MAY 1977 45p

TELEVISION

SERVICING · VIDEO · CONSTRUCTION · COLOUR · DEVELOPMENTS

build the

TV

Single-Chip SYNC PULSE GENERATOR

also:

EMO COLOUR SETS

GEC S/S MONO RECEIVERS

The COLOUR SUBCARRIER EXPLAINED

TELEVISION

May 1977

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CORRESPONDENCE

All correspondence regarding advertisements should be addressed to the Advertisement Manager, "Television", Fleetway House, Farringdon Street, London EC4A 4AD. All other correspondence should be addressed to the Editor, "Television", Fleetway House, Farringdon Street, London EC4A 4AD.

BINDERS AND INDEXES

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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".

this month

OUR NEXT ISSUE DATED JUNE WILL BE PUBLISHED ON MAY 16

TRANSISTORS, ETC.

Type	Price (£)
AC107	0.48
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	0.50
ACY19	0.40
ACY28	0.35
ACY39	0.78
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	1.10
AL103	1.13
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	0.33
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*	†0.18
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	0.49
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	0.65
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	0.92
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	0.48

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
BUY77	2.50
BUY78	2.65
BUY79	2.85
D40N1	0.64
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	1.30
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	0.92
2SC643A	1.36
2SC1172Y	2.80
2SD234	0.89
40361	0.48
40362	0.50
40595	0.89

*Alternative gain versions available on items marked **

LINEAR IC's

Type	Price (£)
BRC1330	†0.93
CA3005	1.80
CA3012	1.32
CA3014	1.80
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	1.15
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	0.95
SC9504P	0.97
SL414A	1.91
SL432A	2.52
SL450	5.10
SL901B	†4.10
SL917B	†5.50
SN72440N	†0.96
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	†0.92
SN76530P	†1.85
SN76533N	†1.20
SN76544N	†1.85
SN76660N	†0.60
SN76666N	†0.90
TA7073P	†3.51
TAA300	†1.84
TAA320	0.94
TAA350A	†1.96
TAA435	†0.85
TAA450	†3.39
TAA550	†0.60
TAA570	†2.30
~~TAA611A~~	~~†1.70~~
TAA611B	†1.85
TAA630Q	3.91
~~TAA630S~~	~~†4.18~~
TAA661B	†1.75
~~TAA700~~	~~†3.90~~
TAA840	†2.38
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	†3.20
TBA550Q	†4.10
TBA560C	†3.13
TBA560CQ	†3.22
TBA570	†1.29
TBA641AX12	2.55
TBA673	†2.19
TBA700	†2.50
TBA720AQ	†2.38
TBA750Q	†2.39
TBA750A	†2.07
TBA750Q	†2.07
TBA800	2.40
TBA810AS	†1.95
TBA920Q	†3.68
TBA940	†1.95
TBA950	†1.95
TBA990	†2.90
TBA990Q	†3.35
TCA270A	†3.55
TCA270CQ	†3.55
TCA270Q	†3.55
TCA800	5.55
TDA440	†3.70
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	0.55
BY176	1.68
BY179	0.60
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	12p each
1/1.3W plastic 3.3-180V	20p each
1.5W flange 4.7-75V	85p each
2.5W plastic 7.5-75V	48p each
20W stud 7.5-75V	74p each
75W stud 7.5-75V	£5.60 each

VDR'S ETC.

Type	Price (£)
E295ZZ	
/01	†0.21
/02	†0.21
E298CD	
/A258	†0.20
E298ED	
/A258	†0.18
/A260	†0.18
/A262	†0.18
/A265	†0.18
/P268	†0.18
E298ZZ	
/05	†0.20
/06	†0.18
E299DD/P116 – P354	all †0.17
E299DH	
/P230	†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
VA1074	†0.17
VA1077	†0.27
VA1086	†0.17
VA1096/97/98	all †0.19
VA1104	†0.44
VA8650	†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	†2.16
PFL200	†0.94
PL36	†1.08
PL81	†0.94
PL84	†0.79
PL504	†1.05
PL508	†1.33
PL509	†1.80
PL802	†1.80
PY81/800	†0.56
PY500A	†1.16

RESISTORS

Carbon Film (5%)†	ea
¼W 5.6 Ω-330K Ω (E12)	1.5p
½W 10 Ω-10M Ω (E24)	3p
1W 10 Ω-10M Ω (E12)	3p
2W 10 Ω-10M Ω (E6)	5p
Wirewound (5%)	
2½W 0.22 Ω-270 Ω	17p
4W 1.0 Ω-10k Ω	18p
7W 1.0 Ω-22k Ω	19p
11W 1.0 Ω-22k Ω	20p
17W 1.0 Ω-22k Ω	24p

SPECIAL OFFER each
DL1 chrome delay lines 75p
DL1E chrome delay lines 80p
RCA scan coils (90° colour) complete £10 per set
(Please add 30p postage to delay lines and £1.20 postage to scan coils.) PAL subcarrier crystals (wire-ended) **ONLY 55p** each

COLOUR BAR GENERATORS
Labgear CM6052/CB: VHF/UHF gives standard 8 band colour bars + variable tuning + front panel on/off switch + VHF/UHF switched output capable of displaying blank raster + red raster + crosshatch + grey scale step wedge + colour bar + centre cross + dot pattern + centre dot. **£148.05**

VHF TO UHF CONVERTERS†
Labgear "Televerta" for DX-ing, or uhf receiver use on relay systems, Eire, etc. Type CM6022/RA. **£21.62***

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 and many more transistors, diodes, ic's & valves.

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

EAST CORNWALL COMPONENTS

CALLINGTON - CORNWALL
PL17 8PZ

TEL: STOKE CLIMSLAND (05797) 439
(OFFICE OPEN 9.30-5.00 Mon-Fri)

REBUILT COLOUR TUBES

ALL SIZES AVAILABLE

Full range of rebuilt mono tubes available, Standard, Rimband and Twin Panel.

★ Complete new gun fitted to every tube.
★ 12 months' guarantee.
★ 18 years' experience in tube rebuilding.
★ Trade enquiries welcomed.

N.G.T. ELECTRONICS LTD.
20, Southbridge Road, Croydon, Surrey
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THE NEW COLOUR TUBE SAGA

As the 1977 trade shows approach, the most interesting point to watch will be the way the setmakers go in selecting from the various in-line gun colour tubes now available for use in their new chassis. There is quite a variety: the RCA PI tube, the Mullard/Philips 20AX, the Toshiba RSI and SSI ranges and the Matsushita (National Panasonic) Quintrix for example, plus various recent US tubes as mentioned in *Teletopics* last month. There are also one or two tubes, from Hitachi and Mitsubishi, which bear an uncanny resemblance to the PI tube. And of course there's Sony's Trinitron, though Sony seem to have preferred all along to keep this to themselves as part of their highly individual approach to TV engineering.

The main contenders in the UK have been the PI, 20AX and RSI/SSI ranges. All in fact are in use in current UK chassis – the PI in the Thorn 9000 chassis, the RSI in the Rank Z718 chassis, the SSI in the Decca 80 chassis and the 20AX in the Decca 100. The 20AX has also been used in various UK produced export chassis, while conversely there have for several months been imported sets – in the Grundig, Nordmende and Telefunken ranges – fitted with this tube.

One odd thing is tube size. In developing their in-line gun tubes RCA and Toshiba started off with the smaller sizes and went on to develop larger ones (similarly with Sony). The first PI tube was the 90°, 20in. one. Decca use 18 and 20in. 90° SSI tubes, and Rank 20 and 22in. 110° RSI tubes. When originally announced however the 20AX was declared to be a tube that would start off in a complete range of sizes from 18 to 26in., though its main impact is being felt in the larger screen sizes. Thus ITT use the PI tube in their 20in. set but the 20AX in their larger models, while the larger Decca models, the 22 and 26in. ones, use this tube (the 100 chassis). We understand that 20AX models will be announced by GEC, Philips and Pye at least before long, starting with the larger tube sizes. RCA's course has varied due to the different market requirements it faces. In the USA 25in. is still the standard colour tube size, while slimline cabinets don't seem to be considered as important as in Europe. For the European market RCA developed a 26in., 110° PI tube – a lot of work on it was done at the Thorn Skelmersdale plant before its closure – but so far as the UK market is concerned it seems that the pound's devaluation last year put this tube at rather a disadvantage economically.

It's taken quite a time between the original announcement of these various tubes and their appearance in setmakers' production chassis. You can't of course retool your tube plants and TV set production lines overnight – and there is no great urge to do so during a recession. But there seems to be rather more to it than that. A tube and its scan coils have to be regarded as a combined system. And in designing the system compromises have to be made between the conflicting requirements of raster geometry, convergence and focusing. It seems to us that the setmakers, in experimenting with the sample in-line gun tubes presented to them, have had various reservations. After all, the 90° delta gun tube and its attendant circuitry had been developed to the point where with correct setting up a really superb picture could be obtained. The basic idea behind the in-line gun tubes is not so much to improve upon this as to make the set, its manufacture, setting up and servicing simpler – with economic benefits to setmakers and consumers alike. But is the picture as good? The point here seems to be that in "building in" the convergence – using scan coils which converge the beam by producing an astigmatic field – you have a much more elegant approach but much less external control over the picture and an increased need for compromise between the conflicting parameters of geometry, convergence and focusing. It seems likely that the in-line gun tube will not produce such a good picture as a well set up 90° delta-gun tube, though we're not condemning the new tubes – it's unlikely that the difference will be noticeable by the domestic viewer, who is used to watching sets which have drifted well away from their optimum settings, and even if he does he will still benefit from the reduced costs and easier servicing.

It's also worth remembering that the tubemakers are engaged in a continuing programme of technical development. Quite a lot happened to the delta-gun shadowmask tube over the years, and it's very early yet in the history of the in-line gun tube.

teletopics

SINGLE VOICE FOR UK COMPONENTS INDUSTRY

The Radio and Electronic Component Manufacturers' Federation and the Electronic Components Board have formed a new joint organisation, the Electronic Components Industry Federation (ECIF), to provide the UK electronic components industry with a single voice representing its interests. One factor behind the move seems to be the imbalance in the industry's import/export performance: exports are now considerable, but we continue to import more than twice as much as we export, and international competition is increasing. The figures for last year in fact were total exports roughly £85 million and imports £180 million. Exports had increased in value by 30% over 1975 but imports had increased by 50%. The main imbalance was in semiconductor devices, particularly integrated circuits, and television tubes. The new group has been formed at a time when the industry has been selected by the Government and the National Economic Development Council for detailed attention in recognition of its potential for development – its importance has already been recognised in establishing a Department of Industry support scheme for electronic components with an initial sum of £20 million.

One wishes the new Federation all success. But with the UK tube industry down to one foreign controlled firm and, on the semiconductor side, massive excess capacity in other parts of the world, it seems unrealistic to expect too much. The UK can compete – take BSR's domination of the world record autochanger market for example – but there's not much scope as far as run of the mill electronic components are concerned. The main possibilities for improvement lie in two areas, the development of sophisticated new devices, and greater knowledge of device performance parameters and reliability. Whatever's done however, it's going to be a long slog.

1976 TRADE RESULTS

Meanwhile, the British Radio Equipment Manufacturers' Association has released the final production/delivery figures in the radio and television sector for 1976. Colour set deliveries, at 1,506,000, were only 5% down on 1975 while monochrome set deliveries, at 1,002,000, were up by 7%. The worst part of the year was the first four months, while VAT remained at 25%. There has been a considerable improvement since, though the final month, December, was hardly inspiring. Colour set imports remained a fairly small proportion of the total, at about 215,000, but well over half the monochrome sets were imported. Figures released by the ECIF (see above) indicate that UK setmakers are expected to hold their own, with forecast output in 1980 of 700,000 monochrome and 1,850,000 colour sets.

Over 11.5 million colour sets have been delivered since the start of colour transmissions in 1967. At the end of 1976 there were 9,569,052 colour licences (8,426,008 monochrome).

TELETEXT

Mullard have announced a new Teletext decoder package consisting of four special i.c.s and a small number of peripheral components. Design of the i.c.s is said to have cost some £500,000. Initial production devices are now being supplied to the TV setmaking industry. The package also offers full remote control facilities.

Meanwhile it's worth emphasising the importance with Teletext reception of an efficient and correctly installed aerial. The problem is that ghost signals affect the timing of the data pulses. In consequence the display becomes garbled. Reflected signals of such short duration that they don't cause visible disturbance to the normal TV picture will nevertheless seriously affect a data signal. Aerial orientation and matching are both critical therefore, while the feeder must be installed without damage, crushing or sharp bends – and must be of good quality. It's hoped that the broadcasting authorities will incorporate in the Teletext transmissions, or the test card, test signals to help the installation of aerials where Teletext transmissions are to be received.

Apart from those annoying lines across the top of the screen Teletext can have other effects on the normal picture. This arises because under some circumstances the Teletext lines can give rise to secondary emission from the screen of the tube, with the result of shadow effects in the top part of the picture. The solution is to increase the field flyback blanking time so that the lines are suppressed at the tube.

VIDEO

Total video product sales – videocassette recorders, CCTV equipment, etc. – in the UK last year has been estimated as "close to £15 million". Still very small beer indeed, and mainly in the commercial and professional fields. At present prices, this shouldn't surprise anyone. There's also the lack of a reasonable library of pre-recorded material. Despite this and recent price increases Philips report that they are doing good business with their current VCRs and that there is a waiting time of some ten weeks from receipt of orders. Reliability has been described by a dealer as "acceptable if not yet outstanding". It's also reported that tape faults are giving cause for concern – and at £15-£20 a cassette we'd think some customers would get pretty angry. Our own experiences have been mainly with audio cassettes which seem to be rather poor in this respect.

The largest TV setmaker in the US, Zenith Radio, has signed an agreement with Sony whereby Zenith has the right to produce and sell VCRs using Sony's Betamax system. The new Zenith machines are expected to be introduced on the domestic US market later this year. Zenith say that the Betamax system offers substantial advantages in terms of reliability, picture quality and economical tape use. Well, in the words of a well known young lady some years back, they would, wouldn't they?

If you or your family have become a TV games addict it's worth giving a thought to the TV set you're inflicting the games upon. The point is that having a fixed, high brightness pattern on the screen for long periods can damage the tube. Unless you have colour games, it would seem best to use an old monochrome set for the purpose and save your colour set for normal viewing.

DIODES

We all know, or should do by now, that the solid-state diodes you use in line output stages should be ones intended for this application. For use as an efficiency diode and for scan and flyback rectification fast-switching *soft-recovery* diodes should be employed. The point about these is their switch off time. Ordinary rectifier diodes have a rather long switch off time after the applied voltage has reversed. Ordinary fast-switching diodes switch off rapidly, but as a result of the abrupt current change harmonics are produced and radiated. The fast, soft-recovery diode has a controlled recovery characteristic which overcomes this problem. They are also essential in switch-mode power supplies.

We can all make mistakes as well. In the March column it was stated that the recommended replacement mains rectifier thyristor for use in the Pye 731 series chassis is the 2N444. This should have read 2N4444.

TV STATION OPENINGS

The following relay stations are now in operation:

Alderney, Channel Islands BBC-1 channel 58, ITV channel 61, BBC-2 channel 64. Receiving aerial group C/D.

Crickhowell, Powys BBC Wales channel 21, ITV (HTV Wales) channel 24, BBC-2 channel 27. Receiving aerial group A.

Port St. Mary, Isle of Man BBC-1 channel 58, ITV (Border Television) channel 61, BBC-2 channel 64. Receiving aerial group C/D.

All these transmissions are vertically polarised.

SABRE TRIAL STARTS

Along with the opening of the Alderney relay station comes news that trials of the IBA's Sabre (steerable adaptive broadcast reception equipment) receiving aerial system have begun. The adaptive aerial system will provide a direct u.h.f. link between the Channel Islands and the Stockland Hill transmitter for re-broadcast purposes. The problem with providing such a link has been the increasing number of stations capable of causing co-channel interference. The Sabre system uses high-speed computer processing to adjust the aerial position in order to minimise interference problems. The full-sized Sabre array replaces a stand-by half-sized prototype erected on Alderney last summer as part of the system which brought colour transmissions to the Channel Islands. An article on Sabre appeared in our June 1976 issue.

SET NEWS

New TV sets announced by ITT use chassis developed from their CVC20 solid-state colour chassis released last year and also feature the Mullard 20AX in-line gun c.r.t. The 26in. Model CS700 is fitted with the CVC30 chassis and the 22in. Model CS600 with the CVC32 chassis. These models use the 20AX tube, the chassis having been developed from the CVC20 for use with this c.r.t. The new 20in. model CS500 is fitted with the basic CVC20 chassis and the PI tube. Another refinement introduced is a l.e.d. system to assist with fault diagnosis.

A new 14in. portable chassis has been announced by Thorn – the 1691. It's similar to the well known 1590/1591/1593 series, with just a single i.c. – an RCA CA3065 in the intercarrier sound department. There's a new line output transistor (BU407) and a redesigned sync circuit. Meanwhile the 1590/91/93 series continues with an interesting modification, the use of a silicon transistor as the series regulator in place of the previous germanium type, in the latest Schedule H versions. Suitable silicon transistors are the T6017V and T6018V, both flat-pack types. With the silicon transistor the l.t. line is 11·1V instead of 11·6V. Associated modifications are the use of a new deflection coil assembly and the replacement of R116 in the supply filter feeding the line timebase with an anti-radiation coil (L13).

Thorn have introduced a number of modifications to their current range of colour TV chassis. One of the things that goes is the f.e.t. in the field timebase, replaced by a bipolar type in the interests of improved reliability. Thorn point out that if it's necessary to replace the Syclops transistor (VT701) in the 9000 chassis it's important to check the excess current sensing diode W714, particularly where no apparent reason can be found for the failure of VT701. The set will operate with W714 open-circuit, but there will be no excess current protection.

JVC have introduced what's believed to be the first combined radio receiver, cassette recorder and TV set, Model 3060UK. The screen size is slightly less than 3in. (diagonal) and there's an electronic tuner with a continuous tuning channel selector. A picture turning switch enables the viewer to invert the picture. The cassette section records through a built-in condenser microphone, directly from the radio or TV sections, or through an external microphone, and there are in addition facilities for microphone mixing. The recommended price is £225 including VAT.

VIEWDATA

The Post Office expects to make decisions on the technical specification of its Viewdata system, and the interfacing between the PO lines and television/Teletext receivers, during the coming month. A field trial using 1,000 sets will probably start in March 1978. If the system is approved, the Viewdata service is expected to be introduced towards the end of 1979.

US TO CURB TV IMPORTS?

Following its finding that TV imports are seriously damaging the domestic industry the US International Trade Commission has recommended that heavy tariff increases should be placed on imported sets, which come mainly from Japan, Taiwan and South Korea.

Caught by a Körting . . .

Les Lawry-Johns

I WAS standing behind the counter wondering why I had sold all those coaxial plugs for 18p when they cost me 19p (I don't study invoices half enough: after all, it's all I can do to keep you lot amused) when this fellow came in.

He said he had a Baird colour set and that a resistor had burnt out and his picture had gone a funny colour and could he have another one. He handed me a charred offering. "That's the thing".

"If you don't mind", I said with icy calm. "I've lost my crystal ball".

"Oh" he said with a disarming smile. "You mean you can't read the value. Don't worry, there were two more of them so I took one out so you can match it up". He showed me a shiny 1·5kΩ 1W resistor. "Ah", I said with something of a snarl in my voice, "what happens if the new one burns out too?" Voice rising "and pray why shouldn't it".

His smile made me ashamed of this outburst. "I thought you'd say that. That's why I put the set in the back of the van. I'll go and get it".

He returned in a trice, carrying the set far too easily for it to have been an old Baird one – but it didn't look much like a Thorn set either.

"It's German", he said. "Nice, isn't it? It's a Korting actually". "Kurting", I said loftily. "Don't you know nothing?"

So, saying he'd call back in an hour, he went – not telling me where the resistors had come from. Well, I looked over every panel and subpanel which could affect the colour rendering, mainly around the BF179C colour-difference output transistors which, on a 51763, are on a plug in subpanel, but no sign.

To cut it short, I eventually found where they lived. On the tube base panel, and on the component side which is the side away from you of course. There was one 1·5kΩ resistor in series with one cathode (see Fig. 1) with the other two missing. The position of the blue 1·5kΩ series resistor was scorched, so we put back the red one and checked around the blue circuitry. Nothing wrong cold. Switch on and see the effect. Weird it was. With the brightness down, a dull blue raster remained. With the controls at the normal settings and an aerial connected, lovely lots of red and green. Nothing wrong around the blue cathode, no shorts, no excess voltages, nothing to burn out a 1·5kΩ resistor.

So we put in another one. Lovely. Turn off the colour, turn down the brightness and set the first anode controls for a nice grey scale, set the drives, perfect.

Ponder. The resistor burnt out. Obviously an excess voltage across it. Where do it come from, where do it go? Spark gap shorted? No. Tube shorting? Again no.

H.T. short? The resistor wouldn't have suffered from this unless the spark gap was short-circuit. But it wasn't, while the BD115 was quite cheerful. Oh dear. But wait, here comes the bloke back again.

"Done is it?" he beamed. "Well done. I knew you'd do it".

"Well, er, you see, in fact it's not quite that easy".

"Rubbish, you're just being modest, the picture's perfect".

Regaining some of our normal arrogance we pointed out that the picture might well be perfect now but at any time the beast could well rise from the depths again, gobble up the poor old resistor and submerge to lie in wait for the next victim. But he could take his set if that's what he wanted....

Well, to stop indulging in all this imaginary chit-chat, back he came a few days later to ask if he could buy two 1·5kΩ resistors as the same one had burnt out again. He hasn't yet brought the set back, preferring to replace the resistor rather than (he says) to have a new tube fitted because he is convinced that there is an intermittent short in the tube....

Körting Again?

The model we have been going on about (51763 series) has proved quite a reliable set really apart from the odd valve and diode failure, but the first generation one (8455 series) was a different kettle of fish. It had its share of shorted diodes and faulty transistors etc. but the one big failure was in the transformers. It had a line output and an e.h.t. transformer and both gave a lot of trouble until they were modified. I think they were of Philips design but I could be wrong. Insulation breakdown was the trouble and the snag was that the customer didn't take kindly to forking out for a new transformer one month only to have the other cook up a month or two later. Not cheap items either.

These sets had two colour controls on the front. The left-hand one was the normal saturation control, the other the hue or drive adjustment. They had sliders, with the optimum point in the centre. It's quite common for the hue control to develop poor contact, with the result that at one moment everyone looks healthy but at the next they look decidedly seasick.

The tuner units were also a bit complicated, being designed for u.h.f. and v.h.f. reception. It's often necessary to attend to the switch contacts in these and to knock off the v.h.f. side while you're at it. One of the advantages of doing this is that a fairly heavy spring can be left off and this takes quite a lot of strain out of the unit and the button selection.

Finlandia

Lovely music that. Old Syble something or the other (I

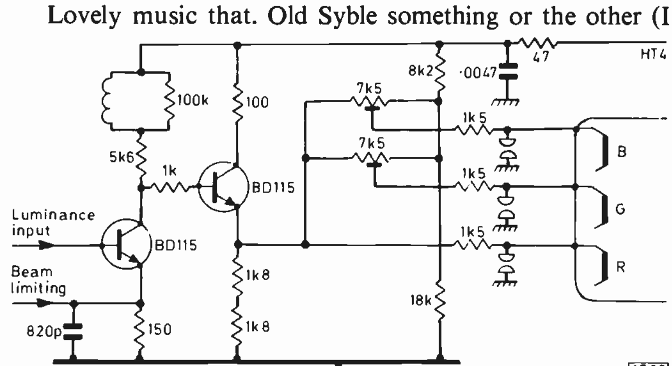

Fig. 1: The luminance output stage, Körting 51763 chassis. In many sets the 7·5kΩ drive potentiometers are omitted.

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AC125	0.20	AF117	0.22	BC142	0.24	BC262	0.20
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AC128	0.20	AF124	0.23	BC148	0.10	BC301	0.30
AC131	0.13	AF125	0.25	BC149	0.10	BC302	0.30
AC141	0.22	AF126	0.25	BC153	0.15	BC307A	0.12
AC141K	0.27	AF127	0.27	BC154	0.15	BC308A	0.12
AC142K	0.27	AF139	0.35	BC157	0.15	BC309	0.14
AC151	0.17	AF151	0.24	BC158	0.14	BC547	0.11
AC165	0.16	AF170	0.29	BC159	0.14	BC548	0.11
AC166	0.16	AF172	0.20	BC160	0.24	BC549	0.11
AC168	0.17	AF178	0.55	BC161	0.24	BC557	0.11
AC176	0.20	AF180	0.60	BC167	0.13	BD112	0.50
AC186	0.16	AF181	0.44	BC168	0.13	BD113	0.65
AC187	0.24	AF239	0.40	BC169C	0.14	BD124	1.00
AC187K	0.28	BC107	0.14	BC171	0.13	BD131	0.39
AC188	0.21	BC108	0.14	BC172	0.13	BD132	0.39
AC188K	0.28	BC109	0.14	BC173	0.15	BD133	0.39
AD130	0.50	BC113	0.12	BC177	0.16	BD135	0.35
AD140	0.60	BC114	0.12	BC178	0.17	BD136	0.35
AD142	0.60	BC115	0.12	BC179	0.17	BD137	0.35
AD143	0.60	BC116	0.14	BC182L	0.11	BD138	0.40
AD145	0.50	BC117	0.14	BC183L	1.11	BD139	0.40
AD149	0.60	BC119	0.27	BC184L	0.11	BD140	0.40
AD161	0.50	BC125	0.15	BC186	0.25	BD222	0.40
AD162	0.50	BC126	0.15	BC187	0.25	BDX22	0.73
AD161	1.30	BC136	0.17	BC209	0.13	BDX32	1.90
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Type	Price (£)	Type	Price (£)	Type	Price (£)	Type	Price (£)
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BF154	0.14	BF258	0.42	OC28	0.60	SN76023N	1.50
BF158	0.20	BF259	0.47	OC35	0.45	SN76023ND	1.20
BF159	0.20	BF260	0.24	OC36	0.58	SN76226DN	1.50
BF160	0.19	BF262	0.32	OC38	0.43	TBA341	0.97
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BF164	0.20	BF271	0.18	OC44	0.18	TBA530Q	1.55
BF167	0.21	BF273	0.17	OC45	0.18	TBA540Q	1.75
BF173	0.23	BFX84	0.27	OC46	0.35	TBA560CQ	1.90
BF177	0.26	BFX85	0.26	OC70	0.22	TBA570Q	1.75
BF178	0.33	BFX88	0.26	OC71	0.22	TBA800	1.12
BF179	0.29	BFY37	0.22	OC72	0.30	TBA810	1.50
BF180	0.31	BFY51	0.25	OC74	0.35	TBA920Q	2.00
BF181	0.29	BFY52	0.25	OC75	0.35	TBA990Q	1.85
BF182	0.35	BFY53	0.27	OC76	0.35	TCA270SQ	1.75
BF183	0.33	BFY55	0.27	OC77	0.50		
BF184	0.23	BHA0002	1.90	OC78	0.13		
BF185	0.23	BR100	0.32	OC81	0.20		
BF186	0.30	BSX20	0.23	OC81D	0.14		
BF194	0.11	BSX20	0.23	OC82	0.20		
BF195	0.11	BSX76	0.23	OC82D	0.13		
BF196	0.13	BSY84	0.36	OC83	0.22		
BF197	0.13	BT106	1.10	OC84	0.28		
BF199	0.17	BU105/04	2.00	OC85	0.13		
BF200	0.28	BU126	1.65	OC123	0.20		
BF216	0.12	BU208	2.45	OC169	0.20		
BF217	0.12	OC22	1.10	OC170	0.22		
BF218	0.12	OC23	1.30	OC171	0.27		
BF219	0.12						
BF220	0.12						

Type	Price (£)
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ECC82	0.42
EF80	0.40
EF183	0.50
EF184	0.50
EH90	0.60
PC86	0.70
PC88	0.70
PCC89	0.55
PCC189	0.60
PCF80	0.50
PCF86	0.58
PCF801	0.60
PCF802	0.70
PCL82	0.60
PCL84	0.55
PCL86	0.60
PCL805	0.60
PFL200	0.70
PL36	0.85
PL84	0.52
PL504	0.90
PL509	1.50
PY88	0.52
PY500A	1.00
PY801	0.50

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GEC Hybrid C.T.V.	5.57
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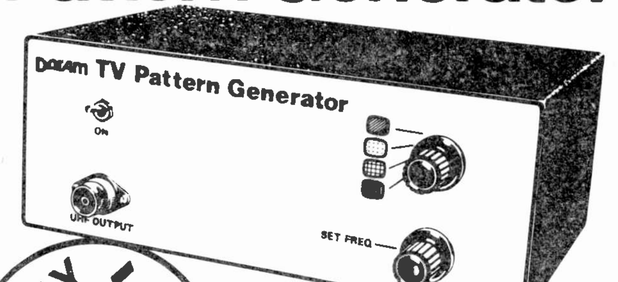

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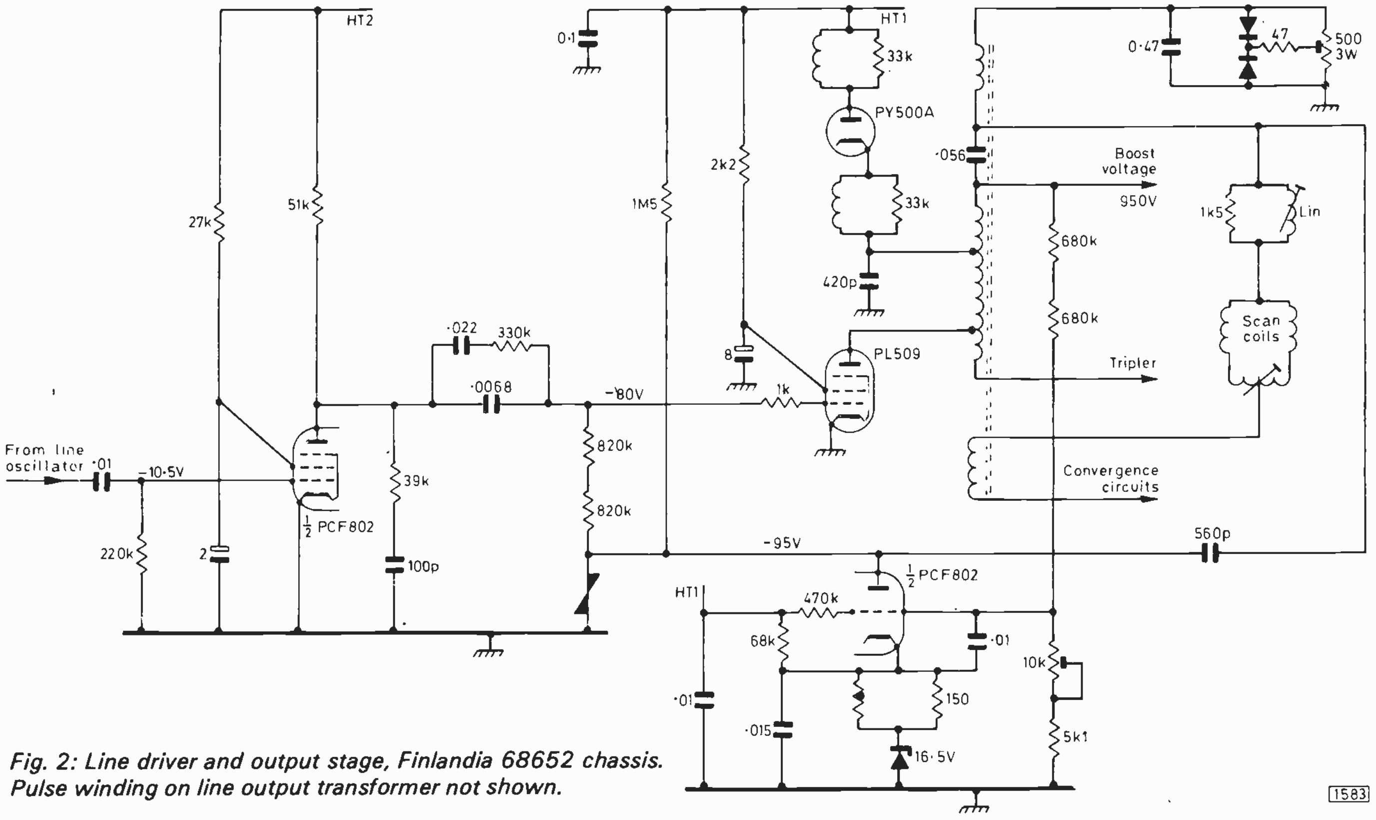


Fig. 2: Line driver and output stage, Finlandia 68652 chassis. Pulse winding on line output transformer not shown.

know my music mate, so don't start getting uppity about it). Anyway quite a few of these nice sets (68652 series) have graced our bench so perhaps a few words about them might not come amiss.

