	0.26
2N1309	0.36
2N1613	0.34
2N1711	0.45
2N1890	0.45
2N1893	0.48
2N2102	0.31
2N2217	0.36
2N2218	0.60
2N2219	0.50
2N2221A	0.41
2N2222A	0.50
2N2369A	0.42
2N2401	0.60
2N2484	0.41
2N2570	0.18
2N2646	0.53
2N2712	0.12
2N2904	0.22
2N2904A	0.26
2N2905	0.72
2N2905A	0.73
2N2926G	0.13
2N2926Y	0.12
2N2926O	0.12
2N3019	0.75
2N3053	0.21
2N3054	0.55
2N3055	0.60
2N3133	0.54
2N3134	0.60
2N3232	1.32
2N3235	1.10
2N3254	0.28
2N3323	0.48
2N3391A	0.23
2N3702	0.13
2N3703	0.15
2N3704	0.15
2N3705	0.11
2N3706	0.10
2N3707	0.13
2N3715	2.30
2N3724	0.72
2N3739	1.18
2N3771	1.70
2N3772	1.90
2N3773	2.90
2N3790	4.15
2N3794	0.20
2N3819	0.35
2N3820	0.49
2N3823	1.45
2N3866	1.70
2N3877	0.25
2N3904	0.16
2N3905	0.18
2N3906	0.15
2N4032	0.31
2N4036	0.52
2N4046	0.35
2N4058	0.17
2N4123	0.13
2N4124	0.15
2N4126	0.20
2N4236	1.90
2N4248	0.12
2N4284	0.19
2N4286	0.19
2N4288	0.13
2N4289	0.20
2N4290	0.14
2N4291	0.18
2N4292	0.20
2N4871	0.24
2N4902	1.30
2N5042	1·05
2N5060	0.32
2N5061	0.35
2N5064	0.45
2N5087	0.32
2M5294	0.35
2N5296	0.37
2N5298	0.38
2N5322	0.85
2N5449	1.90
2N5457	0.30
2N5458	0.35
2N5494	1.85
2N5496	2.05
2N6027	0.65
2N6178	0.71
2N6180	0.78
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3N140	1.21
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AD161/ AD162	0.95
BC142/ BC143	0.70

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AA143	0.10
AAZ13	0.30
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BA102	0.25
BA110U	0.30
BA115	0.12
BA141	0.17
BA145	0.17
BA148	0.17
BA154	0.13
BA155	0.16
BA156	0.15
BA157	0.25
BAX13	0.06
BAX16	0.07
BB103	0.25
BB104	0.45
BB105B	0.45
BB105G	0.35
BR100	0.50
BY100	0.15
BY103	0.22
BY126	0.16
BY127	0.17
BY133	0.23
BY140	1.40
BY164	0.55
BY176	1.00
BY179	0.70
BY206	0.31
BYX10	0.15
BYZ12	0.30
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OA10	0.20
OA47	0.07
OA81	0.12
OA90	0.08
OA91	0.07
OA95	0.07
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IN4003	0.07
IN4004	0.08
IN4005	0.09
IN4006	0.11
IN4007	0.14
IN4148	0.05
IN4448	0.10
IN5400	0.15
IN5401	0.17
IN5402	0.20
IN5403	0.22
IN5404	0.25
IN5405	0.27
IN5406	0.30
IN5407	0.34
IS44	0.07
IS310	0.45
IS920	0.07
IS923	0.12

Diodes can be supplied balanced at a supplement of **5p** per device—e.g. four balanced OA91 would be **£0.48** per set.

Variable capacitance diodes can be supplied matched at a supplement of **3p** per device.

LINEAR INTEGRATED CIRCUITS

Type	Price (£)
CA3045	1.25
CA3046	0.70
CA3065	1.90
MC1307P	1.19
MC1310P	2.94
MC 1327PQ	1.01
MC1330P	0.76
MC1351P	0.75
MC1352P	0.72
MC 1358PQ	1.85
MC1496L	0.87
MC3051P	0.58
MFC 4000B	0.43
MFC 4060A	0.70
MFC6040	0.91
PA263	1.90
SL414A	1.91
SL901A	2.60
SL917B	3.80
SN 76003N	2.92
SN 76013N	1.95
SN76013 ND	1.72
SN 76023N	1.95
SN76023 ND	1.72
SN 76033N	2.92
TAA300	1.46
TAA320	0.94
TAA350	1.54
TAA435	0.85
TAA450	1.85
TAA550	0.49
TAA570	1.39
TAA630Q	3.29
TAA630S	3.29
TAA700	3.30
TAA840	1.64
TAA861A	0.49
TAA100	1.42
TBA120	0.68
TBA120S	0.99
TBA240A	1.10
TBA480Q	1.24
TBA500	1.99
TBA500Q	2.00
TBA510	1.99
TBA520Q	2.72
TBA530	1.98
TBA530Q	1.99
TBA540	2.20
TBA540Q	2.21
TBA550Q	3.29
TBA560C	2.71
TBA 560CQ	2.72
TBA570	1.17
TBA641	0.76
TBA673	1.80
TBA700	1.90
TBA720Q	2.20
TBA750Q	1.54
TBA800	1.75
TBA 810AS	1.75
TBA920Q	3.29
TBA990	3.29
TBA990Q	3.29
TCA270Q	3.30
ZN414	1.25
µ6A995- 159	2.25
709: TO99	0.45
DIL8	0.45
DIL14	0.47
710: DIL14	0.50
711: DIL14	0.62
723: TO100	0.95
DIL14	0.95
741: TO99	0.48
DIL8	0.50
DIL14	0.55
748: DIL8	0.52

DIGITAL INTEGRATED CIRCUITS

Type	Price (£)
7400	0.20
7401	0.20
7402	0.20
7404	0.24
7406	0.45
7408	0.25
7410	0.20
7411	0.25
7412	0.28
7413	0.50
7416	0.45
7417	0.30
7420	0.20
7430	0.20
7440	0.20
7441	0.85
7447	1.30
7450	0.20
7451	0.20
7454	0.20
7460	0.20
7470	0.33
7472	0.38
7473	0.44
7474	0.48
7475	0.59
7490	0.65
7491	1.10
7492	0.75
7493	0.65
7494	0.85
7495	0.85
7496	1.00
74100	2.16
74121	0.60
74122	0.80
74150	1.44
74151	1.15
74154	1.66
74164	2.01
74192	2.05
74193	2.30

HARDWARE

BASES

Type	Price (£)
DIL8	0.16
DIL14	0.16
DIL16	0.18

PADS

T0-5	½p
T0-18	½p

MOUNTING KITS

T0-3	0.06
T0-66	0.06

VALVES

Type	Price (£)
DY87	0.39
EB91	0.30
ECC82	0.41
EF80	0.41
EF183	0.53
EF184	0.53
EH90	0.55
PC86	0.67
PC88	0.76
PCC89	0.58
PCF80	0.47
PCF86	0.58
PCF801	0.58
PCF802	0.63
PCL82	0.50
PCL84	0.54
PCL805/ 85	0.58
PCL86	0.58
PFL200	0.74
PL36	0.80
PL84	0.61
PL504	0.80
PL508	0.95
PL509	1.44
PY81/800	0.45
PY88	0.52

ZENER DIODES

400mW	3.0-33V	**12p** each
1W	3.3-68V	**18p** each

MINIATURE BRIDGES

2A Plastic Encapsulated

N6001	50V PIV	**35p** each
N6002	100V PIV	**38p** each
N6003	200V PIV	**41p** each
N6004	400V PIV	**45p** each
N6005	600V PIV	**50p** each
N6006	700V PIV	**59p** each
N6007	800V PIV	**68p** each

VDR'S, PTC & NTC RESISTORS

Type	Price (p)
E295ZZ /01	12
E295ZZ /02	12
E298CD /A258	6
E298ED /A258	5
/A260	5
/A262	5
/A265	5
/P268	5
E298ZZ /05	6
/06	5
E299DD/P116- P354	all 7
VA1015	20
VA1026	17
VA1033	7
VA1034	7
VA1040	7
VA1053	7
VA1055S	9
VA1077	10
VA1104	27
VA8650	85

RESISTORS

Carbon Film (5%)

¼W	5.6 Ω-330k Ω	(E12)	**1p** ea
½W	10 Ω-10M Ω	(E24)	**1p** ea
1W	10 Ω-10M Ω	(E12)	**2p** ea
2W	10 Ω-10M Ω	(E12)	**3p** ea

WIREWOUND (5%)

2½W	0.22 Ω-270 Ω	**15p** ea
5W	10 Ω-8.2k Ω	**12p** ea
10W	10 Ω-25k Ω	**15p** ea

CAPACITORS

Full range of C280, C296, tubular ceramic, pin-up ceramic, miniature electrolytics, mica, mixed dielectric and TV electrolytics stocked.—Please see catalogue.

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Labgear type CM6000 complete with mains power unit CM6001/PU.
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Labgear CM6004/PG giving crosshatch dots, greyscale and blank raster on 625-lines. Tuning can be preset for anywhere in Bands IV and V as well as Band III (for relays). **£45.39**

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Labgear CM6037/DB: Dual band bar generator gives standard 8 band colour bars + greyscale step wedge + red raster + centre cross + centre dot + crosshatch + dot pattern + blank raster. Sync output also provided **£101.31**

VHF/UHF CONVERTERS

Labgear "Televertas" for DX-ing or single-standard receiver use on relay systems. Type 6022/RA (with pre-amp gain control) **£12.27**

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Please see catalogue.

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TELEVISION
SERVICING·CONSTRUCTION·COLOUR·DEVELOPMENTS
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JANUARY 1975

110° COLOUR

For several years now the pros and cons of 110° colour have been a topic much discussed in the trade. UK setmakers first showed sets fitted with 110° colour tubes at the 1973 trade shows. Since then only two UK produced 110° chassis have been released on the home market, though one or two others are in production for use in export models. Total production is still a trickle compared to the output of 90° colour receivers. In comparison, in most continental countries 110° colour sets are the norm, with very little 90° set production.

What is one to make of this situation? The obvious benefit of a 110° deflection angle tube is saving in the depth of the set. And this has always been the main sales point. But at a couple of inches or so the saving is purely marginal. To be blunt, it's something that most people would hardly notice, still less care about. There is possibly an increase in sharpness, since the shorter beam is less subject to defocusing. But again any improvement is quite marginal.

The disadvantages have for obvious reasons been less openly discussed. Everyone knows however that circuit complexity—convergence, deflection and raster correction—is increased to an appreciable extent. This means added expense, more to set up—and the adjustments are more critical. Then there is the problem of beam landing accuracy. Since this is more critical it seems to be the practice to use a smaller hole size in the shadowmask. As a result you either have a duller picture or it is necessary to increase the average beam current. With increased beam current the shadowmask dissipation is increased and as the shadowmask gets that much hotter the beam landing changes. Back to square one—and the reason why the sunset arrives after the set has been on for a while! There are ways round the problems of course. But whatever you do involves extra complexity, extra expense. In order to get round a problem that needn't have arisen in the first place!

Quite why the continentals should have chosen to burden themselves with 110° colour is a matter for speculation. A likely reason is a sales strategy orientated more towards gimmickry. You might well keep a step ahead of the Schmidts with a 110° set with remote control, a touch tuner, digital read out of the channel and time etc., etc. Looking at our own domestic market however what can be claimed is that the undoubted success of colour in the UK has been due to a considerable extent to the availability of reasonably priced sets capable of good performance—the many 90° chassis that have served us well to date. This seems the sensible approach, and for the present at any rate the trade appears to have indicated thumbs down to 110° colour.

Much admirable engineering effort has gone into and much expertise gained from solving the problems of 110° colour. But just for a couple of inches off the back of the cabinet! The really worthwhile advance could come with self-converging, in-line gun tubes. But the performance that will be obtained from them in sets coming off the assembly line is something we have yet to see.

L. E. HOWES—*Editor*

THIS MONTH

THE NEXT ISSUE DATED FEBRUARY WILL BE PUBLISHED ON JANUARY 20

Held-over: We regret that due to shortage of space in this issue it has been necessary to hold over until next month the concluding instalment in the series on TV Football and Other Games.

All correspondence intended for the Editor should be addressed to Fleetway House, Farringdon Street, London EC4A 4AD. Address correspondence regarding advertisements to Advertisement Manager, Fleetway House, Farringdon Street, London EC4A 4AD.

TELETOPICS

FLAT-PANEL TV DISPLAYS

The development of a flat-panel TV display device to replace the bulky c.r.t. with its substantial power requirements has long been an aim in R and D departments. Several such display systems, in particular plasma types, are in fact already in production—generally at very high prices for military applications. Apart from plasma (ionised gas) the possibilities include liquid crystal devices (we shall be publishing an article on these shortly) and of course light-emitting semiconductor arrays. The problems are to get results that compare with the excellent pictures that can be obtained from a c.r.t., and to do so at an economic price.

A group of engineers led by Dr. T. P. Brody at the Westinghouse Electric, Pittsburgh, Pennsylvannia laboratories is now understood to be about to start pilot production of a solid-state display device which is claimed could "without difficulty" be developed for use in colour TV receivers. The present device is a monochrome one, with 14,400 picture elements (120 by 120) giving a six square inch picture. It is understood to give good reproduction of pictures, to have low power requirements and to be capable of very economic large-scale production. The light-emitting surface of the panel consists of a sheet of more or less conventional phosphor which is directly deposited on to an array of thin-film transistors and capacitors to which the drive signals are applied. The panel is about half an inch thick. Each picture element is driven by a couple of thin-film transistors and a thin-film capacitor, the combination dissipating little more than 60μW at maximum brightness—with 30 per cent of the panel's elements illuminated the device consumes just over 200mW, drawn from a 125V supply. For colour it would presumably be necessary to deposit primary-colour phosphors on the array, and to modify the inputs to this to accommodate the three sets of drive signals that would be necessary.

The technical problems with such arrangements appear to be to make small enough picture elements, to produce an inexpensive drive system, and to find light-emitting materials that give the same output as conventional phosphors struck by a high-velocity electron beam and with suitable response times. On the second point there is clearly no advantage in producing an inherently simple light output device if the drive system has to be far more complex than the simple matter of modulating one or three c.r.t. beams.

The Westinghouse device has been developed under contract to the US Army Electronics Command. Further work on it is aimed at including in the array itself some of the signal processing circuitry required, so that the number of external connections can be reduced—"to around ten or fifteen". On the possibility of TV displays Dr. Brody is reported to have commented that "all it needs is money".

VIDEOCASSETTE CENTRE

The London Video Cassette Centre has been opened by REW Video Contracts Ltd. to cater for the growing interest being shown in the videocassettes, recorders etc. now available. The aim is to have all equipment on the market under one roof so that intending purchasers can make comparisons and evaluations easily. The firm can also provide short- and long-term rental arrangements. Address is: Centre Point, St Giles High Street, London WC2.

DECODING CEEFAX/ORACLE

The accompanying photograph shows an experimental Ceefax/Oracle decoder produced by GEC's research laboratories, mounted beneath a GEC colour receiver. The circuitry itself occupies only a small amount of the space, the large front panels being provided to accommodate controls required for experimental purposes and to give maximum flexibility in the features being tested and assessed. It is possible for example to display the text in white on a dark background, or in black on white, or with a picture

GEC's experimental Ceefax/Oracle decoder.

background; the lettering can be all in capitals, or in upper and lower case as shown here; updated news items can be displayed with flashing to draw the viewer's attention to the latest items, and so on. In fact there are quite a few options available to the decoder designer and one of the purposes of the period of experimental transmissions is to assess the usefulness of the various possibilities.

TRANSMITTER OPENINGS

The IBA's new high-power u.h.f. transmitter at **Knock More,** Banff, Scotland is now in operation. Grampian Television programmes are transmitted on channel 23 (receiving aerial group A). The maximum e.r.p. is 100kW. Polarisation is horizontal.

The following relay stations have been brought into service:

Galashiels (Scotland) ITV channel 41 (Border Television programmes), BBC-2 channel 44, BBC-1 (Scotland) channel 51. Receiving aerial group B.

Tay Bridge (Dundee) BBC-2 channel 44, BBC-1 (Scotland) channel 51. Receiving aerial group B.

Tonypandy (South Wales) ITV channel 59 (HTV Wales programmes). Receiving aerial group C/D.

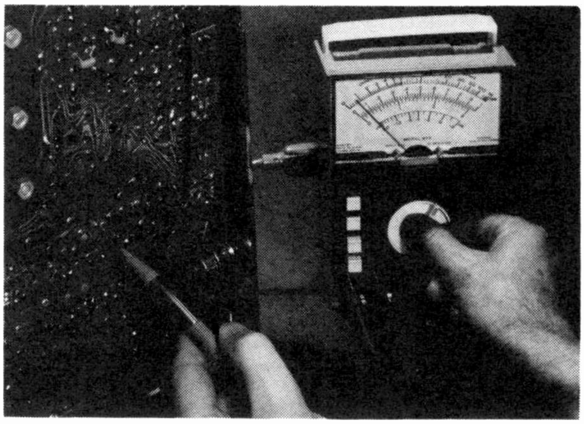
All these relay transmissions are vertically polarised.

UK MONOCHROME CRT PRODUCTION ENDS

The greatly reduced production of monochrome TV sets in the UK has made it "hopelessly uneconomic" (Thorn) to continue producing monochrome c.r.t.s in the UK. Thorn (Mazda) has already ceased production while Mullard are at present phasing out their production. One reflection that occurs to us is that it says a great deal for the high quality of modern c.r.t.s that the replacement market is so small. The Mullard Simonstone monochrome c.r.t. plant is being expanded and modernised to become what is claimed will be "Europe's largest and most modern unit for the manufacture of a wide range of colour tubes"—including a £1 million shadowmask production unit for the new 20AX type of colour tube.

Reports in the press caused considerable confusion by getting monochrome c.r.t. and monochrome TV set production mixed up. The UK's largest setmaker, Thorn, say they will continue "for the foreseeable future" to continue manufacturing the full range—both small-screen and table models—of monochrome sets. Philips however have announced that they will be discontinuing monochrome set production by the middle of this year—their Croydon monochrome TV factory will then be used for videocassette machines instead. Table and portable monochrome sets will remain in the Philips range but will be imported from Philips plants overseas—the portables have been coming from their Singapore factory for several years now. It is understood that one or two other setmakers are also on the point of discontinuing the production of monochrome sets. The demand for monochrome c.r.t.s will in future have to be met entirely by imported tubes.

REMARKABLE IN-CIRCUIT TESTER


Daystrom-Schlumberger 670 tester in use.

A new testmeter from Daystrom-Schlumberger, the Model 670 in-circuit tester, is remarkable in enabling current measurements to be made without the need for any circuit disconnections. With the 670, current measurements are made simply by connecting two probes across a current-carrying conductor. A pair of two-terminal concentric probes capable of contacting printed circuit tracks 0·015in wide and spaced as close as 0·015in apart are used. One contact in each probe senses the voltage drop across the current carrying conductor under test: the signal is fed to a differential amplifier which generates a current to balance the voltage drop, this current being read directly on the meter. In addition to the in-circuit current measuring capability the f.e.t. multimeter has eight voltage ranges and fourteen resistance ranges. Seven of the resistance ranges use low-power techniques (maximum 85mV) for semiconductor testing. Conventional current measurements can be made with the instrument's standard probes. The input impedance on the voltage ranges is 10M Ω. The instrument is mains operated, no bigger than a normal multimeter and weighs less than 2lb. It is guaranteed to withstand a 5ft drop and uses a special ruggedised taut-band meter movement. The price at October 1974 is £132 including the special current probes. Optional extras include a carrying case and kelvin clip probes for in-circuit current measurements in solid wire conductors.

COLOUR TV IMPORTS FALL SHARPLY

Along with the news that colour set deliveries to the trade in August showed a drop of 18% (total 149,000) compared to August 1973 come indications of a sharp fall in colour set imports. Imports from Japan were down 41% compared to August 1973 while total imports for the two months July-August were down 51%. We hesitate to conclude as some commentators have that the Japanese decline has been due to self-restraint: it seems more likely that since imported sets offer no price advantage UK setmakers have been able to compete successfully for an increased share of the available market. Earlier in the year imports had taken a slightly increased share of the market due to a shortage of UK produced sets following the three day week.

LARGE-SCREEN TVs

A company—Mutz-Elman Manufacturing—has been formed in the US to produce TV sets with screen sizes of around 30×40in. Founder Earl Muntz thinks such sets, which will probably sell at around £800 and have cabinets over 5ft tall by 2ft deep, are the thing of the future. Maybe so in those vast Texas ranches.

VIDEO CIRCUITS & FAULTS
part 1

S. GEORGE

ASSUMING that the tuner and i.f. strip are correctly aligned, that the aerial input is ghost-free and well below the overload level, and that the c.r.t. is of good emission and correctly focused, the quality of the picture—by which we mean undistorted reproduction of the transmitted signal—is completely dependent on the video circuitry. This extends from the vision detector diode—or in some chassis its equivalent in an i.c.—to the c.r.t. cathode or in one or two cases its grid. What factors govern video fidelity then, and what symptoms arise when components in this part of the receiver change value or break down completely?

The Video Spectrum

Because of the different problems that arise at the different frequencies involved it is desirable to divide the video spectrum into three sections. Middle frequencies can be broadly defined as those which are low enough to be unaffected by the normal load shunting capacitance present but are not so low that they are attenuated or markedly phase shifted by any coupling capacitors used in the circuit. The high frequencies are those which provide no coupling or decoupling problems but are highly susceptible to the effects of load shunting capacitance. The low frequencies are those which require high-value coupling and decoupling capacitors and when very low make special demand on the power supply circuitry.

Attempting the Ideal

On the basis of this division let's next examine how circuit designers attempt the ideal, that is linear amplification of all frequencies from d.c. to 3MHz on the 405-line system and 5·5MHz on 625 lines. We will start with valve monochrome video circuits since these still comprise the great majority in use.

CRT Drive

In valved chassis cathode c.r.t. drive is almost universally used in order to obtain maximum beam current change per volt change in the signal applied to the c.r.t. This arises since increasing the instantaneous brightness level by reducing the cathode voltage in effect increases the tube's first anode voltage, whereas increasing the brightness by increasing the tube's grid voltage (positive with respect to chassis) in effect reduces the first anode voltage. As with the screen grid voltage of a pentode or tetrode valve, the first anode voltage of a c.r.t. has a considerable effect on the beam current. Cathode c.r.t. drive works out at about 30% greater efficiency than grid drive.

DC and AC Coupling

Directly coupling the video output pentode to the c.r.t. cathode has two advantages. First it maintains the d.c. component of the signal. Secondly should a fault reduce the video output pentode's anode current the screen will be blacked out since the c.r.t. cathode will rise towards the h.t. rail voltage. This was the general practice with v.h.f.-only receivers, but with dual-standard chassis a.c. coupling was widely adopted in order to preserve the same brightness level on both systems—since on switching from one system to the other the video output pentode bias is usually altered, its anode voltage changing in consequence. To make this point clear we have to go back to the coupling between the vision detector and the output pentode. Direct coupling here on v.h.f. means that the valve is biased towards cut-off, the bias being progressively reduced as the positive-going signal from the vision detector rises towards peak white. In a single-standard u.h.f. model however direct coupling here means that the valve is only lightly biased, the negative-going vision detector output progressively increasing the bias so that the valve is driven towards cut off at the sync pulse tips.

