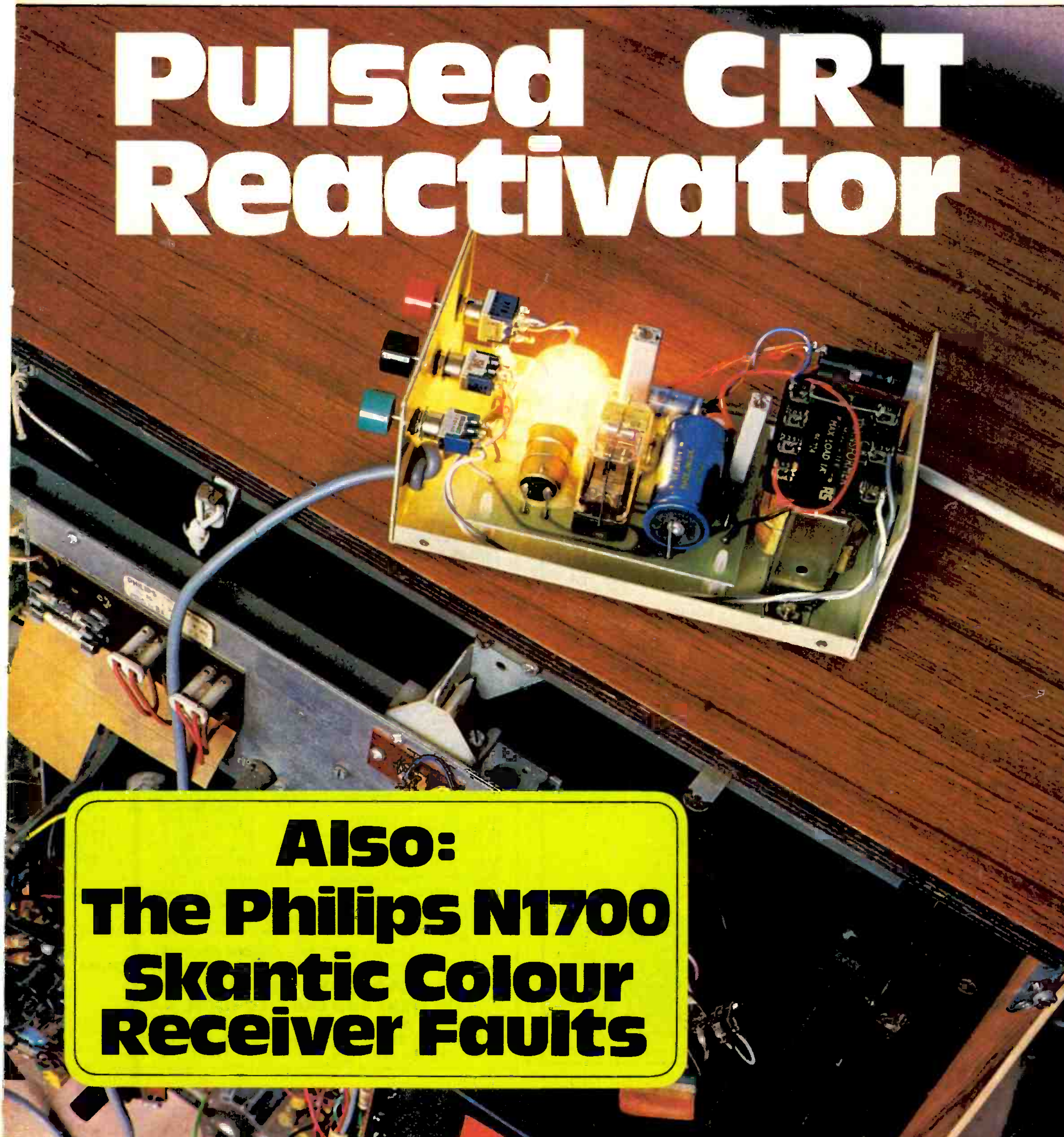
APRIL 1978 Australia 85c; Malaysia $2.50; New Zealand 85c 50p

TELEVISION

SERVICING·VIDEO·CONSTRUCTION·DEVELOPMENTS

Pulsed CRT Reactivator



Also:

The Philips N1700

Skantic Colour Receiver Faults

TELEVISION

April 1978

Vol. 28, No. 6
Issue 330

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

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

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

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

this month

OUR NEXT ISSUE DATED MAY WILL BE PUBLISHED ON APRIL 17

TRANSISTORS, ETC.

Type	Price (£)
AC107	0.46
AC117	0.38
AC126	0.36
AC127	0.40
AC128	0.35
AC128K	0.35
AC141	0.35
AC141K	0.40
AC142	0.34
AC142K	0.39
AC151	0.31
AC152	0.34
AC153	0.42
AC153K	0.43
AC154	0.31
AC176	0.42
AC178	0.42
AC179	0.48
AC187	0.42
AC187K	0.45
AC188	0.42
AC188K	0.42
AC193K	0.48
AC194K	0.52
ACY17	1.20
ACY19	0.95
ACY28	0.98
ACY39	2.02
AD140	0.68
AD142	0.69
AD143	0.71
AD149	0.86
AD161	0.65
AD162	0.70
AF114	0.35
AF115	0.35
AF116	0.41
AF117	0.32
AF118	0.98
AF121	0.50
AF124	0.38
AF125	0.38
AF126	0.36
AF127	0.45
AF139	0.48
AF147	0.52

Type	Price (£)
AF149	0.45
AF178	0.75
AF179	0.78
AF180	0.75
AF181	0.72
AF186	0.99
AF202	0.27
AF239	0.60
AF240	1.40
AF279S	0.91
AL100	1.30
AL103	1.52
AU103	2.10
AU107	1.90
AU110	1.90
AU113	2.40
BC107*	0.16
BC108*	0.15
BC109*	0.17
BC113	†0.16
BC114	†0.20
BC115	†0.21
BC116*	†0.21
BC117	†0.20
BC118	†0.17
BC119	0.32
BC125*	†0.22
BC126	†0.24
BC132	†0.17
BC134	†0.20
BC135	†0.19
BC136	†0.20
BC137	†0.20
BC138	†0.30
BC140	0.90
BC141	0.95
BC142	0.29
BC143	0.35
BC147*	†0.12
BC148*	†0.11
BC149*	†0.13
BC152	†0.25
BC153	†0.20
BC154	†0.20
BC157*	†0.13
BC158*	†0.12

Type	Price (£)
BC159*	†0.14
BC160	0.78
BC161	0.80
BC167B	†0.15
BC168B	†0.14
BC169C	†0.15
BC170*	†0.15
BC171*	†0.15
BC172*	†0.14
BC173*	†0.22
BC174A & B	†0.26
BC176	0.22
BC177*	0.20
BC178*	0.22
BC179*	0.28
BC182*	†0.14
BC182L*	†0.14
BC183*	†0.14
BC183L*	†0.14
BC184*	†0.14
BC184L*	†0.14
BC186	0.25
BC187	0.27
BC192	0.56
BC207*	†0.14
BC208	†0.12
BC212*	†0.17
BC212L*	†0.17
BC213*	†0.16
BC213L*	†0.16
BC214*	†0.17
BC214L*	†0.17
BC237*	†0.16
BC238*	†0.15
BC239C	†0.23
BC251A & B	†0.27
BC252A*	†0.25
BC253B	†0.38
BC261A	0.28
BC262A*	0.26
BC263B	0.27
BC267	0.16
BC268C	0.14
BC294	†0.37
BC300	0.60

Type	Price (£)
BC301	0.35
BC303	0.60
BC307A & B	†0.17
BC308 & A	†0.17
BC309*	†0.17
BC317*	†0.22
BC318C	†0.23
BC319C	†0.26
BC320	†0.28
BC322	†0.24
BC323	0.68
BC327	†0.23
BC328	†0.23
BC337	†0.24
BC338	†0.19
BC347A*	†0.17
BC348A & B	†0.17
BC349A & B	†0.17
BC350A*	†0.20
BC351A*	†0.18
BC352A*	†0.24
BC360	0.24
BC377	0.22
BC441	0.59
BC461	0.78
BC477	0.20
BC478	0.19
BC479	0.19
BC547*	†0.13
BC548*	†0.12
BC549*	†0.15
BC550	†0.15
BC556	†0.18
BC557*	†0.14
BC558*	†0.13
BC559*	†0.15
BD115	0.93
BD123	0.98
BD124	0.88
BD130Y	1.56
BD131	0.48
BD132	0.54
BD133	0.51
BD135	0.42

Type	Price (£)
BD136	0.46
BD137	0.48
BD138	0.52
BD139	0.55
BD140	0.59
BD144	2.24
BD145	0.75
BD157	0.51
BD160	1.65
BD163	0.67
BD177	0.58
BD178	0.59
BD181	1.04
BD182	0.90
BD183	1.18
BD184	1.43
BD187	0.61
BD188	0.86
BD189	0.71
BD201	1.15
BD202	1.50
BD222	0.78
BD225	0.91
BD232	2.20
BD233	0.52
BD234	0.75
BD235	0.69
BD236	0.62
BD237	0.69
BD238	0.70
BD253	2.58
BD410	1.65
BD437	0.98
BD438	1.17
BD517	0.41
BD518	0.43
BD519	0.88
BD520	0.88
BD599	0.87
BD600	1.23
BDX14	1.02
BDX18	1.55
BDX32	2.75
BDX64A	1.89
BDX65A	1.69
BDY16A	0.43
BDY18	1.55

Type	Price (£)
BDY20	1.07
BF115	0.30
BF117	0.45
BF120	0.55
BF121	0.85
BF123	0.58
BF125	0.55
BF127	0.68
BF137F	0.78
BF152	†0.19
BF157	0.32
BF158	†0.25
BF159	†0.27
BF160	†0.22
BF161	0.45
BF162	†0.65
BF163	†0.65
BF164	†0.95
BF166	0.38
BF167	0.52
BF173	0.30
BF177	0.36
BF178	0.38
BF179	0.42
BF180	0.36
BF181	0.35
BF182	0.44
BF183	0.52
BF184	0.31
BF185	0.28
BF194*	†0.12
BF195*	†0.11
BF196	†0.14
BF197	†0.15
BF198	†0.29
BF199	†0.29
BF200	0.65
BF218	0.42
BF224J	†0.20
BF240	†0.32
BF241	†0.31
BF244	†0.37
BF245B	†0.68
BF255	†0.58
BF256L*	†0.49
BF257	0.49
BF258	0.53

Type	Price (£)
BF259	0.61
BF262	0.64
BF263	0.62
BF270	0.47
BF271	0.52
BF273	†0.33
BF274	†0.34
BF333	0.67
BF336	0.43
BF337	0.46
BF338	0.58
BF355	0.52
BF362	†0.62
BF363	†0.62
BF457	0.68
BF458	0.84
BF459	0.91
BF594	†0.16
BF596	†0.17
BF597	†0.17
BFR39	0.33
BFR40	0.29
BFR41	0.26
BFR60	0.35
BFR61	0.29
BFR62	0.28
BFR79	0.36
BFR80	0.32
BFR81	0.28
BFT41	0.48
BFT43	0.55
BFW11	0.66
BFW30	2.17
BFW59	†0.19
BFW60	†0.20
BFW90	0.28
BFX29	0.33
BFX84	0.30
BFY18	0.53
BFY50	0.33
BFY51	0.31
BFY52	0.30
BFY90	1.37
BLY15A	1.09
BR101	0.47
BRC4443	0.76
BRY39	0.58

Type	Price (£)
BRY55	†0.48
BRY56	†0.44
BT106	1.50
BT109	1.99
BT116	1.45
BT119	5.18
BU102	2.85
BU105	1.95
BU105/02	1.95
BU108	3.15
BU126	2.18
BU133	1.77
BU204	2.02
BU205	2.24
BU206	2.97
BU208	3.15
BU407	1.12
BUY78	2.65
BUY79	2.85
C106D	0.89
E1222	0.47
E5024	†0.19
GET872	0.46
MC140	†0.36
MJE340	0.68
MJE341	0.72
MJE370	0.74
MJE371	0.79
MJE520	0.85
MJE521	0.95
MJE2955	1.20
MJE3000	1.95
MJE3055	0.78
MPF102	†0.40
MPS6566	†0.31
MPSA05	†0.47
MPSA06	†0.48
MPSA55	†0.50
MPSA56	†0.53
MPSU05	0.66
MPSU06	0.76
MPSU55	1.26
MPSU56	1.32
OC26	0.90
OC28	1.19
OC35	0.93
OC36	0.88

Type	Price (£)
OC42	0.55
OC44	0.34
OC45	0.32
OC71	0.73
OC72	0.73
OC81	0.53
OC81D	0.57
OC139	0.76
OC140	0.80
OC170	0.34
OC171	0.34
ON236A	0.72
R2008B	2.25
R2010B	2.65
TIC44	†0.29
TIC46	†0.44
TIP29A	0.49
TIP30A	0.58
TIP31A	0.62
TIP32A	0.67
TIP33A	0.99
TIP34A	1.73
TIP41A	0.80
TIP42A	0.91
TIP2955	1.78
TIP3055	0.67
TIS43	†0.38
TIS73	†1.36
TIS90	†0.23
TIS91	†0.25
ZTX108	†0.13
ZTX109	†0.14
ZTX213	†0.21
ZTX300	†0.16
ZTX304	†0.24
ZTX500	†0.17
ZTX502	†0.19
ZTX504	†0.30
2N696	0.30
2N697	0.36
2N706	0.16
2N708	0.35
2N914	0.21
2N916	0.24
2N1164	3.60
2N1304	0.55
2N1711	0.45

Type	Price (£)
2N1893	0.40
2N2102	0.51
2N2221A	0.50
2N2222A	0.52
2N2369A*	0.44
2N2484	0.55
2N2646	0.75
2N2696	1.36
2N2904*	0.42
2N2905*	0.33
2N2926G	†0.15
2N2926O	†0.14
2N2926Y	†0.14
2N2955	1.12
2N3053	0.25
2N3054	0.62
2N3055	0.70
2N3702	†0.19
2N3703	†0.18
2N3704	†0.18
2N3771	1.85
2N3772	1.92
2N3773	2.90
2N3819	†0.35
2N3866	1.72
2N3904	†0.24
2N3905	†0.26
2N4032	0.57
2N4036	0.60
2N4058	†0.18
2N4291	†0.27
2N4392	2.84
2N4902	2.40
2N4921	0.61
2N5060	†0.32
2N5294	0.46
2N5296	0.62
2N5496	1.05
2N6178	0.71
2N6180	1.39
2SC643A	1.36
2SC1172Y	2.80
2SD234	0.89
40361	0.48
40362	0.50
40595	1.39
40654	0.81

*Alternative gain versions available on items marked **

LINEAR IC's

Type	Price (£)
BRC1330	†0.93
CA3005	1.80
CA3012	1.45
CA3014	2.23
CA3018	1.06
CA3020	1.86
CA3028A	1.06
CA3028B	1.26
CA3045	1.35
CA3046	1.02
LM309K	1.98
MC1307P	†1.32
MC1310P	†2.94
MC1312P	2.20
MC1314P	3.85
MC1315P	4.15
MC1327P	†1.86
MC1327PQ	†1.86
MC1330P	†0.93
MC1350P	†0.85
MC1351P	†0.90
MC1352P	†0.90
MC1353P	0.92
MC1355P	1.82
MC1357P	1.42
MC1358P	†1.80
MC1358PQ	†1.85
MC1458G	0.98
MC1496L	0.88
MC3051P	0.58
MFC4000B	0.85
MFC4060A	0.98
MFC6040	1.11
MIC1P	†2.58
ML231	†4.60
ML232	†4.60
NE555	0.72
SAS560A	†2.01
SAS570	†2.01

Type	Price (£)
SC9503P	†1.46
SC9504P	†1.42
SL414A	1.91
SL432A	2.52
SL439	1.50
SL901B	†4.10
SL917B	†5.50
SN72440N	†2.21
SN76001N	†1.45
SN76003N	2.24
SN76013N	1.50
SN76013ND	1.25
SN76023N	1.50
SN76023ND	1.25
SN76033N	2.24
SN76110N	†2.30
SN76226N	†3.15
SN76227N	†1.85
SN76502N	†1.92
SN76530P	†1.85
SN76533N	†1.20
SN76544N	†1.85
SN76660N	†0.60
SN76666N	†0.90
TA7073P	†3.51
TAA300	†3.85
TAA320	0.94
TAA350A	†1.96
TAA435	†1.70
TAA450	†3.39
TAA550	†0.80
TAA570	†2.30
TAA611A	1.70
TAA611B	1.85
TAA621AX1	2.43
TAA630Q	3.91
TAA630S	4.18
TAA661B	1.75
TAA700	†3.90
TAA840	†3.38
TAA861A	0.95

Type	Price (£)
TAA960	†1.35
TAD100	†2.66
TBA120A	†0.90
TBA120S	†0.99
TBA240A	†3.98
TBA281	†2.07
TBA395	†2.58
TBA396	†2.40
TBA480Q	†1.84
TBA500	†1.99
TBA500Q	†2.00
TBA510	†1.99
TBA520Q	†2.98
TBA530	†1.98
TBA530Q	†2.50
TBA540	†3.21
TBA540Q	†3.22
TBA550Q	†4.10
TBA560C	†3.13
TBA560CQ	†3.22
TBA570	†1.29
TBA641A12	2.55
TBA673	†2.19
TBA700	†2.50
TBA720AQ	†2.38
TBA720Q	†2.38
TBA750A	†2.07
TBA750Q	†2.07
TBA800	2.40
TBA810AS	1.95
TBA920Q	†3.68
TBA940	†1.95
TBA950	†3.88
TBA990	†2.90
TBA990Q	†3.35
TCA270A	†3.55
TCA270CQ	†3.55
TCA270Q	†3.55
TCA800	5.55
TDA440	†4.10
ZN414	†1.45

DIODES

Type	Price (£)
AA113	0.17
AA119	0.13
AAZ13	0.30
AY102	1.85
BA100	0.24
BA102	0.25
BA104	0.19
BA110	0.80
BA111	0.70
BA112	0.85
BA115	0.15
BA121	0.85
BA129	0.39
BA145	0.19
BA148	0.19
BA154	0.19
BA155	0.19
BA156	0.15
BA157	0.25
BA158	0.28
BA201	0.13
BAX13	0.08
BAX16	0.10
BAY72	0.18
BB104B	0.52
BB105B	0.52
BB105G	0.45
BB110B	0.45
BR100	0.40
BY100	0.35
BY103	0.35
BY118	1.10
BY126	0.16
BY127	0.18
BY133	0.35
BY140	1.40
BY164	0.75
BY176	2.80
BY179	0.83
BY182	1.14
BY199	0.29

Type	Price (£)
BY206	0.31
BY238	0.25
BYX10	0.31
FSY11A	0.58
FSY41A	0.51
ITT44	0.08
ITT210	0.63
ITT827	0.80
ITT921	0.12
ITT922	0.12
ITT923	0.18
ITT1075	0.15
ITT2001	0.12
ITT2002	0.13
ITT2003	0.25
OA10	0.37
OA47	0.15
OA81	0.17
OA90	0.10
OA91	0.12
OA200	0.10
OA202	0.13
S2M1	0.38
S6M1	0.49
TV20	2.25
IN914	0.07
IN916	0.09
IN1184	1.10
IN1185	1.30
IN4001	0.05
IN4002	0.06
IN4003	0.07
IN4004	0.08
IN4005	0.09
IN4007	0.14
IN4148	0.06
IN4448	0.10
IN5400	0.15
IN5401	0.17
IS44	0.07
IS920	0.09
IS921	0.12

ZENER DIODES

400mW plastic 3.0-33V	21p each
1/1.3W plastic 3.3-180V	20p each
1.5W flange 4.7-75V	99p each
2.5W plastic 7.5-75V	67p each
20W stud 7.5-75V	92p each
75W stud 7.5-75V	£6.88 each

VDR'S ETC.

Type	Price (£)
E295ZZ	
/01	†0.21
/02	†0.21
E298CD	
/A258	†0.20
E298EO	
/A258	†0.18
/A260	†0.18
/A262	†0.18
/A265	†0.18
/P268	†0.18
E298ZZ	
/05	†0.20
/06	†0.18
E299DO/P116 – P354	all †0.17
E299OH	
/P23D	†0.72
2322 554 02221	†0.59
VA1015	†0.78
VA1026	†0.64
VA1033/34/38/39/40/53	all †0.17
VA1055s/56s/66s/67s/	all †0.21
VA1077	†0.27
VA1096/97/98	all †0.19
VA1104	†0.44
VA8650	†1.40
2322, 662, 98003	†1.20

VALVES

Type	Price (£)
DY86/87	†0.54
DY802	†0.54
ECC82	†0.54
EF80	†0.54
EF183	†0.70
EF184	†0.70
EH90	†0.94
EL34	†1.08
PCC84	†0.65
PCC85	†0.79
PCC89	†0.74
PCC189	†0.94
PCF80	†0.65
PCF86	†0.74
PCF200	†1.16
PCF801	†0.74
PCF802	†0.79
PCL82	†0.65
PCL83	†0.74
PCL84	†0.65
PCL86	†0.74
PCL805/85	†0.74
PD500	3.75
PFL200	†0.94
PL36	†1.08
PL81	†0.94
PL84	†0.79
PL504	†1.05
PL508	†1.33
PL509	†3.10
PL802	†3.25
PY81/800	†0.58
PY500A	†1.45

RESISTORS

Carbon Film (5%)†

	ea
¼W 5.6 Ω-330K Ω (E12)	3p
½W 10 Ω-10M Ω (E24)	3p
1W 10 Ω-10M Ω (E12)	5p
2W 10 Ω-10M Ω (E6)	9p

Wirewound (5%)

2½W 0.22 Ω-270 Ω	18p
4W 1.0 Ω-10k Ω	22p
7W 1.0 Ω-22k Ω	24p
11W 1.0 Ω-22k Ω	28p
17W 1.0 Ω-22k Ω	33p

COLOURTEXT ADAPTOR

LABGEAR 7026
Full facility colourtext decoder to place between aerial and receiver. All you would expect of a quality, ready-made unit. Leaflet on request.

†£340.20

REMEMBER NOT A KIT

COLOUR BAR GENERATORS

Labgear CM6052/DB. VHF/UHF gives standard 8 band colour bars · variable tuning · front panel on/off switch · sync trigger output · blank raster · red raster · crosshatch · greyscale step-wedge · colour bar · centre cross · dot pattern · centre dot. **£182.25**

VHF TO UHF CONVERTERS†

Labgear "Televerta" for OX-ing, or uhf receiver use on relay systems, Eire, etc. Type CM6022/RA.

†£24.40

P. & P.: UK: £0.12 per order. **Overseas:** At cost.
Please add VAT at 8%, and 12½% on items marked †.
This advertisement shows only part of our range. Our lists show 7400 series, op. amps., scr's etc., hardware, capacitors, special t.v. items, many more transistors, diodes, i.c's & valves and full Labgear range.

Giro A/C 23 532 4000 *A/C facilities available.*

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(OFFICE OPEN 9.30-5.00 Mon-Fri)

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We are the largest stockists in the south of Ireland of clean used T.V. sets.

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YEAR OF VIDEO?

It's been announced that 1978 may be the year of video. If not, it'll be 1979; or maybe 1980. Previously it was going to be 1977, but that wasn't too good a year for anything, was it? What video though? The very word video seems to conjure up in some minds the belief that a vast new world, bringing untold wealth to the poor old TV trade and scope for all manner of spin-offs, is about to open up before us. Rather like the audio one did. If you remember, we used to listen to our gramophones (what?!). Then instead we started listening to our record reproducers. We had had sound systems (one thinks instinctively of acoustic feedback on Speech Day), and of course hi fi (though not the term) goes back to the thirties when there were some excellent amplifiers and loudspeakers around – your seventies pop groups would be more than happy with some of those cinema loudspeakers. Then all of a sudden we had to forget these old terms and start talking of audio and music centres instead.

Likewise some of us (not me, quite!) had been watching our television sets since 1936. And we knew perfectly well that what was involved was a video signal from the camera eventually ending up as an input to our video amplifier which modulated our c.r.t. Come about 1970 however and some bright spark somewhere decided to start waffling on about video. A simple word with a hint of a million thrills – and the prospect of a new subject for the non-expert to make themselves out to be authorities on! Is the word television likely to become as dead as gramophone and wireless (always an odd term for a box packed with wire!)? Some who would probably approve – if any of them are still around – are those who long battled against the bastard word television. You see, tele comes from the Greek far and vision from the Latin see, and it's just not done to mix them up. Except that it is of course, as time has proved.

Seriously though, audio did signify the advent of an expanding technology. Tape mechanisms, better transducers, and improvements in signal storage systems (records/tapes) to be precise. And when it comes to video there has, as we pointed out recently, been a rapid increase in recent times in the things you can do with TV (oops, video!) signals and sets. TV games for a start have been rather more successful than some of us, who remembered the early days of audio tape recorders, thought they would. Most of those early Elizabethan, Sound and Walton tape recorders turned out to be two-day wonders for their owners: once they'd recorded themselves, mum, dad and a couple of friends the thing tended to be stored atop the wardrobe and forgotten about. Many of us thought that TV games would suffer a similar fate, but then people don't have wardrobes nowadays, they have storage units....

What the "year of video" means however – should it ever put in an appearance – is the year when the predicted take-off of the videocassette and/or video disc market occurs. Much depends of course on whether products giving good performance at a reasonable price come on offer. Video discs do not at present seem to be an acceptable proposition, on performance grounds. They either don't give enough playing time, or the signal leaves something to be desired. Solutions may be found, but the right formula has not yet been struck. The problem some of us foresee with VCRs is a price barrier. The Philips N1700 VCR gives excellent performance for example, but at around £750 not many people are going to rush out and buy one. Some have and others will find that for various professional reasons the VCR is a worthwhile piece of equipment. But we suspect that in the likely economic climate of the foreseeable future the vast majority of people will not feel even the slightest temptation to go out and buy. They might rent, since that doesn't hurt the pocket so much, and this is something of a twinkle in the eyes of the renters just now. What would make all the difference is a substantial fall in prices, and if that happens it'll probably be because the Japanese have invested in massive production capacity, thereby chopping unit costs. For what they're worth however, our own feelings are that the video market, certainly in the UK, is going to be a small, slow-moving one for a long time to come.

Teletopics

IBA'S DIGITAL TV BREAKTHROUGH

IBA engineers have demonstrated the world's first digital videotape recording system capable of producing high-quality colour pictures on one inch tape at a speed of under ten inches a second. The new system was first unveiled at the IEE as part of a number of demonstrations of new digital techniques in television broadcasting, and represents a major advance since IBA engineers last year demonstrated an experimental all digital studio of the future. The digital recording system has been developed as part of a series of studies to assess the potential of new helical-scan videotape recorders adapted for digital recording, and with the aim of establishing international digital television standards. A novel coding system has been devised, and the IBA regard a practical digital recorder as a key element in the wider use of digital techniques in television studios. The system uses a BCN 1 in. segmented recorder made by Bosch-Fernseh who have carried out the modifications required for it to operate with the IBA system. Preliminary investigations have also been carried out with a Sony 1 in. non-segmented machine. The basic system can be used with static head or other 1 in. helical-scan machines.

The advantage of using digital techniques for recording is that there is no significant impairment of the signal due to the recording process – a major proportion of the total picture degradation in the whole broadcasting process is due to the use of analogue VTRs. An important feature of the IBA's system is that no bit rate reduction of the picture information is necessary. Signal sampling for the PAL 625-line demonstrations is at twice the colour subcarrier frequency, representing a digital bit rate of about 80Mb/s, and there appears to be no need for major changes to make the system suitable for use with NTSC or SECAM signals. The IBA have patented the techniques used in the recording system.

NEW FAST RECTIFIERS

ITT Semiconductors have announced that their BY196, BY197, BY198 and BY199 fast rectifier diodes have been superseded by types BY296, BY297, BY298 and BY299. The new diodes are housed in a slightly larger plastic moulded case and have thicker leads. This makes possible a higher current rating – 2A. The diodes are normally used as rectifiers in line scan derived power supplies and similar applications. Using the newer diodes for replacement purposes should give increased reliability.

PROGRAMMABLE GAMES

One of the first programmable TV games units is to be introduced shortly by Radofin Electronics. The basic system consists of two hand-held control units and a master unit which comes complete with one cartridge-like "programme" box. This slots into the master control unit and provides a total of ten games. The retail price is likely to be under £30. The consumer can buy additional programmes (ten games each) at around £10. Apart from straightforward games, it's envisaged that programmes which can be used for educational purposes, e.g. in conjunction with correspondence courses etc., will be made available.

Radofin Electronics, which is one of the largest manufacturers of TV games and similar products such as

One of the first of the new generation of TV games units, providing a wider variety of more complex games. The black box slotted into the master unit on the right-hand side contains the programmes for ten games. See item above.

calculators, predicts that home computers will be available at a realistic price within the next two years.

VIDEO

The Japanese firm JVC is considering releasing on the UK market a "video package" consisting of a portable video recorder and a colour camera. The price would lie in the range £1,090-£1,117, depending on whether the camera is fitted with a zoom lens. The system is aimed at photographers who use standard cine cameras.

RCA has closed its Selectavision VCR production line in the US and has also abandoned development work on its capacitive video disc. Both decisions are due to the restricted playing time (one hour) of the systems. The disc gave half an hour per side. A new disc, carrying surface modulation and capable of an hour's playing time per side, is being developed. On the VCR side, RCA has started to market four-hour, skip-field VHS VCRs under licence from Matsushita at a price of around $1,000.

Sony have issued a warning about US-standard Sony Betamax VCRs which are being converted by "certain companies" for use with PAL and SECAM signals. Sony point out that the modifications are not approved by them and that they can provide no warranty. They propose to introduce PAL Betamax machines in Europe in the middle of next year, and point out that the final specification for their machine has not been decided upon.

THE RENTERS

City stockbrokers Greene and Co. have issued an interesting report on the TV rental companies. They feel that the trend towards concentration into fewer, large firms will continue. The field is already dominated by four companies, the largest being Thorn which accounts for about 40% through its subsidiaries which include Radio Rentals, DER, Rumbelows and Multi-Broadcast. The other major companies are Granada, Rediffusion and Electronic Rentals (Visionhire).

STATION OPENINGS

The following two relay stations are now in operation.
Calne (Wiltshire) BBC-1 channel 21, ITV (HTV West) channel 24, BBC-2 channel 27. Receiving aerial group A (vertical).
St. Dogmaels (Cardigan) ITV (HTV Wales) channel 23, BBC-2 channel 26, BBC-Wales channel 33. Receiving aerial group A (vertical).

THE NEW PYE PORTABLES

Philips have issued a statement that the new Pye monochrome portables, mentioned in *Teletopics* last month, are regarded as "the first positive move in an important policy decision to manufacture more TV sets within Britain" and turn the tide of TV imports. The tube is imported from Taiwan, but if demand is sufficient it too could be produced in the UK.

DEGAUSSING

The use of a pair of positive-temperature coefficient thermistors in a common pack to control the degaussing current in colour receivers was mentioned in the November 1975 *Teletopics*. The technique has been adopted in several recent chassis and type numbers have been announced. The Mullard version carries the part number 2322-662-98009 (so their computer can recognise it!); the recently introduced ITT version is type PT37P. Both units provide about 5A initial current through the coils, diminishing rapidly to 5mA after 30 seconds and to below 2mA after three minutes.

IBA PROMOTE BETTER VIEWING

Five short films, to be shown by ITV companies, have been produced by the IBA to promote better viewing. The films stress the rôle of the retail and rental trade, aerial installers and broadcast engineers in providing viewers with good pictures.

The five films are: (1) the importance of the receiving aerial (30 seconds); (2) the importance of correct receiver adjustment (60 seconds); (3) the expanding coverage of the IBA transmitter networks (60 seconds); (4) new technical developments in television broadcasting (60 seconds); (5) controlling the day-to-day quality of ITV broadcasts (30 seconds).