Most of them come along via the ex-rental market, from Granada. So they have a few years over their heads, and are of hybrid design with only three valves.

The PCF802 is not the line oscillator, so watch that one. The pentode section acts as a driver for the PL509 line output valve while the triode section acts as a stabiliser, with of course the PY500 as the efficiency diode (see Fig. 2). The line oscillator is transistorised, with a pretty complicated circuit which with the line sync filter etc. adds up to quite a few components to think about. Not much seems to go wrong here however, so another load is lifted from our excessive burden of funny fings to fink about. The small electrolytics and the 2·2MΩ discriminator load resistors should receive attention first when things do start happening to the line hold. The 2·2MΩ resistors (RB96 and RB97) are connected to either end of the line symmetry (discriminator balance) control PB7.

Probably the most common fault on these sets concerns the RGB output transistors, which are of the BD115 type. They can short or become open-circuit or be damaged by sparking between tracks, this again being quite a common thing. They drive the c.r.t. grids incidentally, with the c.r.t. cathodes being linked together and used for flyback blanking and beam limiting.

Trouble spots will also be found in the supply lines. There are four separate diodes in the h.t. bridge and a block type diode bridge for the l.t. supply. One of the separate diodes may short and blow one or both of the 2·5A supply fuses, or may pop off the surge limiter RB189 (4·7Ω, 9W) which can also fail when CB102 (0·1μF) across the bridge goes short-circuit.

In short, there is very little to worry about. It's one of those sets where you don't have to spend hours studying the circuitry in order to trace a fault, and I must confess that I have little detailed knowledge of the design because it's never been necessary to delve too deep in order to keep the customers happy. Perhaps it's something to do with all those funny baths they keep on having up in Lapland.

Some of our set designers could do with a few. Someone comes up with a circuit which saves a couple of bob and then it has to be surrounded by gadgets to protect the thing from the effects of it going berserk. It's in the nature of things that these gadgets are in themselves so inherently unreliable that the protectors need protecting (bung in another thick film overvolts unit Joe).

What was wrong with a separate stabilised power supply feeding various parts that could be separately isolated in order to put things right in the least possible time? Do the setmakers pay us to put their products right when they go wrong almost as soon as they've been installed? One or two allow a small percentage, but this amounts to only about one service call. Better by far to build sets with reliable components and to have them in a design which doesn't require a genius to understand – because most of us service people are not geniuses and aren't even particularly bright (I speak for myself, so no abuse please).

In short, what I am saying is that some designs should have been left deep in the heart of Texas. By all means use the latest short neck, quick heating, in-line gun tubes, but for heaven's sake use them in a proved and relatively simple circuit so that morons like me don't have to sit in the toilet half the night trying to understand which bit does what and why all over again every few months. End of plea.

Back Comes the Körting

Since starting these jottings the bloke with the Körting has returned and, yes, it turned out to be an intermittent heater-cathode short in the blue gun. But a new tube wasn't necessary: we simply removed the earth connections from the tube's heater supply, which is provided by a secondary winding on the mains transformer, and ran an extra lead to the c.r.t. base panel. Fortunately the winding has a very low capacitance, so there's no loss of picture detail at all.

Single-Chip Sync Pulse Generator

Luke Theodossiou

THE sync pulse generator to be described is probably the simplest design currently available. It is centred around a new Ferranti i.c., type ZNA134, and provides synchronising pulses which fully meet broadcasting specifications.

The i.c. is a version of the Ferranti "uncommitted logic array", mask programmed to provide the function of a dual-standard (525- or 625-line) monochrome s.p.g. It is possible to phase lock the clock frequency to an external colour subcarrier oscillator for full colour operation as well as to "genlock" for use with multiple camera set-ups. These applications are outside the scope of the present article however, though it's hoped that a later feature will deal with extending the applications of the device. Here we shall deal with the simplest possible use, which highlights the tremendous advantages which large scale integration (LSI) techniques make possible.

As can be seen from the circuit diagram (Fig. 1) the unit is simplicity itself. The only external components required to produce a fully operational s.p.g. are a crystal, a small capacitor and a power supply. In fact the power supply takes up considerably more room than the s.p.g. circuit itself.

Fig. 2 shows a block diagram of the device. In this particular application we use six functions: mixed sync, mixed video blanking, line drive, mixed camera (cathode) blanking, even field and field drive. There is also an output which provides a monitoring point for the reference clock.

In very critical applications the fixed capacitor connected to pin 8 may be changed to a 60pF trimmer. Set up by connecting a frequency counter to the reference clock, adjusting the trimmer until a reading of 1·28125MHz i.e. half the oscillator frequency – due to the ÷2 circuit in the chip – is obtained. For most applications a 22pF capacitor works very well and the author has not experienced any difficulty. Using a fixed capacitor also obviates the need for a frequency counter and makes the whole unit void of all adjustments.

In its basic form the outputs are at medium impedance, which means it will deliver about 2V peak-to-peak into a relatively high impedance. In order to drive 75Ω cables, buffer stages are required for each output (except the reference clock which is only a monitoring point as explained earlier). If the circuit is used inside a camera these buffers are not required. It was felt that they would add unnecessary complexity to the unit, since its practical application will depend on the constructor's particular requirements. If it is necessary to increase the output capability a suitable circuit is shown in Fig. 3. Bear in mind that the p.c.b. shown will not accommodate the additional components however.

In order to reduce the size of the unit to an absolute minimum it was decided to use a subminiature transformer from the RS Components range. By using this transformer the whole unit can be neatly cased in a small Verobox.

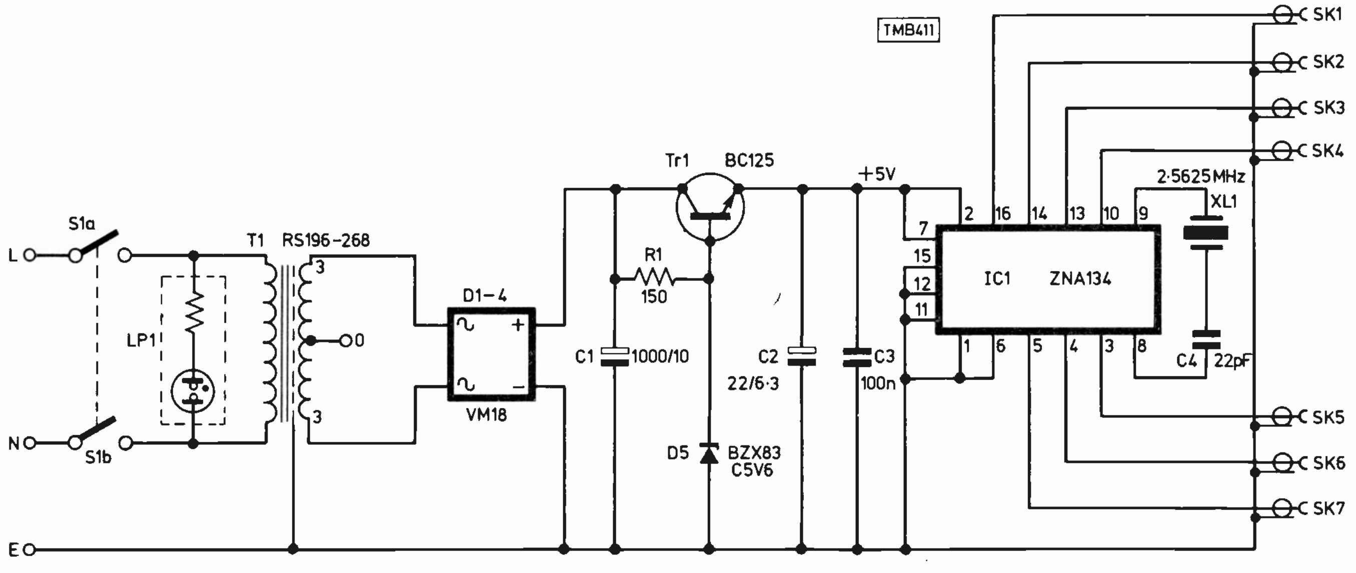


Fig. 1: Circuit diagram of the unit, including the power supply.

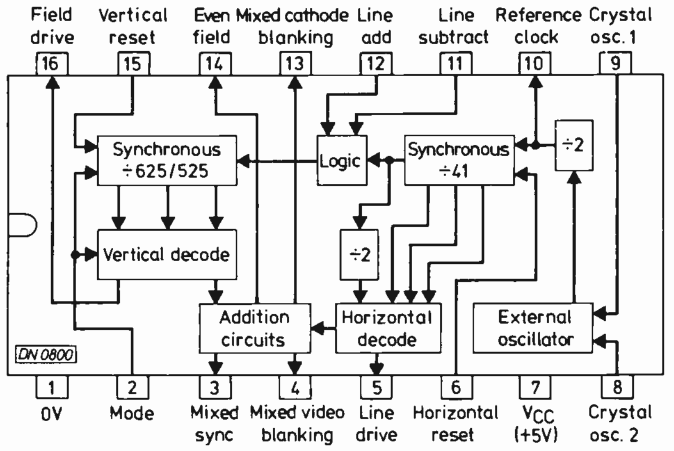


Fig. 2: Block diagram of the ZNA134.

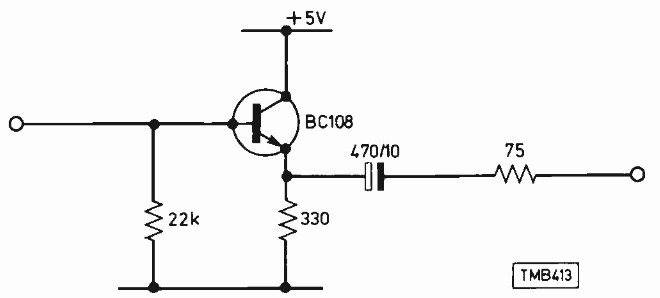


Fig. 3: Circuit of the optional emitter-follower stage which can provide up to 2V into 75Ω.

One drawback was that because of the voltage drop across the diodes in the rectifier bridge, the resultant d.c. voltage across C1 was found to be around 6·5V when drawing around 100mA – the current consumed by the ZNA134. All commonly available 5V i.c. voltage regulators require a minimum input of 7V for correct operation. Consequently one can't be used in this application.

Instead, a zener diode provides a reference voltage for the base of a series regulator transistor. By using a 5·6V zener and deducting the 0·6V developed across the base-emitter junction of the transistor, a stabilised output voltage of +5V is obtained across C2. R1 provides the holding current for the zener and also the base current for the transistor.

The maximum allowable supply voltage for the ZNA134 is 7V. At first glance it would appear therefore that the device could be connected directly to C1. As with all TTL devices however a mains transient which increased the voltage across C1 to a higher level would result in its destruction. Considering that the i.c. costs around £21 it was decided not to run this risk.

Construction is simplicity itself, particularly when using the p.c.b. Details of the printed circuit design and a component layout is shown in Fig. 5. The only point worth noting about the construction is that the mains transformer comes with the clamp reversed. It is an easy matter, using a medium sized screwdriver, to prise the clamp off, reverse it and then use a pair of pliers to crimp it back into position. This enables the transformer connecting pins to be inserted into the p.c.b. and the clamp bolted on to the board for extra security.

The printed circuit board has been designed to enable the unit to operate as a 625-line, single-standard s.p.g. As pointed out earlier, it is capable of dual-standard operation. For this only two changes to the existing circuit need be made. For 525 lines pin 2 is returned to ground instead of the positive supply rail, and the crystal frequency is changed to 2·583MHz.

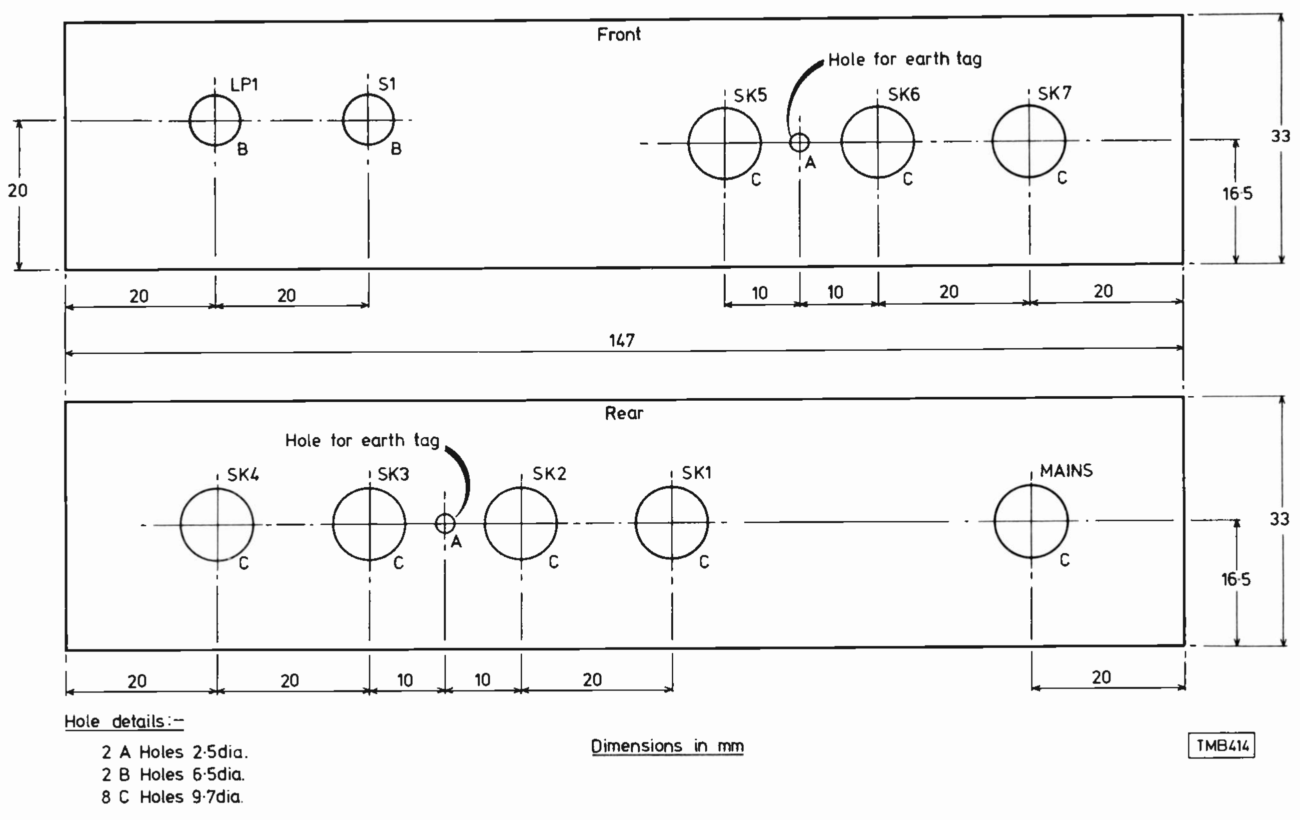
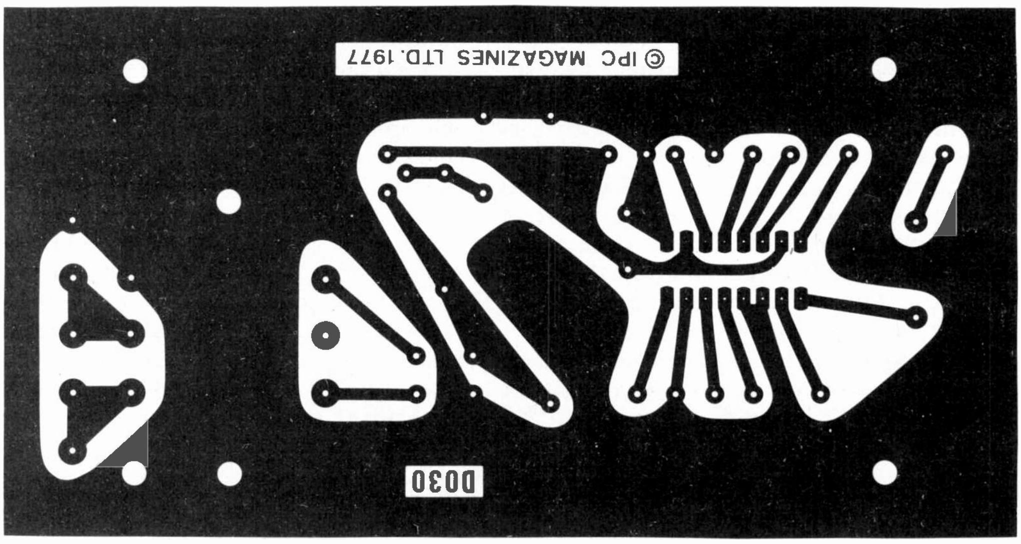


Fig. 4: Front and rear panel drilling details.

★ Components list

R1	150Ω 5% $\frac{1}{4}$W
C1	1,000μF 10V
C2	22μF 6·3V bead tantalum
C3	0·1μF ceramic plate
C4	22pF 2·5% polystyrene
D1-4	0·9A d.i.l. rectifier bridge type VM18
D5	BZX83/C5V6
IC1	ZNA134
TR1	BC125
XL1	2·5625MHz series resonant crystal (Available from Senator Crystals, 36 Valleyfield Road, London SW16 2HR)
T1	RS196-268 mains transformer (Available from Doram Electronics Ltd.)
LP1	250V miniature neon
S1	D.P.S.T. 1A toggle switch
SK1-7	75Ω BNC sockets
PCB	Reference number DO30



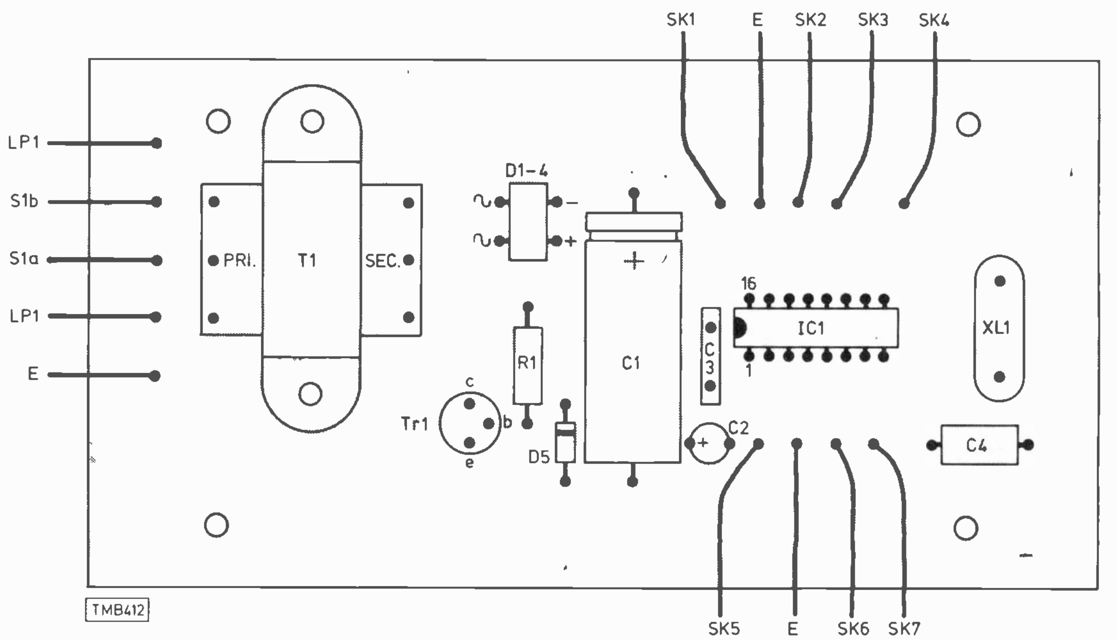


Fig. 5: Printed circuit board copper track details above. Component layout below.

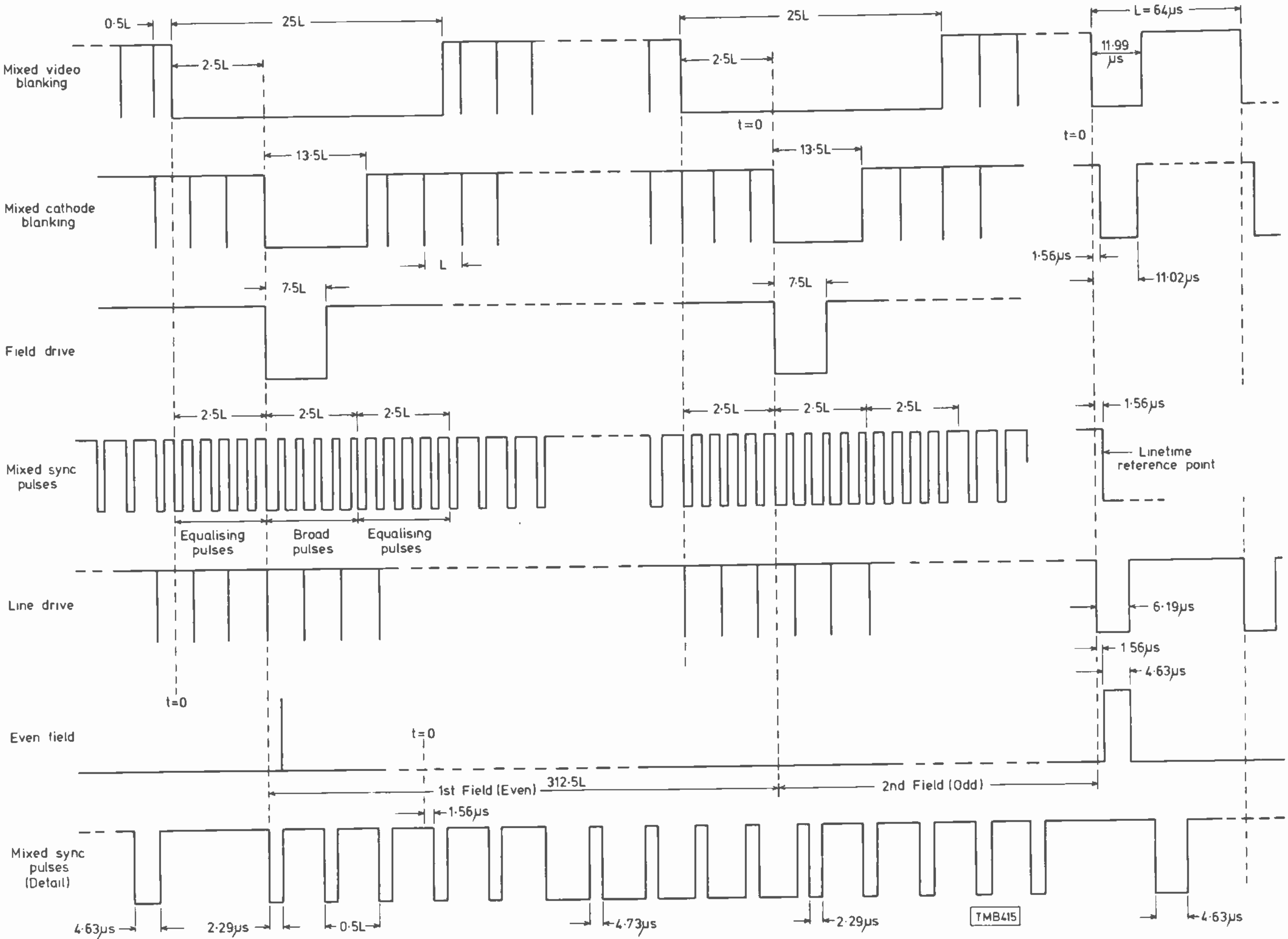


Fig. 6: Output waveforms provided by the unit – excluding the clock output.

Servicing GEC Single-Standard Monochrome Receivers

John Coombes

THE basic GEC group single-standard monochrome chassis was in production for several years. There were three versions, the Series 1, Series 2 and the final 3000 series which featured a varicap tuner. Though the basic circuit remained substantially the same there were several minor component changes and the introduction of a different scan coil assembly necessitated a change of line output transformer, field output transformer and line linearity coil. Another change was from the TAA570 to the TBA480Q as intercarrier sound i.c. Other i.c.s have been used in this position. The final versions incorporated modifications to meet BEAB requirements. Some of the earlier sets also appeared under the Sobell brand name. The most common model is the GEC 2084, a 20in. Series 2 receiver, and the following notes are based on our experience of this set.

Power Supplies

The power supplies are conventional. A BY126 is used as a dropper in the heater chain while the l.t. supply is obtained by rectifying the output from a winding on the line output transformer.

The first fault that comes to mind here is the mains filter capacitor C301 (0·1μF) going short-circuit. This will usually blow the mains fuse, but on later versions the position of the fuse in the circuit is changed – it comes after the on/off switch and the mains filter capacitor. Heater circuit troubles are generally due to the dropper diode (D301), but check whether the line output valve or boost diode heater is open-circuit. A blown mains fuse, often with the glass broken or completely black, will be the result when the h.t. rectifier (D105, BY127) goes short-circuit. Its associated surge limiter resistor R303 (15Ω) goes open-circuit to give the symptoms no results but the valves glowing. Alternatively check R304 and R305 (both 90Ω) for this fault – in later models a single 180Ω resistor is used in this position. R303/4/5 comprise the mains dropper.

Signal Circuits

Going to the other end of the set, the tuner, the only fault we've had here is tuning drift which is usually due to the grease the manufacturer uses on the push buttons.

The i.f. strip is very reliable and the only transistor that seems to give any trouble is the one in the final i.f. stage (Tr103, BF197). One also occasionally finds dry-joints in this stage.