Grey-Scale Cramping

The effect of the c.r.t. and the video output pentode both being biased well back with a low-level v.h.f. input or a high-level u.h.f. input is that it is difficult to separate the two darkest grey-scale squares of the test card. Similarly if the video output pentode no-signal bias is excessive the result will be severe sync pulse clipping and bad tonal gradation (see Fig. 1).

Video Amplifier Load Circuit

Other factors being constant, the gain of a valve amplifier stage depends on the value of its load resistor —closely approximating $gm.R_L$ in the case of a pentode. High gain at middle and low video frequencies can thus be obtained by using a high-value load resistor. If we take the total load shunt capacitance as 20pF however we have in addition a reactance of about 16kΩ at 0·5MHz reducing to about 4kΩ at 2MHz, 2·66kΩ at the top 405-line video frequency of 3MHz and less than 1·5kΩ at the top 625-line video frequency of 5·5MHz. The effective load at high frequencies consists of the load resistor value in quadrature with the reactance of the shunt capacitance: if both values in ohms are the same the net load impedance is 0·7 of the individual values of these two components of the load. The frequency at which the capacitive reactance value and the value of the load resistor are equal is usually referred to as the turnover frequency, half-power or −3dB point.

Thus while the use of a high-value load resistor will give high amplification at medium video frequencies the fine picture detail—corresponding to the higher video frequencies—would receive much less amplification and in consequence would be reproduced at a much lower contrast level. It is necessary therefore to take steps to keep the medium and high video frequency amplification at a commensurate level.

Extending the HF Response

Assuming that the shunt capacitance present cannot be further reduced—by routing the tube cathode lead away from earthed metalwork, mounting the load components well off the chassis and reducing the loading imposed by the sync separator—the high frequency response of the video amplifier can be extended in the following ways. (1) By reducing the value of the load resistor. (2) By using a triode cathode-follower between the output pentode and the c.r.t., a technique used in many Bush and Decca chassis. (3) By adding a peaking coil in the load circuit. (4) By shunting the cathode bias resistor with a small-value decoupling capacitor so that the negative feedback developed across the resistor is reduced at the higher frequencies.

Low-value load resistors are generally used—average value about 3-4kΩ—except where a cathode-follower is employed. It is also usual to incorporate peaking coils and precise value cathode decoupling capacitors ("compensating capacitors").

Use of Peaking Coils

Shunt or series peaking coils may be used (see Fig. 2). Shunt coils are connected in series with the load resistor but effectively in shunt with the circuit stray capacitance: their inductance "offsets" the unwanted capacitive reactance present. The inductive value of such a coil may be selected to meet several requirements—to equalise the −3dB h.f. response so that this is the same as the m.f. response, for best overall linearity, for best phase response, or for best transient response without overshoot (critical damping). The precise coil inductance may in practice be selected by empirical methods—the load resistor value and the shunt capacitance dictate the optimum coil inductance but vary from set to set due to tolerances etc. A peaking coil of the correct inductance will usually improve all these characteristics to some extent—the aimed for one in particular. With a peaking coil in the load the roll-off from the peak response point will be more rapid than with a purely resistive load however: this point must be carefully selected therefore to be just inside the top video frequency.

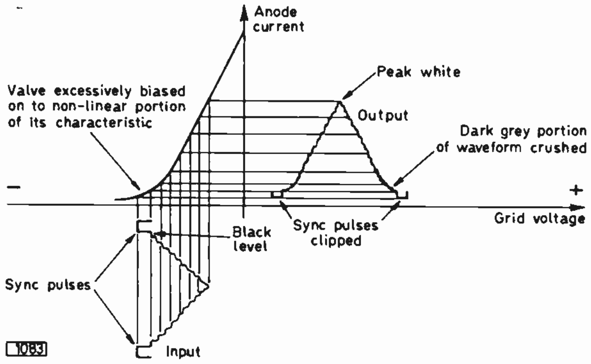


Fig. 1: If the video output valve is excessively biased the dark grey portion of the waveform will be crushed and the sync pulses clipped. On u.h.f. the detector output is negative-going: excessive signal will drive the valve on to the non-linear portion of its characteristic therefore. On v.h.f. the detector output is positive-going: thus in this case a low-amplitude input will keep the valve operating on the non-linear portion of its characteristic.

Series peaking coils are connected in series with the feed to the c.r.t. cathode and function in a rather different manner: by dividing the total stray capacitance present, they act as a low-pass filter giving a boost in the response at the designed for frequency. They can give slightly better results than a shunt coil but their inductive values are more critical and the h.f. roll-off is steeper.

Some designs use both types of coil. As might be expected the inductance values are then particularly critical, though a higher value load resistor can be used.

Use of Negative Feedback

In audio and field output stages the negative feedback developed across the cathode bias resistor is reduced to a minimum by means of a bypass capacitor which has a low reactance at the lowest frequency being handled—the reactance value at this frequency is usually taken to be no more than a tenth of the value of the associated resistor. In most video stages however the value of the bypass capacitor is chosen so that the

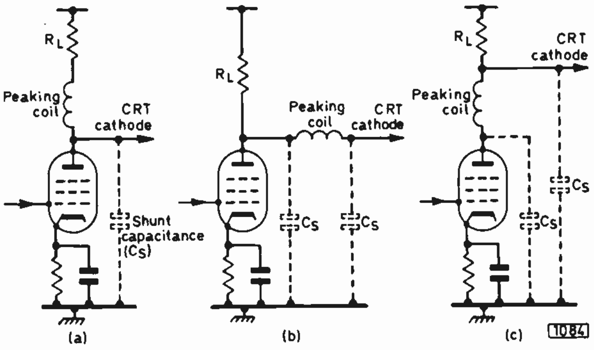


Fig. 2: Use of peaking coils to boost the h.f. response. (a) Shunt peaking coil—the coil shunts the capacitance shunting the load. (b) Series peaking coil—the coil divides the shunt capacitance, forming a low-pass filter which boosts the response at the designed for frequency. (c) This may look at first like a shunt peaking coil but as the output is taken from the junction of the coil and the load resistor it acts as a series peaking coil.

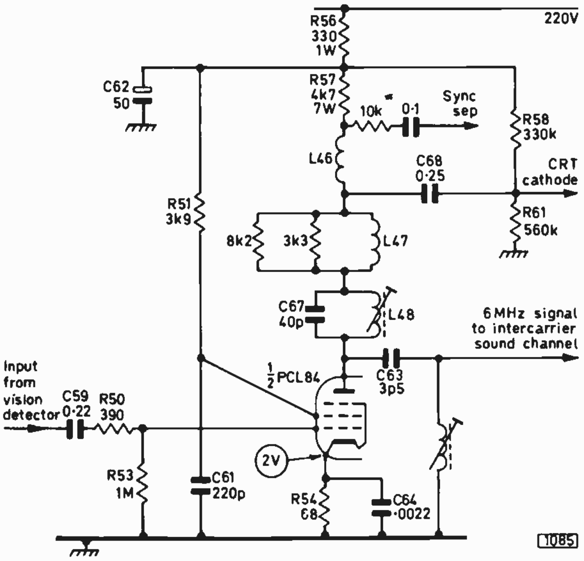


Fig. 3: Video output stage used in the ITT/KB VC100 single-standard chassis. The input from the detector is a.c. coupled, also the output to the c.r.t. cathode. See text for details of how the component values are selected to tailor the response to equalise the gain over the video bandwidth.

negative feedback developed across the resistor at low and medium frequencies tails off as the gain otherwise falls at h.f., thus compensating for the effect of the load shunting capacitance: the time-constant of this capacitor and its parallel bias resistor usually equals that of the load resistor plus the shunt capacitance therefore.

To get the desired negative feedback decrease at h.f. the cathode bias in some video output stages is provided by two series-connected resistors, one of which is fully decoupled while the other is bypassed by the small-value compensating capacitor.

LF Response

Several factors affect the low frequency response. First, as the reactance of the decoupling capacitors becomes comparable and then in excess of the screen grid feed and cathode bias resistors they decouple so they become increasingly ineffective, reducing the gain of the stage as a result of the increased negative feedback. Secondly, the reactance of any coupling capacitors used both attenuates and phase shifts the lower frequencies. At very low frequencies the reactance of even the h.t. smoothing electrolytics plays a part: the internal resistance of the h.t. supply system will be added to that of the load resistor, increasing the very low frequency gain. This results in picture streaking and accentuates aircraft flutter.

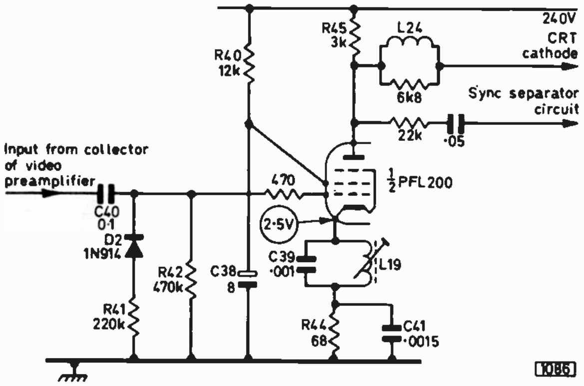


Fig. 4: Video output stage used in the Decca MS2001 series chassis. The input from the detector is a.c. coupled, with partial d.c. restoration. The output is d.c. coupled to the cathode of the c.r.t.

Practical Circuits

In practical circuits the values of the coupling and decoupling capacitors are carefully chosen to attenuate the very low frequency response. Sometimes, as in the ITT/KB VC100 chassis video circuit shown in Fig. 3, very low frequency attenuation is achieved by feeding the output pentode's screen grid from a point in the anode circuit instead of from the h.t. rail. The small-value decoupling capacitor C61 prevents negative feedback at the screen grid at high frequencies, its time-constant with R51 being sufficiently long to "absorb" high frequency variations at this electrode. At medium to low frequencies however it is no longer effective and the resultant signal variations across the feed resistor R51 apply negative feedback to the stage, reducing the gain at these frequencies. At very low frequencies the reactance of C62 in the anode circuit is such that it no longer effectively decouples R56 which is thus added to the stage's load resistance. The voltage at the junction of R56 and R57 also appears at the screen grid of course, the resultant very low frequency negative feedback markedly reducing the stage gain at the lower end of the video spectrum.

The video output is a.c. coupled to the c.r.t. cathode by C68, the potential divider R58/R61 providing bias at the c.r.t. cathode. Note that voltage change at the junction of R56 and R57 at very low frequencies will be applied to the c.r.t. cathode via R58. C64 is the cathode compensating capacitor, L46 a shunt peaking coil and L47 a series peaking coil. The 6MHz intercarrier sound signal appearing at the anode of the valve is tapped off to the sound channel via C63, the 6MHz tuned circuit L48/C67 also preventing this signal passing through to the c.r.t. cathode.

Decca Circuit

Not all video output stages are so involved. Take for example the circuit used in the Decca MS2001/MS2401 series (Fig. 4). The input is a.c. coupled by C40, isolating the pentode's control grid from the collector of the preceding transistor video preamplifier. D2 in conjuction with R41 and R42 provide partial d.c. restoration. The cathode trap L19/C39 removes the 6MHz intercarrier sound signal by introducing negative feedback at this frequency. C41 is the cathode compensating capacitor while C38 decouples the screen grid except at very low frequencies. High frequency compensation is provided by the series peaking coil L24 which has a 6·8k Ω damping resistor in parallel to broaden its response.

Fault Guide

Having seen how designers endeavour to obtain reasonably linear amplification over the video spectrum, with adequate gain and freedom from ringing etc., let's review the main causes of the various picture defects.

Lack of Contrast

First, low contrast. This is rarely caused by a defect in the video output stage. In fact the most common cause of this fault with valve i.f. strips is an increased value resistor in series with the contrast control slider—when this situation arises the contrast control cannot back-off sufficiently the negative a.g.c. line voltage. The most common cause of the fault in the video circuitry is a vision detector diode with high forward resistance. Where the detector circuit is d.c. coupled to the video output pentode a screen grid to control grid interelectrode short can result in the detector load resistor changing value. The PCL84 is a common offender in this respect. The video output valve can loose emission of course.

Poor Tonal Gradation

Poor tonal gradation will result from incorrect biasing, either of the video output pentode or at the cathode of the c.r.t. where a.c. coupling is used to this point. Increase in the no-signal bias, quite common in older dual-standard models, markedly accentuates signal cramping in the dark grey areas—it also affects the synchronisation since the sync pulses are clipped (see Fig. 1). The most common cause of this trouble is a reduced-value bias stabilising resistor connected between the h.t. rail or the screen grid and the cathode. By no means all circuits incorporate a bias stabilising resistor however. Other causes are an increased value cathode bias resistor or reduction in the value of the screen grid feed resistor—this increases the standing anode and screen grid currents so that the cathode voltage rises above the correct figure. On u.h.f. the most common cause of poor tonal gradation is quite simply excessive input. At the c.r.t. cathode R61 (Fig. 3) can increase in value, though the usual effect of this is a dark picture.

Hum Bars

The usual cause of hum bars is poor heater-cathode insulation in a valve. The i.f. strip and tuner unit valves are more likely to be at fault than the video output pentode, though the PFL200 is a known offender. When the loudspeaker hum level is also high and the field locking impaired a reduced value electrolytic smoothing capacitor in the h.t. circuit should be suspected.

Poor Definition

Poor definition is in most cases caused by slight i.f. drift or impaired c.r.t. focusing. Where it definitely originates in the video circuit first check the output pentode's cathode and screen grid decoupling capacitors.

In some video output circuits the anode load consists of two resistors in parallel: make sure that one of these is not open-circuit or dry-jointed. Check the value of the anode load resistor(s)—change can occur after several years' operation.

Make sure that any cathode rejectors have not been misadjusted, trapping out signals within the video passband. If the loss of definition is particularly severe, check any peaking coils in the circuit. In many circuits a parallel *RC* network is connected in the feed to the c.r.t. cathode to provide l.f. attenuation—check the capacitor.

Although now a rare fault, if the c.r.t. is old and there is any suggestion of test card cogging or the brilliance control has to be turned below the normal point to black out the screen, check the c.r.t. for heater-cathode leakage.

Poor LF Response

In the case of poor l.f. response check all decoupling and h.t. smoothing electrolytics: if the fault is particularly severe, try stabbing equivalent value capacitors across any signal coupling capacitors.

Ringing

Ringing when severe is almost certainly the result of i.f. misalignment or instability—certainly so when fine tuning through a channel transmitting the test card results in ringing on different frequency gratings. An open-circuit or more usually a dry-jointed resistor in parallel with a peaking coil can cause ringing however, while as the optimum coil inductance depends on the value of the load resistor an incorrect replacement can introduce minor ringing.

Overshoot

Overshoot, which is somewhat similar to minor ringing, can be caused by an incorrect value cathode compensating capacitor: if a replacement is found to have been fitted check that it is of the correct value.

Patterning

Patterning, when not due to outside interference or a defect in the i.f. strip or tuner such as an open-circuit decoupling capacitor, left-off screening can, unearthed coaxial cable braiding or even a faulty valve, will almost certainly be due to the vision detector stage. If the screening can is still well bonded to chassis, one of the small-value i.f. filter capacitors is open-circuit or more likely dry-jointed. To provide effective i.f. filtering without attenuating the video h.f. response the values of these capacitors are critical. Make sure that replacements are of exactly the same value, preferably of identical type, and wire them in a similar manner to the original.

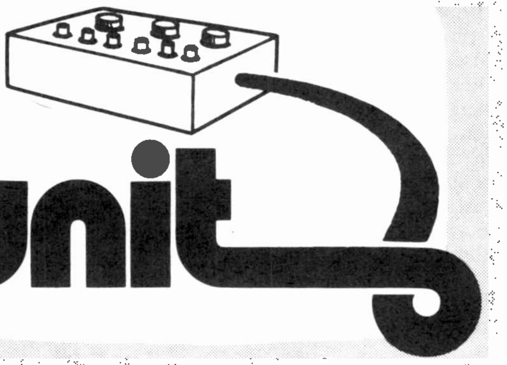
Shading

Shading across the picture is generally caused by an open-circuit decoupling capacitor in the c.r.t.'s first anode or focus supply. In those chassis where the earthy end of the brightness control is taken to the mains side of the on-off switch to provide switch-off spot suppression however this fault can be caused by the connection having been made to the live instead of the neutral connection to the switch.

So much then for the main causes of picture faults in valve video circuits: in the next article we shall continue with transistor monochrome receiver video circuits.

CONTINUED NEXT MONTH

COLOUR TELEVISION remote control unit



A. J. OWEN

This unit was developed for use with the Television colour receiver to provide remote control of brightness, saturation and volume, together with channel selection. It is linked to the receiver by means of a screened multicore cable, which may be up to twenty feet long.

Selection of local or remote control is effected by a six-pole changeover relay which is controlled by a switch mounted on the receiver. It should be possible to adapt the system for use with other varicap tuned receivers with little modification.

Receiver Controls

For the guidance of readers wishing to make such an adaptation, the saturation control in the Television colour receiver sets the bias applied to a pair of back-to-back diodes in series with the chroma signal feed—as in the well known Mullard discrete component decoder design. The brightness control is part of a potential divider which adjusts the amplitude of the pulse used to operate the black-level clamps in the RGB output stages. The mode of operation of the volume control is discussed below.

Circuitry

The brightness control R603 is connected as a variable resistor. Relay contact RLA2 transfers point 3K on the RGB panel between R603 and the remote control VR2.

The saturation control R601 is connected as a potential divider, with the slider voltage fed to point 1B on the decoder. The remote control VR3 is connected across the same 0V and +20V rails as R601 and contact RLA3 selects the output from the appropriate potentiometer.

The volume control R604 was originally fitted across points 9C and 9J of the audio board and varied the amount of negative feedback around part of the audio amplifier, thereby changing its gain. The resulting range of control was rather limited and a different circuit was proposed in a letter published in the Colour Receiver Forum in the February 1974 issue of Television. This involved placing the volume control potentiometer across the audio output of the i.f. strip (2C and 2J) and feeding the audio module input (9B) from the slider. A resistor of 3k Ω should be connected across the now vacant points 9C and 9J.

The receiver must be modified in this way for use with the remote control unit. The local and remote volume control tracks are paralleled and RLA1 connects the appropriate slider to point 9B. The earthy end of VR1 is returned via the screen of the multicore cable.

Tuner Control Units

The local and remote tuner control units are switched by contacts RLA4—RLA6, with points 8D and 8M on the two units strapped as shown in the drawing (Fig. 1).

Relay Type

The relay used has a 48V coil which is driven from the +40V supply rail powering the field timebase. Local/remote selection is by switch S1, a link between pins 7 and 6 of PLA completing the return to the 0V rail at 6C. This ensures that the receiver reverts to local control if the remote control unit is unplugged.

Construction

It is advisable to use a metal case for the unit to provide screening against pickup of hum and noise. The case is earthed via the screen of the multicore cable. The metal cover of VR2 should be connected to the case at the same point as the cable screen.

Receiver Modifications

Three components are added to the receiver: the local/remote switch, the relay and the socket for the remote connections. Positioning of these is left to the discretion of the individual constructor. The wiring methods shown in Fig. 1 should be adhered to—they

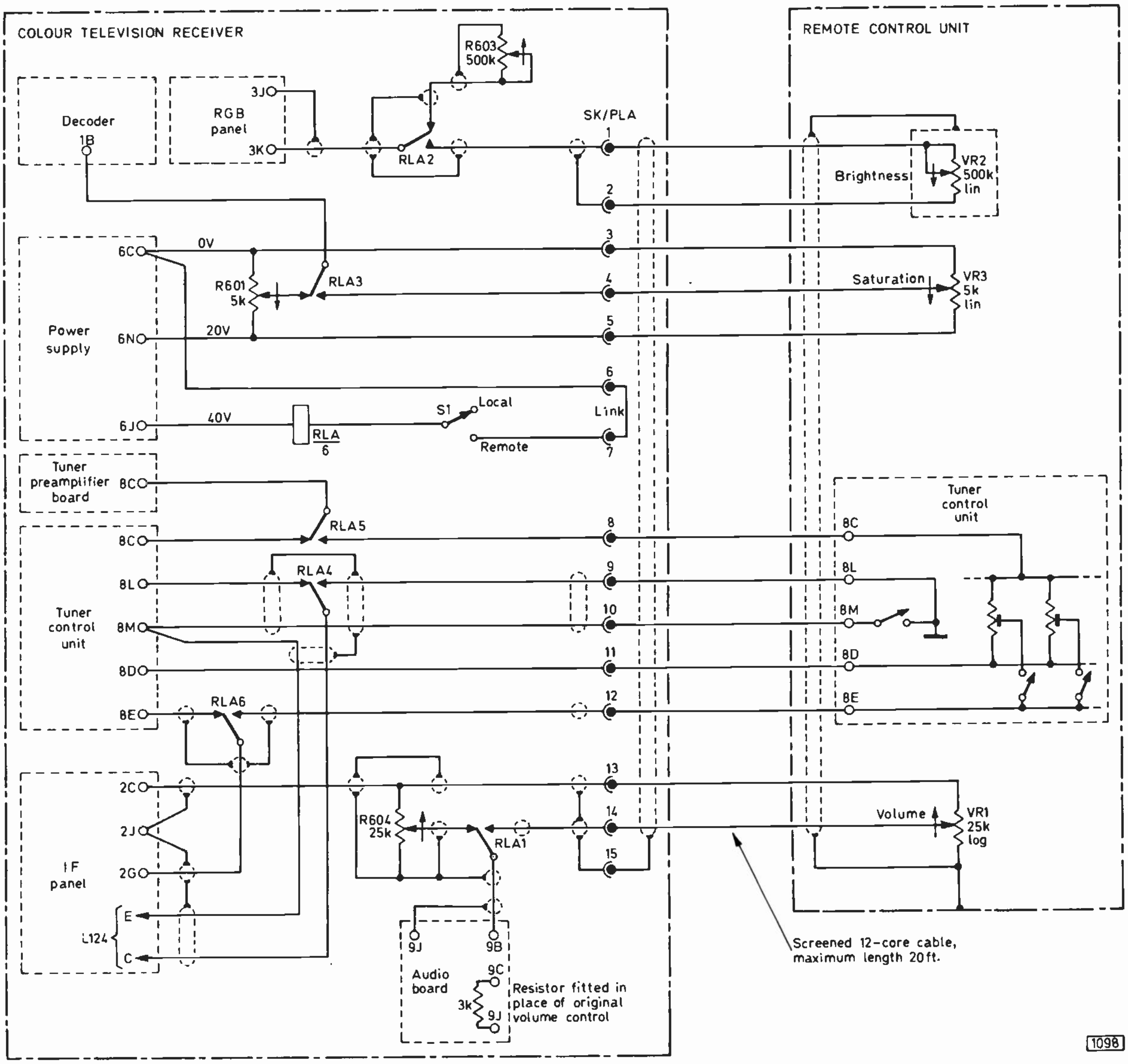


Fig. 1: Circuit diagram of the remote control unit, with details of connections to the Television colour receiver. Earthing and screening arrangements are critica, and should be followed closely—see text.

incorporate improvements suggested in a letter published in the Colour Receiver Forum in our November, 1973 issue.