The film on receiver adjustment is backed by a special leaflet which dealers and rental companies will be encouraged to distribute to viewers.

SANYO SEEK EUROPEAN SITE

The latest Japanese setmaker to announce that it intends to start TV manufacture in Europe is Sanyo. Following the dispute over Hitachi's proposed Durham plant, it's unlikely that Sanyo will consider the UK. Sanyo became established in the US a few months back when it bought a major plant which supplies the mail order house Sears Roebuck. Most major Japanese setmakers now have plants in both the USA and Europe, clearly with the aim of avoiding the effects of possible future trade restrictions.

SWITCH-MODE POWER SUPPLIES

Since switch-mode power supply circuits are becoming ever more common in TV receivers it might be an idea to run over the basics briefly again, especially as some of the rather involved practical circuit diagrams make it difficult to see at a glance exactly which type of circuit is in fact being used. There are only two basic circuits, shown in Fig. 1(a) and (b). The idea is that the mains supply is rectified and presented to a chopper transistor which is switched on and off by a square drive waveform at its base. By varying the on/off time (the mark/space ratio to use the lingo) in each cycle of the drive waveform, a regulated output is obtained. The basic essentials are the chopper transistor, a diode, an inductive reservoir, smoothing components and a drive circuit.

The arrangement shown in Fig. 1(a) is called a series circuit or forward converter, while that shown in Fig. 1(b) is called a parallel circuit or flyback converter. We prefer the terms series and parallel – they're simpler – indicating that the inductor is in series or parallel with the load respectively.

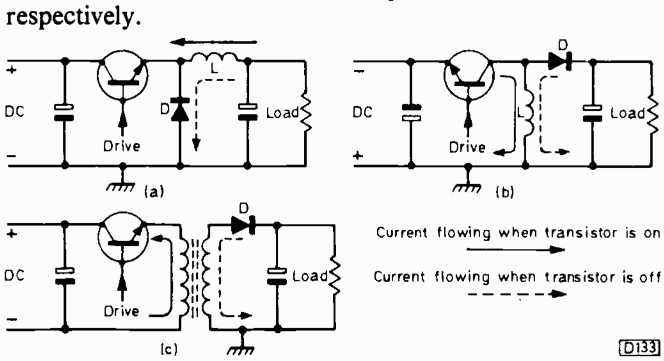


Fig. 1: Basic switch-mode power supply circuits. (a) Series circuit – the chopper transistor's inductive reservoir L is in series with the load. (b) Parallel circuit, with the inductive reservoir in parallel with the load. (c) Showing how a parallel circuit can provide mains isolation.

The series circuit (a) was the first to put in a practical appearance – in the Thorn 3000 chassis. When the transistor is switched on, current flows through the load, the inductor L and the transistor. Diode D is reverse biased. When the transistor is switched off, a negative pulse appears at the cathode of the diode – due to the collapse of the magnetic field around the inductor – and current continues to flow, this time via the load, the inductor and the diode. You can see that the whole thing is very similar to the standard transistor line output stage, where D would be the efficiency diode. More recently this type of circuit has appeared in the Tandberg CTV3 chassis.

The parallel circuit (b) is used in the ITT CVC20 chassis and its derivatives, the Thorn 4000 chassis, and is the basis of the blocking oscillator arrangement used in the Rank T20A and Tandberg CTV2 chassis. When the transistor is switched on, current flows via the transistor and the inductor. The diode is again reverse biased, this time isolating the load. When the transistor is switched off, a positive pulse appears at the anode of the diode which acts as a normal half-wave rectifier.

The most significant difference between the circuits is that current flows continuously via the load and the inductor in the series circuit, while in the parallel circuit energy is first stored in the inductor and is then transferred to the load during the succeeding half cycle. In consequence, the ripple with the parallel circuit is twice that with the series circuit and the smoothing components need to be of correspondingly higher value. The parallel circuit has the advantage that the load is not powered should the chopper transistor go short-circuit. Protection against this eventuality must be provided in the series circuit.

Another advantage of the parallel circuit is that, as shown at (c), it's possible to use a transformer to isolate the load/chassis from the mains.

The Syclops circuit used in the Thorn 9000 chassis is a variant of the shunt circuit, with the transistor driving two transformers and acting as both chopper and line output transistor. If you examine the circuits used in the chassis mentioned above, you'll find that they all break down to the basic series or parallel arrangement, though in the case of the parallel circuit the chopper transistor is sometimes in series with the inductor on the chassis side (e.g. the Thorn Syclops circuit).

TIMEBASE IC DEVELOPMENT

In describing some of the basic aspects of the Rediffusion Mk. III colour chassis last month (*Teletopics*, page 232) we mentioned the TDA9400 i.c. which until now has not appeared in a UK produced set. A brief description of the device is in order therefore.

The TDA9400 and its sister the TDA9500 are the latest versions of the relatively well known TBA940 and TBA950. The latter made its debut in the UK in the Rank Z718 chassis, though it had been used by several continental setmakers for some time. The basic difference between the 940/9400 and the 950/9500 is that the former are designed to provide direct drive to the driver transistor in a transistor line timebase while the latter provide the much shorter pulses required to drive the gate of the flyback thyristor in a thyristor line output stage. The earlier and later versions are very similar, but are not pin compatible. In addition there are slight differences in the peripheral circuitry, so they are not interchangeable for replacement purposes.

The i.c.s comprise a sync separator with internal noise suppression, a field sync pulse integrator, a line sync phase

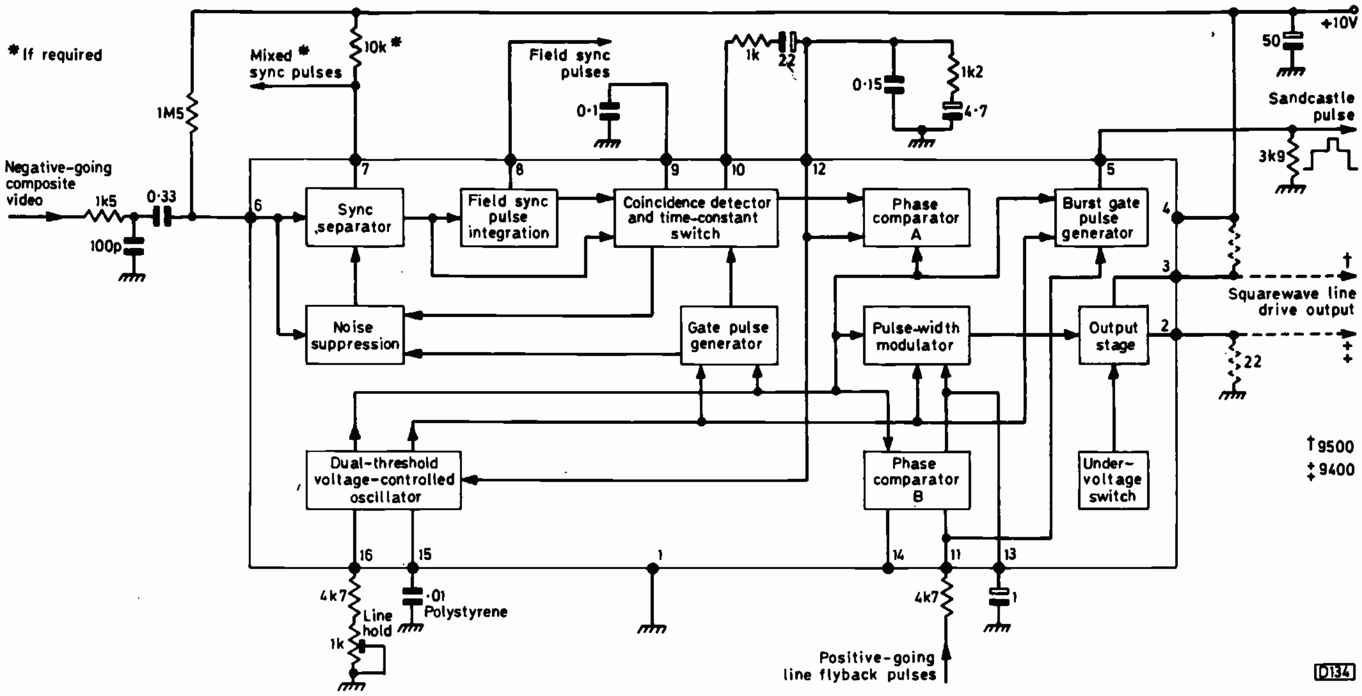


Fig. 2: Block diagram of the TDA9400/9500 sync separator/line generator i.c., also showing the peripheral circuitry.

comparator, a switching stage for automatic changeover to adjust the phase comparator circuit's time-constant, the line oscillator, a second phase control circuit, a burst gate (sandcastle) pulse generator, an output stage, and an undervoltage protection circuit. There are different output stages in the "4" and "5" versions for the reasons already given. Fig. 2 shows a block diagram, together with the recommended external circuitry.

The composite video signal (negative-going) enters the i.c. at pin 6, where the sync separator extracts the sync pulses. A composite sync signal is available at pin 7 if required, but this is not generally used in standard TV applications. To ensure that noise spikes do not affect the operation of the sync separator, a noise gate circuit is included. This ensures disturbance-free operation under most conditions and is unusual in requiring no external components. The field sync pulse is obtained by internal integration and limiting, appearing at pin 8. It can be used to trigger all types of field oscillator circuits, including the field timebase chips from SGS (TDA1170 and TDA1270) and ITT (TDA1044).

The line oscillator frequency is determined by the 0·01μF capacitor connected to pin 15. This is charged and discharged periodically by two internal current sources. The external resistance at pin 16 defines the charging current and thus, in conjunction with the oscillator capacitor, the line frequency.

Phase comparator A compares the sawtooth voltage produced by the oscillator with the timing of the line sync pulse. As a result, an a.f.c. voltage which locks the oscillator frequency is produced. A frequency range limiter restricts the frequency holding range.

The oscillator sawtooth voltage, which is in a fixed ratio to the line sync pulses, is also compared with the line flyback pulses fed in at pin 11. This is done in a second phase comparator circuit. This action compensates for the drift and delay times in the line driver and output stages. Leaving pin 14 open-circuit gives the normal phase position. Phase displacement, which shows as a horizontal picture shift, can be corrected by feeding a current or voltage (obtained for example from a potential divider) to pin 14. Alternatively, since the conditions at pin 14 do not affect the duration of the line-frequency output pulse this pin can be used to provide horizontal shift (though this is effective only with modern tubes). This technique is used in the Rediffusion Mk. III chassis and is certainly a cost-effective approach.

The burst gating pulse is derived from the oscillator sawtooth voltage and is synchronised with the incoming line sync pulses.

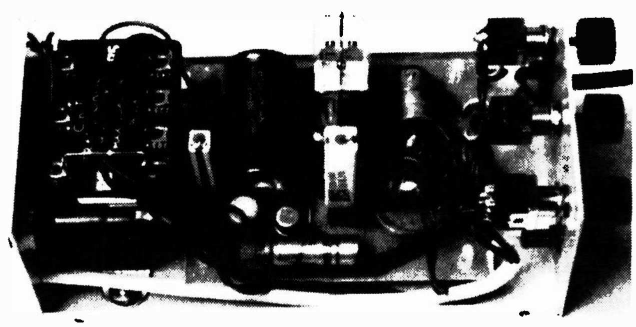
The time-constant switch adjusts for the different conditions under off-air and VCR operation. When the signals from the sync separator and phase comparator A are in sync pin 10 is short-circuited to earth internally. The time-constant of the filter network at pin 12 increases therefore, reducing the pull-in range of the phase comparator to ensure disturbance-free operation. For VCR operation however the automatic switch over is blocked by a positive voltage at pin 9. This reduces the time-constant at pin 12 and increases the phase comparator's control current. In consequence there is a faster reaction to the frequency changes due to the inherent short-comings of the mechanical aspects of both VCRs and tapes, i.e. whenever flutter occurs the i.c. can track the rapid changes in frequency and thereby compensate for them. Without this compensation there is a tendency to line pulling, resembling weak line sync.

The TDA9400 output stage consists of a Darlington emitter-follower which is capable of delivering a maximum of 600mA – necessary for driving a thyristor. The stage is short-circuit protected to avoid disaster! The output stage in the TDA9500 operates in the common-emitter configuration. Its output current is limited to 50mA by the value of the load resistor connected between pin 3 and the supply voltage.

If the supply voltage falls, for example when the set is switched off, a built-in protection circuit ensures that clearly defined line-frequency output pulses are produced until the voltage at pin 4 falls to 4V. Thereafter the i.c. shuts down. This protection prevents the line output stage being damaged by undefined drive pulses, particularly if the frequency is too low.

Pulsed CRT Rejuvenator

Circuit design by W. E. Harrison, text by P. G. Frazer



ALL cathode-ray tubes must ultimately reach the point where the electron emission from the cathode falls to such a low level that the picture displayed is no longer acceptable. This is normally a gradual process which is easy to recognise in its advanced state but can be confused with impaired operation of the video circuits at an earlier stage.

The job of the video, luminance or an RGB output stage is to amplify the small signal picture information voltages presented to it into large voltage swings sufficient to drive the emission of the c.r.t. between zero (black) and peak white – this amplification has to be linear over a wide frequency range. A video output stage therefore leads a fairly hard life, and it's not surprising that its efficiency can and does fall off, producing symptoms which in some circumstances lead to suspicion about the c.r.t. It's prudent therefore to check the video output device, particularly if it's a valve, and the associated circuitry before condeming the tube when the picture displayed lacks contrast or highlights.

Confusion normally arises only when the action of the contrast control produces an unsatisfactory display, with perhaps a tendency for the picture to become negative. The action of the brightness control should however enable suspicion to be removed from the tube, since it should result in a bright, clean raster when advanced, with no tendency to invert or blur the highlights. In the case of a monochrome tube, failing cathode emission results in silvery highlights with an overall grey appearance, improving only when the brightness or contrast are reduced to relieve the demand on the cathode's emitting surface.

Low Emission

While there are several possible tube defects, we are concerned here with failure of the cathode to emit sufficient electrons from its surface, i.e. the tube is losing emission. This is often referred to as a "soft tube", which is not strictly true as the term "soft" implies that the tube's vacuum is impaired and that a degree of gas is present, i.e. it is no longer "hard". The effect in this case is to impede the normal electron beam and defocus it. This effect becomes far more noticeable when the cathode emission is low, which is why the term has become commonly used instead of the more correct "low emission".

It is well known that some types of tube tend to lose emission far more quickly than others, which on average keep their hardness and emission for many years. Those tubes which tend to lose emission early are those which can be doctored to produce more acceptable results. Tubes which have given sterling service over a period of many years do not generally respond kindly to attempts to coax them into giving a further period of service: the reason is that the cathode emitting surface has been entirely used up and is simply no longer there.

Failure Mechanism

In order to understand the failure mechanism, a brief description of the cathode is necessary. The cathode consists of a mixture of barium and strontium oxides deposited on a nickel tube. During manufacture, the deposit is initially a mixture of the carbonates, mixed with some form of glue so that they adhere to the nickel tube. This glue is burnt off during tube processing, which also converts the carbonates to the oxides. During the cathode activation process, which takes place after the tube has been evacuated, some of the oxide is reduced to the appropriate metal (i.e. barium or strontium). This free metal accounts for some 0.01% of the deposit, but without it the cathode simply will not emit electrons.

When a tube has been operating for some time, a layer known as the "interface layer" grows between the oxide deposit and the nickel core. It is due to the interaction of silicon (present in nickel as an impurity) and the oxide layer. For those with some knowledge of chemistry the reaction is as follows:

$$\underset{\text{Silicon}}{Si} + \underset{\text{Barium oxide}}{4BaO} \longrightarrow \underset{\text{Barium orthosilicate}}{Ba_2SiO_4} + \underset{\text{Barium}}{2Ba}$$

The glassy layer of barium orthosilicate forms during the activation process but usually has a resistance of less than one ohm. As the tube ages, this resistance rises and the cathode become less conductive.

Other Factors

There are two other significant causes of failure. One is the action of gas on the cathode. Total tube evacuation is virtually impossible, so there is always gas present from the outset. The tube can also go soft with age: this accelerates the chemical action on the cathode, as well as impeding the flow of electrons towards the screen.

The other cause of failure is the formation of a carbon deposit on the oxide layer. The carbon is a by-product of the glue burning process used in bonding the oxide layer to the nickel core. The mechanism is somewhat involved and is less relevant today due to the different methods of deposition used.

Restoring Emission

There are several means by which other tube faults can be overcome, but only a few ways of restoring tube emission. Again we stress that if the emitting surface has been used up over a fair number of years one cannot expect a further period of life. Efforts should be confined therefore to those tubes which have lost emission inside say six years, give or take a bit here and there.

The first possibility that springs to mind is to revert to the activation process. This means overrunning the heater by around 20% in order to increase its temperature. The best way to do this is to remove the existing heater leads (and, if they form part of a series heater chain as they do in most monochrome receivers, joining them together to preserve the continuity of the heater line) and install a separate heater transformer which has provision for the required heater voltage plus a 20% boost. The primary winding of this transformer will require a 240V supply from the mains (after the on/off switch).

Another and more elegant idea is to overrun the heater for a short while, keeping the cathode potential low and applying a higher potential to the grid, thus treating these two elements as a diode in the conducting mode. By connecting a meter in series with one lead we can record the current. The initial current will be very small indeed, but will increase with time and with the voltage applied to the grid. When the current stops its slow rise (it must never be a sudden surge), flattening out at say 1mA, it can be assumed that the cathode surface has been "treated" and normal operation can be tried.

A third and more potent method consists of taking the cathode to a low potential (earth) as before, but instead of applying a steady positive voltage to the grid to coax up the cathode emission a high pulse voltage is applied to the grid for a very brief period, repeating this a few times. This treatment is potentially more effective, but can sometimes result in the destruction of the tube due to the electrode connections being blown open.

Tube reactivators should be used in strict accordance with any instructions therefore. These will vary from one to another according to the voltages employed and the period of reactivation specified.

Colour Tubes

While a failing colour tube suffers from the same conditions as a failing monochrome one, the fact that there are three guns to consider means that different symptoms will be displayed. It's common for one gun to "go down" before the other two, and though the colour produced by this gun may be vaguely present on dark scenes the cathode will not respond to normal drive and the colour concerned will to all intents and purposes be missing from the displayed picture. The colour may on the other hand be present, but may spread out and smear as the brightness control is advanced, necessitating a low brightness control setting and an unacceptably "muddy" appearance of the displayed colours which will vary according to the brilliance level. Generally speaking, colour tubes respond well to reactivation.

The heater leads should be removed and insulated from one another if a separate transformer is to be fitted, and of course there are three grids and three cathodes to consider – if all three guns need treatment, that is.

Circuit Features

The unit we are featuring this month is a compact pulse-type reactivator which can be used in one of five ways: (1) pulsed; (2) heater booster; (3) continuous; (4) continuous with heater boosting; (5) pulsed with heater boosting. In this way the unit may be used to advantage with all types of tubes suffering from early emission failure symptoms.

The circuit, shown in Fig. 1, is based on the RS Components heater transformer (reference no. 196-224) which has a 6·3V secondary with a 20% boost tap. This is a straightforward way of operating the heater at a higher temperature, the actual voltage being selected by SW2.

The mains is rectified by the half-wave rectifier D1 and smoothed by C1. In the continuous mode (selected by SW3) this voltage is fed to the c.r.t. grid via the 15W pygmy lamp LP2 which serves as a current limiter.

In the pulsed mode, a 20V rail is developed across zener diode D2 via dropper resistor R2. Capacitor C2 then charges through R3, switching on transistor Tr1. This in turn energises the relay which switches the high-voltage line to the c.r.t. grid. The other set of relay contacts short circuit C2 and the base of Tr1 to ground, de-energising the relay. The cycle then repeats. D3 and C3 suppress spikes which could appear at the relay and cause false triggering. The unit produces pulses at the rate of one per second: this was considered to be the optimum.

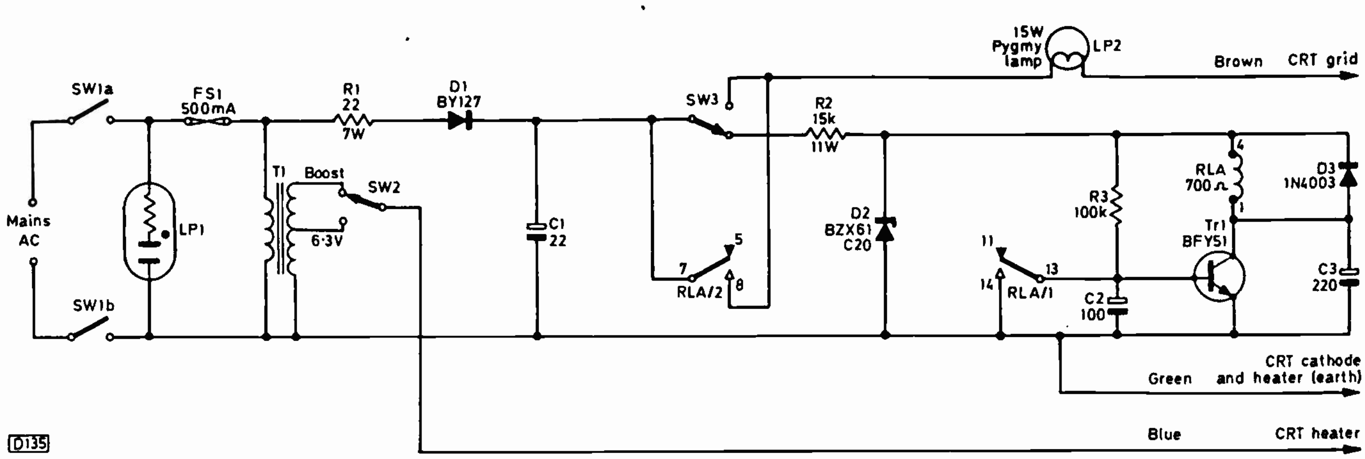


Fig. 1: Circuit diagram of the unit. SW3 shown in the pulsed operation position.

It could perhaps be argued that a meter should be incorporated so that the current can be monitored during the process. This can of course be very easily done by externally connecting a 5mA f.s.d. meter in series with the c.r.t. grid. It was felt that integrating the meter would raise the cost of the unit as well as requiring a somewhat larger case.

Construction

Construction is very straightforward if the printed board and the recommended components are used. The pygmy lamp is wired into the circuit and supported by a length of 22 s.w.g. tinned copper wire which is passed over the lamp base and soldered onto the anchor points provided on the board. Place a small piece of foam under the lamp base to guard it against shocks, and lift it clear of the board. It was thought preferable to have the unit disconnected from the a.c. mains earth – just in case the receiver was left plugged into the mains and possibly switched on. Disastrous results could then be obtained, especially with some more modern sets. It's as well to point out that the case is floating, so extra care with construction is advised.

Using the Unit

To initiate reactivation, connect the c.r.t. heater to the unit and operate it in boosted mode for about 15 minutes. If this does not have any or enough effect continue the treatment for an hour, monitoring the effect every 15 minutes. If this fails, switch the unit to the normal 6·3V heater output and connect the grid to the high-voltage output. Operate in the continuous mode for a maximum of one minute, while monitoring the current on an Avo or similar instrument placed in series with the grid and switched to read 10mA f.s.d. If the current is seen to rise slowly and settle at around 1mA, probable success is signified. If on the other hand it rises very quickly and goes beyond 5mA, switch the reactivator off immediately – otherwise there is a good chance that the tube electrodes will be destroyed.

If this operation doesn't succeed, it can be repeated with the boosted heater supply.

Warning!

These last two processes, i.e. the continuous operation and continuous operation with heater boost, are rather dangerous for the tube because it is quite difficult to switch the unit off in time if adverse reaction is observed. This is where pulsed operation comes into its own. Under pulsed treatment the tube has a chance – in the interval when no voltage is applied to the grid – to dissipate the heat generated. In this way the risk of damage is much reduced. Pulsed reactivation can be considered as "shock treatment" and is generally more effective than continuous operation. It is recommended therefore that continuous operation is tried only if all else fails.

Tube Sockets

Some readers may prefer to connect the unit to the tube base via an appropriate tube socket arrangement, though this is not fitted to the prototype. A B8H for monochrome tubes and a B12-246 for the more recent colour tubes should cover the majority of applications. Obviously for comprehensive tube coverage several other sockets are required. They can be mounted in a small plastic box, but a switch must be fitted so that the cathode and grid connections for colour tubes can be directed to the failing gun – it's not sufficient to parallel the three guns as this can cause failure of a good gun.

We regret that the bad weather conditions in the south west at the time this issue was being passed for press prevented us obtaining the PCB artwork and component layout diagram for this project. Both diagrams will be published in the next issue and we regret any inconvenience this may cause readers. ■

★ Components List

Resistors:

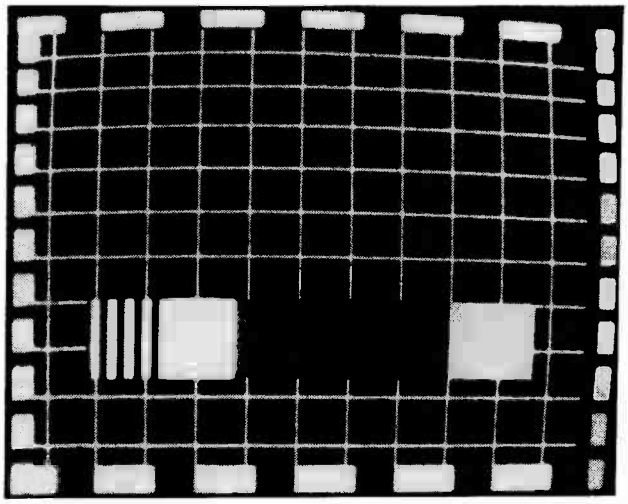
R1	22Ω 7W w.w.
R2	15k 11W w.w.
R3	100k 0·5W carbon film
Capacitors:	
C1	22μ 450V electrolytic
C2	100μ 16V pluggable electrolytic
C3	220μ 25V electolytic
Semiconductors:	
D1	BY127
D2	BZX61 C20
D3	IN4003
Tr1	BFY51
Miscellaneous:	
T1	Mains transformer RS Components type 196-224
LP1	250V miniature neon indicator
LP2	15W pygmy lamp
SW1	Push on/push off mains switch RS Components type 339-257
SW2, SW3	s.p.d.t. latching push-button switch RS Components type 339-241
RLA	RS Components type 348-936 relay with holder type 349-305
FS1	500mA anti-surge fuse and fuse holder
Case	RS Components type 509-967
P.c.b.	Reference DO46 from Readers PCB Services Ltd.

in next months issue

TELEVISION

Simple TEST-CARD generator

Our latest project is a self-contained, simple test-card generator which produces a crosshatch pattern with a four-step grey-scale and two frequency gratings superimposed on it. The complete pattern is surrounded with a castellated border. The unit contains its own power supply and features a one-chip crystal-controlled s.p.g., and its own u.h.f. modulator. It is a very useful tool for the workshop and indispensable when servicing in the field.



● Plus start of new series

TRANSISTORS IN TELEVISION CIRCUITRY

S. W. Amos, C.Eng., B.Sc., MIEE will be going through the complete TV receiver analysing the ways in which the properties of the various types of transistor are used to obtain the performance required. To start with, a survey of transistor types and characteristics, and basic transistor circuits.

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Skantic Solid-state Colour Receivers

John Coombes

SEVERAL Swedish made Skantic colour chassis have been released on the UK market. The first was a hybrid one. This was followed by a solid-state chassis fitted with a 110° delta-gun tube, the subject of this article. The next was very similar and used most of the same printed panels: it was fitted with a Toshiba in-line gun tube however and thus had simplified convergence circuitry. There followed another chassis with a Toshiba in-line gun c.r.t. but with more extensive use made of i.c.s, while most recently a chassis using the Philips/Mullard 20AX tube has been introduced.

A common feature of all the solid-state chassis is the use of a switch-mode power supply employing a blocking oscillator transistor as the switching device (chopper). The circuit was originally devised by Siemens, and has been described in these pages before in some detail – in connection with the Tandberg CTV2 chassis (see the October 1975 and May 1976 issues). More recently it has put in an appearance in the new Rank T20 (20AX c.r.t.) chassis.

The chassis dealt with in these notes features a conventional BU208 transistor line output stage with diode modulator for EW raster correction, a v.h.f./u.h.f. tuner, and colour-difference tube drive. Fortunately, since some of the circuitry is quite complex, the chassis is on the whole very reliable and most of the faults are fairly simple to diagnose.

Power Supplies

One thing that's important is to set up the power supply lines correctly. The stabilised "B3" voltage line should be adjusted for 185V at zero beam current by means of the potentiometer P601. Then check and adjust if necessary the 24V stabilised line: the preset concerned is P621 on the power supply panel.

As with all sets, no results are often due to a blown mains fuse. There are two, S621 and S622 (both 3·15A anti-surge types), in the feeds to the mains bridge rectifier which, incidentally, is connected to provide a –290V output. The usual cause is one or other of the associated mains filter capacitors, C622 and C623 respectively (both 0·22μF), having gone short-circuit. Alternatively one of the diodes D621-D624 in the bridge may have gone short-circuit.

A dead set is often due to rectifier D611 (see Fig. 1) going short-circuit. In this event it's wise to change the chopper transistor Q602 (BU126) and its trigger thyristor TY601 (BRY55/30) as well. Other causes of this symptom are one or other of the reservoir capacitors C608/9/10 having gone short-circuit. Replace as necessary and check or change the associated rectifier diode which may have been damaged by the overload.

Signal Faults

The most common tuner trouble is drift. Check the setting of P281 on the tuner panel – it's in series with the feed to the tuning potentiometers. Alternatively the 33V stabliser diode D285 (ZTK33) could be faulty.

If the customer complains that the low-frequency channels come in at the high-frequency end the trouble is usually a defective u.h.f. mixer transistor (Q102, type AF240).

Patterning is sometimes troublesome. The usual causes are either the tuning voltage decoupler in the tuner (C114, 0·001μF) or incorrect setting of the i.f. output coil (L24).

For low gain, check the setting of the tuner a.g.c. preset control P231 on the i.f. panel. The i.f. strip itself is reliable, but watch out for no video signals due to a dry-jointed coil (L206) in the video detector can Fi203. If sound/chroma beat patterning is experienced, check the tuning of the 6MHz rejector coil L208, also the associated tuning capacitor C222 (0·001μF).

Complete or intermittent loss of sound is generally due to the TBA800 audio output i.c. On one or two cases however I've come across an open-circuit loudspeaker. The speaker switch (back of set) can also go open-circuit. The output from the i.c. is coupled to the loudspeaker via C319 (470μF). This can also go open-circuit to cause loss of sound. The power supply for the i.c. comes via a regulating transistor (Q302, TIP31A). Low, distorted sound is usually due to this transistor.

The luminance output transistor is Q406 (BF458). Loss of luminance can be due to this transistor going open-circuit, or alternatively its collector load resistor R430 (3·3kΩ) or the luminance delay line L403 going open-

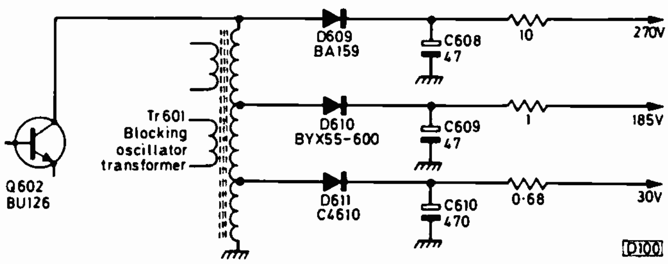


Fig. 1: The parallel switch-mode power supply uses the BU126 chopper transistor Q602 in a blocking oscillator circuit. The primary winding of the blocking oscillator transformer Tr601 acts as the inductive reservoir, feeding three half-wave rectifiers.