AGC Faults

A.G.C. faults are encountered from time to time. Occasionally the a.g.c. amplifier transistor Tr105 (BC148) is at fault but more often the trouble is due to the electrolytic a.g.c. smoothing capacitor C108 (160μF). When this becomes leaky the a.g.c. line does not go sufficiently positive to provide correct forward a.g.c. action in the controlled stages. The a.g.c. rectifier diode D102 (1N4148) sometimes goes open-circuit. There is then no a.g.c. action and the symptoms are excessive contrast or, with a strong signal, sound on vision. The only other component that's caused us trouble in the a.g.c. circuit is the 1·5V zener diode in the a.g.c. amplifier's emitter circuit – it's connected with its cathode to chassis incidentally. It can be checked by simply taking it out and connecting a 1·5V battery in its place.

Video/Sync Stages

A PFL200 is used as video output valve and sync separator and is the biggest offender in this section of the set. No vision can be due to the PFL200, its 3·3kΩ anode load resistor R137 or its screen grid feed resistor R134 (4·7kΩ) going open-circuit. On the sync side the valve can be responsible for poor field and line sync or lack of sync. If its screen grid feed resistor R141 (47kΩ) is defective the result is poor or no field sync.

Sound Faults

A PCL86 is used as audio amplifier/output valve. It can

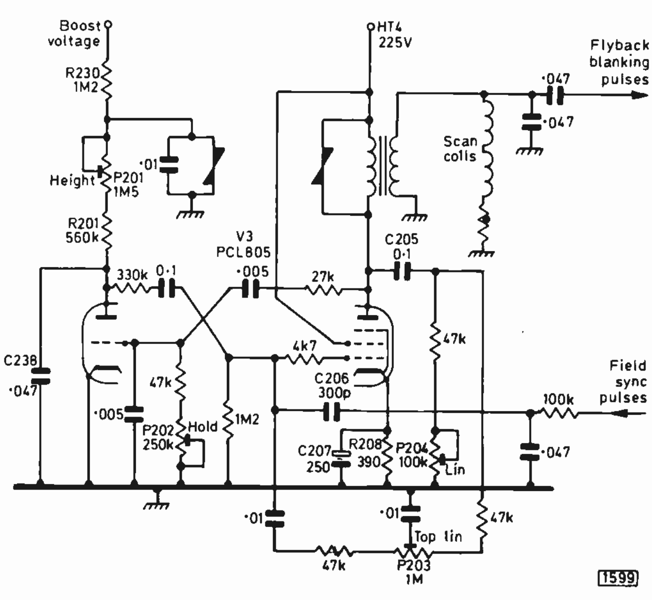


Fig. 1: Field timebase circuit.

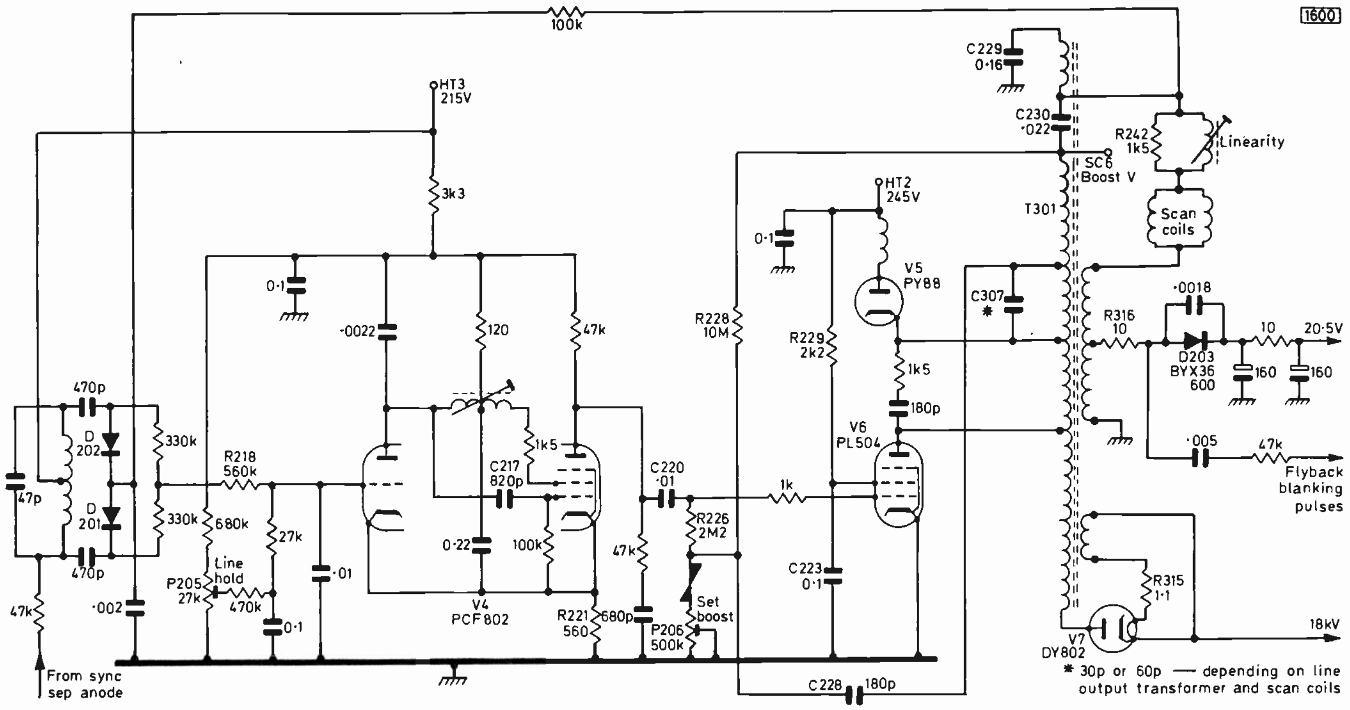


Fig. 2: Line timebase circuit. Later versions have a 100pF capacitor in series with the linearity coil damping resistor R242, while in some sets a linearity sleeve under the scan coils is used instead of a linearity coil. With the later deflection coil assembly and line output transformer C307 is 60pF (two 30pF capacitors in parallel) – sets incorporating this and other modifications have the suffix B following the model number.

be responsible for no sound and can also go microphonic. The output side grid leak resistor R155 (1MΩ) can increase in value to cause poor quality sound. Note that it's important that the boost voltage is correctly set for 890V at SC6 – the first symptom noticed if this voltage is wrong is distorted sound. No sound can also be due to the intercarrier sound i.c. – this fault is easy to deal with using a signal generator. The i.c. is housed inside a module. If this is removed, take care not to overheat the printed lugs: otherwise you may have difficulty with dry-joints and intermittent sound when the unit is replaced.

Field Timebase

The field timebase in these sets is very reliable and is based on a PCL805 valve (see Fig. 1). The most frequent offender is the valve itself, causing picture rolling, field collapse and loss of height. Intermittent field bounce can be caused by the output stage cathode decoupling electrolytic C207 (250μF). It can also cause bottom cramping. Check the associated bias resistor R208 (390Ω) to make sure that it has not changed value due to overheating.

Field bounce at the bottom of the picture can be due to a defective field linearity (overall) control – P204, 100kΩ log.

Two common faults are lack of height due to R230 (1·2MΩ) which feeds the height control increasing in value, and field collapse due to R201 (560kΩ, later 330kΩ) which is connected to the triode anode going open-circuit.

Line Timebase

There are several common faults in the line timebase (see Fig. 2). The line output valve (V6, PL504) and boost diode (PY88) can lose emission with the result no e.h.t. or lack of width. The line oscillator valve V4 (PCF802) doesn't so much lose emission but has to be replaced when it's impossible to lock the line.

The usual cause of no line drive is that the coupling capacitor C220 (0·01μF) is faulty. If the line output valve is running cool on the other hand its screen grid feed resistor R229 (2·2kΩ) is open-circuit. A red hot boost diode is probably the result of the boost capacitor C230 (0·022μF) being short-circuit – since it's returned to chassis via the linearity coil, the scan coils and a winding on the line output transformer. All these faults cause loss of raster due to no e.h.t. If the voltages at the base of the PL504 are correct and everything else seems to be all right the cause is likely to be shorting turns on the line output transformer (T301).

The damping resistor R242 (1·5kΩ) across the line linearity coil can change value giving rise to striations on the left-hand side of the picture. On later sets there is a capacitor in series with this resistor.

Another very common fault is lack of width. Apart from the PL504 and PY88 valves check the 500kΩ set boost control P206 which may have a dud track and, a more common cause, the high-value resistor (R228, 10MΩ) from the width circuit to the boost rail.

We have already pointed out that the PCF802 line oscillator valve can affect the line sync. The flywheel line sync discriminator diodes D201/D202 can cause poor sync, and another cause of this trouble is the filter resistor R218 (560kΩ) going open-circuit.

Picture Ballooning

Picture ballooning is generally due to the e.h.t. rectifier (V7, DY802) but can also be caused by a faulty line output transformer or even the resistor (R315, 1·1Ω) in the rectifier's heater supply.

Dry-joints

Finally, beware of dry-joints throughout this chassis. With the double-sided print, components can make contact on one side but not the other. This can lead to a lot of trouble and a lot of time spent tracing misleading faults. ■

The Colour Subcarrier Paradox

by E. J. Hoare

TELEVISION engineers nowadays tend to take colour for granted. We have settled into a comfortably established routine. The circuitry used in the receivers we have to deal with has become familiar, while most of the faults that need to be diagnosed and repaired fall into well understood patterns. Enough colour television theory was absorbed some while back, and we are perhaps entitled to feel a little complacent that a new and complex technique has in a comparatively short period of time become an everyday matter. All that seems necessary is to get on with the job.

There is one crucial area however about which most people remain distinctly hazy, the business about the colour subcarrier. Is it there or isn't it, and if it is, why? Most of the books on the subject fail to come to grips with this key question, we suspect because of its paradoxical nature.

If you pick up a textbook on PAL you will probably find that it explains, quite correctly, that before transmission the colour subcarrier (4·43361875MHz) is suppressed, only the sidebands being transmitted. It will go on to say that in the receiver a carrier at exactly the same frequency and phase as the original, suppressed subcarrier has to be generated in order to make demodulation possible. Yes, you may say, it is inserted to replace the original. But in practice it isn't reinserted: do you know a single colour receiver design in which this is done? And anyway if the original carrier has been discarded, presumably without loss of information, why do we need a replacement? – we are interested in only the sidebands. But why, anyway, discard the carrier in the first place? We've come face to face with our paradox!

Colour Signal Encoding

Before going into the colour modulation and demodulation processes let's be quite clear about the form of the encoded signals: the way in which they are derived, and the importance of sidebands. The three (red, green and blue) gamma corrected outputs from the camera will be of equal amplitude when the scene being televised is completely devoid of colour. With the presence of colour in the scene their amplitudes will differ. These output voltages have to be processed to provide a luminance signal (Y) which will give the normal black and white picture on a monochrome receiver, and in addition colouring signals which, when added to the luminance signal in a colour receiver, will give a colour picture.

It's well known that the luminance signal is obtained by adding together the three colour camera outputs in the proportions 0·3R + 0·59G + 0·11B, these proportions corresponding to the characteristics of the average human eye, which gets most of its sensation of brightness from green hues and the smallest contribution from blue. In addition to the luminance signal a colour receiver requires three colour-difference signals, R – Y, G – Y and B – Y which, when added to Y, will restore the three primary-colour signals R, G and B.

It can be shown by simple mathematics that if Y is transmitted it is necessary to transmit in addition only two of these three colour-difference signals – the third can be obtained by simply adding together set proportions of the other two. In practice the R – Y and B – Y signals are transmitted. In passing, it's important to note that negative colour-difference signals are just as common and just as significant as positive ones – simply because if we increase the proportion of one primary colour in the picture we must, to maintain the correct brightness level, proportionately reduce the contribution of the other two primary colours.

Transmitted Signals

So the three transmitted signals are Y, R – Y and B – Y. One further complication however. In order to avoid over modulating the vision carrier, and to reduce the amplitude of the beat pattern between the luminance carrier and the colouring signals on the c.r.t. screen, R – Y is reduced to 0·877 and B – Y to 0·493. These are called weighted signals, and are renamed the V and U signals respectively. In accordance with the basic PAL technique, the V signal, whether positive or negative, is inverted on alternate lines, and the phase of the transmitted burst is swung 90° in sympathy.

Signal Sidebands

Any waveform found in a television receiver circuit can be regarded as being equivalent to a sinewave of fundamental frequency $f1$ together with numerous harmonics of $f1$, i.e. the waveform can be made up from a series of separate sinewaves $f1 + 2f1 + 3f1 + 4f1$ ... etc. In general each sinewave will be of different amplitude and will become smaller as the frequency increases.

Let us take a particular case, for example a single thin vertical white line on the c.r.t. screen. This line consists of a white dot which occurs at the same time during each horizontal scanning cycle. Since line scanning (at 625 lines) occurs at the frequency f_H of 15,625 times a second the dot is repeated at this rate. So the fundamental frequency of this item of picture detail is f_H, and in order to make sure that the dot lasts for only a small section of a microsecond and not, say, for the whole duration of each line, harmonics of f_H have to be transmitted. So the signal consists of $f_H + 2f_H + 3f_H + 4f_H$ up to $352f_H$, the last harmonic being equal to 5·5MHz – the limit of the luminance signal passband.

Similarly, horizontal detail is repeated at 50Hz (field rate) and 25Hz (picture rate) and will contain harmonics of these frequencies.

A typical signal energy spectrum therefore, whether of luminance or colouring signal, will consist of spikes of

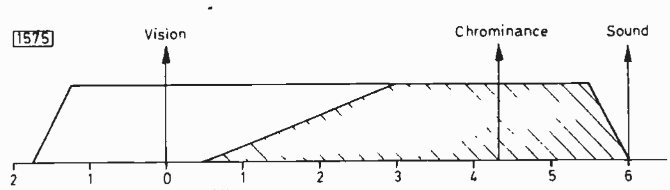


Fig. 1: Showing how the chrominance sidebands are fitted inside the luminance passband.

energy corresponding to each harmonic of the line frequency, flanked by further spikes every 25Hz. In the case of the colouring signals there will also be energy components at harmonics of $f_H/2$, corresponding to the switched components of the PAL signal, and at 50/8 Hz arising from the need to interlace the subcarrier dot pattern.

Channel Bandwidth

In order to save bandwidth the luminance signal is transmitted in a vestigial sideband form, such that the video sidebands (harmonics of the fundamental frequencies listed above) are fully maintained out as far as 5·5MHz on one side of the vision carrier but only as far as 1·25MHz on the other side. The colouring signals are modulated on to a chrominance subcarrier at 4·43361875MHz in double sideband form. Since only the luminance component needs to give the eye an impression of sharp picture detail (the human eye is not sensitive to fine colour detail) the sidebands of the colouring signals are restricted to approximately +1·1MHz and −1·3MHz. The signal carriers and sidebands are shown in Fig. 1.

Thus *all* the picture information is carried in the sidebands and *none* in the carriers which, as their name implies, are there simply to act as vehicles for transporting the sideband information. The chrominance subcarrier – we'll come back to this – can be filtered out without damaging the transmitted signal and with no loss of picture information.

Colour Signal Transmission

The U and V signal sidebands have to be modulated on to the vision carrier in such a manner that they can be easily recovered in the receiver at their original relative amplitudes and polarities – whether positive or negative. It's also important to avoid excessive interaction between the chrominance signals and the luminance carrier as this would result in unwanted beat frequencies being produced in the vision detector.

If you think about it, this is not a very easy requirement to fulfil, bearing in mind that there are four items of information, ±U and ±V, of which two have to be transmitted simultaneously and within a narrow bandwidth. The technique which has been adopted for both the PAL and the NTSC systems – but not SECAM – is to use quadrature amplitude modulation (QAM), with the chrominance subcarrier suppressed. This sounds a little complicated, and compared with some other forms of modulation it probably is, but taken step by step it's quite simple – and gives us the answer to our paradox.

Suppressed Carrier Working

Let's consider one of the important sideband components at the line frequency f_H, corresponding to say an element of U picture detail occurring once each line. The chrominance subcarrier generated at the televison studio is amplitude modulated in the normal way – see Figs. 2 (a) and (b). The dotted envelope of the carrier is the modulating frequency f_H. Now this modulated carrier is actually the sum of three separate sinewaves, one the carrier frequency f_C (4·43361875MHz) and the others the upper and lower sidebands, $f_C + f_H$ and $f_C - f_H$ respectively, i.e. 15,625Hz above and 15,625Hz below the carrier. Another pair of sidebands will be $f_C + 2f_H$ and $f_C - 2f_H$ and there will be others up to the limit of the colouring signal bandwidth.

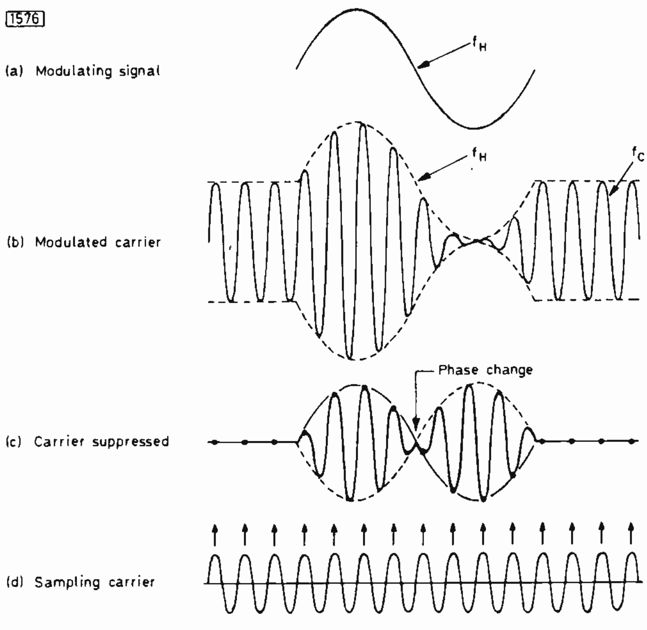


Fig. 2: Amplitude modulation of a suppressed carrier – frequencies not to scale.

Remember that there will also be pairs of sidebands of the other fundamental scanning-related frequencies clustered on each side of the f_H sidebands.

Fig. 2(b) may not look as though it consists of three separate waveforms. In fact it does however and this can be proved either by drawing or by trigonometrical theory.

And now we come to the crunch. Since the sidebands carry *all* the picture information, why not dispense with the carrier? The advantages of doing so are impressive. First, there is a saving of transmitter power, since the carrier comprises at least two thirds of the energy – less than a third lies in the sidebands. Secondly, the absence of the colour subcarrier removes the beat frequency between the luminance carrier and the chrominance signal that would be produced in the receiver at the vision detector. An added advantage is that when no colouring signals are being transmitted there are no subcarrier, no sidebands and no beat frequencies at all in the receiver. In most sets a tuned trap circuit is incorporated in the luminance channel to remove the beat patterns centred on 4·43361875MHz, but the smaller the amount of energy involved the easier it is to remove it without unduly degrading the h.f. end of the luminance response.

Effects of Subcarrier Suppression

Removing the colour subcarrier leaves only the two sidebands $f_C + f_H$ and $f_C - f_H$. The sum of these two gives the waveform shown in Fig. 2(c). This can be regarded as consisting of two new elements. One is the average of the two sideband frequencies: this is f_C and is thus identical in frequency to the original subcarrier at 4·43361875MHz. The other frequency is the beat between the two sidebands, i.e., $(f_C + f_H) - (f_C - f_H) = 2f_H$. The modulation appears to be at twice the original frequency, and can no longer be recovered by ordinary diode detection because the output would not be sinusoidal – it would consist of a series of pulses – and there would be no differentation between the positive- and negative-going colour-difference signals.

Demodulation

This difficulty can be overcome in either of two ways. One is to reinsert the original carrier at exactly the correct

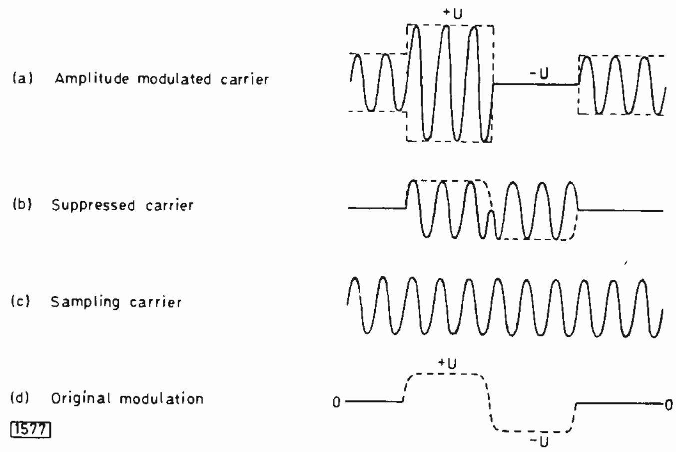


Fig. 3: A U chrominance signal, and retrieval of the modulation by sampling. The modulated waveform is the sum of all its sidebands.

frequency and phase. The original amplitude modulation can then be recovered using a diode detector, but difficulties arise in practice because the d.c. level has to be maintained very accurately if correct identification of the amplitude of positive and negative colour-difference signals is to be achieved. Very few colour receivers have been designed using this principle.

A much more satisfactory method is to use a sampling technique whereby a separate carrier at the correct frequency and phase is not reinserted but instead used as a timing device. The required reference carrier is shown in Fig. 2(d), and it will be seen that if the suppressed carrier signal is inspected, or sampled, at instants in time corresponding to the peaks of the reference carrier the original modulation will be recovered. This is what occurs in our synchronous chrominance detectors.

Polarity and Phase

Notice that the phase of the signal waveform changes by 180° at every point where the modulation changes polarity. It is this phase difference that identifies the polarity of the modulation and conveys half the information that has to be transmitted.

This point can be illustrated a bit more clearly. Suppose that the coded camera output consists of a bar of +U followed by a bar of –U signal. If all the sidebands are added together – as you would see them on the trace of an oscilloscope – the amplitude modulated carrier appears as shown in Fig. 3(a). The suppressed carrier equivalent is shown in Fig. 3(b) and the appropriate sampling carrier in Fig. 3(c). The positive and negative colour-difference signal outputs obtained by this sampling process are the dotted envelopes shown in Figs. 3(b) and (d).

The Paradox

We have now covered the paradoxical aspects of colour transmission using the suppressed carrier technique. The original chrominance subcarrier is indeed suppressed prior to transmission but, rather surprisingly at first glance, a signal waveform at precisely the same frequency is still present. The modulation has been frequency doubled and distorted however. The information about its amplitude and polarity has been changed from amplitude modulation to a combination of amplitude and phase modulation, and this information can be identified at the receiver only by comparing the phase of the signal with that of an accurate reference carrier generated for this purpose.

Suppressing the original subcarrier does not remove any information from the signal: it merely changes the form of the signal, and in consequence a different demodulation technique is required in order to retrieve the information. The sampling process, though a little more complex than ordinary diode rectification, gives a very accurate answer when differentiating between positive and negative colouring signals. There is no problem of d.c. level errors, which could so easily result in a small positive signal being changed into a small negative one, or vice versa, with disastrous results to the colour of the picture.

You may now feel that the ground has been sufficiently covered. There is a bit more to be said however in order to bring out the full subtlety of the technique.

Quadrature Amplitude Modulation

We have been considering an arbitrary ±U signal and the way in which pure amplitude modulation is converted into a mixture of amplitude and phase modulation. This feature has great significance apart from the advantages of reduced subcarrier patterning and the maintenance of correct d.c. levels. Why?

Think for a moment about the basic problem. It is necessary to be able to transmit either + or –U and either + or –V. Furthermore the available chrominance bandwidth is only about ±1MHz, and the whole of this is required for each signal. Both signals have to be transmitted simultaneously. Simple amplitude modulation is inadequate, so how can it be done? The answer is provided by the very elegant, simple and economical technique known as QAM.

A single signal can be transmitted by amplitude modulation of a sinewave having not only a constant frequency but, more important, a constant phase. As we have seen, a phase shift of 180° indicates modulation of opposite polarity. If a second signal is modulated in precisely the same manner but with a phase difference of 90° two important consequences arise. First, one signal will be at zero when the other is at maximum, and vice versa. Thus both signals are completely independent of each other

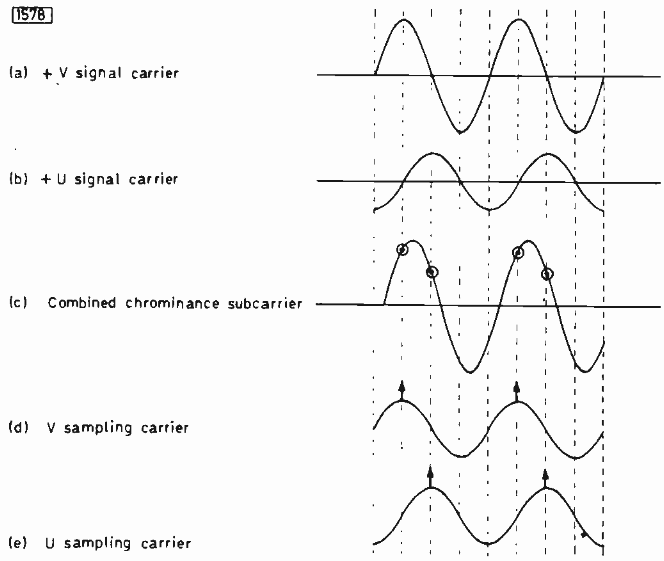


Fig. 4: Quadrature amplitude modulation of the U and V signals. In the Simple PAL system they are retrieved by sampling (synchronous detection).

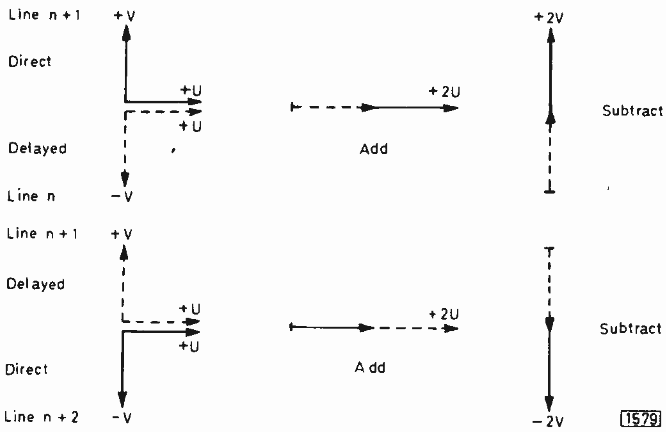


Fig. 5: Phasor diagrams showing how delay line PAL decoding operates.

and the amplitude and polarity of each one can be identified by using a reference signal in the appropriate phase to carry out the sampling process – see Fig. 4.

The second point arises from the first. If the two signals, in this case U and V, are added together a combined chrominance subcarrier of sinewave form is obtained. The amplitude of this new carrier depends on the amplitudes of the U and V signal components. It's a measure therefore of the amount of colouring information and thus the picture's saturation. The phase of the combined chrominance carrier depends on the polarities and *relative* amplitudes of the U and V components. This defines the picture colour (hue).

Demodulating QAM Signals

So the use of QAM with suppressed subcarrier working allows either + or −U and either + or −V to be transmitted simultaneously. The combined chrominance subcarrier can be inspected in the receiver by two separate sampling carriers of correct phase, i.e. with a 90° phase difference between them – and this will enable us to separate the signals. This is Simple PAL decoding. Look again at Fig. 4.

Alternatively, the chrominance signal can be processed using a delay line and matrix circuit in the well-known PAL-D manner to give two outputs – a carrier modulated only with the U signal and another modulated only with the V signal. Each carrier can then be sampled by its own appropriately phased reference carrier. If the circuit is correctly engineered, no crosstalk is possible and complete separation of the U and V video signals is achieved. It is very difficult in Simple PAL to keep the reference carriers sufficiently stable and accurately phased in order to achieve such accurate separation of the signals.

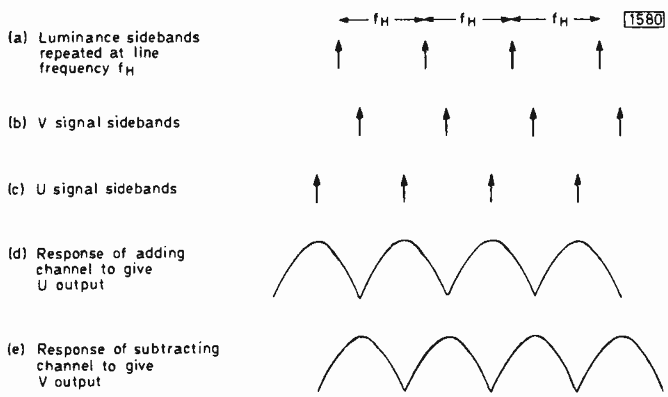


Fig. 6: The delay line and the chroma matrix circuit together form two comb filters. Note how the luminance sidebands are also interleaved – by using an offset chrominance subcarrier.

Frequency Interleaving

This process of signal separation brings us back to sidebands again. Each sideband component of the U signal is a harmonic of a fundamental frequency related to the scanning process. The V signal has sidebands whose harmonic frequencies are in the same way related to the scanning but have a phase difference of 90°. Thus one set of sidebands will be at maximum when the other is at zero and we have true interleaving of the sideband components of the U and V signals – hence the possibility of separating the signals in the receiver. Let us finally take another look at delay line PAL decoding, because the technique is rather more elegant than simple descriptions lead one to believe.

Delay Line/Matrix Circuit Action

The action of the delay line and matrix circuit is well known and understood – or is it? Certainly it's easy to draw the phasor diagrams, as in Fig. 5, making it all nice and clear. Alternatively we can say for example that +U, +V via the delayed signal path added to +U, −V via the direct signal path gives +2U, and −2V by subtraction: complete separation again. But these are merely different ways of presenting the same argument, and neither really describes the fundamental action of the delay line and matrix network.