Depending upon the exact site chosen for the relay, some of the leads shown as screened in Fig. 1 may be so short as not to warrant the use of screened wire. If unscreened wire is used for any such short links, ensure that circuits shown as being completed via the screens are maintained. All the earth return leads from SKA to the various modules must be run separately to avoid earth loops.

Setting Up

When tuning the channel presets on the remote control unit, the a.f.c. must be disabled by means of the button on the local channel selector. ■

★ Components list

VR1 25kΩ log VR2 500kΩ lin VR3 5kΩ lin

S1 SPST min. toggle switch

RLA 6P c/o miniature 48V d.c. coil

PLA/SKA 15-way plug and socket (Cannon 'D' range or similar)

Tuner Control Unit

Metal box 4½x3½x2 in. (Eddystone 6908P or similar)

12-core min. screened cable (20 ft. maximum)

SERVICING television receivers

L. LAWRY-JOHNS

BAIRD 660/670/680 SERIES—cont.

Audio Faults

These differences do not usually affect the fault conditions. It is the output stage that tends to run into trouble. The valve draws grid current, resulting in distortion and high cathode current which in turn results in the 560 Ω cathode bias resistor heating up and probably changing value. Whilst the cause of the trouble is removed by fitting a new PCL82 the cathode resistor will remain either changed in value causing the new valve to overheat or apparently of correct value but then failing after a short time. In addition to changing the valve therefore it is essential to change this resistor if it appears discoloured. Neglecting to do this can result in that nasty mess one finds when the cathode electrolytic explodes due to the resistor going open-circuit (since the cathode voltage then rises well above the capacitor's voltage rating).

Power Supplies

The mains supply is taken direct to the on/off switch, neutral then going to chassis and live to the 2A fuse. A high-voltage 0·1 μF capacitor is connected from the fuse to chassis. If the fuse is found shattered suspect this capacitor.

A purple lead connects the fuse to the centre of the dropper (top centre). From the centre to the right there are two h.t. sections of 11 Ω and 22 Ω respectively. A red lead is connected from the end tag (usually) to the BY100 rectifier. It is a common occurrence for one of these two sections of the dropper to become open-circuit, leaving the set inoperative but with the valve heaters normally glowing. It is our practice in this event to connect a 33 Ω RS section from the centre to the outside tag rather than to fit a section of lower value across the defective part only to have to repeat the exercise with the other bit later.

The left side sections of the dropper concern the valve heaters. Models with valves in the i.f. stages used 195 Ω and 100 Ω sections, while later versions with transistor i.f. stages used a 275 Ω section in place of the 195 Ω one to compensate for the absent valve heaters. It is not uncommon for the heater part of the dropper to give trouble. It is usually the higher value section (195 Ω or 275 Ω) that becomes open-circuit.

Earlier Video Circuit

The PCL84 video valve used in early models had a tendency to develop a screen to grid short in its pentode section. When the receiver has been used on 405 the results are pretty drastic, with damaged resistors and most probably a shorted OA79 vision detector diode to contend with. The damage varies according to whether R82 goes high or low in the initial surge of current. The routine remains the same however. Discard the PCL84, then check R82, R83 and R78. The detector diode X2 can be checked without disturbing it by measuring the resistance from TP3 to chassis. The reading should be very low one way and about 5k Ω the other (due to R78). A low reading both ways or 5k Ω both ways means a new diode. The diode is inside the final vision i.f. coil can incidentally.

The cathode resistors can also be damaged and should be checked. These often survive however when the set has been operated on 405 lines. Conditions are different when the fault occurs on 625 lines because of the presence of the blocking capacitor C118. This and the high-value resistors save the detector diode but the high voltage appearing at the grid results in high cathode current making it far more likely that R86 and R87 will need replacement together with R82. Check R110 and R90 as well—these are better able to carry a higher current however.

Later Video Circuit

The circuitry and habits of the PFL200 are quite different. This valve does not short inside (it does quite a few things, but there are rarely any burn ups). One of the common defects with early PFL200 valves was a tendency to run into grid current—enough to cause the picture to lose contrast and become lighter. This can still happen occasionally, but nowhere near as often as it used to do. The more common complaints recently have been hum bars on the picture and loss of sync—in addition of course to loss of emission giving rise to loss of contrast.

AGC Circuits

The a.g.c. systems also vary between the two versions.

When the i.f. strip uses valves a negative high-impedance a.g.c. source is required. The triode section of the PCL84, strapped as a diode, provides this. The circuit is fairly simple and needs little explanation. The network (R72, C114 and R76) associated with the screen grid of the PCL84 together with X5 forms an anti-lockout circuit so that the a.g.c. action is restored after heavy interference signals. On 625 lines C111 is connected across X5 to alter the time-constant and prevent instability.

The transistorised versions have a more complicated

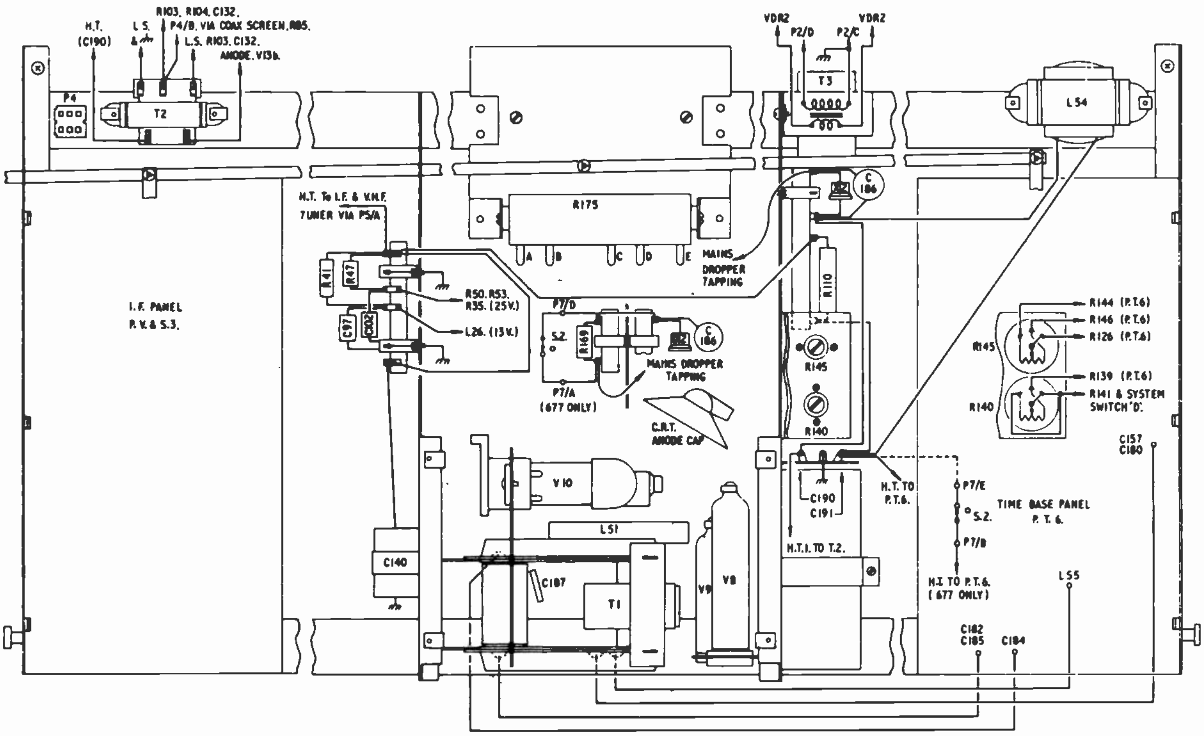


Fig. 3: Rear chassis view, versions with transistor i.f. strip.

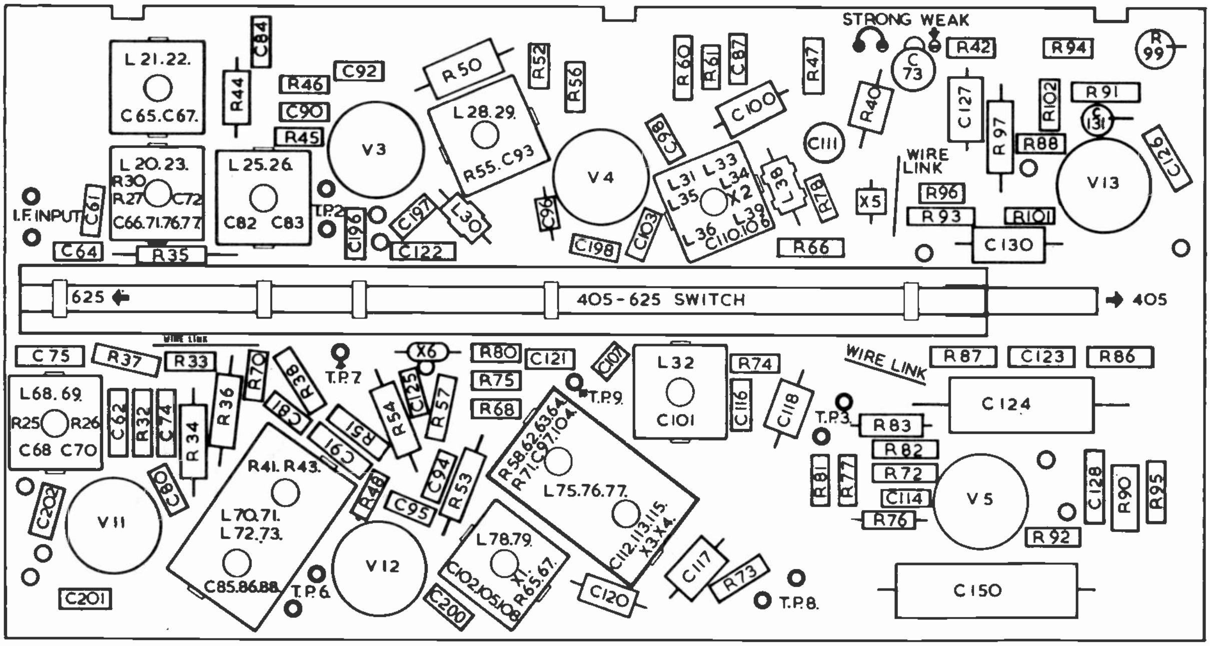


Fig. 4: Layout of the valve i.f. strip, viewed from the component side.

system because although the valved v.h.f. tuner still requires a negative high-impedance control the transistors work better with forward a.g.c. while a low-impedance source is necessary. Since the transistors are npn types the forward a.g.c. potential must be positive-going. In these versions a diode (X6) is used to produce the negative-going control potential—high-impedance as required—and this is also applied to the control grid of the second section of the PFL200 which provides a positive-going, low-impedance control potential at its anode. In this circuit the anti-blocking diode is X7 (BA144). The original control voltage is

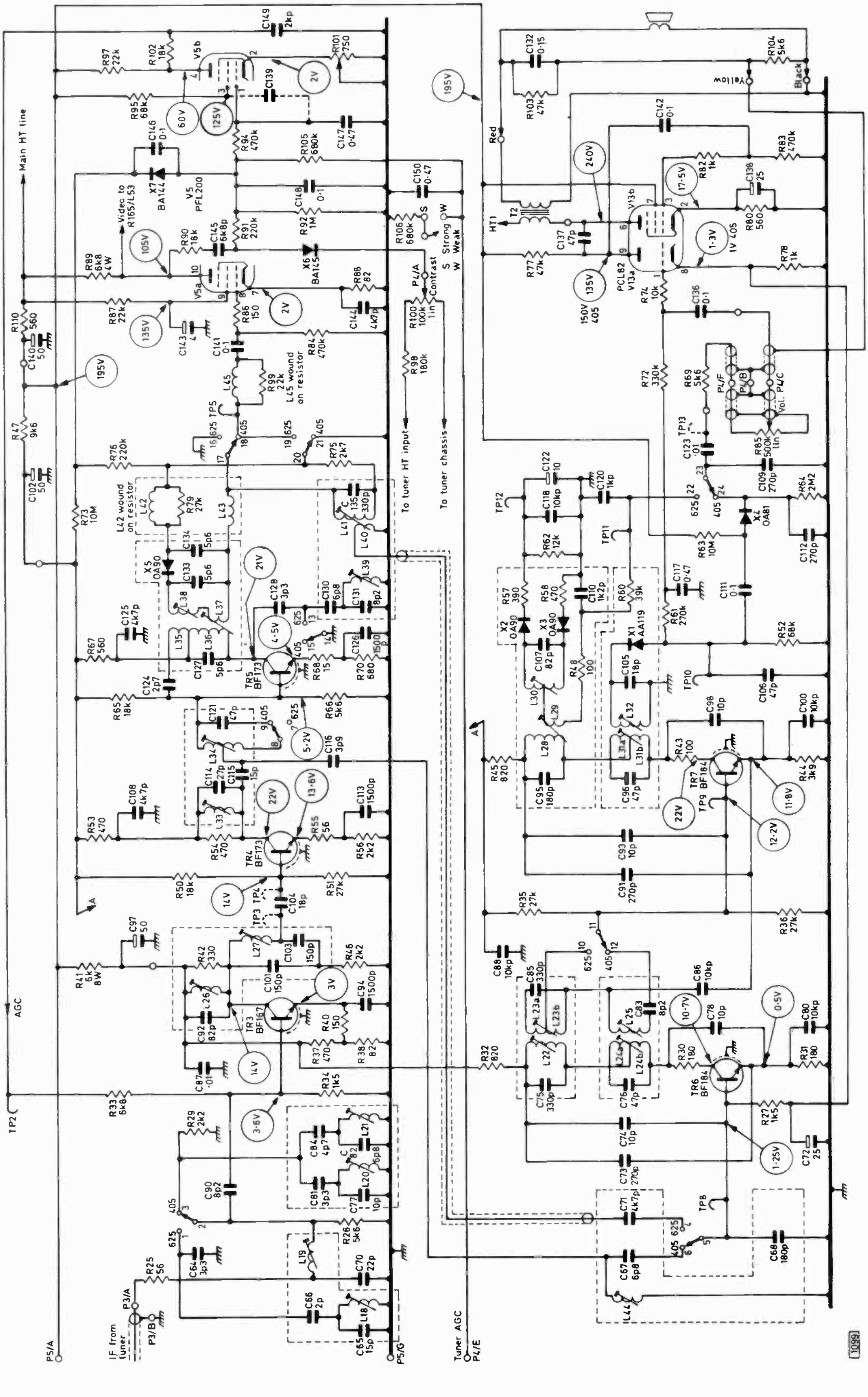


Fig. 5: Circuit of the transistor i.f. strip used in later models. Note that the boost voltage is slightly lower in these models—770V-900V depending on the width control setting.

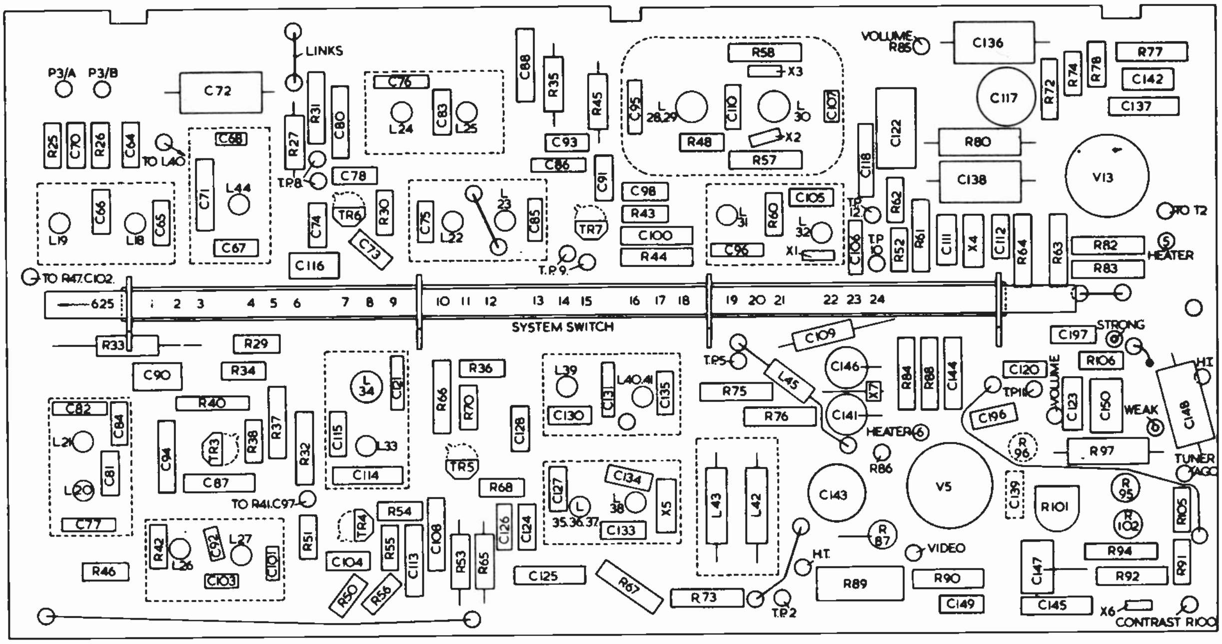


Fig. 6: Layout of the transistor i.f. strip, viewed from the component side.

backed off by the contrast control via the a.g.c. rectifier X6 (BA129).

First Valve IF Stage

The first stage (V3) in the valved i.f. strip uses an EF183. This is a.g.c. operated via R47. The stage is fairly reliable except for the tendency of the valve to run into grid current and of R50 to change value. The former defect results in the a.g.c. to the stage being cancelled, thus causing the control to the tuner to be increased. The symptom is a grainy picture which tends to direct attention to the PC97. In almost every case however the PC97 is not at fault and time can be better spent checking on the EF183. This suspicion of the PC97 applies only to 405-line working of course as it is not used on 625 lines when the output from the u.h.f. tuner is taken to the control grid of the PCF805 mixer which on 625 lines is also gain controlled. The EF183 screen grid (pin 8) should be at about 110V under normal conditions with no signal input. When a strong signal is applied the a.g.c. rises and the valve passes less current: hence the pin 8 voltage also rises.

Second IF Amplifier

The second stage (V4) uses an EF184 as a straight amplifier (no a.g.c.). The defects that occur in this stage relate to the valve itself which can suffer from one of two complaints. It can lose emission, thus causing very little a.g.c. to be applied to the earlier stages. The result of this is some degree of cross-modulation (vision buzz on sound if not sound-on-vision). A quick check on the cathode voltage of the EF184 will establish whether this is the trouble: the voltage should be not less than 2V. The other and more damaging defect is when the valve shorts internally. This certainly upsets the screen grid supply resistor R60 which will nearly always have to be replaced; the anode supply usually escapes damage as the short is generally between the screen and grid (which from a d.c. point of view is at chassis potential).

Sound IF Stages

These stages provide vision amplification only on 405 lines but are common to both vision and sound on 625 lines. There are two sound i.f. stages and in consequence the 405-line sound i.f. can be fed directly from the tuner unit to the sound channel via C62 and the system switch. The sound i.f. stages seem to be more trouble free than the vision ones but there is no basic reason why defects similar to those described above should not afflict the sound EF183 and EF80 (V11 and V12).

Vision Buzz

We have mentioned the possibility of vision buzz and/or sound-on-vision due to a low-emission EF184 (V4). There are other possibilities of course. One of these is when C150 dries up. This 16μF electrolytic decouples the h.t. feed to the i.f. amplifiers, the audio amplifier (triode) and the video stage. These symptoms should not be confused with the results of strong signal input; that condition can be countered by setting the weak/strong plug in the a.g.c. line to the strong position.

VHF Tuner

When the receiver is used on 405 lines the signal route is first via the v.h.f. aerial socket to the input of the v.h.f. tuner. The aerial socket sometimes needs attention and can be the source of weak signals. The first valve (r.f. amplifier) in the tuner is the PC97. This very rarely needs replacement and if the aerial socket is in order weak singals should direct attention to the

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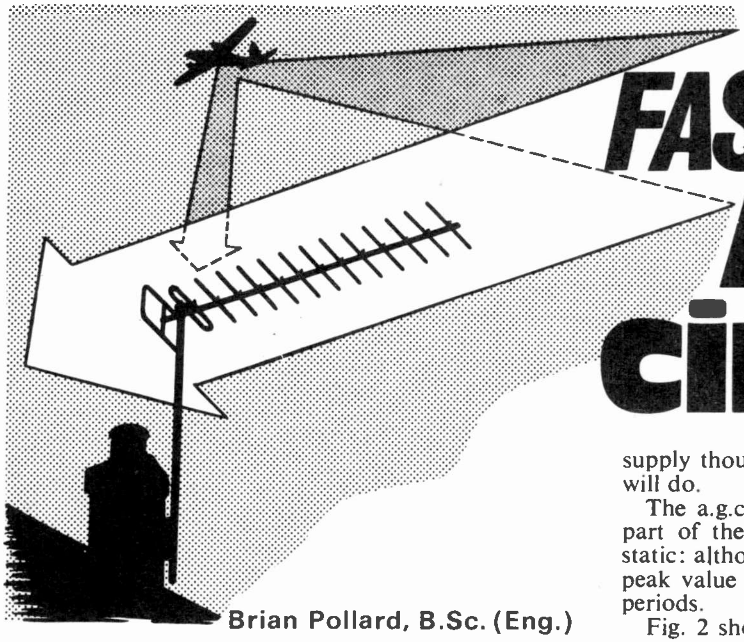


FAST-ACTING AGC circuit

Brian Pollard, B.Sc. (Eng.)

THIS article describes a simple sync pulse tip a.g.c. circuit which since it is fast-acting is very effective in removing aircraft flutter. The control voltage provided is independent of picture content. It was devised for use in the Thorn/BRC 950 chassis along with the black-level clamp described in the November 1974 issue but should be usable in other chassis without much modification.

To provide fast-acting a.g.c. it is necessary to use a circuit whose output is independent of picture content. A fast-acting mean-level a.g.c. system cannot be used: it would produce very bad streaking on the picture since the receiver's gain would vary from one part of the picture to the next.

With positive vision modulation—as used on 405 lines—a picture-independent a.g.c. circuit must be gated so that it samples the signal when it is at a definite level—in practice the sync pulse back porch period. With negative vision modulation as used for the Band IV and V transmissions the problem is very much easier since the sync pulse tips represent 100% modulation and can be measured by a simple peak detector circuit to provide a control potential which is independent of picture content (see Fig. 1).