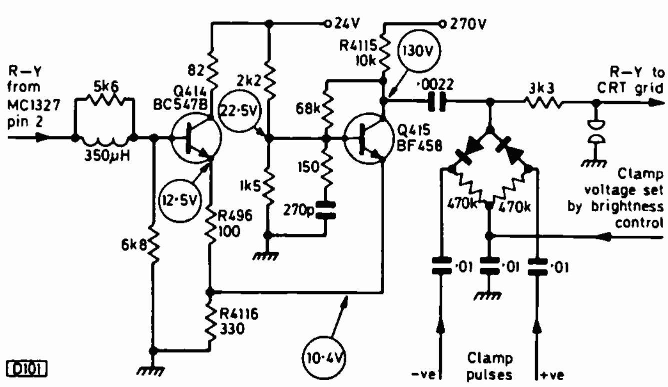


Fig. 2: The colour-difference signal channels are unusual, consisting of an emitter-follower driving a common-base transistor output stage. The R–Y channel is shown above.

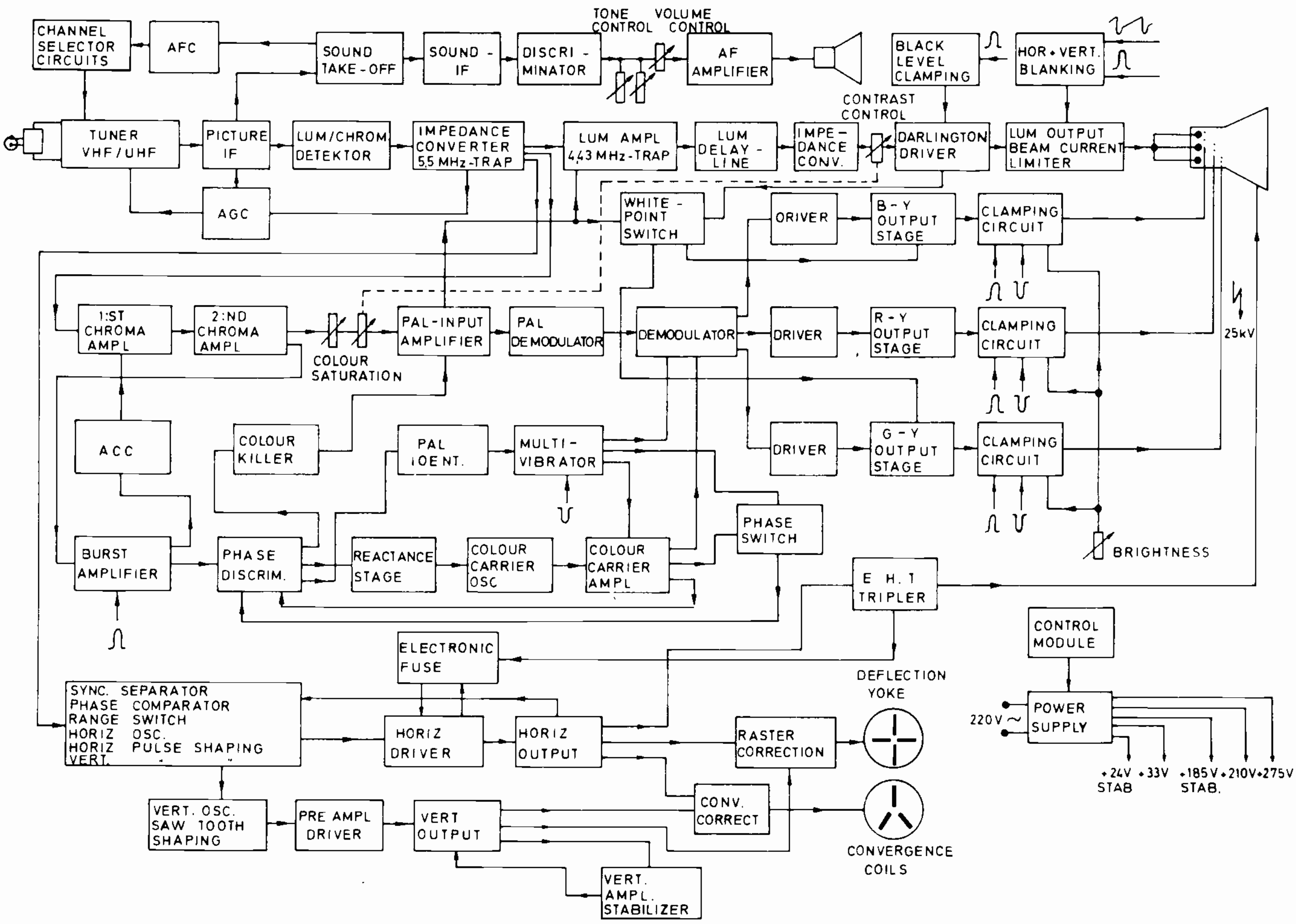


Fig. 3: Block diagram of the receiver.

circuit. L403 can also develop a leak to chassis, and can be responsible for colour displacement and flashes across the screen.

The colour-difference output transistors are a.c. coupled to the tube's grids, with double-diode clamps to maintain the correct black level. The circuitry here is somewhat unusual. One channel (R–Y) is shown in Fig. 2. The demodulated R–Y signal from the MC1327 (alternative SN76227N) i.c. is fed to an emitter-follower which drives a common-base output stage. Loss of one colour or the other is usually due to the appropriate output transistor's load resistor having gone open-circuit (R4115, 10kΩ in Fig. 2). Alternatively the transistor may be open-circuit. The clamp diodes can go short-circuit, causing an all red, blue or green picture. More often however they develop a fault which can be detected only by making a very careful resistance check. The symptom is incorrect grey scale, with a red, blue or green tint across the screen. It's interesting to note that the clamp voltage is set by the brightness control.

In cases of no colour, check the voltages round the 4·43MHz reference oscillator transistor Q419 (BC237B). There should be 23·5V at its collector, 5·2V at its base and 4·9V at its emitter. C4129 (0·0047μF) which is in series with the varicap diode can go short-circuit. On the chrominance side, the MC1327/SN76227N i.c. should be checked. There is also the possibility of a short-circuit in can Fi406 which forms part of the quadrature phase shift network.

The burst gate/amplifier stage drives three detectors: a simple diode rectifier to provide the a.c.c. potential, and two synchronous demodulators. One of these provides an output to control the reference oscillator, the other an output which is fed to the colour-killer circuit and to the ident transistor Q421 (BC238C). The usual cause of no ident is that Q421 has gone open-circuit, but the diodes in the demodulator circuit (D435 and D436) can also be responsible for this.

Timebase Faults

A TBA950 i.c. is used as the sync separator and line oscillator. This i.c. is responsible for two faults occasionally encountered: complete loss of sync, or weak line sync with critical adjustment of the line hold control P803.

The only field timebase fault I've had is field jitter. The usual cause is a faulty field output transistor (Q854, type BD183). Less often the driver transistor Q853 (BC338) is responsible. The use of a can of freezer assists in pinpointing the cause of this fault.

Loss of e.h.t. is usually due to the tripler being defective. The only other cause I've come across is a short-circuit line output transistor (Q703, BU208).

If the raster cannot be centred horizontally, check D706 and D708 (BA158) which can go open-circuit.

Miscellaneous

Convergence difficulties can be experienced due to D924 going open-circuit (red verticals displaced) or C925 (0·1μF) going short-circuit (blue horizontal convergence out).

Finally, a very important warning. The chassis is at mid-rail voltage. It should not be earthed via test equipment leads therefore. ■

Long-play VCRs:

The Philips N1700

S. R. Beeching, T.Eng (CEI)

THE new long-play machines achieve more than twice the playing time of the original Philips N1500 series of video-cassette recorders by packing twice as much information on to the tape. The 130 minutes' playing time is obtained by recording on the same VC60 cassettes at less than half the previous tape speed. How this is done is rather clever, and it's been rumoured that Grundig had more than a little to do with the idea.

The original and the new long-play standards are compared in Fig. 1. In the original N1500 system, there's a gap called the guard band between each video track laid down (one track equals one field, i.e. 312·5 lines), while the two video heads are mounted 180° apart on the scanning drum. To increase the storage density, the tracks in the long-play system are laid down side-by-side with no guard bands, giving more video tracks per length of tape. Doing this alone would not produce a workable system, since the scanning head would pick up small amounts of magnetism from adjacent tracks. Two things have been done to overcome this problem.

First the head gaps are slanted at ±15°: thus head A is tilted 30° with respect to head B. Now it's well known that if you tilt an audio head the treble (high-frequency) response is reduced. Frequency modulation is used for the video signal, with a bandwidth of 3·3-4·8MHz (which, incidentally, is higher than the 3-4·4MHz used on the 1502). The idea then is that by tilting the heads one will not reproduce anything recorded by the other and vice versa. In consequence the tracks can lie happily side by side.

You can prove this on an N1700. If the tracking control is slowly adjusted the video mistracks, goes blank, and then reappears. The blank bit of course is where one head is scanning the other's track.

There's a snag however. The colour information is modulated on to a low-frequency carrier – at 562·5kHz to be precise. Gap tilting is not effective at this frequency, so something else has to be done in addition in order to get long-play colour reproduction.

As in all colour systems, the insensitivity of the human eye to colour detail can be used as the basis of a compromise. If you take two lines, one each from the same part of adjacent fields, you will usually find that the colour is the same or has changed only a little. They can be assumed to be the same therefore, the eye not noticing. If we lay (see Fig. 2) the lines of adjacent fields next to each other, making sure that the phase of the R – Y colour-difference signal is the same, then if head A picks up some of head B's colour information it will *add to* rather than *interfere with* the colour output. The eye will not notice this.

To put this into practice, the heads are mounted 179° 25′ 45″ ± 16″ apart instead of 180° apart. This, together with an angle of 3° 45′ 52″ between the drum and the moving tape, means that the heads are shifted with respect to each other by one line. Head A records and replays

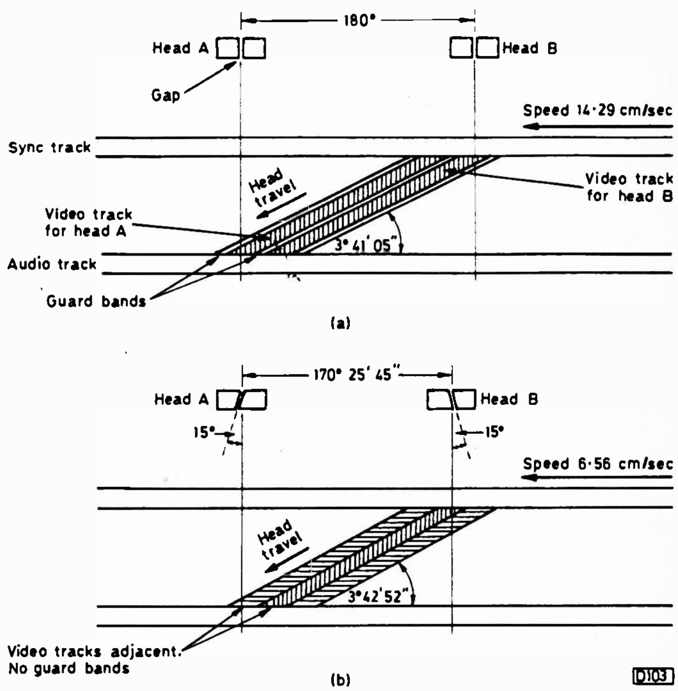


Fig. 1: Comparison of the basic N1500 (a) and N1700 (b) systems. In the 1500 the video track width is 130μm, the distance between tracks 57μm and the distance between track centres 187μm. In the 1700 the video track width is 85μm, the tracks are adjacent and in consequence the distance between track centres is also 85μm. The track length is 16·5cm in both systems.

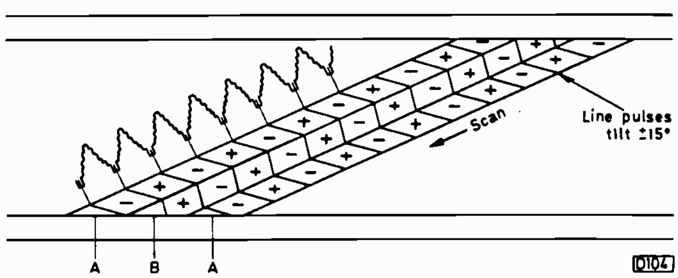
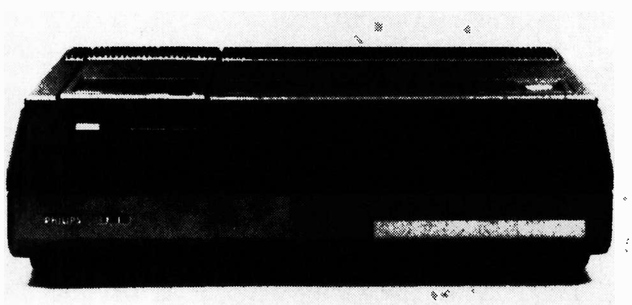


Fig. 2: Schematic (not to scale – head A's field contains 311·5 lines and head B's 313·5 lines) showing how lines with identical colour phases are laid beside each other.



The Philips N1700 VCR.

311·5 lines therefore while head B records and replays 313·5 lines. This makes sure that lines with "identical" colour and the same phase R – Y signal are side-by-side on adjacent fields. Anyone thinking of fitting N1700 heads to an N1502 machine and slowing it down must take this into account.

The signal processing techniques used in the N1700 are little different from those in the N1502, though the circuitry has been redesigned and rationalised. The N1502 had a video input/output facility, and by adding an extra board the N1512 audio-visual version was obtained. The circuit functions in the N1700 are similar to the N1502 though some features have been omitted. This makes modification more difficult, though I'm working on this. There's no microphone preamplifier for example, while the tuner selector buttons are hard wired so that using channel 8 to switch external inputs will involve a lot of rewiring at high cost – say around £120.

Two distinct changes have been introduced. One is that frequency and group delay correction are carried out by a much more sophisticated unit called the signal preparation module. This drives the u.h.f. modulator. The module also provides VCR identification pulses. These little pulses sit on the bottom of the line sync pulse: the idea is that they are gated out in the receiver and used to switch automatically the time-constant of the line sync circuit for VCR operation. The second change is that by using wideband record and playback amplifiers and better heads (which are no more expensive that 1500 heads) the need for a crispener circuit is overcome. The replay in fact is superb, easily as good as a U-matic and certainly less noisy than the Grundig VC4000.

The servo hasn't been altered much either. The main changes here are a redesigned tracking and tape sync module, and the addition of a speed discriminator in the tape servo. This integrates the servo pulses, producing a d.c. level which is buffered and added to the tape servo error amplifier to give faster locking.

The power supply board is nothing like the one on the previous models. Most of the tape transport and protection circuitry uses CMOS i.c.s, CD4027 flip-flops and CD4001 NOR gates. There is also a third motor called the friction motor. This is driven by a fairly elaborate circuit to keep the forward take-up torque constant during threading, unthreading and forward wind. A large capacitor is included to maintain current through the motor for a short time after the machine has been switched off.

The clock is a 24 hour, three day one, again controlled by CMOS logic. It has a programmable recording time of up to two hours. If two hours ten minutes or a full cassette is required, the selector switch – which has positions lock, start, length, day and set time – is left in the length instead of the lock position for a remote recording.

I've not had many problems with the N1700 so far, though I get the impression that some manufacturers should put longer stop foil sensors on their cassettes: the N1700 rewinds at a very high speed, and I've had a lot of cassettes that need reterminating after pulling off the end stop. ■

Faults Analysed

Robin D. Smith

Snubber Trouble

The problem with a GEC solid-state colour receiver seemed to be simple enough. The 3·15A mains fuse had blown badly, and on examination C58 was short-circuit and R69 burnt out (see Fig. 1). Replacements were fitted and on switching the set on it jumped into life, displaying an excellent picture with good convergence. Easy, and a suitable charge was made.

The following day however the customer rang to say that everything was o.k. except for "a thin white line running up the screen at mains frequency". I said it was probably some local interference that would soon go, but the customer insisted that it wasn't there before the set had been repaired. Here we go again I thought, but asked the customer to call back and report further the following day. At nine o'clock he was on my doorstep with the set!

When he'd gone I switched on and there was this white line running up the picture at mains frequency, as he'd said. I'd seen nothing like it before, so was rather puzzled. For speed I changed the power supply and field timebase panels, but the fault persisted. Now I knew I'd not touched any other part of the set when carrying out the previous repair – not even lifted the chassis thereby disturbing wiring and possibly causing an earth loop. I had a think, then decided to phone GEC's Technical Liaison Officer at Slough. I've spoken to him many times and he's always turned out to be right. On telling him what I'd done he commented that the time-constant of the network C58/R69, which he referred to as a snubber network, was critical. Had I used a wide tolerance capacitor?

Well, I'd used an RS MDC type and the manual quoted a tolerance of 20%, so I thought I was o.k. Tried another but the fault was still there. I then opened up a new stock GEC set to see what they were using: no brand name, just 0·22μF, 1kV. So I thought let's pinch it and see what happens. Happily this got rid of the white line. But my initial profitable ten minute job had turned out to be a lengthy, unprofitable one.

Scan Correction

The report on a set fitted with the Thorn 1400 chassis was no picture, and on arriving we found the customer sitting there with the set on, listening to the sound. The foul stink told us immediately that the tripler had gone – the customer said he thought it was the cat....

The customer lived only a few yards from the workshop, so as we didn't have the right tripler with us we took the set back to the workshop. My assistant fitted a new tripler, switched on and up came the picture. Good, he said, that's that. The picture didn't look right to me however. No s-correction I said, which seemed to puzzle him. Now it's been my experience that many people don't understand this business of scan correction, so let's explain.

If the tube face was spherical – see Fig. 2(a) – there'd be no problem. The beam would travel across the face of the tube at the same speed. With a relatively flat-faced tube however – see Fig. 2(b) – the distance the beam travels for a given angle of deflection varies across the screen. So without correction the picture would be stretched at the sides and compressed at the middle – giving the narrow heads, broad shoulders symptom. To correct this we need to slow the spot at the sides of the screen. It's easy enough to do this by connecting in series with the line scan coils a capacitor which tunes them to about half the line frequency. The effect is to add a parabolic component to the scan current.

Returning to the 1400, sure enough the s-correction capacitor C107 (0·1μF) was short-circuit. Replacing it resulted in a linear scan but with reduced width, due to the width control having burnt out. I can only assume that a previous engineer had been called to attend to low width and, overlooking the non-linearity, had simply advanced the width control – with the result that the tripler had a shortened lease of life.

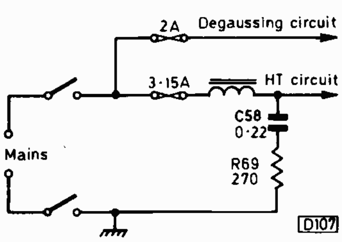


Fig. 1: Snubber network (C58, R59) connected between the junction of the mains filter coil and the anode of the thyristor mains rectifier to chassis to protect the thyristor against peak voltages. The type of capacitor used is important.

Gross Convergence Errors

The customer who brought in his ITT set (CVC9 chassis) reported "blue and yellow lines everywhere". Switching on revealed gross convergence errors which couldn't be removed by adjustment since the various coils and preset resistors were inoperative. A check up with the oscilloscope

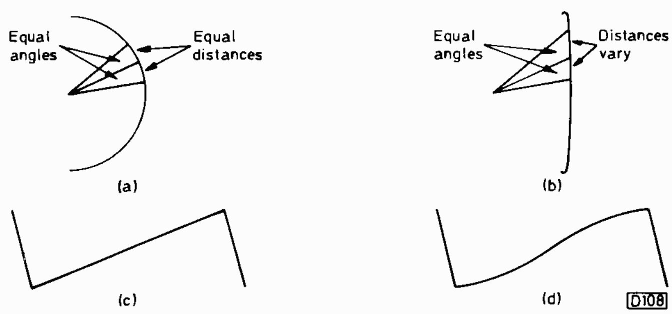


Fig. 2: (a) If the c.r.t. face was spherical, equal beam deflection angles would mean the spot travelling equal distances across the c.r.t. screen. (b) With a flat faced tube however equal deflection angles result in the spot travelling a greater distance at the edges than at the centre of the screen. The problem is overcome by using scan-correction – distorting the scan waveform by adding a parabolic component. (c) Shows a linear, uncorrected scan waveform, (d) a scan-corrected waveform. The same problem arises with field scanning of course. In this case correction is obtained by shaping the field drive waveform.

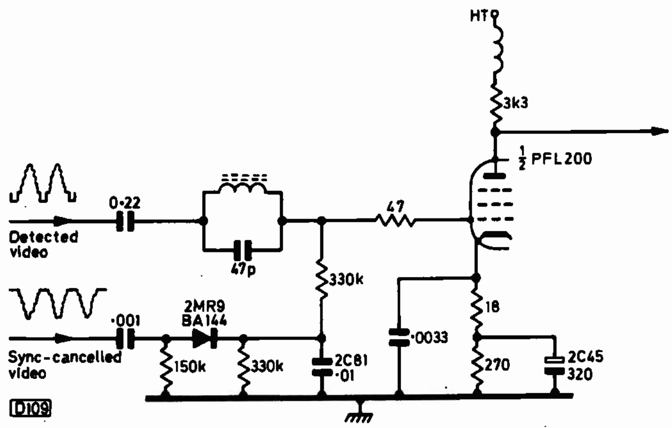


Fig. 3: The video output stage used in the Rank A640 chassis. The detected video signal is a.c. coupled to the output pentode's control grid, a black-level correction circuit being used to restore the black level at this point. This works as follows. A proportion of the signals at the anodes of the video output pentode and the sync separator are mixed, so that the sync pulses are cancelled. The peak level of the resultant signal represents black level therefore. This signal is detected by 2MR9 so that a voltage corresponding to the black level is developed across 2C81.

soon revealed the cause of the trouble: no flyback pulse from pin 5 of the line output transformer to the covergence circuit.

On inspection I found that the set had had a nasty knock at some time: the metal chassis which holds the printed board was warped, the warp being worst where the line output transformer was mounted. One result was that pin 5 was dry-jointed. I decided to desolder the transformer to see whether the pins could be inserted into the panel further. Fortunately they could, and on resoldering the transformer the convergence controls operated normally. A quick tickle up produced an excellent picture.

When the customer saw it he said he'd never seen a picture like that since he'd bought it new three years previously. On further questioning he said he had thought the picture normal until his neighbour had had a new set installed. . . .

Intermittent Field Roll

Intermittent field roll was the problem on a Bush model fitted with the Rank A640 chassis (the TV161 series), and I ran the set for about an hour before seeing this. It turned out to be "black-level field roll", indicating that the trouble was not in the timebase section.

Other symptoms observed were that the tube seemed to be low while the brightness control couldn't be turned down to give a good dark picture. Taking all these faults into consideration, it seemed likely that something was wrong in the video output stage (see Fig. 3). Sure enough, the anode voltage was high and the cathode voltage low at only 2V instead of 6V. The input signal is a.c. coupled, and there's a black-level correction circuit. So there were several possibilities. We pounced however on the large cathode decoupler 2C45 (320μF) and on test this turned out to have become a low resistance. So with 2C45 virtually short-circuit inadequate cathode bias was being generated explaining the poor picture, while the increased negative feedback was upsetting the field sync pulses.

Comments Please

Since the introduction of colour sets whose chassis are at either half or full mains potential irrespective of the mains plug connection I've been worried about the safety precautions we should observe. Particularly as the information given by the factory inspectors seems misleading and open to various interpretations. I've discussed this with many people, all of whom have come up with different answers. So before one of us electrocutes ourself, perhaps someone could solve the problem once and for all.

To isolate a live chassis, a mains isolating transformer is required. Fair enough. But should test equipment which has an earth lead connected to the mains plug be connected to the same isolation transformer, to a separate one, or should the earth lead be disconnected and the equipment run from the raw mains, or should the earth lead be left and the equipment connected to the raw mains with only the set having an isolated supply. . . ? Please help!!

Please note . . .

MITSUBISHI MODEL CT200B

In *Faults Encountered* in our February issue (page 185) it was mentioned that when the fusible resistor R904, connected across the series regulator transistors, goes open-circuit the spring clip touches the chassis, blowing the fuse. A way of avoiding this was suggested. Mitsubishi point out however that the spring clip is deliberately intended to contact the chassis on opening as a safety measure, drawing attention to the fault by blowing the fuse. The arrangement should not be altered therefore. The usual cause of the resistor going open-circuit is a short-circuit line output transistor. Alternatively a fault may have turned off the series regulator transistors.

MONOCHROME PORTABLE

There is some ambiguity concerning the 6MHz ceramic filter used at the input to the TBA120S intercarrier sound i.c. The circuit diagram and components list specify type SFE6·0MA. This is a three-terminal, in-line device and is the preferred type to use. The holes on the printed board however are arranged to suit the SFC6·0MA filter. This has four terminals, though only three are actually used. For anyone using the SFC type filter the short terminal must not be soldered to the board despite the hole for it. We do not recommend using the SFC filter however since it can be responsible for vision buzz on sound. The SFE6·0MA can easily be coaxed into position with some gentle leg pulling.

ON-SCREEN CLOCK

As mentioned last month, there were some changes between the circuit and the printed board in order to simplify board layout. The changes (referring to the circuit) are as follows:

IC4c and IC4f are interchanged. The input pin of IC4c is 7, its output pin 6; the input pin of IC4f is 11, its output pin 12.

IC5a and IC5d are interchanged. The input pins of IC5a are 13 and 12 and the output pin 11; the input pins of IC5d are 8 and 9 and the output pin 10.

Three of the switches in IC7 have been interchanged. The gate time input is to pin 5, RV2 feeds pin 4 and the output to K is at pin 3. The gate background input is to pin 12, RV3 feeds pin 11 and the output to L is at pin 10. RV5 feeds pin 1, the output to N is at pin 2 and the gate hue inputs are to pins 13 and 6 (the latter is unchanged). The adjustments and external connections are not affected.

LETTERS

TV COWBOYS

If you pick up a copy of a local evening newspaper and glance at the list of classified adverts under the heading Radio and Television Repairs you will often find a surprisingly long list of services on offer. Very few of the adverts give the address of a bona fide company, most just including a telephone number for you to ring after 6 p.m. The rates charged for servicing and for installing aerial systems are well below the prices of the established servicing organisations, and rarely include VAT.

Who are these people who can run a repair service so efficiently that they are at your door in a matter of minutes, but manage to keep the cost of the repair to a surprisingly low figure? The majority are already in the servicing trade, working for the large rental companies or the larger retail outlets. If there is a set manufacturer in the area it is more than likely that some of your local cowboys are shop floor fault finders.

The way in which the cost of the repairs is kept low is simple. Most have a company car, many of which are unmarked, containing nearly all the field test equipment needed together with a pretty fair selection of spares and replacement panels. If the company car is marked, then it's an easy matter to transfer the test equipment to a private car or van before making the service call. Petrol, depreciation and wear and tear on the car may all be paid for by the company – together with many of the components used for the repair! Another advantage that the cowboy has is that he does not pay income tax and is not plagued by the time consuming problems of VAT. He's paid cash for the job, and that goes straight into his pocket with little or no overheads.

There are of course many people who advertise in this manner and are self-employed, running a valid registered business. But they seem to be very few and far between because of the increasing numbers of part time competitors. The legitimate self-employed person advertising in this way has much the same overheads and paper work as a large servicing company, though on a smaller scale. With the competition they're faced with at the moment, they have the choice of keeping their prices in line with the larger TV companies and accepting a smaller proportion of the market, or lowering their prices to fall into line with the part time competitors, accepting a situation where the profit margin is barely enough to stay in business.

Not only is this situation against the interest of the legitimate radio and TV servicing trade: it also puts the prospective customer in a difficult situation. They have the choice of paying one of the many retail outlets, or their local servicing shop, a relatively high price for the repair of their TV or, using the TV advertisement column in the local paper, picking a telephone number and receiving a call from an unknown person who does not advertise his company's name or address, taking a chance that the repair will be successful. In the majority of cases the customer is satisfied, but should things go wrong it's very difficult to get them put right. Unless the customer takes full details of the person who made the service call, it's likely that should a failure occur there'll be no record of who made the call, what was replaced, or the cost of the repair. Unless a receipt is issued it can be difficult to prove that any repair has been made at all. The customer may then have no choice but to call in a reputable TV servicing company.

There are many cases where a company making a service call to a receiver that has been 'repaired' by a cowboy finds that replacement parts for which the customer paid are not in the receiver while the original parts were never faulty in the first place; or that damage inflicted on the receiver during replacement of the faulty component is worse than the original fault.

The courts do deal with situations like this, members of the servicing trade having to go to court (in the company's time) to testify that the claimed repairs were not in fact made. In one recent court case here a TV cowboy was found guilty of a similar offence and was reported in a local evening paper which advertised, and continues to advertise, the services of the guilty defendant!

This whole situation is against the interest of the public, the servicing trade and the self-employed serviceman. The remedy is simple. Local evening papers that advertise the services of people offering Radio and TV Repairs – or any other form of repair service whether it be plumbing, household wiring or car maintenance etc. – should include in the advert a business name which is registered at Companies House, and the address and telephone number of that business. This simple step would make life for the servicing trade and the self-employed much easier, because they would then be competing on equal terms. The customer on the other hand would be assured that he's dealing with a bona fide company. In addition, retail and rental companies that allow their staff to use a company car should insist that spares and test gear are removed from the car before the employee takes it home.

Those who genuinely want to supplement their daytime income cannot object to the small financial outlay that would assure them a fair, competitive and therefore profitable market. – **R. A. Fisher,** *Plymouth, Devon.*

FLYWHEEL LINE SYNC

With reference to Part 5 of the TV Servicing series, see pages 190-2 of the February issue, I would like to point out an error in the description of the action of the flywheel line sync discriminator circuit.

It was stated correctly that when the two diodes conduct – on arrival of the negative-going sync pulse – the sawtooth reference waveform is clamped to the potential set by the line hold control, and that when the reference sawtooth and the sync pulse are in phase the d.c. output from the discriminator is due solely to the potential tapped from the line hold control. This condition is shown in Fig. 1(a).

In the out-of-phase conditions however, i.e. the oscillator running fast or slow, the important point is not that the sync pulses move up or down the slope of the sawtooth but that the sawtooth moves up and down with respect to the d.c. reference level set by hold control as shown in Fig. 1(b) and (c). As (b) shows, a fast (early) reference signal moves positively with respect to the d.c. level to which the diodes

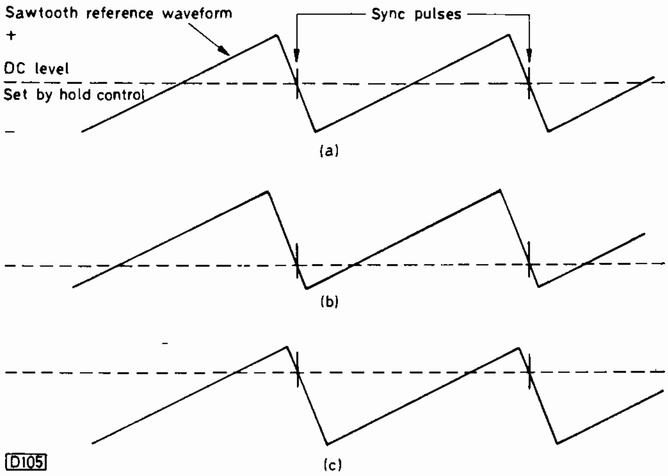


Fig. 1: Action of a flywheel line sync discriminator circuit. Note how the areas above and below the d.c. level vary when the reference sawtooth is early (b) or late (c), giving rise to a positive- or negative-going output respectively after integration by the filter circuit.

clamp it, while a slow (late) reference signal moves negatively as shown in (c). R54 and C50 integrate the clamped waveform, producing an average *positive-going* error voltage when the oscillator is fast and an average *negative-going* error voltage when the oscillator is slow – positive and negative with respect to the potential tapped from the line hold control.