A plot of the frequency responses of the adding and subtracting channels compared against the distribution of the U and V sideband energy is shown in Fig. 6. It can immediately be seen that the response of the U channel of the delay line/matrix network is exactly matched to the presence of the U sidebands in the chrominance signal but rejects the V sidebands, while the V channel similarly accepts the V sidebands and rejects the U ones. The important point is that the delay line/matrix network circuit consists of two comb filters matched to the line frequency harmonics of the U and V signals respectively. The 25 and 50Hz harmonics are bunched close to the line frequency components and are also accepted. This way of looking at the process of U and V signal separation is clearly a much more fundamental one than that commonly accepted as the complete explanation.

Confusion sometimes arises because in practice the add circuit provides the V signal output and the subtract circuit the U signal output. This is simply because the delay line introduces an extra 180° phase shift in the system.

In Conclusion

In conclusion then, suppressed carrier QAM working allows the U and V signals to be transmitted simultaneously in a common r.f. passband with interleaved sidebands. These are then selected and separated by two comb filters in the receiver. What could be more elegant and efficient? Our confrontation of the paradoxes of the colour subcarrier has taken us quite deeply into the process of understanding the basic theory of encoding and decoding PAL colour transmissions: we started off with some puzzling aspects of suppressing the subcarrier and finished up with interleaved sidebands and comb filters. We hope that this approach has helped to make it all that much more clear. ■

Servicing EMO Colour Receivers

Also Euravox and Eurosonic

D. Gennard, B.Sc.

THE EMO 90° PAL colour chassis is of French manufacture. Quite a number were imported during the period of the colour boom back in 1973-74 and were marketed under several names, including EMO, Euravox and Eurosonic. Since then however many of the companies originally involved in the importation, distribution and servicing of these sets in this country have either ceased trading altogether or ceased dealing with the chassis, making data and spares difficult to obtain. This is unfortunate since it's basically a good set and a fair number are now on the ex-rental market at reasonable prices.

The chassis is surprisingly conventional electronically – as conventional as a colour chassis can be that is. It's fully solid state except for the unusual (6V heater) line output and efficiency diode valves. RGB drive is applied to the cathodes of the c.r.t. The most likely sources of trouble however are the power supply and the line output stage.

Layout

Looking into the back of the set at the main chassis frame, which hinges vertically outwards after slackening two wing nuts, there are from left to right the power supply, the chroma panel, the timebase (vertical and horizontal) panel and the line output stage panel. Mounted vertically on the left-hand side of the cabinet interior is a subchassis holding the u.h.f. and v.h.f. (if fitted) varicap tuner board, the i.f./a.f. board, the varicap pushbutton assembly, the user slider controls, the on/off switch and the mains fuses. This subassembly is quite inaccessible and can be worked on only after being completely removed – by unscrewing the four securing nuts and pulling off (carefully) the slider control knobs.

The convergence panel is obvious and hinges into view nicely after removing two screws.

Power Supplies

Fig. 1 shows the complete power supply circuit, which is arranged on three separate boards. Once you get used to it the power supply is relatively simple to deal with.

A hefty mains transformer supplies everything, and is consequently under severe strain. The author has not, touch wood, had one fail but wouldn't be surprised if this did occur.

The output from the 35V secondary winding is rectified by D1102 with CH902 as its reservoir, giving –40V which is used by the field output transistor and one side of the brightness control. After voltage dropping this supply provides –12V for the tuner board.

The 18V winding output is rectified by the bridge Rd3101 and regulated by T1101, T1102 and T901, supplying 12V which is adjustable by means of P1101.

The 300V secondary feeds a full-wave voltage doubler (D1103/D1104/CH903/CH904) which provides a 280V supply for the line output stage and, after dropping by R3102 and zener diode D901, a 150V line for the video (RGB) output transistors. The regulated 33V feed to the varicap tuner pushbutton assembly is also obtained from this line.

No Results

The chassis is littered with seven fuses most of which are apparent. If preliminary testing suggests an open-circuit mains transformer primary winding however first check the mains fuse hidden in the 110/220V voltage tapping selector. The 220V 1·6A fuse seems to blow for no apparent reason: since it's not a particularly standard type of fuse body the easiest course is to replace it with the 3A fuse from the 110V side of the selector since this is not required. If the 3A fuse blows there is obviously an overload on the transformer, either on one of the secondaries or possibly due to a shorted turn on the primary winding.

Apart from fuses, another common cause of no results is the on/off switch. This shouldn't be difficult to diagnose but may be harder to put right due to the spares situation. Usually only one pole fails, and at a pinch this can be shorted and the switch operated as a single-pole one: this is not recommended however due to the obvious safety risks.

LT Regulator

It is quite common to find trouble with the 12V regulated supply, generally due to one or other of the transistors (T901/T1102/T1101). Note that the series regulator transistor T901 can be replaced without soldering. Another possibility is the mica insulating washer beneath the series regulator transistor T901 – it's been found short-circuit on occasion, grounding the collector of T901 and thus removing the 12V supply.

Line Output Stage

The circuit of the line output stage is shown in Fig. 2. As can be seen the circuit is quite conventional save for the valve types. The only difference between the EL509 and EY500 and the more familiar PL509 and PY500 is the heater voltage.

The main cause of trouble is the line output transformer. This is unfortunate in view of its price and availability. Because of its bifilar construction, and the supposed lack of

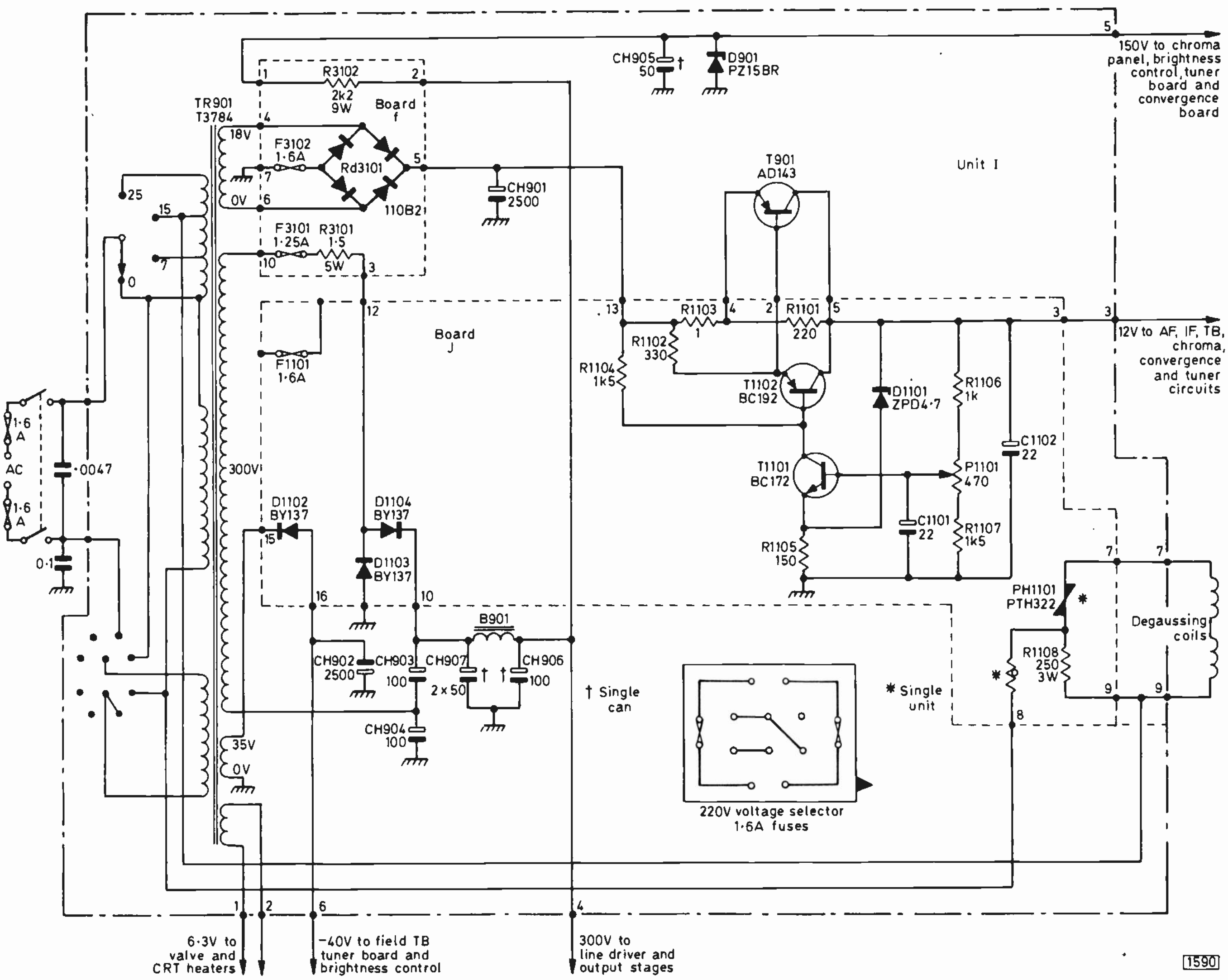


Fig. 1: The power supply circuits. Note that the fuse panel f, on the side of the power supply unit, also acts as a general tag panel for the various outputs. The 220V connections on the mains voltage selector/fuseholder are shown: the 110V side incorporates 3A fuses.

demand, UK replacement line output transformer manufacturers just don't seem to want to know about it.

No EHT

The usual cause of no e.h.t., assuming no input to the tripler, is shorting turns on the line output transformer primary winding. As a result the EL509 overheats and may glow red. Unless there are obvious visual signs of the trouble on the transformer itself the diagnosis can usually be made only after checking everything that may overload the transformer, especially the boost capacitor C1403, the scan-correction capacitor C1404 and the reservoir capacitor C1405. Also make sure that drive is present at the control grid of the EL509 – indicated by a negative reading of about 50-70V on an Avo Model 8 at pins 1 and 8.

After replacing the line output transformer it is a good idea to replace the line output valve's 2·2kΩ screen grid feed resistor R1409.

The tuning capacitors C1502, C1503, C1504 and C1505 (usually not all fitted) on the focus board above the line output transformer are physically very near the hot EL509 and EY500. Consequently they can go short or more likely open-circuit, causing lack of or no e.h.t. The EY500 will be very unhappy of course if they short.

The tripler is very reliable but if necessary can be easily replaced by a variety of the five-stick units on the surplus market.

After replacing the line output board make sure that R1405 (47kΩ) which is mounted vertically above the width control is not shorting to the chassis frame.

Convergence

Once disturbed, good convergence is difficult to obtain on this chassis, partly because of the poor translation of the recommended procedure in the manual. More experienced engineers are advised to play it by ear, and perhaps settle for more approximate results than one might normally accept.

L. A. Ingram writes:

The push-push on/off switch is a hefty item mechanically but none too reliable. It is difficult to replace it with a standard item, but as long as the contacts have not become too burnt due to sluggish operation it can, with care, be dismantled and restored to working order using fine emery paper and a thin lubricant.

The l.t. bridge rectifier is a very small black cube on a

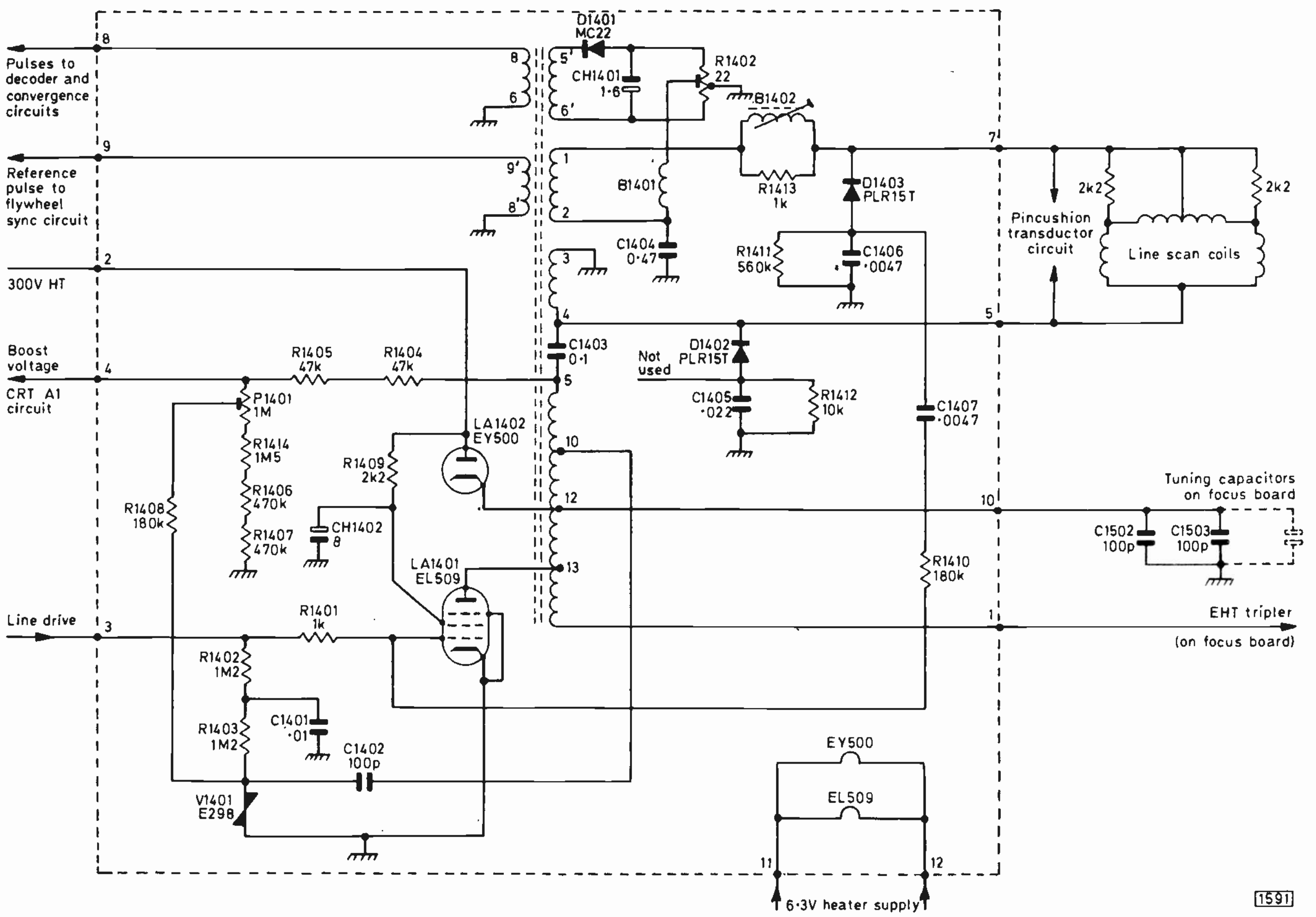


Fig. 2: Line output stage circuit. The flywheel sync circuit, sinewave line oscillator and a high-voltage transistor driver stage (T1302, BF179C) are mounted on the timebase board. In addition to the normal VDR width stabilisation arrangement, regulation is provided by D1403 and the associated components.

small panel on the front side of the mains transformer: a quick examination will usually confirm any suspicions about it as the case shows bulges and in some cases partly melts away.

In the event of failure of one or more of the rectifiers and electrolytics in the voltage doubler h.t. rectifier circuit they should all be examined with great care, especially CH903 whose can must be insulated from chassis. The 150V zener diode must be a heavy duty type if replacement is necessary.

We've had little trouble with the tuner and i.f. panels except for the presets. In the case of intermittent or complete loss of gain these warrant examination.

The AU107 field output transistor is mounted separately on the main chassis assembly. In the event of its failure, the field charging capacitor CH1307 (47μF), the two capacitors in the linearity network – CH1308 (100μF) and CH1309 (47μF) – and the AC180 driver transistor (T1308) should all be checked before it is replaced.

Intermittent or complete loss of luminance is usually due to the luminance delay line LR2501. Check by the usual freezer/warmer method. We have successfully replaced it using a standard line stood off the panel with stiff wire – in the event of the miniature one not being available.

Intermittent or more likely complete loss of the R – Y or B – Y signal can be due to the chokes, S2504 and S2508 respectively, in the synchronous detector output circuits. These can be difficult to replace without experimentation. Fortunately the values are usually marked, but it's better to try to get the correct replacements. They are mounted at the opposite corner of the decoder/RGB board to the chroma delay line.

The original e.h.t. tripler is type TVK31. If not obtainable, the more conventional type as fitted in the ITT CVC5 chassis for example can be used though this will mean some metal work to the can cover or scrapping this completely. The original cover does not allow much ventilation, and with the accumulation of dust the original tripler develops corona in every conceivable way.

Should intermittent varying focus be experienced you will often see the 10MΩ focus potentiometer P1501 tracking between the tags. Replacements are not always easy to obtain.

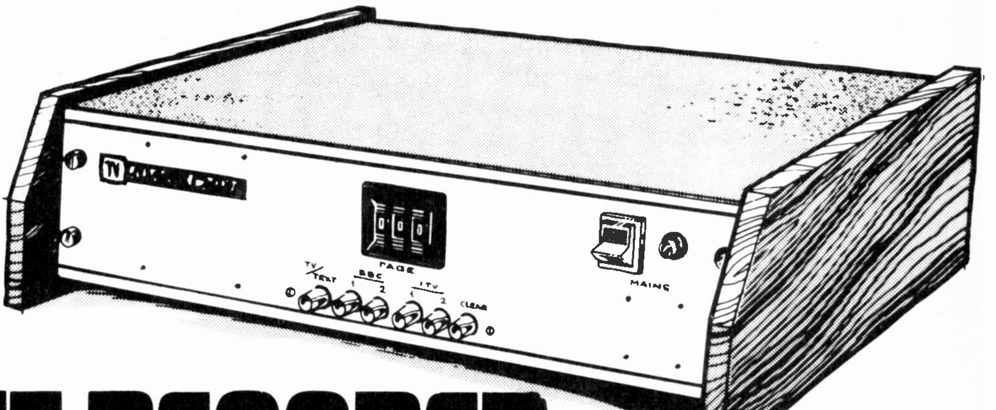
Great care should be taken with dressing all leads and connections in the e.h.t. section. Tidy solder work here is essential.

Editorial note:

A blocking oscillator (T1301, BC192) is used in the field timebase, followed by a discharge transistor (T1307, BC192) a driver stage (T1308, AC180) and the field output transistor (T1602, AU107). The output transistor can be responsible for field jitter. The timing capacitor in the blocking oscillator circuit is an electrolytic (CH1306, 6·8μF): this is suspect in cases of field hold troubles.

Help with spares can be obtained from Electronic Engineering Services, Cambridge Street, Rotherham, South Yorkshire.

THE TV TELETEXT DECODER Part 3



Steve A. MONEY T. Eng. (CEI)

In order to reduce the page transmission time, and give more rapid access to any selected page, it is usual for rows of blank spaces to be omitted when the page is transmitted. The technique used differs slightly between the BBC and ITV. On Ceefax it is usual for blank rows at the bottom of the page, after the last row of text, to be omitted, whereas on Oracle pages any blank rows that occur within the page are omitted.

With both Ceefax and Oracle therefore it's essential that when a new page is selected the data for the page being displayed must be erased from the memory before the text for the new page is accepted. If this were not done and the new page contained a number of blank rows the new display is likely to be incorrect – where the blank rows should be, the corresponding points in the memory will not have been overwritten and the text from the previously displayed page will still be shown on the screen.

Clear Page Logic

In commercial decoders it's usually arranged that when a new page number is selected by the page switch an automatic memory clearing operation is carried out, thus leaving the screen blank ready for the new page of text. This facility requires some additional logic in the decoder system however and it was felt that in this basic decoder design a manually operated clear page system would be perfectly adequate. In this case, after the new page has been selected by means of the page switch it will be necessary to push the clear button on the front panel in order to erase the current page from memory, leaving a blank screen ready for the text of the new page to be accepted and displayed.

For "rotating" pages, where there may be a number of different pages of text which are sent out in sequence but with the same page number, an automatic system of erasing the memory is required and this must be controlled by a command from the transmitting station. For this purpose a special clear page command is included in the header row of the page whenever the text for that page is about to be changed. This clear page command uses a spare data bit in the tens of minutes address word. Since there can be only a maximum value of five for tens of minutes only three bits are needed to provide the code which in fact uses bits 2, 4 and 6 of the data word. Bit 8 is therefore used to tell the decoder that it must clear its memory ready for a new page of text. Normally this bit is at the 0 level, but when new text is about to be sent it is set at 1.

First let's look at the way in which the memory is cleared by using the manual clear switch. When the clear button is pressed it resets the clear page flip-flop IC16b which in turn activates the write command to the memory circuits via gate IC23c. At the same time the Q output of the clear page flip-flop resets the data latches to produce the code for a blank space on the memory data input lines.

As each memory location is selected during the next display scan, its contents will be overwritten by the code for a blank space. At the end of the display scan an end of page signal from the memory circuits returns the clear page flip-flop to its normal preset state, thus removing the write command and restoring the data latches to normal. During the following scans the screen display will be blank – until text for the new page is accepted into the memory.

The code for a blank space is 0100000, where bit 6 of the data is at 1 and the other bits are all at 0. In this case the binary number has been written using the normal convention of most significant digit first. In the data transmission, the least significant bit is sent out first and hence has been called bit 1 of the data word.

To obtain a blank space code for the memory it is convenient simply to clear the output data latches IC13 and IC14, thus setting all their Q outputs to 0. To obtain a 1 on the bit 6 data, the output is taken from $\overline{3Q}$ rather than from 3Q. To correct the input data, which would otherwise be inverted by this connection, the input to 3D is inverted in IC10f.

For the automatic clear page action required on a "rotating" page, the clear page control bit in the header row is detected and stored in flip-flop IC15b by feeding bit 8 of the data to its D input and clocking the flip-flop when the tens of minutes data word is present on the output latches IC13 and IC14. The clear control flip-flop IC15b is normally placed in the reset state by end of page pulses from the memory circuits. When a 1 is detected in the clear page position in the header row the flip-flop will be set and its Q output is then used to control the state of the clear page flip-flop IC16b. Gate IC18c ensures that only the clear page bit for the selected page causes a memory erase action. When the clear page bit has been detected for the selected page, the D input of the clear page flip-flop IC16b will be set at 0. This flip-flop is clocked by the row 1 pulse from the memory circuits and its Q output will go to 0 to start a memory erase cycle in the same way as if the manual button had been pressed.

It should be noted here that the clear page cycle is started when the display scan starts to select row 1 of the memory rather than the start of the header row. This is done to avoid erasing the header row information which has just been written into the memory.

At the end of the display scan, both flip-flops IC15b and IC16b are returned to their normal state and the page clearing action ceases. Usually rows 1 and 2 of the text for the new page will be received during the following field blanking interval.

Rolling Header

One problem produced by completely clearing the text display on the screen when a new page is selected is that the viewer will now be watching a blank screen until the text for the new page is received. This could involve a wait of perhaps half a minute under normal conditions, but if the selected page is not included in the magazine being transmitted the screen could remain blank indefinitely. To avoid this state of affairs it has been arranged that after a manual clear page operation has occurred there will be a continuous display of the header row until the text for the new page has been received.

This rolling header display is produced by writing the header row of every page into the memory until the selected page is deleted. Since the format for the header row is the same for all pages in a magazine the result is that a single row of text is displayed at the top of the screen and the displayed page number will change as the various pages of the magazine are received. When the page selected by the viewer is received, the header row display will freeze and the rest of the text for the page will be displayed. This can be a very useful facility for checking which pages of the magazine are actually being transmitted.

Flip-flop IC16a controls the rolling header display. When the clear page button is pressed, this flip-flop is reset and its $\overline{Q}$ output is used to control the write signal to the memory via gate IC18a. This gate is controlled by a signal from flip-flop IC15a, which detects the header row address. This flip-flop will be reset when row address 00000 is detected. Thus a write command to the memory will be produced only during the header row and every header row will be written into the memory. When the new page is detected, a signal from the page accept flip-flop IC17b is used to clock the flip-flop IC16a into the set state and stop the rolling header display.

Clock Display

The typical format for a header row on a Ceefax page as displayed on the screen will be

CEEFAX P105 SUN 23 JAN 18:32/15

In the case of an Oracle transmission the word Oracle is inserted in place of Ceefax and the letters ITV appear just before the time display at the end of the row.

The six figures at the far right of the header row constitute a real-time digital clock display in hours, minutes and seconds. It updates once per second.

If the header row is written only when the selected page is received, the clock display will be updated only once every thirty seconds or so – which rather defeats the idea of having a clock display there in the first place! In this decoder it is arranged that the clock display is updated continuously to give a correct time display.

This action is produced by the clock display flip-flop IC19a which is clocked by a pulse from the character counter in the memory circuits. This pulse occurs when the 32nd character of any row is written into the memory array. To ensure that the clock display flip-flop is set only in the header row, its D input is fed from the header row flip-flop IC15a. When set, the clock display flip-flop will open the write circuits to memory and allow the text for the clock dispaly to be written in. An end of line signal from the memory circuits is used to reset the clock display flip-flop at the end of the header row, after the last character of the clock display has been accepted.

Memory Clock

A word clock signal is required to drive the memory address counters during both the input and display modes of operation.

The clock for writing data into the memory is timed by the counter IC7 and gate IC23a. Flip-flop IC19b is used to switch on the memory clock after the row address codes has been received and the first text character is present on the output data lines. During the display scan, the write clock is turned off and replaced by a clock pulse derived from the display logic. This pulse is passed through gates IC23b and IC12d and eventually produces the memory clock drive during the period of the display scan.

Construction

A double-sided printed circuit card 8 inches long by 4 inches wide carries the input logic circuits. At one end the card is extended by 0·3 inches to form a 32 way 0·1 inch pitch edge connector which will be inserted into a 32 way socket on the mother board when the card is installed in the decoder unit.

The track layouts for the two sides of the printed circuit board are shown in Fig. 1, whilst the layout of the integrated circuits and other components is shown on the right-hand side of Fig. 1.

Some care will be required in the assembly of the input logic card but, since there are no adjustments to be made, if the board has been correctly assembled it should work first time.

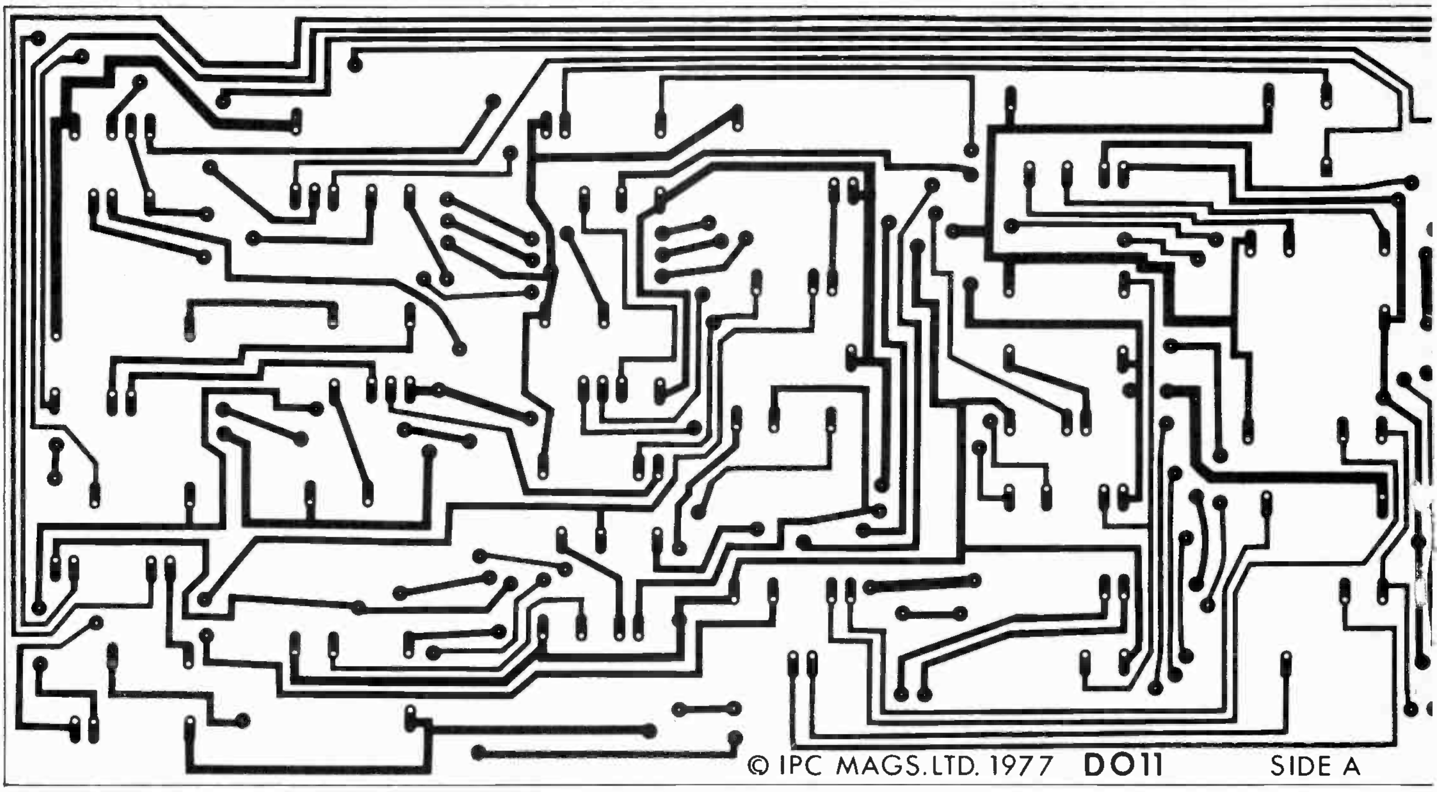
Before describing the construction process a few points about soldering equipment should be made. First, because of the complexity of the circuits the tracks on the board are of necessity packed quite close together. It is essential therefore to use a soldering iron with a small bit. A 1/16 inch diameter bit, or one of the fine pointed bits such as those used on Weller irons, is recommended. In order to avoid applying excessive amounts of solder to the tracks it is suggested that a fine gauge solder such as Multicore 23 SWG should be used.