The only place in the receiver where the sync pulse tips appear at a definite potential with respect to chassis is at the vision detector. Their amplitude here is only a few volts however and the circuit is very sensitive to stray capacitance. The signal has to be amplified and buffered therefore before it can be used.

This operation is made easier if the detector output is measured with respect to a negative potential rather than with respect to earth (chassis). To do this, all d.c. connections from the detector circuit to chassis must be removed and taken to a negative supply (see Fig. 2). If any instability occurs it may be necessary to decouple these points to earth across the gaps in the circuit where the earth connections have been removed. Use 1,000pF capacitors at each point if this measure proves necessary. The −30V rail used in the black-level clamp circuit previously described is ideal for the negative supply though any voltage between −20V and −40V will do.

The a.g.c. amplifier must be d.c. coupled since the part of the signal we are interested in is essentially static: although the sync pulses occur every 64μS their peak value remains constant over comparatively long periods.

Fig. 2 shows the detector circuit used in the Thorn 950 chassis and the coupling to the video output pentode. This circuit is fairly typical of the usual practice adopted in dual-standard, valved monochrome receivers. The amendments necessary to the circuit are also indicated. The anti-lockout diode should be removed—it is not required since the new a.g.c. circuit, being independent of the conditions in the video output stage, is not susceptible to lockout.

In some circuits it may be necessary to insert a.c. coupling between the detector and the video output pentode (if this is not already used—the usual practice is d.c. coupling on 405 lines and a.c. coupling on 625 lines). The time-constant formed by the coupling capacitor and the output pentode's grid leak resistor should be around 500mS. If this action is taken it will probably be necessary to alter the cathode bias resistor in order to get the mean anode current of the video amplifier right again. A good rule of thumb is that with a.c. coupling the video amplifier anode voltage should be half the h.t. line voltage when there is no signal present.

Fig. 3 shows the a.g.c. circuit added to the video detector circuit shown in Fig. 2—which must be switched to 625-line operation of course. D1 is the a.g.c. detector diode—note that it conducts the positive-going signal modulation, the vision detector conducting the negative-going modulation (refer to Fig. 1). The

★ Components required

Resistors:		**Capacitor:**	
R1	68k Ω	C1	0.02μF
R2	330k Ω*		
R3	12k Ω		
R4	68k Ω	**Diode:**	
R5	1 M Ω	D1	1N4148
All ¼W 5%			
		Transistors:	
		Q1	BC107
*See text		Q2	BC107

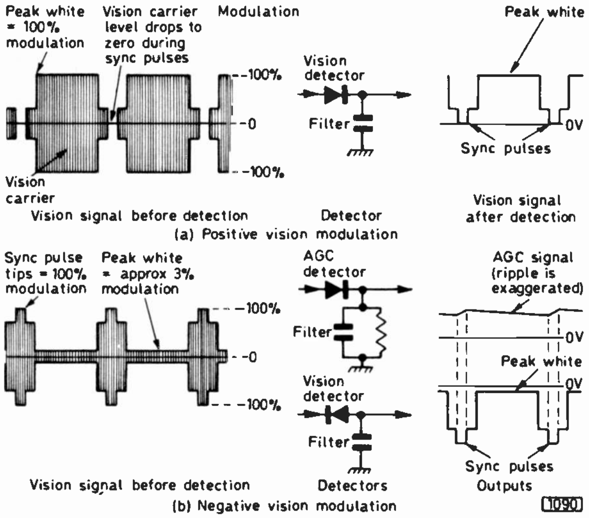


Fig. 1: Comparison between video signals with (a) positive modulation as used on 405 lines and (b) negative modulation as used on 625 lines, showing the appropriate detector arrangements and the way in which a peak detector can be used on 625 lines to obtain from the sync pulses an a.g.c. voltage proportional to signal strength. For clarity a signal waveform corresponding to peak white is shown.

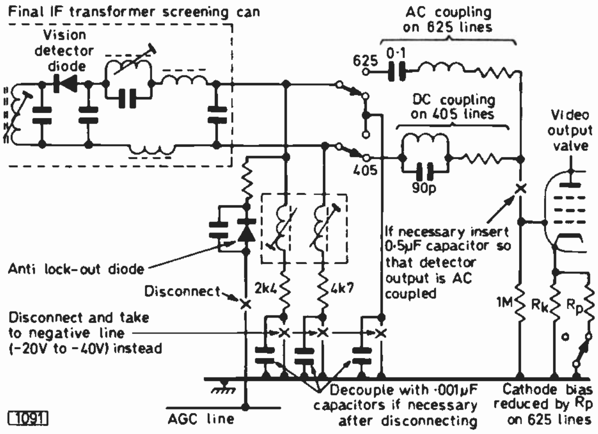


Fig. 2: Typical detector output coupling and video amplifier biasing. The detector circuit is as used in the Thorn 950 chassis. The output stage biasing arrangements shown do not correspond with those used in the 950 chassis.

buffer stage Q1, being an emitter-follower, has a very high input impedance and low input capacitance. C1 charges to the peak video signal level appearing at D1 cathode, the time-constant of C1 and R1 determining the a.g.c. circuit's response time. The values used give a time-constant of 5mS which is fast enough to follow severe aircraft flutter—this circuit in fact is an extremely effective cure for those unfortunate enough to suffer from this form of interference.

Q2 is a straightforward common-emitter d.c. amplifier whose output is taken to the a.g.c. line via R4 and whose gain depends on the value of R2. There is no point in setting it too high since this will cause Q2 to turn fully on at low signal strengths, preventing any further a.g.c. action as the signal strength increases.

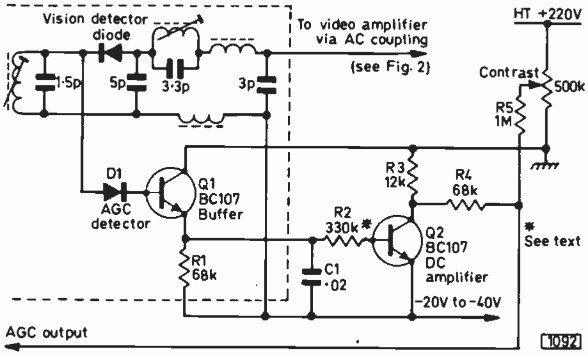


Fig. 3: The fast-acting sync pulse tip a.g.c. circuit, shown connected to the detector circuit used in the Thorn 950 chassis.

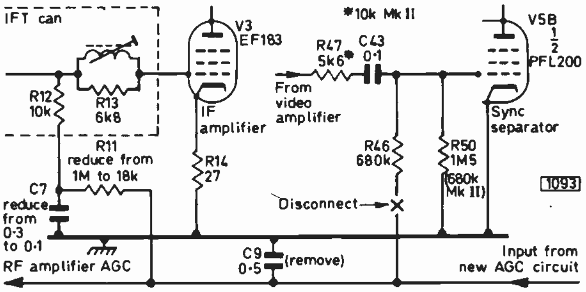


Fig. 4: A.G.C. line connections—Thorn 950 chassis. Rearrange the contrast control circuit as shown in Fig. 3. Leave in circuit the a.g.c. line clamp diode W1 and the filtering in the a.g.c. line to the v.h.f. tuner (both the r.f. amplifier and the mixer provide i.f. amplification on u.h.f. and are gain controlled).

The value of 330kΩ was found to give satisfactory results on the prototype when fitted to a Thorn 950 chassis. The best way to find the optimum value for R2 is to disconnect the a.g.c. line, turn the contrast control to minimum and either attenuate the input signal in some way or put a negative bias on the a.g.c. line until a picture with normal contrast is obtained. A value should be chosen for R2 to give more or less equal voltages across R3 and Q2 under these conditions. The circuit should then be reconnected as shown and the contrast control set to give a picture with normal contrast again.

If the contrast is consistently too high or too low try altering the value of R4 to get the range of adjustment right. By juggling with the values of R4 and R5 it's possible to make the contrast control have as much or as little range as you like. This seems to be very much a matter of personal preference, though I have never seen the point of contrast controls which reduce the contrast right down to zero—when do you ever want the contrast to be less than the maximum the video amplifier will handle without overloading?

Since it requires about 2V at D1 anode to start to turn Q2 on, the circuit has inherent delay in its a.g.c. action. This is rather useful since it means that the a.g.c. does not come into effect until it is needed, i.e. when there is already a good signal present.

Q1, R1 and D1 are shown in Fig. 3 mounted inside the final vision i.f. transformer screening can: this is very desirable since it ensures that there is the minimum of unwanted extra capacitance. With the Thorn 950 chassis there is plenty of room inside the can and there are even some spare tags which can be used for the external connections. If there is no room in the final i.f. transformer can these components should be mounted as near to the detector circuit as possible—aim for short leads rather than a tidy appearance. There are so few other components that it is not worth mounting them on a separate board: the components in the prototype were soldered directly to the underside of the printed circuit, using insulating sleeving where necessary.

Fig. 4 shows part of the Thorn 950 a.g.c. circuit. The original a.g.c. feed should be disconnected at the point marked × and taken instead to the output of the new circuit. The time-constant of the a.g.c. line should then be reduced to match that of the a.g.c. amplifier: remove C9 and reduce C7 to 0·1µF and R11 to 18k Ω. The a.g.c. applied to the r.f. amplifier still has a long time-constant but since most of the receiver gain comes from the i.f. amplifier the a.g.c. to the r.f. amplifier has comparatively little effect anyway. ■

ANSWER TO PUZZLE CORNER *(page 77 last month)*

H. K. Hills

THE problem set last month was to design a single-standard monochrome receiver vision detector circuit and subsequent emitter-follower video stage using a specified list of components. The aim was to duplicate the original circuit, shown in Fig. 1. This should be possible since the components specified could be used only in the correct circuit position. The following considerations determine the arrangement of the circuit.

First the adjustable drive to the a.g.c. circuit means that the 1k Ω potentiometer must be the emitter load resistor of the video emitter-follower stage, the slider tapping off the feed to the a.g.c. circuit. VR1 in fact acts as a preset contrast control as well as being the emitter-follower's load resistor.

Next, what about the detector load resistor? R1 would be on the low side and R3 much too large: R2 it is, at the typical value of 3.9k Ω. That leaves R1 and R3 to provide forward bias for the emitter-follower: which way round are they connected? The emitter voltage of a video emitter-follower is typically about 5V, so its base voltage must also be around this figure (slightly above in practice of course). With a 20V supply rail we must use R3 as the upper and R1 as the lower resistor therefore in the potential divider network used to bias the emitter-follower. The bias is applied to the earthy side of the detector load resistor, the detector's output being superimposed upon the bias.

Since C1 and C2 are only 6.8pF each they clearly form an i.f. filter—in conjunction with the r.f. choke L1. The arrangement consists of a pi network which filters out the carrier frequency.

The earthy end of R2 must be decoupled—otherwise R1 and R3 will form part of the detector's load. Before deciding upon which capacitors to use for this purpose however what about the polarity of the detector diode? It was stated last month that the video output transistor which is fed from the emitter of the emitter-follower drives the c.r.t. cathode. This means that the sync pulses must be the most positive part of the waveform fed to the cathode of the c.r.t. Since the video output stage will provide phase inversion between its input and output this means that the signal fed to its base must have the sync pulses as the maximum negative-going excursion and peak white as the maximum positive-going excursion as the inset waveform shows. There is no phase inversion in an emitter-follower of course so this is the form of signal that must be present at the output of the detector as well. Now at u.h.f. the sync pulses represent maximum signal amplitude and peak white minimum signal amplitude. The detector diode must be connected therefore so as to pass the negative-going modulation applied to it. Thus with the waveform shown in Fig. 1 applied to its cathode the negative-going signal excursions will appear at its anode across the load resistor R2.

So which capacitors should we use to couple signals to the base of the video output transistor and the sync separator? As the input impedance of the video output transistor is low a large value capacitor must be used for coupling in order to avoid undue attenuation of the lower-frequency components of the video signal. C6 is used for this purpose therefore.

C3 (0.001µF) is too low to provide coupling to the sync separator: one of the 1µF capacitors is used for this purpose and the other to decouple the earthy end of the detector diode's load resistor. Since small electrolytics often have an appreciable inductance C3 is used to provide r.f. decoupling at this point. Without this, C2 could add appreciable reactance at high frequencies to the detector load circuit.

The 6MHz series trap simply shunts the emitter-follower's load resistor. By being placed here it provides two functions. First it acts as a short-circuit at this frequency across VR1. And secondly by removing negative feedback at this frequency it increases the intercarrier signal developed in the emitter-follower's collector circuit.

This is a typical, basic detector circuit for u.h.f. operation. Many commercial circuits may appear to be more complex but the additional components merely modify the performance. For example, slightly different i.f. filtering may be used, a peaking coil may be added in the detector load circuit, and in some designs a limiter diode is incorporated across the intercarrier sound tuned circuit. ■

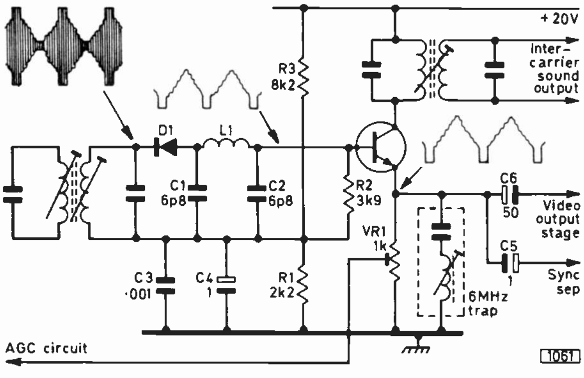


Fig. 1: The single-standard (625-line) vision detector and video emitter-follower circuits.

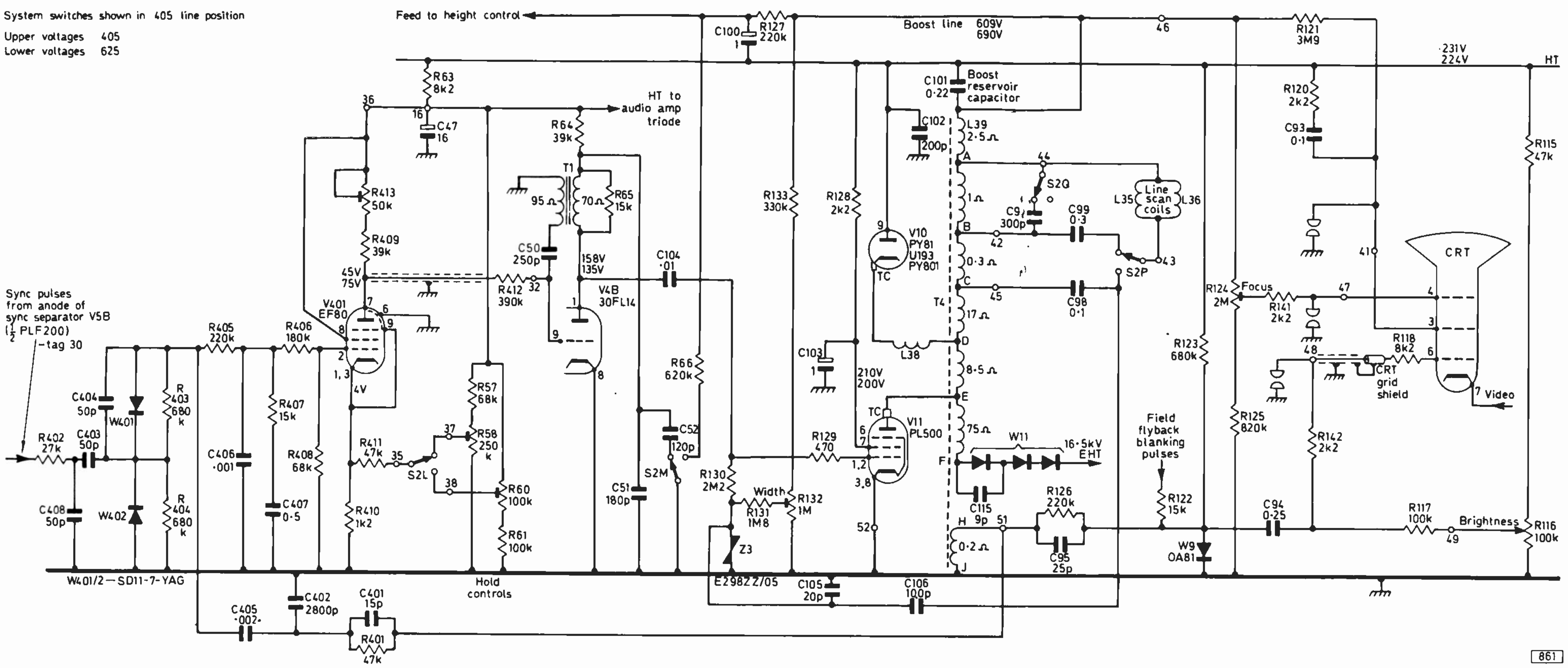


Fig. 2: Complete line timebase circuit, with flywheel line sync via a pentode connected d.c. amplifier, as used in earlier production. The video signal is a.c. coupled to the c.r.t. cathode which is biased by a potential divider connected between the h.t. line and chassis. In some models the d.c. amplifier is connected as a triode (see Fig. 4).

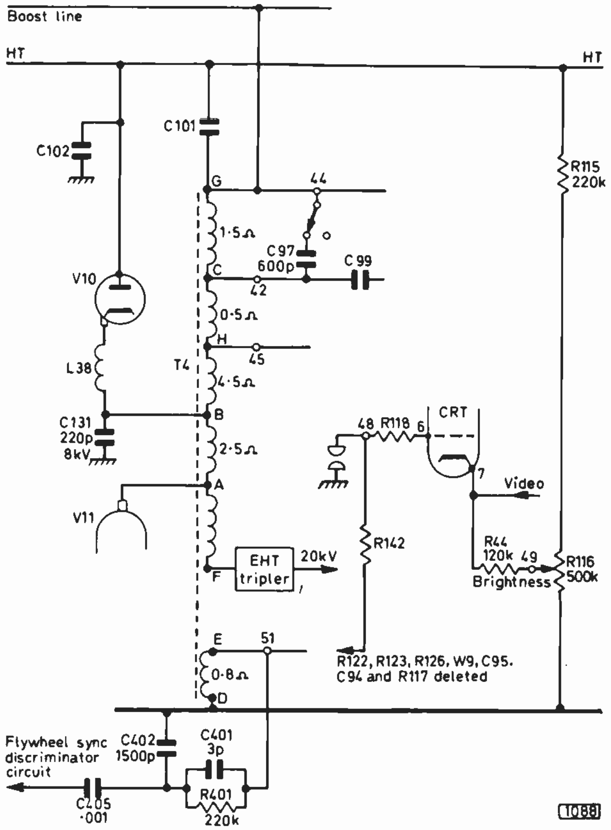


Fig. 3. Modifications to the line output stage and c.r.t. circuits in the Mark II version of the chassis which is fitted with a different line output transformer.

in others—see Fig. 4) and used to control the timing circuit C50/R412 connected to the grid of the blocking oscillator triode V4B (the pentode section of this valve is used as the second vision i.f. amplifier). C51 charges via R64 to produce the line drive waveform, being discharged by V4B when it conducts to give the flyback. C52 is added in parallel with C51 on 405 lines.

C104 couples the oscillator output to the grid of the line output pentode whose control grid is returned via R130 to a width/e.h.t. stabilising circuit—voltage-dependent resistor Z3 rectifies the flyback pulses fed back via C106, producing a bias potential which varies as the flyback pulse amplitude varies.

With direct line sync (Fig. 1) negative-going line sync pulses are fed to both the anode and, via a delay network, the grid of the blocking oscillator triode. This arrangement provides good control of the oscillator, which is stabilised against drift by thermistor X1 connected in its cathode lead.

EHT Tray Breakdown

One fault which proclaims itself to all and sundry is breakdown of the selenium rectifier e.h.t. tray: few smells are more obnoxious and penetrating. Individual rectifier sticks can be replaced but it is best to fit a complete new tray. Apart from complete breakdown faulty sticks can cause "arcing" on the screen or a small or varying width raster. A word of warning: never draw arcs from the tray to see whether it is working as this can be fatal to it.

Some Difficult Faults

Thinking back over the years since these chassis first appeared we can recall some tricky faults. For example a set with uncontrollable line slip. Careful adjustment of the line hold control enabled the picture to be held for up to half a minute, after which it would float away into wild fluctuations across the screen. All the usual things were tried—valves, voltage checks and the flywheel sync diodes—but nothing remedied the fault. The routine checks were run through again and this time it was noticed that there was a slight but definite hum on the sound. This pointed to the main smoothing electrolytic block and on paralleling a 32μF capacitor across the four sections in turn the fault cleared when the h.t. smoothing electrolytic section was shunted. Over a period of time sections of the block are subject to breakdown. Individual sections can be bridged of course but it is tidier and better—since leaks between sections can occur, shorting out the associated smoothing components—to replace the complete can.

Yet another case of erratic lines on the screen gave the appearance of an oscillating scan—a visible motor-boating effect. Again routine fault-finding failed to reveal the cause of the trouble. A meter connected between the control grid (pin 1) of the line output valve and chassis to check for negative drive steadied the picture to a normal size with a slow rhythmic pulse superimposed on it however: the control grid had apparently been floating with no earth return until the meter was connected. A study of the circuit showed that the trouble could be an open-circuit grid leak resistor R130 or the v.d.r. Z3: the resistor was not discoloured—the usual sign of being faulty—and closer examination revealed a dry-joint from the v.d.r. lead to chassis. This suggested an overload. Resoldering the joint cleared the fault but after the set had been running for some minutes the v.d.r. showed signs of overheating and the meter measured over 500V across it. This could only be coming through C106 and a check showed that this capacitor was leaky, a replacement curing the fault. It is worth noting that time could have been saved by initial scrutiny of the printed circuit panel around the v.d.r.: the moral is, don't reach automatically for the Avo leads, look first, act later!

Another fault on this chassis which can be awkward is normal 405-line reception but poor field lock and possibly intermittent loss of line hold on changing to 625-line operation. The fault is in the PFL200 video amplifier control grid circuit and BRC introduced a modification to cure it: increase the value of the 625-line signal coupling capacitor (C32) from 0·1μF to 0·3μF and reduce the grid leak resistor (R36) from 1MΩ to 330kΩ. The basic cause of this fault is a slightly soft PFL200. This valve is a.c. coupled to the vision detector on 625-lines and if the valve is soft grid current is drawn, charging the capacitor and altering the basic operating conditions of the stage. D.C. coupling is used on 405 lines so that reception is normal on this system.

Common Faults

Weak or lost line sync is generally due to either the flywheel sync discriminator diodes W401/W402 or the EF80 d.c. amplifier V401. In cases of line pulling it is worth checking the value of R412 (a ½W, 5% HS resistor must be used in this position). Where both the field and line sync are weak check the value of the upper resistor R48 (47kΩ) in the potential divider network which feeds the screen grid of the sync separator section of the PFL200. Failure of the main smoothing block can result in poor sync, hum and curved verticals.