You can easily verify this by slightly increasing or decreasing the value of the oscillator circuit timing capacitor C52, thus altering the blocking oscillator's frequency. – **R. Dickinson,** *Peterborough.*
We stand corrected – *Editor.*

MONOCHROME PORTABLE

I have successfully built one of the *Television* monochrome portables. Apart from the various corrections you've printed, constructors may be interested in the following two points. First, some residual buzz on sound was found to be due to coupling between the printed tracks on the board – the track carrying the field flyback blanking pulses runs parallel to the input to the audio i.c. IC103. Cutting the flyback track at both ends and using screened cable instead eliminated the problem. Secondly, the a.g.c. circuit refused to operate. This was found to be due to D19, though it read all right on an ohmmeter. Oh, and don't forget to reverse the detector diode in the i.f. gain module! – **P. S. Kershaw,** *Herne Bay.*

SET RENOVATIONS

I read with interest Steven Knowles' article on set renovations in the March issue, and would like to add some points which should be helpful to those who decide to obtain their sets from trade outlets – I've obtained several monochrome and colour sets for renovation in this way.

The first thing to do is to make sure that you are able to carry out a full inspection of the set, both inside and out, and to make sure that a tube tester is available if you do not have one yourself. I've found incidentally that the best colour sets and the ones most readily available are the Pye 691 – 697 series of hybrid chassis, while possibly the best monochrome chassis is the Philips 210. The following hints apply equally to colour and monochrome sets.

When selecting a set or sets, make sure that the cabinet and trim are in good condition. Next look at the tube, and make sure that it is not scratched or any phosphors are missing. If everything is in order so far, look at the back of the set. Check that all the screws are in place and of the same type – missing or odd ones indicate that a lot of servicing has been carried out, so the set could be a rogue one. These simple checks can save you the trouble of taking the back off – people sometimes hurriedly unscrew the back only to find that the cabinet is split.

Next remove the back and observe. A set well covered with dust means that it's not been serviced recently, a good sign indeed. Check that all the components are there i.e. the valves, tripler, etc.

Then check the condition of the printed panel or panels. Make sure that there are no holes, and that the tracks have not been bridged with copper wire. On the Pye hybrid colour chassis the two boards where these problems are often found are the convergence panel and the colour-difference amplifier panel.

Finally, the tube. Most testers have a colour coded indicator scale. Usually red indicates poor emission, white low emission and green good emission. When testing monochrome tubes, connect the tester base to the tube and switch on. When the heater lights up, the pointer on the scale should rise *without hesitation* into the green sector on the scale. If it goes about a quarter of the way or more into the green sector the tube is in good condition. When testing a colour tube the same rule applies, but make sure that the emission of each of the three guns is approximately the same, i.e. the indicator pointer settles in the same place. This is very important, since if one of the guns is low there will be grey scale errors when the brightness control is advanced – due to the three guns not tracking evenly to produce white.

I hope these few comments will help others interested in obtaining sets for reconditioning, and indeed help avoid some of the pitfalls one can so easily fall into. – **P. G. Dixon,** *Crawley, Sussex.*

IN SITU TRANSISTOR TESTER

The first collector/emitter probe I made to go with the in situ transistor tester featured in your October 1976 issue was made from an empty alloy solder tube, with a couple of long sewing needles cemented in the plastic lid. These were positioned fairly close together, but I found difficulty because the emitter and collector leads of some transistors in sets are spaced fairly widely apart – when I tried to spread the needles in order to make contact they snapped off.

The solution I found was to make up a probe using a couple of segments of the type of plastic jointing strips available from stores such as Woolworths. As shown in Fig. 2, the ends of the wires from the tester are screwed into one end of the junctions, while into the other are screwed 3in. lengths of taut, plastic-covered curtain wire. Into the business end of these wires are screwed small, self-tapping screws which are then ground down to give fine points. The result is ideal: by squeezing the back of the probe the points open out, while squeezing the front brings the points closer together. This gives quite a wide range of adjustment. –
J. Bloor, *Micklover, Derby.*

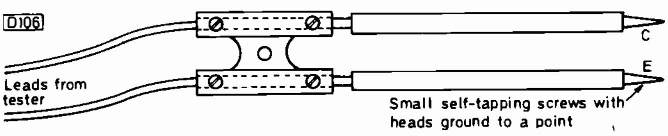


Fig. 2: Suggested probe for use with the in situ transistor tester featured in our October 1976 issue.

Test Report:

Manor Supplies' Colour Test Generator

E. Trundle

SEVERAL kits from Manor Supplies have been reviewed in these pages in the past, and the firm is becoming well known as a supplier of effective test gear at rock-bottom prices. The bar generator is probably the most ambitious yet, and at £35 for the basic kit it's got to be the cheapest bar generator ever. If we're going to be honest, it was with some misgiving that we agreed to review this instrument – no doubt it will produce colour of sorts we thought, but full-spec colour bars to the PAL system with a correctly timed burst signal and all parameters adequate for decoder servicing at £35? Well .....

Constructing the Kit

The review model came assembled and tested, but we consulted a colleague who had purchased and built the kit. He reported that assembly and setting-up had taken about five hours, with few problems, and that the instrument worked first time. Some confusion arose over the locating spigot on the inter-panel connecting plug. This was too large for the hole in the panel and had to be cut off. Later models do not have the spigot however. A certain capacitor had to be remounted to clear a switch which is fitted later in the construction sequence, and one or two of the components supplied were not exactly suited to the board, requiring a little manipulation to get them to fit. One of the switches did not work, but was quickly replaced by the suppliers. Apart from these minor points all went well, although locknuts were found and fitted to the printed board support bolts to ease the process of removing and refitting the panels should it be necessary.

Setting-up was carried out without problems, all the adjustments coming in near mid-travel. It's essential that the oscilloscope used for setting-up has an adequate bandwidth (6MHz or more) and that its probe compensation is correctly adjusted. The kit-built generator is still working well after many months, and with low-level circuitry such as this a long, trouble-free life can be expected.

The Works

The instrument consists of two printed panels, the smaller one for a u.h.f. modulator and the sync pulse generator. Simple line and field sync pulse trains are generated by a couple of 555 timers, with preset controls for setting the line and field frequencies to give a random-interlaced raster. The ubiquitous 7400 logic package processes the blanking pulses for application to the bar generator proper. The u.h.f. output comes from a single-transistor fixed frequency modulator whose frequency is arranged to fall in the Band IV/V border.

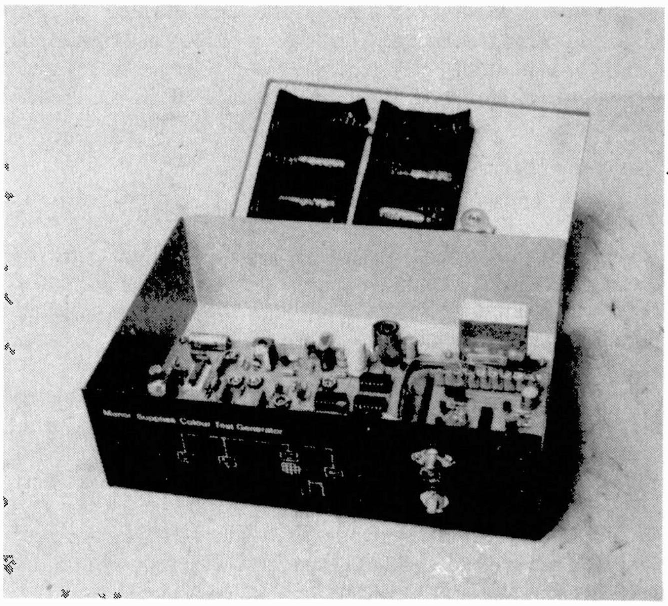
The colour generator panel contains four digital i.c.s, powered from a stabilised 5V rail, to generate the luminance signals – including the crosshatch pattern. A precision resistor matrix generates R–Y, B–Y and luminance outputs for the colour bars, the colour-difference waveforms passing into the TBA990Q chrominance i.c. This i.c. is a standard decoder-type synchronous demodulator, used here as a modulator. The chip takes two outputs (90° apart) from a 4·43MHz crystal oscillator and modulates them with the colour-difference signals. The resulting chroma signal is filtered and added to the luminance and sync signals before application to the modulator. Provision is made for switching off the B–Y and R–Y signals to enable delay-line matrix adjustments to be made.

The grey-scale and colour-bar output is of ascending luminance, i.e. black on the left to white on the right, so that the colour-bar signal is in effect back-to-front compared with the broadcast colour-bars. This approach enables low-cost up-counters to be used in the generator, and partly accounts for its very low cost.

Performance

The u.h.f. output was found to be about 7mV and drift-free, producing clean signals with no sign of modulator overload on the white and yellow bars. In this respect it's superior to some expensive commercial generators.

The instructions with the kit make the point that lock-out can occur with certain a.f.c. systems, so that the a.f.c. has to be disabled. We found that most sets did not require this,



The Manor Supplies' colour test generator.

Specification

Patterns:	White raster, black level, crosshatch.
8-bar grey-scale:	Colour bar (ascending luminance). R—Y and B—Y axes switchable.
Output:	Video or u.h.f. channel 30-60.
Power requirement:	12V at 170mA.
Sync:	Random interlace, single broad field sync pulse.
Colour Signal:	Amplitude 100%, saturation 100%. Vector tolerance $\pm 3°$, amplitude $\pm 5\%$.
Optional Extras:	Aluminium case, de-luxe case, battery holders, mains power pack kit, v.h.f. modulator.

although one or two models, notably a Thorn 9000, would not display the patterns at all until its a.f.c. system was docked.

The cross-hatch signal is close-knit and reminiscent of the old Rank TPG88 signal. The peak-white raster output was clean and vice-free, enabling purity and beam current checks to be made with ease.

On colour bars the bar width tended to drift into the line blanking period with time and temperature, apparently due to slight drift of the stabilised 5V line. This happened on both the instruments tested, but was not detrimental to receiver checks and adjustments. The colour bars are of the basic textbook type, 100% amplitude, 100% saturation, making colour-difference amplitude adjustments in discrete decoders simple. The accuracy of the amplitudes and phases of the colour bars depend on the care taken in setting up the generator, and should be within the quoted tolerances when correctly adjusted. Unfortunately we were unable to get access to a vectorscope during the period that we had the instruments for review, so we were unable to check phase accuracy, but we found no reason to suspect that it was not spot on. Amplitude checks proved both instruments tested to be within the 5% tolerance quoted.

Proof of the pud is in the eating said we, so we realigned a Pye hybrid decoder with the generator. Subsequent checking of the alignment with the trusty Philips PM5509 showed that nothing was very far out, and the Pye's performance was no different after the very slight retweaking necessary to satisfy the PM5509. Finally we tried the colour bars on a Sony non-PAL receiver. This raised no objections at all, producing correct colours with the hue control near mid-travel.

Practicalities

One or two points arose from practical sessions with the generator. Battery consumption is about 160mA, which gives a life of about ten hours with eight U2 cells when used intermittently. SP2 and HP2 cells will give rather longer life, but in view of the exorbitant price of dry cells, and the fact that where there's a colour TV there's usually a mains supply, we feel that a mains power pack kit will very soon pay for itself. On battery operation the colour performance becomes erratic when the voltage drops to about 9·5V on load.

When investigating a faulty decoder in which some waveforms are incorrect, this engineer (perhaps like some readers) is often filled with alarm and confusion. Because of the ascending luminance characteristics the Manor Supplies generator produces decoder and RGB waveforms which do not correspond with those illustrated in manuals. This means that a little more thought is necessary when analysing waveforms, and we would have liked to see a set of oscillograms illustrating the more common waveforms such as U, V, R–Y, B–Y, R, G and B when a correctly adjusted decoder is working from the generator. These can easily be made by the user however.

The front panel controls are rather vulnerable to damage in the average field service vehicle. They could with advantage be protected, perhaps by providing a flange around the front or making a protective faceplate. This would also prevent the toggle-switch being accidentally flipped on, running down the batteries.

A couple of hints and suggestions. We found that we could set up the three generator frequencies (line, field and subcarrier) with greater accuracy than the setting-up instructions allowed by direct comparison with a broadcast signal, using either a dual-beam scope or a receiver in which the frequency in question has been set up with the appropriate sync feed deleted on both broadcast and generator signals.

If the instrument was ours, we would bring the burst amplitude control out as a front panel potentiometer, with a click position for correct amplitude, thus providing an easy check on the a.c.c. and a.p.c. functions of the receiver under test.

Conclusion

Nobody would expect this bar generator to compare with £250 commercial instruments, but it comes a lot nearer than we expected! We can recommend it wholeheartedly as some of the best value for money we've seen.

Servicing Saba Colour Receivers

Chassis H Telecommander System

Part 3 **P. C. Murchison**

THE S6735 and associated models can be operated with a hand-held remote control box which is powered by a 1·5V battery. This control box houses an ultrasonic oscillator and is capable of transmitting nine different frequencies for selecting the various control operations, enabling the receiver to be turned on or off, the channel to be changed, or the volume, brilliance or colour to be turned up or down. The signals are transmitted by a transducer mounted at the front of the control box. They are picked up by a similar transducer mounted at the front of the set, and are then fed to the various tuned circuits for activating the appropriate circuits within the receiver. Before moving on to these circuits however we will make a brief examination of the ultrasonic transmitter itself.

Ultrasonic Transmitter

Fig. 6 shows the internal circuit of the transmitter, which consists of a single transistor oscillator (T1, L1, C2, C3) working at a basic frequency of 44·75kHz, a bank of push buttons which select lower frequencies by switching additional capacitors in parallel with C3, and the transducer UW1. The choice of frequencies used is rather important, because interaction between the harmonics of the line timebase and those of the ultrasonic link could cause spurious operation of the remote control circuit. The frequencies used are chosen so that they lie between the first and second harmonics of the line oscillator (31·25kHz to 46·875kHz), the useful range being from 34 – 45kHz, allowing for the spread of line frequency when the oscillator is free running. The lowest frequency used is 34·25kHz, the highest 44·75kHz, with one exception of 28·25kHz used for channel selection.

When one of the push buttons is depressed to select an operation such as "increase brilllance", the additional parallel capacitor is switched in first to ensure start up at the correct frequency, followed by the connection of the positive terminal of the battery supplying the oscillator with voltage. The switch is of the sliding variety, and its contacts are staggered in order to achieve this "delay" effect.

In theory the oscillator will continue to oscillate even when the battery voltage has fallen to 0·8V, but in practice it has been found that even a slight fall off in battery performance will cause some variation in frequency. The result is interaction between controls. The purpose of the diode D3 in the base-emitter circuit of T1 is to keep the emitter-base voltage constant so as to stabilise the frequency when any button is pressed for a lengthy period of time. This will not compensate for a very low battery however, although it should theoretically improve the situation under low battery conditions.

The transducer UW1 is of the capacitance variety. This type of transducer has to be biased to avoid frequency doubling when the sinewave signal is applied. The bias voltage, of around 170V, is obtained from the voltage-doubling circuit D1, D2, C4, C5.

Fault Conditions

The first suspect should any fault occur is the battery. The transmitter seems to draw a fair amount of current from the battery: this, coupled with the fact that users often don't bother to fit a new one, often leads to a service call merely to replace a battery. The symptoms are mixed operations and lack of remote colour control, with the oscillator sometimes tending to stop working at the higher frequencies.

Sometimes however the oscillator fails completely, the result being no control operations working. The usual cause is failure of the transistor T1. To check the oscillator, connect an oscilloscope across the transducer UW1 and then press one of the selector buttons. A 180V peak-to-peak sinewave should be seen on the oscilloscope screen. Failure of the oscillator has also been caused by C3 breaking down, though this sometimes doesn't cause complete failure but a shift in frequency due to a change in capacitance value. The result will again be muddled operation of the selector buttons, coupled with general insensitivity of the remote control.

A common culprit in cases of insensitivity is the transducer (UW1). This can become so insensitive that the remote control has to be held about six inches from the front of the set before any results can be obtained. At the same time frequency shifts, and the operations once again tend to interact with each other. Replacing the transducer is the only way to prove whether it's faulty or not.

Insensitivity faults can be caused by a failure in the receiver, so it's as well to have a known good transmitter to hand to avoid being misled into looking for a non-existent transmitter fault! More will be said later about the receiver side.

When an ultrasonic transmitter comes in for repair it's as well to quiz the customer very carefully about the exact cause of its failure. We've had units with tea or soup spilt over them, and units that have been hurled to the ground cracking the printed circuit in a multitude of places. Soup in the transducer spells disaster, but the customer always seems amazed that the unit is ruined, expecting it to withstand all manner of domestic disasters.

Transmitter Alignment

Inevitably the temptation for field service engineers is too great: they can't resist having a twiddle of the oscillator coil L1 or the trimmer capacitor C2 when confronted with a transmitter malfunction. So the transmitter finds it way into the workshop for realignment. The only way to do this properly is to use a frequency counter. Connect the frequency counter between terminal A of the transmitter transducer and the positive pole of the 1·5V battery. Depress the volume negative push button and adjust the core of the oscillator coil L1 to give the correct frequency of 34·25kHz on the frequency counter. Having set the lower frequency, the next thing to do is to bring in the highest frequency with the trimmer C2. Depress the colour positive button, and trim C2 for a frequency of 44·75kHz on the counter display. Having carried out this procedure the transmitter should be on frequency and all operations should function correctly.

Ultrasonic Receiver

Having had a look at the ultrasonic transmitter and its faults and setting up procedures, the time has come for us to move on to the more complex and interesting circuitry of the ultrasonic receiver and to find out how the individually transmitted frequencies control the brilliance, colour, volume, on/off and channel change circuits.

When an ultrasonic signal reaches the television receiver it's picked up by the electrostatic microphone UW951 (see Fig. 7) and is then fed into an operational amplifier i.c. (IS951) via the coupling capacitor C952. The microphone is biased by a 130V d.c. supply which is obtained from the 200V a.c. line. The rectifier is D953 and the smoothing filter C964, R962 and C951. The incoming signal is of extremely low amplitude, and to be of any use needs to be amplified about a million times. The operational amplifier consists of a three-stage amplifier with a gain of about 120dB. For its operation the i.c. requires a 13V stabilised power supply. This is obtained from the 14V a.c. supply which is rectified by D952 and smoothed by the large electrolytic capacitor C962 and then stabilised by means of the 13V zener diode D951. This 13V line can be switched on or off by means of switch S1, the remote control on/off switch provided on the front control panel of the set.

Because of its extremely high gain, the i.c. provides some limiting action. Thus the output signal applied to the primary of transformer U951 is approximately rectangular in shape. Connected across the secondary of this transformer – in parallel with it – are nine tuned circuits, one for each frequency and corresponding to an individual control function. Each tuned circuit is a very high *Q* series resonant arrangement, the general set up being shown in Fig. 8. Before taking a closer look at this however we'll mention one or two faults associated with the operational amplifier stage.

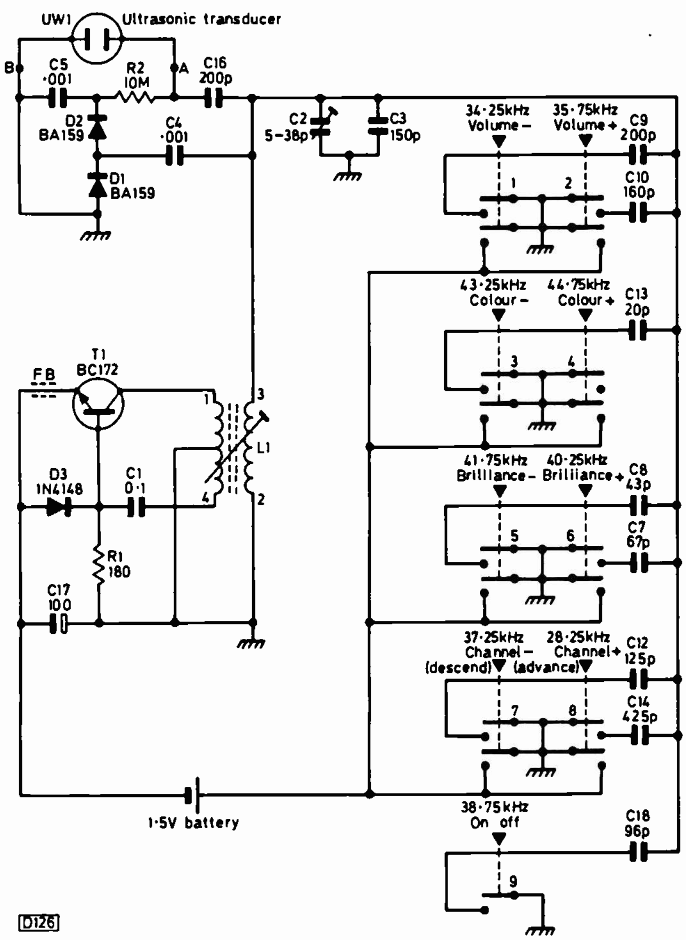


Fig. 6: Circuit of the ultrasonic transmitter unit.

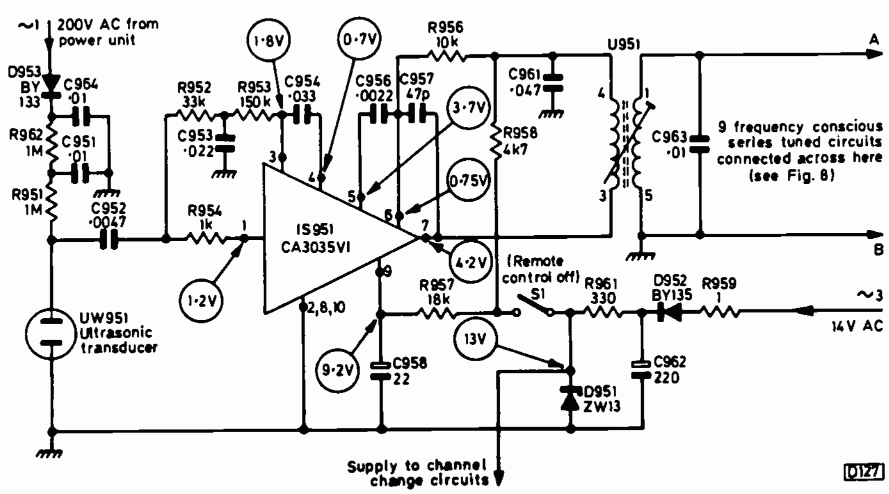
Fig. 7 (right): The ultrasonic signal receiver circuit in the TV set.

Front-end Faults

As with the transmitter, one of the most common troubles in lack of sensitivity. The ultrasonic transmitter may only just manage to work the set when held with its transducer against the receiver transducer.

The first thing to do in this instance is to check whether the 130V bias is present across the transducer UW951, because the two 1MΩ feed resistors R962 and R951 can go open-circuit to remove the bias. Similarly D953 can fail as can R636, the a.c. feed resistor in the power supply section dealt with in Part 1. If all is well here, check the transducer itself by substitution. The i.c. has proved to be reliable, and should be suspected only as a last resort after checking the transducer, the coupling capacitor C952 and the supplies to the i.c. and the transducer.

To check the operation of the i.c., hold the transmitting transducer against the receiving transducer and connect an oscilloscope between pin 6 of the i.c. and earth. If all is well, an output square wave of 1V peak-to-peak should appear at pin 6 when one of the remote control buttons is depressed. When the oscilloscope is connected across the transducer itself, a very noisy 0.2V peak-to-peak sinewave should be present. This provides a further check as to whether the transmitter is working correctly.



CORRECTION

We regret that C676 in the line output stage was shown incorrectly as 3·3μF in both the circuit (Fig. 4) and the text last month. Its correct value is 0·0033μF.

Remote Brilliance, Colour and Volume Control

So much for the front end. We'll now consider the tuned circuits mentioned earlier and see how the various controls are operated.

The brilliance, volume and colour controls all operate on the same principle, which rather surprisingly involves the use of motorised potentiometers. Each control can be manually operated from the front control panel of the receiver, or alternatively can be rotated electrically by means of two a.c. motors mounted upon the same shaft and coupled to the control through a reduction gear train. One a.c. motor is used for forward rotation of the control, the second motor being used for reverse control. If we take the colour control for example, pressing the "colour increase" transmitter button will cause the control to rotate in a clockwise direction, whilst the "colour decrease" button will cause the motor to rotate in the opposite direction.

Staying with the colour increase operation, when the frequency of 44.75 kHz is received the sinusoidal waveform is selected by the series tuned circuit C976 and L966, taken

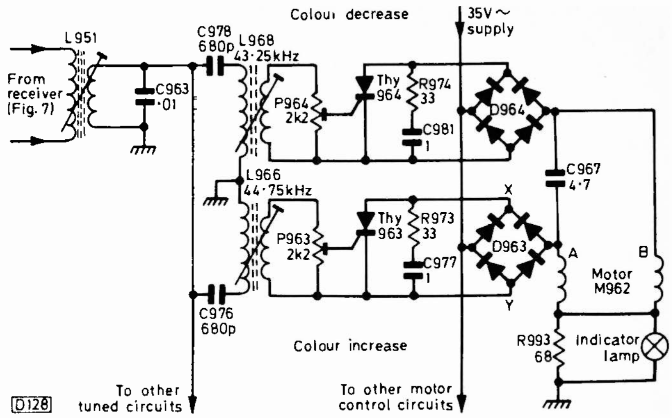


Fig. 8: The motor control system for colour change.

off by the secondary winding and fed via the sensitivity control P963 to the gate of thyristor Thy963. The thyristor conducts and connects the top and bottom junctions (X and Y) of the full-wave rectifier D963 together, therby opening a path so that the 35V a.c. supply can be applied to motor

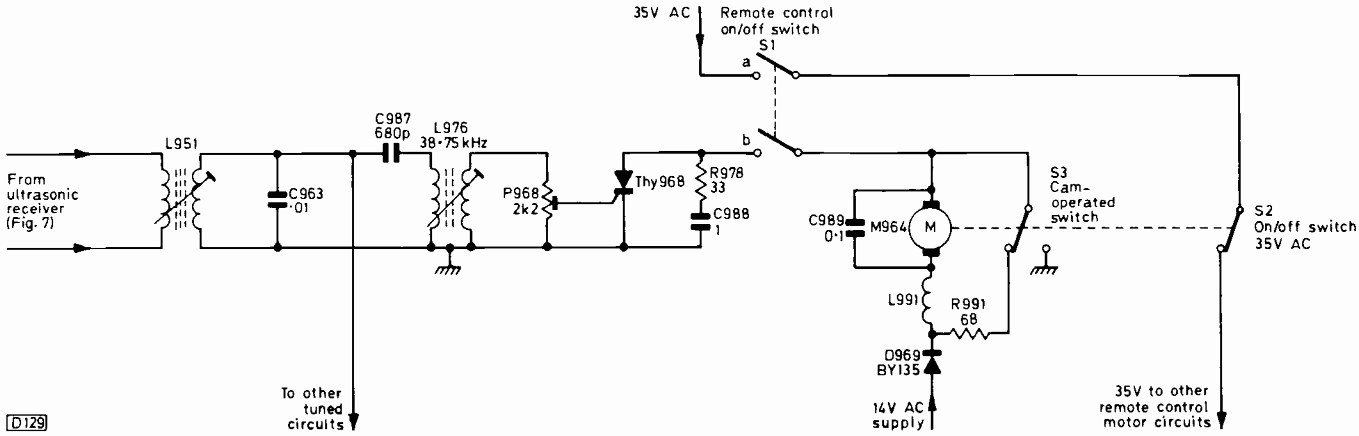


Fig. 9: The on/off control circuit.

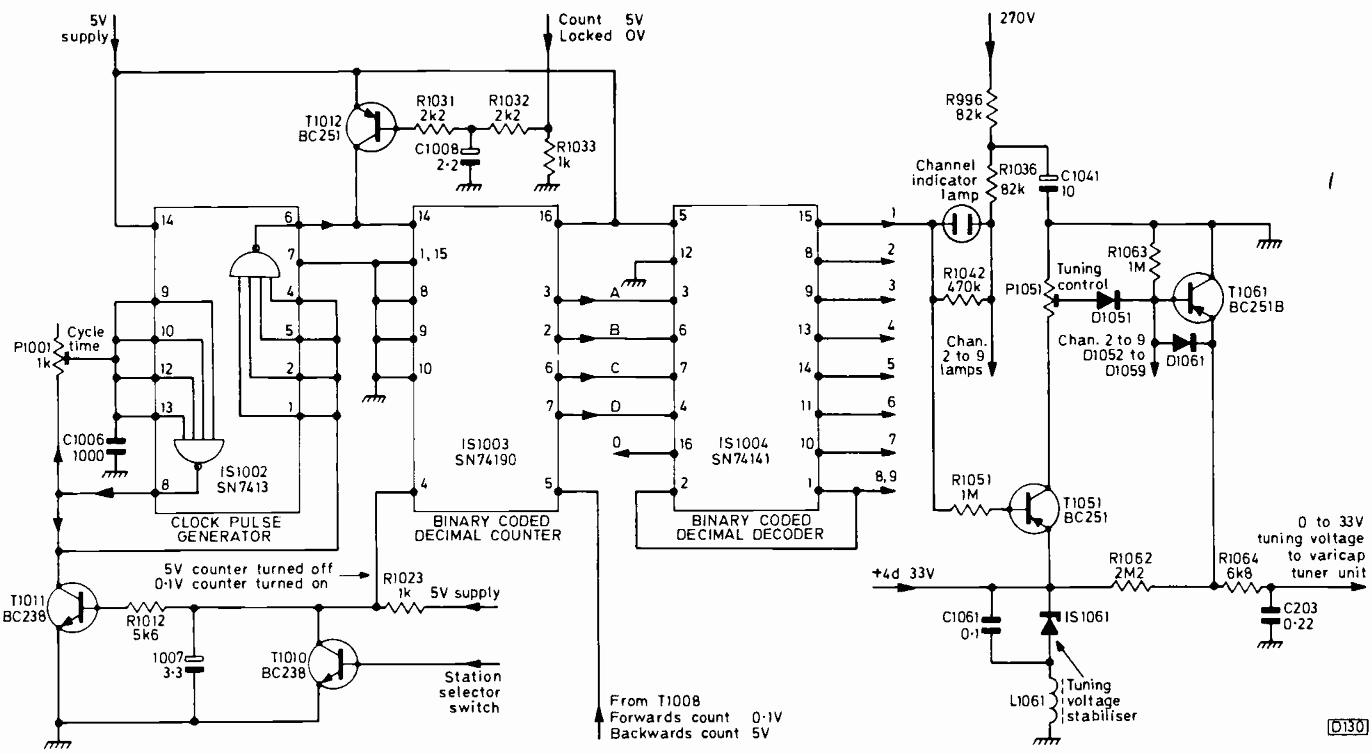


Fig. 10: The electronic channel selection circuitry. Pin 11 of IS1003 is fed from the 5V line via a 4·7kΩ resistor decoupled by a 4·7µF electrolytic capacitor (R1034, C1013, not shown).

M962. The motor is then energised and rotates the colour control in a clockwise direction. At the same time a voltage is developed across the 68Ω resistor R993 and the indicator lamp at the front of the set is illuminated to tell the user that the signal is being received and all is working correctly. Any spurious noise pulses picked up by the tuned circuit are suppressed by C977 and R973, thereby preventing the motor being pulsed.

The circuitry associated with the volume and brightness controls is the same as that for the colour control: for this reason Fig. 8 shows only the colour control increase and decrease functions.

On/off Control

In Part 1 we saw how the on/off switch is motorised so that should an overload occur the protection circuit energises the motor which then automatically shuts off the mains supply. When the receiver is being controlled remotely, this same motor is used to switch the receiver on or off, being in this instance energised from a different source. The circuitry is shown in Fig. 9.