Care must be taken to avoid getting any solder on the gold plated edge connector pads at the end of the board since this could lead to connection problems when the board is inserted into its socket.

Component Assembly

It's convenient to start construction by inserting all the integrated circuits and other components into the board at their appropriate positions as shown in Fig. 1. At this stage the integrated circuits can be held in the board temporarily by soldering just one of their pins, but the other components can be inserted properly. Check now that the i.c.s are in their proper positions. Note that the 74164 IC6 has to be mounted the opposite way round compared with the other i.c.s. Since the circuits are at this stage held in by only one pin any corrections are easy to make.

When all the i.c.s have been checked and found to be in their proper places, the top soldered connections can be made to them – where the tracks on the component side of the board go to pins on the i.c.s. There is a total of 115 of



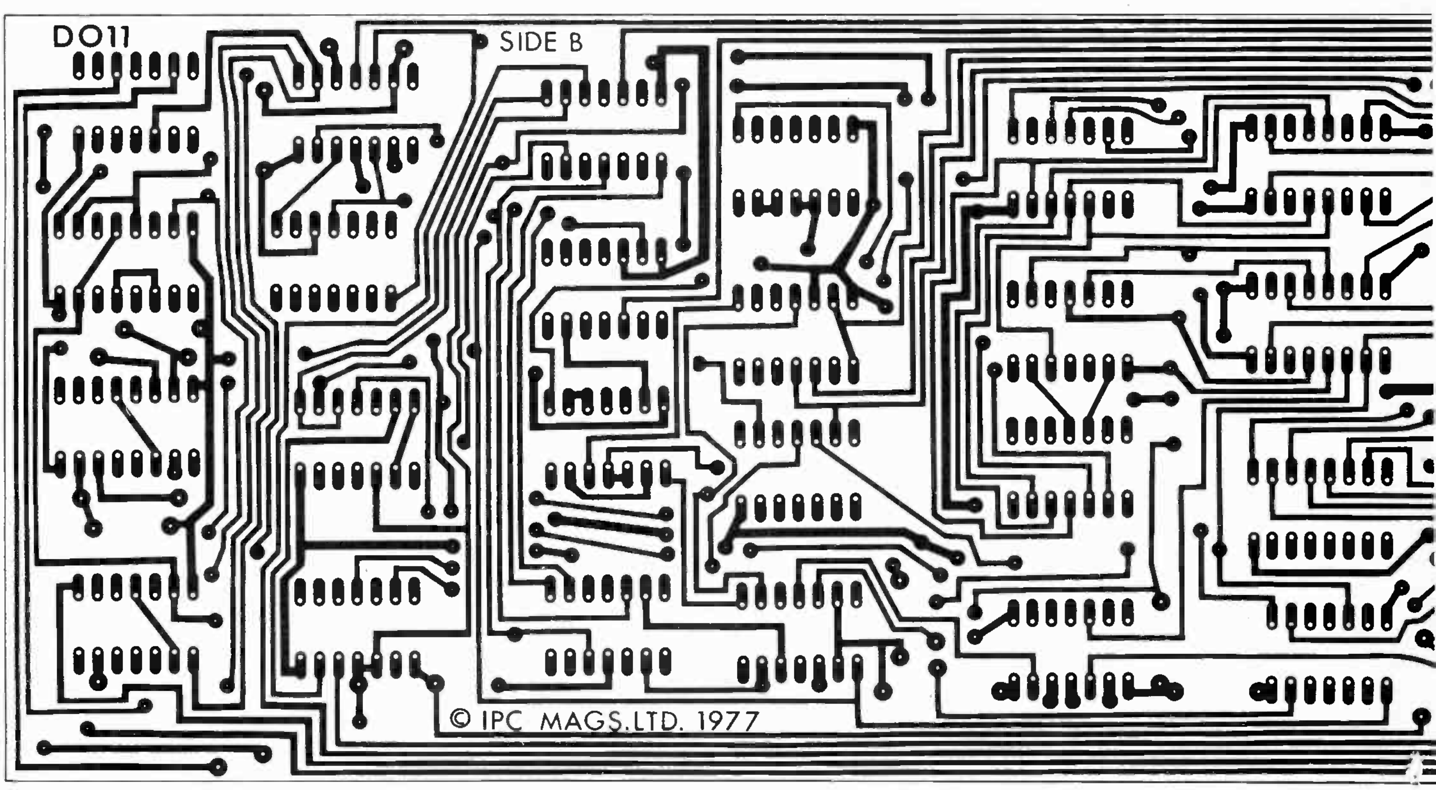
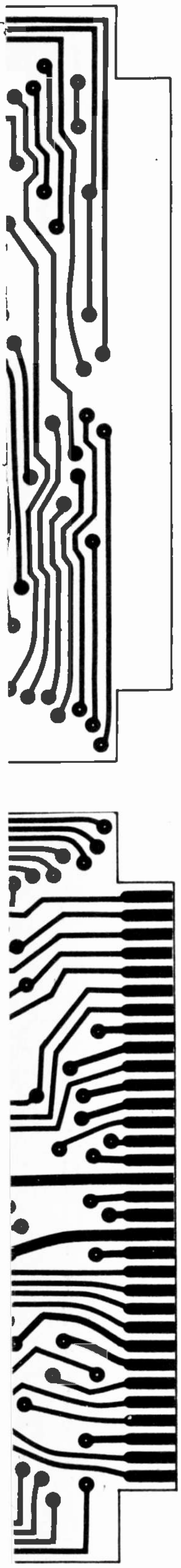
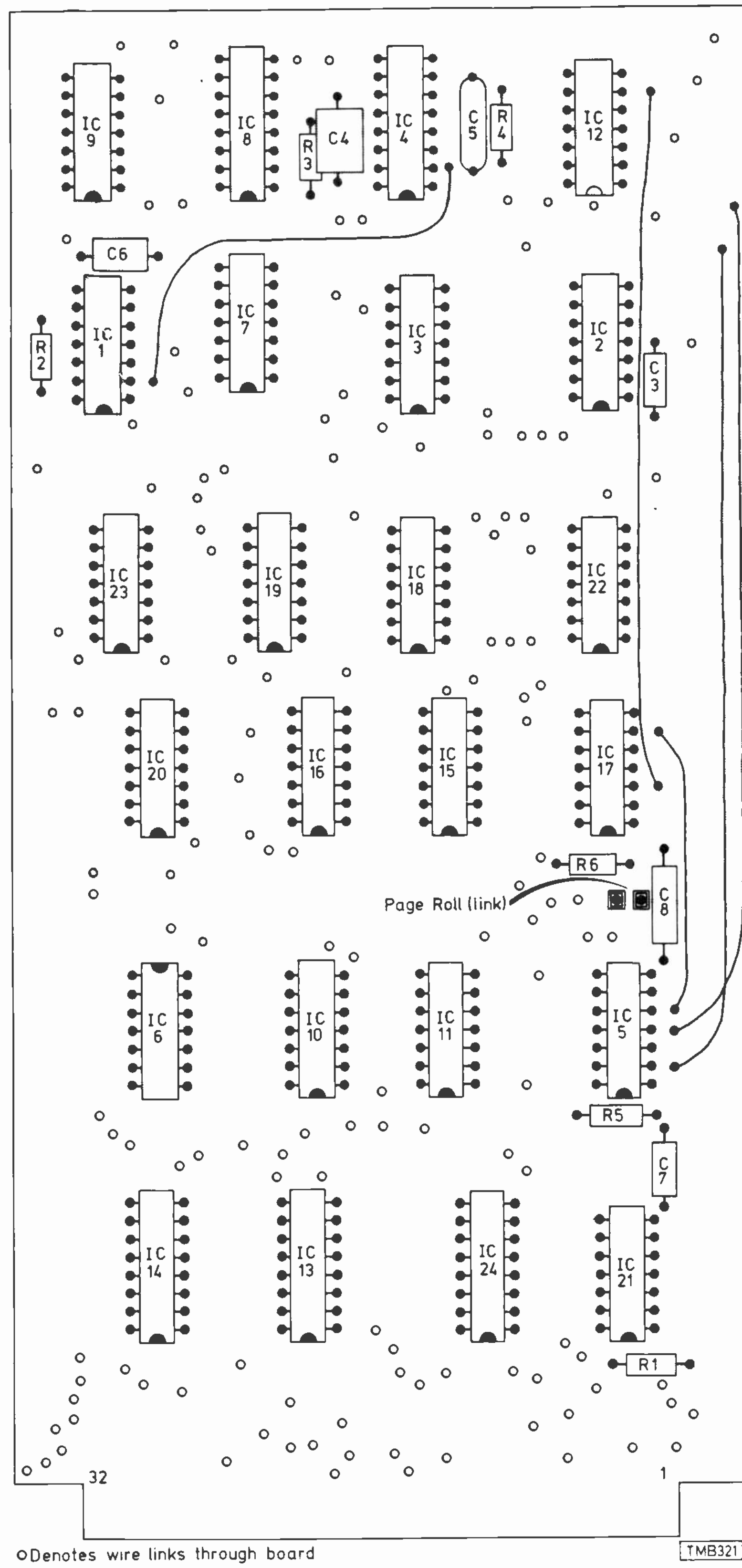


Fig. 1. The top left diagram shows details of the copper track on the component side of the input p.c.b. (side A). The bottom left dia
structing the board it is essential to check very thoroughly that all top connections, through-hole links and wire links have been mad
between i.c. pins or between adjacent tracks.

these solder connections to be made. Table 1 gives a breakdown of the number of top connections on each i.c. and should be helpful in checking for completion of the top soldering. Each join is made by running a fillet of solder between the outer side of the i.c. pin and the track on the board. When the top connections have been soldered, go back again and carefully check that none have been missed out.

Having soldered the top connections to the integrated circuits the connections on the underside can be made. Here it is necessary to solder only those pins of the i.c. which have a circuit track going to them. Some





*ɡram shows the copper track of side B. On the right the component layout, through-hole links and wire links are shown. When con-
ɘ. Other things to watch out for are dry joints, putting the i.c.s in the right way round, and ensuring that there are no solder bridges*

constructors may find it convenient however to solder all the pins on this side of the board. In either case, when the connections have been made go back and check that none have been missed. When soldering this side of the i.c.s care is needed to ensure that solder does not run between adjacent pads to form a solder bridge.

For the page roll link it is convenient to use a pair of Soldercon sockets which can later be linked by inserting a short length of bare wire between them. This link is used during the setting up procedure, but once the decoder has been set up the link will normally be left permanently joining the two points on the board. At this stage a simple direct wire link could be soldered into the board if desired.

Five wire links are required across the board to deal with connections where there is insufficient room to use printed circuit tracks. These links are best made with single-core PVC or PTFE covered wire which can be made to lay more neatly on the board than flexible multistrand wire. If PVC covered wire is used, some care will be needed when the soldered joints are made at each end otherwise the PVC insulation will melt and run back leaving a bare wire.

Through Board Links

At this stage of construction it will be noted that there are still at lot of pads which have not been soldered on the circuit board. Because of the complexity of the circuit and the fact that both sides of the board are used for tracks, it is necessary to have a large number of links through the board to join tracks on opposite sides.

Plated through connections could have been used, but this would have made the boards rather more expensive and only a limited number of printed circuit manufacturers can offer this facility. Many of the through links could have been made through the integrated circuit pins, but this does make the integrated circuits very difficult to remove and it was considered a better policy to avoid soldering the i.c. pins on both sides of the board whenever possible. As a result, wire links have been used to interconnect the tracks on the two sides of the board.

Making the links

The method of making a wire link connection through the board is shown in Fig. 2. 24 SWG tinned copper wire is suitable. The first step is to push the end of the wire through the hole in the board and then bend about a 1/16 inch length of wire at the tip to form a right angle. This little hook is then pulled down on to the track and soldered down. Next the wire on the other side of the board is folded down to lay on the track on that side, and cut off to leave just a 1/16 inch length which is then soldered down to the track. By forming these hooks on each side of the board before soldering, the wire link will not fall out whilst it is being soldered and a better connection is made to the track on each side.

Carefully work around the board inserting all the through board links. Their positions can be easily seen because there is a solder pad on each side of the hole where a link has to be inserted. There are a total of 145 through board links on this card. Check around the board at least twice to make sure that none of these wire links has been omitted.

When all the wire links have been inserted the assembly of the board is complete. At this stage it is not possible to test the operation of this logic board because it requires signals from the other boards to make it work.

Next month we shall examine and construct the memory board for the decoder.

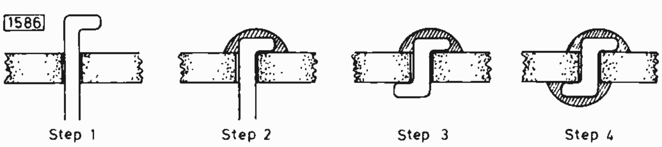


Fig. 2: The correct way to make through-board links. Here again ensure that there are no dry joints or solder bridges.

Table 1: Top connections to i.c.s.

IC No.	Connections
1	4
2	7
3	6
4	5
5	5
6	4
7	2
8	6
9	5
10	7
11	4
12	7
13	5
14	3
15	4
16	3
17	3
18	6
19	6
20	6
21	3
22	6
23	4
24	4

TO BE CONTINUED

The Decca 80 Chassis

Part 2

Barry F. Pamplin

LAST month we dealt with the tuning arrangements and the regulated power supply. It's logical next to look briefly at the i.f. and sound panel.

The IF Strip

There are four i.c.s on this panel, plus a light sprinkling of discrete components. The signal from the tuner passes via a bandpass shaping filter to the first of the i.c.s, a Motorola MC1349 which provides most of the i.f. gain. There are three differential amplifiers in this i.c. and the only tuned circuits required are those which couple its output to the following i.c. There are two d.c. feeds to the MC1349, both obtained from the 37V rail. Stabilisation is provided by a 16V zener diode.

The following i.c., a Mullard TCA270, incorporates a final i.f. amplifier, synchronous vision demodulator, noise inverter, a sync peak detector for generating the a.g.c. applied to the MC1349 i.c. and the delayed a.g.c. for the tuner, an a.f.c. detector, and output stages which provide a positive-going video signal for the decoder and a negative-going video signal for the sync separator. A 12V supply for this i.c. is obtained from the 37V rail. There are two coils associated with this i.c., an a.f.c. amplifier tank coil and the demodulator tank coil. The tuner a.g.c. preset control is set by rotating anti-clockwise until the picture becomes noisy, then backing off until the noise disappears.

The widely used TBA120S is employed as the intercarrier sound channel. The input from the preceding TCA270 is taken via a 6MHz ceramic filter. The audio amplifier consists of an SGS TBA800 which provides 3W from the 16Ω loudspeaker. Since the TBA800 operates in the class B mode its h.t. current requirements vary over a wide range. For this reason it's powered by a 25V line derived from the 37V line via a shunt stabiliser consisting of a BD375 (Tr801) mounted on the chassis and Tr303 which is on the timebase board.

Faults

Like most i.f. strips in solid-state sets the one in the 80 chassis is reliable and, surprise surprise, when faults do occur the culprit is nearly always one of the i.c.s or a dry-joint. Perhaps the most common fault is an obviously poor i.f. performance with severe ringing. This is usually due to the MC1349 i.c., though the TCA270 can produce similar symptoms. Another trick of the TCA270 is to produce a "fuzzy" output at pin 10 which feeds the sync separator: the result is poor sync symptoms which fail to respond to the usual cure for such trouble – replacement of the TBA920 i.c. on the timebase board.

Such faults are rare however. The more common trouble spot on the board is the sound section. Both the TBA120S and the TBA800 can produce the symptoms no sound, low sound, distorted sound or crackles that sound like an intermittent volume control. The TBA800 has a particularly nasty habit of overheating and suggesting that too much is being asked of it. Fit a new one: experience tells that overheating is merely due to the TBA800 being defective. As with all i.c.s the key to diagnosis is careful voltage measurements on the various pins (see Fig. 6).

Intercarrier buzz is an occasional problem. If it's constant, a small adjustment to the quadrature coil (L110) associated with the TBA120S i.c. will provide a cure. If it's intermittent however try replacing the TBA120S together with the 6MHz ceramic filter X100.

Decoder Panel

Two types of decoder panel have been fitted to the 80 chassis. The earlier Mk 1 version can be identified by the use of a TBA395 in position IC201 instead of the TDA3950 used on later boards. Another check point is the presence on the earlier panel of a small variable capacitor alongside the crystal. The panels are interchangeable but the i.c. in position IC201 must be the appropriate sort for the board.

The circuit of the later version is shown in Fig. 8. The deviations on the Mk 1 will be noted as they occur in the description.

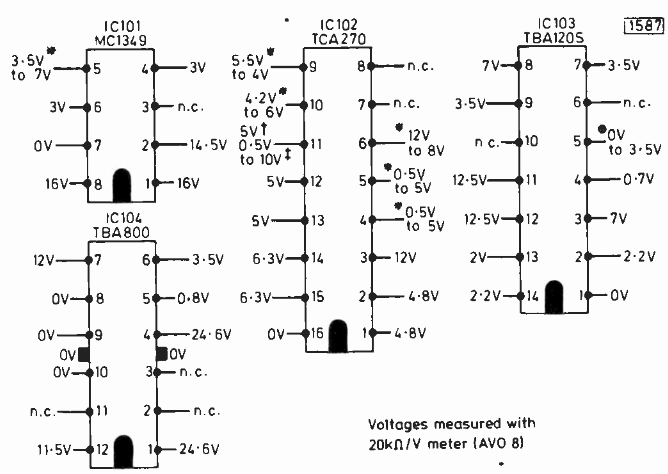


Fig. 6: I.F. strip i.c. voltages. Readings marked with an asterisk vary with signal strength: the first figure given is for no signal input, the second for a strong (2-3mV) signal. There will be 5V at pin 11 of IC102 with no signal, and 0·5-10V with signal – depending on receiver tuning. The voltage at pin 5 of IC103 depends on the setting of the d.c. volume control (if this type of control is used).

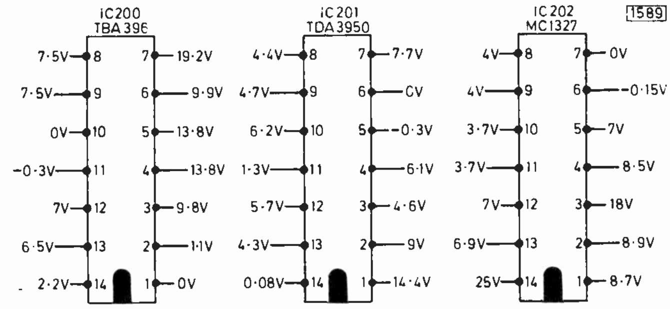


Fig. 7: Decoder panel i.c. voltages. Measured with an Avo Model 8 (20kΩ/V).

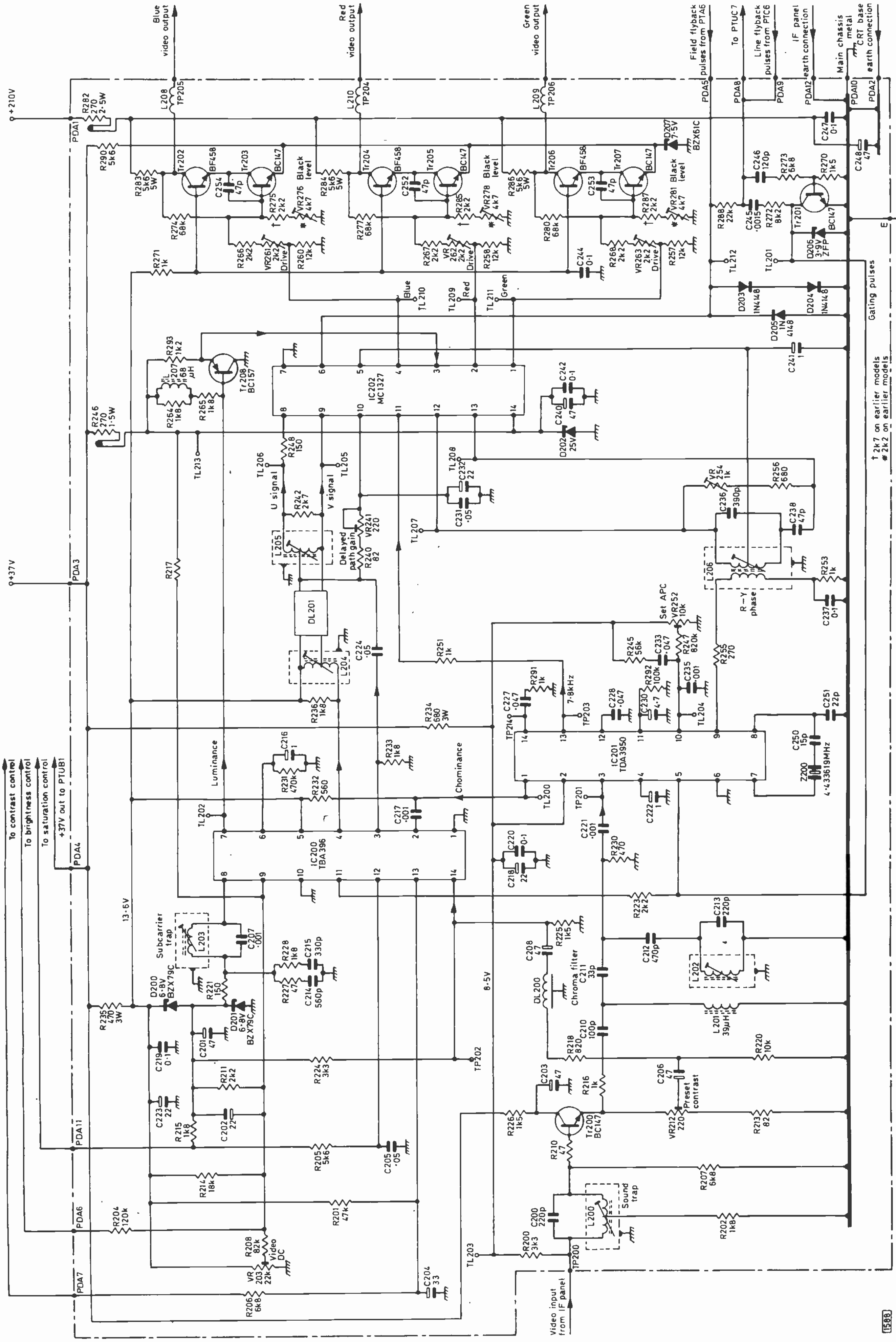


Fig. 8: Circuit diagram of the Mk 2 decoder board. The earlier Mk 1 used a different (TBA395) i.c. in the IC201 position and Tr208 was omitted.

The decoder operates on the positive-going video signal received from the i.f. panel via TP200 at the top right-hand corner of the panel. This signal has its intercarrier content removed by a trap L200/C200 and is then fed to the emitter follower Tr200. The output of this stage is tapped from the emitter circuit via the preset contrast control VR212 and fed to pin 14 of IC200, a Motorola TBA396, via the luminance delay line DL200.

IC200 contains the luminance amplifier, black-level control circuit and chroma delay line driver. The components L203/C207 are a conventional subcarrier trap whilst C216 is used in the black-level control loop. The luminance output from the i.c. appears at pin 7 from where it is fed, via the emitter-follower Tr208, to pin 3 of the demodulator/matrixing i.c. IC202. The emitter-follower is omitted on the Mk 1 panel.

Returning now to the emitter-follower Tr200 at the input it will be seen that the output of this stage also feeds, via various filters, pin 3 of the chroma processing i.c. IC201, a Motorola TDA3950 (TBA395 on Mk 1 boards). This device amplifies the chroma signal to a preset level, then removes the burst, and passes burst free chroma out, via a colour killer, to pin 1. It also generates an ident signal at 7·8kHz to operate the PAL switch in IC202. Finally it incorporates a reference oscillator whose frequency is controlled by the crystal connected between pins 7 and 8 of the device. Quite an achievement in a package not much bigger than a couple of match sticks. There are some problems however as will be seen later.

The burst-free chroma at pin 1 of IC201 passes, via pin 2 of IC200, to the chroma delay line driver amplifier and from there to the PAL delay line circuit where the R—Y and B—Y components are separated in the normal way and fed to pins 9 and 8 of the demodulating and matrixing i.c. IC202.

Reference signals at 4·43MHz are fed to IC202 at pins 12 and 13, and the three colour outputs appear at pins 4 (blue), 1 (green) and 2 (red) from where they are fed to conventional cascode output stages, each comprising a BF458/BC147 combination to provide about 100V of drive for the c.r.t.

The ident signal, a 7·8kHz squarewave, is generated in IC201: it appears at pin 13 and is fed into IC202 at pin 11 to drive the PAL switch.

This description of the decoder operation is brief because to deal with every aspect in detail would run to many pages. Anyone who requires more information should obtain from the Decca service department a copy of their excellent manual, available under the code 79 0434 7, which contains many diagrams and block schematics of the decoder – and indeed of all the panels in the set.

Decoder Faults

Now for fault finding. Once again the main trouble spots are the i.c.s, but some sort of logical approach is essential if decoder faults are to be tracked down in a reasonable time.

Complete absence of luminance or chrominance information suggests a check at TP200 to see whether the panel is getting any signals to process. If it is, then the absence of luminance should be tackled by checking from TP200 to the emitter of Tr200, each end of the luminance delay line, pin 14 of IC200 (TP202), pin 7 of IC200 (TL202), the emitter of Tr208 and then pin 3 of IC202 to find out where it's getting lost. Once again a check on the i.c. pin voltages (Fig. 7) is essential for speedy fault location.

A similar approach should be followed to track down a no colour fault. Starting at TP200, proceed to TP201, TL200, pin 2 of IC200, pins 3 and 4 of IC200, each end of the PAL delay line DL201 and finally TL205 and TL206. If chroma is reaching IC201 but not emerging it is important to ensure that the burst gating pulses from Tr201 are present at TL201. Then, if necessary, check whether a reference signal is being produced at pin 9 of IC201. It should be present at TL207 and TL208 for feeding to pins 12 and 13 of IC202.

So much for generalities. More specifically we must now turn to the problems already mentioned concerning IC201. The changed panel design for the Mk 2 board was a result of the poor ident performance of this device under certain conditions of service. The most common trouble was persistent complaints from viewers that they could not get colour on IBA channels. The reasons for this are rather obscure but it's a fact that the burst on some IBA transmitters is not all that it should be – especially its position on the signal with respect to the line sync pulse. The combination of transmitter errors and critical ident operation in IC201 caused a few headaches with the early 80 series chassis.

The Mk 2 chassis uses an improved device for IC201 and most of the previous problems have been resolved. Some specimens of the TDA3950 have a nasty habit of unlocking the a.p.c. loop when the cabinet temperature rises however, giving rise to complains about loss of colour after the set has been switched on for a while. If you suspect this sort of trouble the key voltage is 6·2V at pin 10 of IC201. If this falls to around 2/4V under the fault condition a replacement i.c. should be tried.

The MC1327 demodulator/matrixing i.c. IC202 has been around for several years now and most of its foibles will be known to engineers. Amongst its more common tricks are no video, poor chroma, too much of one colour and out-of-phase PAL switching, giving Hanover bars at one side of the screen. One or two specimens have been found that give white streaking across the picture – this looks rather like electrical interference.

The colour output stages, being of conventional design, give conventional faults, viz. output transistor goes open-circuit and one colour disappears, or goes short-circuit and one colour floods the screen. In fact if one of the BF458s goes short-circuit it usually kills all trace of luminance on the screen.

Symptoms of uncontrollable brightness, if not due to an obvious fault like R282 going open-circuit, can sometimes be tracked down to C216, C231 or C232 becoming faulty. Another puzzling one is failure of C224, causing apparent faults in IC202 as evidenced by unequal drives from the i.c. Smearing on one colour is often due to the relevant peaking coil (L208-L210) going high-resistance.

Before leaving the decoder there is one final point that requires emphasis. Because of the way in which the i.c.s are powered from the line timebase derived 37V line via series resistors and zener diodes it is imperative before replacing a faulty i.c. to check the supply voltage across the appropriate zener. There is a small pitfall here. D202 clearly controls the supply voltage for IC202, and D200/D201 the supply voltage for IC200. IC201 is a bit more mysterious however. The i.c. is fed from the 37V line via R234 but no zener is in sight to give the 8·5V which are to be found on the other side of the resistor!! Any reader who discovers where the zener is hidden is eligible for the recently announced award of Doctorate of lost things (DOLT). All right then, it's inside the i.c.