A common complaint on this chassis is a narrow picture. In most cases a replacement PL500 (PL504) or less often PY801 will clear the fault but occasionally attempts to adjust the width control reveal a burnt spot here: this is characterised by loss of raster or flashing on the screen. Replacement of this preset control is the only cure. In one case where the picture was narrow and the width fluctuated accompanied by crackles on sound it was found that the latter symptoms disappeared when the control was reduced to minimum, though the picture was still narrow: in this position the

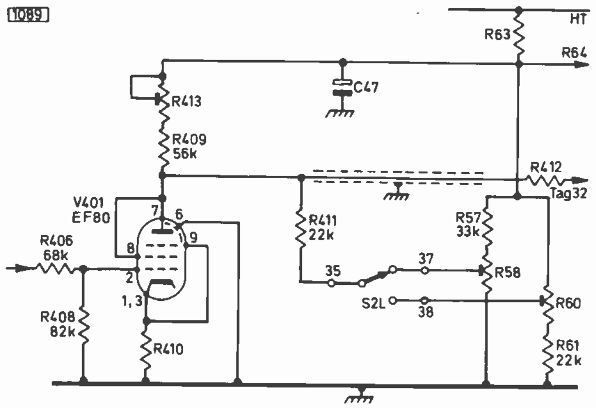


Fig. 4. Modifications to the flywheel line sync circuit when the d.c. amplifier is triode connected.

v.d.r. is in effect short-circuited. Although the v.d.r. showed no external signs of breakdown its replacement completely cured the fault. Reduced width control range occurs when R133 increases in value. Lack of width on 625 lines can result from the scan correction capacitor on this system (C98) going short-circuit. It is worth using a replacement rated at 1kV.

The PL500 can produce a variety of faults ranging from no picture or a small picture to a burnt out screen grid feed resistor or a varying size picture.

If replacing the PL500 or the PY801 fails to cure loss of raster check the boost reservoir capacitor C101 which may be short-circuit.

For no e.h.t. but a clear line whistle check the e.h.t. tray itself by fitting a replacement.

The no picture symptom can also be caused by absence of or incorrect c.r.t. first anode voltage (pin 3): check R121 and C93. Alternatively the symptom when these components are defective may be a poor picture.

Failure of C131 (Mark II version) can result in no raster—it can fail with spectacular arcing or alternatively if leaky will rapidly reduce the width after switching on. For reliability use a replacement rated at 12kV: alternatively use two 400pF 8kV capacitors connected in parallel.

The line timebase will also be killed by a faulty scan-correction capacitor (C98 or C99) or pulse feedback capacitor (C106). A leak in C106 can damage the v.d.r. as previously mentioned.

Line linearity which deteriorates from the left-hand side of the screen, turning into foldover at the right-hand side, can be due to the line output valve screen grid feed resistor R128 or its associated decoupling capacitor C103, the line output transformer tuning capacitor C131 (Mark II versions), the line drive coupling capacitor C104 or even the line oscillator valve or charging capacitor C51.

Striations with normal linearity can be caused by winding H–J (E–D in Mark II versions) on the line output transformer being defective or a connection to it dry-jointed or diode W9 in the line flyback blanking circuit being faulty.

Common Field Timebase Faults

Common field timebase faults are field creep in which case a new PCL85 should be tried then if necessary the pentode cathode components R112 and C89 checked, also C88 in the linearity feedback circuit and the field charging capacitor C81; and field roll in which case again first try a new PCL85, then check the cross-coupling capacitor C79 from the pentode anode (a replacement should be rated at 1kV at least).

In spite of this list of faults, the Thorn 950 chassis is reliable and sets fitted with it have a good many years' faithful service left in them yet. Accessibility for repairwork is good.

BOOK REVIEW

RECEIVING PAL COLOUR TELEVISION by A. G. Priestley. Published by Fountain Press, Station Road, Kings Langley, Herts, at £5·00 (UK only). 261 pages.

THIS is undoubtedly the book for those of our readers who have yet to acquaint themselves with the facts of the PAL colour television system and the techniques used in PAL receivers. It can also be recommended as a handy reference source—you will find most of the odd items you may be uncertain about clearly explained at some point or other—and as a refresher for those who may have started out on their colour careers by trying to digest one of those rather turgid efforts, full of unnecessary mathematics, that appeared in the early days of colour TV broadcasting in this country.

The great advantage of Alfred Priestley's book is that, as its title indicates, it ties everything down to the *reception* of colour television. In other words, instead of treating the subject as some abstract world of its own the book concentrates on what actually happens in domestic receivers—the circuits required, what they do and how they operate, the way in which colour tubes reproduce the full range (well, almost) of colours, the adjustments required and so on. The accounts of circuit action tell you exactly what you need to know, leaving nothing to guesswork. All this is perhaps what one might expect from an author who has worked for many years now on the development and production of commercial colour TV chassis, but even so few writers have his gift for putting things over so clearly and to the point.

The book is up to date, covering for example the Trinitron, Chromatron and PIL tubes, though not the 20AX. I.C.s are touched upon, but there is not a great deal one can say about them anyway.

An impressive feature is the series of full colour photographs of the standard colour bar test pattern, showing the effects on the display when various signals are absent or the PAL switch is operating incorrectly. A detailed chapter is devoted to colour faults and servicing techniques and should give the reader a sound idea of how to go about analysing fault conditions and the setting up techniques required. This is in addition to a separate chapter on colour display adjustments.

The only complaint we have is that the price seems a little on the high side, though the colour photographs mentioned will have been expensive to reproduce and in these days of inflation it is difficult to know just what to expect. What we can say without hesitation is that the contents are well worth having on your reference shelf.

J.A.R.

FAULT FINDING GUIDE

John Law

THORN 950 LINE TIMEBASE

SOME forty models in the Ferguson, HMV, Marconiphone and Ultra ranges were fitted with the Thorn 950 and 950 Mk II chassis. There were also rental models, mainly DER sets. They are dual-standard chassis, dating from 1965–67, and there are also plus f.m. radio and portable (960 chassis) versions. The chassis employs valves except for the u.h.f. tuner and the selenium "stick" rectifier clip-on e.h.t. tray. The Mark I version with a three-stick tray operates at 16kV while the Mark II version with a tripler operates at 20kV. Slightly different line output transformers are used in the two versions. Some sets use direct line synchronisation (Fig. 1) but most have flywheel line sync (Fig. 2).

The field timebase used in these chassis was covered in the March 1973 issue while the portable versions with their unusual power supply arrangements were covered in the April 1974 issue. A PFL200 is used as the video amplifier and sync separator.

Most of the components are laid out on a flat rectangular printed board which has a vertically mounted metal frame at each end. Looking from the rear of the set, the left-hand frame carries the mains autotransformer, the field output transformer, the TV/radio switch solenoid (in those models with f.m. radio) and the panel carrying the two line hold controls, two contrast controls and the field hold control; the right-hand frame supports the mains h.t. rectifier and associated components, the smoothing electrolytics (single can) and choke, the system switch solenoid and the line output transformer with clip-on e.h.t. rectifier tray. On the printed board itself are the system switch and most of the remaining parts, with the line timebase components on the right-hand side (the flywheel line sync components are mounted on a small panel above the line blocking oscillator transformer T1). The two tuner units are mounted on the cabinet front panel.

Circuit Description

Looking at the circuit shown in Fig. 2, negative-going sync pulses from the sync separator anode are integrated by R402/C408 and fed via C403 to the cathodes of the flywheel sync discriminator diodes W401/W402 while a reference flyback pulse from winding J–H on the line output transformer is integrated by R401/C402, with phase correction by means of C401, so that a sawtooth with a steep trailing edge appears at the anode of W401. Depending on whether the reference sawtooth leads or lags the sync pulse a negative or positive potential is developed by the discriminator circuit, smoothed by R405/C406, amplified by the d.c. amplifier V401 (this is connected as a pentode in some models, as a triode

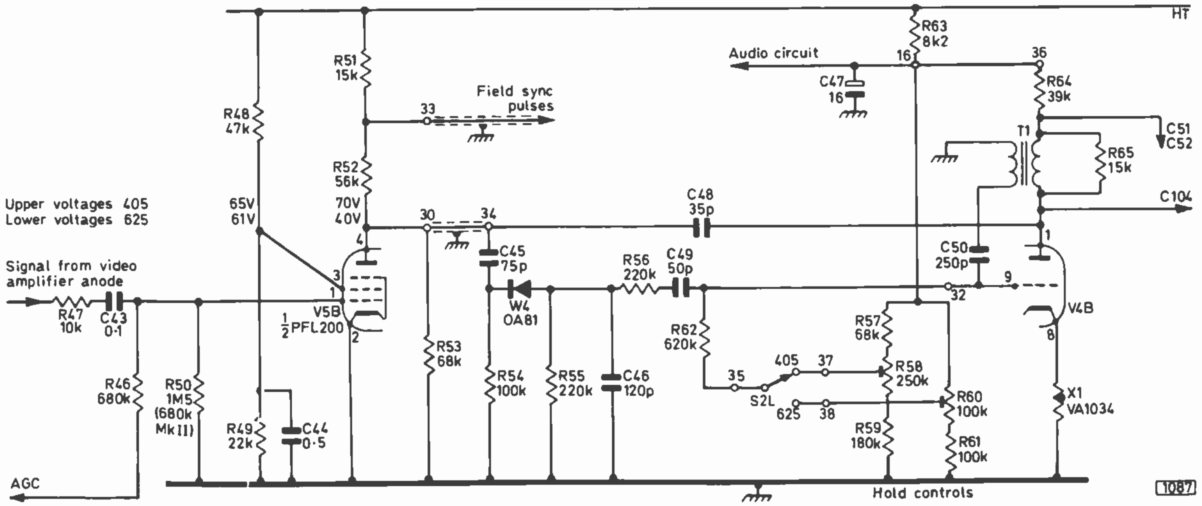


Fig. 1: Circuit of the sync separator stage V5B and the line oscillator with direct synchronisation. Most models incorporate flywheel line sync as in Figs. 2 and 3. R47 is 5·6k Ω in the earlier version of the chassis.

LONG-DISTANCE TELEVISION

ROGER BUNNEY

As 1974 draws to a close it seems that conditions are also declining. October was certainly not a month to be remembered. The tropospherics were quiet while Sporadic E—apart from a good opening on the first—was equally uneventful. With the exception of an Auroral occurrence during the month business left much to be desired!

The Sporadic E opening on the first was a good one however. Signals were received from the south-eastern direction at about 1,000 miles, high-level signals being received from Austria, Yugoslavia, Hungary, Czechoslovakia and Southern Germany. Ian Beckett (Buckingham) noted good colour from Austria (ORF) on chs E2a and E4; also West Germany ch. E2 (actually Grunten on the Fubk card) and RTV Ljubljana ch. E3 (Yugoslavia).

Hugh Cocks (near Honiton) wrote us in haste about Auroral activity on the 13th from 1715-1815 CET, with reception from YLE (Finland) on chs E2 and E3. It is interesting that this followed a more active Aurora some 28 days earlier—i.e. one complete rotation of the sun. We hope to cover the mechanism of Auroral reception again shortly. Hugh has also noted TVE (Spain) on ch. E3 using a very fine crosshatch pattern (similar to the one shown in Data Panel 29 January 1974).

My log for the period reflects the indifferent conditions:

1/10/74 DFF (East Germany) Chs E3, 4; DR (Denmark) E3; CST (Czechoslovakia) R1; TVP (Poland) R1—all MS (meteor shower); ORF (Austria) E2a, 4; MT (Hungary) R1; CST R1, 2; WG (West Germany) E2; also unidentified signals—all SpE.
2/10/74 DFF E3, 4; DR E3; CST R1; TVP R1—all MS.
3/10/74 DFF E4; CST R1; SR (Sweden) E2; WG E2; TVP R1; TSS (USSR) R1; RAI (Italy) ch. D (i.e. Band III!)—all MS.
4/10/74 DFF E4; CST, TVP R1; DR E3; TVE (Spain) E3—all MS.
5/10/74 DFF E4; TVP R1—MS.
7/10/74 DFF E4; CST R1—MS.
8/10/74 DFF E4; DR E3; CST R1; TVP R1—all MS.
9/10/74 DFF E4; DR E3; CST R1; SR E2; TVE E2, 4; RAI IB—all MS.
10/10/74 CST R1; SR E2; TVE E2—all MS.
11/10/74 TVP R1—MS.
12/10/74 DFF E4; DR E4; CST R1—all MS.
13/10/74 DFF E4—MS.
14/10/74 DFF E3, 4; DR E3; SR E3, 4; CST R1—all MS.
15/10/74 TVE E2; DR E3; DFF E4; RAI IB; CST R1; TVP R1—all MS.
17/10/74 DFF E4; ORF E2a; TVE E2—all MS.
18/10/74 DFF E4; WG E2; TVP R1—all MS; SR E2—SpE.
19/10/74 CST R1—MS.
21/10/74 DFF E4—MS.
22/10/74 DFF E4; CST R1—MS.
23/10/74 TVE E4—MS.
24/10/74 DFF E4; TVE E2; RAI IB—all MS.
25/10/74 DFF E4; RAI IB—both MS.

The blank CST Fubk card is still being seen at various times during the day in Band I—as yet no identification has been included on the card. Another interesting sighting is the 5540 electronic card—which NOS (Holland) used extensively in earlier days and at times still does—originating from West Germany. Clive Athowe (Norwich) has reported seeing this card several times on ch. E2. The Band III MS experts have continued their work and successful loggings have been reported—mainly Sweden, Norway and Denmark. Clive noted Switzerland ch. E7 on September 26th however!

Hetesi Laszlo (Budapest) has sent us several interesting photos including the ch. R2 Pecs transmitter using Test Card G! I have seen no reports of this card on ch. R2 this season but great care must now be taken since we have always assumed that Bulgaria is still using this card—it was several years ago. We have included some of Hetesi's shots this month.

On the other side of the world (Australia) Anthony Mann reports that F2 layer reception is improving as the summer approaches (the winter months in the UK correspond to the Australasian summer). He has already received several KBS f.m. links and other communications in the mid-40MHz region and on October 6th received ch. R1 video signals for several minutes! We await Anthony's further reports with great interest.

News Items

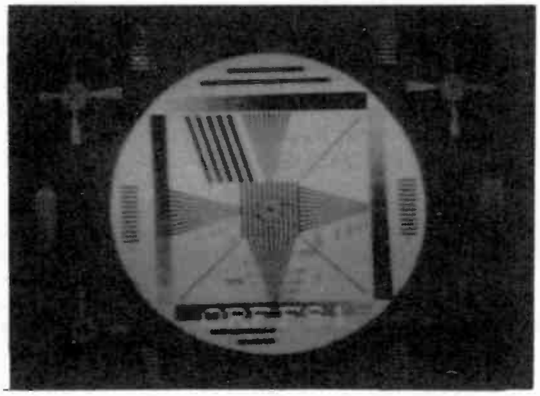
Australia: The Australian Broadcasting Control Board has allocated the u.h.f. channels 28-34 (Band IV) and 39-63 (Band V) to television. New services will use these channels in five years time, though u.h.f. relay stations will be in operation sooner. System G channel spacing (8MHz) will be used. ABC commenced colour tests on October 7th using the now infamous 5544 card with "ABC" at the top and "Television" at the bottom for identification. F.M. radio transmissions will commence in Band II and not Band IV as originally decided some years ago. Initially 92-94MHz will be used, channels 3, 4 and 5 being cleared of TV transmitters—starting with ch. 5 and working down to ch. 3 (chs 3-5 lie between 86·25-107·75MHz). This will take many years however. Our thanks to Nick Earley for this information.

Antarctic: The US Navy Antarctic Support Group has three TV stations in operation at the South Pole. Transmissions on three channels from the McMurdo Base are from 0700-1200 summer and 2300-0900 winter (GMT). Call signs are ch. A2 AFAN-2-wired; ch. A4 AFAN-4; ch. A7 AFAN-7. Main service areas are McMurdo, Scott and Williams Field bases. No information is available so far about transmitter powers. Information from the WTFDA.

Eire: Paul Duggan tells us that from September 22nd last the colour output of RTE has risen to 80%. All test transmissions are in colour from 0900 until 15 minutes prior to programme commencement. Trade bulletins are carried at 1020 each Tuesday and Thursday.

Holland: The five main "A" broadcasting concerns in Holland have main programme periods as follows: Saturday, Katholieke Radio Omroep-KRO; Sunday, Neder-

White Russian identification slide received on ch. R1 via SpE. *Courtesy Ryn Muntjewerff*



Telefunken T05 test card with ORF (Austria) identification. *Courtesy Hetesi Laszlo.*

Second Hungarian (MT-2) chain identification slide. *Courtesy Hetesi Laszlo.*

landse Omroep Stichting-NOS; Monday, Televisie Radio Omroep Stichting-TROS; Tuesday, Nederlandse Christelijke Radio Vereniging-NCRV; Wednesday, Nederlandse Omroep Stichting-NOS; Thursday, Omroepvereniging-VARA; Friday, Algemene Vereniging Radio Omroep-AVRO. On Saturdays and Wednesdays children's programmes are broadcast by different organisations. On Sundays various organisations produce programme material —Teleac, Ikor Kro/Rkk. Our thanks to Peter Vaarkamp for this information.

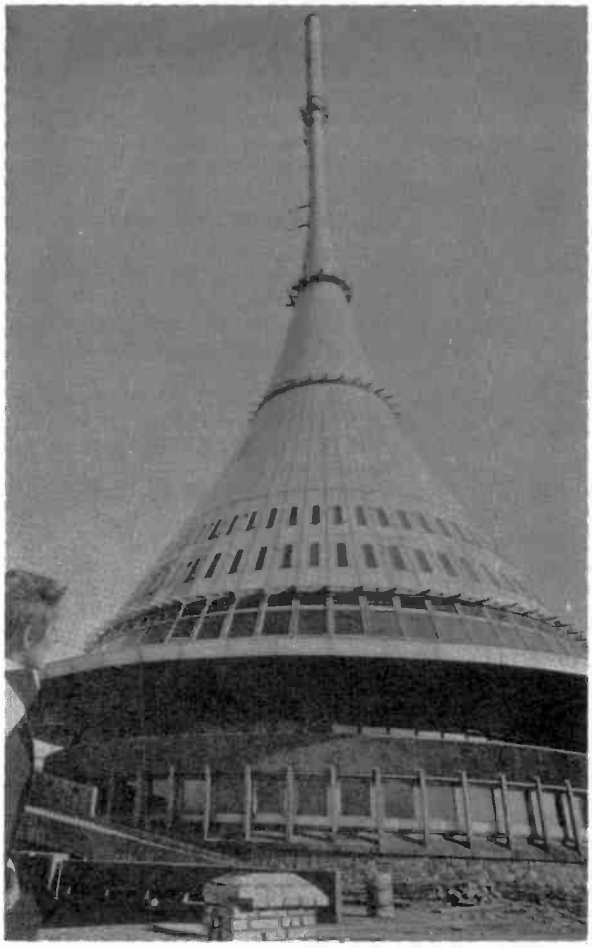
France: Information from *Tele-Sept-Jours* on the test transmissions.

ORTF-1: Test transmissions daily from 1000 until programme commencement—except Thursday when commencement is at 1200. If programmes commence prior to 1000 tests precede them by 30 minutes. Sound France Inter.

ORTF-2: Tuesday-Saturday 1400 to programme start; Monday 1400 in Paris, 1600 elsewhere. If programmes commence prior to 1400 there are test transmissions during the preceding 30 minutes. Sound France Musique.

ORTF-3: Tuesday-Saturday 1600—programmes. If the transmitter has been in service less than two months testing is from 1400. Monday 1400 Paris, 1600 elsewhere. Sound 'FIP' (France Inter Paris).

West Germany: The following transmitters are operating at reduced e.r.p.: Hornisgrinde SWF-1 ch. E9, reduction in e.r.p. from 100kW to 80kW; Cuxhaven DBP-2 ch. E24, reduction in e.r.p. from 330kW to 230kW; Ostfriesland DBP-2 ch. E33, reduction in e.r.p. from 410kW to 220kW; Wesel DBP-2 ch. E35, reduction in e.r.p. from 500kW to



Mt. Jested, Liberec, Czechoslovakia transmitting mast. Transmissions are on channels R8 and R31—there are also two f.m. radio programmes. Photograph by Oldrich Karasek, courtesy Czechoslovak Life Magazine.

490kW; Ostfriedland DBP-3 ch. E43, reduction in e.r.p. from 400kW to 210kW.

Jordan: Following a successful year of colour transmission testing JTV officially started colour operations on April 27th. The major portion of colour is on the foreign language channel though important events and programmes are carried on chs. E3 and E6. It is anticipated that locally originated drama programmes in colour will be transmitted shortly.

From Our Correspondents . . .

Kevin White (Cork) has been extremely active this past SpE season. In his letter he queries the origin of several test cards he has received: these have been confirmed as Austria, Yugoslavia and Switzerland. In addition to the SpE signals he is also active at u.h.f., using a Katherine (West German) array.

Robert Copeman (Sydney, Australia) has sent a long log detailing receptions in recent months. Using a Crossfire 3610 aerial he has received many stations such as Te Aroha AKTV-1 (New Zealand), Broken Hill ABLN-2 (NSW), Hedgehope DNTV-1 (NZ), Wollongong ABWN-5a, Wagga ABMN-O (NSW). We hope that conditions remain favourable for Robert and await—as from Anthony Mann—news of possible F2 receptions.

Neil Breward (Stoke-on-Trent) mentions an interesting line sync condition on his Bush TV set. While experimenting with the sync separator stage he found that excellent line and field sync could be obtained with the valve's screen grid voltage at zero: in this condition the field will lock on barely visible video and the line locks just as strongly!

Finally our old friend A. Papaeftychiou in Cyprus is still in good health and despite other actions on the island has managed to maintain some form of TV-DX lookout. He received a new Greek ch. E8 transmitter—while his local station was off the air—from Thira Island. Following the Turkish military occupation the RIK ch. E8 transmitter at Kantara (North East of the island) which was initially silent has commenced relaying TRT (Turkey) TV programmes—via off-air pickup.

DX-TV Booklet

The *Long-Distance Television* booklet written by yours truly covers all aspects of the DX-TV hobby: later in the New Year it is hoped that a larger, revised version will be available from Bernards Publishers—further details as soon as I know more myself. Meanwhile a few copies of the current edition (yellow cover version) are still available but once these have gone there will be no more until the new Bernards version. The yellow cover *Long-Distance Television* costs 55p from Weston Publishing, 33 Cherville Street, Romsey, Hants, SO5 8FB—please excuse this commercial!