To switch the receiver on the on/off button on the ultrasonic transmitter is pressed briefly so that a short burst of oscillation is received at the set. This is amplified and selected by the tuned circuit C987, L976, which is tuned to 38.75kHz. This causes thyristor Thy968 to fire, in the same way as previously, and one side of motor M964 is then connected to chassis via the thyristor. The motor is thus energised and starts to operate the on/off switch.

Connected to the shaft of the motor is a cam-operated switch. After the cam has rotated slightly the switch contacts make, thus connecting the motor directly to earth. The motor current now takes this path instead of flowing via the thyristor. When the mains switch reaches the on position, the cam switch breaks and the motor stops – providing the thyristor is not being fired. R991 is connected in parallel with the motor by a second contact on the cam-operated switch, the low-resistance load giving a braking effect so that the motor stops instantly. The cam-operated switch is now back in its original position. Further operation of the remote control will cause the motor to restart, and after further rotation the mains switch will be pulled back into the off position.

The 14V, 35V and 200V a.c. supply rails are all derived from the unswitched mains transformer and are consequently present for the whole time that the set is plugged in. This is necessary to allow the circuitry for switching the set on remotely to be continuously powered so that the set is always ready for action.

Channel Changing

The most complicated section of the receiver is the part concerned with channel changing. There are nine channel positions which can be selected in sequence upwards or downwards either via the remote control unit or from the front panel of the receiver where there are two buttons, one for upward selection and one for downward selection. The channels are numbered 1 to 9 and there is a series of nine cut-out numbers, each illuminated by a small neon lamp, which indicate which channel the set is switched to. Each time the upward button is depressed the channel advances by one position. On reaching number 9 it returns to number 1 again. The downward button allows channel selection in the reverse direction from 9 back to 1, the downward button moving the channel down one position each time it's pressed. In each channel position a tuning potentiometer is connected to the 33V tuning voltage supply, and a portion of this is fed to the varicap tuner unit in the normal way.

Before looking at station selection by means of the remote control we shall have to examine the electronics of the system. This involves some use of digital circuitry.

Fig. 10 shows in somewhat simplified and hopefully easier to understand form the circuit of the heart of the channel selection system. It's centred around the three integrated circuits IS1002, IS1003 and IS1004.

The first i.c. acts as a clock pulse generator and phase inverter/pulse shaper, the net result being a clock pulse output at pin 6. The mode of operation of this i.c. is a bit complicated, but briefly it revolves around two NAND Schmitt trigger circuits, the first one operating as the clock pulse generator. The output voltage at pin 8 is fed back via the cycle time control P1001 to the input of the gate. The output is also fed from pin 8 to the second trigger which shapes and inverts the pulse before it leaves the i.c. at pin 6.

The clock generator is normally stopped because pin 8 is shorted to earth by the bottomed transistor T1011. When the channel selector button is depressed however T1010 is turned on and the voltage at the base of T1011 falls to chassis potential. T1011 then switches off and the clock pulse generator starts to run. It continues to do so as long as the channel selector is depressed.

The clock pulses are fed into the second i.c. IS1003, the BCD counter. This consists of several bistable circuits but for simplicity is best regarded as a black box. The clock pulse input goes in at pin 14 of this i.c., which has four outputs at pins 3, 2, 6 and 7. These are coded A, B, C and D (see Fig. 10), the voltage levels at these pins depending on the number of clock pulses received at the input. The various states of the outputs are shown more clearly in the truth table below, where 0 is zero volts and 1 is 5V.

Clock pulses	Pin 7 (D)	Pin 6 (C)	Pin 2 (B)	Pin 3 (A)
0	0	0	0	0
1	0	0	0	1
2	0	0	1	0
3	0	0	1	1
4	0	1	0	0
5	0	1	0	1
6	0	1	1	0
7	0	1	1	1
8	1	0	0	0
9	1	0	0	1

The counter has to know whether the "ascend channel" or the "descend channel" button is being pressed, so an additional circuit (to be dealt with later) puts a high or low voltage level on pin 5 of the i.c., the high level telling the counter to count downwards whilst the low level tells it to count upwards.

The counter circuit is provided with two interlock circuits to ensure that operation is trouble free. The first interlock circuit consists of transistor T1012 whose collector is connected to the counter input. During the count period the transistor is cut off, with 5V applied to its base to bring its base to the same level as its emitter. This action clears the counter input. When counting ceases however the positive voltage is removed from the transistor's base and it conducts, short-circuiting the counter i.c.'s input. Included in this circuit is a delay network consisting of R1032 with C1008 to prevent any spurious pulses causing random channel changing.

The second interlock circuit is applied to pin 4 of the i.c. The counter will operate only when this pin is at a potential of 0·1V. This voltage drop at the start of the count

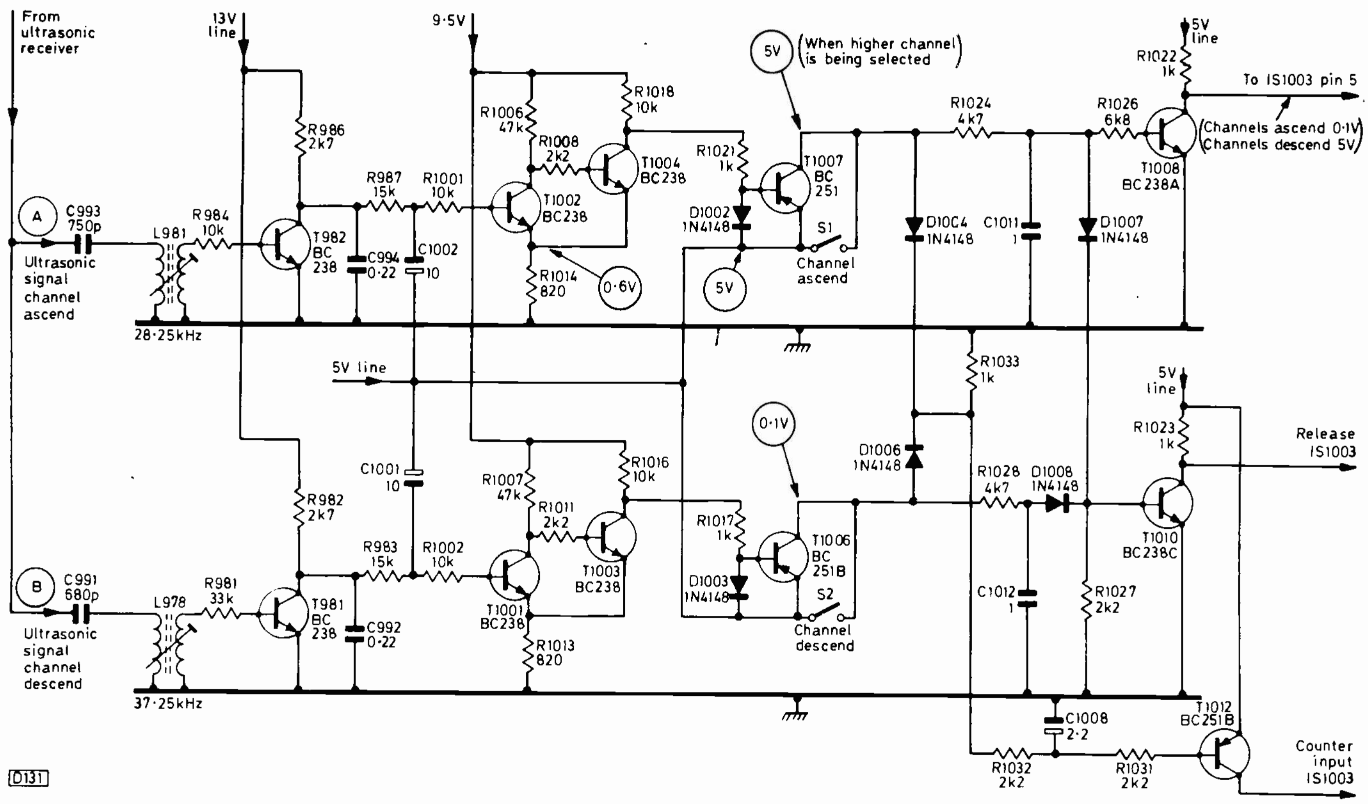


Fig. 11: The channel change circuit which drives the circuitry shown in Fig. 10.

is derived from transistor T1010 which as previously mentioned turns on hard when the station selector button is pressed.

The binary data from outputs ABCD of IS1003 is fed directly into IS1004 pins 3, 6, 7 and 4. This integrated circuit can be regarded as another "black box", whose function in life is to convert all incoming binary codes into the decimal system, giving ten outputs each of which is switched in turn to chassis potential (0 level) when the appropriate binary code is fed into its input.

Although there are ten outputs from the i.c. there are only nine channels to be selected. To dispense with the unwanted output, pins 1 and 2 are connected together. As a result, twice the time is required to change from channel 9 to 1. Output 0 is connected to the channel 1 circuitry so that the set will automatically switch to this channel when first switched on from cold. To make the binary to decimal decoding process a little easier to grasp, the truth table below sets out the states of the inputs and the resulting output channel selected.

		Input state		
Channel	D	C	B	A
1	0	0	0	0
2	0	0	0	1
3	0	0	1	0
4	0	0	1	1
5	0	1	0	0
6	0	1	0	1
7	0	1	1	0
8	0	1	1	1
9	1	0	0	0
9	1	0	0	1

As previously mentioned the switched output is at almost chassis potential, this being the condition when the output transistor within the i.c. is turned hard on. When the internal transistors are cut off however their collector-emitter voltages are limited to around 50V by internal zener diodes connected in parallel with them.

Channel Selector Circuit

Thus any one of the nine outputs of IS1004 is connected to chassis in ascending or descending order, so that the appropriate channel selection circuit is made to function. Consider the case of channel 1, which is selected when pin 15 of the i.c. goes to chassis potential. When this happens the transistors T1051 and T1061 switch states. Prior to this the voltage at pin 15 of the i.c. will be somewhere around 50V while the voltage at the other end of the neon indicator lamp will be around 60V. The neon will be extinguished therefore, and T1051 will be cut off since its base potential will be 17V higher than its emitter potential.

As soon as channel 1 is selected, pin 15 of the i.c. drops to zero volts, the neon lamp lights and at the same time T1051 is biased on since its base is now negative with respect to its emitter. The 33V tuning voltage, stabilised by IS1061, is thus applied to the tuning potentiometer P1051. T1061 conducts and connects the tuning voltage to the varicap tuner via D1051 and its base-emitter junction. There are eight similar circuits for channels 2 to 9. All function in the same way, each being connected to an output of IS1004.

Fault Conditions

Having looked at this rather complicated arrangement we'll take a short breather to consider fault conditions before going on to the final part of the channel selection circuit, involving the actual manual and ultrasonic switching of the counter and clock generator circuits.

The i.c.s and the station selector circuitry are housed on a small printed circuit panel which lives on the reverse side of the removable loudspeaker grill. As explained in Part 1, this grill can be removed to reveal the convergence panel, but with the ultrasonic models it also incorporates the channel ascend/descend buttons along with the nine neon indicator lamps plus the additional unpluggable circuit board. Two of the i.c.s, IS1003 and IS1004, are unpluggable whilst for some curious reason IS1002 is soldered into the board. Perhaps the manufacturers were being optimistic about the reliability of this component: sadly, experience has shown that soldered in i.c.s always seem to fail much more frequently than the plug in variety, and care has to be taken not to ruin the very thin print when unsoldering these i.c.s.

Included on the channel selector printed circuit board is the 5V stabiliser i.c., IS1001, a TBA625A which was mentioned when we dealt with the power supply. This i.c. powers the three logic i.c.s IS1002-4, and often causes misleading effects when it fails. Measuring the 5V line will often reveal six or seven volts present and this upsets the operation of the logic i.c.s, causing erratic channel selection and random channel selection when for one push of the button the channel will often ascend several positions in one go. A change of TBA625 will correct the 5V line and all then reverts to normal. Another cause of random channel selection is failure of either IS1003 or IS1004, where presumably the correct binary code is not present at the output of IS1003, whilst IS1004 fails to receive binary information on all four of its inputs. These i.c.s are plug in ones and can be easily checked by substitution.

C1006, at the clock pulse generator, has been known to fail, usually intermittently. The result is again random channel selection.

Sometimes it's impossible to get any change of channel, the indicator lamp for one of the positions remaining stubbornly lit regardless of pushing the channel change "up or down" buttons. The answer is first to try IS1004 as it's unpluggable. If the circuit still refuses to function, the next suspect is the clock pulse generator IS1002 which has to be unsoldered from the board. On replacing IS1002 all should revert to normal.

Tuning drift seems to occur quite often and there are a number of components, apart from the tuner unit itself, which can cause this. The obvious one is the stabiliser i.c. IS1061 (ZTK33A) which is a notorious component used in many German receivers. Since these Saba sets do not incorporate any form of a.f.c. stability is essential, the slightest drift off frequency lowering the picture quality. A slight shift in tuning voltage can be caused by T1061 or C203, or sometimes a variation in the switching level within IS1004. One way to deal with a problem like this is to substitute components one at a time until the culprit comes to light. Alternatively suspect components can be sprayed with freezer – after the receiver has warmed up. When the faulty component is hit the tuning should revert to normal.

It has been known for one channel to jump suddenly off frequency, resetting the preset tuning control bringing the set back on to tune. Any one of the diodes D1051 to D1059 can cause this, the one to change depending upon which channel the receiver is set to.

Finally a puzzling fault, the channels continually changing upwards for no apparent reason. This can be traced to a simple fuse failure (Si606) in the power supply. The fuse feeds the "AC3" 14V a.c. line to the Schmitt triggers in the channel switching circuits. These circuits are next on the agenda.

Channel Switching

Fig. 11 shows the complete circuit for channel selection, either when pressing the channel ascend/descend buttons or when receiving an ultrasonic signal. This circuitry precedes the counter i.c. IS1003 and the clock pulse generator i.c. IS1002, and as well as releasing the counter it provides the voltage level which decides whether the count is upwards or downwards.

To simplify matters we'll start by considering what happens when a higher channel is selected via the remote control unit.

The tuned circuit L981, C993 is connected to the output of the ultrasonic receiver in the same way as with the other controls, and selects the channel ascend frequency of 28·25kHz. As a result T982 turns hard on, its collector voltage dropping suddenly from 12V to practically zero volts. T982 is connected to the Schmitt trigger T1002/T1004, and consequently the first transistor in the trigger circuit, previously conducting, switches off, its collector voltage rising to 9.5V. This causes the second trigger transistor to reverse its state, switching on. The base of the pnp transistor T1007 then goes negative with respect to its emitter, so this transistor also starts to conduct. Its collector voltage is now 5V and this is passed via R1024 and R1026 to the base of T1008, turning this transistor on so that its collector falls to 0·1V. This transistor determines the logic level for counting in the forward or backward direction: if its output, which feeds IS1003, is low the count is forwards, whilst if its output remains high the count is in the reverse direction.

The 5V at T1007 collector is also fed via D1004, R1032 and R1031 to the base of transistor T1012. This transistor feeds the counter input (pin 14) and is normally conducting, shorting out the input to the counter i.c. IS1003. When 5V arrives at its base the transistor cuts off and removes the short-circuit. The clock pulses are then free to pass into the counter from the clock pulse generator i.c.

The 5V also passes via R1024 and D1007 to T1010's base. This transistor then switches on, its collector potential falling to around 0·1V. As a result the counter and clock pulse generators are both released as previously described.

The operation when selecting a lower channel via the remote control unit is the same as before. This time T1006's collector voltage rises to 5V, switching T1012 off and T1010 on to allow counting to commence. T1008 has to remain cut off, D1004 and D1007 preventing the 5V arriving at T1008's base. Hence T1008's collector remains at 5V and this information at pin 5 of IS1003 ensures that the counter is programmed to count downwards.

For manual channel selection the push buttons S1 or S2 connect the 5V directly to T1007 or T1006 collector. T1008, T1010 and T1012 are then switched in the same way as with the remote control operation to allow IS1003 to commence counting.

Reliability

Having gone through the rather involved channel selection circuits of the remote control version of these Saba sets it remains only to note that the circuitry shown in Fig. 11 is very reliable in operation, possibly because it involves the use of simple low-current transistor circuits. To date we've never had a failure in this part of the set, despite the fact that we look after a couple of hundred of these receivers and have had failures in almost every other circuit. Doubtless someone somewhere has had the pleasure of a fault here, and has spent many hours puzzling over a circuit diagram trying to sort it all out.

TO BE CONTINUED

Transistor Video Circuits

G. R. Wilding

THE video circuit starts with the demodulator and ends with a device capable of providing the voltage swing required to drive the cathode or grid of the c.r.t. In valved receivers there was usually a diode detector and an output pentode, with peaking circuits and selective negative feedback used to optimise the performance. Solid-state circuitry has led to a much greater diversity of techniques however.

Demodulation

Let's start by taking a look at the reasons for the general abandonment of the diode detector in favour of i.c. demodulators. The input/output characteristic of a diode is not completely linear. Consequently the output is not proportional to the input, particularly at low signal levels. The effect at u.h.f. is a tendency towards cramping of the picture highlights, since these represent the lowest modulation levels. On v.h.f. (405 lines) however it's the dark picture areas and the sync pulses that represent the lower modulation levels and get distorted.

Its non-linear characteristic also makes the vision detector diode susceptible to developing beat frequencies in the presence of stray r.f./i.f. signals, and for this reason it's always screened. The effect of such beat frequencies is background patterning.

In addition, compromises are necessary in the design of a diode detector circuit. First, there must be some capacitance across the diode's load resistor in order to filter out the i.f. carrier and increase the efficiency of the stage (if the capacitance is too small, there will be signal breakthrough via the diode's own capacitance during the half-cycles when it's reverse biased). Too great a capacitance will seriously affect the h.f. response of the stage however. Next, due to the diode's forward resistance the value of it's load resistor must be as high as possible for maximum detection efficiency. To maintain the h.f. response however the value of the load resistor cannot exceed a few kilohms.

These problems are all removed in video demodulator i.c.s since they employ synchronous demodulation. The

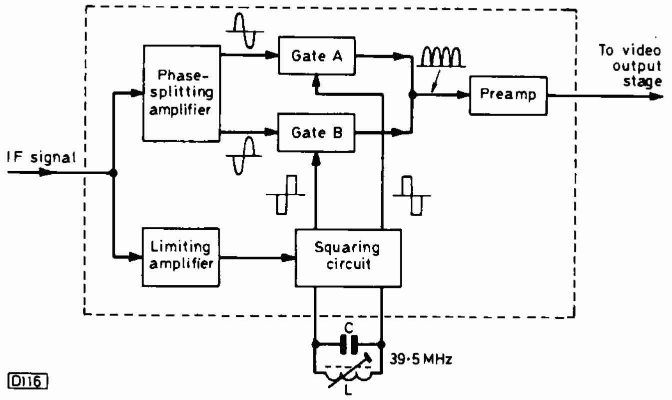


Fig. 1: How synchronous demodulation is carried out in a video demodulator i.c.

process is illustrated in Fig. 1. The i.f. signal is passed to a phase-splitter which feeds two gates. The signal is also limited and squared to produce switching squarewaves at the carrier frequency. These squarewaves open and close the gates alternately, producing a linearly demodulated signal which is passed to an integrated preamplifier. The external tank circuit *LC* is required to generate the carrier-frequency reference signal. The *Q* factor of the coil is important: the higher the value, the greater the freedom from unwanted beat components, but the more critical the tuning. *Q* values of around 30 to 50 are used in practice.

Driver Stage

Whether a diode or a synchronous demodulator is used, an emitter-follower is almost always incorporated between the detector and the output transistor to prevent the output transistor's comparatively high input capacitance swamping the detector stage. The nominal input capacitance of the transistor may not be large, but it will be greatly increased by the Miller effect. As a result of the high input and low output impedance of an emitter-follower, it imposes negligible loading on the detector while minimising the effect of the output transistor's capacitive loading.

CRT Drive

Most receivers use cathode c.r.t. drive because of its greater sensitivity. This is simply because reducing the cathode voltage to increase the beam current at the same time effectively increases the first anode voltage (with respect to the cathode that is). With cathode drive however both the tube and the output transistor are driven towards cut off by the video signal. This results in the darker picture tones becoming slightly cramped, evidenced by difficulty in separating the two darkest grey-scale sections on the test card. Dark picture tone cramping is less evident with grid drive, while as the input capacitance of the c.r.t. grid is smaller than that of the cathode there is less capacitive loading across the output transistor's collector circuit and in consequence improved h.f. response.

Contrasting Circuits

So much then for underlying factors. Let's take a look at one or two video circuits which illustrate contrasting approaches to the design problems.

Something rather unusual is shown in Fig. 2, a common-base transistor output circuit (see also the Skantic article in the current issue – *Editor).* This was used in the last ITT monochrome portable chassis, the VC400. A TDA1330 i.c. is used for demodulation, providing a video output signal with a peak-to-peak amplitude of about 4.5V – the no-signal voltage is about 7·5V, the output being negative-going. This signal is passed via the video level potentiometer

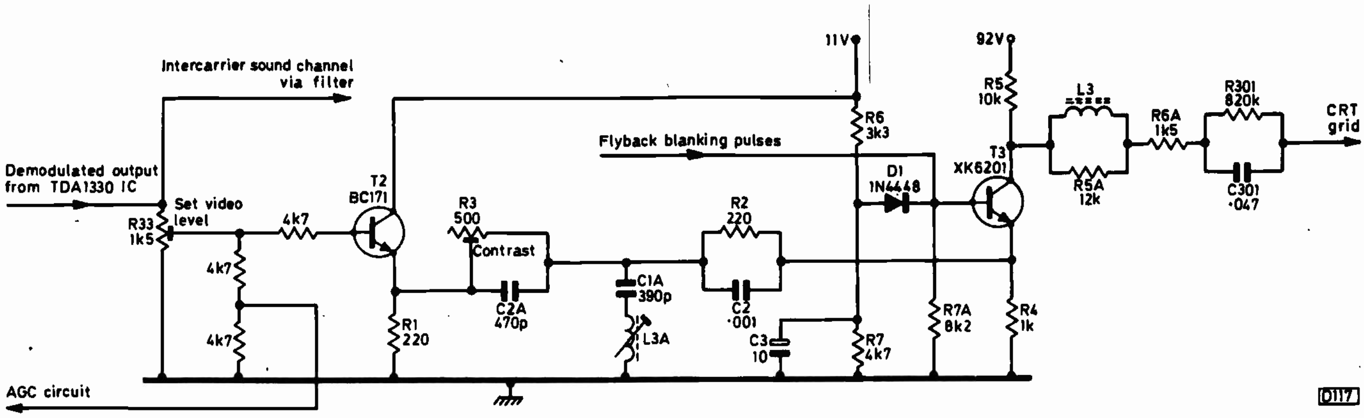


Fig. 2: Video channel, with common-base output stage, used in the ITT VC400 chassis.

R33 to the base of the emitter-follower transistor T2. R33 sets both the d.c. and the signal levels at the base of T2 and, with direct coupling through to the c.r.t. grid, the correct d.c. level at this point also.

The signal developed across R1 is applied via an *RC* network, which contains the contrast control R3, to the emitter of the output transistor T3. Notice how R3 with R2 and R4 form a potential divider. The smaller the value to which R3 is set, the greater the proportion of signal developed across R4. With the video level control set correctly, the emitter voltages of T2 and T3 should be similar so that varying the contrast control setting alters the contrast without altering the brightness level. C2A ensures that the h.f. response is maintained whatever the setting of the contrast control, C2 across the input current limiting resistor R2 fulfilling a similar function. The trap L3A, C1A forms an acceptor circuit to short out the 6MHz intercarrier signal.

T3's base is biased by R6, R7, D1 and R7A. Since D1 is conductive during the forward scan, R7A is then in parallel with R7 while C3 decouples T3's base. When the positive-going flyback blanking pulses arrive however, D1 is cut off and T3 is driven fully on. Thus a negative pulse is applied to the c.r.t. grid, cutting it off.

The series peaking coil L3, damped by R5A, divides the stray shunt capacitance present, giving a lift in the h.f. response. R6A with the parallel *RC* combination R301/C301 protect the output transistor against tube flashovers and attenuate the very low frequencies. It's worth mentioning that whilst the value of a video output pentode's load resistor is calculated to give a certain gain/bandwidth figure, in a transistor video output stage the first consideration has to be the permissible power dissipation in the transistor.

A more conventional transistor video circuit is shown in Fig. 3 (Thorn 1613 chassis). This consists of an emitter-follower driving a common-emitter video output transistor.

As in the previous circuit, the contrast control R39 varies the signal drive to the output transistor. The d.c. voltages at the junctions R33/R34 and of R40/R44 are the same, so the d.c. conditions at the base of VT5 do not vary as R39 is adjusted, R39 acting as a signal potential divider with R44. An *RC* network between VT4's load resistor R34 and the input to the contrast control favours the medium to high frequencies, since at l.f. the reactance of C50 is so high (318·4kΩ at 50Hz) compared to R38 that only the latter then provides a signal feed.

H.F. compensation in the output stage is achieved by only partially decoupling R45: i.e., the small value of C55 means that R45 is decoupled at the higher but not the lower frequencies, so that negative feedback is introduced at l.f. The large-value capacitor C56 on the other hand ensures that the video d.c. level control R43 and the diodes W2/3 are fully decoupled right down to l.f. The aim of h.f. compensation of course is to boost the h.f. gain to overcome the attenuation otherwise introduced by the presence of stray shunt capacitance. In general therefore the time-constant of the emitter circuit compensating components tends to be near that of the collector load.

Diodes W2 and W3 develop a constant voltage over a wide current range, thus stabilising VT6's emitter voltage and enabling a smaller value resistor to be used to develop the required emitter bias voltage.

Field flyback blanking is introduced via VT6 which is fully conductive during the forward field scan. The negative-going field flyback blanking pulse cuts it off, and the resultant positive pulse at VT5's emitter cuts it off as well.

W5 provides beam limiting. It becomes reverse biased

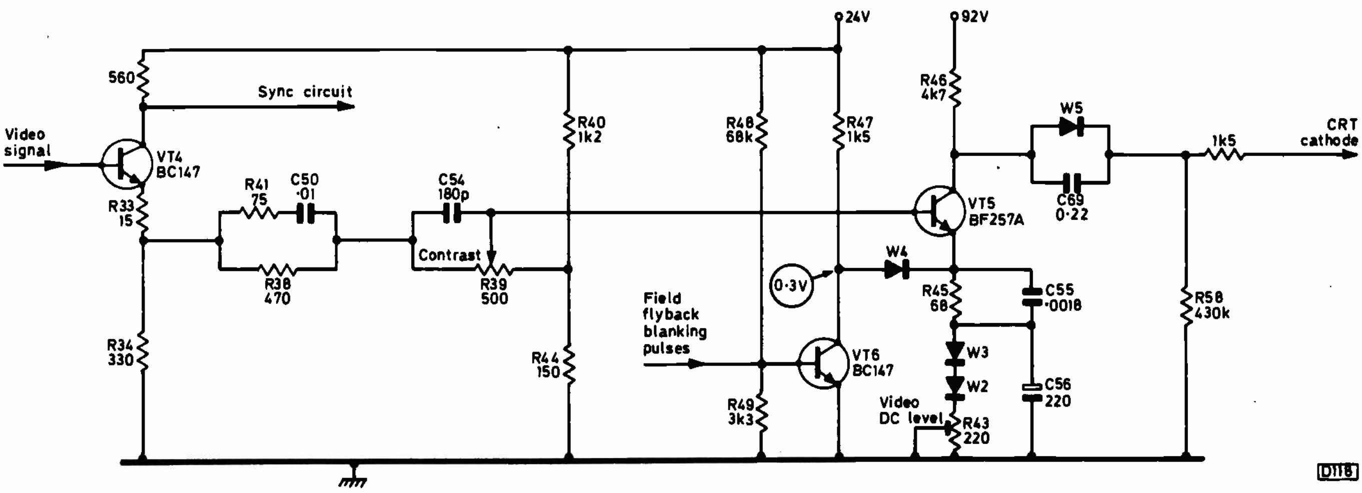


Fig. 3: Video circuitry used in the Thorn 1613 chassis.

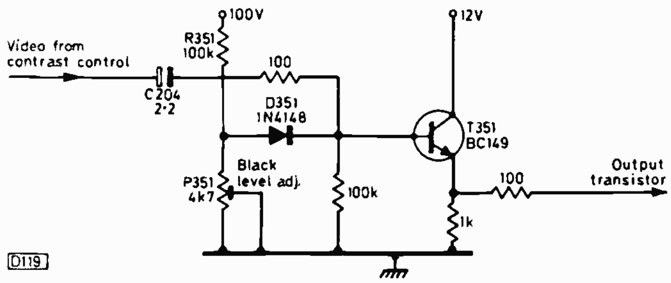


Fig. 4: Diode D351 acts as a d.c. restorer to set the black level following a.c. coupling via C204 in the GEC 3133 series.

when the c.r.t.'s cathode current, flowing via R58, is excessive. The signal coupling is then via C69, removing the d.c. component which is largely responsible for a heavy beam current.

DC Restoration

In most large-screen, solid-state sets direct coupling throughout the video channel maintains the correct d.c. level from the detector through to the c.r.t. In some portables however, which are often used under adverse lighting and signal conditions, largely removing the value of the correct black level, a.c. coupling is employed to simplify interstage circuit design.

The circuit shown in Fig. 4, used in the GEC 3133 and 3135 portables, introduces a further variation, a.c. coupling between the video demodulator and the driver transistor Tr351, with the d.c. level re-established by diode D351 which acts in a similar fashion to the d.c. restorer diodes used in some older valved dual-standard models. In those sets the d.c. restorer diode simply shunted the video output pentode's grid leak resistor, being connected so as to conduct on the sync pulse peaks. The d.c. level of the signal was thus set with the sync pulse at virtually chassis potential. As a video output transistor needs an appreciable forward bias however this technique has to be applied rather differently. The driver transistor is forward biased from the junction R351-P351, the latter control (black level adjust) setting the operating point of D351 and thus the d.c. level on which the sync pulses stand. D.C. coupling is subsequently used through to the c.r.t. cathode.

Emitter-follower Output

As old hands will recall, some valved chassis produced by Bush and Decca employed a cathode-follower between the video output pentode and the c.r.t. This improved the gain/bandwidth figure by transferring the main capacitive loading from the pentode's anode circuit to the low-impedance cathode-follower output circuit. In colour receivers using colour-difference c.r.t. drive, the loading imposed on the luminance output stage by the input impedances of the three guns plus the c.r.t. drive control circuitry can be quite high. To overcome this problem, hybrid Korting models use an emitter-follower between the luminance output amplifier transistor and the feeds to the three c.r.t. cathodes. The circuit is shown in Fig. 5, where T150 is the main amplifier and T151 the emitter-follower.

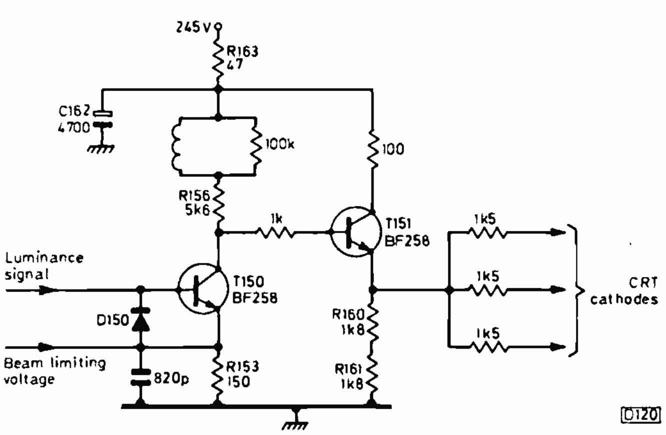


Fig. 5: Luminance output stage used in Korting hybrid sets, with an emitter-follower driving the c.r.t. cathodes.