CONTINUED NEXT MONTH

LONG-DISTANCE TELEVISION

ROGER BUNNEY

THE month of February was a poor one for DX-TV: as a colleague has commented, "it's been hard work seeing anything". Apart from the usual MS (meteor shower/scatter) signals punctuating each day there's been an unusual absence of signals propagated via any other mode. One hopes that this is the lull before the storm, and personally I'm looking forward to an active Sporadic E season just as good as last year's. On the basis of previous years there will be a small SpE opening in mid-April if we are to have a good main season starting about the second week in May.

There's little point in including a log this month. The most frequently received signal here was SR (Sweden) on ch. E2. This was present almost daily, often around 0800. CST (Czechoslovakia) has been a good signal at times on ch. R1, in company with MTV (Hungary) – both also around 0800. The West German Grunten ch. E2 transmitter has been frequently received radiating the Fubk card in the early morning period. I've had a record number of letters this month but all record the dismal DX-TV conditions.

The new aerial system, designed to try to overcome the interference from the nearby computer installation, is at an advanced stage and I hope to erect it this month. I'm told that work is progressing on redesigning the computer installation to reduce the problem.

A Correction

In editing the March column some errors were unfortunately introduced in the section on aerial stacking. The final paragraph under the heading "Effects of Stacking", starting "For economy we could . . ." (see page 259), should have read as follows:

"We can stack various types of aerials in order to reduce the vertical beamwidth. For example two ten element arrays or, for economy, two three element arrays. A ten element system would have the greater efficiency, with a forward gain of perhaps 12dB, the three element system having a gain of around 6dB (both relative to a half-wave dipole). Obviously if we stack two aerials we must ensure that, in order to maintain maximum gain, the apertures of the two aerials don't overlap. It's essential to use identical aerials when stacking arrays."
(*Our apologies* – Editor)

Aerial Sense is Good Sense

The Aerial Manufacturers' Association has just published an interesting small booklet called "Aerial Sense is Good Sense". It's intended as a guide to better reception of conventional TV signals but DXers will find helpful advice in it. Copies can be obtained from: AMA, c/o Spectrum Aerials Ltd., Thirsk Place, Osmaston Park Industrial Estate, Derby DE2 8JJ. Requests should be accompanied by a stamped, addressed envelope.

News from Abroad

Eire: A 54ft. four-channel u.h.f. transmitting aerial is being installed at the Cairn Hill, Co. Longford transmitting site. This will be the first high-power u.h.f. transmitter to operate in Eire.

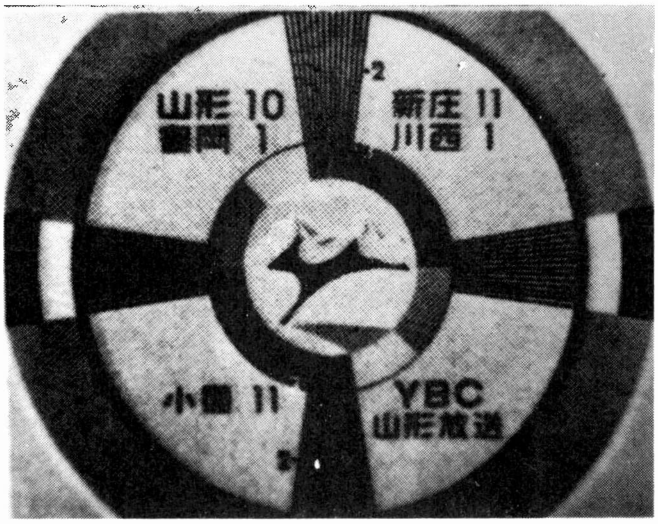
Canada: The Hermes satellite is currently demonstrating "direct to home" TV transmissions at 12GHz in the Montreal, Ottawa and Toronto areas. Results have been extremely encouraging, using a variety of home reception systems with dish arrays ranging in diameter from 60cm. to 2m. giving typical signal-to-noise ratios of 40 and 47dB respectively. Rain seems to cause short-lived fading, resulting in an increase in displayed noise, but such effects are more noticeable with the smaller dish systems.

Yugoslavia: An unusual venture has been the construction of a relay TV transmitter at Litija, a joint project between the town itself and the Ljubljana network. It relays both the first and second chain programmes.

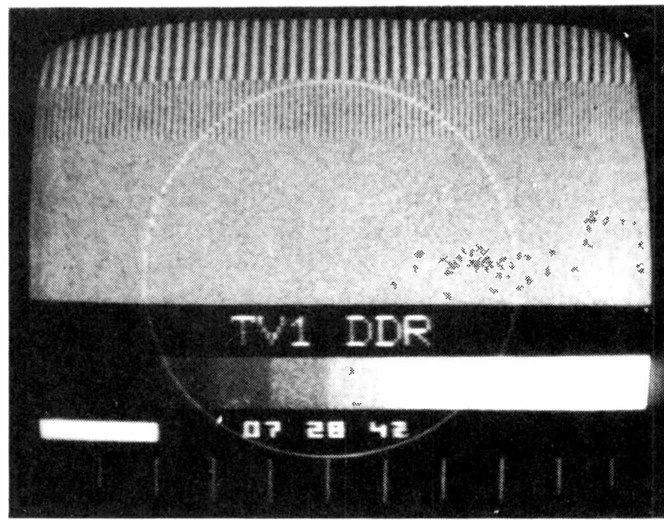
India: India is considering a plan to launch two further satellites by 1978 for TV transmission and relaying domestic services. The number of land-based transmitters is already being increased to cover the area originally served by the SITE experiment. To increase the coverage from a single transmitter the use of captive balloons is being studied: it's estimated that 18 balloons at approximately 10,000ft. will cover the Indian land mass at a fifth of the cost of a conventional land-based network.

In Brief

The Kenyan Television Service is to be expanded to cover most of the country wherever domestic electricity is available. In the Northern parts of the country a number of mobile transmitters will be used. Norway is to construct a TV centre in the North (Kautokeino), initially to cover the mountainous Lapland area (which includes parts of Norway, Sweden and Finland). Saudi Arabia is to commence colour transmissions to the south in late spring. New transmitters are being installed in Poland at Mt. Gubalowka and Roznowo in order to improve second channel coverage. The new TV centre at Vilnius, USSR is now in operation. Cuba has commenced colour tests on



YBC-TV test card, Japan. Photo Courtesy Keith Hamer.



The new DFF (East Germany) test pattern. Photo courtesy of Ryn Muntjewerff.

Sunday evenings – we assume SECAM since considerable Russian help is being provided.

Report from a Reader

Brian Fitch (Scarborough) has provided us with a lot of helpful information. Armed with a Russian VEF206 short-wave transistor portable he monitors many foreign broadcasts. A selection of his reports follows. Radio Prague has suggested that low sunspot activity will be maintained until 1980, with an increase to a new maximum in 1982. The coming summer is expected to feature a number of large solar storms. The Scandinavian countries have reached an agreement for a satellite giving TV facilities (I assume telecommunications) and a throughput of eleven TV channels to be operative by end 1979. Radio Sweden has reported that the "Peace Ship" has sailed through the Suez Canal and is expected to commence colour TV transmissions using the PAL System B. Israel Radio reports that the owner of the ship is trying to raise money to commence transmissions.

IC Wideband Amplifier

Our thanks to Hugh Cocks for bringing to our attention a wideband amplifier with a quoted bandwidth of 10-120MHz. This is in a TO5 encapsulation and has both video and r.f. outputs. It needs no tuned circuit apart from a v.h.f. input choke. Originally a Plessey product, these amplifiers are being sold off at five for 57p (plus 20p post) by J. Birkett, 25 The Strait, Lincoln. They are referred to as "radar amplifiers". On checking with one unit the measured voltage gain was 11·6dB at 55MHz. They can also be used as i.f. preamplifiers. Indeed a most useful device, and well worth the investment – the price above excludes VAT incidentally. Connections are as shown in Fig. 1.

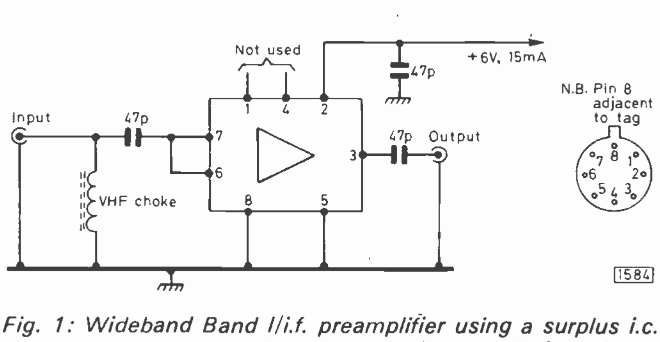


Fig. 1: Wideband Band I/i.f. preamplifier using a surplus i.c. Two such circuits can be connected in cascade in order to obtain increased gain.

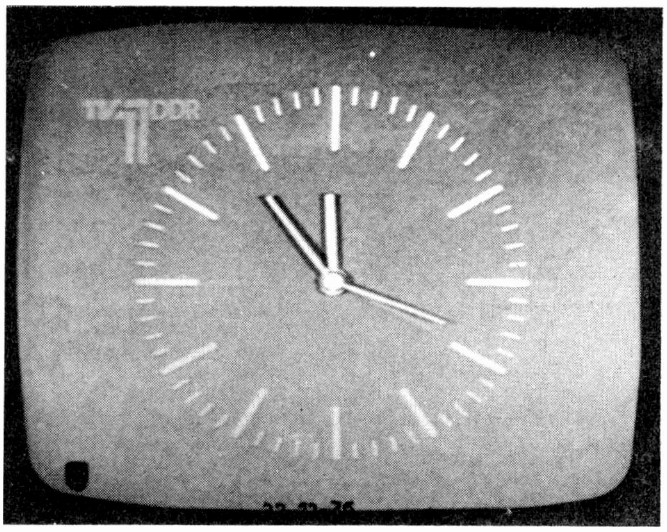
New French Transmitters

Pierre Godou (Rennes) has sent details of the French first chain colour u.h.f. programme using 625 lines, SECAM. Christmas 1976: Lille ch. E27 50kW transmitter power (not e.r.p.); Rouen E23 20kW; Le Havre E46 10kW. First quarter 1977: only two relays at Maubeuge 250W ch. E39 and Nantes 4kW E64. Second quarter: Amiens E41 at 20kW; Abbeville E63 at 10kW; Dunkerque E42 at 4kW; Paris E25 at 50kW. Third quarter: Boulogne E29 at 4kW; Niort E28 at 50kW; Lyon (Mt. Pilat) E46 at 50kW; Lyon (Fourviere) E29 at 4kW. Fourth quarter: Marseille (Gde Etoile) E29 at 50kW; Marseille (Pomegues) E40 at 250W. The information comes from an official French journal so these dates must be regarded as highly likely. It seems that there may be slight delays due to equipment shortages!

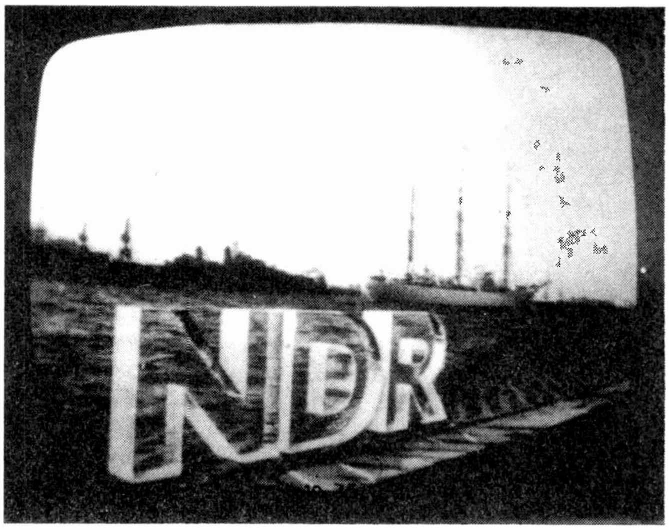
From Our Correspondents . . .

Robert Copeman (Sydney) has been successful in receiving test signals from the nearby Pye television factory at Marrickville "just down the bottom of the street where I live". These patterns, a crosshatch and horizontal bars, are received at low level when conditions are good, on chs. 6 and 8 respectively. He also reports that graziers in mid-Queensland are to construct their own series of relay transmitters in the land belt West of Blackall. The network will be called the Cootabynya Translator Service. These stations will re-radiate signals from the parent transmitter at Conebreak Mountain some 90km West of Blackall. The reason for this is the delay by ABC in providing equipment – expected to take 5-10 years.

Stereo sound on TV! Ryn Muntjewerff tells us that the WDR-1 TV transmitters are transmitting the WDR-2 f.m. stereo radio programmes during the time when the EBU bar is being shown – 14-1600 CET. He also mentions that the Kreuzberg transmitter on ch. E3 is radiating the Fubk card with the transmitter name across the centre.



The new DFF (East Germany) clock. Courtesy Ryn Muntjewerff.



NDR-TV (West Germany) identification. Photo courtesy of Ryn Muntjewerff.

A new reader, A. Vassallo (Malta), has let us know what DXing is like in his part of the Mediterranean. He uses a dual-band Yagi aerial and matching amplifier giving about 16-18dB gain and has received signals from most parts of Europe, as well as a few from N. Africa such as Libya and Tunis, a smattering via trop ducting from Greece, and rather surprisingly Holland at u.h.f. – at least the PTT-NED-2 PM5544 card was received on his northwards facing aerial system for the Italian "locals". His locals are Maltese TV at v.h.f., RAI-1 (Italy) at v.h.f., RAI-2 at u.h.f. and RTT (Tunis) at v.h.f.

Finally Anthony Mann (Perth, Australia) reports fantastic trop conditions accompanying near record temperatures. The Great Australian Bight, between Adelaide and Albany, a distance of 1,200 miles, was bridged by radio amateurs using 1296MHz. This occurred on January 24-25th and is a record for this part of the world.

How to DX – Part 1

A long-distance television (DX-TV) column has appeared in this magazine since the early 1960s and throughout the period a steady stream of "how do I start DXing?" letters has been received. The basic theory – signal propagation modes and so on – has been covered before in these pages and is also covered in my *Long-Distance Television* book. During the next few issues we shall be giving practical guidance on setting up a receiving station for DX-TV. Its actual construction and effectiveness will depend however on the skill and initiative of the individual operator. As a general rule, the more one works at it the better the results obtained – skill and knowledge of the equipment being used pay dividends.

For optimum results the receiver will need to be modified, both because of the weak signals you are trying to resolve and because of the need to reduce interference from co-channel and adjacent channel signals which are often of much greater strengths. An understanding of signal propagation modes and the different TV standards used in Western Europe and farther afield is essential. The aerial is the most important item in the chain, and here the need for high gain and wide bandwidth conflict – not forgetting the problem of "local" TV channel interference. Aerial amplifiers also require consideration and need to be operated with some form of filtering on one or more channels. The aim then in this short series is to suggest ways and means of establishing an efficient signal system, from the viewpoint of both economy and effectiveness.

As a personal note I've been active in this field for fourteen years, during which I've lived at three different locations, none of which have been particularly favourable for DX-TV reception: indeed the present location is a small terrace house with a typical modern (i.e. small) garden in the centre of a town and adjacent to an industrial site, the town itself being in a valley at 75ft. a.s.l. – experience indicates that there couldn't be a worse site for DXing!

Aerials

We'll start with aerials – a wide and diverse field. The signal delivered to the receiver is collected by the aerial and should be matched into the downlead so that it arrives at the receiver with the minimum attenuation. Some enthusiasts concentrate on u.h.f. reception, others on Band I reception of Sporadic E signals, but most attempt to cover Bands I, III and u.h.f. Due to the many v.h.f. channels it's impossible to have a high-gain array for each: such a system would have great efficiency, but the confusion when changing channels would also be great, apart from the inconvenience.

Wideband Operation

My own approach is to use wideband aerials, one for Band I, another for Band III and a third for u.h.f. The disadvantages of wideband operation are the reduced gain for a given bandwidth over that of a single channel array with the same number of elements, and susceptibility to interference from frequencies adjacent to the required one. Fortunately reduced gain can be made up by using amplifiers, while interference can be reduced by using filters and making amplifiers tunable.

The most active band for signal reception is Band I, reducing in Band III and u.h.f. Despite the greater "traffic" in Band I this spectrum is often given least thought and minimum investment. The general approach is to erect, usually at some expense, a commercial high-gain u.h.f. Yagi (or Yagis if separate "group" aerials are used instead of a single wideband array), whereas for Band I the system is usually home-made and of much simpler design, or is a modified commercial Band I aerial. Home construction is necessary for wideband Band I aerials since these are not generally made for UK use – Antiference however market a combined wideband Band I/III array though this is basically an export model.

Practical Band I Arrays

Two wideband designs covering the ch. E2-4 spectrum (48-64MHz) are shown in Fig. 2. The wideband dipole works efficiently and two such systems mounted at right angles and with their outputs switched at the receiver will give coverage in all directions. The three-element design will need rotation of course due to its directional characteristics, but has the advantage of gain and a polar response that can be used to differentiate against interference and unwanted signals. There is no reason why the wideband dipole shouldn't be incorporated in this system, or if a two-element array is desired a 120in. reflector can be added to the wideband dipole spaced at say 36-40in. Finding a source of Band I aerials may now be difficult. Commercial single-channel arrays can still be obtained and then modified, while a number of smaller manufacturers will I gather supply new components – at a price. The alternative is to refurbish unwanted second-hand Band I arrays. The usual source of these will be your friendly neighbourhood aerial rigger, who will normally be pleased for you to remove any old Band I/III aerials (that he would otherwise need to arrange to get rid of).

Aerials for Bands II and III

I feel that Band II (TV), i.e. the East European channels R3-5, is best left until the enthusiast is experienced in the more easily covered Bands I/III (chs. R3-5 are beyond the frequency coverage of UK tuners).

For Band III and u.h.f. reception I strongly advise the potential enthusiast to buy commercially made and designed systems. Their performance will inevitably exceed that of a home constructed array. The choice in Band III is somewhat restricted since what production there is at present is mainly for export. As a minimum I would suggest an eight-element and preferably an eleven-element system. Wideband Band III arrays are currently available from Antiference, Jaybeam and Wolsey.

UHF Aerials

Many excellent high-gain u.h.f. arrays are available. The first decision that has to be made is whether to use grouped arrays or go wideband. The answer depends on the mounting system (lattice mast, scaffold pole type mast, wall or chimney mounting) and the method of rotation, bearing in mind load bearing if a rotor motor is used, and of course how much one can afford. If grouped arrays are employed then either three aerials are necessary (groups A, B and C/D), two arrays (groups A and E), or with Antiference the export group K and C/D. A further point is that each array needs good quality feeder, which can be expensive, while if masthead amplifiers are used perhaps three will be necessary. I feel that a good high-gain wideband system with a medium-gain good quality amplifier will suffice for the average enthusiast.

I have used five wideband u.h.f. systems in recent years. Two of these were log-periodics – that was before the advent of multi-element directors. I would not now suggest using log-periodic aerials because of their low gain. The short backfire aerial had an impressive performance but this is unfortunately no longer in production. The final two systems are capable of excellent results – the inexpensive Wolsey Colour King, which is a stacked bowtie with four bays and has a relatively flat response over the whole band; and the Antiference XG21W, a multi-element director array which is physically very large. The former array is simple, effective and inexpensive, but its wide forward acceptance angle can be a problem when attempting to reject a co-channel or adjacent channel signal in favour of a weaker signal. The XG21W has a much sharper forward lobe and a higher gain towards the top of the band coverage but is expensive.

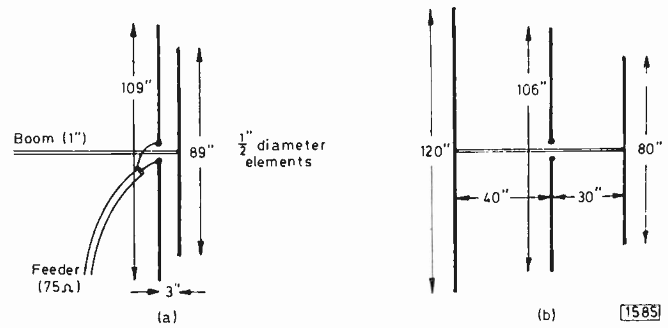


Fig. 2: Wideband Band I aerials. (a) Wideband dipole (based on the Antiference Tru-match). Mounting two such dipoles at right angles gives omnidirectional coverage. (b) Wideband three-element Band I Yagi aerial – based on a design by Jaybeam.

Choice of Aerial

The selection of a system is best made by the individual after his evaluation of each aerial manufacturer's literature, the individual knowing his budget limits. The major aerial manufacturers now conform to a minimum electrical and mechanical standard laid down by the BASC (British Aerial Standards Council), so provided a manufacturer is a member the purchaser will be assured of the quoted performance. Several smaller manufacturers have formed another association – the AMA (Aerial Manufacturers' Association).

Manufacturers

I suggest that prospective customers write to the companies below (including say 15p for return postage) for details of their aerial range:

Aerialite Aerials Ltd., Whitegate Broadway, Chadderton, Oldham, Lancs. OL9 9QG.
Antiference Ltd., Bicester Road, Aylesbury, Bucks. HP19 3BJ.
Jaybeam Ltd., Moulton Park Industrial Estate, Moulton, Northampton NN3 1QQ.
Maxview Aerials Ltd., Maxview Works, Setch, King's Lynn, Norfolk.
Wolsey Electronics, Cymmer Road, Porth, Rhondda, Glamorgan CF39 9BT.

LONG-DISTANCE TELEVISION

Servicing the Beovision 2600/3000/3200 Chassis

Part 3

Keith Cummins

A CONVENTIONAL PCF802 line oscillator circuit is used. The flywheel sync circuit is rather unusual however and is worthy of note. The circuit is of continental origin and is known as a Gassman detector. Transistor Tr49 is normally conducting and is switched off by the negative-going sync pulse from P/S3-2. The tuned circuit in series with the collector of Tr49 rings when the current through it is turned off, one sinewave cycle occurring before Tr49 turns on again and damps the circuit. The secondary winding on the tuned circuit presents the single sinewave cycle to the junction of the discriminator diodes D434, which are turned on during the line flyback by symmetrical pulses from the line output transformer. When the picture is locked the gating pulses and the sinewave coincide. Any phase change results in an error voltage being rapidly developed. This is applied to the triode reactance modulator section of the PCF802 to pull the timebase into lock.

Transistor Tr48 introduces a line frequency ramp at the lower end of the winding feeding the discriminator diodes, so that the timebase can be pulled in adequately from an unlocked condition. The discriminator then produces an output dependent upon the position of the gating pulses relative to the ramp, thus sliding the timebase operating point along the ramp until the circuit latches strongly on to the sinewave produced by the tuned circuit.

The circuit provides an excellent noise-free lock, since the system bandwidth is narrow. Successful operation however depends upon the received sync pulses being immaculately regular in appearance. This remark should not be taken to imply that the system is susceptible to noise: just the opposite is the case. The point is that if a disturbance of the sync pulse phase should occur, as in certain "gen-locking" processes between, for example, a commercial break and a networked programme, the circuit may unlatch. This results in a sideways slip of the picture. The effect can be minimised by slightly off-setting the discriminator balance control VR427 so that the oscillator always pulls in from one side.

The line oscillator is also modulated by a feed from the field timebase. This comes in at point X. Potentiometer VR409 should be adjusted so that the verticals at the centre of the picture are straight. This form of raster correction operates by phase modulation of the line oscillator.

If the receiver is to be used with a videocassette recorder, the line timebase has to be modified so that it can accommodate the higher slewing rate requirement of the non-standard VCR sync pulses. Details of this modification are given later.

Line Output Stage

The output from the pentode anode circuit of the PCF802 provides the drive for the line output valve control grid. Besides providing horizontal scanning the line timebase also produces several power supplies and all the gating pulses for the chrominance, a.g.c. and clamp circuits. The e.h.t. supply for the tube is not included however since this supply has its own generator. As a result, the loading on the line output stage is lower than usual, and is also substantially constant. A PL504 is employed as the line output valve. Despite the lower loading, this valve is still quite hard-pushed in this position. Valve life can be improved by increasing the value of its screen grid feed resistor R540 to 3·3kΩ. A fusible type *must* be used. The PL504 can become gassy and overheat, and the trip resistor protects the receiver and power supplies.

The control grid circuit of the PL504 contains the usual width stabilisation components and also a network fed from the field timebase. This, by applying a parabolic waveform at field rate, assists in correcting EW raster distortion.

Line Timebase Derived Supplies

Various diodes provide the following power supplies which, by virtue of the stabilisation of the line output stage, may themselves be considered well stabilised:

(1) Positive and negative 27V supplies for static convergence.

(2) Positive 820V supply for the picture tube first anodes.

(3) A negative 225V supply for the brightness and quiet warm-up circuits.

(4) A positive 340V supply (derived from the boost rail) for the field timebase charging circuit.

(5) A variable 5kV supply for picture tube focusing.

Line Output Stage Faults

Failure of some of these supplies can occur, the diodes being the usual culprits. Breakdown of D551 or D553 will result in their 27Ω series resistors (R559, R560) burning out. The outcome is a grossly misconverged picture accompanied by smoke from the burning resistor. A similar resistor should be used for replacement, spaced safely off the printed board. These components are awkward to replace: great care should be taken to avoid burning the e.h.t. cable with the soldering iron.

Diode D554 will remove the −225V supply if it fails, and will give the appearance of a dead set since the brightness control voltage will also be at zero.

The 100pF (7kV) capacitor from the focus control slider to the TV6·5 focus rectifier can fail. Should this happen the rectifier, the 33kΩ resistor R584 and focus control will be destroyed. A tired rectifier will produce a defocused picture when the set is first switched on, becoming normal after two-three minutes. A leaky 100pF capacitor can produce a similar effect. If in doubt, change both items.

A tubular 270pF 6kV tuning capacitor is connected from the PY88 cathode circuit to chassis. Occasionally this can overheat and short-circuit, so destroying the PY88 valve. Strangely enough, we have never had a boost capacitor (0·1μF, 1·6kV) failure in this circuit.

The line output transformer itself can fail, but since there is no e.h.t. winding such failures are rare. The most

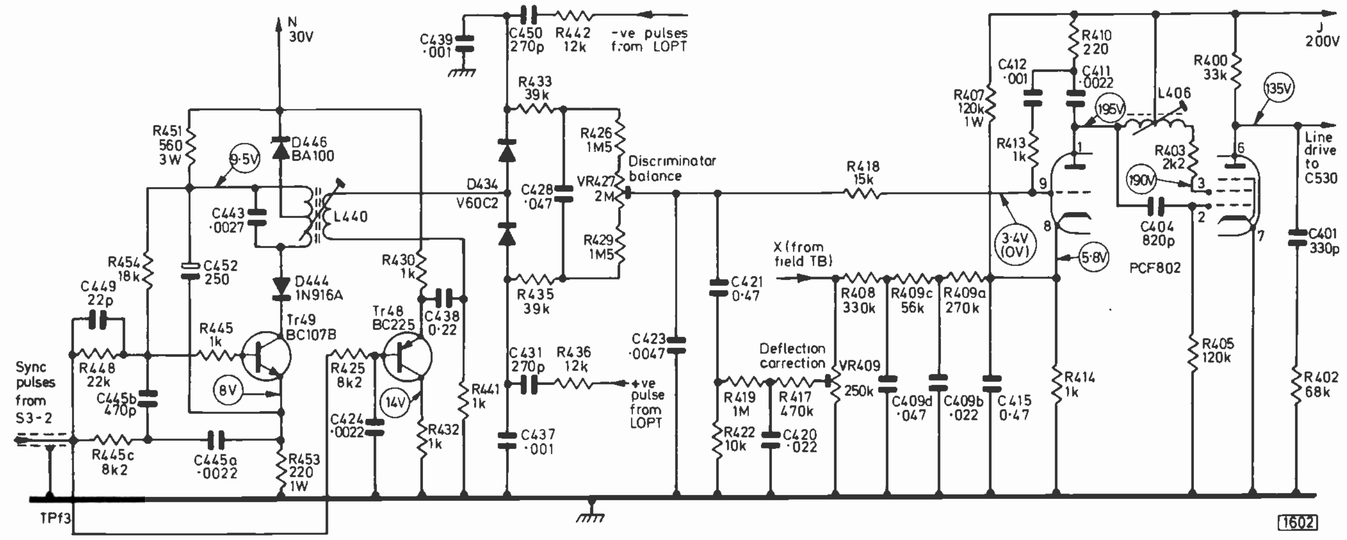


Fig. 5: The flywheel sync and line oscillator circuits.

