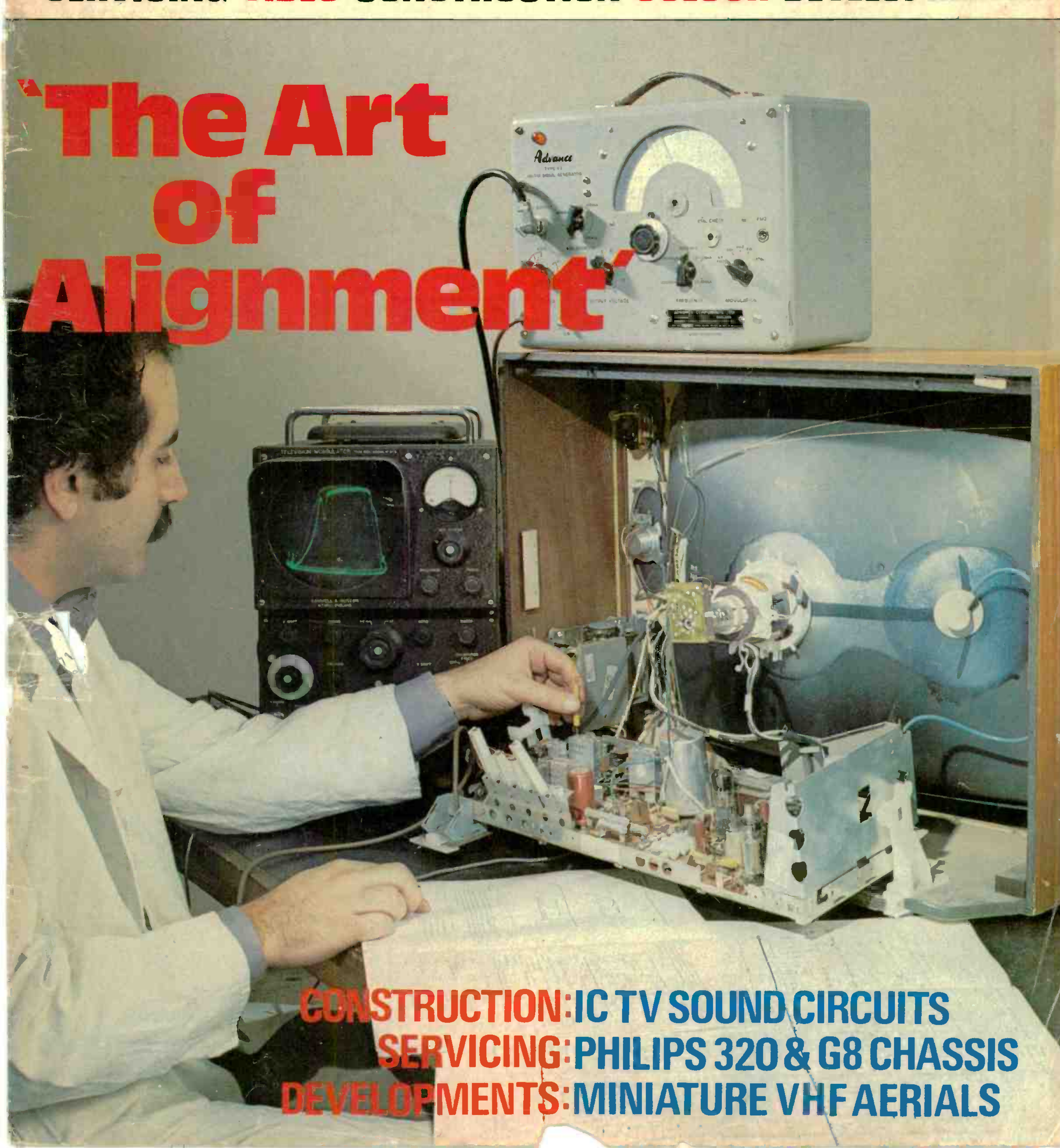
DECEMBER 1976

45p

TELEVISION

SERVICING·VIDEO·CONSTRUCTION·COLOUR·DEVELOPMENTS



'The Art of Alignment'

CONSTRUCTION: IC TV SOUND CIRCUITS

SERVICING: PHILIPS 320 & G8 CHASSIS

DEVELOPMENTS: MINIATURE VHF AERIALS

RADIO AND TV SPARES ALL COMPONENTS BRAND NEW. CASH WITH ORDER ONLY. P & P 35np. ALL PRICES INCLUDE VAT. AT 12½%
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PHD COMPONENTS DEPT 2
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Description	
400-400/350	3.00
200-200-150-50/300	2.50
1000-2000/35	80p
600/300	1.90
600/250	1.55
200-300/350	2.05
1000-1000/40	1.00
2500-2500/30	1.30
300-300/300	2.25
200-200-75-25/350	2.40
100-300-100-16/275	1.60
150-100-100-100-150/320	2.60
150-150-100/350	1.50
175-100-100	2.35
220/100	32p
2500-2500/63	1.70
700/200	1.30
400/350	1.55

DROPPER SECTIONS 16p each

MAINS DROPPERS

Pye 11062	75p
Pye 11009	1.20
BRC Mono 1400	80p
BRC Mono 1500	75p
BRC Colour 3000/3500	75p
BRC Colour 8000	75p
BRC Colour 8500	75p
Phillips G8	50p
Phillips 210 (with link)	55p
Phillips 210	65p
RRI Mono 141	75p
RRI Mono 161	80p
GEC 27840	75p
GEC 2000	75p
Phillips G9	35p

DIODES

				BA100	14p	BA164	17p
AA113	14p	OA81	11p	BA102	24p	BAX13	5p
AA116	14p	OA85	11p	BA130	35p	BAX16	6p
AA117	14p	OA90	6p	BA145	16p	BAY38	10p
AA119	8p	OA91	6p	BA148	16p	IN4148	4p
OA47	6p	OA95	6p	BA154	12p	BY206	30p
OA79	6p	OA202	11p	BA155	15p		

RECTIFIERS

BY100	21p	IN4001	4p
BY126	15p	IN4002	5p
BY127	15p	IN4003	6p
BY133	22p	IN4004	7p
BY182	2.00	IN4005	8p
BY238	40p	IN4006	9p
BYX10	14p	IN4007	10p

TUNER
ELC1043/05
4.50 each

LOPT
A29100
(Korting etc.)
6.50 each

THYRISTORS

2N4443	1.20
TV106	1.20
BR101	45p
BRY39	45p
BR100	35p

Bridge Rectifiers

BY164	50p
BY179	65p
W005	35p
W02	35p
W04	35p

INTEGRATED CIRCUITS

MC1307P	1.50	MC1310P	2.50
TAA350	1.90	SN76003ND	1.70
TAA550	50p	SN76013N	1.80
TAA630S	4.00	SN76013N07	1.80
TBA120S	1.50	SN76013ND	1.60
TBA120SQ	1.50	SN76023N	1.85
TBA520Q	3.00	SN76023ND	1.60
TBA530Q	2.50	SN76033N	2.75
TBA540Q	3.00	SN76665N	2.50
TBA550Q	4.00	CA3065	2.50
TBA560CQ	4.00	MC1358P	2.50
TBA750Q	2.20	MC1327P	2.00
TBA800	1.60	MC1327PQ	2.50
TBA920Q	4.00	MC1330P	1.50
TBA990Q	4.00	MC1351P	1.20
SN76003N	2.75	MC1352P	1.60

TRANSISTORS

		AF179	55p	BC182L	10p	BD138	49p	BF257	48p
AC107	33p	AF180	53p	BC182LB	10p	BD139	80p	BF258	65p
AC126	23p	AF181	49p	BC183L	10p	BD144	2.10	BF271	15p
AC127	30p	AF186	39p	BC183LB	10p	BD155	74p	BF273	15p
AC12701	50p	AF239	39p	BC184L	10p	BD157	74p	BF274	15p
AC128	23p	AL102	1.05	BC186	24p	BD183	55p	BF336	34p
AC12801	50p	AU107	1.05	BC187	26p	BD235	74p	BF337	34p
AC141	24p	AU110	1.85	BC203	15p	BD237	74p	BF338	34p
AC141K	40p	AU113	2.20	BC204	15p	BD238	74p	BF458	59p
AC142	24p	BC107	10p	BC205	15p	BDX32	2.50	BFX29	29p
AC142K	25p	BC108	10p	BC206	15p	BF115	19p	BFX84	24p
AC153	23p	BC109	10p	BC207	15p	BF118	25p	BFX85	25p
AC176	24p	BC113	12p	BC208	11p	BF121	24p	BFX88	23p
AC17601	50p	BC114	19p	BC209	15p	BF152	30p	BFX89	30p
AC187	23p	BC115	19p	BC212L	11p	BF154	30p	BFY50	22p
AC187K	24p	BC116	19p	BC213L	11p	BF157	30p	BFY51	22p
AC188	24p	BC117	19p	BC214L	11p	BF158	24p	BFY52	22p
AC188K	40p	BC118	28p	BC225	15p	BF163	24p	BU105/01	1.90
AC193K	29p	BC119	28p	BC237	15p	BF167	24p	BU105/02	1.90
AC194K	31p	BC125	21p	BC238	11p	BF173	24p	BU105/04	2.50
AD140	45p	BC126	19p	BC251A	16p	BF177	29p	BU108	3.00
AD142	50p	BC136	19p	BC301	32p	BF178	32p	BU126	2.90
AD143	50p	BC137	19p	BC303	59p	BF179	32p	BU204	1.90
AD145	50p	BC138	19p	BC307	11p	BF180	34p	BU205	1.90
AD149	1.00	BC139	19p	BC308	9p	BF181	32p	BU206	1.90
AD161	45p	BC142	29p	BC327	12p	BF182	43p	BU208	3.00
AD162	45p	BC143	34p	BC328	12p	BF183	43p	MJE340	65p
AF114	50p	BC147	12p	BC337	15p	BF184	25p	MJE520	80p
AF115	23p	BC148	11p	BC547	12p	BF185	25p	MJE2955	1.10
AF116	23p	BC149	13p	BD115	64p	BF194	14p	MJE3055	73p
AF117	19p	BC153	19p	BD116	60p	BF195	14p	MPSU05	65p
AF118	48p	BC154	19p	BD124	79p	BF196	14p	MPSU55	1.25
AF121	30p	BC157	14p	BD131	44p	BF197	14p	R2008B	2.00
AF124	23p	BC158	12p	BD132	49p	BF198	19p	R2009	2.00
AF125	23p	BC159	14p	BD133	49p	BF199	24p	R2010B	2.00
AF126	23p	BC171	14p	BD134	49p	BF200	34p	TIP31A	60p
AF127	23p	BC172	13p	BD135	39p	BF240	19p	TIP32A	60p
AF139	34p	BC178	21p	BD136	45p	BF241	21p		
AF178	53p	BC179	19p	BD137	47p	BF256LC	44p		

REPLACEMENT COMPONENTS

TV20 Stick Rectifiers	1.60 each
Crystals 4.433MHz	1.60 each
BRC 3500 Cutouts	1.60 each

VALVES

DY86/87	42p	PCF80	43p	PL36	[illegible]
DY802	42p	PCF86	49p	PL84	[illegible]4p
ECC82	42p	PCF801	52p	PL504	[illegible]5p
EF80	38p	PCF802	54p	PL508	88p
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EF184	44p	PCL84	52p	PY88	48p
EH90	45p	PCL85	59p	PY500A	1.12
PCC89	52p	PCL86	57p	PY800	47p
PCC189	52p	PFL200	73p		

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BRC1400	2.40	PYE731	7.50
BRC1500(17")	2.40	Decca2030	6.00
BRC1500(24")	2.75	GEC2028	6.50
BRC3500	6.00	GEC2110	7.00
BRC8000	2.60	ITTCVC5	6.00
BRC8500	5.00	RRI111/174	9.00
BRC9000	7.00	RRI A823	7.00
Decca CS190	6.50	Korting 90°	6.50
Phillips L8	6.60	Tanberg	6.50

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TELEVISION

December 1976

Vol. 27, No. 2
Issue 314

this month

OUR NEXT ISSUE DATED JANUARY WILL BE PUBLISHED ON DECEMBER 20

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ECC82, EF80, EF183, EF184, EH90, PCF80, PCF802, PCL82, PCL84, PCL85, PCL86, PCL805, PL504, PY81/800, PY88, 30PL14, 6F28.

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ALL PACKS UNUSED PARTS – **PK1**-40-C280 (MULLARD) AXIAL LEAD CAPACITOR MIXED VALUES FROM ·01uf TO ·47uf (250V/W). **PK2**-30-C281 (MULLARD) RADIAL LEAD CAPACITORS MIXED VALUES FROM ·015uf TO 1·5uf (250V/W). **PK3**-6 CO-AX PLUGS. **PK4**-6 CO-AX CONNECTORS. **PK5** 8-5m/m FORMERS WITH SLUGS. **PK6**-25-AC128 TRANSISTORS. **PK7**-3 BF200 (VHF) TRANSISTORS. **PK8**-2 BF182 (UHF) TRANSISTORS. **PK9** ANY 6 TRANSISTORS – BC108, BC113, BC135, BC153, BC171, BC172, BF194, BF195, BF196, BF197. **PK10** 8-1 amp 400 volt rectifiers. **PK11** 4-5 pin din plugs (180°). **PK12**-5 PP3 BATTERY CONNECTORS.

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TEL: RAMS (070 682) 3036.

TRANSISTORS, ETC.

Type	Price (£)
AC107	0.35
AC117	0.24
AC126	0.25
AC127	0.25
AC128	0.25
AC141	0.26
AC141K	0.27
AC142	0.20
AC142K	0.19
AC151	0.24
AC152	0.25
AC153K	0.28
AC154	0.20
AC176	0.25
AC178	0.27
AC187	0.25
AC187K	0.26
AC188	0.25
AC188K	0.26
AC193K	0.30
AC194K	0.32
ACY28	0.25
ACY39	0.68
AD140	0.50
AD142	0.42
AD143	0.51
AD149	0.50
AD161	0.48
AD162	0.48
AF114	0.25
AF115	0.25
AF116	0.25
AF117	0.20
AF118	0.50
AF121	0.32
AF124	0.25
AF125	0.25
AF126	0.25
AF127	0.25
AF139	0.35
AF147	0.35
AF149	0.45
AF178	0.55
AF179	0.60
AF180	0.55
AF181	0.50

Type	Price (£)
AF186	0.40
AF239	0.40
AF279	0.84
AL100	1.10
AL102	1.10
AL103	1.10
AL113	0.95
AU103	2.10
AU110	1.90
AU113	2.40
BC107	0.12
BC107A	0.13
BC107B	0.14
BC108	0.12
BC108B	0.13
BC109	0.13
BC109C	0.14
BC113	†0.13
BC114	†0.20
BC115	†0.20
BC116	†0.20
BC117	†0.20
BC119	0.29
BC125	†0.22
BC126	†0.20
BC132	†0.15
BC134	†0.20
BC135	†0.19
BC136	†0.20
BC137	†0.20
BC138	0.20
BC142	0.30
BC143	0.35
BC147	†0.13
BC148	†0.12
BC149	†0.14
BC152	†0.25
BC153	†0.20
BC154	†0.20
BC157	†0.15
BC158	†0.13
BC159	†0.15
BC161	0.48
BC167B	†0.15
BC168B	†0.13
BC169C	†0.13

Type	Price (£)
BC170	†0.15
BC171	†0.15
BC172	†0.14
BC173	†0.20
BC174B	0.26
BC176	0.22
BC177	0.20
BC178	0.22
BC178B	0.22
BC179	0.20
BC179B	0.21
BC182L	†0.11
BC183	†0.11
BC183K	†0.12
BC183L	†0.11
BC184L	†0.13
BC186	0.25
BC187	0.27
BC208	†0.12
BC212L	†0.12
BC213L	†0.12
BC214L	†0.15
BC238	†0.12
BC261A	0.28
BC262A	0.18
BC263B	0.25
BC267	0.16
BC268C	0.14
BC294	0.37
BC300	0.60
BC301	0.35
BC303	0.60
BC307B	†0.12
BC308A	†0.10
BC309	†0.15
BC323	0.68
BC377	0.22
BC441	1.10
BC461	1.58
BCY33	0.36
BCY42	0.16
BCY71	0.22
BCY88	2.42
BD115	0.65
BD123	0.98
BD124	0.80
BD130Y	1.42

Type	Price (£)
BD131	0.45
BD132	0.50
BD135	0.40
BD136	0.46
BD137	0.48
BD138	0.50
BD139	0.55
BD140	0.62
BD144	2.19
BD145	0.75
BD163	0.67
BD183	0.56
BD122	0.78
BD234	0.75
BD410	1.65
BD519	0.76
BD520	0.76
BD599	0.75
BDX18	1.45
BDX32	2.56
BDY18	1.78
BDY20	0.99
BF115	0.20
BF117	0.45
BF120	0.55
BF121	0.25
BF123	0.28
BF125	0.25
BF127	0.30
BF158	†0.25
BF159	†0.27
BF160	†0.22
BF161	0.45
BF162	0.45
BF163	0.45
BF167	0.25
BF173	0.25
BF177	0.30
BF178	0.33
BF179	0.33
BF180	0.35
BF181	0.33
BF182	0.44
BF183	0.44
BF184	0.26
BF185	0.26
BF194	†0.15

Type	Price (£)
BF195	†0.15
BF196	†0.15
BF197	†0.17
BF198	†0.20
BF199	†0.25
BF200	0.36
BF218	0.35
BF222	1.08
BF224J	†0.15
BF240	†0.20
BF241	†0.22
BF244	†0.18
BF254	†0.45
BF255	†0.45
BF256	†0.45
BF257	0.49
BF258	0.66
BF259	0.93
BF262	†0.70
BF263	†0.70
BF273	0.16
BF336	0.35
BF337	0.35
BF458	0.60
BF459	0.63
BF596	†0.70
BF597	†0.15
BFR39	†0.24
BFR41	†0.30
BFR61	†0.30
BFR79	†0.24
BFT43	0.55
BFW10	0.55
BFW11	0.55
BFW16A	1.70
BFW30	1.38
BFW59	†0.19
BFW60	†0.20
BFW90	†0.28
BFX16	2.25
BFX29	0.30
BFX30	0.35
BFX84	0.25
BFX85	0.26
BFX86	0.26
BFX87	0.28
BFX88	0.24

Type	Price (£)
BFY18	0.53
BFY40	0.40
BFY41	0.43
BFY50	0.25
BFY51	0.23
BFY52	0.23
BFY57	0.32
BFY64	0.42
BFY72	0.31
BFY90	0.95
BLY15A	0.79
BPX25	1.90
BPX29	1.70
BPX52	1.90
BRC4443	0.68
BRY39	0.47
BRY56	†0.40
BR101	0.47
BSX19	0.13
BSX20	0.19
BSX76	0.15
BSX82	0.52
BSY19	0.52
BSY41	0.22
BSY54	0.50
BSY56	0.80
BSY65	0.15
BSY78	0.40
BSY91	0.28
BSY95A	0.27
BT106	1.50
BT116	1.20
BU105/02	1.95
BU108	3.25
BU126	2.99
BU204	1.98
BU205	1.98
BU207	3.00
BU208	3.15
BU209	2.55
BUY77	2.50
BUY78	2.55
BUY79	2.85
D40N1	0.45
E1222	0.55
E5024	†0.20
ME6001	†0.16