Station Identification

As the number of hours during which there are television transmissions has increased, with an inevitable extension of the amount of programme material transmitted, the problem of identifying the source of transmissions has become greater. The usual method has been to await—with growing impatience—the end of the programme being received and then (provided the signal hasn't faded!) obtain the source from the end credits/captions. With language difficulties this too can present problems, especially if the station/network doesn't show a well known identification slide. During the past Sporadic E season however a number of enthusiasts have been busy finding a way round this problem—by using for identification purposes the test signals inserted in the field blanking period.

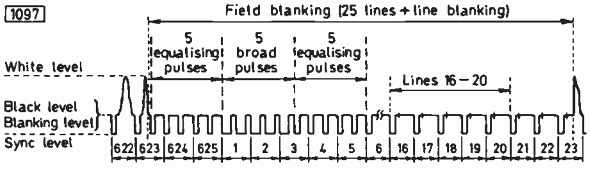


Fig. 1: The signal waveform during the field blanking period. Many broadcasting authorities nowadays insert test signals on some of the lines normally out of sight at the top of the picture.

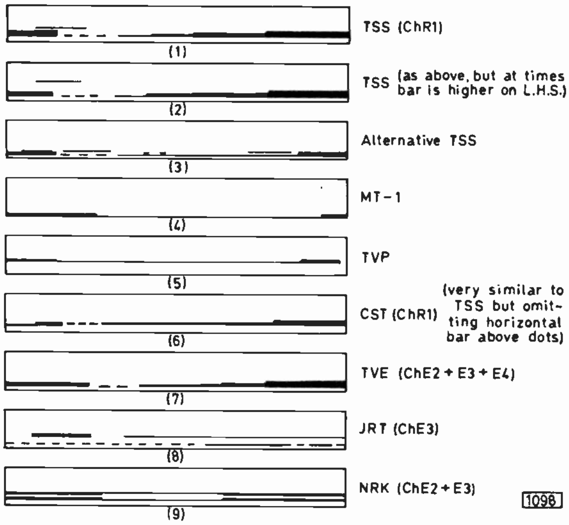


Fig. 2: The test signals used by the various authorities provide a useful means of identifying signal sources.

If a strong signal from a local transmitter is tuned in and the field "slipped"—i.e. the field hold control adjusted so that the picture rolls slowly down—a series of dots and test signals will be seen in the otherwise blank area at the top of the screen. Fig. 1 (courtesy IBA) shows the signal waveform (625 lines) during the field blanking period. On the left is the final line and a half of picture information. This is followed by the field sync pulse sequence—the equalising pulses and the five broad sync pulses. Then come a number of blank lines which represent a margin at the top of the picture. Test line signals are nowadays inserted in line 19 and sometimes in line 20, additional signals also sometimes being accommodated in line 16—these signals take the form of a binary code which transmits data along the network. More recently there have been the addition of Oracle and Ceefax signals.

Various countries in Europe are now using the field blanking period in this way and it has been found possible to identify a number of networks by closely examining the test signals displayed. Fig. 2 shows what the signals from various networks look like, as observed during the past season. This method of identification has great possibilities and we hope to be able to include further illustrations as these become available. We would appreciate from readers any comments they might like to make on this technique, results obtained, observations etc. Our thanks to Keith Hamer and Garry Smith of Derby and Hugh Cocks near Honiton for the information they have supplied.

TV SIGNAL STRENGTH METER

PART 2

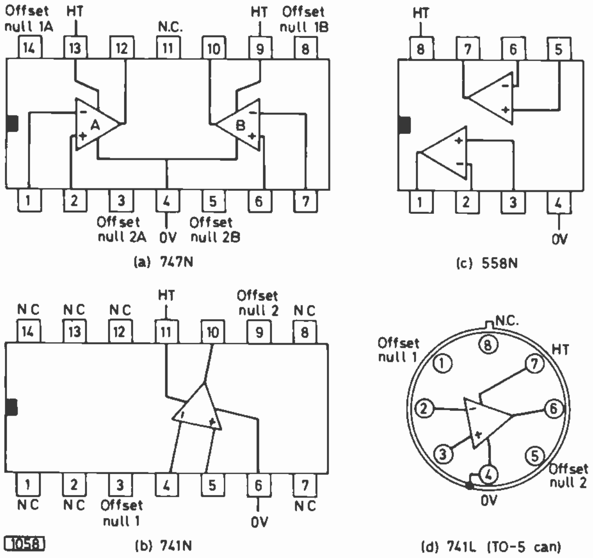
Caleb Bradley B Sc

Varicap Tuner

The varicap u.h.f. tuner may be the Mullard ELC1043 which is readily available on the surplus market and was fully described in the March 1973 issue. Alternatively the RIZ 243-619 (Guest International) is economical and similar. Any u.h.f. varicap tuner used in British receivers should be suitable but if buying surplus types, especially of Philips origin, obtain details of the pin connections as these can vary. Possibly some tuners offered as surplus are below specification for gain or noise but this is immaterial for this application.

IF Strip

The author used the i.f. strip from the Philips G8 colour chassis since this strip seems to be readily available on the surplus market and suits a portable instrument as it is remarkably compact. It actually consists of two small boards named "vision selectivity" and "vision gain" (circuit Fig. 3) intended to be soldered edge-on to a larger board and to be fitted with screening cans. In practice it is necessary to screen only the vision selectivity board. This can be done by bending up a can from any old tin (e.g. Coca Cola) to fit snugly round the board. The can should be connected to 0V and insulated on the inside with tape.



(a) 747N

(c) 558N

(b) 741N

(d) 741L (TO-5 can)

Fig. 4: Various guises of the '741' type operational amplifier, including dual versions. Many manufacturers add their own prefix to the basic number, e.g. Texas SN72747N. The letter suffix indicates the package, thus N signifies a plastic dual in line pack, J is a ceramic dual in line pack with the same pin assignments and L is the version in a TO-5 can.

Almost any transistor 625 i.f. strip, such as might for example be salvaged from a defunct portable TV set, could be used provided the h.t. and a.g.c. supplies can be arranged correctly and the d.c. return of the vision detector modified as shown in Fig. 3. Although the varicap tuner output coil is intended to be tuned by the input capacitance of the i.f. strip this is usually uncritical and can be ignored.

Operational Amplifier

The type 741 operational amplifier i.c. is available in many guises some of which are shown in Fig. 4. Types 747 and 558 are really "double 741s". The 558 lacks the offset null connections which are not used in this application anyway. Since the circuit is designed around three 741s one could instead use two 747s or two 558s (wasting one operational amplifier), or one 558 and one 741, etc. Note that if the two operational amplifiers in a 747 are used both pins 9 and 13 must be connected to the positive (30V) supply. Type 709 operational amplifier i.c.s are not recommended since they need extra stabilisation components.

Construction

The ready-made metal box specified in the parts list is strong enough for outdoor use and large enough to contain batteries which will last many months—i.e. four type PP1 (6V) and one type PP6 (9V). The PP6 has about half the lifetime of the PP1s.

The 1mA meter, the controls (VR1, VR2, S1, S2—all fitted with pointer knobs) and the l.e.d. are mounted

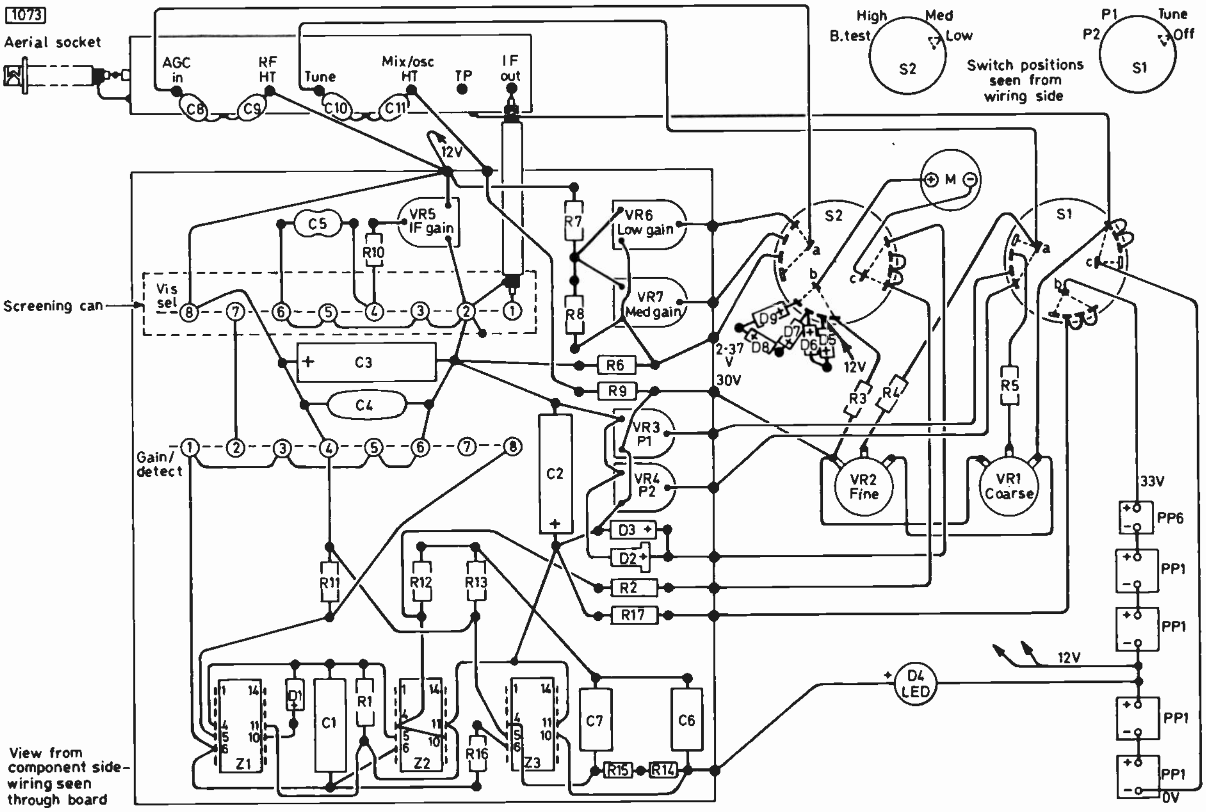


Fig. 5: Component layout using 0·1in. matrix Veroboard. The vision selectivity and gain/detector boards are mounted on the component side of the Veroboard with their track sides facing each other. Z1-Z3 are type 741 operational amplifiers.

on the lid. The two surplus boards forming the i.f. strip and most of the components are mounted on a small piece of Veroboard. The layout is shown in Fig. 5 and could be adapted for a printed board if desired.

After completion the board is connected to the controls and to the varicap tuner—which carries 0.1µF ceramic decoupling capacitors soldered directly between the appropriate pins and the case—with minimum lead lengths. Screened coaxial lead is needed only for the connections from the aerial socket to the tuner and from the tuner to i.f. strip.

After checking the wiring, paying special attention to the polarity sensitive components (diodes, electrolytics and meter), the batteries can be connected to S1. Finally the tuner, Veroboard, aerial socket and batteries are mounted in the box which is connected to 0V via the case of the tuner.

Testing

For testing and setting up first switch S1 and S2 to tune and high sensitivity respectively. Plug in a good u.h.f. aerial. As the coarse tune control VR1 is slowly turned over its range a double meter deflection should be obtained for each channel received. Find a weak channel and set VR5 (i.f. sensitivity) for maximum deflection. If with high i.f. gain there is deflection with no aerial plugged in this is a sign of i.f. instability and the screening should be improved—as well as checking all decoupling capacitors. VR5 will not need to be adjusted again except possibly to reduce the i.f. gain to cope with an exceptionally strong signal. In the high sensitivity position some distant stations may be detected as well as the three (BBC-1, BBC-2, IBA) locals. The l.e.d. should be identifying the vision carrier of each pair of carriers. Note that this always flashes briefly when tuning across carriers and may flash intermittently on a strong sound carrier.

Adjust the tuning to obtain exactly full scale meter deflection. Switch to medium sensitivity and adjust VR7 for 10% deflection. If a sufficiently strong signal is available obtain full scale deflection on this range and adjust VR6 for 10% deflection when switched to low sensitivity. The settings of VR6 and VR7 can be changed if a different overlap (or none) between ranges is desired.

Calibration

The coarse tune control VR1 can best be calibrated with channel numbers by marking where known channels are received (with the fine tune control VR2 set midway). The graph in Fig. 6 shows the approximate relation between tuning voltage and channel number for the Mullard ELC1043 tuner, but there is some variation between individual tuners. It can be used to calibrate VR1 roughly however. If calibrating VR1 this way measure the voltage at its slider with a high-impedance voltmeter (>1MΩ input impedance) to minimise loading error over the middle of the range.

Presets VR3 and VR4 are set as accurately as possible to any two desired channels. If more than two preset channels are required it is a simple matter to add a further selector switch and any number of presets, or to incorporate a commercial pushbutton varicap tuning assembly.

Use

Before use always switch to "battery test" and check that there is a visible meter deflection. Before erecting an aerial connect to it a sufficient length of coaxial lead to reach the receiver. Mount the aerial on the mast at approximately the right angle, plug the lead into the signal strength meter and check that deflections can be obtained on the local channels. Select an appropriate sensitivity and tune for maximum deflection on a vision carrier, i.e. l.e.d. glowing steadily. It may be worth fitting a small hood over the l.e.d. to improve its visibility in daylight.

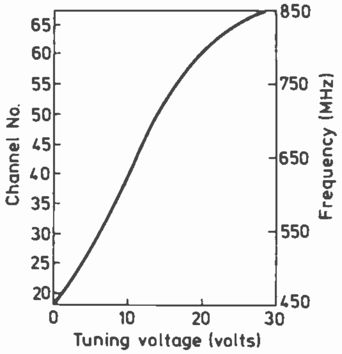


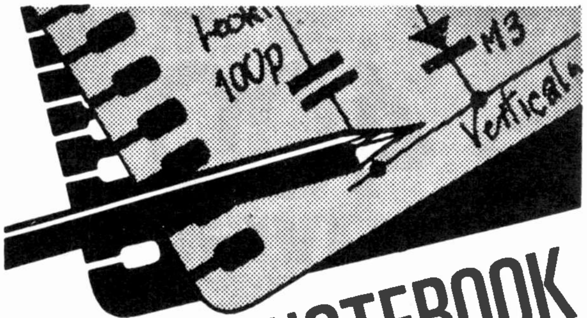
Fig. 6: Graph showing the approximate relationship between tuning voltage and frequency/channel number for the Mullard ELC1043 tuner.

Align the aerial for maximum deflection. Check that adequate deflection is obtained on all three channels of the local group. If they are unequal the aerial may be for the wrong channel group. Plug the aerial into a receiver and inspect all three pictures closely for any sign of ghosts. If any are present the situation may be improved by experimenting with different aerial positions; a better answer however is to use a more directional (more elements) aerial mounted higher (a log-periodic type will give best results).

The signal strength meter can also be used for tuning aerial preamplifiers.

VHF Version

A v.h.f. version of the meter for 405 transmissions or for continental DX has not been tried but should be feasible since v.h.f. varicap tuners are available. A Band I/III switch is needed for these tuners. Although 405 modulation polarity is reversed relative to 625, the 625 i.f. strip could be retained and the same detector polarity used. This will give a peak negative voltage on picture whites. The meter would only be useful on channels broadcasting a steady picture (e.g. a test card) since the reading would fluctuate on a changing picture; also the l.e.d. would light erratically on both sound and vision carriers since both are amplitude modulated. ■



SERVICE NOTEBOOK

G. R. WILDING

Trouble Savers

Two things which should never be done. First, when servicing an old set with an ageing c.r.t. never reduce the mains voltage tapping to boost the picture. When the valves are old the increased operating temperature often results in them drawing grid current, with results such as cramping at the base of the raster, weak field lock, distorted sound and the early complete demise of the line output valve and/or the boost rectifier. Since one side of the c.r.t. heater is usually connected to chassis in an all valve receiver (there are only a few exceptions where there is another valve lower in the chain) the best way of boosting the tube in this case is to connect a wire-wound power resistor of 8–10k Ω from the live mains supply to the live c.r.t. heater connection.

Secondly, when faced with lack of width in a colour receiver change valves if need be but unless you have an e.h.t. meter and/or a manufacturer's approved e.h.t. setting-up procedure never make any adjustments which may alter the e.h.t. voltage. Excessive e.h.t. results in more line output transformer and e.h.t. tripler failures than anything else, impairs the beam limiting performance and whether the e.h.t. is above or below normal makes it difficult if not impossible to get good convergence and focus.

HT Fuse Blowing

Occasional and erratic h.t. fuse blowing can be a time consuming fault to trace, especially in solid-state colour receivers with complex thyristor or transistor voltage stabilising circuits. Trouble-shooting is made difficult because the defective component(s) usually test OK when cold, breaking down only when high peak voltages are applied to them.

A KB colour receiver fitted with the CVC5 chassis sometimes blew the 400mA h.t. line fuse minutes after switch on. On test the cause was found to be absence of drive to the PL509 line output valve. A new PCF802 line generator valve failed to cure the trouble and although both flywheel line sync discriminator diodes tested OK they were replaced since when faulty they can prevent the onset of oscillation in the line generator stage. The fault persisted however and a great number of components in this area came under suspicion. We decided to replace suspect capacitors in the line generator stage first and subsequently found that on replacing C291f (0·001μF) which provides the quadrature signal feed to the reactance triode section of the stage no further hesitancy in the line oscillator was experienced. The capacitor appeared to be OK on meter test, proving that the only sure way of testing capacitors giving this type of trouble is by replacement.

No Signals

A set fitted with the Pye group's 67 chassis had an unmodulated raster and no sound, though there was normal hum from the loudspeaker. There was no grain on the screen so it appeared that either the tuner or the i.f. strip was non-operative. The tuner voltages were the easiest to check but proved to be within limits. We then commenced testing back from the third and final i.f. amplifier transistor VT3. The voltages in this stage were found to be OK but on turning attention to the second i.f. amplifier VT2 we found that the emitter voltage was −18V instead of −14·7V while on contacting the base with the test prod the picture and sound were immediately restored.

The i.f. stages in this chassis use npn transistors with their emitters fed from the −18V l.t. rail and their collectors returned to chassis. It became clear (see Fig. 1) that the resistor (R11) between VT2 base and chassis was either open-circuit or dry-jointed, the signals being restored by the slight forward bias applied through the meter's resistance. Inspection showed that R11 had a dry-joint and on resoldering the connection normal operation was obtained.

It is far more usual to find npn i.f. transistors operated from a positive l.t. rail with their emitters returned to chassis. When receivers are encountered that use npn transistors operated from a negative l.t. rail or pnp transistors with a positive l.t. rail it is important to take care when checking base voltages since if the test prod slips and momentarily shorts a transistor's base to chassis almost the entire supply voltage will appear across the transistor's emitter-base junction. This can ruin a transistor. With an npn transistor operated from a positive l.t. rail shorting the base to chassis only removes the forward bias.

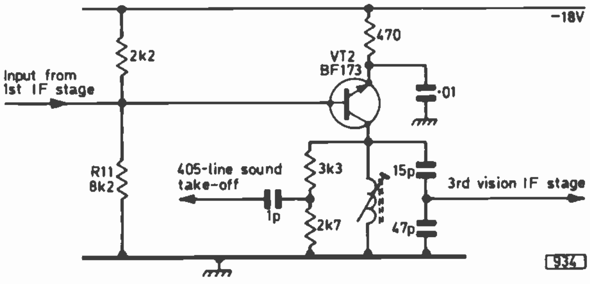


Fig. 1: The second vision and sound i.f. stage in the Pye dual-standard 67 chassis. The i.f. strip is unusual in using npn transistors operated from a negative supply line. No sound or screen modulation were present until a voltage check was made at the base. Care is required when making this check since if the base is accidentally shorted to chassis almost the entire supply voltage will appear across the transistor's base-emitter junction.

Review of the Forgestone 400 COLOUR RECEIVER KIT

R.A.PHILBY

THE Forgestone 400 is so far as we are aware the only PAL colour receiver kit that has been put on the market. Most of the components are supplied in packs to go with each of the seven printed boards used. The kit is available complete or the packs can be purchased separately thus spreading the financial commitment over a period of time, at no extra cost incidentally.

Requirements of a Kit

In designing and producing this kit attention has been paid to the many problems that constructors may experience in tackling such a complex project. There is a detailed technical handbook which provides a circuit description; details of construction and interconnections with guidance on points requiring particular attention; circuit, layout and assembly diagrams; setting-up instructions; voltage tables; waveforms; and component specifications. As a final "fall back" an after sales technical service is available for constructors who get themselves into difficulties. Nevertheless a word of warning, which Forgestone themselves emphasise, is necessary. The successful construction and setting up of a colour receiver is a considerable undertaking and is not for the complete beginner. If you have had success with other electronic projects however you should be able to complete this one.

A technical handbook is a particularly important feature of an undertaking such as this since the constructor is dependent on the amount of practical guidance given, its clarity and freedom from the possibility of misinterpretation. It is obvious that a lot of thought has gone into the preparation of the handbook, which leaves one with no doubt as to exactly what has to be done.

Success depends not only on clear instructions however. If the layout and wiring, the testing and setting up are needlessly awkward even the experienced constructor can come unstuck. Here too the project has been well thought out, with a neat, easily accessible board layout and, particularly helpful, the provision of an inter-unit wiring loom already prepared and with the various connections labelled.

Another point that has to be taken into account in producing a kit is the amount of test equipment the constructor is likely to have available. Things have been arranged to reduce this to the minimum. A multimeter is essential of course, and must have a sensitivity of at least 10,000Ω/V, also a crosshatch generator and an e.h.t. meter. A crosshatch generator can be purchased or made up for a few pounds and Forgestone can arrange for the hire of an e.h.t. meter. A few small components required for testing, including those for a simple diode probe, are provided in the kit's sundries pack. And that's all you need.

Further important requirements for success are suitable component quality and the use of circuits that are not highly critical. Component ratings have been carefully attended to throughout and the use of some thick-film resistor units and glass epoxy printed boards guarantees a high quality finished product. To ensure that the circuitry can be handled with the minimum of problems a ready-built and aligned i.f. module is provided, extensive use is made of integrated circuits, while a valve (PL509 and PY500A) line output stage is employed. Those are the only two valves in the set.

On completion you will have a set that is thoroughly up to date. There are nine integrated circuits; automatic frequency, gain and chrominance control; a sync separator with noise cancellation; beam limiting; and a varicap tuner. The neat mechanical arrangements include plug and socket connections to the printed boards.

Circuit Features

A good signal from the i.f. strip is crucial to the achievement of good colour receiver performance. There should be no problem here since the i.f. strip consists of a preassembled and prealigned screened unit which provides the selectivity and most of the gain, driving a TCA270 synchronous demodulator/video preamplifier/a.f.c. integrated circuit with a TBA750 for the intercarrier sound channel. Overseas customers can have the i.f. module aligned to a 5·5MHz sound spacing.