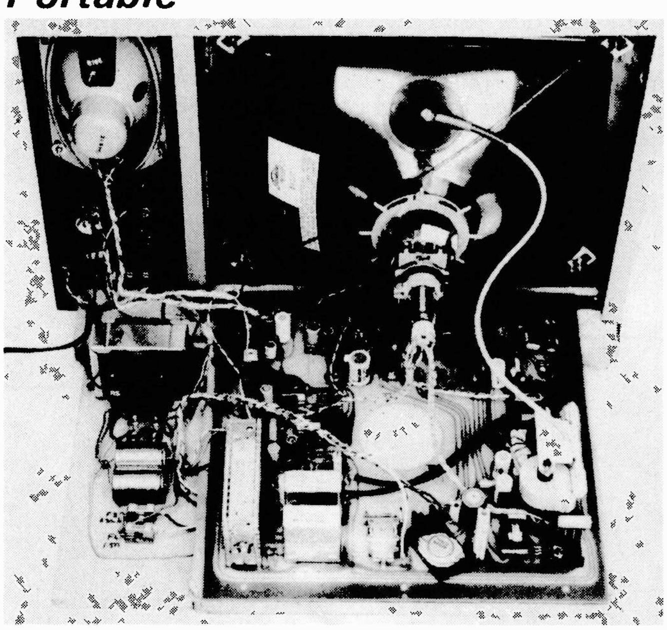
A positive-going beam limiting voltage is applied to the emitter of T150, cutting it off to bias back the tube when the brightness threatens to become excessive. D150 is present to protect T150's base-emitter junction. During normal operation, the voltage applied to R153 from the beam limiter circuit is constant.

H.F. compensation is provided by the shunt peaking coil wound on the 100kΩ resistor, while at l.f., when the reactance of C162 becomes appreciable, R163 is added to T150's total load resistance. The emitter-follower's load resistors total 3·6kΩ in value, but since they are in parallel with the transistor's output impedance the effective output impedance is quite low.

Scope for Experiment

Provided the h.t. supply can accommodate the added current demand, incorporating a simple emitter-follower stage could provide an interesting opportunity to experiment. If the preceding output amplifier has an entirely resistive load, including an emitter-follower will slightly reduce the overall voltage gain while giving an extension of the point in the h.f. response where the gain falls to half. Where an emitter-follower is added to a stage incorporating peaking coils, these will no longer have optimum value – since their inductance is determined by the total shunt capacitance present in the circuit. Their value will have to be reduced therefore, the aim being to ensure that the high-frequency test card gratings are reproduced with the sharpest definition and minimum ringing. ■

Television Monochrome Portable



The Manor Supplies demonstration version (above) of the Television *monochrome portable can be seen at 172 West End Lane, London NW6.*

TV Servicing: Beginners Start Here...

Part 7

S. Simon

WE touched briefly on transistors and semiconductor diodes in Part 5, where we pointed out that a transistor is a three layer (npn or pnp) semiconductor device while the diode is a two-layer device (just an n and a p region), and that n denotes negative and p positive. This latter point means that n type semiconductor material has been treated so that it had an excess of free electrons in its atomic structure – you will recall from Part 1 that an electron carries a negative electrical charge – while p type material is treated so that it has a shortage of electrons. Bias a semiconductor diode so that its p region is positive with respect to its n region and electrons will flow from one region to the other, i.e. current flows through the device.

A conducting diode has a certain voltage across it. For a simple silicon diode this voltage is about 0·7V, which can be regarded as the minimum bias voltage before the diode will conduct. The basic characteristics of a pn junction are shown in Fig. 1. Once the forward bias exceeds 0·7V, current starts to flow, non-linearly at first then increasing linearly with increase in forward bias. By forward bias we mean making the p region (the anode) positive with respect to the n region (the cathode).

If we apply reverse bias (cathode positive with respect to the anode) there will be some negligible current flow called leakage current. This is due to temperature effects. At a certain point however the junction will "break down" and there will be a rapid increase in current. This increase is virtually independent of any further increase in the bias voltage, the characteristic being made use of in zener diodes. These are manufactured so that they start conducting at some specific reverse voltage. For example, the BZY88 C3V9 starts to conduct at 3·9V, the BZY88 C10 at 10V and so on. This is useful since the zener diode will hold the voltage steady at its rated value despite considerable variations in the current flowing through it.

There are other types of diode which have particularly useful characteristics. For example, some have a capacitance which varies with the voltage applied to them. They can be used in a tuned circuit therefore, and by varying the voltage we can vary the tuning.

Let's keep to the run of the mill diode for the time being however, one say with a high voltage rating so that it won't go up in a puff of smoke when the voltage applied to it rises to quite a high level. As we have seen, such diodes can be used for h.t. rectification and for reducing the voltage applied to a heater chain. What happens when they go wrong, since this is the main concern of this series? An ordinary rectifier is designed to conduct in one direction only, so we need not concern ourselves with the breakdown voltage. We can assume that this is well outside the range of voltages the diode is likely to encounter.

Since the diode will conduct to a noticeable extent in one direction only, and since it requires a forward bias of a low magnitude, it should be possible to check a suspect using an ohmmeter – this operates by passing a current through whatever is on test, the current being derived from one or more batteries in the meter. The lower the resistance of the thing being tested the greater the current flow, so the meter needle is deflected farther across the dial which is suitably inscribed. We don't need to get too precise about this, since in the case of a simple diode all we want to know is does it conduct in one direction only?

A complication is that with the vast majority of meters the negative side of the internal battery is connected to the positive (red) meter probe and the positive side of the battery to the negative (black) probe – via the internal resistors and selectors of course. When we connect the

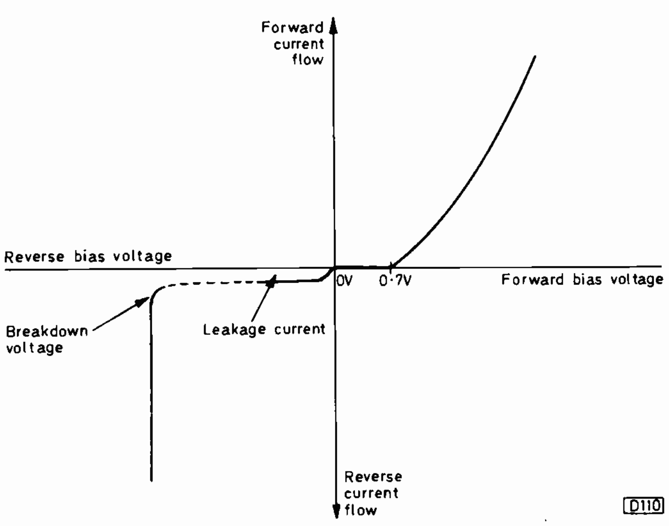


Fig. 1: Silicon diode characteristics. With a germanium diode, forward conduction starts at a lower forward bias voltage, typically 0·3V. The breakdown voltage varies for different types of diode.

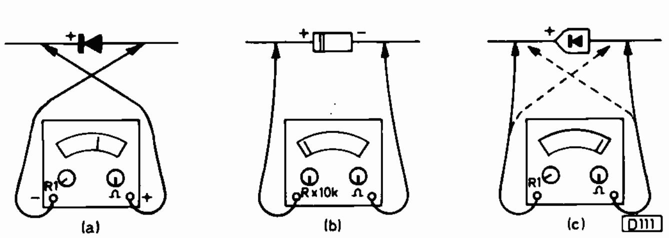


Fig. 2: Diodes in different guises. Note that although the cathode is marked plus, it's actually the n-type section of the diode. The plus indicates that this is the side which produces a positive output in a rectifier circuit. Now to tests. (a) A forward biased silicon diode should give a reading of about 30Ω while a germanium diode should read about 200Ω. With nearly all meters the negative (black) probe carries the positive voltage from the meter's internal batteries while the positive (red) probe carries the negative voltage. (b) Reversing the probes to apply reverse bias to the diode. This time the diode should not conduct and there should be no meter deflection therefore. (c) Full meter deflection with the probes connected to the diode both ways round spells disaster! No deflection either way indicates that the diode is open-circuit.

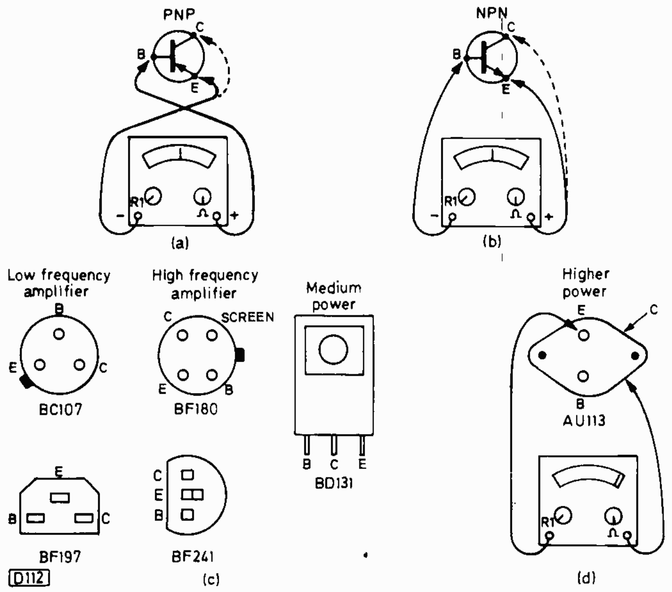


Fig. 3: Transistors in different guises. (a) Testing a pnp transistor. Depending on the type of transistor, the reading with the red probe connected to the base and the black probe to the emitter or collector should be 10Ω to 50Ω. With the black probe to the base no readings should be obtained. (b) An npn transistor should give readings with the black probe connected to the base and the red probe to the emitter or collector. As previously mentioned, the negative and positive markings beside the meter indicate the black and red meter probes respectively, not the voltage polarity. (c) Base connections to some commonly encountered transistors. (d) The AU113 is a high-power transistor used in some battery portable receiver line output stages. As with many of the high-power transistors, the collector is connected to the case. Full meter deflection with the probes connected to the emitter and collector means that the transistor is short-circuit and, with a line output transistor, the fuse will probably be blown.

positive probe to the diode's cathode and the negative probe to its anode therefore it should be forward biased and should conduct, the resulting current pushing the meter needle over to give a goodly reading which, on the low resistance range (R × 1), should settle at around 30Ω for a silicon diode. Reverse the leads and the diode should no longer conduct, the meter reading remaining at infinity (no needle movement).

We can test the small germanium diodes commonly found in signal circuits (as detectors etc.) similarly, but when the diode is conducting we should find a rather higher resistance reading, more like 200Ω say. Whether the diode is functional or not will be established by this simple test (see Fig. 2) however. A low resistance reading in both directions means that the diode is short-circuit, and is probably the reason for the blown fuse (h.t. rectifier) or brightly lit valves (heater dropper) in the case of power diodes, while a high reading in both directions means that the diode is open-circuit internally.

Since the transistor is simply a device with an extra layer it should be possible to apply similar tests, and indeed it is (see Fig. 3). We must first know whether the transistor is an npn or a pnp one of course (refer back to Fig. 2, Part 5), and also the transistor connections. Forward biasing the base-emitter or the base-collector junction should give a low reading, while applying reverse bias should give no reading. If these results are obtained, the transistor is capable of performing provided there is no short between its collector and emitter. A reading may be obtained when this is checked, but it will be higher and will be more in one direction than the other. Different transistors have different characteristics, but at this stage we don't want to bring in too many ifs and buts.

These simple tests are not conclusive, but are very handy as a quick check to find out if a transistor is capable of conducting or not. Readers can experiment with known good transistors in order to confirm the type of readings to be expected. We will try to point out variations of pattern as we go along, and where particular types of circuit are concerned.

Whilst this type of "cold" test can be easily employed, in many instances without removing the suspect from the circuit, it must be realised that testing a device in its circuit means that other components will be involved. This is of little consequence where the associated components are resistors of high value, or capacitors. It's often the case however that low-value resistors are associated with a particular transistor, or diodes and other transistors. One has to use a bit of common sense when applying such tests therefore, and take into consideration the associated circuitry. One dodge is not to remove the suspect completely, instead isolating one or more of the connections in order to divorce it from the circuit. This can be done by removing the solder from the wire or leg with a solder sucker or desoldering braid, leaving your test point unconnected. Suspect capacitors and resistors can often be checked in the same way to save removing them completely.

Switching the meter to the volts range enables us to get a good idea of what is happening when the set is switched on. The essential fact to remember is that current passing through a resistor will result in a certain voltage being developed across it. Say an npn transistor is being used in a signal circuit as an amplifier. Let's consider VT7 in the Thorn 1500 chassis i.f. strip (see Fig. 4). The emitter is returned to chassis via R24. With the collector supplied via R25 from the positive supply line, and the base biased on (3·5V) by R21-R22, emitter current should flow through R24 as well as through VT7 and R25. There will be a voltage across R24 therefore, the precise figure depending on the current actually flowing. The service information states that if all is well 2·9V will be recorded with the negative prod of the meter to chassis and the positive prod at the emitter side of R24.

If this voltage is not present, it indicates that no current is flowing. This could be due to the transistor being defective, but it could also be due to the base not receiving its "turn on" bias of approximately 3·5V, or to R25 or R24 being open-circuit. In addition, if the transistor is not conducting there will be little current through R25 and the voltage across it will be negligible. Thus instead of the correct 23V at the transistor's collector the full 26V supply line voltage will be recorded at this point.

We point this particular instance out because VT7 (BF197) seems to fail more often than any of the other transistors in this chassis, often being responsible for the condition of "no vision signals with perhaps very faint sound signals not originating from a TV transmitter". The sound signals in fact consist of random pick up by the sound i.f. stages (the vision i.f. strip, which handles both the vision and sound signals, being open-circuit at VT7 as voltage and a cold resistance test will probably prove).

It will be seen then that the tests described can be of use in a very practical sense in all sorts of equipment – ranging from powerful public address amplifiers to tiny radios. We hasten to add that a cold resistance test on a transistor is not conclusive, particularly where the device is required to operate as an oscillator or part of an oscillator.

We have said that a transistor starts to conduct when its base voltage moves away from its emitter voltage – moving towards the voltage at its collector. Now the resistors used to obtain the base bias voltage may be of high value,

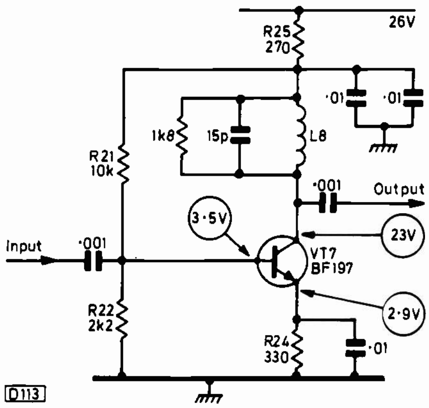
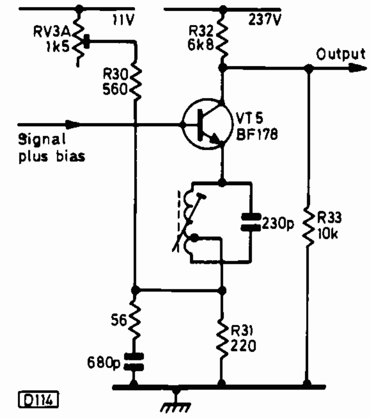


Fig 4 (left): The final i.f. amplifier stage in the Thorn 1500 chassis. R21/R22 provide forward bias for the base. If the voltage across the emitter resistor R24 is correct the transistor is operating normally.

Fig. 5 (right): The video output stage in the Pye 173 chassis. R33 limits the voltage at the collector of VT5 when the transistor is not conducting. The current flowing through R31 is the sum of the currrents flowing through the transistor and resistors R30/RV3A. If the transistor is not conducting there will still be voltage readings across R31 and R32 therefore.



100kΩ or more. In such a case it requires only a small leak between the base and the emitter to cancel out the "turn on" bias. To detect such a leak, disconnect the transistor's base, switch the meter to a high-resistance range, and apply the meter probes so as to reverse bias the transistor's base and emitter. Such a leak would have little effect in a circuit using low-value resistors; say an audio output stage, but will be sufficient to keep the transistor "turned off" in a preamplifier or any other high-resistance circuit. Working voltage tests are of more use in this sort of situation, although here again the resistance of the meter itself (usually specified as so many ohms per volt; 20kΩ per volt being typical) must be taken into consideration. When confusion exists it's often because all factors are not being considered and a small point is escaping attention.

More confusion can arise since some types of transistor read quite low from collector to emitter on an ohmmeter, a typical figure being about 50Ω for say a BF196 i.f. amplifier transistor. The figure for collector to emitter is much higher for BC types.

It's instructive to connect an ohmmeter from collector to emitter and then apply a finger between the base and collector, noting how the reading varies. This demonstrates the "turning on" effect of the base being brought nearer to the collector voltage via the resistance of the skin surface (say 50kΩ). The meter leads will have to be round the right way of course, so that an npn transistor has a positive voltage applied to its collector from the "negative" probe. Try it and see.

Voltage readings can also be a little misleading, due to the fact that a voltage may be read across an emitter resistor although the transistor is not passing any current. This is due to the fact that a stabilising resistor is connected from the supply line to the emitter, so that current passes through the emitter resistor to chassis although the transistor itself remains quietly saying nothing. The clue here is that the collector voltage will be high as the collector will not be collecting any current. No current, no voltage drop, collector voltage high.

There's room for doubt even here however, since there may be a resistor from the transistor's collector to chassis to prevent the collector voltage rising to too high a figure when the transistor is cut off. Take for example the video output circuit used in the Pye 173 monochrome chassis (Fig. 5). This illustrates both these points. VT5 is the video output transistor, whose emitter is returned to chassis via a rejector tuned circuit (to remove any sound signal still present at this point) and R31 while its collector load resistor is R32. Due to the bias stabilising network RV3A and R30 there will still be current through R31 and thus a small voltage across it when the transistor itself is not conducting, while due to R33 there will at the same time be a current flowing through and a voltage across R32. So the moral is to back up the voltage test with a cold resistance test, and if there's still doubt replace the suspect.

So much then for two- and three-layer devices. There are also four-layer devices, in particular the thyristor which plays an important role in some TV receiver circuits. A diode conducts when its anode is positive with respect to its cathode. The thyristor also has an anode and a cathode. It also has a gate connection which switches the device on when the appropriate turn-on voltage is applied. The gate may be thought of as analogous to the base of a transistor therefore, but there's an important difference. Once a thyristor has been switched on by applying the appropriate voltage to its gate connection, removal of this voltage won't stop the thyristor conducting – it now acts as a diode, and will stop conducting only when the anode and cathode voltages are the same, or reversed so as to reverse bias the device, or the current through it is reduced to a very low level. It may be thought that this apparent lack of control is a serious disadvantage. If the anode voltage is rising and falling anyway however – say it's the 50Hz mains supply – use of the gate enables the precise switch on point during the anode waveform to be controlled. In other words we have a controllable rectifier, which can be used to provide a stabilised output.

There are other semiconductor devices such as diacs and triacs. These are switching and triggering devices which are used to switch more powerful devices on and off – rather as relays are used in other equipment. We don't wish to go into lengthy explanations of these less common sorts of devices at this stage however, because there are lots of other basic points we've not yet touched upon. Suffice it to say that these devices are often encountered in colour receiver power supply circuits where they – thyristors and diacs we specifically mean here – can be responsible for such fault conditions as a jittery picture.

Suspect diacs and triacs cannot be checked by conventional means. They must be replaced. Nor can a thyristor be checked if it's suspected of being the cause of a jittery picture. It can however be tested to see whether it will switch on when its gate is operated (see Fig. 6).

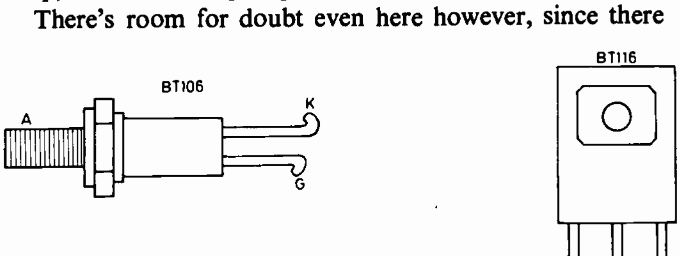


Fig. 6: Specimen thyristors. To test whether a thyristor is operational, connect the black probe to the anode and the red probe to the cathode: there should be no reading until the gate is shorted to the anode.

LONG-DISTANCE TELEVISION

ROGER BUNNEY

JANUARY was a good month for long-distance television reception in the UK. The Quadrantids meteor shower occurred on the 3rd, there was an Aurora on the 4th, excellent tropospheric conditions on the 15th, Sporadic E at various dates throughout the month and increasing F2 activity towards the end! I had excellent MS reception on the 3rd, particularly from Scandinavia, improving tropospheric reception on the 6th, excellent tropospheric reception from DFF (East Germany), W. Germany and Denmark at both v.h.f. and u.h.f. on the 15th, excellent Sporadic E reception from YLE (Finland) ch. E2 and TSS (USSR) ch. R1 on the 27th, and an exciting lift in cross-Atlantic reception via F2 on the 29th, with various highway patrol communications at up to about 35MHz. I've asked Hugh Cocks (South Devon) to provide the log this month however. This follows:

1/7/78	Improved trop. reception from France, down to Clermont Ferrand.
3/1/78	Good mid-day MS with many Band III ch. E5 signal pings from NRK (Norway). Also ch. R1 via SpE.
4/1/78	A small Aurora during the evening gave ch. E3 signals.
5/1/78	MTV (Hungary) ch. R1 via SpE; RTVE (Spain) ch. E4 via trops.
6/1/78	Excellent trop. signals from W. Germany, France, CLT (Luxembourg) and Switzerland at Band III and u.h.f. Late afternoon Sp.E reception from ORF (Austria) and CST (Czechoslovakia) on ch. R1.
7/1/78	Good French trop. reception.
9/1/78	Early morning NRK reception on chs. E2/3/4; unidentified ch. R1 SpE signal.
13/1/78	Fair trop. reception from the east.
14/1/78	Excellent trop. reception from RTE (Eire).
15/1/78	Excellent trop. reception with DR (Denmark), W. Germany and SR (Sweden) in Band III and at u.h.f.
20/1/78	SpE reception of RAI (Italy) chs IA and IB, and JRT (Yugoslavia) ch. E4.
27/1/78	Early morning reception of TSS ch. R1 via SpE. Also communications signals, RTTY etc.

Ray Davies (Norwich) reports receiving RUV (Iceland) ch. E4 for 45 minutes during the evening of the 9th.

Miscellaneous Matters

We recently listed the various Italian "free" TV stations and it seems that both Reg Roper (Torpoint) and Hugh Cocks have received Nord Center Television from Udine, but on ch. E3 rather than ch. IA. Reception occurred during the intense SpE. openings last August.

The business about the reception of TV station KLEE-TV Houston in the UK some years after it had been sold to KPRC-TV has brought a letter from J. Pinniger of BBC Engineering Information. He comments that KLEE-TV was sold to KPRC in May 1950, some seventeen months after its opening in 1949, but apparently KPRC continued to transmit the KLEE-TV caption for some years. Since the station operates on ch. A2 it could well have been subject to F2 layer propagation, especially as during the record sunspot period 1957-9 the m.u.f. rose to over 60MHz on the North Atlantic path. How the system M signals were resolved on system A receivers is another mystery however!

The ATS-6 satellite still operates at 860MHz, but with its transmitting facility leased for 90 minutes daily to an El Paso, Texas organisation. The "Beamed Christian Broadcasting" is intended for the remoter Caribbean islands. The satelite itself is in orbit over Hawaii.

Kerry Packer (of cricket fame) is believed to be the organiser of a satellite project to give Australia its first truly national TV coverage. At the present there are many areas with no television. Coverage of the total landmass will probably be at u.h.f.

Bob Cooper (Oklahoma) has sent extracts from technical reports on certain USSR TV satellites. Statsionar T operates at 99°E in geostationary orbit at 35,600km. The transmitter power is 200W fed to a 33·5dB gain aerial, operating at 714MHz with a bandwidth of 24.10^3kHz.

Foreign News

Afghanistan: TV will shortly start from the new Kabul studio centre, using the PAL system. Japanese engineers are constructing the transmitter atop Mount Asmai.

Ivory Coast: France is to finance the modernisation of the television broadcasting facilities in the capital, Abidjan.

Kenya: Colour transmissions are being planned by the authorities. Anticipating this, certain companies have been importing colour receivers – but for the wrong system!

Iran: The service is being converted to colour. The anticipated start is September 1978.

USSR: The new TV tower at Vilnius, Lithuania is a 165m high concrete one topped with a 162m aerial mast. Towers at Tallinn, Sverdlovsk and Baku will be of similar design.

Eire's Second TV Service

RTE (Radio Telefis Eireann) is to introduce a second TV service later this year, and a number of radical changes will be required. RTE has sent us the following details.

RTE-2 will commence from main transmitters in November 1978, with an end to the 405-line transmissions as replacement 625-line transmitters become available. An exception is the 405-line service in N.E. Donegal.

Truskmore ch. B11, 405 lines, now has reduced power and will cease when the Cairn Hill u.h.f. main station opens and the Truskmore 625-line ch. I polarisation change (to horizontal) is completed. Earliest date for the end of 405-lines is August 1978.

Kippure ch. B7 and Donnybrook ch. B3. The 405-line transmissions will end when the Dublin Three Rocks u.h.f. main station opens. Earliest date for end of 405-lines is September 1978.

The Monaghan ch. B10 405-line transmissions will end when the replacement ch. D transposer is in operation – earliest date for the end of 405-lines is August 1978.

All Donegal transposers will continue on 405-lines until a 625-line replacement service is available. Earliest date for the end of 405-lines in 1979.

Test transmissions from the new RTE-2 transmitters are to commence in late Spring, with pilot programmes in the Summer.

The transmitter network (main stations) for the two-channel service is as follows:

V.H.F.

	RTE-1		RTE-2	
Kippure	ch. H H	100kW e.r.p.	—	
Mt. Leinster	ch. F V	100kW e.r.p.	ch. I V	100kW e.r.p.
Mullaganish	ch. D V	100kW e.r.p.	ch. G V	100kW e.r.p.
Maghere	ch. B H	100kW e.r.p.	ch. H V	100kW e.r.p.
Truskmore	ch. I H	100kW e.r.p.	ch. G H	100kW e.r.p.

U.H.F.

	RTE-1		RTE-2	
Longford	ch. E40 H	800kW e.r.p.	ch. E43 H	800kW e.r.p.
Dublin (Three Rocks)	ch. E29 H	10kW e.r.p.	ch. E33 H	10kW e.r.p.
Transposers				
Cork City	ch. E39	165W V	ch. E49	165W V
Crosshaven	ch. F	130W H	ch. E59	250W V
	ch. E55	250W V		
Fermoy	ch. F	6W H	ch. I	6W H
Glengarriff	ch. F	60W H	ch. E49	250W H
	ch. E39	250W H		

From Our Correspondents . . .

George Francis has written to us from Port Moresby (Papua New Guinea). There are no TV stations as yet, but transmissions are expected to start in 1982 via geostationary satellites, with a single video channel and several audio channels. The proposed system will have studios at Port Moresby, an uplink station, four regional mobile units and 5000 community receivers in rural areas. There is some DX-TV activity however and George gives details of numerous receptions from South Australia and, more exotic, Nanking and Harbin, China. To date Malaysia hasn't been seen. His equipment consists of a v.h.f. super colinear aerial, a Labgear masthead amplifier, and a Sony colour receiver.

Anthony Mann (Australia) has received tropospheric Band III signals over 1,200 miles across the Australian Bight – our congratulations! He's also received West Malaysia (test card G) on ch. E2 at approximately 3,000 miles. Robert Copeman (Sydney) also reports excellent SpE receptions, with strong signals from most New Zealand stations.

Back home, John White (Scunthorpe) reports that a whirlwind blew the reflector off his Jaybeam ABM11 wideband Band III array. The aerial survived however and produced excellent signals on the 15th.

January's winds will long be remembered. During a particularly severe northerly wind I had to scale the lattice

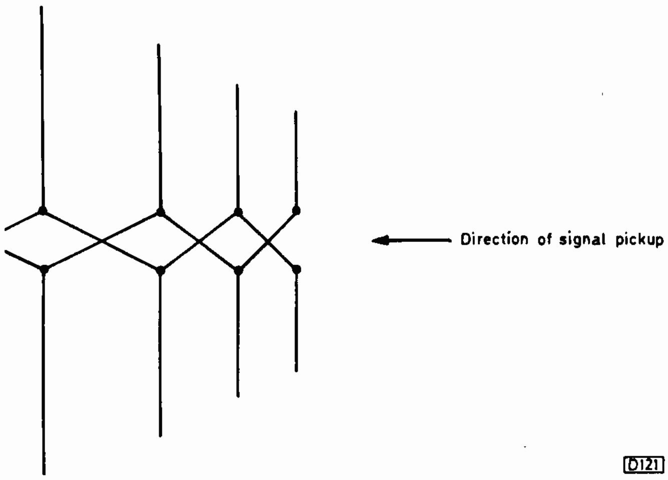


Fig. 1: Basic principle of the log-periodic aerial, showing the cross-connections (not to scale).

at midnight to bolt on an extra guy wire. It's reported that the winds here reached 70 m.p.h. that night.

Following our February report on Korea's ventures into colour, H. Westwood has sent us more accurate information – he's actually visited the studios at Seoul! At the time (last July) at least three studios were equipped for colour, using Philips equipment, though colour transmissions hadn't started. The programmes were apparently for sale abroad. There are two studio centres (Seoul and Busan, Pusan) while the two main transmitters are at Namsam (South Mountain) Seoul and Youngdo (Pusan). 67 relays were in operation at the time.

K. Rutgers has written about our earlier comments on a mystery ch. E37 transmission from the direction of Lopik. He lived in Holland only a few miles from the transmitter, and reports that due to harmonic problems another signal is often present at +7 channels spacing. He suspects therefore that the ch. E30 transmitter for the third programme (not yet officially ready) may be installed so that the report was of a harmonic from the ch. E30 transmission appearing on ch. E37.

P. Ellis (Ipswich) started DXing only recently but has already had some quite dramatic results. He's at present using an Antiferénce XG21W aerial at 40ft, with a Labgear CM6030/WB preamplifier, and has designed a phase inverter for switching between positive- and negative-going vision signals. As a result of this he's had good reception of CLT (Luxembourg). He's using a digital voltmeter calibrated in channel numbers with his varicap tuner.

LOG-PERIODIC AERIALS

There are only a few commercially available log-periodic aerials in the UK, and these are intended mainly as caravan aerials or for use in locations where there are extremely difficult ghosting problems. The advantages of the log-periodic aerial are its virtually level gain throughout the designed for bandwidth, and the clean polar response which similarly remains consistent through the bandwidth. The polar response is perhaps the greatest advantage, being without secondary lobes in either the horizontal or vertical plane and with a good front/back ratio. Unfortunately the gain of a log-periodic is modest compared to that of a Yagi with a similar number of elements, while construction is more precise and difficult, especially for the home constructor.