Type	Price (£)
ME6002	†0.17
ME8001	†0.18
MJE340	0.68
MJE341	0.72
MJE370	0.65
MJE520	0.85
MJE521	0.95
MJE2955	1.20
MJE3000	1.85
MJE3055	0.74
MPF102	†0.40
MPS6566	†0.21
MPSA05	†0.47
MPSA55	†0.50
MPSU05	0.66
MPSU06	0.76
MPSU56	1.26
MPSU55	1.26
OC26	0.38
OC28	0.65
OC35	0.59
OC36	0.64
OC42	0.55
OC44	0.25
OC45	0.32
OC70	0.32
OC71	0.32
OC72	0.32
OC73	0.51
OC75	0.25
OC76	0.35
OC81	0.53
OC81D	0.57
OC139	0.76
OC140	0.80
OC170	0.25
OC171	0.30
OC200	1.30
OCP71	0.92
ON236A	0.65
ORP12	0.55
R2008B	2.05
R2010B	2.95
TIC44	0.29
TIC46	0.44
TIC47	0.58
TIP29A	0.49

Type	Price (£)
TIP30A	0.58
TIP31A	0.65
TIP32A	0.67
TIP33A	0.99
TIP34A	1.73
TIP41A	0.80
TIP42A	0.91
TIS43	†0.30
TIS73	†1.36
TIS90	†0.23
TIS91	†0.23
ZTX109	†0.12
ZTX300	†0.16
ZTX304	†0.22
ZTX310	†0.10
ZTX313	†0.12
ZTX500	†0.17
ZTX502	†0.17
ZTX504	†0.42
ZTX602	†0.24
2N525	0.86
2N696	0.23
2N697	0.15
2N706	0.12
2N706A	0.15
2N708	0.35
2N744	0.30
2N914	0.19
2N916	0.20
2N918	0.42
2N930	0.35
2N1164	3.60
2N1304	0.21
2N1305	0.21
2N1306	0.31
2N1307	0.22
2N1308	0.26
2N1309	0.36
2N1613	0.34
2N1711	0.45
2N1890	0.45
2N1893	0.48
2N2102	0.51
2N2217	0.36
2N2218	0.60
2N2219	0.50
2N2221A	0.41
2N2222A	0.50
2N2270	0.41

Type	Price (£)
2N2369A	0.42
2N2401	0.60
2N2484	0.41
2N2570	0.18
2N2646	0.53
2N2712	0.12
2N2894	0.77
2N2904	0.22
2N2904A	0.26
2N2905	0.26
2N2905A	0.28
2N2926G	†0.13
2N2926Y	†0.12
2N2926O	†0.12
2N2955	1.12
2N3012	0.91
2N3019	0.75
2N3053	0.21
2N3054	0.55
2N3055	0.60
2N3133	0.54
2N3134	0.60
2N3232	1.32
2N3235	1.10
2N3250	1.02
2N3254	0.28
2N3323	0.48
2N3391A	0.23
2N3501	6.99
2N3702	†0.13
2N3703	†0.15
2N3704	†0.15
2N3705	†0.11
2N3706	†0.10
2N3707	†0.13
2N3715	2.30
2N3724	0.72
2N3739	1.18
2N3766	0.99
2N3771	1.70
2N3772	1.90
2N3773	2.90
2N3790	4.15
2N3794	†0.20
2N3819	†0.35
2N3820	†0.49
2N3823	1.45
2N3866	1.70
2N3877	0.25

Type	Price (£)
2N3904	†0.16
2N3905	†0.18
2N3906	†0.15
2N4032	0.43
2N4033	0.54
2N4036	0.52
2N4046	0.35
2N4058	†0.17
2N4123	0.13
2N4124	†0.15
2N4126	†0.20
2N4236	1.90
2N4248	†0.12
2N4284	†0.19
2N4286	†0.19
2N4288	†0.13
2N4289	†0.20
2N4290	†0.14
2N4291	†0.18
2N4292	†0.20
2N4392	2.84
2N4871	†0.24
2N4902	1.30
2N5042	1.05
2N5060	†0.32
2N5061	†0.35
2N5064	†0.45
2N5087	0.32
2N5294	0.35
2N5296	0.57
2N5298	0.58
2N5322	0.85
2N5449	1.90
2N5457	†0.30
2N5458	†0.35
2N5494	0.85
2N5496	1.05
2N6027	0.65
2N6178	0.71
2N6180	0.92
2SC643A	1.36
2SC1172Y	2.80
3N140	1.21
40250	0.60
40327	0.67
40361	0.48
40362	0.50
40429	0.80
40439	2.67

LINEAR IC'S

Type	Price (£)
CA3045	1.35
CA3046	0.70
CA3065	1.90
MC1307P	1.32
MC1310P	2.94
MC1327PQ	1.86
MC1330P	0.93
MC1351P	0.75
MC1352P	0.82
MC1358PQ	0.85
MC1496L	0.87
MC3051P	0.58
MFC4000B	0.43
MFC4060A	0.70
MFC6040	0.91
NE555	0.72
NE556	1.34
SL414A	1.91
SL901B	4.20
SL917B	5.92
SN76001N	1.45
SN76003N	2.35
SN76013N	1.43
SN76013ND	1.25
SN76023N	1.43
SN76023ND	1.25
SN76033N	2.35
SN76227N	1.46
SN76530P	1.05
SN76533N	1.20
SN76660N	†0.90
SN76666N	†0.65
TAA300	1.84
TAA320	0.94
TAA350A	1.96
TAA435	0.85
TAA450	3.39

Type	Price (£)
TAA550	0.55
TAA570	2.02
TAA611A	1.70
TAA611B	1.85
TAA630Q	†4.18
TAA630S	†4.18
TAA661B	1.32
TAA700	†4.18
TAA840	†2.02
TAA861A	†0.49
TAD100	†2.66
TBA120S	†0.99
TBA240A	†2.97
TBA281	†2.28
TBA480Q	†1.90
TBA500	†1.99
TBA500Q	†2.00
TBA510	†1.99
TBA520Q	†3.34
TBA530	†2.71
TBA530Q	†2.71
TBA540	†3.21
TBA540Q	†3.21
TBA550Q	†4.10
TBA560C	†4.09
TBA560CQ	†4.10
TBA570	1.17
TBA641	2.30
TBA673	2.26
TBA700	†2.59
TBA720Q	†2.45
TBA750Q	†2.33
TBA800	1.75
TBA810AS	1.75
TBA920Q	†4.23
TBA990	†4.10
TBA990Q	†4.10
TCA270Q	†4.18
ZN414	1.25

Please enquire for linear op. amps, 709, 710, etc.

DIODES

Type	Price (£)
AA113	0.15
AA119	0.09
AA129	0.20
AA143	0.10
AAZ13	0.30
AAZ17	0.12
BA100	0.15
BA102	0.25
BA110	0.80
BA115	0.12
BA141	0.17
BA145	0.17
BA148	0.17
BA154	0.13
BA155	0.16
BA156	0.15
BA157	0.25
BAX13	0.06
BAX16	0.07
BAY72	0.11
BB104	0.52
BB105B	0.52
BB105G	0.45
BB110B	0.45
BR100	0.50
BY100	0.22
BY103	0.22
BY126	0.16
BY127	0.17
BY133	0.23
BY140	1.40
BY164	0.55
BY176	1.68
BY179	0.70
BY206	0.31
BYX10	0.15
BYZ12	0.30
FSY11A	0.58

Type	Price (£)
FSY41A	0.61
OA10	0.20
OA47	0.07
OA81	0.12
OA90	0.08
OA91	0.07
OA95	0.07
OA200	0.10
OA202	0.10
OA210	0.29
OAZ237	0.78
S2M1	0.22
TV20	1.85
IN914	0.07
IN914E	0.06
IN916	0.10
IN1184	0.92
IN1195	1.10
IN4001	0.05
IN4002	0.06
IN4003	0.07
IN4004	0.08
IN4005	0.09
IN4006	0.11
IN4007	0.14
IN4148	0.05
IN4448	0.10
IN5400	0.15
IN5401	0.17
IN5402	0.20
IN5403	0.22
IN5404	0.25
IN5405	0.27
IN5406	0.30
IN5407	0.34
IS44	0.07
IS310	0.45
IS920	0.07

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1.3W 3.3-100V **20p each**

DIGITAL IC's

Type	Price (£)
7400	0.20
7401	0.20
7402	0.20
7404	0.24
7406	0.45
7408	0.25
7410	0.20
7411	0.25
7412	0.28
7413	0.50
7416	0.45
7417	0.30
7420	0.20
7425	0.37
7430	0.20
7440	0.20
7441	0.85
7445	1.95
7447	1.30
7450	0.20
7451	0.20
7454	0.20

Type	Price (£)
7460	0.20
7470	0.33
7472	0.38
7473	0.44
7474	0.48
7475	0.59
7489	4.32
7490	0.65
7491	1.10
7492	0.75
7493	0.65
7494	0.85
7495	0.85
7496	1.00
74100	2.16
74121	0.60
74122	0.80
74150	1.44
74151	1.15
74154	1.66
74164	2.01
74192	2.05
74193	2.30

VDR'S, PTC & NTC RESISTORS

Type	Price (£)
E295ZZ/01	0.21
E295ZZ/02	0.21
E298ED/A258	0.18
/A262	0.18

Type	Price (£)
E299DD/P116-P354	all 0.17
VA1015	0.78
VA1033	0.17
VA1034	0.17
VA1040	0.17
VA1077	0.27
VA1104	0.44
VA8650	1.25

CAPACITORS
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BASES

Type	Price (£)
DIL8	0.16
DIL14	0.16
DIL16	0.18

MOUNTING KITS

TO-3	0.06
TO-66	0.06

VALVES†

Type	Price (£)
DY87	0.39
EB91	0.30
ECC82	0.41
EF80	0.41
EF183	0.53
EF184	0.53
EH90	0.55
EL34	0.87
PC86	0.67
PC88	0.76
PCC89	0.58
PCF80	0.47
PCF86	0.58
PCF801	0.58
PCF802	0.63
PCL82	0.50
PCL84	0.54
PCL805/85	0.58
PCL86	0.58
PFL200	0.74
PL36	0.80
PL84	0.61
PL504	0.80
PL508	0.95
PL509	1.44
PY81/800	0.45
PY88	0.52

RESISTORS

Carbon Film (5%)†	ea
¼W 5.6 Ω-330K Ω (E12)	1.5p
½W 10 Ω-10M Ω (E24)	1.5p
1W 10 Ω-19M 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

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Please	**Group B, Yellow code**	**39-51**
Specify	**Group C-D, Green code**	**52-68**

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MAINS TRANSFORMER 280W for "T.V." Colour Set £11.50 p.p. £1.20.
TRIPLER £5.00 p.p. 75p, ERIE FOCUS £2.20, NEW AUDIO UNIT £2.60 p.p. 30p. Original packs still available. List on Request.
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Field & Line Blanking Mod. Kit 30p, Beam Limiter Mod. Kit £1.00. Line Osc. Coil 60p. 500 ohm Contrast 25p, 250 ohm 25W 32p, A1 Slide Switches (Break before make) 3 for 48p. Ident Coil 50p. p.p. 15p.
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SPECIAL OFFER Jap colour T.V. Chassis, PAL, Solid State, new, boxed, for 90° Shadowmask, incl IF, Decoder, Timebases, CDA, Regulator, EHT with circuit data £20.00 p.p. £1.50.
DECCA Colour T.V. Thyristor Power Supply, HT, LT etc, £3.80 p.p. 95p.
BUSH CTV25 Power Supply Unit £3.20 p.p. £1.20
PYE 697 Line T.B. for "Television" set parts £1.50 p.p. 80p
MULLARD AT1023/05 convergence yoke. New £2.50 p.p. 60p.
MULLARD DLIE delay line. New 90p p.p. 40p.
PHILIPS G6 single standard convergence panel, incl. 16 controls, switches etc., and circuits £3.75 p.p. 75p, or incl. yoke. £5.00. PHILIPS G8 panels for spares, decoder £2.50 p.p. 75p. Field/line osc. 75p p.p. 35p.
VARICAP, Mullard ELC1043 UHF tuner £4.00, ELC1043/05 £4.50, G.I. type UHF varicap tuner £2.50 p.p. 30p. VHF or UHF salvaged varicap tuners £1.40. Control units, 3PSN £1.25, 4PSN £1.80, 5PSN £2.30. Special offer 6PSN £1.00, 7PSN £1.80 p.p. 25p. TAA 550 50p p.p. 15p.
VARICAP VHF PHILIPS £3.80, ELC1042 £4.40, p.p. 30p, ELC1042 on PYE P.C.B. £5.40, Plug in 6 posn. control unit £2.50 p.p. 65p
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PHILIPS 625 I.F. Panel incl. cct 50p p.p. 50p.
TURRET TUNERS, KB "Featherlight" VC11, Philips 170 series, GEC 2010 £2.50. GEC 2018, 2019, 2038, 2039 5 position £4.20 p.p. 75p.
TBA "Q" I.C.s. 480, 530, 540, £2.20, 550, 560C, 920 £3.20 p.p. 15p.

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BUSH 105 to 186SS, etc.	£6.40
DECCA DR95, 101/606, DRI 2, 3, 121/123, 20/24, 2000	£6.40
FERG., HMV, MARCONI, PHILCO, ULTRA, THORN 850, 900, 950, 1400, 1500 series	£5.80
GEC 2000, 2047 series	£6.20
KB VC1/9 51, 52, 53, 100	£5.90
MURPHY 849 to 2417, etc.	£6.40
P/SCOTT 960, COSSOR 1964	£4.90
PHILIPS 19TG121 to 19TG156	£3.80
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PYE 11U, 368, 169, 769 series	£5.90
PYE 40, 67 series (36 to 55)	£3.80
PAM, INVICTA, EKCO, FERRANTI equivalents as above	£3.80
SOBELL 1000 series	£6.20
STELLA 1043/2149	£6.20

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EKCO 380 to 390	£1.00
EKCO 407/417	£1.00
FERR. 1084/1092	£1.00
FERG. 506 to 546	£1.00
GEC 448/452	£2.50
KB/RGD 003, VC11	£2.75
P/SCOTT 733 to 738	£1.00
REG 10-6, 10-17 etc.	£1.00
SOBELL 195/282/8	£2.50

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BUSH 182 to 1122 etc.	£6.80
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DECCA "Bradford" (state Model No. etc)	£7.80
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WHEN IS PROFIT TOO MUCH?

On the whole the rental side of the TV industry has come out of the Price Commission's investigation of rental charges pretty well, though you may not immediately think so from the final conclusion and the reports that have appeared in the press. The report found that (1) increased charges were in general related to increases in VAT and increased costs, and complied with the Price Code. Full marks here it seems. (2) That reductions in VAT were passed on to existing subscribers though it was probably unwise of companies to offset the reduction by a simultaneous increase arising for quite separate reasons. This seems to be neither here nor there. Does the Commission think that more frequent changes are for some reason better, though clearly less efficient? (3) That many people are unaware that charges can be increased during the lifetime of a set. How many people in transactions of any sort read the "small print"? And how many people at the present time are unaware of inflation? (4) That in some cases small rentals for old monochrome sets were raised disproportionately, adding that while this may have been justified on economic grounds it showed lack of sensitivity to the feelings of the customers concerned. Well, no one likes being asked to pay more, but is business expected to be run on the basis of sensitivity to such feelings? It's true that old monochrome sets have paid for themselves, but it's very expensive to maintain old sets as more and more obsolete parts give up and have to be replaced. All in all these conclusions don't seem to amount to much one way or the other.

But the final conclusion is that while the rental companies have kept to the limits of the Price Code there is "an argument that prices could well be lower even if this would have to be at the expense of profit margins". The way this conclusion is expressed seems to indicate that the Commission is none too sure of itself but nevertheless feels that it has to give some admonition to the industry.

What it really boils down to is what is a fair profit, a question which is hard enough to answer in all conscience. While many people don't seem to like the idea of profit at all, one has to remember that profit is simply what's left over, if anything, after costs have been covered. Without profit there is nothing left over for further development, no point in bothering to continue in business and, one might add, nothing to tax. So we're faced with what's fair and what isn't. Even that's not too easy – doesn't it depend on the risk taken? There's no great risk in TV rental of course, so what we have to decide is whether the Commission's discovery that the trade had net profits in the year to March 1976 averaging 16·5 per cent and a return on capital of 19·4 per cent is reasonable. That may sound good, and the Commission calls the trade "prosperous", but you could have been getting 13 per cent or more by lending your capital to the government and not bothering to trade. Surely a company is entitled to make a bit more from its efforts than the rate on government borrowing? If this is being "prosperous" it merely underlines the abysmal lack of profitability of most of the rest of industry at the present time.

Generally we feel that the trade has given its customers a fair deal and, in being relatively prosperous, has simply shown that it is efficiently run and highly cost conscious – too much so many of its hard-pressed service personnel would say. There is probably no business that has competed for customers more aggressively than the radio and television industry. The renters have to compete not only with each other but with the established chain stores, the many independent dealers still in business, and the discounters, all of whom offer comparable facilities.

The trade will probably, and quite rightly, quietly ignore this rather pointless report. One thing the Commission made no effort to do was to compare what UK viewers have to pay with what the costs are in other countries that do not have an extensive rental industry. That would have made the beneficial influence of TV rental quite clear.

teletopics

RETRA CODE OF PRACTICE

The Radio, Electrical and Television Retailers' Associations' new Code of Practice has now been brought into operation and is obligatory to the 2,000 RETRA member companies who between them operate over 4,000 retail outlets. Under the code there is a "no-strings" comprehensive twelve month guarantee, with improved standards of providing service. A first visit must be made to a customer within three working days of receiving a request and repairs should be completed within 15 working days of the first visit. If this is not possible the retailer should lend the customer a similar item. The reason for being unable to complete a repair on the first visit should be made clear to the customer, who should also be informed of any minimum service charge. Repairs will be guaranteed for a minimum of three months. The scheme is being given considerable publicity to raise public confidence in members of the RETRA, and customers are being encouraged to return to their dealer if they have any problems. In cases of dispute, a disputes procedure has been introduced.

These don't sound very onerous conditions to us, and on the whole are the least one might expect, code or no code. Maybe it's better to have the code than nothing at all however, and at least those firms who are members are now committed to certain minimum standards, but we shall have to see whether it makes much difference in practice.