The decoder is of the Mullard four-i.c. variety as used in many commercial receivers. As Harold Peters said in describing this decoder circuit in our November 1973 issue, setting up is a piece of cake. Incidentally Mullard circuitry has been widely adopted, as in many sets from the well known UK setmakers, with additional circuitry introduced as necessary, and the whole concept of the chassis is nicely matched together. Good quality audio is assured by using a single-ended Class A push-pull output stage which delivers up to 2·5W into a 15-20Ω loudspeaker.

In addition to the two valves already mentioned the line timebase incorporates a transistor driver stage while the oscillator section is incorporated along with the sync separator and flywheel line sync system in a

TBA920 i.c. The solid-state field timebase uses the well-known circuit described in some detail in our April 1974 issue. A silicon e.h.t. tripler is employed.

A neat arrangement is used for the convergence circuitry. This is arranged on two circuit boards distanced slightly from each other. The resultant assembly can be swung up so that the controls can be adjusted while viewing the screen from the front of the set. The tube first anode presets and gun cut-off switches are also mounted on this module.

An important feature of the power supply is the ample, double-wound mains transformer. The chassis is thus totally isolated from the mains supply and can be earthed. This makes simple and safe connections to a video recorder and/or hi-fi system possible. The 40V and 12V supplies are well stabilised and plenty of fuses are incorporated.

Forgestone can provide various c.r.t.s and cabinets are anticipated.

Because of the simple arrangement of the panels and other components however the construction of a suitable cabinet is not difficult. A strong cabinet is essential of course in order to take the strain of the weighty c.r.t.—Forgestone can supply recommended details for mounting the tube and a cut-out diagram for the faceplate.

Construction

It is not difficult to build the receiver if you are an experienced constructor and confident that you can connect everything up without error. The need for care cannot be over emphasized—mistakes can cause damage. By making use of experience and common sense however the constructor should be well rewarded. Having said this, let's report on our experiences.

The constructor must be familiar with component markings and colour codes of course. He must also realise that near equivalents may be provided in non-critical positions, for example decoupling electrolytics. The handbook states that "panel construction is straightforward if the following points and order of construction are followed". And so it was when we went through the procedures. In fact making up the boards should not take more than about thirty hours in all. It is necessary to have the usual wiring tools, and two soldering irons are advisable, a 25W type for large or heavy duty connections and a smaller one (maximum 15W) for work on the printed circuit boards. Components and boards can both be damaged by using too large an iron—many of the components are delicate and need handling with care. A small hand drill with a range of twist drills is also required, in order to prepare the power unit chassis plate for component mounting.

No real problems were experienced in making up the i.f. panel, decoder panel and timebase board. One small point worth watching is that the timebase printed board layout in the handbook shows a lockfit transistor outline for the field sync pulse amplifier transistor 3TR1: the transistor supplied is an MPS6566 (which is not a lockfit type) and although this has electrode markings it is possible to insert it inadvertently the wrong way round. Trimming the component leads to the shortest possible length after soldering is very important—exceptions are warm-running components and suitable advice on these is given. Make sure that you understand the instructions clearly before committing yourself with the soldering iron.

The rest of the construction was found to be straightforward though great care is necessary with the heavy c.r.t. The inter-unit wiring loom provides an easy method of checking that the interconnections have been completed as well as saving a lot of time.

Off-air test card photograph, showing the excellent linearity and good grey scale.

The setting-up instructions are of necessity long and detailed—there are some 86 steps. Adequate warnings about the safety precautions necessary are given.

Performance

After completing the setting-up a picture performance that is difficult to criticise was obtained. It is important to appreciate the necessity of an adequate, clean signal from the aerial. If you feed in a signal full of ghost images you might be tempted to start twiddling and this will only make matters worse.

The resolution was found to be excellent though the bottom frequency grating was lost—this is usual of course. The grey scale is easy to adjust, and the tracking obtained was first class. The range of the brightness control was somewhat critical but on taking this up with Forgestone we were advised that a modification has been introduced here—2R35 on the earthy side of the brightness control has been increased in value to 820 Ω and an 820 Ω resistor 2R35A has been added in parallel with the brightness control. On making these changes we found that the brightness control operated over its range as we would expect.

A common colour receiver fault is poor convergence —in fact it is not possible in any set to get perfect convergence over the entire screen. This receiver showed very good convergence however, the only visible errors being slight ones at the top left- and right-hand corners. Programme viewing was not impaired by these slight tolerances. Line and field linearity are excellent as the accompanying photograph shows, and there is negligible hum on the timebases.

Colour fidelity (decoding accuracy) was checked by observing the colour bars at the top of the test card and the castellations at the left and bottom. There were no visible discrepancies within the normal limits of the controls and therefore no cause for criticism.

To conclude, the design of this kit is such that it is capable of very good performance. The steps on the way to achieving this are quite considerable but should not be a deterrent to those with competence and some experience of constructing electronic equipment. ■

CCTV

PART 10

Peter Graves

Last month we dealt with field timebase circuits for scanning a vidicon tube. The line timebase has to operate at a much higher frequency—15·625kHz in the case of a 625-line system, compared to the 50Hz field timebase operation—and at this frequency the inductive reactance of the scan coils is very much higher than their resistance, the opposite to the case with the field scan coils. In most CCTV cameras the line scan coils are driven directly, without the line output transformer found in domestic TV sets. Where an output transformer is used there is no e.h.t. overwinding as the maximum voltage requirements for a vidicon tube are only a few hundred volts and it is simpler to derive them from a mains transformer (there are exceptions as we shall see later). A few cameras use some of the flyback energy to provide a boost h.t. rail—as in domestic sets—but in most cases the energy is shunted to earth. Note too that the amount of energy involved both for scanning and flyback is much smaller with the vidicon because of its low-velocity electron beam and small dimensions.

Line Output Stage Operation

Let's look at one form (the most common) of line output stage, stripped of its frills—see Fig. 1. The transistor acts as a switch and is turned on by a positive-going pulse applied to its base. As soon as it is turned on the current through the scan coils will start to rise exponentially (the standard *LR* series circuit). The first part of the rise will be approximately linear and the electron beam will be deflected linearly from the centre of the target (zero current) to the right-hand edge—as shown in Fig. 2(a). Next we come to the clever bit, the flyback. The trailing edge of the line output transistor drive pulse turns the transistor off. The magnetic field that has been built up around the scan coils then collapses, inducing a heavy pulse of current in the circuit—see Fig. 2(b). The value of C1 is chosen so that it resonates with the scan coil inductance—usually at the second or third harmonic of the line frequency.

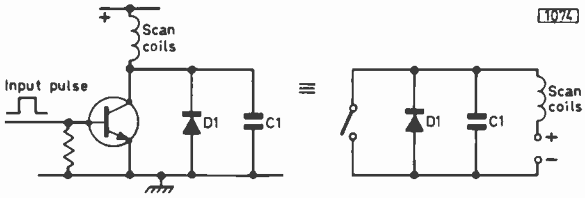


Fig. 1: Simplified line output stage. The output transistor acts as a switch.

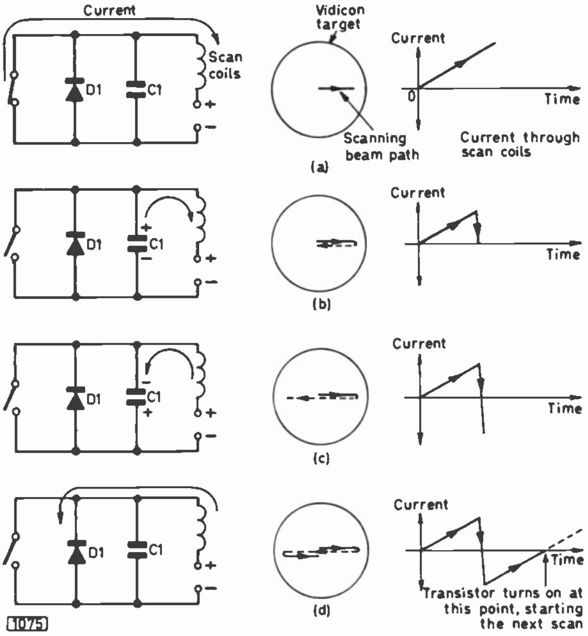
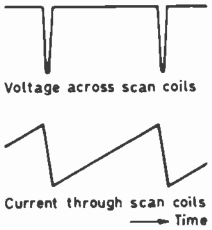


Fig. 2: Basic line output stage operation. (a) When the line output transistor is conducting current flows into the scan coils. (b) When the line output transistor is switched off a half-cycle of oscillation starts, the scan coils being tuned by C1. (c) Conditions during the second part of the half-cycle of oscillation—the oscillation reverses. (d) At the end of the oscillatory half-cycle D1 conducts, the collapsing field around the scan coils producing a decaying current through them to give the first half of the line scan. When the current has decayed to zero the transistor is switched on again.



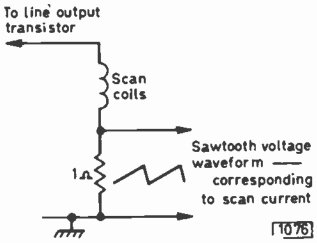


Fig. 3 (left): Scan coil waveforms—not drawn to scale.

Fig. 4 (right): Using a sampling resistor to monitor the line scan current.

In consequence there is a rapid transfer of energy between them, producing a fast beam flyback to the left-hand side of the target. The half cycle of oscillation executed by the scan coils with C1 is illustrated in Fig. 2(b) and (c). Following this half cycle of oscillation D1 conducts—see Fig. 2(d)—damping out any further tendency for the circuit to oscillate. At this stage all the energy from the oscillation is stored in the scan coils but the magnetic field is in the opposite direction to that in Fig. 2(a). The current decays in an exponential manner and as the magnetic field around the scan coils decreases the beam moves from the left-hand side towards the centre of the target. When it reaches the centre (approximately) the transistor is turned on again by the next pulse, completing the scan. The whole process is then repeated.

An oscilloscope connected across the scan coils would see only the negative-going flyback spikes (Fig. 3) but the current waveform will be close to our desired sawtooth. The line scan current waveform can be monitored by inserting a low-value—an ohm or two—resistor in series with the scan coils and monitoring the voltage across it (Fig. 4). Since the line output transistor requires a rectangular drive pulse waveform the line drive pulses from the sync pulse generator can be used with the minimum of modification.

Typical Circuit

Fig. 5 shows a simplified circuit of a typical line output stage. The transistor base is fed with rectangular pulses to switch it on. A choke (L1) in the collector circuit prevents line-frequency currents entering the power supply. R3 limits the current drawn through the transistor and hence controls the width. D1 and C4 correspond to D1 and C1 respectively in Figs. 1 and 2. C5 is a high-value capacitor (typically 50µF) which prevents the scan coils shorting out the transistor's collector from a d.c. point of view while being an effective short-circuit at line frequencies. By comparison C4 is about 4,700pF. An adjustable inductance L2 is inserted in series with the scan coils to provide some control over the scan linearity. The linearity of this type of circuit is in fact excellent so this control is omitted in many cheaper cameras.

Alternatively but less commonly a sawtooth generator and feedback linearisation circuit similar to the field circuit shown last month may be used. Every manufacturer has his own pet circuit for line stages as well as field stages and a comprehensive guide would cover many pages! Most line timebases operate on the basic principles described above however.

Line shift is carried out by passing an adjustable d.c. through the scan coils. In Fig. 5 a potential divider made up of R4, R5 and R6 provides the d.c., L3 preventing the diversion of line-frequency currents from the scan coils.

Separate Head Cameras

In cameras with a separate head which contains the scan coils, vidicon and the first stage of the head amplifier, all connected to the camera control unit (CCU) by the camera cable, the field scan voltage is usually generated in the CCU and fed via the cable to the field scan coils. The higher frequency line scan cannot be applied to the coils in this way because of cable losses. Instead, the line output stage drive pulses are fed up the cable, the line output stage being inside the head (see Fig. 6).

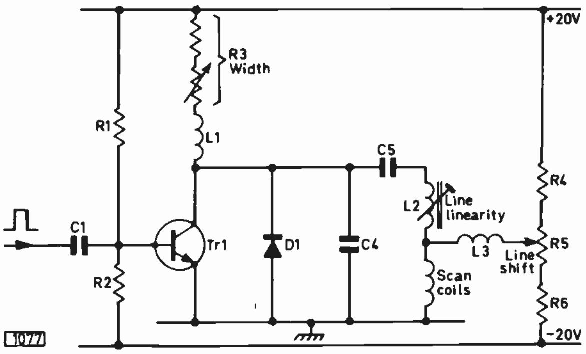


Fig. 5: Practical line output circuit.

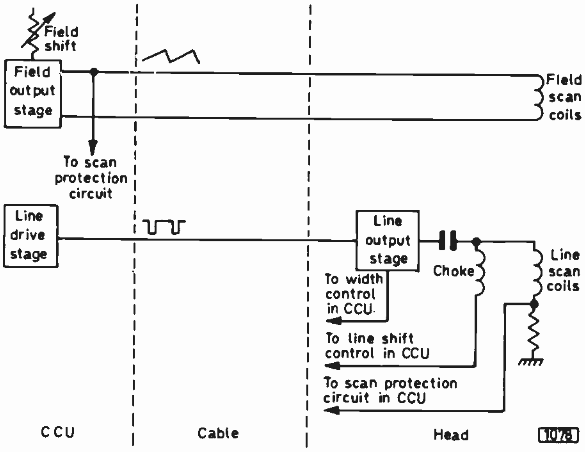


Fig. 6: Simplified block diagram of a separate head camera —the line output stage is in the head.

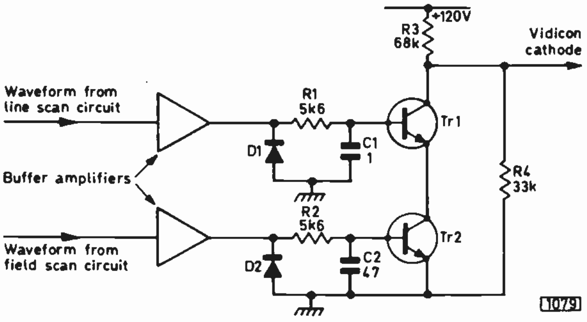


Fig. 7: Simplified scan protection circuit.

Scan Failure Protection

A vidicon target—unlike the modern, aluminised c.r.t. screen—is comparatively "soft" and thus easily damaged by a scan failure since during a failure (of one or both scans) the electron beam is concentrated on a small area of the target layer. A scan burn caused by the collapse of one of the scans appears—when the scan(s) have been restored—as a permanent bright white line, vertical or horizontal depending on which scan failed, and spells the ruin of the tube. Thus most cameras have some form of scan protection circuit to monitor the line and field scan outputs and cut off the electron beam in some way should one of the scans fail. The most sophisticated versions monitor the current through the scan coils (as in Fig. 4): other versions take an output from across the scan coils at some point in the circuit.

A typical protection circuit is shown in Fig. 7. Consider first the line scan protection circuit, associated with Tr1. D1, R1 and C1 form a rectifying circuit whose d.c. output when the scan is present forward biases Tr1 so that it turns on. Similarly the circuit at Tr2 base rectifies the incoming field scan waveform, biasing Tr2 on when the field scan is present. With

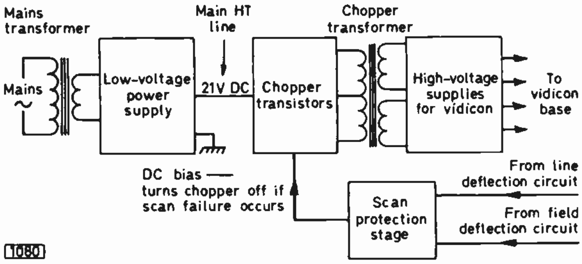


Fig. 8: Scan protection system used in the Marconi V321 camera.

both transistors conducting the collector of Tr1 will be pretty well at earth potential (within a volt) and the cathode of the vidicon will also be at earth potential. The vidicon target will be at a positive potential of a few tens of volts with respect to the cathode and the tube will be operating. Suppose one or other of the scans fails. The appropriate transistor Tr1 or Tr2 will be cut off due to the removal of its forward bias and the transistor chain will become effectively open-circuit. The voltage at the junction of Tr1 collector and R3 will be determined by the potential divider R3, R4—when the transistors are both on R4 is shorted out. With the resistor values shown the vidicon cathode will be at a positive potential of about 40V with respect to earth and the tube will be completely biased off, protecting the target.

Another system (used on the Marconi V321 CCTV camera) removes all the voltages from the tube in event of a scan failure. Instead of the high voltages for the tube being derived from the secondary of the mains transformer an auxiliary high-voltage transformer driven by a two-transistor chopper circuit is used (see Fig. 8). The scan protection circuit monitors the scans in the usual way but the output from the protection circuit is linked to the chopper transistors. Scan failure biases the chopper transistors off, stopping them oscillating and since the primary of the chopper transformer no longer receives any a.c. killing the h.t. voltages to the tube so that it is turned off. A further advantage of this system is that the entire tube supplies are floating above earth—they are not referenced directly to the h.t. rail. This enables the autotarget voltage to be supplied while allowing the target connection to remain at near earth potential. The advantages of this were discussed in an earlier article.

Recognising Scan Collapse

From a practical point of view, how do you recognise scan failure when observing the screen of a monitor fed by a camera? First, let's say that complete failure of both scans is rare: collapse of one is more common. The symptoms of a complete failure of both scans would be no picture at all on the monitor although the monitor would remain locked since scan collapse does not usually affect the sync pulses. Lock could be lost as well in the case of complete failure of a sync pulse generator feeding the camera with line drives, field drives and syncs, but it would also depend on the design of the scan circuits. If for any reason you suspect a complete failure, turn the camera off immediately. Then turn the beam and target controls right down or remove the vidicon before checking the scan voltages across the scan coil tags with a 'scope.

Line and field scan collapses have their own characteristic appearances on the monitor screen—if you happen to be watching at the time! Consider what happens when the field scan collapses. All the lines that were previously spaced out from the top to the bottom of the target are now scanned as a single line across the centre of the tube (strictly this depends on the setting of the field shift control—if it is still operative). The beam scans this single line 625 times in a frame period (ignoring the inactive lines that are normally blanked out) instead of once every frame period as under normal conditions: it is this tremendous increase in the energy supplied to a very small area of the target layer that damages it.

Suppose the camera is focused on a chequerboard pattern (Fig. 9). Every line will have the same information (since every line scans the same part of the target) for as long as the target layer holds up. The monitor, since the sync pulses supplied to it are unaffected, will be displaying the normal raster. Every line of this raster will be the same however and the displayed picture will consist of smeary streaks of black and white down the screen, corresponding to the scanned area of the chequerboard pattern. If on the other hand the camera is looking at a normal scene this will appear as a smeary mess down the monitor screen: nothing will be recognisable, although the overall brightness will change if the scene or its illumination changes—a mystifying fault if the caused is not realised.

Similarly if the line scan fails with the camera looking at a chequerboard pattern (Fig. 10) there will be a single vertical line down the target consisting of 625 lines each the width of the scanning beam. Thus the "lines" falling on a black square will be black for their whole length and those falling on white will be white for their whole length. The monitor picture will consist of alternate horizontal smears of black and white. Once again the details of a scene will be non-existent though brightness changes will show.

Servicing Scan Circuits

While this is all very interesting don't waste time trying to analyse the type of smears if they appear. Turn the camera off immediately—it takes only a few seconds to ruin the target permanently. A camera that has been repaired or modified should be tried first, with a test vidicon—one that does not matter if it gets damaged, usually a victim itself! When it is certain that no scan failures exist (or wrongly connected heater voltages for that matter) the good tube can be substituted. If a test vidicon is not available or the camera is inaccessible (say a separate head unit in the roof) check the scans with the beam and target controls turned down. Then watch the monitor very carefully as you turn the beam and target controls up.

An oscilloscope is essential for servicing scan circuits and the approach to servicing will depend on the particular circuitry, particularly on whether or not a scan protection circuit is fitted. As we have seen the output of a scan protection circuit consists of a changed d.c. level. It is convenient if possible to locate a test point so that an instant check of the state of the scan protection circuit can be made. It may be possible to bring out to the front panel a test point (say a wire from the junction of R3, R4 in Fig. 7). It is also useful to know exactly where the scan coil connection tags are.

A word of warning about scan protection circuits.

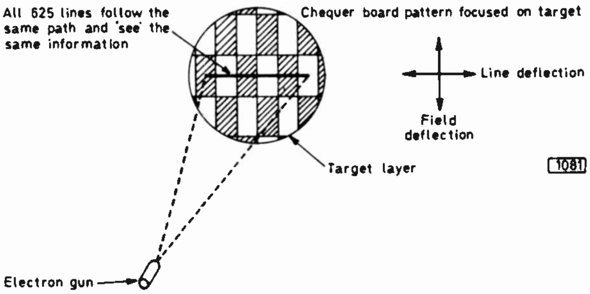


Fig. 9: Effect of camera field scan collapse.

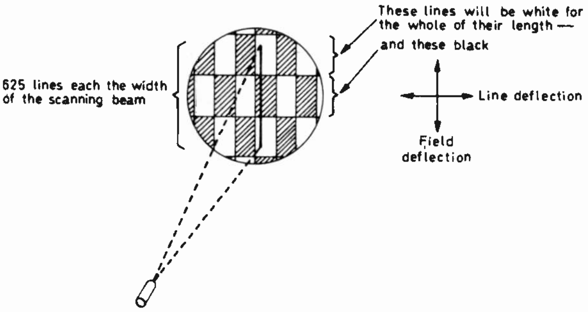


Fig. 10: Effect of camera line scan collapse.

In the simplest type of circuit the voltages across the scan coils are used by the monitoring circuit: it can happen that the scan coil goes open-circuit so that (depending on the type of circuit) the scan voltage is still present. This cheats the scan protection circuit into thinking that everything is all right. The situation does not occur with circuits that monitor the actual scan current. Separate head equipments may monitor the scan voltages before they go up the connecting cable. Thus a faulty cable connection (not so rare!) can kill the scans without tripping the protection circuit.

Fault Tracing

Fault finding in general is a logical progression through the circuit. Check particularly that links—where applicable—are correctly connected. Most faults involve transistor failure, usually the output transistor. Don't forget to check the components around the failed transistor in case they have gone too. Scan coils are very reliable but if suspect can be checked for continuity: shorted turns are very rare and the only sure method of checking for this is by substitution. Be alert for cable troubles in separate head units—an output from the CCU does not always mean that the head is being supplied.

Field scan circuits using two output transistors can be roughly checked for output transistor failure by allowing the equipment to run for a while (taking precautions to protect the tube) and then feeling the transistor cans. Do this with the power off as some unpleasant—though not lethal—pulse voltages may be present on them. They should feel warm but not too hot to touch. One hot, one cold spells trouble.

Care must be taken during any form of servicing or setting up to avoid accidental short-circuits (or open-circuits) in the vicinity of the scan circuits. Instrument probes that are too big or using a screwdriver instead of an insulated proder are frequent causes of trouble.