The log-periodic aerial consists of a series of active elements directly connected to a transmission line which, in a u.h.f. array, often doubles as the support boom. The dipole elements are not connected directly across the line in parallel however but are cross-connected as shown in Fig. 1. Thus adjacent elements are connected to opposite sides of the line. Each dipole resonates within the bandwidth, and the length and spacing of the successive elements is reduced by a logarithmic-law scaling factor known as the Tau

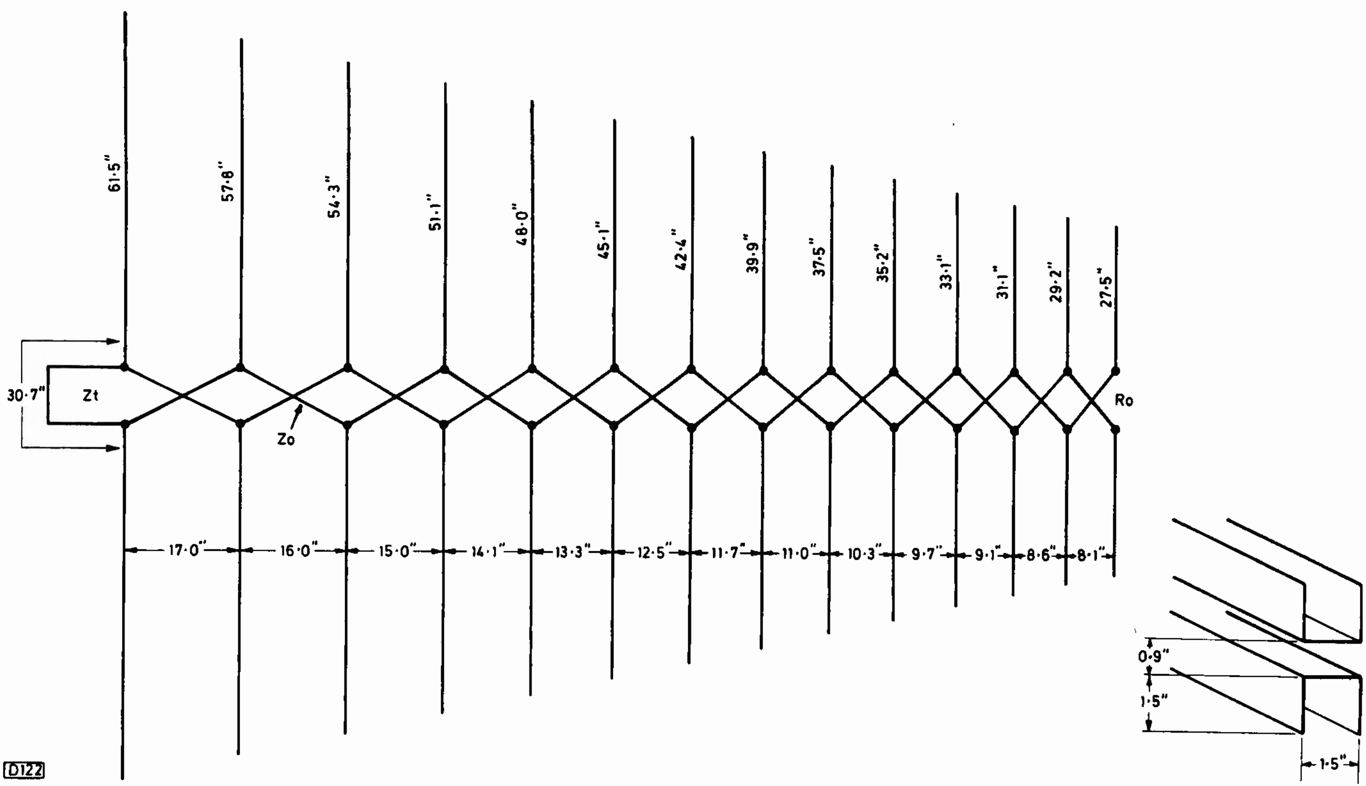


Fig. 2: Log-periodic aerial design by D. Browne, covering 48.25-85.25MHz with a gain of 9.25dBi. Dipole tubing diameters are as follows: 1, 2 1in.; 3, 4 $\frac{7}{8}$in.; 5-7 $\frac{3}{4}$in.; 8-11 $\frac{5}{8}$in.; 12-14 $\frac{1}{4}$in. The boom can be 2in. tubes spaced 2·5in. between centres, or two lengths of U channelling as shown, with the stub Zt shorted 15·3in. from the final dipole. Boom length 13·2ft.

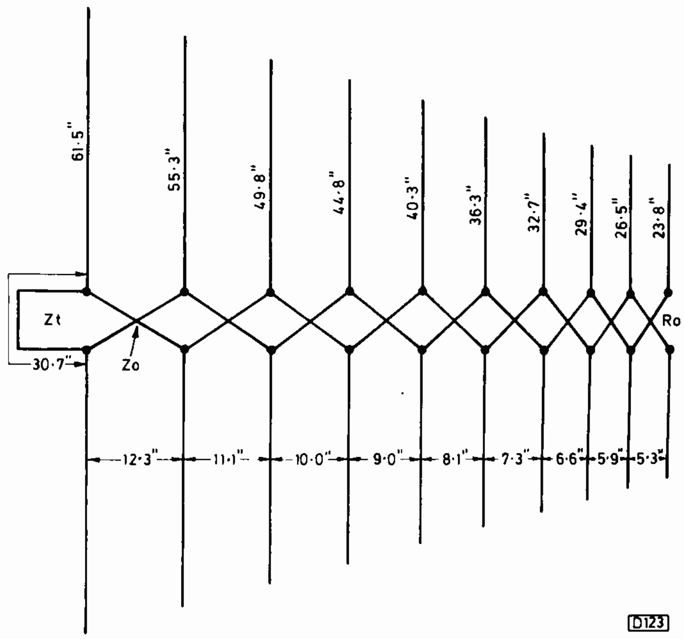


Fig. 3: Ten-element log-periodic aerial design by D. Browne, covering the same bandwidth as before but with a gain of 8·25dBi. Dipoles 1, 2 1in.; 3 $\frac{7}{8}$in.; 4, 5 $\frac{3}{4}$in.; 6, 7 $\frac{5}{8}$in.; 8-10 $\frac{1}{4}$in. Boom two 2in. tubes spaced as before and with stub as before. Boom length 6·3ft.

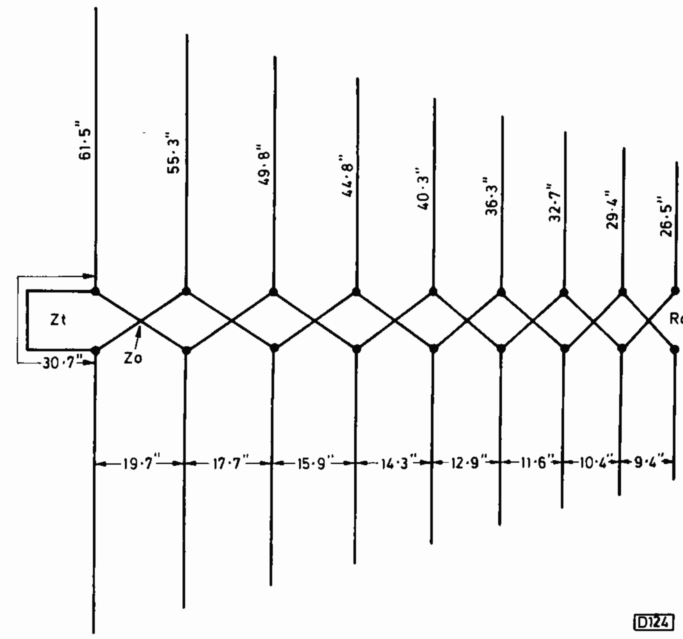


Fig. 4: Nine-element log-periodic aerial design by D. Browne, covering 48-68MHz. Gain 8.6dBi. Dipole 1 1in.; 2, 3 $\frac{7}{8}$in.; 4 $\frac{3}{4}$in.; 5, 6 $\frac{5}{8}$in.; 7, 8 $\frac{1}{4}$in.; 9 $\frac{3}{8}$in. Boom and stub as Fig. 3.

Factor. Obviously if the Tau Factor is reduced to enable extra dipole elements to be included within the aerial's bandwidth a greater number of elements will be active at any given part of the spectrum and the gain will thus be increased. The Tau Factor has been defined as "the bandwidth of a period of operation, that is F1/F2 equals one Tau where F1 and F2 are two frequencies exactly one period apart".

Due to the cross-phasing (i.e. 180° phase difference) between adjacent elements, incident signals arriving at the sides of the array tend to cancel, while the fact that there's a larger element at the rear of all but the last dipole means that there's a good front/back ratio.

The signal connection is theoretically to a balanced feeder at the high-frequency end. In practice however conventional 75Ω unbalanced feed is used, but by running this either inside one of the booms or immediately outside one boom the aerial acts as its own balun.

Designing a log-periodic array involves some mathematics: would be enthusiasts are advised to obtain a copy of the Babani Press book number 26 *(Radio Antenna Handbook for Long-Distance Reception and Transmission* by B. B. Babani), 85p at the time of writing – pages 55-73 give much detailed information on this subject.

Band I log-periodic arrays have never been used in the UK since for normal Band I reception the aerial has to be optimised for a single channel. In the past however Antiference have marketed a single or stacked Band III system (LP7), while Premier Industries currently have a Band III log-periodic aerial for the export market. Overseas however, particularly in Australia and the Americas where multiband and multichannel operation are common due to the multiplicity of channels in use, the log-periodic aerial is very common. At u.h.f., Antiference, Jaybeam and Premier have log-periodic arrays for use in the UK where wideband operation is required or ghosting is a problem.

In the past we've featured a number of wideband Band I arrays based on the Yagi principle. Some years ago the Benelux DX club marketed a Band I through to 88MHz log-periodic array for DXing. The advantage for DXing over the simpler Yagi array is that the directional

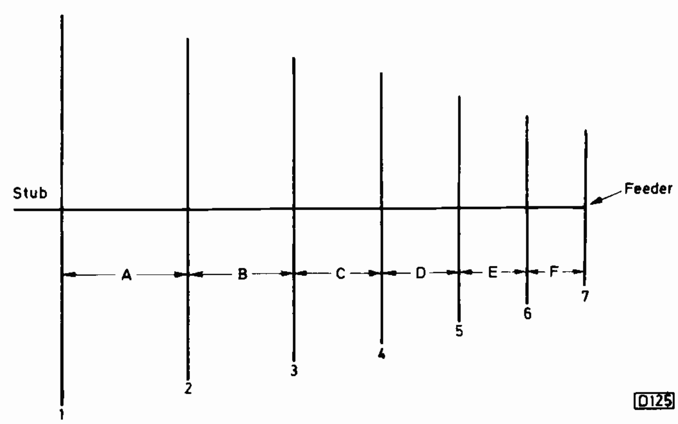


Fig. 5: Band I log-periodic system designed by C. Wilson. For a four-element version dipole 1 is 10′ 3″, 2 8′ 2$\frac{1}{2}$″, 3 6′ 6$\frac{3}{4}$″, 4 5′ 3″; A is 2′ 10$\frac{1}{2}$″, B 2′ 3$\frac{1}{2}$″ and C 1′ 10″. For a five-element version dipole 1 is 10′ 3″, 2 8′ 8$\frac{1}{2}$″, 3 7′ 4$\frac{3}{4}$″, 4 6′ 3$\frac{1}{2}$″, 5 5′ 4$\frac{1}{4}$″; A is 3′ 3$\frac{7}{8}$″, B 2′ 9$\frac{1}{2}$″, C 2′ 4$\frac{1}{2}$″ and D 2′ $\frac{1}{4}$″. For a seven-element version dipole 1 is 10′ 3″, 2 9′ 1$\frac{1}{2}$″, 3 8′ 1$\frac{1}{2}$″, 4 7′ 2$\frac{3}{4}$″, 5 6′ 5$\frac{1}{4}$″, 6 5′ 8$\frac{3}{4}$″, 7 5′ 1″; A is 2′ 5$\frac{1}{2}$″, B 2′ 2$\frac{1}{8}$″, C 1′ 11$\frac{3}{8}$″ D 1′ 8$\frac{7}{8}$″, E 1′ 6$\frac{1}{2}$″ and F 1′ 4$\frac{1}{2}$″ – the seventh element can be omitted. In each case the stub is 2′ 6″ and the connections between the dipole terminals are via copper power cable.

characteristics and polar response remain consistent over the bandwidth. In addition, impedance matching remains accurate, with a correspondingly low voltage standing wave ratio (VSWR).

In constructing a log-periodic array, isolation between the two booms can be difficult, since the distance between the two affects matching. Perhaps the easiest approach for the experimenter is to use a single boom, with standard insulators, cross-connecting the terminals of each insulator.

We're fortunate in being able to call upon two experts in log-periodic aerial calculations – Derick Browne and C. Wilson – who have given us details (see Figs 2-5) of several designs for Band I use. The systems are large, but should give superior performance to the usual wideband Band I Yagi array. We'd be interested to hear from any experimenter who successfully makes up such an array – as to how the mechanical problems were overcome, and what sort of performance is obtained.

CATastrophe

Les Lawry-Johns

I'M not a cat lover. On the other hand, I don't hate them either. Our own cat Spock has her endearing, selfish little ways, but I wouldn't dream of harming her. Except that is when she brings in a poor flapping bird and proceeds to torture it. Then I could kill her without a second thought, regretting it later of course. She lives, however, and grows fat. The fatter she is, the less likely she is to succeed in catching a bird. So we live in peace. This is just as well because whenever I have lost my temper with a cat I have always come off second best.

A little while ago, I was called to a house to attend a Bush CTV1122 which had "gone bang". As I was removing the rear cover I became aware of two things. First, there was a horrible smell which had not been immediately obvious lingering around. Secondly, the window near me was wide open on this cold day.

The lady of the house explained that her cat had had kittens, and that a horrible tom cat had been in and had left the smell in addition to having made an attempt to kill the kittens. As she returned to the kitchen, shutting the door behind her, I resumed my job behind the Bush.... Being partly concealed, I was not noticed by the thing which entered through the window. It was the ugliest ginger tom cat I have ever seen, and it was obviously going to have another go at the kittens. I rose to my full height.

"Got you, you horrible swine," I hissed. "Now you'll pay." The cat glared at me with hate filled eyes. Every hair on its scraggy body stood out, and it looked twice as big as it had done a moment ago. Its back arched and it spat out its challenge. Who would be the victor in this battle of the giants?

I made the first move: my screwdriver sped through the air with deadly accuracy. The cat leapt on to the sideboard and the screwdriver knocked a chunk off the coffee table. Oh dear. I looked for another weapon. The vacuum cleaner hose. Just the thing to put an end to this vile beast. I swung it viciously as the cat leapt again, and all the silver on the sideboard was scattered in all directions together with family pictures and a bowl of mixed nuts.

The cat then really got going. It literally tore round the walls, never once touching the floor. Down came the curtains and several other items which had adorned the walls. I aimed another blow at the beast and missed again. Missed the cat that is, I didn't miss myself since the metal end of the hose rebounded off the wall, knocked my glasses off and sliced my ear.

Since the curtains were no longer covering the window the cat vanished with a parting hiss, leaving behind the most horrible smell, easily eclipsing that of a burnt up tripler. By this time the lady of the house had reappeared. Viewing the devastation, her eyes widened with horror. "Has the set blown up completely this time? Look at my curtains and silver and everything . . ."

"Calm down" I urged her, quickly replacing the silver and pictures and things. "That tom cat came in and turned the place upside down and attacked me, that's all. Send for the police, it'll have to be shot."

Having rehung the curtains, some sort of order was restored. ... So rather shaken I returned to the Bush to investigate the source of the bang. Lower left 3·15A mains supply fuse missing except for its metal ends. Remove power board. Lots of burn marks and damaged print around the base of the thyristor (BT106) and down to the surge-limiting thermistor which didn't look up to much either. After cleaning up the area carefully, we fitted a new thermistor and a new BT106, then checked the diodes and everything else in sight. All seemed well, so like a fool we put it back without looking at the print on the decoder panel.

With a nice new 3·15A anti-surge fuse in we switched on. On came the sound and the e.h.t. rustled up. Easy job after all.

"Picture o.k.?" we enquired from our position behind the set.

"No," said the fair lady.

"Oh," we said as we clambered around to the front. Turning up the brilliance and contrast did nothing. There was only a dull blue glow which remained unaltered by anything. Tube base voltages revealed that the first anodes were normal but the cathodes high. The bang must have damaged the SL901B demodulator i.c. we decided, reasonably enough. We didn't have one with us. So we put the thing together and took it to the van, promising to return it the following day all being well.

On the bench, out came the decoder panel, out came the desoldering braid, out came the i.c. and in went a new SL901B. Brightness restored, contrast o.k. Careful tuning brought in some sort of colour, that is if you like green faces. Despite the fact that we had replaced the upper i.c., we were still too stupid to examine the board closely on the print side.

Pressing the buttons a few times restored normal colour about once out of every three goes. This was not a good average, so we checked the ident control which didn't help matters. Looking on the black side we concluded that the lower i.c. had also been dealt a mortal blow. Out came the decoder panel, out came the desoldering braid, out came the SL917A and in went a new one. All to no avail and the time was galloping away.

"Bistable, bistable, it's that cat's fault," I mumbled. Out came the board once more (I've never got round to a set of extension leads, as we don't deal with that number of these models and we rarely have faults on the decoder anyway) and this time we did what we should have done in the first place. Careful examination of the print around the ident detector transistor 3VT11 (BF194) showed discolouration. The transistor in fact was open-circuit base-to-emitter. Clean up the tracks, fit for a new BF194, and flesh is flesh (leaving Kermit out of this).

So ends this catalogue of disaster. The moral is: if you have a blow out, check up on the semiconductors on the adjacent panel. Oh, and never try to kill a cat.

Thorn 1600 Chassis

A young fellow brought in a nice white mains portable and asked us if we could repair it. It was an Ultra Model 6831, fitted with the Thorn 1600 chassis. As we were removing the rear shell, he remarked that it had been with a firm many miles from here for a period of eight weeks, and that they had given it up as a bad job.

"Will it take more than a few minutes to do? Only my friend's waiting in the car and there are double yellow lines you know." A swift check revealed that the BU205 line ouput transistor was a dead short, and it was obvious that a lot of other work had been done around the line timebase. The alarm bells rang. Take care they rang.

"Leave it with us a few days and we'll let you know" we said cautiously. Off he went, leaving us to sort out what had been done and why. The BF337 line driver transistor VT15 had been replaced and appeared to be in order. With a weather eye on our depleted stock of line output transistors (Mr Doubleday you remember) we removed the side panel which holds the line output transistor and to which the body of the TIP31 regulator transistor is bolted (having released the latter), noting that the top screening cover was missing. This enables the flyleads of the line output transistor to be removed and the BU205 to be replaced.

We fitted an approved replacement for the BU205 and hooked up a large wirewound resistor in series with its collector lead in order to protect it in the event of it being switched on for too long. This appeared to be unnecessary, as it did not switch on at all when we had cleared the decks for action and switched the set on. The BF337 was overheating however. Checking the base and emitter produced an immediate change of conditions however and the line output stage started to function, the tube heater lighting dimly etc. Obviously we had prodded something into life. It was time for thought.

The *RC* network connected across the primary winding of the driver transformer T1 (see Fig. 1) is essential to prevent "ringing", which would tend to keep the BF337 conducting. If the BF337 was overheating, it was conducting too long. So it was prudent to check these damping components, particularly as application of the meter could have perhaps sealed one up so that normal working was resumed. Investigation showed the components to be R139 6·2kΩ (2W) and C122 0·0056μF *(polystyrene)*. Ah ha. In the event however the capacitor was not at fault: we had jumped to yet another wrong conclusion. . . . Such was our confidence however that we removed the wirewound resistor from the feed to the line output transistor's collector and then switched on. Nothing.

We again applied the test prod to the base of the BF337, and on came the tube heater and a raster appeared on the screen. The raster then vanished and there was a click from the line output transistor. Hurriedly switching off we found the line output transistor to be a dead short and we were back to square one.

Convinced that the trouble was in the driver stage, we carefully checked all the components there, after removing the BF337. An ohmmeter reading from the base connection to the h.t. line showed 5MΩ. We shook the meter and rechecked the range. The reading should have been more like 500kΩ. No, 5MΩ it was. R138 turned out to be a tiny 470kΩ resistor which had gone high, not allowing the base of the BF337 to discharge. Fitting a larger 470kΩ resistor

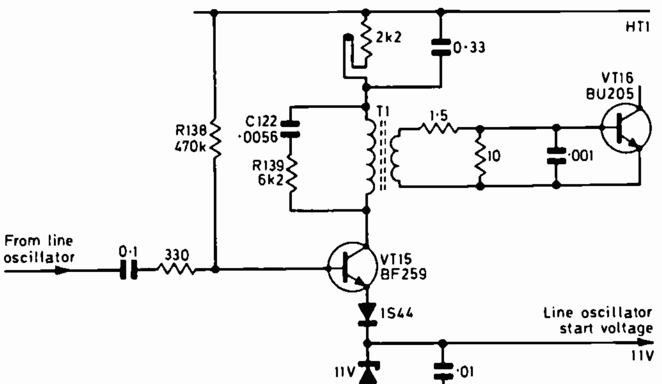


Fig. 1: Line driver stage, Thorn 1600 chassis. In earlier versions VT15 was type BF337.

and refitting the BF337 and another new line output transistor (2SC643A) produced normal working and another threatened nightmare was averted. This is the first time we've encountered this one.

Our usual troubles with the 1600 chassis have been around the e.h.t. rectifier: either the rectifier (pencil type) itself or insulation breakdown has been our lot. It should be appreciated that the e.h.t. lead is screened and that the screening is earthed. This can be a source of trouble, but is fairly obvious and unlikely to cause heartache. The proximity of the screening cover seems to promote discharge from, and breakdown of, the insulation of the e.h.t. rectifier's end caps.

LT Transformer Trouble

We had a call to service a Pye hybrid colour set the other day. It was fitted with the 691 single-standard chassis, which has the metal housing over the line output transformer and e.h.t. tripler as opposed to the more open arrangement of the later 697 chassis which has the vertical printed panel on the right side. The later models use a revised mains transformer with a thermal cutout incorporated in the body of the transformer. Earlier versions did not have this, and under some fault conditions the transformer can overheat and suffer damage before the mains fuse fails. The set we visited had suffered this condition, and it was not the first we've encountered.

The complaint was that the picture and sound had gone off and that there was a smell of burning before the set went dead. When these symptoms are reported, our first suspicion is the small bridge rectifier which provides the l.t. supplies. If there is a short in the h.t. line or in the line output stage, the mains fuse normally fails and puts an end to any hanky panky. A smell of burning however means either a short in the boost line feed to the c.r.t. first anodes (the sound continuing for a time) or some l.t. fault if the sound fails immediately.

Our first action therefore was to withdraw partly the right side unit and turn it, having ensured that there were no shorts from the PY500 top cap to chassis. Turning the unit exposes the h.t. and l.t. supply components. An ohmmeter test on the BY164 bridge rectifier confirmed that there was a direct short from the positive leg to the a.c. input. Removing the BY164 is only a matter of moments, and once removed a recheck showed that the short was indeed in the rectifier and not in the circuit. A new rectifier was fitted and the unit replaced.

A new 2·5A anti-surge fuse was then inserted, but this blew immediately the mains was applied. When the meter was applied to the l.t. transformer primary winding it swung over further than normal and confirmed our suspicion that this was at fault and not the filter capacitor or any other easily replaced component. Leaving things as they were, we beat a hasty retreat back to the workshop where we found that we had just one spare transformer. Returning to the house thus armed, we inverted the power unit and extracted the defective transformer. It has only about six connections, so the new one was easily fitted. Another new fuse and we were ready to go again. Switch on and the immediate rush of sound confirmed that the short had been cleared. The picture was good and little more needed doing.

The lesson then is that if the model is the original dual-standard or the subsequent single-standard one with the metal box on the right side, a defective bridge rectifier can ruin the mains transformer if the set is not switched off immediately the sound and vision fail.

And, oh yes, do be kind to moggies.

Video Notebook

Contributions by John de Rivaz, B.Sc.(Eng.) and David K. Matthewson, B.Sc.

AUTOMATIC SWITCH-OFF

A lot of VCR head life can be wasted should the autostop fail or the capstan slip while the machine is unattended, since there will be no signal to switch the machine off and it could run for hours or even days. When the clock is used the machine switches off after an hour, but anyone who uses the thyristor method of making one VCR come on after another in order to record for two hours at normal speed (see *Television*, February 1977), or who uses the speed reduction modification (*Television*, February 1978) and fits a thyristor to their clock, has lost his safeguard. Also, it's dangerous to set the machine to rewind and leave it unattended: the tape sometimes jams just before shut-off, and as it's under tension there is accelerated head wear, often causing several pounds' worth of damage.

The cure is to modify the 40s auto shut-off timer. Remove and discard the switch on the main control button grouping, and add the arrangement shown in Fig. 1. The capacitor C1 charges from the 12V line via the 1MΩ resistor R1, but is regularly discharged through the 470Ω resistor R3 by the reed switch. The latter is operated by a revolving magnet which is cemented with RS 554-197 adhesive to the counter pulley. If the machine stops when the magnet has closed the switch, the capacitor is discharged and the transistor cuts off. If on the other hand the switch is open when the machine stops then the capacitor charges up to the full extent: when it is fully charged no further current flows via the transistor which switches off. When the transistor is off, the 40s circuit charges and eventually shuts off the machine.

Solder the reed switch to the main frame by the counter pulley, with the 470Ω and high-value (e.g. 10MΩ) resistors providing support. Fit the other components to panel 10 (circuit E). **J. de R.**

MAINS LOCK CIRCUIT

The field sync pulses are prone to interference, the resultant bouncing picture being very aggravating. There is a partial solution however. The VCR is phase locked to the mains on replay, so in an emergency the television set can also be phase locked to the mains. The resulting picture is not perfectly stable, but the movement is slow and less objectionable.

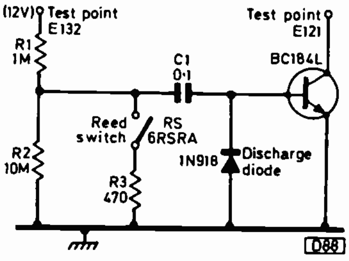


Fig. 1: Automatic VCR switch-off modification. The reed relay is operated by a magnet cemented to the counter pulley. A suitable magnet is the RS type 349-052.

The fault can usually be cleared by cleaning the machine, repairing the lacing, replacing the video heads or whatever else is necessary. This doesn't help with an already recorded tape however. To view this, the circuit shown in Fig. 2 can be added to the set. It has to be set up for the particular gap setting of the VCR, and may require alteration if the gap is changed. If you use this with a skip-field modified VCR with flyback time modulation, as described in the February issue, the extra modification shown must be added.

The 100kΩ preset phase control provides fine phase control: coarse control is obtained by varying the value of the associated capacitor C and selecting the correct input sinewave phase. If negative-going field sync pulses are required they can be obtained from the other output of the 74121 monostable i.c.

The results given by this circuit are not perfect, but are better than nothing. It doesn't work so well on a skip-field modified N1500, as the flyback modulation circuit is rather precise in its setting up and shows up the small phase modulation introduced by the noise in the head disc servo.

This sort of fault can also be reduced by adjusting the gap to come after the field sync pulse, not before it as recommended by the makers. In some cases, however, this may cause disruption of the colour, and if the receiver can't handle it the modification must be abandoned. **J. de R.**

SYNC PROBLEM

A Philips N1512 VCR was brought to us with the complaint that the line sync "went a bit funny" when some tapes were played backed on some TV sets. The N1512 incidentally is a video in/out version of the N1502, which is a modular version of the N1501 which in turn is basically the N1500 (the point is that the N1512 is not a skip-field

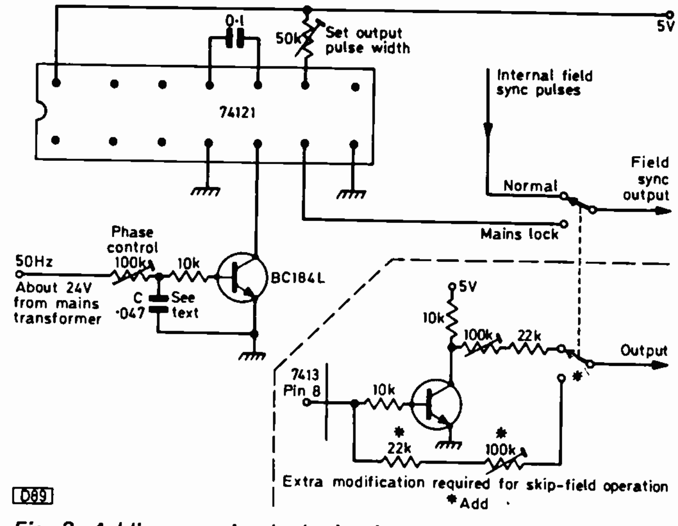
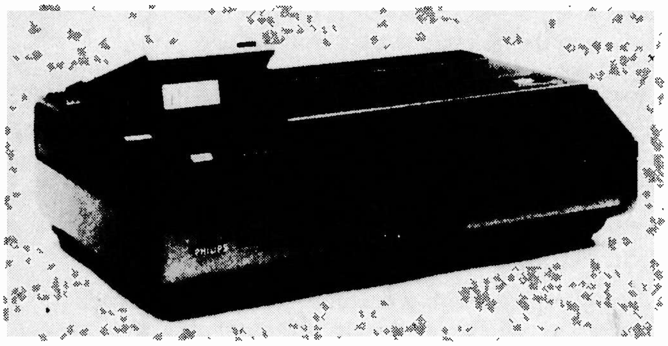


Fig. 2: Adding a mains lock circuit to overcome the problem of recorded tapes with unreadable field sync pulses.



The new Philips N1700 long-play VCR.

machine or anything strange like that). Perfect results were obtained on playing back a standard test tape, but as the man said the problem was only on some tapes on some machines. Examining the line sync pulses on a scope revealed a strange sight, two pulses instead of one, and on examining the circuit we found that the N1502 and N1512 have a system which adds an extra pulse to the line pulse, to act as an "automatic identification" signal. This automatically alters the time-constant of the flywheel line sync circuit in the Philips K12 chassis (amongst others) from the broadcast to the VCR standard. This appears to work o.k. on broadcast signals, but when rather rough signals, say from a cheap helical-scan VTR, are recorded on the N1512, or maybe a second generation tape is used, the resultant playback can be rather dire. Under these conditions an "auto ident" defeat switch would be of value: what about it Philips? **D.K.M.**

COLOUR SIGNAL INDICATOR

The basic Sony 1810 U-matic VCR is equipped with an LED to show when an input signal is in colour, but this feature is not included on the more expensive VO2850P editing version – maybe it's considered that if you can afford around £3,500 for an editing U-matic then the expense of a few colour monitors is not so great. In the use to which we put our 2850 however it would be very helpful to be sure that the signal going into the machine and the tape being played back are actually in colour. The following modification was devised therefore.

The switching between monochrome and colour inputs is controlled by the "video mode" switch on the front panel. This is a two-position switch which acts on both record and playback. The two options are: monochrome, which puts the machine into the black-and-white mode on record and plays back only the luminance part of the signal on playback; and "auto", which switches, on record only, between

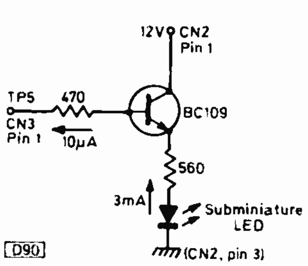


Fig. 3: Adding a colour signal indicator light to the Sony Model VO2850P U-matic editing machine.

monochrome and colour by detecting the presence or absence of the colour burst. The electronics for this switching are located on board CD1/2, the chrominance demodulator board. Test point TP5 in this circuit goes from 0V on monochrome to about 4·5V when a colour signal is present, providing a means of operating our colour indicator (see Fig. 3). To avoid loading the circuit, a transistor switch is used: the total base current of the transistor is less than 10μA, so there should be no ill effects. The 12V supply and chassis connections can be made to the same board – at CN2 pins 1 and 3 respectively. The LED can be mounted on the top panel, next to the video mode switch, by drilling a small hole in the plastic faceplate and press fitting the LED in place.

The LED lights on playback if the tape is a colour one, even when the video mode switch is in the black-and-white position – the playback is not then in colour, of course.

D.K.M.