PRICE COMMISSION REPORT

We comment elsewhere in this issue on the conclusions reached by the Price Commission in its report on television rental charges. Apart from the conclusions themselves however quite a lot of interesting information on the domestic TV market has been assembled by the Commission, along with BREMA, in its report. The number of TV sets in use in the UK is estimated to be around 22 million, with the proportion of colour sets having risen from 4 per cent to 43 per cent since 1970. Trade estimates are that the proportion of colour sets could rise to 80 per cent over the next five years. Half the sets in use are rented, 40 per cent in the case of monochrome and 60 per cent in the case of colour. The typical rented monochrome set is a six year old 20in. set which originally cost under £50, excluding VAT: the typical rented colour set is a three year old 22in. model which cost under £180. The cost of sets has fallen over the past six years. Rentals however have increased by 51 per cent in the case of monochrome and 26 per cent in the case of colour over this period, though a large proportion of this was due to VAT. If VAT is excluded the increases become 22 per cent and 2 per cent respectively. The largest single item in a rental organisation's costs is set depreciation. At present firms assume that a monochrome set has a rentable life of four years while a colour set has a rentable life of six years. The Commission comment that if these set life estimates prove conservative then firms' profits will accelerate. That seems fair enough. We don't know what sort of treatment the average rented set receives, but if the wear and tear are reasonable its life should be rather more than that. On the other hand renters aren't interested, like some of us, in coaxing the last flicker out of a half dead set. You soon lose custom and reputation unless your sets are giving a first rate picture.

The TV rental trade's turnover now exceeds £500 million a year, while the trade's investment in sets is over £1,000 million. As you might expect, profits reached their peak level during the boom period in 1973. They have since fallen back. In the five years 1971-76 profits rose from about £20 million to £60 million. This however was largely due to a substantial rise in turnover as a result of customers switching from monochrome to colour sets. A second factor quoted is the greater realiability of modern sets, a point worth knowing.

PYE'S INCREASED TV RELIABILITY

Changes is production techniques that have helped considerably in improving the reliability of Pye TV sets were explained and shown during celebrations recently to mark the 25th anniversary of Pye's TV plant at Lowestoft. The improvements have been implemented over the last three years and as a result Pye say that the fault call rate for their current solid-state colour sets is now 0·6 per year or less. In the case of the 110° chassis the call rate (one year is taken to be equivalent to 2,000 hours of soak testing) was put at 0·95 per year when production started in June 1974. At the end of that year it was found to be down to 0·6 while the results of three independent dealer tests at the end of 1975 with batches of 116, 130 and 88 sets, showed call rates of 0·57, 0·65 and 0·43. In the case of the 90° chassis soak testing gave a rate of 0·7 calls a year, while dealer feedback has suggested that the actual rate is rather lower. These are impressive figures, comparable with the levels achieved by Japanese setmakers, and we've seen confirmation from other sources. They would also back up the comments of the Price Commission mentioned above.

An extra visual check of panels as they are completed is now made, and the panels are preheated prior to undergoing the flux-and-solder bath process. There is a more sophisticated system of panel checking, involving comprehensive checks on jigs wired to electronic comparators instead of checking visually by switching them into an otherwise complete receiver. Prior to individual testing the panels are given a twenty minute soak test in order to reduce the likelihood of suspect panels being sent to the production line. All completed sets undergo a two hour soak test. There is then an "acceptance check" when experienced operators look for the type of point that dealers or their customers might raise. There is also a "boxed stock audit" – a variable random sample is taken from each batch of packaged sets, unpacked and thoroughly tested before the batch is allowed to leave the plant for distribution.

During the past year a soak test building has been brought into operation. Here development samples, pre-production and pilot run models and final production samples are tested. There are also environmental test rooms where special tests can be carried out to ensure that sets will operate successfully under various conditions overseas. During its quarter of a century of operations the plant has produced over four million monochrome sets, over a million colour sets, and large quantities of car radios, record players and radiograms.

NEW PHILIPS VCR

The latest version of the Philips video-cassette recorder, Model N1502, has now been released. Various improvements have been made to the specification. There is improved cassette loading, a digital electronic timer which can be set with one minute accuracy up to three days in advance and has an LED display, improved picture definition, and almost 50 per cent reduced power consumption – from 115W to 60W – as a result of the use of d.c. instead of a.c. motors. The improved picture definition comes from increasing the bandwidth to 3MHz on colour and 3·2MHz on monochrome and including crispening circuits, which sharpen picture transitions. The unit retains the facilities of previous models in the range and is compatible with them. Three LEDs indicate reception of an off-air signal, presence of an audio signal, and whether the video signal is a colour one. The colour circuits are automatically switched off if the colour signal level is too low. The output of the audio LED varies with the received signal level. The price is expected to be around £560.

LICENCE DODGING

At the launching of yet another national anti-TV licence evasion campaign the Home Office Minister Lord Harris claimed that there were around 850,000 people using sets without a licence, the revenue loss being some £7·5 millions. With the BBC hoping for a fairly hefty increase in the licence fee sometime next year one can only wish the campaign all success.

STATION OPENINGS

The following relay stations are now in operation:
Abercraf (Brecknock) BBC Wales channel 22, BBC-2 channel 28. Receiving aerial group A.
Combe Martin (Devon) ITV (Westward Television) channel 49. Receiving aerial group B.
Ffestiniog (Gwynedd) ITV (HTV Wales) channel 25. Receiving aerial group A.
Tiverton (Devon) ITV (Westward Television) channel 43. Receiving aerial group B.

All these transmissions are vertically polarised.

IMPORTS FROM TAIWAN CURBED

The government has placed restrictions on the import of portable monochrome sets from Taiwan. Imports have been limited to 70,000 during the fifteen month period from October 1st 1976 to December 31st 1977, with a maximum of 50,000 during 1977. The industry has given qualified approval to the step, feeling that it does not go far enough and has been taken too late.

PHILIPS INVESTS IN TAIWAN

The importance of Taiwan in the world TV market seems to be growing rapidly. Two announcements have been made recently by Philips about their intentions to invest substantially there. First came news that Philips is to start a $50 million plant to produce colour tubes. This seems odd at a time when there are threats hanging over Philips' tube plants in the UK. After all, this is a capital intensive process and once the investment has been made it would be curious to scrap it and start again elsewhere. Perhaps our tubes are in the wrong place? But if the Japanese can ship their tubes all over the globe there seems to be no reason why this should be uneconomic for UK plants. The whole affair of the virtual collapse of the UK tube industry gets more and more curious. There seems to be a lot that should be brought out, maybe by a thorough Department of Trade enquiry.

The second announcement is that Philips is to set up colour receiver production facilities in Taiwan – Philips originally set up plant in Chupei, North Taiwan, as long ago as 1970. An investment of $10 million in colour set production is envisaged. Philips say that they have no plans to export the sets "backwards" to Europe but that they would be produced for the "home and off-shore markets".

FINLUX WITHDRAWS FROM UK

The Finnish TV manufacturer Finlux, one of the first Scandinavian setmakers to become established in the UK, has decided to withdraw. Spares will continue to be available, as at present, from RCA Ltd, Lincoln Way, Windmill Road, Sunbury-on-Thames, on a cash on delivery basis.

CLASS B VIDEO CIRCUITS

We described the Mullard complementary-symmetry class B video output circuit in the May "Teletopics" earlier this year. Mullard have now announced the availability of the pair of transistors then mentioned. These are types BF422 and BF423 which are rated at 830mW and are suitable for use with the 20AX tube or with standard colour tubes. Another pair rated at 1·8W is also now available, type numbers being BF469 (npn) and BF470 (pnp). These can be used with the 20AX and also with the PIL tube whose video drive power requirements are more severe.

NEW PRODUCTS

TWO NEW SCOPES FROM GOULD ADVANCE

Two new dual-trace scopes have been announced by Gould Advance. The first is the OS245 – a low-cost 10MHz instrument which is particularly suitable for general servicing. It incorporates a 100mm c.r.t., low drift circuitry and the timebase speeds are from 100nS to greater than 1S per division.

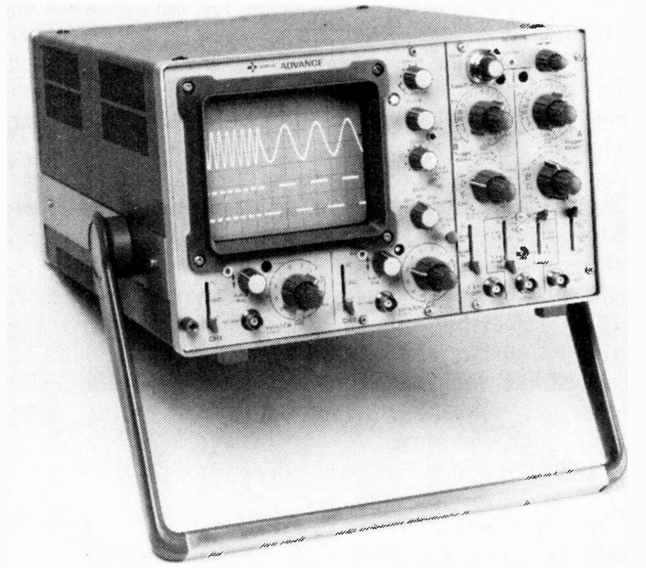
Sensitivity can be switched from 5mV to 20V per division in a 1:2:5 sequence, and vertical deflection accuracy is ±5%. An important feature of the instrument is the trigger performance: full trigger level control is available even when the bright-line facility is in use. The OS245 has an X-Y mode using the Y1 channel for X deflection and the Y2 channel for Y deflection.

The second unit is the OS3300B which features a 50MHz bandwidth and complete portability. It combines a high sensitivity (1mV/cm maximum from d.c. to 10MHz) with a high timebase speed (10nS/cm maximum) and a high e.h.t. voltage (13kV), making the instrument ideal for the display of fast transients. In addition, comprehensive triggering facilities are incorporated to ensure a stable trace on both channels, irrespective of frequency or waveform.

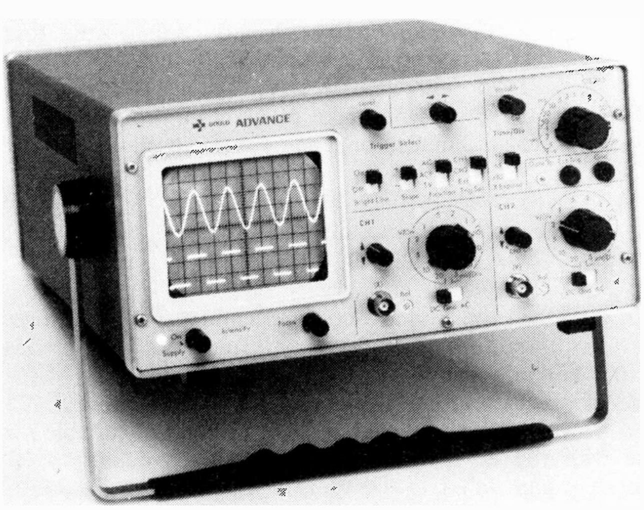
Detailed examination of complex waveforms and pulse trains can be carried out by using the delayed sweep timebase facility, while the mixed-sweep facility gives continuous identification of the section of waveform under examination.

A trace location system gives immediate indication of trace position, independently of the vertical and horizontal shift control settings and brightness. Warning lights indicate when either the vertical channel or the timebase is uncalibrated.

Further details and prices may be obtained from Gould Advance Ltd., Roebuck Road, Hainault, Essex. Tel: 01-500 1000.



Another newcomer from Gould Advance is the OS3300B; this is a portable 50MHz dual trace unit which is suitable for both laboratory and general servicing use.

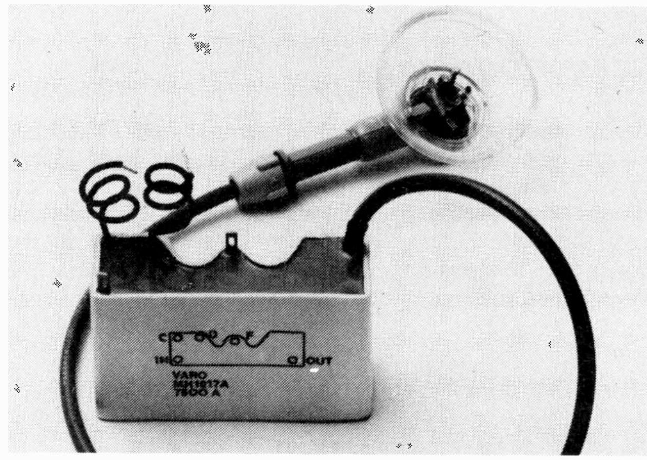


The new Gould Advance low-cost dual trace 10MHz scope, the OS245.

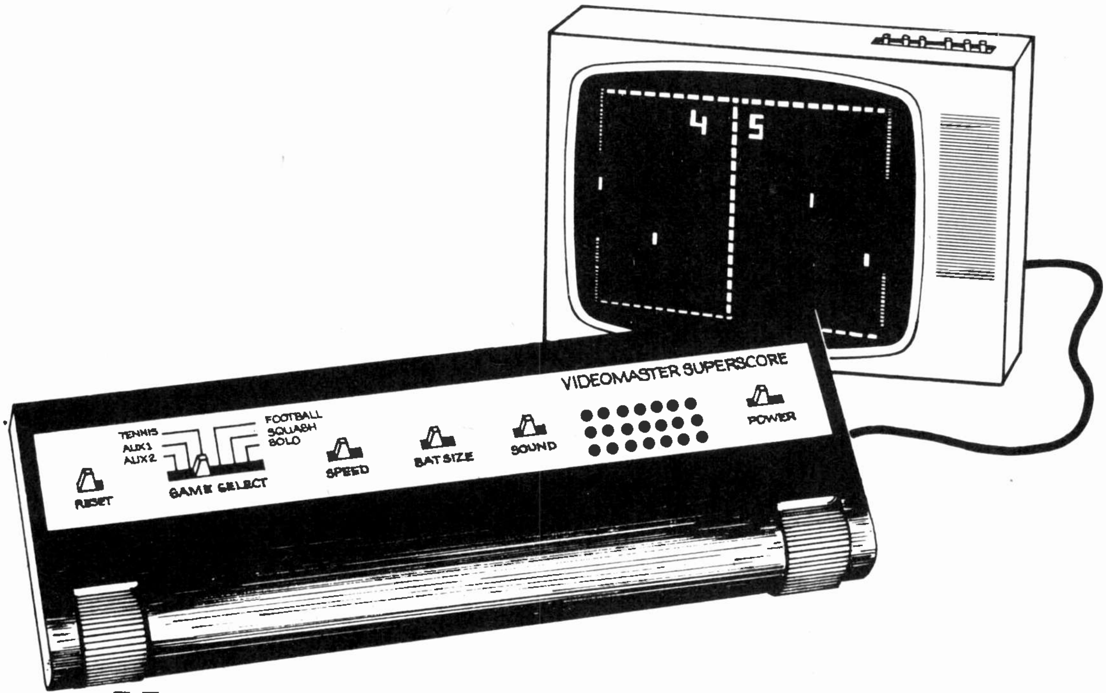
VARO TRIPLER ON DISTRIBUTION

A tripler specifically designed for the service industry and manufactured by Varo Semiconductor is now available from Lingrael. The unit, type number NH1017S01, is suitable for the Rank and Pye 90° and 110° solid state chassis, as well as the Grundig 5010 and 6010, Tandberg CTV2-2 and some other continental chassis.

The product is intended for the European market and takes into account the regulation and radiation requirements in addition to meeting BS415:1972. Further details and prices are available from the distributors, Lingrael (South East) Ltd., 111 Ferndown Estate, Wimborne Road West, Wimborne, Dorset BH21 7RA. Tel: 0202 871422.



The Varo tripler type NH1017S01 which is now available from Lingrael.



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BF159	0.18	BF260	0.23	OC42	0.45
BF160	0.17	BF262	0.30	OC44	0.18
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BF164	0.18	BF271	0.15	OC46	0.35
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BF173	0.20	BFX84	0.25	OC71	0.22
BF177	0.24	BFX85	0.25	OC72	0.30
BF178	0.30	BFX88	0.24	OC74	0.35
BF179	0.28	BFY37	0.20	OC75	0.35
BF180	0.30	BFY51	0.23	OC76	0.35
BF181	0.28	BFY52	0.23	OC77	0.50
BF182	0.34	BFY53	0.25	OC78	0.13
BF183	0.30	BFY55	0.25	OC81	0.20
BF184	0.22	BHA0002	1.90	OC81D	0.14
BF185	0.22	BR100	0.30	OC82	0.20
BF186	0.30	BSX20	0.22	OC82D	0.13
BF194	0.11	BSX76	0.22	OC83	0.22
BF195	0.11	BSY84	0.34	OC84	0.28
BF196	0.12	BT106	1.05	OC85	0.13
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TELETEXT DECODER ON IMMEDIATE DELIVERY

Chelsea-based Spectrum Laboratories is said to offer immediate delivery of its Spectrum Telefax Decoder. The unit includes all the features for receiving Ceefax and Oracle while providing optional facilities for decoding the Post Office Viewdata service. Control is from a slim hand-held keypad wired to the decoder, with the option of ultrasonic remote control.

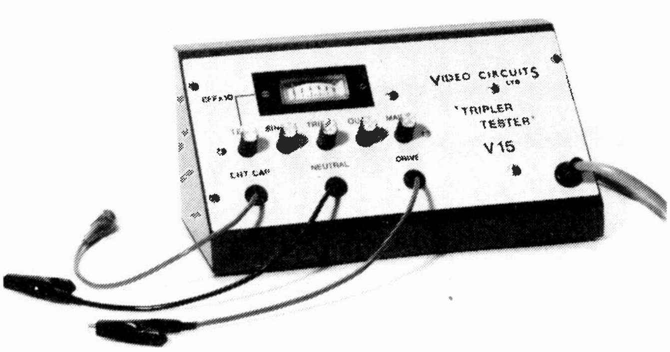
Page number is continuously displayed at the top left of the information page. Usual features include roll with pages changing continuously and a time display which is inserted into the top right of an ordinary TV programme. Priced at around £300, the unit may be built into a set or else mounted externally, but it must be wired in. Spectrum will advise on the conversion. Further information may be obtained from Spectrum Laboratories Ltd., 32 Royal Avenue, Chelsea, London SW3 4QF. Tel: 01-730 1801.

EHT TRAY TESTER AND CRT TESTER FROM VIDEO CIRCUITS

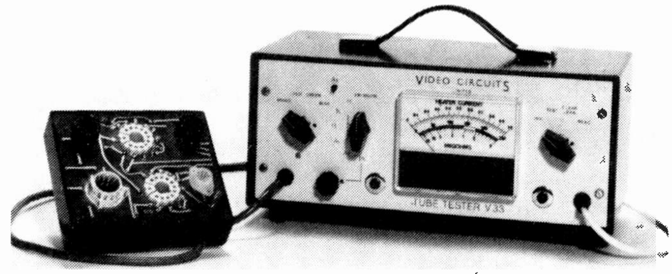
An e.h.t. tray efficiency meter, called the "Tripler Tester", has been introduced by Video Circuits. The instrument gives direct reading and tests drive absorption and final output on load. Three flexible leads are provided for connection to the tray and when the "test" button is depressed the unit produces a drive of approximately 800V pk-pk at 625-line frequency and will reach stability within 15 seconds from switch-on.

The meter is illuminated from the rear when any of the buttons marked "Single", "Triple" or "Quadruple" is depressed. The meter is scaled 0-10 and the reading must be multiplied by ten to obtain the efficiency percentage. The unit is priced at £37.40, including VAT and postage and packing.