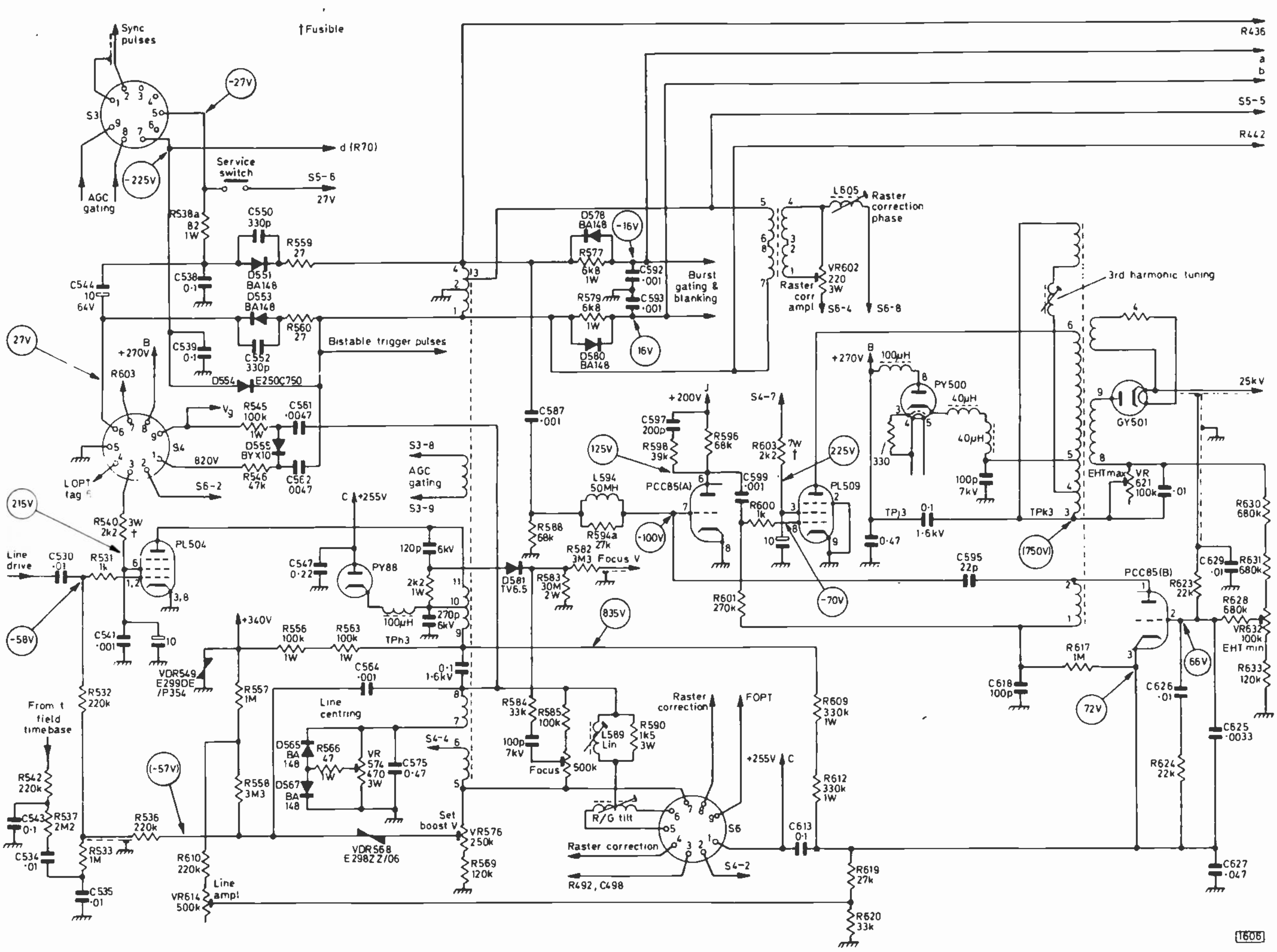


Fig. 6: The line output and e.h.t. generator circuits.

important thing is to ensure that the boost voltage is not high: under no circumstances should it exceed 835V, measured at the "hot" end of resistor R563.

Horizontal picture shift is achieved by introducing a standing d.c. through the line scan coils and transformer. The d.c. is produced by diodes D565 and D567. Shift potentiometer R574 adjusts the balance of the circuit so that the current may be adjusted in either direction as required. In the earlier 3000 chassis a slightly different arrangement is used, the d.c. shift voltage being obtained from the cathode of the line output valve.

The EHT Circuit

A 240V positive pulse from the line output transformer drives the e.h.t. generator circuit. By this means, the total synchronism of the two circuits ensures that no unwanted interactive effects can occur.

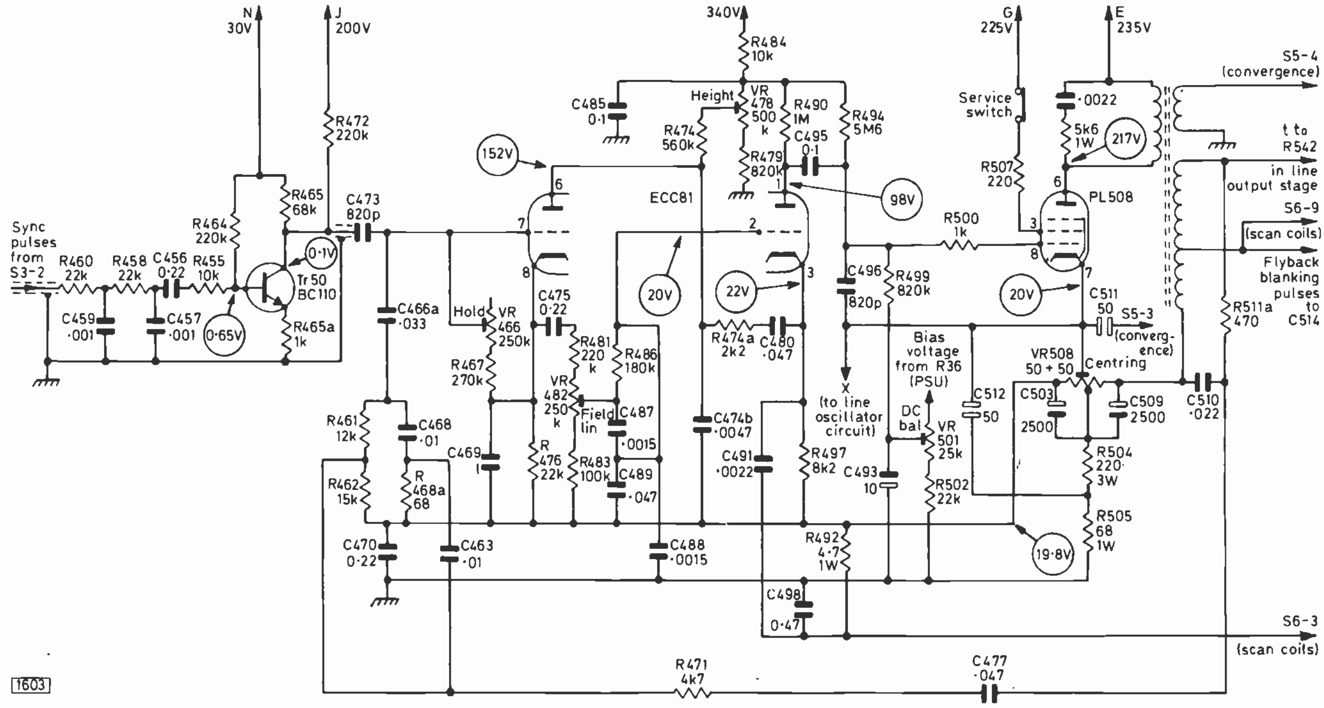


Fig. 7: The field timebase.

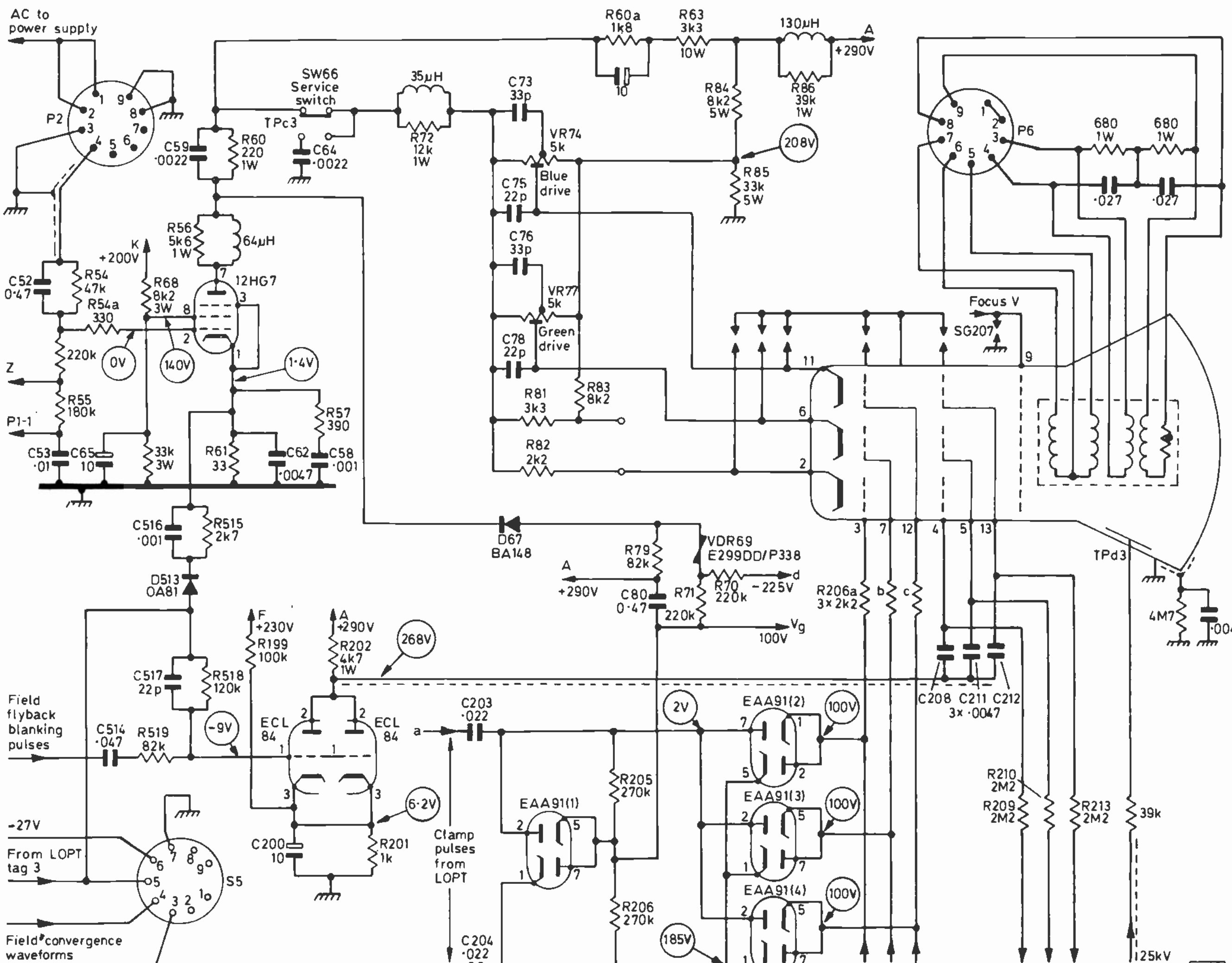


Fig. 8: The luminance output, colour-difference drive clamping, flyback blanking and c.r.t. circuits.

The e.h.t. generator uses valves PCC85, PL509, PY500A (originally PY500) and GY501. This is the most dangerous part of the receiver and great care should be taken when setting up. A positive feedback circuit is employed to keep the e.h.t. voltage stable under heavy loading conditions.

The pulse from the line output transformer, fed via C587, drives one triode section (A) of the PCC85: this triode is used as a shaper and driver stage for the PL509. Bias for the grid of the PL509 is derived from the second triode (B) which is employed as a controlled rectifier. Pulses from winding 1-2 on the e.h.t. transformer are rectified by triode B, so that a negative voltage is produced at the opposite end of the winding – tag 1. This voltage biases the PL509. The cathode of triode B is tied to a +72V supply derived from the stabilised line boost rail (via R609 and R612). Its grid voltage is taken from potentiometer VR632 which is part of a network from the low-voltage end of the e.h.t. overwind on the transformer. The e.h.t. winding is connected to the e.h.t. generator's "boost" rail (the voltage boosted by the PY500A damper diode) via potentiometer VR621.

Under no output current conditions the voltage across VR621 is minimal compared with the rest of the network. Thus the setting of VR632 determines the final biasing of the PL509 and in consequence the amount of drive and the final e.h.t. voltage produced. A GY501 rectifier provides the e.h.t., with its heater fed from a winding on the e.h.t. transformer.

When current is drawn from the e.h.t. supply a negative voltage is developed across VR621. This reduces the positive voltage applied to the grid of PCC85 triode B. As a result, less bias is produced by this valve and applied to the PL509, the PL509 conducts more heavily, and more energy is fed into the e.h.t. transformer. When VR621 is correctly set, the e.h.t. will be stable from the no current to the maximum current conditions.

The e.h.t. should first be measured with no brightness, and VR632 adjusted for an e.h.t. of 25kV. Then turn the brightness fully up and adjust VR621 to maintain 25kV. The adjustments may need repeating before the tracking is exact.

The outer sheathing of the e.h.t. cable is coupled via R623 to the bias rectifier grid so that fast fluctuations of the e.h.t. with picture content may be fed back rapidly to the e.h.t. generator. In this way almost instantaneous stabilisation takes place.

The reader will now realise why such a cautionary attitude has to be adopted towards this part of the receiver. The e.h.t. supply is capable of supplying an instantaneous 7mA at 25kV, which is lethal. Mishandling the circuit can cause the e.h.t. to rise alarmingly, and arc over from the GY501 anode to the adjacent printed panel where it usually destroys several diodes.

EHT Faults

Failures in this part of the circuit are surprisingly few. Unfortunately it is usually the transformer that fails when a breakdown does occur. Note that should the line timebase fail a feedback path is provided via capacitor C595 to maintain oscillation in the e.h.t. circuit so that the PL509 does not become unbiased. Little or no e.h.t. is produced under these conditions. On the odd occasion we have known VR621 to burn out, generally as a result of a short-circuit GY501.

Although this circuit is complicated, there is no doubt in the writer's mind that it probably represents the "best ever" e.h.t. supply from the stability point of view: no picture size fluctuations take place even during the most lurid of flashing commercials. The picture assumes great rigidity therefore in terms of scan amplitude and presentation. The performance of this circuit has yet to be equalled, even in modern solid-state receivers.

Setting up the Line/EHT Circuits

In setting up the boost and horizontal amplitude controls in the line timebase the following procedure should be adopted: Set the horizontal amplitude control VR614 half way and adjust the boost (VR576) for 575V, measured between the "hot" end of R563 and the positive side of the 0·1μF boost capacitor. Then set up the e.h.t. as outlined above and finally set the horizontal amplitude control for the correct picture width.

Field Timebase

The field timebase employs valves ECC81 and PL508. The circuit is rather different however from what one might expect by the use of these valves. The PL508 is the output stage of course, but virtually all the preceding circuit is unconventional.

Positive feedback from the field output transformer is taken to the grid of the first triode of the ECC81. This valve is kept cut-off during the forward scan by a negative voltage built up by rectification of the flyback pulse. This negative voltage, in the form of a charge on capacitor C466a, discharges through the hold control VR466 and the associated resistors at a rate determined by the value of the hold control.

While the first triode is cut off, capacitor C480 charges from the vertical amplitude control VR478 via resistors R474, R474a and R497 to the cathode potential of the output valve. As the cathode of the second triode is connected to resistor R497 this valve is cathode driven by the charging current. Its grid on the other hand is driven by an antiphase waveform from the linearity network, including the linearity control VR482. By this means the output waveform from the anode of the second triode is made the correct shape to drive the output stage. The grid of the PL508 is set to zero voltage d.c. by adjusting the balance control VR501 which introduces a variable negative voltage to offset the positive feed via resistor R494.

Note that the whole circuit "sits" on a floating rail which develops a tilted parabolic waveform relative to earth. This is used for dynamic convergence.

The incoming sync waveform is passed through the double integrator network R460, C459, R458 and C457 before being amplified and inverted by Tr50. The positive sync pulse thus produced is applied to the grid of the first triode so that it conducts. Obviously the timebase has to be near the correct frequency, so that the discharge of the timing components is near enough correct to enable the pulse to effect synchronism.

Field Faults

This involved circuit appears to have few regular faults. Most can be cured by valve replacement. As might be expected, folding or cramping at the bottom of the picture can be caused by a low-emission PL508. On the other hand the same effect can be produced by the ECC81, which also gives rise to an unstable hold condition. Experience dictates

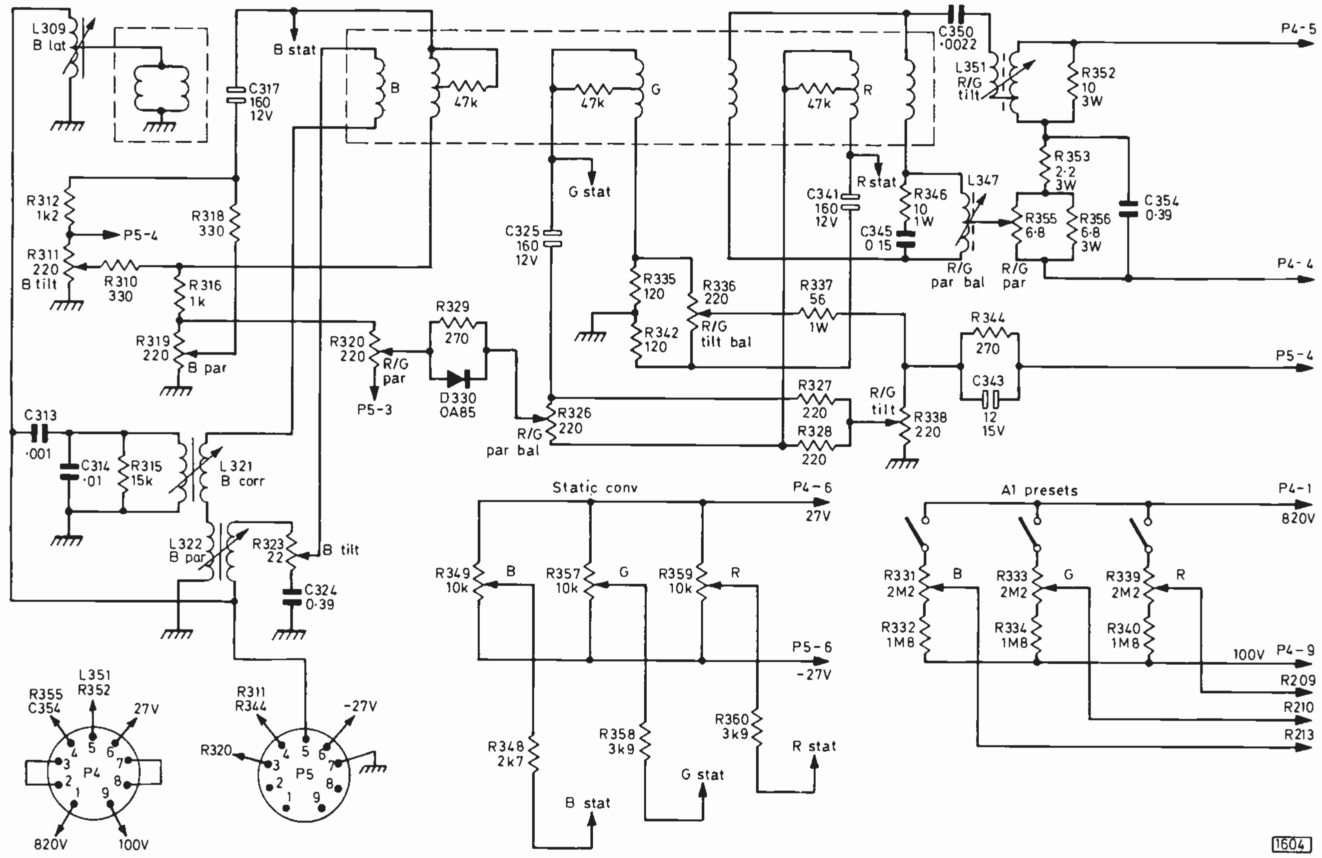


Fig. 9: Convergence and c.r.t. first anode supply circuits.

that it is often most economical in terms of time and effort to replace both valves at the same time.

Random variations of height and hold have two usual causes. Usually the problem lies with the 5·6MΩ resistor R494 which is simply and easily replaced. The other cause, an expensive one, is intermittent shorting turns in the field output transformer.

Raster Correction

It is convenient to mention raster correction at this point. The familiar transductor is used, the field section being connected in series with the two halves of the field scanning coils. The phase and amplitude controls are connected in the usual way. In case anyone is wondering what has happened to the tuning capacitor for the phasing coil L605, it consists of two capacitors mounted on the scanning coils as part of the damping network.

The other side of the transductor connects directly to the line output transformer. Note that additional raster correction is applied to the line output valve's control grid circuit (via R542 etc.).

Badly distorted picture geometry, accompanied by an objectionable rattling whistle, indicates that the transductor core is coming adrift. It may be stuck together again very successfully by using Araldite.

Flyback Blanking

The main flyback blanking circuit uses two of the "spare" triodes available in the ECL84 valves employed as colour-difference output stages. These two triodes are connected in parallel and biased to cut-off by a common cathode network. Positive line and field flyback pulses are introduced at the grids, so producing at the anodes negative pulses of 125V for line and 150V for field flyback blanking. The pulses are conveyed to the tube's first anodes via coupling capacitors C208, C211 and C212, thereby turning the guns off during the flyback. Since the line pulses are of lower amplitude further blanking is achieved by introducing line flyback pulses at the cathode of the luminance output stage via diode D513, as a result of which the tube cathodes move positively during the line blanking period.

Only rarely does this circuit fail. In every case we have come across the cause has been the 4·7kΩ anode load resistor R202 being open-circuit.

Convergence

In the 25 and 26-in. models the convergence panel is fitted behind a removable cabinet panel at the front of the set to the left of the tube. This latter panel is removed by inserting a coin into the slot at the bottom and pulling gently forward at the lower end. A comprehensive set of convergence controls is then revealed. The 22in. version has the same panel mounted underneath the set, and secured by two screws.

With patience very good convergence can usually be obtained. The makers recommend that the numbered sequence is adhered to, but familiarity will enable a certain amount of "dodging around" to be employed with beneficial results. Note that radial static convergence is adjusted from this panel (electronic control) while blue lateral adjustment has to be carried out at the tube neck in the usual way.

The line scanning coil balance control (R-G tilt bal), which is adjusted so that the red-green horizontal lines are straight across the centre of the screen and do not cross

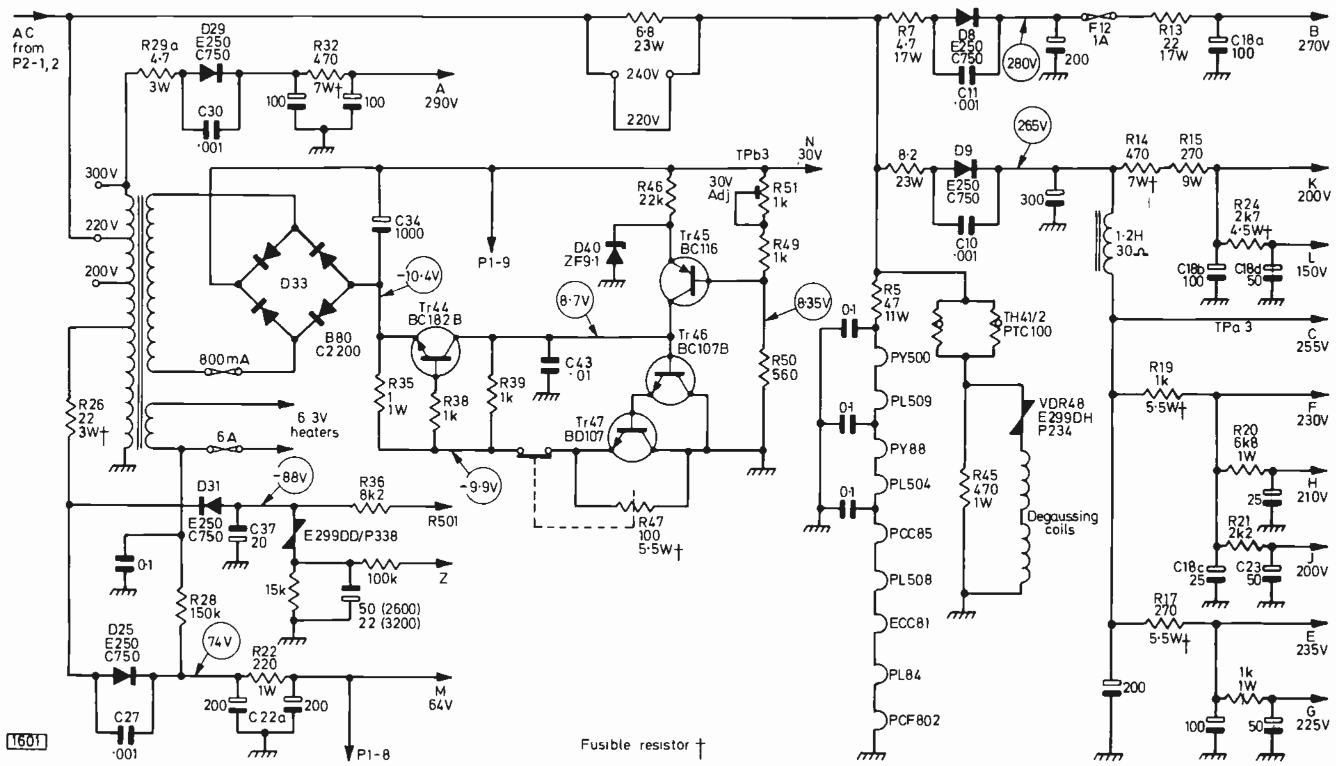


Fig. 10: The power supply circuits. Further supply lines are obtained from the line output stage – see Fig. 6.

over, is situated inside the line scan enclosed area within the receiver, and can only be adjusted by lowering the chassis.

Grey-scale

The tube first anode controls and gun switches are mounted on the convergence panel, and grey-scale adjustment at the front of the set is particularly convenient from the setting-up point of view. When setting up the grey scale, the service switch (at the top right of the colour-difference output panel, viewed from the rear) should be used. Avoid touching the hot luminance anode load resistor, which has 290V on it!

The tube may then be set up so that the three lines are just visible. This adjustment also ensures that the beam limiter circuit operates at the correct point. On returning the service switch to normal, the two drive potentiometers may be adjusted to produce a final black and white picture. These controls are also situated on the colour-difference panel.

Convergence Panel Faults

The convergence circuits themselves give very little trouble. Only once have we had to replace a convergence potentiometer. R/G matrixing is employed in the usual way for both the line and field circuits. The blue dynamic convergence system is a little unusual in that shock excitation of the second harmonic blue correction coil is via a separate feed capacitor (C313). It's also worth noting that the line convergence circuits are driven directly by voltage waveforms from the line output transformer, and do not integrate the scanning current as was the practice in most early UK receivers. As a result the circuits have more integrating components than is usual.

Lowering the chassis a few times can flex the leads to the convergence coils to the extent that one or more may break off. If a convergence fault develops while working on the set, it may well be worth checking this simple point first.

Setting up the Colour Circuits

The setting up of the colour circuits follows normal practice. If one suspects drive troubles in the colour-difference output stages all three ECL84 valves should be replaced to avoid the effects of differential ageing.

The following procedure can be adopted for setting up the decoder. Great care should be taken with these adjustments which should be undertaken only if really necessary.

(A) Adjustment of the reference oscillator.

(1) Short TPh2 to chassis. Adjust the burst phase discriminator coil for maximum output measured at one end of the discriminator balance potentiometer VR119. Adjust the potentiometer for zero volts at its slider.

(2) Remove the short-circuit across TPh2 and adjust the oscillator coil until the slider of VR119 again reads zero volts.

(B) Colour killer and 7·8kHz amplifier.

Connect a scope to the collector of Tr40 and adjust the coil for maximum signal.

(C) Demodulators, R – Y and B – Y.

(1) Connect meter to TPb2 and adjust the B – Y demodulator coil for maximum voltage.

(2) Connect meter to TPe2 and adjust the R – Y demodulator coil for maximum voltage.

(3) Connect scope to TPa2 and adjust potentiometer VR61 for maximum signal.

(4) Connect scope to TPc2 and readjust R – Y demodulator coil for maximum signal.

The remaining setting up, the colour-difference output levels, for example, can be carried out using colour bars in the usual way. A normal grey scale should be displayed with the colour off. Next, turn off the R and G guns and turn up the colour so that four equal-intensity blue bars are displayed. (The tint control must be centralised during these adjustments.) Now turn off blue and turn on red. Adjust

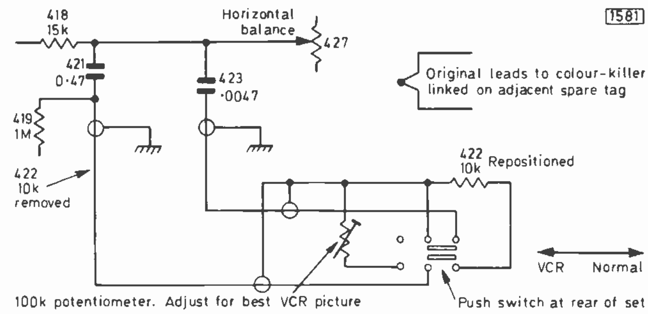


Fig. 11: Modifications for use with VCRs.

VR218 if necessary to obtain two equal intensity red bars. Now turn off red and turn on green, adjusting VR206 for a uniform green area on the left-hand half of screen.

Performance

To summarise, it is fair to say that the receiver is only capable of yielding its full performance if care has been taken in setting up.