VIDEO SLICER

A video slicer unit was described in the January 1977 issue, designed to take a composite monochrome video signal and process it to give a digitised composite video output consisting of just black-and-white, i.e. no greys. This gives an interesting "pen and ink" type effect when the output is displayed on a monitor. The design also provides a TTL level switching signal for use in conjunction with the video effects unit described in the April/May 1976 issues of *Television,* giving a type of keying. The design was based around the 710 operational amplifier i.c., which compares the video input signal with a preset reference voltage.

It was suggested in the original article that an LM319 dual-comparator i.c. could be used in place of the 710. This requires only a single rail power supply as opposed to the more complex requirements of the 710. We have now done this and produced a slicer which gives very effective results. There are a few differences between the LM319 and the 710 to be considered, but no problems arose. First the LM319 is an open-collector device, so the output must be linked via a 1kΩ load resistor to the 12V rail (see Fig. 4). Also pin 6 must be connected to chassis. The device can otherwise be used as the 710, but it should be noted that the pin connections are not the same.

The LM319 has an additional advantage over the 710 in that the unused half of the dual comparator could be used to provide an intermediate shade of grey, between the black-and-white extremes of the original design.

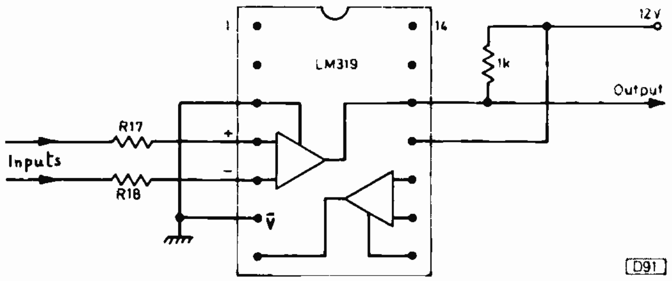


Fig. 4: Using an LM319 dual-comparator i.c. as a video slicer. Only one half of the i.c. is used.

The basic design gives a very effective black-and-white effect and, if the composite video output is fed to a simple colour encoder, a two-colour picture is produced. This is an effective way of producing colour captions from a monochrome camera. The design works well with large lettering (say 1in. Letraset) but will not resolve fine detail such as typescript.

Finally, note that there is an error in the power supply circuit (Fig. 2) in the original article. The base bias resistors R1 and R2 should both be 680Ω, not 680kΩ.

D.K.M.

Service Commentary

Steven Knowles

A RECEIVER fitted with the Philips 210 dual-standard monochrome chassis was brought in with the complaint sound, no picture. On examination we found that we could achieve faint screen illumination by advancing the brightness control to roughly the three quarters mark, but that any advance beyond this point caused the screen to black out.

This is the classic symptom of low e.h.t., and although a healthy line whistle was present on both systems it was impossible to see any heater illumination in the DY87 e.h.t. rectifier due to an accumulation of soot around its envelope. We decided first to try the effect of adjusting the preset 625-line width control however, not only because this was nearer to hand but also because they have a habit of developing poor wiper to slider contact which can cause similar symptoms. The control itself proved to be perfect, and we found that at its maximum setting a much better display was present on the screen. This also showed the true cause of the trouble, insufficient line output, as the width was heavily in on either side.

Importance of Correct Boost Volts

We made the usual checks on the valves and the resistors in the width stabilising circuit, but we didn't hold up much hope as we have come across these symptoms before on this chassis – due to shorted turns in the line output transformer. Ultimately the transformer was replaced, restoring normal results. After this we reset the width control for the correct 930V at the boost test point. We make a point of always checking the setting of these "set boost" controls whenever we do any servicing in a receiver's line output department.

There was one occasion recently however when we didn't! The set in question was fitted with the Thorn 1400 chassis, and the complaint was simply sound, no vision. Inspection showed that the fusible resistor feeding h.t. to the line timebase had opened, denoting excessive current. As usual, before doing anything else we gave the chassis a quick visual check. This revealed that one end of the third harmonic tuning capacitor, which is wired between two tags on the line output transformer, was badly blackened. An ohmmeter check confirmed that it was short-circuit.

We replaced it with a round disc type rated at 12kV, resoldered the cut-out, and switched on. Results were normal so without further ado we replaced the back and thought no more about it – until a week later we received another call to say that the set had again failed! Once again we found that the fusible resistor was open, and a glance showed that the new capacitor was badly blackened.

We then looked at the boost preset and realised why. It was set at maximum! Obviously what had happened was that the original capacitor had developed a leak (as often happens) causing a reduction in width, and at some stage this had been compensated for by increasing the boost preset to maximum. The capacitor had subsequently gone completely short-circuit, and when we replaced it with a new one, restoring full line output, the maladjusted preset had escaped our attention. The increased power then resulted in the new capacitor's early failure.

It's not often realised that over-advancement of these controls can contribute to the early failure of valves, triplers, and even the line output transformer itself. Bearing this in mind, the little time taken to check the boost voltage can be well worth while in terms of subsequent reliability.

Thorn 1590 Series

The complaint with a portable set using the Thorn 1590 chassis was simply no signals. A good raster was present, and a lively rushing sound from the loudspeaker seemed to indicate a tuner fault. The tuner used in this chassis is identical to that used in the 1500 hybrid chassis and suffers from the same main fault. The push buttons operate a bar which actuates the tuning mechanism. This bar is soldered into two slots (one at either end) and after some years' use the solder cracks. If both ends go at once the bar drops out to the bottom of the set. More often however only one end becomes detached, station selection then becoming completely erratic (if it works at all). This turned out to be the trouble with the set in question. Resoldering the bar restored normal operation, and we then ran the set for a while to ensure that everything was o.k.

During this time a further fault appeared. A ripple would appear in the centre of the screen, and at the same time the raster would contract by about half an inch on either side, leaving distinctively wavy edges, while field lock became critical. Although the sound was not affected, the appearance of the picture definitely suggested poor smoothing, and it was found that by rocking the main electrolytic smoothing can the symptom could be aggravated. We examined the print beneath the can but as we could find no fault here we concluded that the can was internally defective. Its replacement cured the fault.

Encounter with a Dabbler

With the advent of colour television it was hoped that the day of the dabbler would be numbered. Whilst quite a few people were prepared to fiddle with their old black-and-white bangers, valve swapping and the like, it seemed unlikely that they would contemplate doing the same with their 300 quid colour tellys! This has largely been true, but there have been exceptions. . . .

A set fitted with the Philips G8 chassis was received with the complaint that it "went bang when we switched on". The owner omitted to tell us however that he had himself removed the back, found the 3·15A mains fuse blown, and had – no, not replaced it – but wrapped some kitchen foil round it and put it back in! Anyway we cleaned up the mess, then noticed that a large section of print had been blown off the power board. We repaired this, fitted a new fuse, and then removed the cause of the original short-circuit – a shorted BT106 thyristor. This restored normal results, and after checking the h.t. the set was returned to the customer with a warning to the effect that if it was tampered with again we would not accept it for further service.

Indesit T24

The Indesit model T24EGB has proved itself to be on the whole quite a reliable chassis, although the resetting accuracy of the u.h.f. tuner is not always all that it should be, whilst the most common fault is undoubtedly output valve failure (see *Servicing Television Receivers*, December

1975/January 1976). Apart from this the most challenging aspect of these sets to any newcomer is trying to find out how to remove and refit the back! If any reader seems sceptical about this, Indesit have seen fit to print a set of instructions on the back cover explaining how to do it.

The only other odd fault that we have had on more than one of these sets is an effect very similar to vision buzz on the sound, but in this case the buzz can still be heard through the loudspeaker with the volume control at minimum. The tuner and user control panel are adjacent to one another on this model, and the problem is due to interaction between the wires running from these to the main deck. Careful repositioning of the leads solves this one.

An Audio Cassette Recorder

Finally, on a lighter note, we were asked to examine a mains/battery cassette recorder of reputable make with the complaint that the sound was distorted at all levels and that it would not work on the mains supply. We decided to tackle the latter complaint first, and this was cured by replacing the step-down transformer which had an open-circuit primary winding. Sound was still distorted however, and the maximum output was definitely not what it should have been. As is our usual practice, we decided to commence by making checks on the loudspeaker and output stage, working back from there. We struck lucky! The output stage uses two transistors of the Japanese 2SB series, and one of these was found to be open-circuit. The two were replaced with a couple of AC128s.

It was whilst the recorder was being run on test that we happened to glance at the instruction leaflet which the owner had kindly provided . . .

For recording, it informed us that "Microphone should be held eight inches away from the speaking mouth". "Speaking mouth?" we said. The procedure for erasure looked even more formidable. "The recording anew on the already recorded tape will automatically erase the previously recorded material to be replaced with the now recorded information". If you wished to monitor the recording being made, it informed you that "the earphone of yours should be connected to the MON jack".

We're still recovering! See you soon. ■

Customer Relations

Malcolm Burrell

IT'S a fact of life that for most TV service engineers, unless they are confined to the service department and don't have to deal with callers or 'phoned enquiries, customer relations is a major part of the job. Many technicians leave the trade or develop a rather cynical outlook on life due to the distress caused by awkward customers. The old adage of the customer always being right does not always apply to TV servicing: after all, if the customer thinks he knows so much he doesn't need a technician to come and sort things out for him! Since there's no way of avoiding this problem, it's best to try to mould the customer to your way of thinking. It's a rewarding art to cultivate, and can be achieved by even the most sheepish of us. Personally, I've had a good few years in which to try it out. The advice which follows is based on this experience and will, I hope, prove of help to others.

It's important to try to relax and not rush things. Provided one carries out the repair properly there's little to be gained from dashing off to the next call – save maybe a nervous breakdown. Also, there's no point in making the customer think you've no time for him. Remember that you may well be calling again in the future, so it's best to establish good relations from the start. There are of course always the odd few who will keep you talking all day given half the chance. The answer to this is to listen patiently for a bit then try to slip in a few words. Something like "well, I've got to go all the way to so and so now" usually makes it possible to break off the conversation politely.

Most of us find it difficult to explain some points to customers despite our attempts to keep abreast of developments in TV technology. Try to keep a few aces up your sleeve by way of literature and pamphlets which can help when you're confronted with a disbelieving customer. It's a pity that proper documentary backing is rare when you have to explain aerial and interference problems, though the IBA has a *Guide to Good Viewing of ITV* which is available free in small quantities and can be very useful in impressing customers.

Though it can be tempting at times, it's best not to blind the customer with science. It's better to keep to generalisations. For example, if asked about the line output transformer you can reply that "it's all tied up with generating the twenty thousand volts or so required by the tube and in moving the spot from side to side". This should keep the customer happy and prevent him feeling at a disadvantage. Similarly, when discussing the virtues of a masthead preamplifier over a set-back type there's no point in going on about decibel gain: better to say that there's always loss of signal in a downlead and it's better to boost the stronger signal up at the aerial.

Ghosting

Ghosting causes many problems. Whilst most viewers accept that "double vision" is due to a delayed signal reaching the aerial at the same time as the desired one, the added effects of pulling and poor sync are not so easily explained, while a demonstration with another make and type of set may prove quite embarrassing if it performs even slightly differently. The best solution is to say that there are pulses sent out by the transmitter at the sides of the picture, to tell the set what to do. Sometimes a ghost in the wrong position will confuse the set so that part of a face may be displaced. For the same reason, even with slight ghosting an image of one of these special pulses may appear down the left of the picture in the form of a light or dark band (not to be confused with foldover or lack of line flyback suppression).

Noisy Pictures

A similar case arises when confronted with a noisy picture. Whenever possible one should make sure that a fault in the set is not responsible. Even a spare set can be misleading since occasionally in marginally weak areas a particular tuner may function perfectly and then develop trouble. A little extra trouble taken by the technician in conveying the set to the workshop for a check, having first warned the customer that his aerial is almost certainly to blame, can save a great many heated exchanges later.

Knowledge of local conditions will enable a technician to advise on the most suitable installation for a given area. It's unfortunate that whilst we all dream of high-gain XG21 arrays the most that the average aerial rigger can muster is an odd 18-element unit of unknown pedigree, a preamplifier and the reply "that's the best it'll every be". High-gain aerials, costly as they are, are rarely offered as a choice to the customer: I feel that a great deal more could be done by aerial manufacturers to promote their products to the public rather than the trade, because only public demand can boost sales.

There are some positions where an aerial like Jodrell Bank will not suffice, and it's useful to have some alternative source of signal such as a crosshatch or colour-bar generator in order to be able to demonstrate results with a reasonably ideal signal. It's even possible to carry a second-hand TV camera with an r.f. output, though this is generally a complication which finds surprisingly little use.

Some customers cannot be pleased, such as the old lady with a set-top aerial who agrees that it works better on top of the set but insists than an equally good picture should result when it's concealed underneath! A little time spent extolling the virtues of loft aerials and a free copy of the IBA good viewing guide is the most one can do.

Establishing Rapport

The value of a smile should not be under estimated. The TV engineer's sixth sense often tells him that reception at a certain front door will be a cold one. A well-timed smile or a cheerful expression usually breaks the ice. If you notice something particularly pleasing in the house, say so – you may even get a cup of tea! To address the customer by name is a help – provided you can read it correctly from the job card and that it isn't mis-spelt. Some names can sound surprisingly rude if mispronounced.

The stern expression of a high court judge is totally unnecessary, and a fairly relaxed attitude interposed with such expressions as "Oops" as you grab the e.h.t. lead can greatly advance your customer relations.

Dogs can be a problem but are better ignored. Try to keep your tool box between you, particularly if the dog shows over friendly tendencies. A polite request to the customer, indicating the danger to a dog in close proximity to a live chassis, is better than a hot soldering iron or splash of e.h.t. which could severly shorten your job prospects as a field engineer!

The Critical Viewer

One of the most difficult situations is when after repairing or installing a set the customer looks at the picture with disgust and complains of a non-existent fault, e.g. "Look! Can't you see? It's flickering". Assuming that the interlace is correct and that there is a good aerial signal, also that there is an acceptable transmission, a brief explanation of how twenty-five separate pictures are transmitted every second, together with a short while spent adjusting the contrast and brightness, will help. A little expansion into other causes of flicker, such as moiré patterning, aircraft flutter, cross-colour etc., will at least demonstrate to the customer that you are not only aware that these problems exist but that you have some experience of them and can define their causes.

The television system itself causes many critical comments from customers. The glittering frequency gratings on the test card when displayed in colour is one example. This is known as cross-colour and is the result of fine monochrome patterns being confused by the decoder for colour information. Assure the customer that this is normal, show him the test card in black and white, then as you turn up the colour control explain that the set thinks it's seeing a colour signal. Draw his attention to the fact that he has probably at times noticed the same effect on actors with finely patterned suits.

Another question arises from the fact that the intensity of the colour varies from programme to programme. This does occur – but we don't have to endure such great variations as with other colour systems. One can only point out that this is what the colour intensity control is there for – to adjust!

There are many other problems, such as monochrome film excerpts broadcast with ghastly coloured tints, transmissions with noisy colour, grainy film stock, "hop" and "weave" on some film sequences, badly lit objects such as might occur on outside broadcasts where extremes of light and shade necessitate the camera lens being stopped wider than normal, causing flattening of highlights, and fuzzy colours on the distant players at a football match, caused by the inability of the colour system to resolve fine colour detail.

Installing a Colour Set

A little expertise when first installing a colour receiver is all that is required to reassure the customer. The fact that you are at the house with a colour set signifies that the customer has been sold on the idea of colour, so whatever you say is unlikely to dissuade him.

If he has a monochrome set, try this first (if it is a 625-line u.h.f. one) and point out any shortcomings which could spoil a colour picture. Plug in and set up the colour receiver, and explain that because the screen is composed of minute dots or slots (a demonstration with a magnifying glass or showing a piece of shadowmask impresses here) he may not obtain the absolute sharpness to which he has become accustomed on his black-and-white set. Also stress that if he looks closely for colour fringeing he will undoubtedly find it. Impress upon him that the eye is not conscious of fine detail in colour, and that the colour system is basically black-and-white with a coarse colour signal added. Emphasise the need to sit at the correct viewing distance (about four times the picture height) to avoid noticing blemishes in the picture, and mention that unfortunately not all transmitted programmes are of the same high standard.

One final point is worth mentioning. When installing a new set, emphasise that it's a highly complex piece of electronic equipment and that there's always the possibility that some minor breakdown may occur during its initial running-in period.

The Positive Approach

The emphasis above has been on a positive approach to a new customer. The intention should be to display honesty and concern that he should obtain the best possible enjoyment from his set while at the same time showing that you, the engineer, have a great deal of experience in your subject. By starting on the right foot, you pave the way to a good servicing relationship with your customer, who will therefore more readily accept any future suggestions you make. The moral is: kill complaints before they're made, and before they kill you as a field engineer!

The best of luck to you all! ■

Your PROBLEMS solved

Requests for advice in dealing with servicing problems must be accompanied by a 50p postal order (made out to IPC Magazines Ltd.), the query coupon from page 331 and a stamped addressed envelope. We can deal with only one query at a time. We regret that we cannot supply service sheets nor answer queries over the telephone.

Pye 697 Chassis

A 2in deep hum bar keeps moving down the screen from the top to the bottom. I've changed, without success, the l.t. bridge rectifier, the h.t. smoothing electrolytics, the luminance and colour-difference output valves, and the electrolytics in the l.t. supply lines. There's no hum on the sound.

Since you seem to have cleared the h.t. and l.t. lines of suspicion, the trouble could well be in the earthing of the colour-difference amplifier panel. This is a constant trouble spot in these models. Remove the panel, resolder the tracks and ensure that they are well bonded to the main frame when the panel is refitted. If this is not the cause, check the earthing of the smoothing electrolytics and note the effect of reducing the contrast.

Philips G8 Chassis

Line hold is very easily lost on this set. Critical adjustment of the line oscillator coil will get the picture to lock again, but it's liable to go after a short period. The voltages around the line oscillator/reactance stages seem to be about right and the waveforms resemble those given in the manual. The electrolytic (C4498) in the flywheel sync filter circuit has been replaced. The control voltage at the base of the reactance transistor Tr4500 is slightly lower than the correct figure, so I'm beginning to suspect the TAA700 video/sync i.c.

If the line oscillator coil L4501 will "float" the picture it seems likely that the sync control is deficient. The i.c. (IC2001) can be destroyed by a tube flashover. It's fairly expensive, so it would be as well first to check, preferably by substitution, the reactance transistor Tr4500 and C4520 (16μF) which decouples its collector supply. Also make sure that the zener diodes D4531 and D2166 are not defective.

Baird 710 Chassis

There is e.h.t. trouble with this set. When it's first switched on and whilst warming up the valves (PY500 and PL509) in the line output stage overheat. If the top cap is taken off the PY500 for about ten minutes and then replaced however the e.h.t. and raster appear and will remain as long as the set is switched on. Switch off and let the set cool down and the same thing happens on switching on again. The line output stage valves and the PCF802 line oscillator valve have all been replaced along with a few resistors which had increased in value. Could it be a defective line output transformer?

It seems that the line oscillator is reluctant to start. The usual cause of this is faulty capacitors in this stage. We suggest you check the small electrolytics C442 and C437 (both 5μF), the feedback capacitor C426 (470pF) and the waveform shaping capacitor C445 (820pF). Also if necessary the tuning capacitors C425 (0·0027μF, 405 lines only) and C438 (0·0022μF). This should sort things out.

Telefunken 710B Chassis

The trouble with this set is a form of field collapse: there is illumination over about the middle third of the screen, but this illuminated area is not linear, instead being apparently modulated from side to side of the screen. The PL508 field output valve and the BC237A driver transistor have been checked and found to be in order.

The fault appears to be in the north/south pincushion distortion correction circuit. This employs a resonant transformer (Tr721), with the field scan current flowing through its secondary winding. The primary is driven by a four-transistor modulator circuit (T721-4), with phase and amplitude controls. Phase adjustment is very important. Should the tuned circuit L722/C730 go off frequency, there will be severe effects. C730 can change value to cause the sort of trouble you describe, while misadjustment of the coil can cause similar effects. Tr721's tuning capacitor is C738 and this can change value to cause raster distortion.

Pye 173 Chassis

There's very poor line sync on this set, with intermittent line slip all the time. The valves all seem to be in order and there are no discoloured resistors.

The most common cause of the trouble is the polystyrene capacitors in the line oscillator circuit, especially the feedback capacitor C67 (820pF). Other suspects are the line oscillator coil and the jungle i.c., which may be type TAA700 or TBA550.

GEC D/S Colour Chassis

Soon after switching on there's pulling to the left at the top of the picture. This is followed later by loss of line sync. Neither line hold control will lock the picture, and while a new PCF802 line oscillator valve has been tried this provided only a temporary cure.

The fault is unlikely to be in the line oscillator stage itself, though the 820pF polystyrene feedback capacitor C513 could be playing up. We suggest you check the two flywheel sync discriminator diodes D501A/B, the reference pulse integrating resistor R505 (47kΩ), the sync pulse feed capacitors and load resistors in the flywheel sync circuit (C503/4, R507/8), then if necessary the sync separator's screen grid feed resistor R502 (47kΩ) and the components in the flywheel sync filter circuit, starting with R512 (560Ω).

Philips 300 Chassis

The picture takes a long time to appear after the set has been switched on – sometimes it takes fifteen minutes, sometimes much longer. The picture is excellent when it does come on, and remains good throughout the evening.

The most common cause of this trouble is that the boost diode or the line output valve is tired. Replace these, then check the width circuit. The components to examine here are the two high-value (8·2MΩ) resistors R2166/7, which increase in value over the years, and the width potentiometer which might have a burn spot on its track.

Philips G6 Chassis (S/S)

There is an irritatingly slow picture roll which is very difficult to remove by adjusting the field hold control. This can occasionally be done with the control at the centre of its range, but usually the rolling stops of its own accord and the set will then stay synchronised for maybe a couple of hours – until the channel is changed. I have checked the valves in the field timebase and the capacitors in the output valve's control grid circuit without any success. The voltages in this area seem to be normal.

You should check the luminance output/sync separator circuit rather than the field timebase. The most likely causes of the trouble are the sync separator's screen grid feed resistor R2122 (220kΩ) increasing in value or the valve itself (PFL200) being defective. A less likely possibility is the luminance output pentode's screen grid decoupling electrolytic C2047 (12·5μF).

ITT CVC20 Chassis

The problem with this set is lack of height plus field roll. The field timebase is fairly complex. Are there any quick checks?

We've known this problem to be due to the 12V rail being low: it supplies one of the field oscillator transistors (T3, BC172B). The supply is derived from the EW modulator in the line output stage, and is regulated by a series stabiliser circuit. The problem is that R102 (16kΩ) in the network which feeds the base of the error detector transistor tends to increase in value. If it goes open-circuit incidentally the effect is no sound or vision, with just the c.r.t. heater alight.

Pye D/S Colour Chassis

The trouble is good sound but no raster, with the line output and boost diode valves glowing, especially the PL509. The line timebase valves have been changed, and the boost line smoothing components (R228, C229) checked. There is negligible voltage at the c.r.t. first anode preset potentiometers, while the boost voltage is only 500V instead of 710V (measured at R228). After half an hour there is a smell of burning which I can't trace. There is a faintly audible line whistle, and no signs of arcing can be seen.

The line whistle suggests that the line oscillator is working, though for good measure you could check the electrolytics in the stage (C212/C216/C221). The fault is more likely to be in the output stage however. Relieve the load on it by removing the GY501 e.h.t. rectifier valve. If the load is still present, check the high-voltage capacitors C226 and C222 (third harmonic tuning and pulse feedback respectively). Although you say you've checked the boost line smoothing components, these components often give trouble and the incorrect voltages and smell of burning suggest a failure here. So make sure that C229 is not leaky, and that R228 is still 100kΩ – if it falls in value C229 damps the line output stage sufficiently to remove the raster.

Hitachi CSP680

The fault on this set is a very slight intermittent red tint which occurs at intervals of several seconds, the overall fault lasting a couple of minutes. The picture is normal in between these "blushes".

First make sure that the PAL circuit board is making good contact at its pins. If all is well, check the c.r.t. red first anode control R807 for intermittency, then suspect the red output transistor TR27 (2SC154C) and the R – Y amplifier TR24 (2SC460) and their connections.

GEC D/S Colour Chassis

When the picture brightness increases, the width comes in at the sides. This happens whether the increased brightness is caused by advancing the brightness or contrast control settings, or the white content of the picture increases.

Check the voltage at the cathode of the PL509 line output valve. It should be 2·8V. If necessary, check the valve and the value of its cathode resistor (R61, 10Ω). It's important that the voltage at the emitter of the beam current limiter transistor TR34 is 2·8V. Check the setting of P507 and the circuit as necessary. It's possible that the e.h.t. tripler is faulty.

Philips G6 D/S Colour Chassis

The fault on this set is intermittent field bounce, but various efforts to track down the cause have proved unsuccessful. Are there any stock causes?

Field bounce can be deceptive in these sets. It could be due to any of the three valves in the field timebase – the ECC81 oscillator, PCC85 cathode-follower or the PL508 output valve – or to a slight discharge from the field output transformer, a faulty preset control (linearity, stabilising, correction etc.) or to the field output pentode's screen feed resistor R4116 decomposing. Its value is 6·8kΩ, 2W.

Thorn 1591 Chassis

The picture seemed to be out of focus, so I adjusted the focus control. Half an hour later there was a loud crack and smoke came from capacitor C110. This was replaced, but the replacement gets very hot after a few minutes.

C110 is the reservoir capacitor for W13. Between them they provide the c.r.t. first anode and focus supplies. The trouble is almost certainly that W13 has gone short-circuit. A BY207 is a suitable replacement. When you've done this, make sure that C110 is still in good condition and that the focus control R134 still reads 1MΩ.

Thorn 2000 Chassis

The trouble is vertical white lines for the first two inches on the left-hand side of the screen, with some non-linearity. I gather that this can be caused by the diodes in the horizontal shift circuit, but have been unable to get the type fitted.

The diodes are type BA148, and shouldn't be a problem since they are listed in current adverts. A later equivalent is type BY206. If changing the diodes fails to cure the fault, check the linearity coil damping resistor R27 (1·2kΩ), the efficiency diode W4, the first anode supply reservoir capacitor C23 (0·047μF) and the h.t. supply smoothing capacitors C30 (5·6μF) and C31 (10μF).

Pye 169 Chassis

When the set is switched on a white spot appears on the screen. After a few seconds this spot disappears, the sound comes on, and then the picture appears very dimly, taking four to five minutes to reach full brightness. After this the picture is good.

Unfortunately the symptoms indicate a low emission c.r.t. You could try boosting it, but be careful not to disturb the l.t. supply for the transistor stages. This is derived from the earthy end of the heater chain, after pin 8 of the c.r.t., and the voltage at this point should be 19V d.c.

KB VC2 Chassis

When the set is switched on all that appears is a blank raster. Then after about ten minutes an intermittent picture appears, alternating between good, degraded and no picture at all. With a good picture the sound is normal, but with no picture or a degraded one the sound is noisy, accompanied by a buzz. The picture improves as the set warms up, but remains intermittent. The system switch appears to be in order.

There seems to be a fault in the i.f. stages. Assuming that 625-line reception is being used, first check C44 (120pF) in the coupling network between the first and second i.f. stages. It could be leaky, and substitution is the best test. If this fails to cure, check the a.g.c. clamp diode D9 (M1). The two vision i.f. valves (EF183 and EF184) and the video output valve (PCL84) are also suspect.

Telpro C501/Decca 30

The trouble is pulling on peak whites. The more the contrast is increased the more the picture, on peak whites, is displaced to the right. The pulling is not noticeable on a dark picture. The line hold control has been set up correctly, but the verticals on the test card are never straight. The picture also occasionally shakes about in the bottom half when the picture is bright.

The problem is not uncommon on the Decca 30 series chassis, which is electrically almost the same as the Telpro sets. It's due to the RGB output stages working at the wrong operating point, usually because VR239 which sets the clamping level in the luminance channel is misadjusted. Setting this up and then if necessary adjusting the preset brightness control to achieve the correct user brightness control range should cure the trouble.

TEST CASE

184

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

The monochrome picture and sound reproduction from a set fitted with the ITT CVC8 chassis were perfectly normal, but after the set had been running for a while the colour saturation tended to reduce. This was sometimes a gradual process, as though the colour control was being slowly retarded; at other times the effect was much more abrupt and very intermittent. Since the symptom was visible only with the colour control advanced (there was no effect on the monochrome display with the colour control fully retarded), it was concluded that the picture tube biasing, drive and video circuits were free from blame.

The model uses an MC1327 colour demodulator and matrixing i.c., which delivers red, green and blue primary-colour signals to the appropriate two-transistor amplifiers for driving the tube cathodes. The i.c. is driven from a BC171B (T29d) transistor via the PAL delay line. The i.c. is also fed with the Y signal from the luminance channel, the subcarrier reference signal, and the ident signal. All these circuits appeared to be operating correctly since there was no hue imbalance when the colour saturation changed with the appearance of the fault condition.

The chroma channel is fed from a distribution amplifier, and consists of two transistors in front of the T29d delay line driver. Automatic chroma control (a.c.c.) is applied to the first transistor T27d, while colour killing is associated with the delay line driver transistor T29d, this transistor being switched on only when a colour transmission is being received.

As no oscilloscope was at hand it was decided to monitor the potentials first at the emitter of the second chroma amplifier transistor T28d and then at the emitter of T29d, with the set receiving a steady-state colour test card transmission (off-air).

When the fault occurred there was no voltage change at T28d emitter, but at T29d emitter an appreciable voltage change occurred as the saturation diminished.

What was the most likely cause of the trouble, and which area of the circuit would require further detailed investigation to bring the defective component to light? See next month's Television *for the solution and for a further item in the* Test Case *series.*

SOLUTION TO TEST CASE 183
– Page 273 last month –

It will be remembered that the trouble was poor ident in a colour set fitted with the Decca Bradford chassis. The technician found a good clue to the cause of the trouble, since improved performance was obtained by screwing in the core of the 7.8kHz tuning coil. The implication of this was reduced capacitance across the coil, and since the symptom occurred only after the receiver had thoroughly warmed up the message was that the coil's shunt capacitor was decreasing in value with increased temperature. The trouble in fact was impaired temperature coefficient of the parallel 0.1μF tuning capacitor C238, replacement completely clearing the trouble. The core of the inductor could then be adjusted for maximum amplitude of the 7·8kHz ident signal.

QUERY COUPON

Available until 17th April 1978. One coupon, plus a 50p (inc. VAT) postal order, must accompany EACH PROBLEM sent in accordance with the notice on page 329.

TELEVISION APRIL 1978

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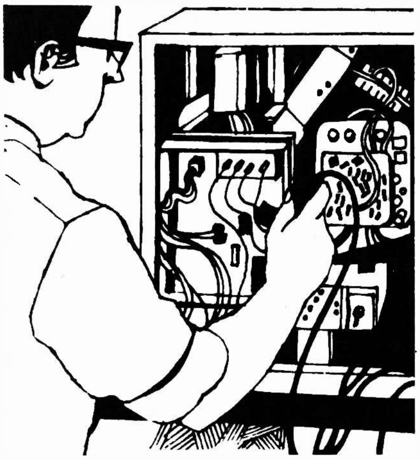

We regret that due to an error in the February 1978 issue of TELEVISION, the advertisement on behalf of Mr. C. Caranna on page 221 contained a wrong telephone number. Would readers please note that Mr. Caranna's correct number is 01-458 4882 as shown in his advertisement on page 333 of this issue.

SMALL ADS

The prepaid rate for classified advertisements is 16p per word (minimum 12 words), box number 60p extra. Semi-display setting £3.20 per single column centimetre (minimum 2·5 cms). All cheques, postal orders etc., to be made payable to Television, and crossed "Lloyds Bank Ltd". Treasury notes should always be sent registered post. Advertisements, together with remittance, should be sent to the Classified Advertisement Manager, Television, Room 2337, IPC Magazines Limited, King's Reach Tower, Stamford St., London, SE1 9LS. (Telephone 01-261 5846).

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