Video Circuits has also announced a successor to the V31A tube tester. The new unit, designated the V33, tests colour or monochrome tubes in situ without the necessity to even remove the e.h.t. cap. It tests the red, green and blue guns individually, measures interelectrode leakage (with a "clear leak" facility), accurately measures the beam current, and incorporates a reactivator facility. The unit is priced at £65.34 including VAT and postage and packing. Further details from Video Circuits Ltd., 104 Salisbury Road, Barnet, Herts. EN5 4JN. Tel: 01-449 3087.



The new tripler tester type V15 from Video Circuits costs £37.40 and can test single-stick rectifiers as well as doublers, triplers and quadruplers with an internally generated 800V pulse. The efficiency is read directly on a meter.

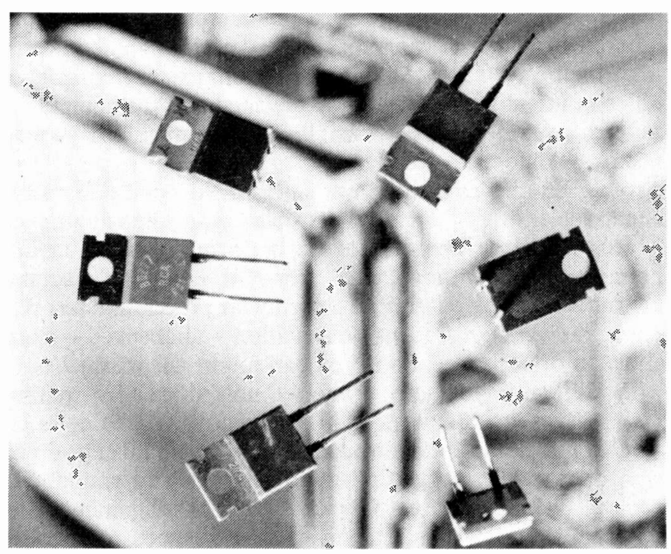


Successor to the V31A tube tester from Video Circuits is the V33, priced at £65.34. The instrument incorporates a boost facility.

FAST-RECOVERY DIODE FOR TV DEFLECTION

A new fast-recovery diode from RCA Solid State is available in a low-cost TO-220 Versawatt plastic package, giving excellent heat-sink capability and making the device particularly suitable for use in thyristor line output stages for 110° large-screen TV tubes. Two such diodes are used in conjunction with two thyristors to control the horizontal yoke current, one pair conducting alternately during the forward scan while the other pair conduct alternately to give the flyback action.

The diode is designed for operation from supply voltages between 150 and 270V, and can handle a maximum reverse voltage of 800V and an average current between 2 and 7A, depending on the heatsinking facilities. The diode can handle surges of more than 100A, and has a soft (i.e. low in harmonics) recovery characteristic. Other applications include clamp and boost diodes, diode modulators and switch-mode power supplies.



New from RCA, a fast-recovery diode suitable for TV deflection applications, housed in the low-cost TO-220 Versawatt plastic package.

FIRST MAINS/BATTERY COLOUR PORTABLE

Sanyo have announced the introduction of the first mains/battery colour receiver to appear on the UK market, and say that about 1,000 will be available before Christmas. The new set, Model CTP1101, is fitted with a 10in. 70° picture tube and is expected to be sold at a price of around £250. In addition to operation from the mains or a 12V battery it seems that a compact lead-acid battery about the size of a medium transistor radio may be made available.

The Art of Alignment

Part 1

Harold Peters

ONE of the earliest servicing skills was alignment, something one had to do quite often to the sets of years ago. It seems odd to the writer that this skill is so little used today. Maybe this is due to the lack of any standard work on the subject, especially one which starts from scratch. If you are shy when you have to face set realignment, wish you could handle a sweep generator and talk glibly about 39·5dB or 26dB traps, or wonder why a tweak on L28 improves the sound, then this is for you. Starting with superhet theory we shall be as basic as possible, with only the bare minimum of mathematics. We'll then look at tuned circuits of all types, the tools and equipment required for alignment, and end up with enough practical examples to enable you to tackle almost any set – or at least to understand what the service manual is getting at.

Service Manual Instructions

Since service manual instructions are guaranteed to put you off before you start, let us try to dispose of them as a major source of initial worry. Manuals originate from the laboratory at the setmaker's factory, and as all setmakers have their own ways of going about things their manuals all differ in the alignment methods specified and the equipment quoted. It's more than possible that the technical writer responsible for the instructions given in the manual has never tried the alignment out under field conditions with cheap gear. It's equally possible that the alignment procedure as written cannot be performed at all, having been adapted without trial from a group of factory instruction sheets relating to a particular production test rig. It could even be a student's translation – unchecked – from German or Japanese. So if you can follow the manual only with difficulty you are probably not alone. By getting yourself wise to the ways of i.f. strips however, so as to be able to understand the purpose of the instructions, you are well on the way to getting good pictures and sound. To square one then, the "Ohm's Law" of alignment and superhet theory – this establishes why we need to align at all.

Fourier's Theorem

The "Ohm's Law" of alignment, Fourier's Theorem, asserts that any complex waveform can be broken down into a fundamental sinewave and its harmonics (Fig. 1). Our complex waveform is the picture signal from the local transmitter, and its fundamentals are the r.f. carrier wave and the studio picture which is modulated upon it. For our purposes we can shuffle Fourier's Theorem round the other way, to produce the law of mixing – "if any two frequencies are mixed together, the resultant complex waveform will contain those two frequencies as well as their sum and their difference".

From Camera to TV Screen

This mixing process occurs three times between the camera and the eye of the viewer: first at the transmitter, then in the receiver mixer, and finally in the vision detector. We'll follow one such signal (Fig. 2) all the way. For ease of the necessary mathematics we choose London's BBC-2 channel 33 and assume its video modulation to be 5MHz – this represents the upper end of the video spectrum nicely rounded off – and hope you will accept that what works for 5MHz works for all the intervening frequencies as well. Also, to make the figures easy we'll ignore any sound modulation – its bandwidth is very small by comparison with the other frequencies involved.

Our basic signal then is:

> The channel 33 vision carrier at 567·25MHz, the sound carrier at 573·25MHz, and the vision modulation (0–) 5MHz.

Mixing at the Transmitter

The mixing that takes place at the transmitter therefore is:

> Two fundamentals, 567·25MHz and 5MHz, which produce their sum at 572·25MHz and their difference at 562·25MHz. Also the sound at 573·25MHz.

The sum and difference frequencies are called the upper and lower sidebands (more about these later) and as all five of the above frequencies make their way to the aerial the 5MHz signal is so far outside the tuning range of the circuits that it gets lost altogether while the difference frequency – lower sideband – is mopped up in a sort of

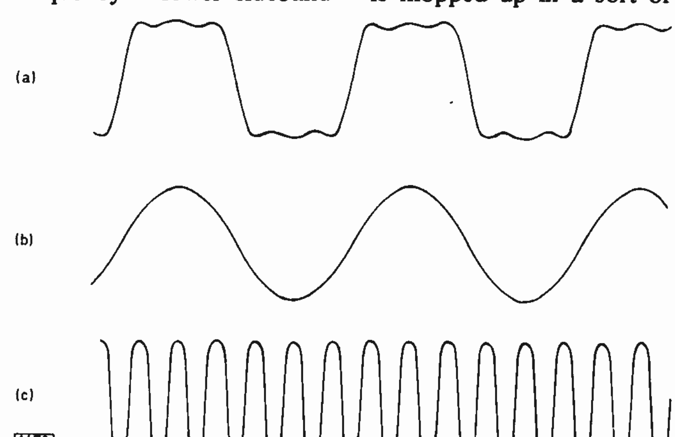


Fig. 1: Fourier's Theorem: a complex waveform (a) can be broken down into its component sinewaves (b) and (c).

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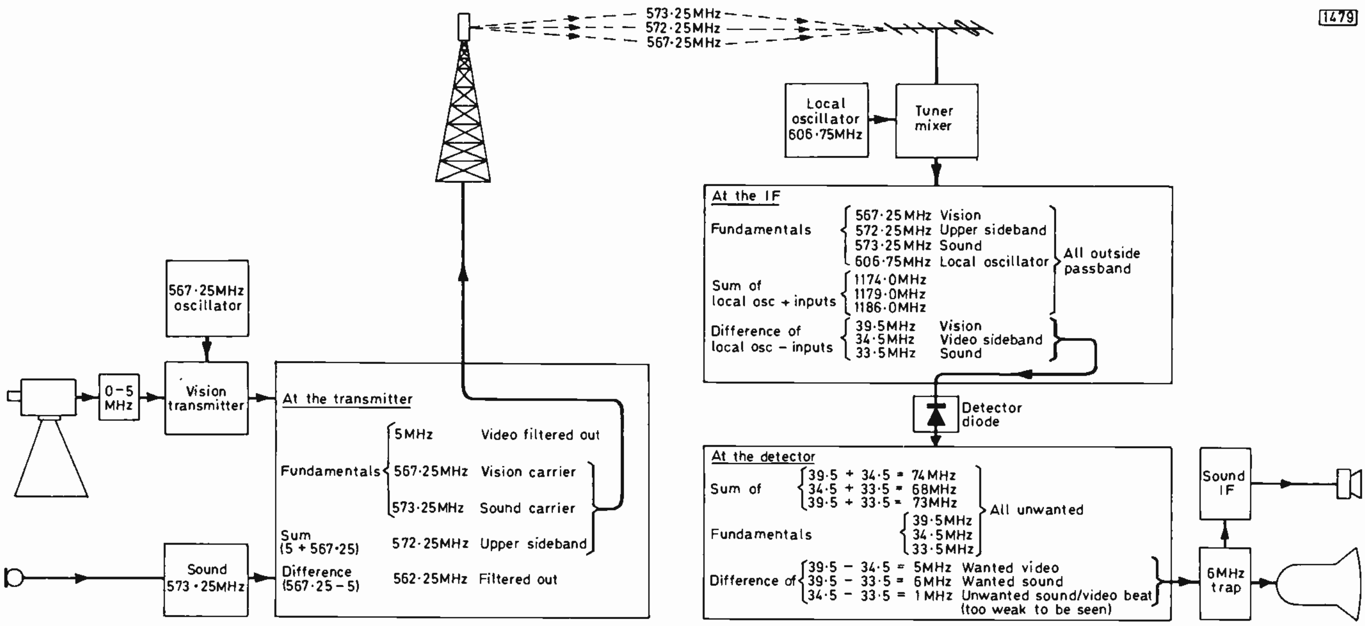


Fig. 2: Mixing processes, from the studio to the c.r.t. screen. To simplify matters the sound is shown unmodulated, i.e. as just a carrier, and the picture detail from the camera is simply a 5MHz sinewave.

electronic trombone called the vestigal sideband filter. The rest – 567·25, 572·25 and 573·25MHz (see Figs. 2 and 3) – are radiated by the transmitting aerial.

Action of the Tuner

At the receiver tuner we have another mixer stage where the three transmitted signals are introduced to a locally generated oscillation. This is kept at a frequency 39·5MHz higher than the selected vision carrier. In our case (ch. 33) it will be at 567·25 + 39·5 = 606·75MHz. The mixing process in the tuner thus gives us:

> Fundamentals at 567·25MHz and 606·75MHz, their sum at 1174·0MHz – these three we don't want any more – and their difference at 39·5MHz, the wanted signal or intermediate frequency (i.f.).
>
> Similarly the local oscillator mixes with the sound carrier. Here the fundamentals are 573·25MHz and 612·75MHz, their sum is 1186·0MHz – again all unwanted – and their difference is 33·5MHz, the wanted sound i.f.

If we place at the tuner output a tuned circuit which passes only frequencies in the 30-40MHz region, rejecting all others, only the difference frequencies will get through to the i.f. stages. Note incidentally that the sound and vision carrier frequencies change over, sound now being on the lower side of vision. This always happens when the local oscillator frequency is above the signal frequency as it invariably is, even on 405 lines.

After passing through several highly efficient fixed tuned circuits and at the same time receiving amplification a substantially larger i.f. signal is presented to the vision detector. We will assume that this is a diode. The mixing law still applies here.

You may have noticed that we conveniently ignored the vision sidebands when we described the action of the tuner. They are still present however, having themselves been transferred to the intermediate frequency range on either side of the 39·5MHz vision i.f. carrier. Thus the original 5MHz video signal, which became 572·25MHz (5 + 567·25) at the transmitter and the receiving aerial, mixed with the 606·75MHz local oscillator signal to give the unwanted sum and wanted difference frequencies 572·25 + 606·75 = 1179MHz and 606·75 − 572·25 = 34·5MHz respectively.

Vision Detection

So our maths finishes with all this stuff, i.e. the vision i.f. 39·5MHz (1), the sound i.f. 33·5MHz (2) and the 5MHz sideband 34·5MHz (3), being applied to the vision detector. Here the sum of (1) and (2) produces 73·0MHz, the sum of (1) and (3) 74·0MHz and the sum of (2) and (3) 68·0MHz – all of which we don't want so we filter out.

The difference of (1) and (2) is 6MHz, the wanted sound second i.f. The difference of (1) and (3) is 5MHz, the wanted video signal, and the difference of (2) and (3) 1MHz, an unwanted "tizz" which is likely to get right through to the screen because the video amplifier cannot differentiate between it and the 1MHz bars on the test card. In practice it's removed by keeping the 33·5 MHz sound i.f. 20dB down with respect to the 39·5MHz vision carrier (or 26dB from peak) and by fitting another sound trap to attenuate this still further after the 6MHz content has been successfully spirited away to the intercarrier i.f. channel.

In mentioning trap depths we have jumped ahead a little, and although some of you can juggle with decibels like they were PCF80s may we break off here to refresh the minds of those who are a little rusty on these units, since they are likely to pop up from time to time as we proceed.

The Decibel

The decibel is a unit normally used to compare power ratios on a manageable scale. Thus 10 × log (power 1/power 2)=power gain expressed in decibels. R.F. types usually use dBs to compare voltages across a common load, and since power is related to voltage by $W = V^2/R$ the formula becomes 20 × log ($V1/V2$).

For example if our output meter jumps from 1V to 2V and then to 10V the first increase is 20 log (2/1), or 20 log 2. The log of 2 is 0.3010 so 20 log 2 is 6·02 – near enough 6dB.

The second increase is 20 log (10/1) = 20 log 10 = 20 × 1·0 = 20dB.

Table 1: Voltage/dB conversion table.
(0-100dB to 100mV – 1μV)

dB	Millivolts	dB	Millivolts	dB	Microvolts	dB	Microvolts	dB	Microvolts
0	100	20	10	40	1000	60	100	80	10
1	89·1	21	8·91	41	891	61	89·1	81	8·91
2	80	22	8	42	800	62	80	82	8
3	70·8	23	7·08	43	708	63	70·8	83	7·08
4	63	24	6·3	44	630	64	63	84	6·3
5	56·2	25	5·62	45	562	65	56·2	85	5·62
6	50	26	5	46	500	66	50	86	5
7	44·7	27	4·47	47	447	67	44·7	87	4·47
8	40	28	4	48	400	68	40	88	4
9	35·5	29	3·55	49	355	69	35·5	89	3·55
10	31	30	3·1	50	310	70	31	90	3·1
11	28·2	31	2·82	51	282	71	28·2	91	2·82
12	25	32	2·5	52	250	72	25	92	2·5
13	22·4	33	2·24	53	224	73	22·4	93	2·24
14	20	34	2	54	200	74	20	94	2
15	17·8	35	1·78	55	178	75	17·8	95	1·78
16	16	36	1·6	56	160	76	16	96	1·6
17	14·1	37	1·41	57	141	77	14·1	97	1·41
18	12·5	38	1·25	58	125	78	12·5	98	1·25
19	11·2	39	1·12	59	112	79	11·2	99	1·12
20	10	40	1	60	100	80	10	100	1

To use, follow these examples:
26dB down on 10mV = 20dB + 26dB = 46dB = 500μV.
Stage unaligned gives 300μV, aligned gives 1mV: gain is 50dB – 40dB = 10dB.

So doubling a signal increases it by 6dB and amplifying it ten times is expressed as 20dB. Table 1 shows how to convert between millivolts/microvolts and decibels when comparing gain or attenuation.

Vestigial Sideband Transmission

When, some way back, we looked at the transmitter we mentioned that the 5MHz video signal mixed with the 567·25MHz r.f. carrier to produce two sidebands, at 572·25 and 562·25MHz. However complex the TV signal, these two sidebands lie symmetrically about the carrier, the lower one being a mirror image of the upper one. This means that the signal we followed would take up 10MHz of "airspace". There is not enough room for this if, with the "space" available, we are to have a four programme service with country-wide coverage. To economise we suppress the lower vision sideband – after all it's exactly like the upper one. This saves us 5MHz, and with the sound 6MHz away from the vision and a "no man's land" before the next channel enables us to have our u.h.f. channels 8MHz apart.

There are snags however. First it's impossible to chop off the lower sideband cleanly just below the vision carrier, and secondly it's necessary to reduce the vision carrier power by half (6dB!) because half the lower sideband power is still left. So the vision transmitter response is tapered off, starting at 1·25MHz above the vision carrier and ending, as shown, 1·25MHz below it. You will notice that the vestige of sideband below the carrier would exactly fill the gap above it on the h.f. side. It is this *vestigal sideband* system which is used on u.h.f. today, and all that it's necessary to remember is that the 8MHz channel spacing starts at the lower end, with vision carrier 1·25MHz in followed by the sound at 6MHz higher and with an 0·75MHz guard space before the start of the next channel. See Fig. 3.

You may now be thinking that it's a pretty tall order to ask a tuner to track all the way from ch. 21 to ch. 68 admitting only a chunk of frequencies 8MHz wide, so you will not be surprised to find out that the tuner response is pretty flat and that all the response curve shaping is done in the fixed frequency i.f. section where the response is adjusted to follow the shape of the transmitted signal fairly closely. This answers the question "why tune i.f.s?".

The Ideal Response Curve

The receiver's "response curve" is simply a graphical representation of output plotted against frequency – usually as seen at the vision detector. If it conjures up an impression of a complicated hook-up involving oscilloscopes and sweep generators, remember that you can produce one easily enough with just a simple signal generator and a voltmeter – by plotting the results on graph paper with an ordinary lead pencil. More of this anon.

Right now let's look at the response curve carefully to see what the shaping in the i.f. stages involves and why the particular frequencies chosen are used. This is because: (1) We have agreed internationally to use an i.f. bandwidth of 30-40MHz. (2) We still use channel 1 for 405-line transmissions. (3) The vision i.f. carrier is 6MHz above the sound carrier on 625-lines. (4) The space between our vision carrier and the next channel's sound is 2MHz.

Selecting the IF Carrier

If you think about it, the only fixed parameter above is item (2). The channel 1 sound carrier is at 41·5MHz, just outside the i.f. band. This frequency allocation is a relic of the good old pre-war days of "Ally Pally" (who remembers Cabaret Cruise?) and is still used today by Crystal Palace, Divis, Redruth and others in sufficient strength to cause interference. Obviously a trap has to be fitted in the receiver's i.f. channel to attenuate this frequency, and what better than to kill two birds with one stone by using it to suppress the adjacent channel sound i.f. on 625?