Use with a VCR

The receiver can be used with a VCR but as mentioned earlier a modification has to be carried out. Disconnect the colour-killer button from its normal function and convert it to a VCR/normal button. The circuit is shown in Fig. 11. The leads from the line oscillator to the push-switch should be screened. The potentiometer can be soldered to the switch and adjusted for optimum line stability while viewing the picture from the VCR.

Voltage Conditions

The voltages shown on the circuits were measured with a 12MΩ/V meter. Those readings shown in circles were measured with the set switched to an empty channel, the contrast control at three quarters of full scale, and medium brightness (170V at the anode of the 12HG7 luminance output pentode). The readings shown in brackets were measured with an input signal of approximately 1mV, the contrast control adjusted for maximum tube drive (100V black-to-white at the service switch), the brightness control in the normal position (tube only just switches off at black) and the saturation control set to maximum (200V peak-to-peak signal at the anode of the B – Y output pentode).

E. Trundle writes: We have a number of these sets out on rental. To increase reliability and set life we adopt the following course:
(1) Make sure the PL504 line output valve's screen grid feed resistor is 3·3kΩ.
(2) Set the line linearity control L589 for maximum width consistent with acceptable linearity – this coil consumes quite a lot of power.
(3) Set the width control R614 for maximum width.
(4) Reduce the e.h.t. to 21·5kV, using the presets R632 and R621, then adjust the focus control as necessary. Focus will be lost at a lower e.h.t. setting.
(5) Adjust the set boost control R576 for correct width. The boost voltage at TPh3 should then be down to somewhere in the region of 760-790V.

We have found that the reliability of the line output stage and e.h.t. system is much improved by being operated under these easier conditions.

LETTERS

RELIABILITY

Having read your March editorial on the relative reliability of European and Japanese TV sets I'd like to make one or two points.

I can't speak for Japanese sets since I've never worked on them. I've done a lot of work on ITT and Decca sets however and it's these I'd like to comment upon. But first let me say that the sets produced by these companies over the years have been most reliable, and I've never had any doubts about recommending them to potential customers.

There have however been a number of annoying faults that could perhaps have been avoided. On the ITT CVC5-CVC9 series for example I've had to change an alarming number of PCL805 field output valves. I know that this has never been the most reliable of valves, but the mortality rate in these chassis has certainly been higher than in the monochrome chassis where it is generally used. In my opinion the valve just isn't man enough to supply the necessary deflection power for a 90° thick-neck colour c.r.t. and drive the convergence circuits. On paper, analysing the PCL805's characteristics, one finds that the valve is up to the job, but in practice it's working constantly flat out and in consequence breaks down fairly frequently. It's like two men starting a race at the same point, one running flat out and the other trotting: the one who trots may get left behind but will be able to travel a lot farther! The same sort of thing can be said of the 4·7MΩ resistors in the focus chain. If high stability types had been used instead of carbon ones there would have been no defocusing due to resistors going high.

The weak point in the Decca Bradford chassis has been the sound output stage – mainly due to the short pins used on the PCL82 valve holder. Decca did at least modify the holder in the later version of the chassis however, using one with longer pins.

I have singled out these examples because they are the most common ones I've been confronted with. I dare say that other service engineers will have come across similar problems in other makes.

To sum up, surely with a bit more thought these faults and others like them could have been avoided? – **M. L. Biddlecombe** *(Yarmouth, Isle of Wight).*

FUSE FAILURE AND OTHER POINTS

First I'd like to say that I agree with H. K. Hills' conclusions about mains fuse failure *(The Problem of Mains Transients,* March 1977). To take a chassis with which I am familiar, the Philips G8. When this colour chassis was first introduced, the on/off switch was a special slow-action type, with shaped contacts to minimise arcing. Random fuse failure was and is rare on the Philips 520-534 series of receivers. Then came the 550 series. The good switch was thrown out and a standard type fitted. Then the fuses started to go. Later the degaussing circuit was changed. By now the 3·5A semi-anti-surge fuse was a regular pest. I have found that to avoid going back to the same job every three months or so it's best to fit an alternative make of fuse which doesn't fail so often.

Slow-start circuits were a good idea, though the G9 chassis still has power supply failures, often the mains fuse. Diodes and transistors go too. The usual customer remark is "it just didn't come on!", confirming that the under-rated fuse has blown on switching the set on.

Digressing a bit, why can't UK setmakers leave a good design alone? The sets are changed or modified much too often. Thorn must take the prize: does it take four different chassis to make up a range of colour TV sets?! Syclops, oh no, just for a 20in. model!

The finest 26in. set I've come across in ten years experience of colour television is the Tandberg CTV1 chassis. This suffers from slight misregistration of the chrominance and luminance but is otherwise a superb set. Of the smaller colour TV sets Hitachi win by miles. Good pictures, no c.r.t. trouble, well made, a pleasure to deal with. The only regular Hitachi fault is the electronic tuner in the CNP192. Our service department has had five years' experience of these sets and we've never had to change a c.r.t., tripler, transformer or power regulator transistor. We've had only occasional field output stage faults due to the 100μF (C606) and 3·3μF (C607) electrolytics drying out. Another point, both the field and line output transistors are semi-plug-in types and easily checked – no burrowing to the armpit to make a simple check.

All that's required is relatively straightforward designs like those by Decca, ITT, Philips (UK!), Hitachi and Tandberg. These makes present quite enough to be technically challenging without going to ridiculous extremes like the B and O and Sony colour sets. I refuse to even start on a Sony KV1810 in the field. We grab the conveniently placed cabinet holds and place the set snugly in the Escort.

Finally, if the chaps who designed the rubbish had to service it, perhaps there would be less of it around. – **K. Wells** *(John Lewis and Co., Liverpool).*

POCKET TV

When the local or even the national press released the earth shattering news of Sinclair's breakthrough in giving the world its "first" pocket TV I shrugged my shoulders at this example of typically uninformed news reporting, but when the only technical publication in the country devoted entirely to TV repeats this nonsense I feel it is time to enlighten them that in the big bad world outside this tight little isle life goes on.

In the small New York state town of Platsburg some eight years ago I walked in and bought, retail, a National Panasonic Model TR001 1·1in. u.h.f./v.h.f. pocket TV set weighing 1·8lb. It had probably been on the market for the best part of a year at that time. It was by no means the smallest set on the retail market: Motorola had a 1in. TV set the size of two US standard twenty cigarette packs about a year before. Both sets used all i.c. circuitry.

I am disappointed with you over this since it creates doubt in reading your generally excellent magazine as to whether what I am reading is up to date or old hat. – **John L. Barber** *(Southampton).*

Editorial comment: Many thanks for the details! We endeavour to keep up to date but simply cannot monitor the retail markets world wide. Our main concern has to be limited to the technical scene as it affects the day-to-day problems of our local readers.

VCR Modifications

D. K. Matthewson, B.Sc.

AS the Philips VCRs become familiar to us various modifications suggest themselves in order to give greater operating convenience. The models referred to here are the N1460 replay only machine, the basic N1500, and the N1520 which incorporates editing facilities. If you are going to carry out any modifications to these machines it's essential to have access to a service manual.

Model N1460

The N1460 provides a u.h.f. output signal. Many of us would like to have standard video and audio outputs as well, and Fig. 1 shows a circuit which has been tried successfully. Another point is that there is no provision on this machine for manual colour killing. This can be done by earthing point 629 on panel 60 via a switch – see circuit C in the manual.

Model N1500

The N1500 was released in several different forms. The /M version also gave colour video in and out. Various dealers modified the machines to give monochrome video in and out in different ways. In addition to video in/out modifications we have modified a machine to give audio monitoring on record (both manual and a.g.c.), still frame (for what it's worth) and video on fast forward and fast rewind (to enable positions on the tape to be found).

A monochrome video output can be taken from the TV socket on the machine and passively combined with the chroma signal to give a standard 1V peak-to-peak composite colour signal.

Arranging for a video input can be rather more of a problem, especially if you want colour in as well. We have modified a machine to accept a monochrome video input only (see Fig. 2), though colour in can be achieved through a filter network as used in the Radio Rentals VCR. When this modification (Fig. 2) is used with the video monitor modification shown in Fig. 3 and a colour signal is fed in, the monitor will display a colour signal though the recording will be in monochrome.

The still frame and video output on fast forward/fast reverse modification is simple. Link pins 54 and 56 on the forward/stop switch SK402, panel 45.

The sound record monitoring modification consists of removing R541 and R565 and linking contacts 65 and 67 on the forward/stop switch SK402, panel 45.

Model N1520

The N1520 suffers from white dots which sometimes fly about the middle portion of the screen. These are due to the video heads reading part of the sync track during playback. The flyback pulses appear only on certain monitors, making identification and cure of the problem a bit of a headache at times. The N1460 and N1501 both have an extra board, between the final luminance board and the output board, for the specific purpose of obliterating these flyback dots. The board is panel p65 on the N1501 and panel p65a on the N1460. Only the p65a has a time-constant that will not cause hooking at the top of the picture. It can be inserted between panels P70 and P95 to remove the white dots. The sync signal required can be obtained from point 660 on panel P65 (this is not the same as panels p65 and p65a!) and the 12V supply from point 654 on panel P65. This board is no longer being manufactured, but if stocks are now exhausted it should not be too difficult to build one (see Figs. 4 and 5).

Video on fast forward and fast rewind can be achieved by linking pins 1 and 2 on switch 26 on the N1520. The incoming video can be previewed by depressing the record key, though it must be borne in mind that this will record the incoming signal on one frame of the tape. This facility can be made switchable by using spare contacts on switches 8 or 9.

Earlier versions of the N1520 did not have an audio monitoring board. If only track one is used for recording audio, the two circuits shown in Fig. 6 can be used in these early machines. Many professional users will use only line in/out, thus freeing the diode in/out relay for use as a spare.

Time-delay Switch-off Adjustment

To avoid excessive tape and head wear the machine switches off after about 45 seconds if no transport buttons are depressed – the switch off time is increased to 90 seconds in the case of the later Model N1501. The time delay can be adjusted – though it must not be extended too much or problems will occur! – by altering the value of C115. This is the charge up capacitor for the f.e.t. which drives the head disc protection circuit. It's fed by a 44MΩ resistor (2 × 22MΩ) on the earlier models and a 47MΩ

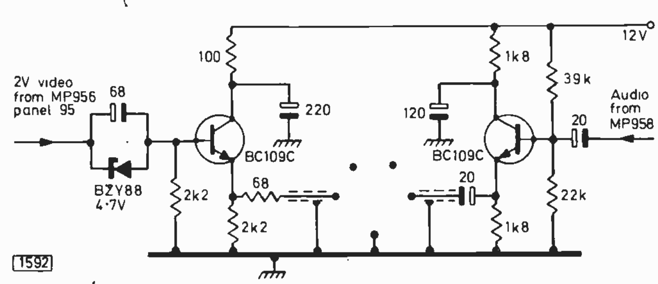


Fig. 1: Circuit giving video and sound out, Model N1460.

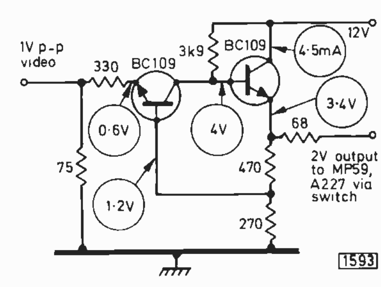


Fig. 2: Monochrome video input modification, Model N1500.

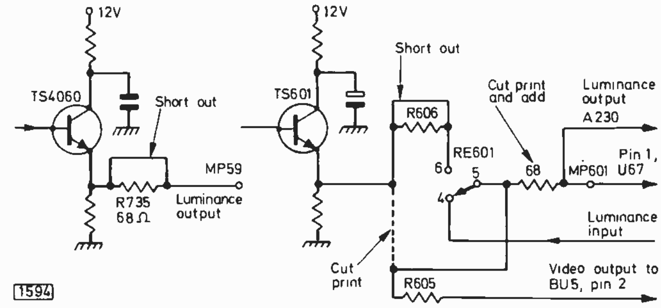


Fig. 3: Modification to give video monitoring, Model N1500. The two cuts on the board can be made with a small file.

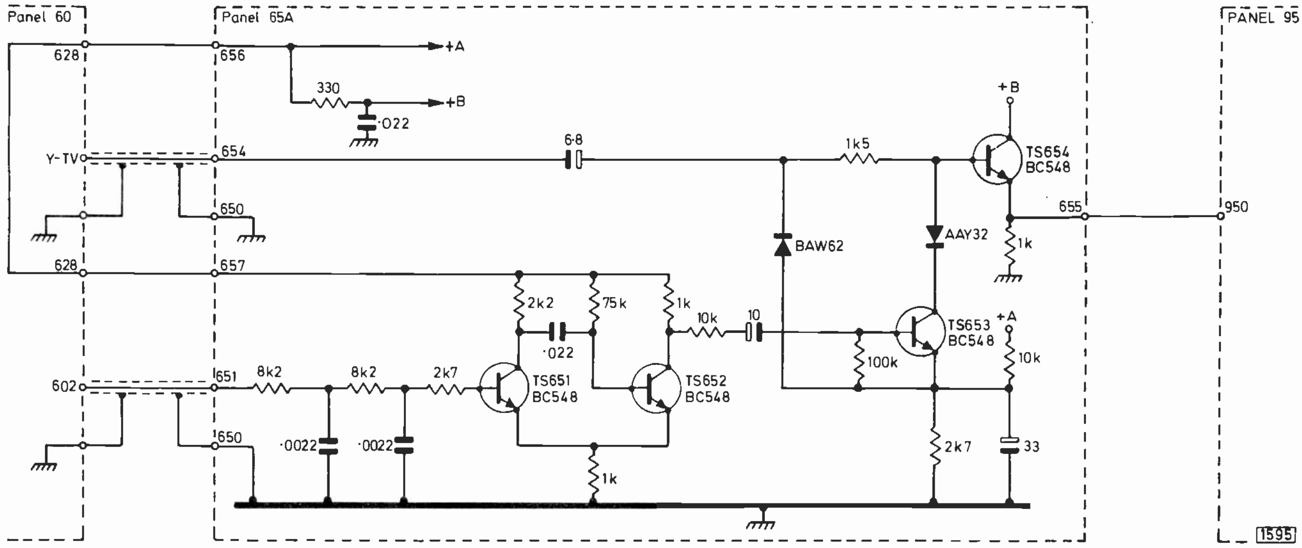


Fig. 4: Circuit of panel p65a, with connections as when used in Model N1460/15.

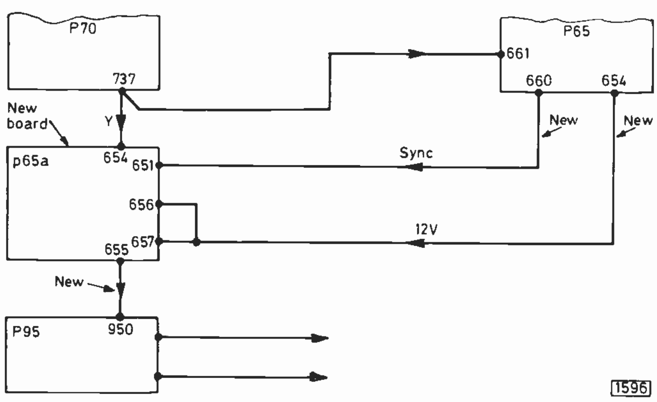


Fig. 5: Adding panel p65a in Model N1520.

resistor on later ones, and is of 1μF or 2·2μF, again depending on model. Increasing it to 4μF will give about two minutes delay before the machine switches off. Don't use electrolytic capacitors: they leak so much that they won't charge up at all! Polyester capacitors are suitable.

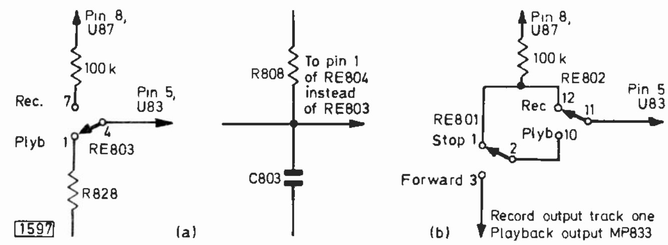


Fig. 6: (a) Modification to provide audio monitoring on record, track one only. (b) Modification to provide audio monitoring on record, track one only, plus stop, playback plus stop, and record plus play (disconnecting the diode in/out connections to relay contacts 3 and 5).

Editorial Note:

In an earlier article on VCR modifications (February 1977) it was stated that the Sangamo Weston miniature hour meter (S477) was available from Electroplan Ltd. We have since been informed that Electroplan no longer handle this item. Enquiries should be directed to Sangamo Weston Ltd., Great Cambridge Road, Enfield, Middx.

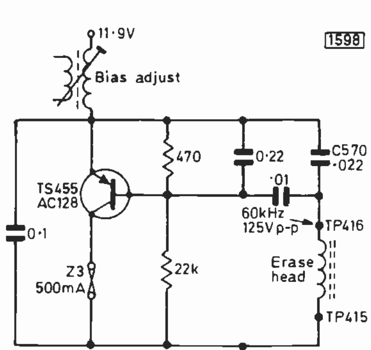
VCR Fault: No Erase

A Philips N1500 VCR was brought into the workshop with the faults intermittent no erase and failure of fuse Z3. Replacing the fuse did not restore erasure so an oscilloscope was connected to TP416, the feed to the erase head (see Fig. 1), to check the waveform and voltages. The d.c. conditions were found to be normal, but the waveform was only some 20V peak-to-peak instead of 125V, while the oscillator transistor TS455 (AC128) was overheating. It seemed that the transistor, being a germanium type, was leaky and suffering from thermal runaway. Replacing it made no difference however. Since the erase head forms the inductive part of the oscillator circuit, and is subject to physical wear, this was next changed, again without effecting a cure. Just as panic was starting to spread through the workshop it was noticed that C570 (0·022μF) was hot. Now capacitors, being relatively powerless devices, don't usually heat up, so it was removed and checked. It was not leaky, short-circuit or open-circuit, and showed both charge and discharge on the Avo. A small crack down one side where the leads sometimes fall off – and with very little effort one did! – was noticed however. Replacing the capacitor cured the problem and restored normal working conditions.

C570 carries most of the oscillatory current required by the erase head, and any series impedance would cause the symptoms found in this machine. The crack in the capacitor's ceramic coating had almost disconnected the lead, making it resistive and causing power dissipation in the form of heat at the joint. The reduced amplitude oscillations resulted in the transistor conducting excessively.

S. R. Beeching, T. Eng. (CEI), A.M.I.E.R.E.

Fig. 1: Bias and erase oscillator circuit.



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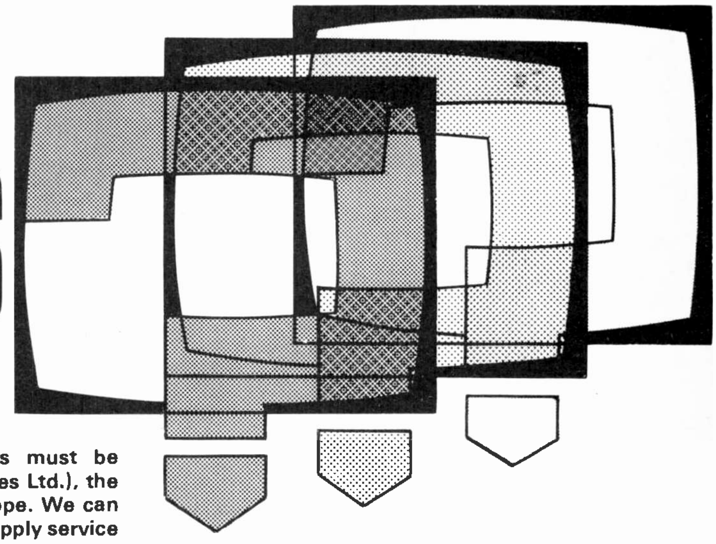

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PYE CT205

There was a sudden "tick-tick" noise and the picture went off completely, the sound remaining all right. On close inspection, with the set switched on, the three c.r.t. guns can be seen to be emitting blue sparks at a very high speed which is controllable by means of the volume control. Is the tube defective?

The tube could be soft and in need of replacement, but what's more likely is that the PL802 luminance output pentode has been robbed of anode voltage due to a crack in the long conductors beneath the colour-difference amplifier panel. While checking this, disable the line output stage by disconnecting the large 2·7kΩ resistor R231 connected to pin 6 or 3 (screen grid) of the PL509 line output valve. (Pye 697 chassis.)

MARCONIPHONE 4801

The problem with this set is horizonal distortion: the circle in the test card is oval on the right-hand side. This distortion fluctuates from time to time. The line output stage valves have been replaced without making any difference.

The fault appears to be due to leakage through the scan-correction capacitor C90 (0·1μF) which is connected in series with the line scan coils. (Thorn 1500 chassis.)

BEOVISION 3400SJ

This set has always suffered from a slow swaying of the verticals – not easily noticeable on programmes but definitely there on the test card, especially over the last four inches on the right-hand side of the screen. The degree of swaying varies from day to day, sometimes being hardly noticeable even on the test card. On occasions the swaying speeds up appreciably and then reduces to a smaller movement, all within an hour or so. The local agents have tested the set and say it is up to specification.

First check with a neon screwdriver to ensure that the chassis is at neutral potential – the colour coding on the mains lead on this model can be suspect. Then check the setting of the "set 32V" control 2R145 – this must be spot on. The 32V series stabiliser transistor OTR8 (MJ3055) and its driver 2TR28 (BC107B) can give rise to this fault. If the trouble persists, suspect ripple on the A and L (both 270V) h.t. lines. Check the earth line bonding of the reservoir and smoothing electrolytics.

TUBE REFLECTIONS

My colour set gives a perfectly satisfactory picture except for a white reflection in two places at the top of the screen – and sometimes at the sides as well under very dark figures on a white background. Although the picture extends to the top of the screen, the white reflections do not. When there is something dark at the top of the screen the white reflection goes right across it.

This symptom can occur with shadowmask tubes, due to the screen being bombarded by secondary electrons which find their way around the edge of the shadowmask. The trouble should be present only on dark scenes where a bright object brings heavy beam current to an isolated area. There is no cure that we know of.

RGD 627

On 405-lines the sound intermittently varies between weak and strong. The operation of a light switch in the same room will produce this change, as will touching the anode of the first 6BW7 sound i.f. amplifier valve with a metal screwdriver blade – the insulated end has no effect. I've tried changing valves and have resoldered every joint in the area.

We suggest you change the 0·01μF coupling capacitor between the 405-line sound detector can and the sound interference limiter diode. (STC/ITT VC1 chassis.)

FERGUSON 3713

Greens and yellows in the picture intermittently turn to pink or magenta – as if the green gun is operating spasmodically. The colours are quite normal when the fault is not present.

Concentrate your search around the green output transistor VT119. If you are lucky, the problem will be no more than a dry-joint – tap the printed board gently – or poor contact at the slider of the set green drive control R216. VT119 (BF258) could be faulty or, though less likely, the preceding MC1327 chrominance detector/matrix/PAL switch i.c. (IC3). If the i.c. is faulty, the voltage at pin 1 will change from the normal reading of 9V when the fault is present. (Thorn 8500 chassis.)

PHILIPS S26K497

The fault on this set is line pulling to the left at the top of the picture plus intermittent field jitter. The sync circuitry has been thoroughly checked and any suspect components replaced. The waveforms appear to be correct but some of the voltages are on the high side.

The trouble appears to be in the 25V/18V stabiliser circuit. The transistors concerned are TS421 and TS422, but the main suspect is C768 (47μF) which smooths the 18V line. An open-circuit capacitor here would mix up the line and field sync pulses. (Philips K70 chassis.)

BAIRD 675

The fault on this set is a repeated discharge across the spark gap at the c.r.t. first anode. Could it be the tube?

First check the value of R161 – it should be 220kΩ. This resistor is the resistive element in the boost supply *RC* filter network. The voltage at pin 3 (first anode) of the c.r.t. should be about 600V. If this voltage is correct, either the tube is arcing internally or the spark gap has been damaged. We're inclined to suspect the tube. (Baird 660 chassis.)

FERGUSON 3667

The initial problem with this set was corner to corner running. This was solved by replacing the sync separator's screen grid feed resistor. Now the problem is very bad line tearing on both systems. The sync and line oscillator valves have been replaced and the flywheel sync and d.c. amplifier stages checked, but everything there seems to be in order.

If the tearing occurs on turning up the brightness control, but lessens when the control is turned down, replace the e.h.t. tripler. If there is no difference between light and dark, the line oscillator charging capacitor C54 could well be at fault. (Thorn 1400 chassis.)

BUSH CTV174D

The line output valve is overheating (dull red) while the blocking coil 3L7 in its cathode circuit burns if the set is left on too long. The line sync is all right when the set is switched on but after about a minute the picture starts to shift to the right by about three inches, then goes out of sync. By resetting the line hold control lock can be restored, but only with the picture three inches off to the right: sync is then lost again and the line output valve starts to overheat. The components in the line hold and drive circuits have been replaced, new valves, a new e.h.t. tray and a new line output transformer have been tried, but without success.

It's reasonable to assume that the trouble is in the line output stage rather than the line oscillator. The line output stage seems to be heavily damped by excessive loading, upsetting the flywheel sync circuit via the feedback line. In order of likelihood the damping is probably due to: shorting turns on the shift choke 3L7 since this overheats, shorting turns on the PL509's d.c. feed choke 3L6, leakage in the boost line smoothing capacitor 3C37, leakage in the line drive coupling capacitor 3C27, the line output transformer tuning capacitor 3C34 being faulty, or simply the line output valve drawing excessive current (the voltage across the horizontal shift potentiometer 3RV5 in its cathode circuit should not exceed 1V at zero beam current).

KORTING HYBRID COLOUR CHASSIS

There is sound but no picture when the set is first switched on. As soon as I start investigating the line timebase board with a meter or prod however the picture appears and may or may not go off again. If it does go off the prod will restore it and the picture will remain for any length of time.

It appears that the line oscillator is reluctant to oscillate. This is a conventional PCF802 circuit and we suggest you check by substitution the polystyrene capacitors in the stage.

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

A single-standard Decca Model CTV25 colour receiver exhibited the curious symptoms of very mild changes in overall picture size accompanied by shading at the top left-hand corner of the screen and focus drift. These effects tended to appear after the receiver had been running for an hour or so, and were present on all channels. The sound was not affected. The picture brightness remained constant and the focus could be temporarily restored by adjusting the focus potentiometer at the rear of the e.h.t. section.

An h.t. supply fault was first suspected but monitoring the three primary supply lines disproved this possibility since the voltages remained constant throughout the period of display deterioration. Although there was no major change in the grey-scale tracking, it was thought desirable to monitor the tube's first anode voltages. These too remained constant. A measurement was then made of the potential at the focus electrode (pin 9) of the picture tube. This was reasonably normal and was adjustable over the expected range by means of the focus control. When the effects mentioned occurred however it was seen that there was an appreciable change in the focus voltage.

The focus voltage in this chassis is derived from an output on the e.h.t. tripler via a resistive potential divider whose centre element is the focus control. The resistors concerned have high values – 20MΩ, 10MΩ (the control) and 30MΩ – with in addition a 1MΩ "hold-off" resistor between the slider of the control and the focus electrode. It was assumed therefore that the trouble was due to a fault in one or more of these components. After replacement of all these resistors (they all looked *suspect!) the troubles remained however.*

At this stage it was decided to send the receiver back to the workshop for more detailed examination. It was disconnected from the mains therefore and taken to the front door ready for carrying to the van. After discussing with the customer the possibility of a loan set and then finishing the last cup of tea there was a loud, staccato explosion and the hall was filled with the pungent odour of evaporating selenium! What had happened? See next month's Television *for the answer and for a further item in the* Test Case *series.*

SOLUTION TO TEST CASE 172
Page 331 (last month)

Further investigation of the Thorn 8000 chassis power supply revealed that R724 (100kΩ in this particular set) which is in series with the set e.h.t. control R725 had increased in value. On replacing this however the only change in the fault condition was that the correct line output transistor peak collector voltage could be obtained with R725 more towards mid-travel. Other components in the power supply circuit were checked and changed if at all dubious, including the key capacitor C712 which charges to provide the thyristor firing action via a trigger circuit. One curious fact discovered was that the voltage across the h.t. smoothing electrolytic C704 was higher than the correct figure of 170-180V, suggesting incorrect firing of the thyristor (W703). No reason for this could be found, so it was decided to change the thyristor. This proved to be the correct move, the replacement completely curing the symptoms and enabling R725 to be set in its correct position. It was clear therefore that the thyristor's parameters had altered to some extent, modifying the firing point.

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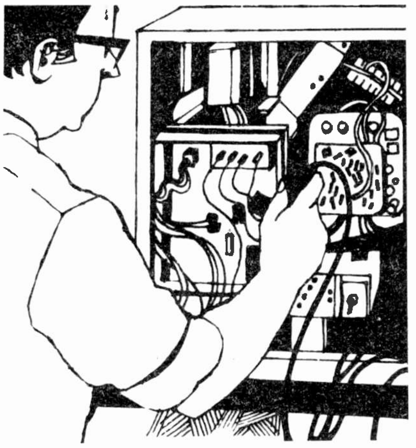

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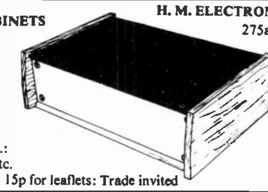

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