SERVICING TV RECEIVERS

—continued from page 115

coil biscuit and contacts, the PCF805 mixer valve and the resistors (especially the PCF805's screen grid feed resistor which should be approximately 18kΩ). Lack of signals is most often due to a faulty PCF805 which is reluctant to oscillate.

UHF Tuners

The u.h.f. tuner may be a Mullard, Fairchild or Hopt unit. They are similar in design except that the Hopt type is simpler and seems almost empty compared to the others. Once again start at the aerial socket which will often be found loose and in need of soldering. Weak and noisy reception is most often due to the r.f. transistor suffering from a dose of heavy electrical interference. A cold check on its back-to-front resistance should be the first step.

An AF239 in circuit measures about 30Ω between its base and emitter and between its base and collector with the "positive" (red) probe to the base, well over 100Ω when the leads are reversed. The frequency changer is usually an AF139 and the same readings should be found.

The usual remarks about reluctance to oscillate at the lower end of the scale (say between channels 20 and 30) apply to the AF139. The drill is first to check the vanes of the tuning gang to ensure they are not fouling at near full mesh. If they are not it is prudent to change the transistor although it is quite possible that the first replacement tried will be just as stubborn as the original.

The Mullard and Fairchild u.h.f. tuners use npn transistors.

The u.h.f. tuner output is passed to the control grid of the PCF805 on the v.h.f. tuner for extra i.f. amplification. Thus this valve and its supplies are not above suspicion where poor u.h.f. performance is experienced.

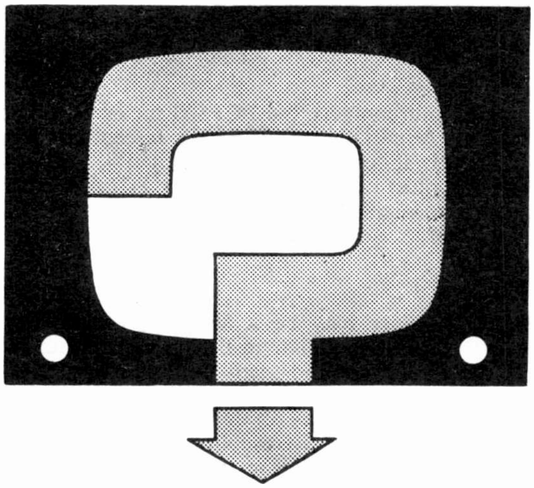
It should be noted that versions of the 680 chassis with v.h.f. radio employ an extra stage of i.f. amplification using a BF167 (Tr8). This operates on v.h.f. radio only, being switched out on TV. The stage has its own little a.g.c. system, feeding back a negative control voltage to the PC97 on the v.h.f. tuner.

Models, Modifications and Variations

The following models were fitted with these chassis: 11, 12, 15, 16, 661, 662, 663, 664, 665, 671, 672, 673, 674, 675, 676, 681, 682, 683 and 685. The plus f.m. radio versions are Models 677, 687 and 688. The following c.r.t.s are used in these models: A59-11W, A47-11W, CME1905/A47-17W. C187 (line output transformer tuning) is omitted in later production. The flywheel line sync diodes (X8, X10) may be type OA91 and the field sync circuit filter diode (X11) type BA114.

In some models R103, R104 and C137 are omitted, the yellow and red leads being connected.

C87 on the transistorised i.f. panel was 4,700pF in early production. It was changed to 0·01µF to provide protection for Tr3 in the event of c.r.t. flashover. Where C87 is 4,700pF add an 0·02µF capacitor in parallel with it on the print side of the i.f. panel. If Tr3 is found to have broken down this capacitor must be added regardless of the value of C87 fitted.



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DECCA CTV19

The trouble is intermittent loss of colour density. This may happen several times in one evening or not at all for several evenings. The colours do not disappear completely but fade to a pastel effect. This loss of colour density may last from several seconds to about twenty minutes. It can be corrected by advancing the colour control but the colour is then too dense when the fault rights itself. Occasionally the screen is a purple/magenta colour for a few minutes after switching on, until the colour fully appears.—P. Winder (Southsea).

Check carefully for poor contact in the plugs and sockets which connect the colour control to the decoder and tap the decoder panel to detect any dry-joints that may be present. The effect can be caused by D600 (OA90) which clamps the colour-killer bias potential applied to the chrominance delay line driver stage being faulty.

PHILIPS G19T210A

At the normal brightness control setting the top half of the picture pulls to the right or breaks up. When the brightness is reduced so that only peak whites are visible or alternatively the brightness is turned up full the line hold is normal. The two ECC82 valves in the line generator stage, the PFL200 video amplifier/sync separator valve and the valves in the line output stage have all been changed and all voltages seem to be correct.—R. Hudson (Brierley Hill).

Reduce the value of the sync separator screen grid feed resistor R2136 (pin 3) from 680kΩ to 330kΩ and check the value of its anode load resistor R2138 (100kΩ, pin 4). Ensure that the c.r.t. aquadag coating is adequately earthed. If the problem persists check the 20µF capacitor C2052 which smooths the supply to the line oscillator and flywheel sync valves and the components around the latter valve (V2003). (Philips 210 chassis.)

MARCONIPHONE 4801

The problem is wavy verticals, more pronounced at the top of the screen; also line tearing at the top going to left or right depending on the line hold control setting. The fault clears if the contrast control setting is reduced but the picture is then too weak. The contrast itself is good, also the field hold. A new e.h.t. tray, line timebase valves and sync separator screen grid feed resistor have been tried without success—S. Betterson (Newton le Willows).

Since the fault can be cleared by adjusting the contrast control it seems that the video output transistor is not operating under the correct conditions—the contrast control sets the input applied to this stage. The most likely trouble is that the input coupling capacitor C37 (64µF) is leaky. Check this, also C32 (50µF) which decouples the bias applied to the video driver. Other checks if necessary: C42 (0·015µF) the input coupler to the sync separator, and the flywheel sync discriminator diodes W3/W4. (BRC 1500 chassis.)

GEC 2000DST

There is no raster although there is a slight line whistle when the line hold control is turned. The PY800 boost diode is glowing red. The valves in the line output stage and the line output transformer have been changed.—P. Ednor (Warwick).

First check the boost voltage at the junction C139/R127—this should be approximately 800V. If it turns out to be considerably less try the effect of disconnecting the line scan coils. The output from the PCF802 line oscillator could be low so a new valve should be tried and the voltages in this stage checked.

FERGUSON 3621

The width is excessive and the line output valve is overheating. When the brightness control is turned up the picture disappears. The line output valve and boost diode have been replaced, also the v.d.r. in the width circuit.—C. Richards (Epsom).

Check the value of R98 (330kΩ) which is in series with the width control. If this is o.k. check the coupling capacitor C84 (0·01µF) to the line output valve for leakage and then the line output transformer which could have shorted turns. (BRC 850 chassis.)

BAIRD 701

There is a heavy and continuous crackling within a few seconds of the picture appearing. This results in the picture loosing width and partially collapsing. Previously there were frequent flashovers but these tended to cease when the set had been in operation for about half an hour. At first glance no flashover is visible but the set has not been left switched on for long in case of damage to the e.h.t. components.—J. O'Dwyer (Glasgow).

Remove the top and side covers of the line output transformer assembly, switch on and you should see the source of the discharge. The two 160pF pulse capacitors across the input to the e.h.t. tripler often give trouble on this chassis. The tripler itself could well have damaged insulation—individual components in the tripler can be replaced but if the paxolin case is marked it would be best to replace the whole unit. If the e.h.t. lead is punctured a suitable replacement cable is marketed by RS components. (Baird/Radio Rentals 700 chassis.)

PYE 161

There is neither sound nor raster with this set and the valves are overheating. No spark can be obtained at the anode of the PL504 line output valve or other points in the line output stage.—R. Smith (Wembley).

Over-run valve heaters suggest that the heater chain rectifier D3 (BY126) is short-circuit, the most likely cause of these symptoms. If the overheating is in the line output stage check the PCF802 line oscillator and its associated components. If drive is present at the control grid of the line output valve (high negative voltage at pin 2) suspect the boost reservoir capacitor C73 (0·022μF) then the line output transformer. (Pye 169 chassis.)

KB WV05

The trouble we are experiencing with this set is reflection of the picture on the left-hand side of the tube.—J. Carson (Nottingham).

We suggest you first check the values of the resistors in the ECC81 line multivibrator stage and the 16μF electrolytic which decouples the supply to this stage. Also check the flywheel sync discriminator diodes and the associated resistors and capacitors. Further checks if necessary: the scan-correction capacitors (C127/8/9) and the 4μF electrolytic which decouples the supply to the PY801 efficiency diode. (STC VC1 chassis.)

FERGUSON 36469

When the set is first switched on the picture keeps flickering rapidly until the field hold control is adjusted. A good picture is then obtained on v.h.f. for three or four hours after which it gradually fades away, the sound then going as well. If the set is left on for a time—half an hour to an hour—the picture gradually returns to normal, also the sound. The picture and sound are all right on u.h.f., the fault being present on v.h.f. only.—T. Wallis (Bournemouth).

The initial rolling is probably due to a lazy PCL85 field timebase valve. Fading of the v.h.f. signals must be attributed to a fault in the v.h.f. tuner unit. Check the two valves (PC97 and PCF805) by substitution, then replace the v.h.f. oscillator anode feed resistor R206. This is the 5·6k Ω resistor just inside the front between the contact bar and the side wall. (BRC 950 chassis.)

PYE CT154

There is an annoying fault which occurs for several days then disappears for about a week and so on. The fault appears to be compression of the field scan over several lines, producing a bright line across the picture in the lower half of the raster: at the same time the height is decreased. I have changed the field output transistors and the electrolytics in the field timebase but the fault persists.—I. Page (Fulham).

A common cause of this trouble is failure of one of the diodes in the circuit—D45 which discharges the scan charging capacitors or D46 in the base circuit of the upper output transistor. Field scan peculiarities can also be caused by the AC128 driver transistor being defective. See circuit in the April 1974 issue. (Pye 693/7 chassis.)

PHILIPS 520

This set will work perfectly all evening provided the channel is not changed. If another channel is selected after the set has been on for a few hours the effect obtained (on all buttons) is as if the tuning potentiometers are not correctly adjusted. Normal results can be obtained in fact by retuning the potentiometers to new positions—but then the tuning is incorrect when the set is switched on from cold.—R. Tovey (Worcester).

We suggest you replace the TAA550 stabiliser i.c. which regulates the 30V supply to the tuning potentiometers. This is IC144 on the tuner panel—observe correct polarity when replacing. If this does not solve the problem replace its 33k Ω series feed resistor R2143 which is mounted on the i.f. panel. (Philips G8 chassis).

ALBA T877

We are trying to get this old set working but are troubled by field collapse with severe arcing around the field output valve. Could this be caused by a faulty field output transformer?—F. Milliner (Welwyn).

The field output transformer is unlikely to be at fault. The arcing between the pins of the PCL85 field timebase valve base probably indicates that the linearity feedback loop is open-circuit. Check the components in this network, suspecting first the 0·1μF capacitor (C71) connected to the pentode anode (pin 6) of this valve. The printed board itself could well be at fault—cracked or burnt away. Check all components and tracks from pin 6 of the valve base.

DYNATRON CTV10/A

The fault on this set started with the appearance of a wedge-shaped band across the centre of the screen, wider on the left-hand side. This did not seriously affect viewing and there was no loss of colour within the band but captions were distorted when passing across it. About a week later however there was complete loss of line hold.—F. Smith (Swindon).

The fault is in the line oscillator circuit and we suggest you first replace the cathode coupling electrolytic C213, also the electrolytic (C210) which decouples the line hold control. We assume that a new line oscillator valve (PCF802) has been tried. Check the value of the oscillator pentode anode load resistor (R219, 33k Ω) and the condition of the flywheel sync discriminator diodes (D40, D41). Reset the line hold in accordance with the manufacturer's instructions when the fault has been cleared. (Pye 693 chassis.)

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BUSH CTV1026

The fault on this single-standard colour set is that as it warms up the height increases and eventually top foldover occurs over the top ¾in. of the screen. A temporary cure was obtained by replacing the field scan charging electrolytics 5C24 and 5C25 but the fault reappeared. We are rather at a loss since all the voltages appear to be correct while the midpoint voltage, linearity and height controls have all been set up following the instructions in the manual.—R. Douglas (Finchley).

The usual cause of the trouble is the AC128 driver transistor 5VT7. We suggest you let the set warm up thoroughly and then freeze this and the other semiconductor devices in the field timebase in turn, using an aerosol freezing compound. The faulty component should soon be revealed.

PHILIPS G22K520

While servicing this receiver a drop-off resistor (R5525, 560 Ω 2W) was found. This comes from the line output stage but on replacing it the resistor overheated and dropped off again. The service manual states that the coil in the base circuits of the line output transistors should be adjusted for zero reading on a voltmeter connected across this resistor—otherwise it will overheat and drop off. It is possible to obtain a reduced but not zero reading when making this adjustment. The purpose of the resistor is rather puzzling as the set works perfectly happily without it being in circuit.—E. Talbot (Hornchurch).

R5525 and its associated series capacitor C5530 form part of the line output transistor balancing circuit. It has been found however that because of component tolerance spreads these components are not necessary and they are not fitted in later production versions. If you are unable to zero the meter proceed as follows—with R5525 removed from circuit. First set up on a test pattern, then switch off the c.r.t. first anode supplies (G2s). Set coil L5003 to the centre of its core and connect a d.c. voltmeter across the h.t. feed resistor (R5535) to the line output stage. The voltage should drop by some 2V when L5003 core is adjusted either side of centre. If this cannot be achieved it is possible that one of the line output transistors may be defective. Examine the two flyback balancing capacitors C5545 and C5546 as well. (Philips G8 chassis.)

BUSH CTV184S

The trouble with this set is field bounce after the set has been on for about an hour and a half. The fault may last for anything from a couple of minutes to twenty minutes after which the set stabilises again. The fault will then recur after a further half hour. The field hold and height controls operate normally and have no effect on the fault. —T. Parson (Gateshead).

The cause of the trouble could well be in the power supply section as we have found that the BT106 thyristor h.t. rectifier (8THY1) often causes field bounce. Unfortunately this component can be checked only by substitution. The associated control circuit could be faulty, in particular zener diode 8D2 (BZY88) or the diac 8D3 (BR100). Poor field sync in this chassis is often the result of 2C37 (125μF) being defective. This capacitor decouples the collector of the a.g.c. amplifier on the i.f. panel. Try replacing it with a 25μF type as this can improve matters. (RBM single-standard colour chassis.)

PHILIPS G22K523

The dynamic convergence is causing difficulties. The set was degaussed and reconverged and the picture was then perfect for about two weeks. After that it started to drift again. I reconverged the set using a crosshatch generator and found that all the controls have the appropriate effect. But again there is drift.—G. Downs (London SE11).

To suggest particular components it would be necessary to know which beams are affected and whether it is the horizontal or vertical convergence that is drifting. We can however say that most cases of convergence drift with time are the result of the effect of heat on faulty clamp diodes. In this chassis the convergence clamps are the diode-strapped AC128 transistors T1910, T1941 and T1925. (Philips G8 chassis.)

MARCONIPHONE 4713

The fault on this set is no e.h.t. Before the e.h.t. went there was a click, loss of colour and an approximately one inch foldover on the left-hand side of the screen. The BU209 line output transistor was found to be short-circuit but replacements also fail unless a limiting resistor is connected in series with the collector. A negative drive pulse is present at the BU209 base and the components on the line output panel heatsink have been checked by substitution. A new line output transformer and e.h.t. tray have been fitted—and the timebase panel functions in another set!—T. Johnson (Dundee).

A common cause of this trouble is intermittent failure of the line output stage tuning capacitor C406 (0·002µF) which is in parallel with the line output transistor. It rarely shows up faulty on test and is a special component—only the manufacturer's approved replacement should be fitted. (BRC 8500 chassis.)

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TELEVISION JANUARY 1975

TEST CASE

145

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 dual-standard Bush Model TV138R was examined for the symptoms of vision-on-sound (rough buzz) and mild sound-on-vision. It was found that the symptoms were present on the u.h.f. channels only, the 405-line v.h.f. channels being completely free from the effect. The local u.h.f. stations provided a fair level of signal and the picture was free of noise, though appearing rather dirty.*

The first measurement made was for a.g.c. voltage. This was found to be fair to high at a low contrast control setting, falling normally towards zero as the control was advanced. Lack of a.g.c. was ruled out therefore. U.H.F. tuner overloading was next suspected, but even after attenuating the aerial signal by 10dB the symptoms were not removed completely—and the picture was then noisy.

Further tests included replacing the r.f. and i.f. valves and shunting the main smoothing and decoupling electrolytics with known good components, but the symptoms were unchanged!

Voltage checks in the i.f. strip indicated that all was well, from the d.c. point of view at least. More detailed investigation into the i.f. strip finally supplied the answer to the problem however and replacing one component cleared the trouble.

What was the most likely cause of this fault? See next month's Television *for the solution and for a further item in the Test Case series.*

SOLUTION TO TEST CASE 144

Page 91 (last month)

The series of effects described last month obviously indicates trouble in the line timebase. A red herring was followed by checking the d.c. voltage at the open end of the line drive coupling capacitor however. The signal at this point tends to be unidirectional and quite a few multimeters switched to d.c. read it! This was subsequently proved by the technician when he found that a reading at the open end of the capacitor was obtained only when the line oscillator was running.

Although the symptoms did not include all the classic characteristics of line output transformer failure this component was in fact proved to be responsible for the fault, but only through substitution (fortunately the chassis features a plug-in transformer!). The service manual does not give d.c. resistance values for the various windings.

After replacing the transformer the line output stage delivered its full power without trouble. In fact the e.h.t. and boost voltages were abnormally high to start with, resulting in e.h.t. flashover. This was tamed simply by turning down the boost voltage by means of the preset control. It is desirable with this chassis to set this control at the lowest setting consistent with sufficient horizontal scan amplitude (even if this means readjusting the line linearity sleeve) in order to conserve line output transformer life.

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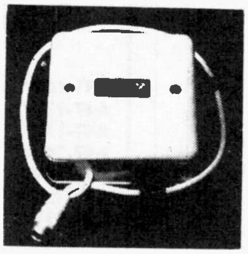

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MONOCHROME
TV Line out-put transformers
(Discounts to Trade)

ALL ONE PRICE
£5.72 EACH V.A.T. & CARRIAGE PAID
(£5.45 PERSONAL SHOPPERS)

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TUG versions
TV75 or C
TV76 or C
TV77
TV78
TV79
TV83
TV84
TV85
TV86

TV91
TV92
TV93
TV94
TV95 or C
TV96 or C
TV97
TV98C
TV99 or C
TV100C
TV101C
TV102C
TV103 or D
TV105 or D or R
TV106
TV107
TV108
TV109
TV112C
TV113
TV115 or C or R
TV118
TV123
TV124
TV125
TV125U
TV128
TV134
TV135
TV135R
TV138
TV138R
TV139
TV141
TV145
TV148
TV161
TV165
TV166
•TV171
TV175
TV176
TV178
181S
183
183D
1835
183SS
185S
186
186D
186S
186SS
191S
191D
193S
193D

From model TV123 to TV139 there have been two types of transformer fitted. One has pitch overwind, the other has plastic moulded overwind.
Please state which type required as they are not interchangeable.

BAIRD

600
602
604
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Please quote part No. normally found on tx. base plate; 4121, 4123, 4140 or 4142.

DECCA

DR20
DR21
DR23
DR24
DR29
DR30
DM30
DR31
DR32
DR33
DR34
DM35
DM36
DM39C
DR41
DM45
DR49C
DM55
DM56
DR61
DR71
DR95
DR100
DR101
DR121
DR122
DR123
DR202
DR303
DR404
DR505
DR606
666TV-SRG
777TV-SRG
MS1700
MS2000
MS2001
MS2400
MS2401

SOBELL

T24
SC24
TPS173
TPS180
ST195 or ds
ST196 or ds
ST197ds
SC270
T278
ST282
5T283
ST284 or ds
ST285 or ds
ST286 or ds
ST287 or ds
ST288 ds
ST290ds
ST291ds
ST297ds
1000ds
1002ds
1005ds
1010dst
1012
1013
1014
1018
1019
1020
1021
1022
1023
1032
1033
1038
1039
1047
1048
1057
1058
1063
1064
1065
1066

MURPHY

V310
V310A
V310AD
V310AL
V310CA
V320
V330 or D
V330F or L
V410
V410C
V410K
V420
V420K
V430
V430C
V430D
V430K
V440
V440D
V440K
V470
V480
V490
V500
V510
V519
V520
V530
V530C
V530D
V539
V540
V540D
V649D
TM2 Chassis
V843•
V849•
V873•
V879 or C•
V923•
V929 or L•
V973C•
V979•
V653X
V659
V683
V739
V735
V783
V787
V789
V153
V159
V173
V179
V1910
V1913
V1914
V2014
V2014S
V2015D
V2015S
V2015SS
V2016S
V2017S
V2310
V2311C
V2414D
V2415D
V2415S
V2415SS
V2416D
V2316S
V2417S

•Two types fitted. One has pitch overwind, the other has plastic moulded overwind. Please state which type required as they are not interchangeable.

PHILIPS

23TG111a
23TG113a
23TG121a
23TG122a
23TG131a
23TG142a
23TG152a
23TG153a
23TG156a
23TG164a
23TG170a
23TG171a
23TG173a
23TG175a
23TG176a
23FG632
G19T210
G19T211
G19T212
G19T213
G19T214
G19T215
G20T230
G20T232
G20T236
G20T238
G20T300
G20T301
G20T302
G20T306
G20T307
G20T308
G23T210
G23T211
G23T212
G24T230
G24T232
G24T236
G24T238
G24T300
G24T301
G24T302
G24T306
G24T307
G24T308
G24T324

GEC

2000
2001
2010
2012
2013
2014
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2017
2018
2019
2020
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2023
2032
2033
2038
2039
2043
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2047
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2063
2064
2065
2066
2082
2083

PYE

11u Series	
12u	
13u	State Pt. No.
14u	required
15u	AL21003 or
20u	772494

V700 or A or D	
V710 or A or D	State Pt. No.
V720	required—
V830A or D or	772444 or
LBA	771935

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950/2, 1400 -5 stick	RT3	£3.90
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PYE	713 CT200	£6.40
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THORN BRC	3000	£7.10
THORN BRC	8000	£4.10
THORN BRC	8500	£7.00
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G6 ,, S/S
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CTV184S
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CTV25 ,, ,,
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CTV25 ,, ,,
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CS1910
CS2030
CS2213
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CT104 £13.00 ea.
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CT105
CT106
CT107
CT108
CT109
CT111
CT120
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CT71 £13.00 ea.
CT72
CT73
CT78
CT79
CT152
CT153
CT154 £9.90 ea.

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CV1912
CV1916S
CV2210
CV2212
CV2213
CV2214
CV2510 Mk.3
CV2511 Mk.3
CV2516S
CV2610
CV2611
CV2614
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