Having fixed this point, all the other frequencies fall into place. The vision carrier comes 2MHz lower at 39·5MHz (half way up the slope in Fig. 4(a), at the right-hand –6dB point). The slope of the curve around the 39·5MHz part of the response should mirror that of the vestigal sideband

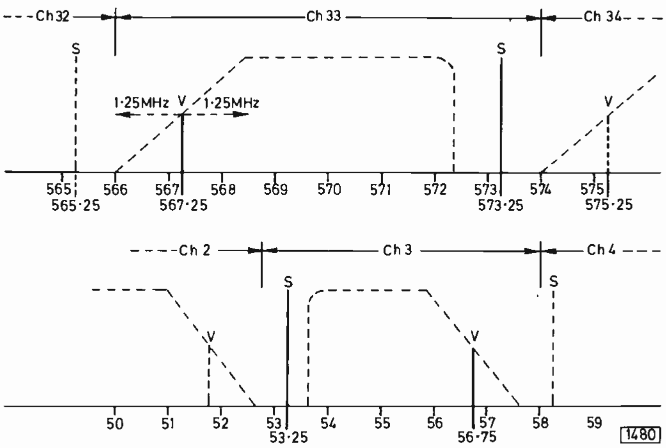


Fig. 3: Vestigial sideband transmission. Top, the channel 33 sound-vision signal disposition, showing how a 13MHz quart is squeezed into an 8MHz pint pot. Below, the 405 system to the same scale.

transmission, levelling off to a minimum 1·25MHz higher.

On the lower frequency side, i.e. to the left in Fig. 4, we see a level top and then a more gradual fall-off towards the sound carrier than at the transmitter. The 33·5MHz sound carrier is seen to sit on a shelf (steady!) at 26dB below peak or 20dB (one tenth) below vision carrier. We need to stop the sound signal appearing on the screen, yet we need to preserve some sound in order to get a 6MHz intercarrier i.f. output from the vision detector. Experience shows that 26dB of attenuation is just about right.

At 2MHz lower still (31·5MHz) another trap is used to remove any trace of the vision carrier of the next channel higher up.

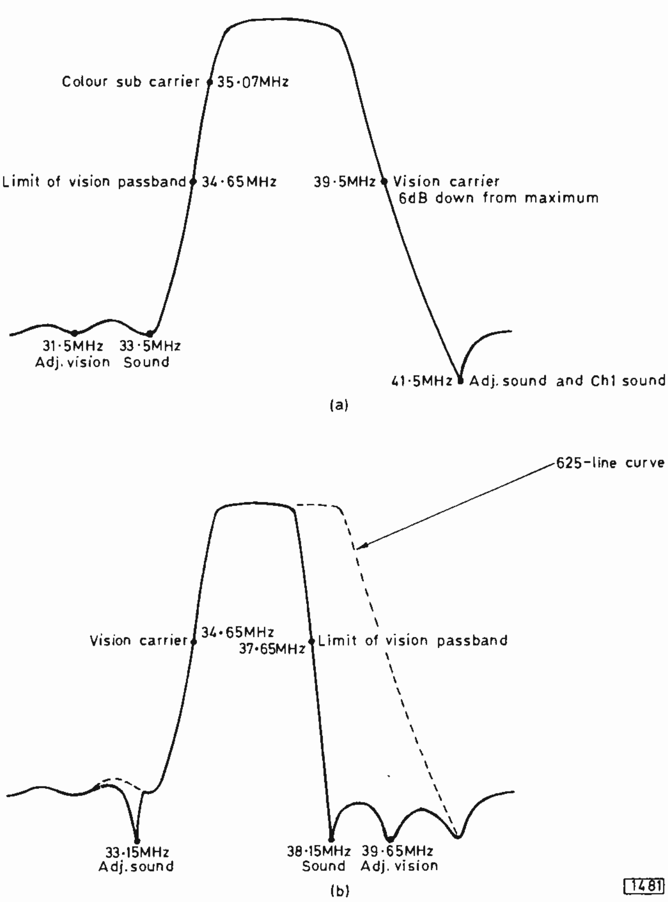


Fig. 4: Ideal i.f. response curves, (a) 625-line system, (b) 405-line system.

Two other "markers" are shown in Fig. 4(a), and although they are sitting in typical positions their precise location varies with the set and its designer's whim. The colour subcarrier comes at 35·07MHz (39·5–4·43MHz) and there is a "bandwidth" marker at 34·65MHz. If this particular frequency rings a bell, it is the invariable choice of vision i.f. for 405 lines and is also a convenient indication of satisfactory bandwidth at 625 lines.

Conditions on 405 Lines

Before looking at Fig. 4(b) go back to the lower half of Fig. 3 where the 405-line transmitter spacings have been set out on the same scale as our channel 33 example above. Note the differences: sound is 3·5MHz *below* vision, the channels are 5MHz apart, with 1·5MHz between the vision and adjacent channel sound carriers, and the slope of the vestigal sideband is 0·7MHz either side of the carrier instead of 1·25MHz. Two other differences also affect the alignment. First the sound is amplitude modulated (a.m.) so we cannot use the intercarrier sound technique. This obliges us to use the full 38·15MHz sound i.f. and hope that the tuner doesn't drift. Secondly the vision is positively modulated, so the sound/vision ratio will vary with picture content.

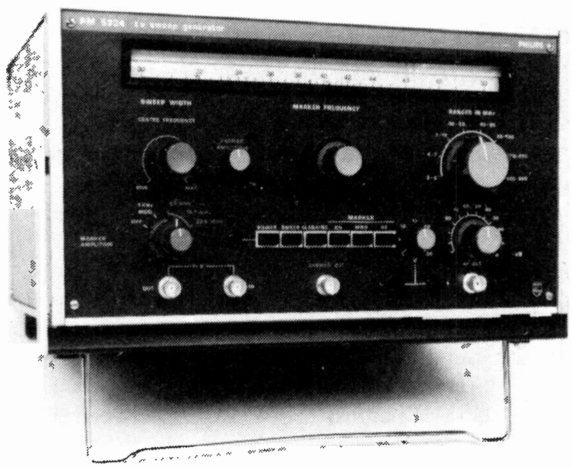
Because the sound and vision signals change over places in the mixing process in the tuner, the i.f. response curve is the reverse of that on 625. We have shown it tucked into the 625 curve (dotted). With the vision carrier at 34·65MHz – 6dB down – at the left-hand side, the sound carrier is therefore $34·65 + 3·5 = 38·15$MHz while the vision carrier of the next channel down is another 1·5MHz on at 39·65MHz. The other possible source of interference, the next sound channel up, is at 1·5MHz below vision i.f., i.e. 33·15MHz. So traps are fitted at 33·15, 38·15, and 39·65MHz and you will note that the sound trap at 38·15MHz is as deep as the rest, for we no longer require any sound left at the vision detector to provide the inter-carrier signal. 40dB or more rejection is in fact needed for sure-fire killing of all sound-on-vision.

We deliberately ghosted in the 625 curve as most old sets are dual-standard ones. As Vivian Capel described in the April 1972 issue, most 405 only sets can be aligned by eye. Notice how the 625 response takes up the 405 shape by simply switching in three extra traps. Notice too that the 33·5MHz 625 sound trap (the one that gave the shelf at 26dB) has been left in. This is common practice since with a vestigal sideband roll-off of only 0·7MHz below the vision carrier the transmitted signal ends at $34·65 - 0·7 = 33·95$MHz, almost half a megacycle in front of the trap which therefore will not influence the curve shape much. This is why dual-standard sets must be aligned by the book: adjustments made on one system are bound to affect the other.

Intercarrier Sound

Why do we use the intercarrier sound system on 625 lines? Imagine that we didn't and that the set had a true 33·5MHz sound i.f. strip. This could be done just as easily. The i.f. strip would be sharply tuned, with a bandwidth of 100kHz at the most.

Unfortunately however most tuners used on u.h.f. drift much more than this during the first half hour of use, while most of the push-button mechanisms do not have a reset accuracy anything like as good. So if you turned the set on for the news you would have to get up to it again before the weather forecast. To avoid this we take advantage of the



The Philips PM5334 television sweep generator.

two – vision and sound – crystal controlled transmitters which, give or take a co-channel offset, are exactly 6MHz apart. The signals will stay that way right through the receiver regardless of the detuning the mechanism produces. It makes sense therefore to pick off this 6MHz beat at the vision detector and to amplify it further as the sound i.f. With it goes an awful vision buzz, but because this is a.m. while the sound is f.m. the limiting action of whatever type of discriminator you use will kill it off – provided you have kept the signal ratios right at the beginning. The 405-line a.m. sound, usually amplified at 38·15MHz, would drift just as badly if it were on u.h.f.: but it isn't, so the need does not arise.

Continental Conditions

Not having a pre-war 405-system to tie them down to channel 1 most Europeans use 625 lines on v.h.f., as well as u.h.f. The channel spacing is 7MHz on v.h.f. and 8MHz on u.h.f. where the channel allocations are just like ours. Their sound is 5·5MHz from vision, however, which accounts for the buzzing we get on foggy nights, and the vision i.f. carrier is usually 38·9MHz. This makes the rest of the i.f.s: vision carrier 38·9MHz; sound carrier 33·4MHz; colour sub-carrier 34·47MHz; adjacent sound 40·4MHz v.h.f., 41·4MHz u.h.f.; adjacent vision 31·9MHz. Notice that they are not tied like we are to 41·5MHz.

Frequently imported sets arrive aligned to these frequencies, and in a minimum-effort exercise the importers simply adjust the 5·5MHz sound to 6MHz and leave the rest untouched. This can give rise to patterning or interference in some areas.

So much for basic theory. Let's move towards the practical side of things by next taking a look at the types of circuit used to provide the required receiver response.

Tuned Circuits

The five basic types of tuned circuit are shown in Fig. 5. It's sometimes a job to recognise them as such however due to the way in which they are drawn in circuit diagrams. When trying to understand a circuit, first attempt to subdivide the tuned circuits into signal circuits and traps. The former enable the wanted frequencies to pass from one stage to the next, whilst the latter reject unwanted sections of the frequency spectrum.

Taking these circuits in order, the basic *simple tuned circuit* is a single coil which is normally adjustable by means of a threaded iron dust core inside the coil former. This tunes the coil in conjunction with a series or parallel capacitor. If this is not immediately obvious from the circuit you can safely assume that the designer is using the self-capacitance of the coil, its capacitance to the associated screening can or the coupling capacitor to the next stage to do the tuning. The gain and bandwidth of the circuit depend upon its Q, or magnification. The higher the Q the greater the gain but the narrower the bandwidth. Frequently circuit damping is used to broaden the bandwidth by lowering the Q. This can be done by adding a parallel damping resistor, by using thinner wire, smaller cores, a screening can, or by having a high L to C ratio.

To broaden the bandwidth without losing gain a pair of high Q coils, both tuned to the same frequency, can be mounted close together so that they affect each other. This coupling combines the response curves of the pair to give a single response curve with two humps and a trough at the centre frequency. The ideal flat topped bandpass response can be nearly attained by carefully varying the coupling in design. In some cases this becomes an alignment adjustment.

Various forms of bandpass coupling can be encountered. There is mutual coupling by coil proximity (ask your Dad!). Mutual coupling by a ferrite or dust core – probably swivellable. Top capacitance coupling – see Fig. 5(b). Bottom capacitance coupling – the coaxial lead connecting tuner output to the i.f. deck for example. And bottom inductive coupling – a small winding common to both coils.

The test for a true bandpass design is to pass a signal through at centre frequency, damp the secondary heavily and tune the primary for maximum. Then transfer the damping to the primary and tune the secondary for maximum. When the damping is removed the response

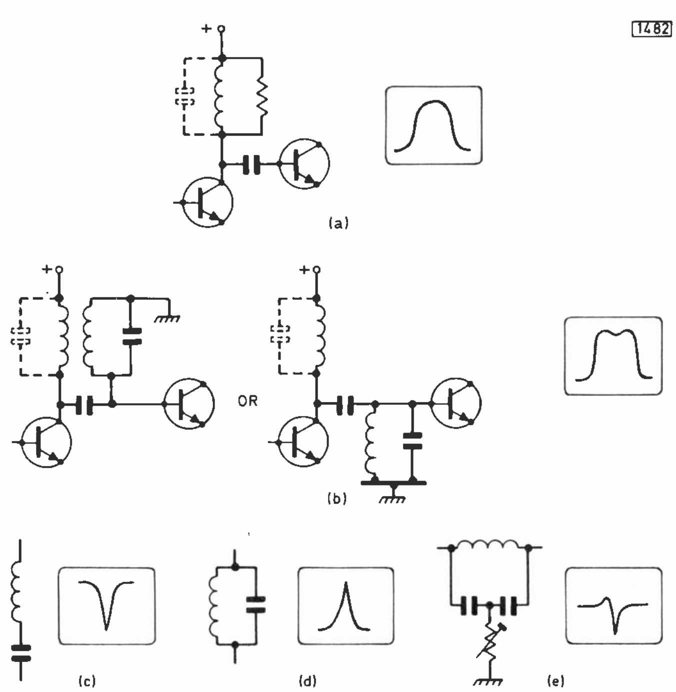


Fig. 5: Types of tuned circuit and their effects on the i.f. response. (a) Simple flatly-tuned resonant circuit – used for example to drive the detector. (b) Bandpass tuned circuit, drawn in two conventional ways. Used for example as the middle i.f. stage. (c) Series rejector – for example the 33·5MHz sound trap. (d) Parallel rejector – used as a 6MHz intercarrier sound rejector/take-off point for example. (e) Bridged T trap – 41·5MHz rejector for example.

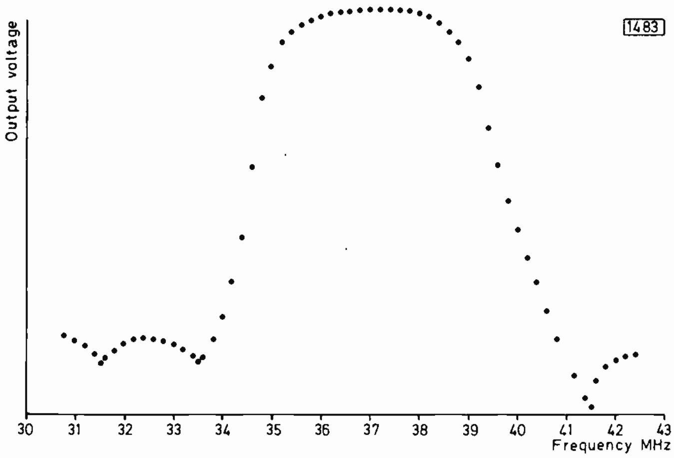


Fig. 6: Plotting a response curve using a simple signal generator and output meter. If the output voltage is plotted against the input frequency from the generator, say every 200kHz, a response curve can be drawn as shown above.

curve should lie symmetrically around the centre frequency.

Series rejectors are a means of removing an undesired spot frequency, such as own or adjacent sound channels. They work by presenting a dead short at the required frequency. The Q of the circuit determines the depth of the rejection and is fixed in design by adjustment of the L/C ratio of the components.

Parallel rejectors work the opposite way, showing a high impedance at the chosen frequency. They are usually found in emitter or cathode circuits when heavy negative feedback at a particular frequency is required.

When a very deep rejection is needed a bridged T trap – see Fig. 5(e) – is used. This takes the form of a balanced bridge. Adjusting the coil determines the frequency while adjusting the resistive leg determines the Q or trap depth. Suckouts of the order of 60dB can be obtained in this way, but not without modifying the overall response shape – the high Q produces a pop-up on one side of the trap. This will steepen the side of a response curve or make it necessary to provide further trapping.

There are other means of shaping the response – usually not self-evident by looking at the circuit – but once a panel has been checked on a sweep generator their purpose is made clear. This is all the more reason for us to press on to the more practical aspects of alignment.

Signal Generator Alignment

Time was when alignment was universally carried out with a signal generator and an output meter. Although sweep generators and oscilloscope displays have ousted the other two in common use, they nevertheless remain the tools of the basic alignment method as well as providing a check upon your sweep gear.

In the signal generator and output meter method (Fig. 6) an output meter (such as an Avometer) is connected across the vision detector load resistor, set to read about 2-3V d.c. The set's a.g.c. is immobilised by a fixed bias supply or battery, and the signal generator is applied sequentially across the inputs to the i.f. stages, starting at the back end and working forward to the tuner. The tuned circuits are adjusted appropriately as you proceed – rejectors for minimum reading, signal circuits for maximum. When complete, the response curve can be plotted as a graph – as in Fig. 6 – by reading off the output throughout the passband at every 0·25MHz say. This is a laborious method, and it does not permit you to see what effect any one adjustment has on the coils that have been aligned so far. The curve plotted should however agree with the trace of the same set as seen on a sweep generator. This gives a useful check on the test gear.

Sweep Generator Alignment

Although used exclusively in set manufacture the sweep generator (wobbulator) and display ('scope) method of alignment is viewed by most service engineers with some trepidation. And justifiably so, as it is often possible to produce any curve shape you wish merely by altering the test rig and leaving the set alone.

The sweep generator replaces the signal generator used in the previous method while the display oscilloscope replaces the meter across the vision detector load. By applying the oscilloscope's X sweep voltage to some device inside the sweep generator, such as a varicap diode, the frequency of the sweep generator's output can be varied right through the i.f. passband in perfect step with the horizontal scan of the oscilloscope. If the sweep generator's output voltage is maintained constant regardless of frequency, then any variation in the receiver's output will be due to changes of i.f. gain with frequency. Thus the display will plot continuously the graph shown in Fig. 6 as the familiar response curve. To be able to see the entire vision i.f. response at once makes alignment more accurate and simple.

A snag for retailers and field engineers is that for every different make of set the manufacturer's own favourite brand of testgear will be specified. Don't let this put you off however, because once you have set up your own test rack it will tell you all you want to know about anybody's i.f. strip without much additional effort. The only variables you will encounter will be the probes for injecting and extracting the signals, the bias arrangements, and the damping resistors. Happily these seem to get handed down from one generation to the next.

Sweep Speed

Too high a sweep speed will distort the trace at just about every stage in the hook-up – the varicap may not be able to follow the voltage change from the 'scope, the set may intermodulate, and the time-constants in the detector and the probes could smooth out or phase shift the result. Conversely, too slow a sweep rate produces a flicker or even makes only part of the trace visible, it enhances noise, and it reproduces spurious signals. A good compromise is 50Hz, and there is no reason why the mains should not be utilised via a transformer to feed a sweep voltage to the wobbulator and give the 'scope its X scan at the same time.

Markers

There was a time when an error of 500kHz would not matter all that much. Not so today. As we saw earlier, the 6MHz difference between the vision and sound transmitter outputs is used to give us our sound i.f., while it is important to sit the adjacent sound trap at 41·5MHz in areas still getting channel 1. We also noticed how important it is to sit vision carrier exactly 6dB down from peak, and to shape the other side of the curve correctly to avoid intercarrier buzz and sound-chroma beats.

We didn't get round to mentioning automatic tuning control (a.f.c.), so we had better do so now. By detuning the early u.h.f. monochrome sets you used to be able to take up a vast number of alignment errors. This is not possible with colour sets, and if there is a.f.c. it will bring your aligned strip right back to the way you have mistuned it once the user has let go of the tuning button. Accurate markers then are a *must*.

Consider buying a couple a crystals and making them up into simple one-transistor oscillators in order to set up the sweep markers accurately. The two most useful are a third overtone 39·5MHz (basic 13·166MHz) and a 6MHz crystal for exact sound spacing. The harmonics of this will also give you checkpoints along the i.f. spectrum at 30MHz 36MHz and 42MHz.

You can introduce markers on to the display in many ways. The simplest is to add a little of the crystal generator output or signal generator output to the input together with the sweep. This has the disadvantage of raising the baseline of the trace – see Fig. 7 (a) – due to a d.c. voltage which is proportionate to the beat amplitude being produced at detection – a plain sweep produces very little d.c. at the detector. For the same reason this kind of marker will almost disappear in a trap, making the trap difficult to set with any precision.

More sophisticated sweep generators include marker amplifiers to produce pulses which can be applied to the 'scope's Z input to give the display a bright-up or gap depending on the pulse polarity. Such "bright-up" markers are the easiest to work with. Another type of marker, the "birdy bypass", produces a birdy at an external socket for adding to the display input after detection. This removes the disadvantages of the simple "birdy" mentioned above, keeping the baseline steady.

Bias Supplies

Sweep alignment requires that the a.g.c. line is clamped to a fixed bias. Otherwise the a.g.c. will fight the sweep generator and try to straighten out the response. It cannot win, due to the small amount of d.c. we have just said is present at detection from a sweep signal. Alignment is normally carried out at about the level required to transfer the a.g.c. to the tuner ("crossover") about which more anon. Trying to align at maximum gain makes for a noisy trace with much instability.

The majority of bias needs can be met by using a 1·5V or 4·5V battery with a potentiometer across it. If a small variable power supply, 0-20V positive or negative, is available however this is better. Often you can use a transistorised i.f. strip's own l.t. supply by clipping a 5kΩ potentiometer from l.t. to chassis. Observe the polarity demanded by the design of the set, and take care with transistor strips using forward a.g.c. – as most do. These give the required trace size with two settings of the potentiometer, one when forward bias is applied and the other with reverse bias. You will never get the strip to align if you are on the wrong one.

Sweep Generators

The number of readers with access to a Polyskop can probably be counted on the fingers of one foot. In fact carefully disguised enquiry puts the number of workshops with any sort of sweep generator as "small", and those that use the thing regularly as "smaller still". Apart from the very expensive instruments made for the manufacturing side of the industry, the selection of generators available is virtually non-existent. Some of you may still have a Telecheck from the old 405 days. These will still function on 625 if you recall that the i.f. band covers the same group of frequencies but reversed.

Philips have introduced their PM5334 into this gap in the market. For about the price of their colour bar generator it covers 3MHz to 860MHz in eight bands and has three fixed and one variable marker — the latter can be modulated and its output made available separately for use as a signal generator as well. Also included is a floating bias supply, 0-30V at 50mA, hefty enough for use on radio repair work as well.

At the lower price end of the scale there are various kits. Even less expensive but not too accurate is the adaptation used by the writer of an unrequired pattern generator which tuned down to channel 1. The pattern was discarded,

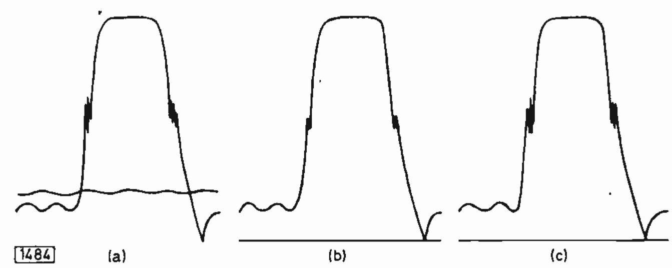


Fig. 7: Different types of sweep marker. (a) Birdy markers – note the rise in the base line, proportional to the marker's amplitude. (b) Bright-up markers, using the 'scope's Z modulation input. (c) Birdy bypass markers.

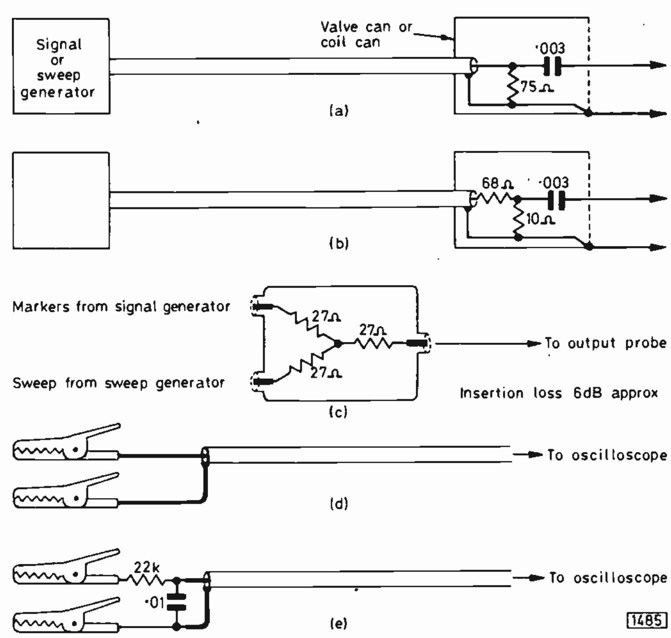


Fig. 8: General purpose probe details. (a) Simple probe suitable for most valve stages. (b) Divide by eight probe to present the low impedance often required when working on transistor circuits: 800µV from the signal generator yields 100µV at the probe end. (c) Mixer unit to enable markers to be added without upsetting the impedance of either feed. (d) Simple take-off probe. (e) Take-off probe with filter to remove spurious beats.

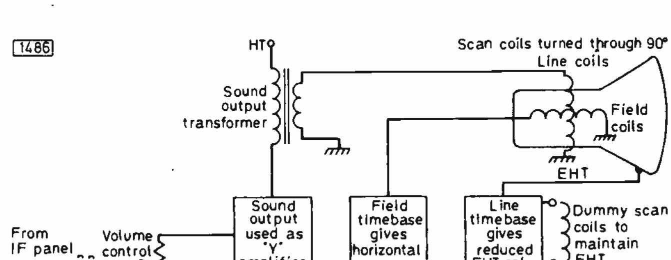


Fig. 9: Simple display made from an old 405-line receiver – see text for further details.

making the output c.w., and a primitive varicap diode consisting of a doctored loudspeaker with metal foil across the centre gauze dust filter was fitted across the r.f. oscillator tuning capacitor. A variable 50Hz supply from a 6·3V heater transformer vibrates the speech coil, with the result that the bit of foil and the speaker body become a variable capacitor at mains rate. This modulates the "signal generator" at mains rate, sweeping it through the i.f. band, whilst the full 6·3V drives the scope X amplifier in step. For the experimenter willing to try it this will give acceptable results on sets of some age, but we would hesitate to approve its use for colour. Nevertheless it's an excellent introduction to sweep alignment and an ideal tool with which to learn the craft at minimum cost.

Signal Probes

To accommodate all the probes specified in all the manuals would take a fair sized nail in the wall. Usually however you can manage with half a dozen. You need one for valve sets, one for transistor i.f.s and two for the tuner i.f. points. Add to this list a mixing unit to add the markers. There is no special magic about probes. They exist to ensure that the sweep generator, looking out, sees 75Ω. At the same time their loading on the circuit being adjusted should not tilt the trace. For most modern transistor work a low input impedance is desirable and the ÷8 probe shown in Fig. 8 (b) is favoured.

Displays

Most oscilloscopes provide suitable displays, but the smaller the screen the harder it is to see to set traps well. Depending on the hook-up, the X deflection may need bringing out to drive the sweep generator, or switching off so that the sweep generator – or 50Hz – can drive it. If the mains is used to drive the sweep generator the flyback gets modulated as well as the forward trace, so it either needs blanking out or made "phase shiftable" so that both traces coincide. The ideal display size is 11in., and most commercial X-Y displays are this size. If you were thinking of having an attempt at the transductor sweep generator we have just described you might also be tempted to produce a display from a discarded TV set. An old 14in. set that still works is ideal. You substitute a dummy load for the line scan coils (see Fig. 9). This maintains the e.h.t. supply, at a reduced voltage. Turn the scan coils through 90° and use the field timebase to provide the horizontal scan. You can derive the sawtooth for the sweep from the field timebase or from a 50Hz heater transformer. The input from the detector of the receiver is fed to the volume control, and the output from the audio output stage is taken to the line scan coils instead of the loudspeaker. A mains isolating transformer must be included.

Display Probes

The simplest type of display probe (see Fig. 8 again) consists of a coaxial lead with crocodile clips at the receiver end. You may need a small series resistor to reduce loading effects, and possibly a 2,000pF capacitor across the coaxial lead to reduce noise and spurious signals.

These then are the tools of alignment, and before we proceed next month to their use may we utter a word of caution. Until you are thoroughly conversant with i.f.s, leave tuners severely alone.

CONTINUED NEXT MONTH

next month in

Television

● **TV PATTERN GENERATOR**

Various patterns are required for checking and setting up colour receivers. This unit provides a crosshatch pattern for convergence and linearity, an eight-step grey-scale to enable the c.r.t. drive circuits to be set up, and a blank white raster so that hum bars and other such faults can be examined. In designing the unit the two principle aims were independence and compactness. To meet the first requirement the unit contains its own sync pulse generator so that access to the receiver circuitry is not necessary. Meeting the second requirement means that the unit can be carried around conveniently without taking much space in the tool box. There are two outputs, a video one for use with CCTV equipment and a u.h.f. one for use with off-air receivers. The unit is based on the latest i.c. technology, using CMOS logic circuits.

● **SERVICING FEATURES**

The Decca Gypsy monochrome portable was first introduced in 1971. Complete circuit plus fault experiences from Barry F. Pamplin. On the colour side E. Trundle describes common faults on the ITT CVC1 and CVC2 hand-wired chassis. Plus more from Les Lawry-Johns on the Philips 320 chassis.

● **VIDEO BLACK/WHITE SLICER**

A simple video effect unit devised by A. Parr. This produces dramatic pictures which look like pen and ink drawings. The effect is achieved by slicing the video input signal so that the video output signal provided is at one of two levels only, corresponding to black and white. Can be used with the Effects Generator unit published in the April/May issues to give a form of keying.

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IC Sound Circuits for the Constructor

Luke Theodossiou

ONE of the first incursions made by i.c.s into TV sets was in the sound section. The TAA350 limiter/amplifier and TAA570 limiter/amplifier/demodulator were quickly introduced into a number of chassis to take over the intercarrier sound channel, and the circuit techniques they employed are still used in the latest intercarrier sound i.c.s. The scene then changed, as i.c.s took over in all sorts of other parts of TV chassis. This rather took the spotlight away from the sound section.

There has followed a kind of generation game, as increasingly more sophisticated families of i.c.s have been announced and have later appeared in TV chassis. At the present time a host of new i.c.s have been proposed by i.c. manufacturers for the next generation of TV chassis, and once again changes are likely in TV sound circuitry. There are two main developments. First a number of combined intercarrier sound/audio output i.c.s, and secondly some audio i.c.s which require an absolute minimum of peripheral components. The purpose of this article is to introduce these new devices to readers in a more tangible form than by merely showing circuits and block diagrams. In fact the author picked two i.c.s, one of either variety, from the selection at present being offered by the i.c. manufacturers and tried them out practically. The main criteria for the choices were that the devices selected should be readily available from retail outlets – something which is not always the case with the very latest components that have yet to be adopted in current production chassis – and that the external circuitry should be as simple as possible. There is no inherent reason for the latter point except that it does enable a more accurate assessment to be made of the way in which i.c. technology is developing for the next generation of receivers.

One other point that concerned us was the obsolescence of the GE PA263 audio i.c. which is now no longer obtainable. This i.c. was used for the audio section of the *Television* colour receiver and has been used in one or two imported sets, for example the Philco Tommy monochrome portable. Some readers may therefore find that they need a modern replacement which has similar operating conditions.

Complete sound channel

The first circuit to be described is a complete sound channel using the National Semiconductor LM1808. This is an 18-pin d.i.l. device which performs the functions of i.f. amplifier and limiter, detector, d.c. volume control, and audio power amplifier. No external heatsinking is necessary if the heatsink pins on the i.c. are soldered to a sufficiently large area of the copper on the p.c.b. When used with a 24V supply and a 16Ω load it provides about 2W output. The power amplifier is both thermally and short-circuit protected. This device is a combination of the LM3065 sound i.f./dectector i.c. (with an improved volume control circuit) and the LM380 audio power amplifier.

As the circuit (Fig. 1) shows, there are very few peripheral components. The input can be taken from any

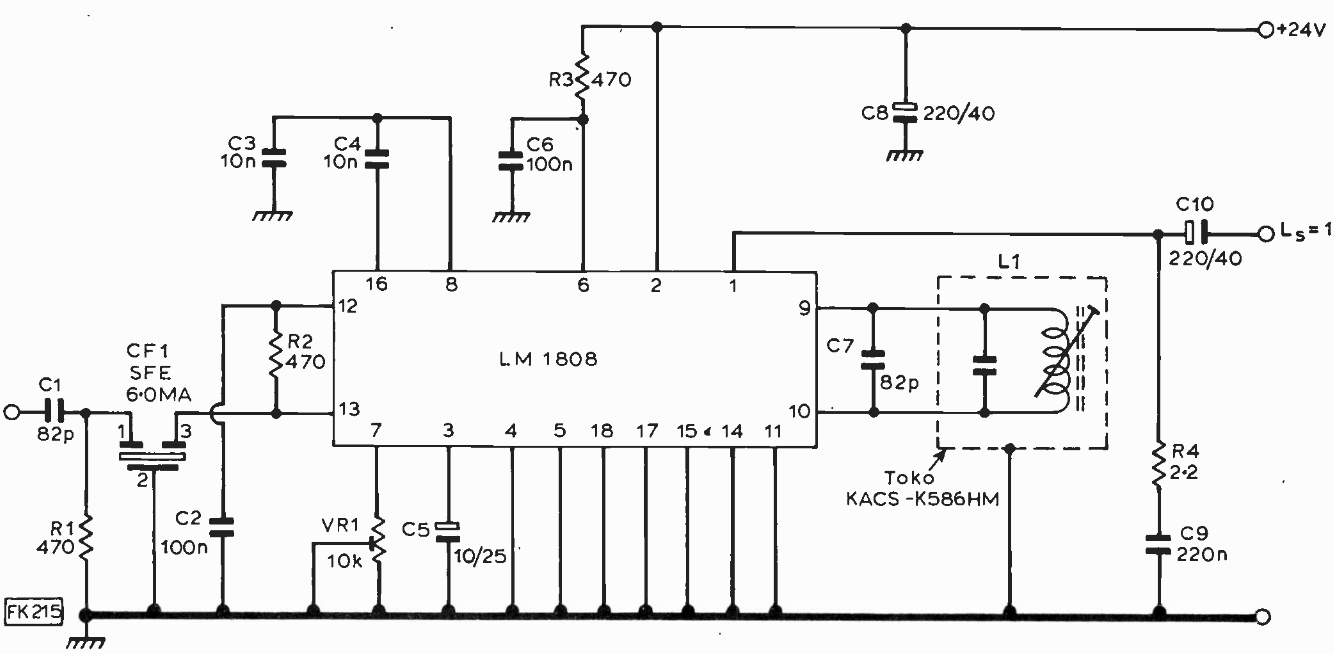


Fig. 1. Circuit diagram of the sound channel unit. See text and Fig. 3 for matching the ceramic filter to the source impedance of the signal input circuit. Since L1 was designed for use at 10·7MHz, C7 is added across it to bring the resonant frequency down to 6MHz.

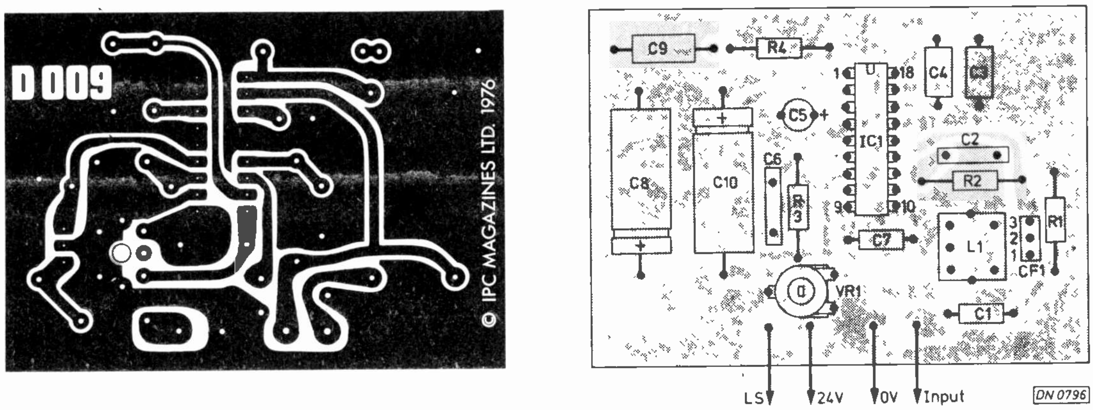


Fig. 2. P.c.b. details and component location diagram for the complete sound channel using the LM1808 i.c. The i.c. may be obtained from D.T.V. Group Ltd, 126 Hamilton Road, London SE27 9SG. The ceramic filter and Toko coil are stocked by Ambit International, 37 High Street, Brentwood, Essex CM14 4RH.

point after the vision detector in the TV set, but because a ceramic filter is in this case used to extract the 6MHz signal this must be fed from the correct impedance – 470Ω. Fig. 3 shows the various arrangements possible to give correct matching. The 6MHz signal enters the i.c. at pin 13. R2 serves to bias pin 13 from pin 12 and also to match the output of the ceramic filter. The detected audio signal appears at pin 8 and may be taken from this pin to an external amplifier. De-emphasis is applied by the 10nF (C3) capacitor and the signal is then capacitively coupled (C4) to the power amplifier section whose input is at pin 16. A potentiometer connected between pin 7 and chassis varies the d.c. level at this pin and therefore the degree of attenuation of the signal. Note that as it is a d.c. volume control the potentiometer can be situated some distance away from the board without the necessity of using screened cable.

The quadrature coil used in the prototype was a Toko unit designed for 10·7MHz operation. So a shunt capacitor (82pF) was used to reduce the frequency. There is no reason why the individual constructor can't wind his own coil, or use a spare part from practically any set which uses an i.c. quadrature detector circuit.

The output is taken from pin 1 through the d.c. blocking capacitor C10 to the loudspeaker. The Zobel network comprising the 2·2Ω resistor R4 and the 220nF capacitor C9 in series is present to ensure stability, particularly with a reactive load such as a loudspeaker.

Construction of the unit is very straightforward and should present no difficulties to the experienced constructor.

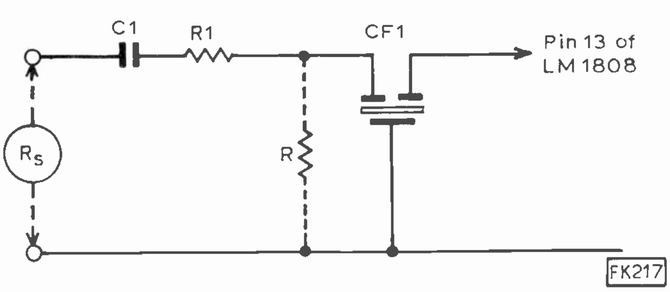


Fig. 3. For correct operation the ceramic filter CF1 should see an impedance of 470Ω. Where the source impedance Rs is high, a 470Ω resistor in position R will give this condition. Where the source impedance is between 470Ω and approximately 3kΩ the value of the resistor in position R will have to be adjusted so that the effective impedance seen by CF1 remains 470Ω. With a very low source impedance, i.e. Rs less than 470Ω, a series matching resistor (R1) is required, its value being adjusted so that Rs + R1 = 470Ω.

The circuit will work with a wide range of supply voltages – the upper limit is 30V but it is not recommended that the unit is operated at this voltage since there is a chance that the supply voltage may rise from its nominal value (e.g. due to mains voltage fluctuations) in which case the i.c. could be destroyed. If the supply voltage is reduced by an appreciable amount from the nominal value of 24V the

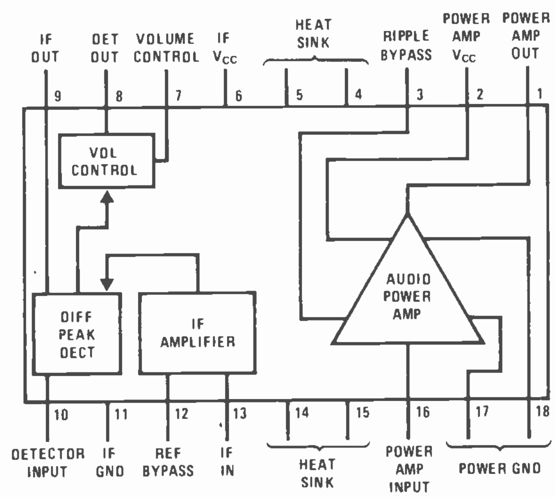


Fig. 4. Functional block diagram of the National LM 1808.

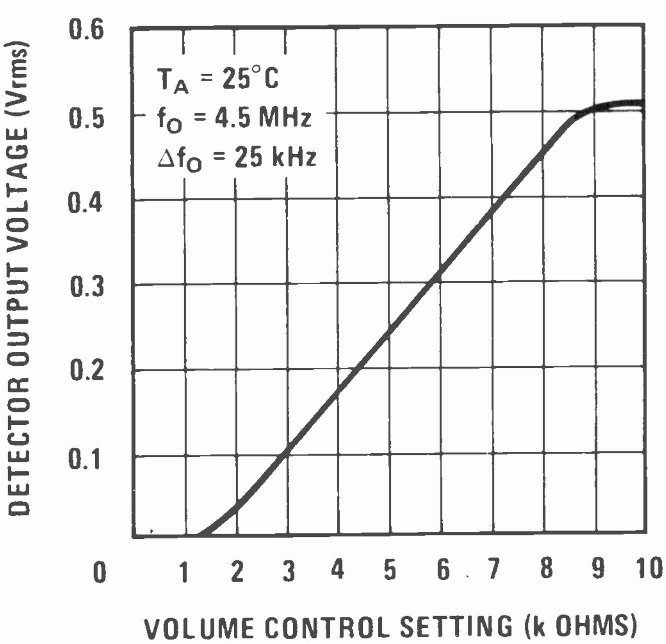


Fig. 5. Volume control characteristic of the LM 1808.

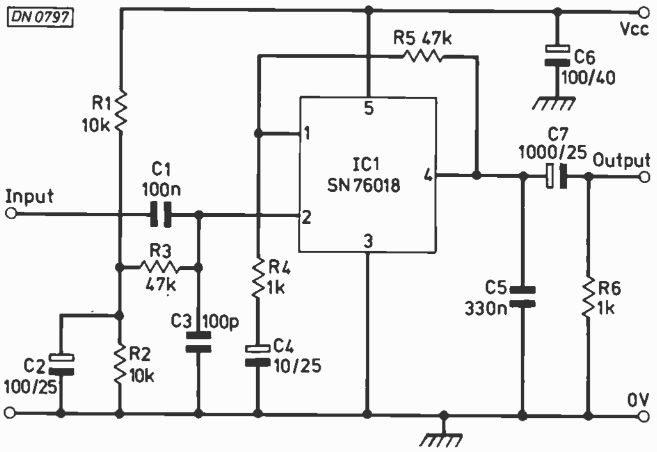


Fig. 6. Circuit diagram of the audio amplifier using the Texas Instruments SN76018 i.c. Changes in the closed loop gain may be made by adjusting the value of R4, see text for calculating the actual value.

470Ω resistor R3 feeding pin 6 will have to be reduced to allow sufficient current to flow to the internal zener diode stabiliser which feeds the i.f. and detector sections of the i.c. The stabilised voltage at pin 6 is around 11·5V.

Audio amplifier circuit

The audio amplifier circuit shown in Fig. 6 may not be the simplest seen by readers but has certain advantages over other i.c.s which have a similar function. First it features externally set closed-loop gain. This means that more external components than would otherwise be required are necessary for circuit operation but gives the advantage that the unit can be used with a variety of input signal levels. In fact with the gain set fairly high the unit can be used with a volume control as a general purpose audio amplifier. This can prove very handy in the workshop. It is worth bearing in mind however that the higher the gain the higher the distortion level, etc. In other words the amplifier's performance is directly related to the set gain.

Another advantage of this particular i.c. – the Texas Instruments SN76018 – is that it is housed in a new 5-pin plastic package rather similar to the TO220 transistor case. This leads to reduced mounting problems as compared to conventional d.i.l. i.c.s with cooling tabs – particularly when, as with this i.c., additional heatsinking is necessary. In this case a simple piece of aluminium with a single fixing hole is all that is required, although the prototype used a proprietary heatsink which offers better thermal performance and is readily available.

It is expected that Texas will use this versatile package for other i.c.s but at present only three audio i.c.s employ it. One of these has a higher output power capability and short-circuit and thermal protection. At the time of writing however the device used in this project is the only one readily available.

Once again construction is very straightfoward and provided the p.c.b. layout is faithfully followed no problems should be encountered.

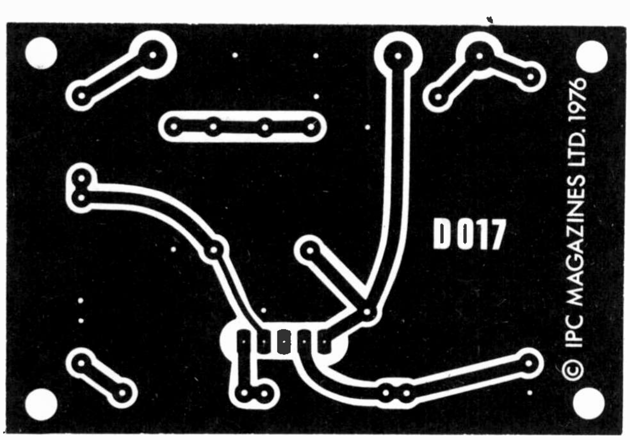
The input signal is applied to pin 2 via the coupling capacitor C1. C3 prevents instability if the source impedance is high or a long input lead is used. R1 and R2 form a potential divider which, through R3, provide pin 2 with bias at half the supply rail potential. C2 removes any supply rail ripple which may otherwise be injected at pin 2 and appear at the output. The input impedance of the amplifier is governed by the value of R3 and the input resistance of the i.c. itself. With the value given for R3 the input impedance will be in the region of 45kΩ.

The closed-loop gain is defined by R4 and R5 in the ratio $Av = (R4 + R5)/R4$. R5 is chosen to be equal to R3 so that the input bias currents of the differential input pair of transistors in the i.c. are approximately equal. C4 sets the lower frequency limit, the gain at this frequency being 3dB down when the reactance of C4 equals R4. C5 serves to ensure amplifier stability.

The output is taken from pin 4 via the output coupling capacitor C7 to the speaker. R6 is there to form a path to ground in the event of no load being connected to the output. In the absence of R6 the coupling capacitor will not be polarised; a d.c. voltage equal to that on pin 4 will thus be applied to the speaker when this is connected and could damage it.

As with the previous circuit this one will work with a wide range of supply voltages – from about 14V to 28V. The load impedance is not important except in as much as it defines the actual output power for a given supply voltage. It is not recommended that it is reduced below 8Ω however. Depending on the heatsink being used, with higher supply voltages it will be happier driving a 16Ω load because of the higher dissipation. The output power into 8Ω with a supply of 26V is 9W at 10% distortion or 7·5W at 1% distortion.

The author feels that these circuits can be put to a variety of uses, and at the very least give an indication of the way in which the latest i.c. technology is currently being applied. ■



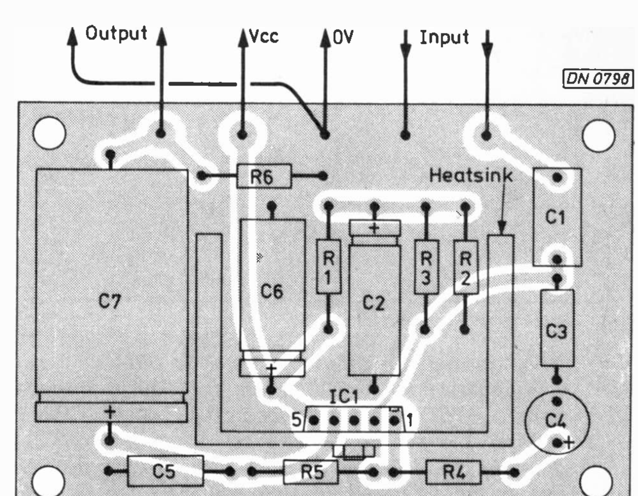


Fig. 7. P.c.b. details and component layout diagram for the audio amplifier circuit. The i.c. and heatsink (type TV35) are available from A. Marshall (London) Ltd, 42 Cricklewood Broadway, London NW2 3ET. Both this board and the p.c.b. for the sound channel circuit are available from Readers PCB Services Ltd, PO Box 11, Worksop, Notts.

MINIATURE VHF AERIALS

Pat Hawker

THE coming of u.h.f. television to the United Kingdom brought with it one significant advantage: the gradual removal (deliberate or by wind or metal fatigue) of an enormous number of long metal rods from the rooftops. The old Band I channels were in particular responsible for long, awkward and potentially dangerous structures: in comparison the Band III arrays were far more manageable. The current standard u.h.f. arrays are relatively neat and only a few people carp at their appearance. Today many of the physically largest arrays are those for v.h.f./f.m. sound radio.

Despite its susceptibility to interference due to Sporadic E propagation, ignition and electrical interference, Band I remains a useful means of reaching difficult areas. Band III is probably – at least from an area coverage viewpoint – the optimum band for domestic TV broadcasting.

Before many years, with the final ending of 405-line transmissions, there will be an opportunity to re-engineer Bands I and III, possibly for domestic TV, possibly for educational or other special purposes. Will it then be necessary to put all that metalwork back on the roofs? A Channel 1 reflector can be 3·3m (about 11ft) long: a four-element Band I array is a massive creature to erect, a constant source of worry during its lifetime and a positive danger when it comes down.

Indoor aerials

What are the alternatives? Set-top aerials may deliver enough signal but are affected by movements in the room or in the street outside. Loft aerials are often satisfactory but nearby metalwork such as water storage tanks can cause problems. Their performance may be affected by snow on the roof – and for Band I there may not be sufficient space.

Outdoor aerials

Could outdoor aerials be made smaller without seriously reducing their bandwidth, directivity and pick-up, or seriously increasing the cost? The answer increasingly would seem to be "yes", using one of several promising recent techniques, though there are still unknown economic factors. The most promising ideas seem to be ferrite loading and miniature active aerials. In addition there are ideas for providing directional characteristics with only a single element, although these may provide only low sensitivity.

Dielectric loading

If an aerial functions in a dielectric-filled atmosphere its dimensions can be scaled down by a factor depending on the relative permittivity of the dielectric. This remains true even if the aerial elements are merely coated with materials of high permittivity. For several years there has been work along these lines in both the USA and the UK, using powders such as barium-titanate or special ceramic ferrite materials. Reduction factors of up to ten have been reported. While the motivation for this research has usually been for radio communications, particularly military communications, it has been recognised by several firms that the technique may have application in the future to TV reception. It would be particularly suitable as a means of reducing the length of Band I aerials.

Miniature active aerials

In the late sixties, the work of Professor Hans Meinke and Dr H. Lindenmeir of the Munich Technical High School showed how the size of TV receiving aerials could be significantly reduced by integrating active devices with compact aerial structures. A transistor for example may act not only as an amplifier, as in a masthead amplifier, but also to enable a good noise match to be achieved without frequency-dependent matching networks, so achieving bandwidths normally associated only with full-size structures.

Amplifier problems

Considerable care is needed in the selection of the active device and the design of the matching amplifier to ensure that the system is not vulnerable to cross-modulation in the presence of strong local signals or signals on frequencies which may be remote from that of the required channel.

At Montreux in 1969 a number of miniature active TV receiving aerials were described, including a Band I active dipole only 30cm high with a top capacitance plate 30cm in diameter. Although the dipole element can be reduced in size, the spacing between elements in Yagi-type arrays

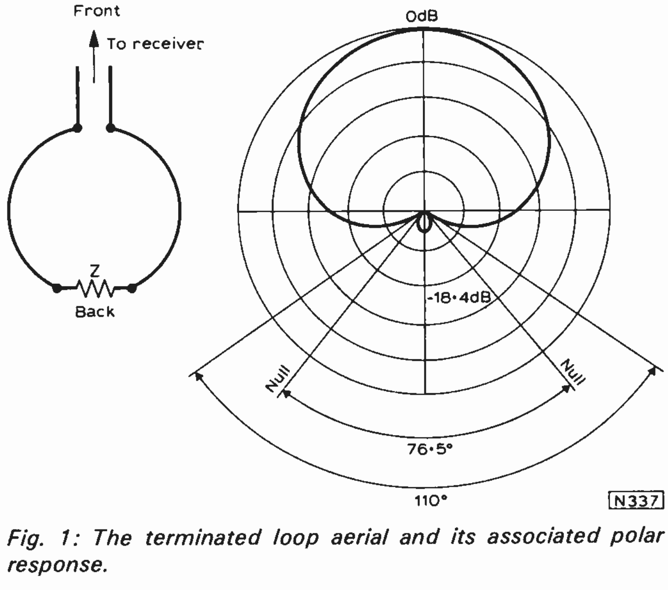


Fig. 1: The terminated loop aerial and its associated polar response.

RCA "Mini-state" Aerial

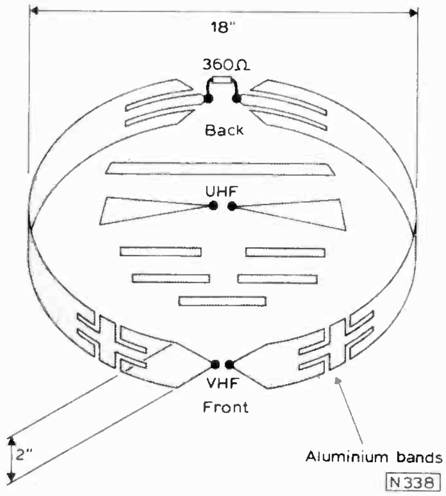


Fig. 2: Basic elements of the aerial system.

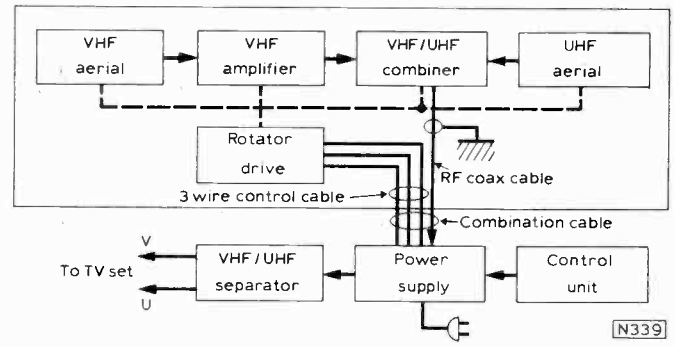


Fig. 3: Block diagram of the system.

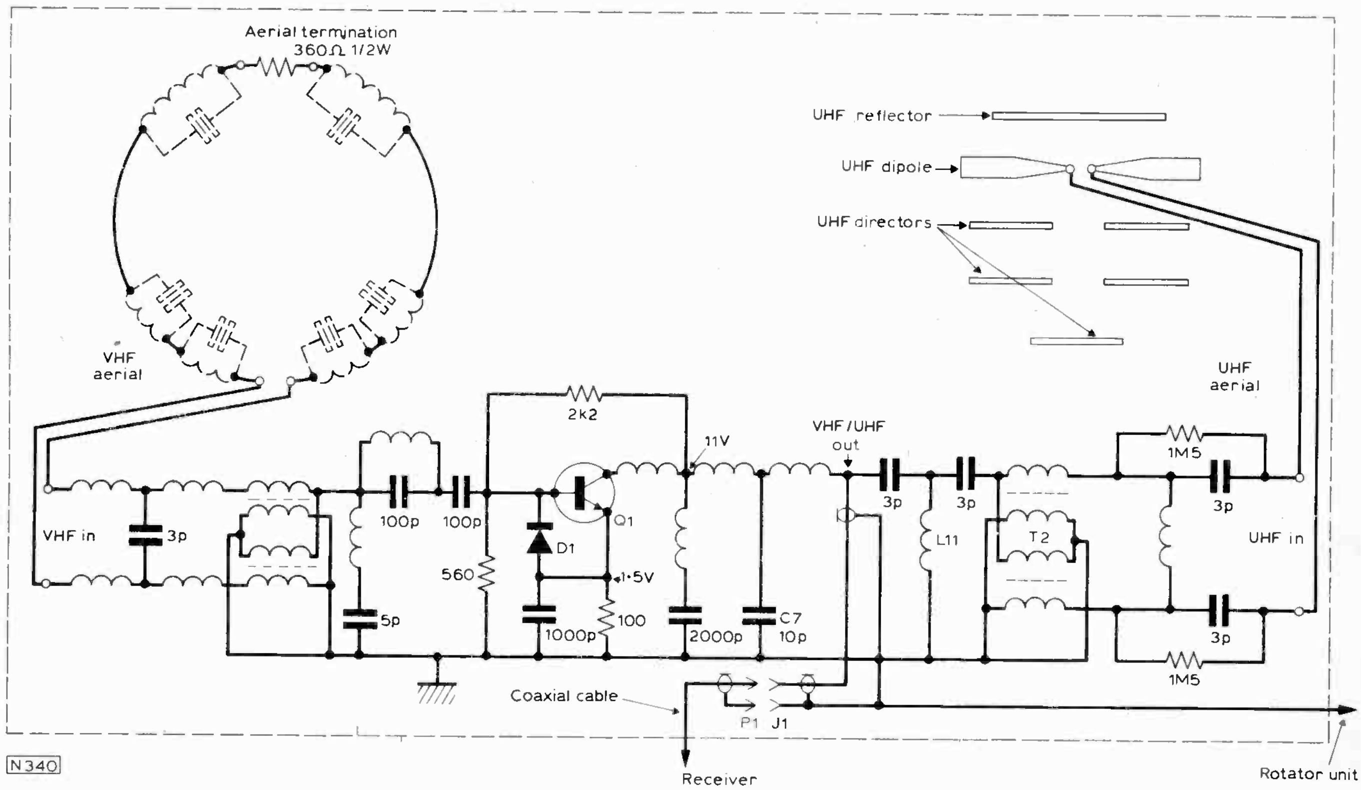


Fig. 4: Circuit diagram of the aerials and associated amplifier and matching system.

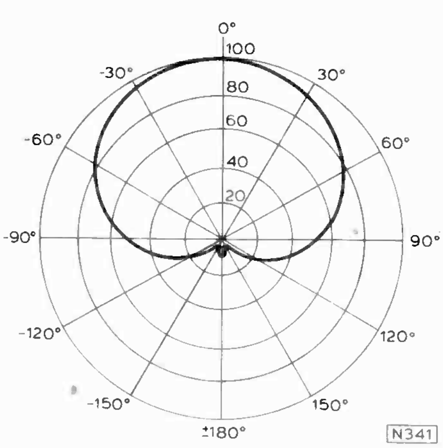


Fig. 5: Typical Band I response.

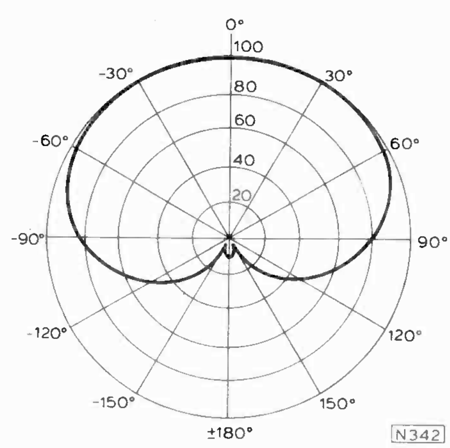


Fig. 6: Typical Band III response.

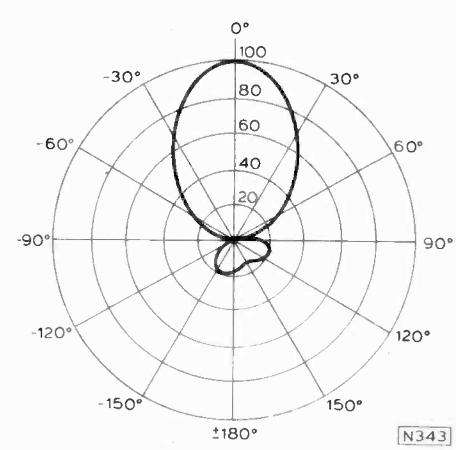


Fig. 7: Typical u.h.f. response.

cannot be similarly "miniaturised" and the Munich active aerials have found more application in h.f. communications than for TV reception.

Terminated loop

The problem of providing directional characteristics in a single miniaturised element can be overcome by using the terminated-loop (sometimes called "a two-port loop aerial") however – see Fig. 1. This is a variation on the normal "loop" bi-directional aerial widely used in radio reception.

The terminated-loop, which was originally developed in the 1920s by H. H. Beverage, has a resistor (and reactance) opposite the feed-point, and provides a cardioid response pattern with a front-to-back ratio usually better than about 12dB. A small aperiodic loop of this type thus itself provides the directional characteristics which are desirable for TV reception, without the problem of non-miniaturised element spacing.

RCA "Mini-state" aerial

A recently developed active-aerial system by RCA, called the "Mini-state" (see Figs. 2-7), provides a horizontally-polarised system covering 54-88MHz (the USA does not use channel 1) and 174-216MHz, and incorporates a separate full-size structure for u.h.f. (470-800MHz) all within a circular protective radome 21 inches in diameter and 7 inches thick – it looks rather like a pole-mounted flying saucer. The weatherproof radome has the broadband v.h.f. aerial in the form of two semicircular aluminium bands wrapped around the outer rim of an 18-inch circular plastic foam platform. The Yagi-type u.h.f. aerial consists of a dipole, reflector and five directors which fit into recessed pockets moulded into the top surface of the foam platform. Since the u.h.f. array is completely surrounded by the v.h.f. element, special stubs, forming filters, are cut in the v.h.f. element, thus in effect providing additional u.h.f. elements without affecting the v.h.f. performance.

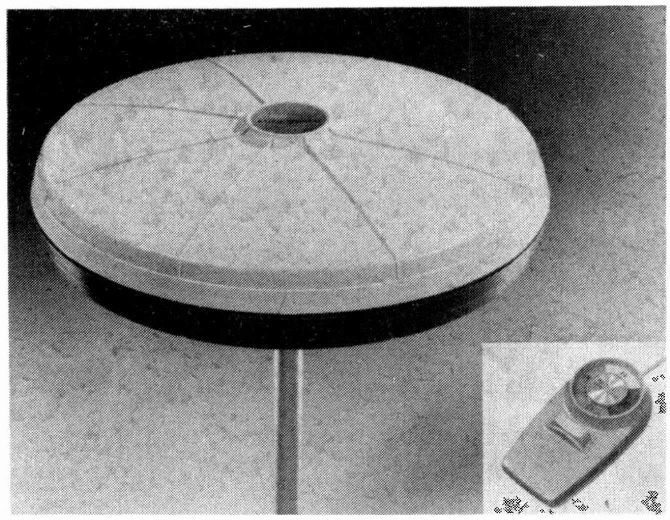
On v.h.f. the output from the loop is fed to a matching amplifier using a low-noise 2SC1424 transistor biased for the relatively high collector current of 14mA to minimise cross-modulation, at a noise figure of 3·25dB – in Band I the amplifier provides 20 to 24dB gain at a noise figure of 4·5dB. The u.h.f. signals are not passed through the amplifier. The output of the system to the 75Ω coaxial cable represents an aerial gain of 4 to 8dB with a front-to-back ratio of 19dB and a null depth of 30dB.

Aerial rotation

The system is supplied with or without remote aerial rotation facilities. The complete weight of the radome is about 5·5lb. It's claimed that the aerial is suitable for use up to 35 miles from high-power stations on v.h.f. or u.h.f. This is stated to be a conservative figure and it's said that in many areas excellent pictures are received at distances of 40 miles. This represents field strengths of around 66dB (reference 1μV) on Band I from a 100kW e.r.p. station, about 74dB on Band III (316kW) and 82dB at u.h.f. (with an American super-power 5MW station).

A particular advantage of the terminated loop is the existence in the response pattern of deep nulls which can be used to reject unwanted signals.

The RCA "Mini-state" system includes a hand-held rotary control and display unit, with the ability to "fine tune" the direction of the circular aerial structure. It's



The RCA "Mini-state" aerial system. Inset right, the hand-held remote control unit for the optional aerial rotator.

claimed to be suitable for indoor and outdoor installations in situations where a full-sized v.h.f. array would not be convenient. Steps are taken in the design to minimise the risk of cross-modulation from other TV stations or from local v.h.f./f.m. sound broadcasts.

Unidirectional dipoles

In areas close to a TV transmitter, receiving aerial directivity – to reduce or eliminate ghosting – may be significantly more important than signal pick-up. It is not unknown for a multi-element array to be used in conjunction with an attenuator. In conventional practice the way to achieve directivity is to use several elements. The result for v.h.f. is a physically large array.

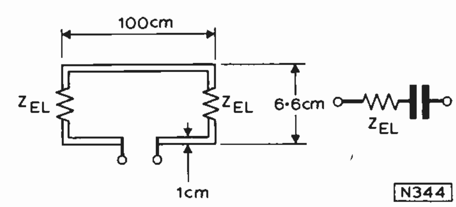


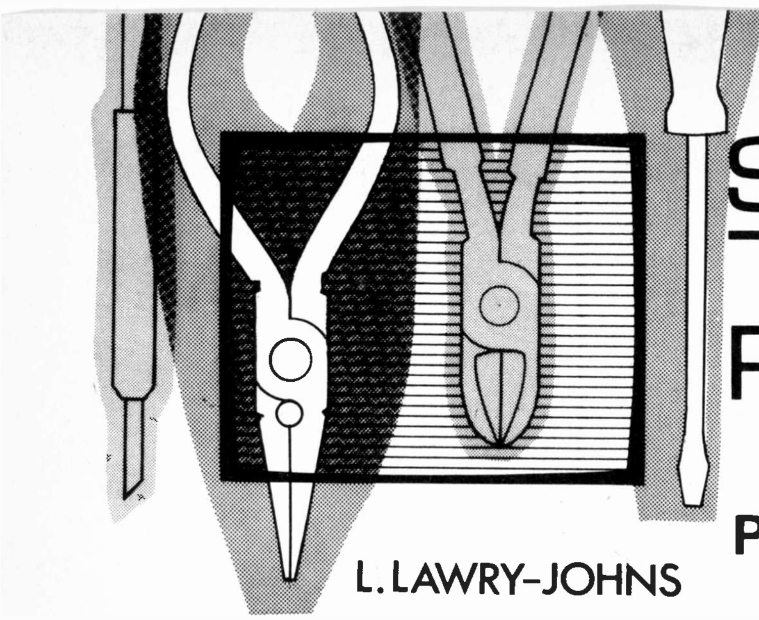
Fig. 8: Experimental miniature unidirectional dipole for Band I TV reception, developed at the Toshiba Research Centre.

A rather different concept, though related to the terminated loop, has been proposed in Japan: the unidirectional dipole (see Fig. 8).

The aerial closely resembles a shortened folded dipole, but with the connections between the ends of the two dipole sections made via impedances (for example a capacitor in series with a resistor) rather than directly. It then acts like a terminated loop or an extremely close-spaced two-element array.

Front-to-back ratios of up to 30dB have been achieved experimentally, giving a very useful degree of directivity. It should be noted however that the maximum signal output will be reduced below that of a conventional dipole, possibly by some 13dB.

This means that such aerials would not be suitable for weak signal areas. But in "noisy" urban locations the signal-to-noise ratio obtained will be higher than with a standard dipole because of the directivity. ■



SERVICING TELEVISION RECEIVERS

PHILIPS 320 CHASSIS

L. LAWRY-JOHNS

THERE are three basic models in this series, a rather pretty 17in. set, and 20in. and 24in. receivers with rather more sedate styling. Those who have frequent contact with the G8 colour chassis will find that these black and white models pose few problems. To those not acquainted with the G8 however, servicing the 320 chassis can be a bit of a headache – due to the use of several unusual design features which mean that fault-tracing techniques must depart from the well worn paths used in hybrid or valved designs. In the main the chassis is pretty reliable. Thus when faults do develop the repairer is unlikely to be able to pounce on the source of the trouble blindfolded and with one arm tied behind his back whilst at the same time filling in his football coupon, as he can with some designs, because he is unlikely to be called upon to service these sets so regularly.

It is a relief therefore when the complaint is only that the fuse went pop. Since this is the most frequent complaint we'll start at this end of the set (the mains input and power supplies) and plod on from there.

The Mains Input

From the on-off switch the mains is applied to either side of a bridge rectifier, one lead via a fuse. Note that neither side of the mains goes to chassis. This means that the chassis is always at half mains potential whichever way round the plug is wired. So point number one is that the chassis is always live when the set is working and must be respected accordingly.

The fuse is the first item to warrant attention. If it has failed, look at it. If it doesn't look distressed and is rated at 1·25A, replace it with a 1·6A one. As a matter of fact, if the fuse hasn't gone and it's a 1·25A one still replace it with a 1·6A one (so there). If the fuse is blackened, suspect the mains filter capacitor (C4622) which has a habit of shorting at odd moments though proclaiming its innocence when checked with a multimeter. It must be replaced if suspected since it serves to absorb those nasty high-voltage spikes which tend to appear on the line at odd moments and can spell disaster to solid-state devices such as thyristors, bridge rectifiers and the ordinary run of transistors etc.

Quite often however we tend to pounce on the filter capacitor and subject it to all manner of indignities (cutting off its extremities with wire cutters for example) when in fact the fault lies elsewhere. It should be abused in this way only when there is no short recorded on the meter.

In a fair number of cases it will be found that the fuse has blown because the bridge rectifier is at fault. It may be thought that there is little to say about replacing a bridge rectifier, and indeed there isn't if the exact replacement is used. In fact however there are several perfectly acceptable alternative types (Rect 65A for example) which will fit in and perform correctly.

Looking at this type of bridge, it will be seen that whereas one end is squared off the other is inclined. So if the exact replacement is used it can be fitted the same way round without looking at the polarity markings. This cannot be done with a different type however and the polarity markings must be examined to ensure it is fitted in the right way round. Ah ha! you may say, you'd soon find out if you fitted it the wrong way because it would blow the fuse. Not so, because there is no electrolytic to object to the reversed polarity.

In fact there is nowhere to go at all since the thyristor is in the way and this certainly won't conduct if the polarity of its input is wrong. Ah ha! you may say (or Ah so! if the rising sun is ascendant), the meter will soon show you what time it is. Quite so unless a gremlin has pressed the polarity button on the meter. Nobody could fall for that one, could they? . . . Oh yes they did, they did!

Now let's get back to the blown fuse. If it is not blackened but has definitely blown, again check for shorts. If none are found, check the thyristor. If this is short-circuit the h.t. will have risen to an unacceptable level and the neon 5609 will have fired to call attention to this state of affairs.

Regulated Power Supply

Let's chat for a moment about the thyristor and its attendant bits and pieces. Some readers may not be quite clear about this type of voltage regulation and how it works. Having read all about it they may still feel uncertain, possibly because of some of the terms used. In simple terms, and cutting out the niceties, we can look upon the thyristor as a gate which is opened at a particular time during the mains input waveform in order to pass current – as opposed to a diode which conducts as soon as the voltage across it rises sufficiently, passing current the whole time that the voltage across it permits this.

A thyristor can be used direct from the mains or via a rectifier, provided the rectifier's output is not smoothed. If the voltage applied to the thyristor was smoothed it would conduct whenever the gate had been opened, thus acting as a diode – whatever you did to the gate you couldn't shut it. So the input has to fall in order to shut the thing off. This of course happens if the input is not smoothed or is not rectified. Once the input falls sufficiently, the device cuts off and doesn't start conducting again until not only the input rises but the gate is also opened. Because of this characteristic we can time the thyristor's period of conduction, narrowing this to a very short burst before it's again cut off by the falling input. In this condition the output doesn't amount to very much and the h.t. is low. Opening the gate earlier results in the thyristor conducting for a longer period, allowing the h.t. to rise to the value required. Any further rise shortens the time during which the gate is open, i.e. the thyristor's conducting period, due to feedback control action. The feedback circuit monitors the input and output voltages, using the latter to move the gate opening time up or down the reverse side of the slope of the input waveform.

This is quite nice when the control circuit is working properly and the thyristor is in good condition so that it is able to respond to the control voltages.

Fault Finding

By and large the control circuit is pretty reliable and the main trouble is with the thyristor. Two types have been used, a black one coded BT100A/500R and a gray one coded BT100A/02. The black one is not as reliable as the gray one so wherever possible the latter type should be used.

If a thyristor is defective with an open-circuit internal connection it won't conduct no matter what voltage is applied to its gate. There will then be no h.t. at its cathode, i.e. at the 400μF reservoir capacitor C4625. But let's get this bit straight first. We said the reservoir capacitor (C4625) and not the smoother (C4626). Mistaking the two can be a painful experience since it's quite likely that the smoothing resistor R4644 will be found open-circuit, shutting off the h.t. but leaving C4625 fully charged and quite willing to hand out a clout before you can say May's out.

If R4644 (33Ω) is open-circuit, switch the set off and bridge a resistor across the defective one or connect it across C4625. Merely shorting the charged capacitor to chassis with a screwdriver blade is a very nasty habit indeed: life is a lot quieter if say a 33Ω resistor (almost any low value will do) is used to discharge C4625.

If there is no h.t. at either capacitor tag check back to R4639 (the 10Ω surge limiter) which could well be open-circuit. Since there is no capacitor lurking around to remain charged after switch off little more need be said on this score.

If h.t. is present at both sides of R4639 and the choke (R4635) is intact the h.t. will also be on the anode of the thyristor and if it's not present at the cathode one is immediately posed with a question: is the thyristor defective (open-circuit), or is it not being turned on at its gate?

The first check in this event should be at the junction of C5624/R5647 where 1·6V should be recorded. This should vary when the set h.t. control R5630 is adjusted. If there is no voltage here a few more checks are needed in the control circuit. Check the BC147 transistor, diode D5607, the zener diode D5603 and the s.c.s. BR101 (D5604). Philips recommend that the BA154 diodes D5607 and D5608 be changed to type BAW62 or BA318 – particularly if the h.t. rises to over 165V.

We have not met a defective BR101 yet but this is probably because we have not handled a large number of sets using it. Note that it's an s.c.s., not the diac commonly found in this position.

It may be only a coincidence but we have had two cases where the 0·22μF pulse coupling capacitor C5624 has been dry-jointed to the print. In consequence the thyristor has not been turned on although 1·6V has been present at the junction of this capacitor and R5647. This is worth bearing in mind on lots of other sets as well, since the importance of this capacitor is often overlooked.

Well now, if the control circuitry is not at fault we are left with suspicion of the thyristor and as we have already said if it's a black one change it for the gray type for better reliability.

Checking the Thyristor

It's easy to check a thyristor for functioning (to prove whether it is open-circuit or is leaky) provided one wants only a rough check and not a 100% conclusive one.

For a leakage test, remove it completely and identify the anode, cathode and gate. Switch a meter to the lowest ohms range. Apply the positive probe to the cathode and the negative one to the anode. There should be no meter reading. Briefly short the gate to the anode and a steady reading of about 20Ω should be recorded (once it's turned on it stays on). Any variation from this is an indication that the device is faulty.

If this seems a queer test from a polarity viewpoint remember that with the meter on the resistance range the positive probe applies a negative potential and that the positive potential will be applied to the anode by the negative probe. All this will be old hat to those experienced in servicing solid-state sets. There are many who are not so sure about this type of circuitry however and it is beyond doubt that the majority of the faults encountered will concern the power supplies. It is for this reason that we are dwelling a little over the details.

To continue then. A thyristor can also leak. It then behaves more like a diode, i.e. it doesn't wait for the gate pulse to turn it on. Therefore the h.t. rises. Note that in this circuit the device is preceeded by a rectifier, so leakage will not immediately blow the fuse as it would if the a.c. was applied directly to the thyristor as in some other designs.

HT Voltage

Having got the circuit functioning we must ensure the output voltage is correct. For lasting reliability it should be adjusted (R5630) to a little below 160V. The makers recommend 158V. If this results in slight lack of width, connect the link across L2442 in the line output circuit.

There are times when the h.t. voltage will be found to be no more than 90V. This happens when the line output stage is inoperative, and is a safety measure. Investigation will probably reveal that the fuse FS2618 has failed or that the thermal cut out R4465 is open (if this type of resistor is fitted – early versions did not have the thermal cut out).

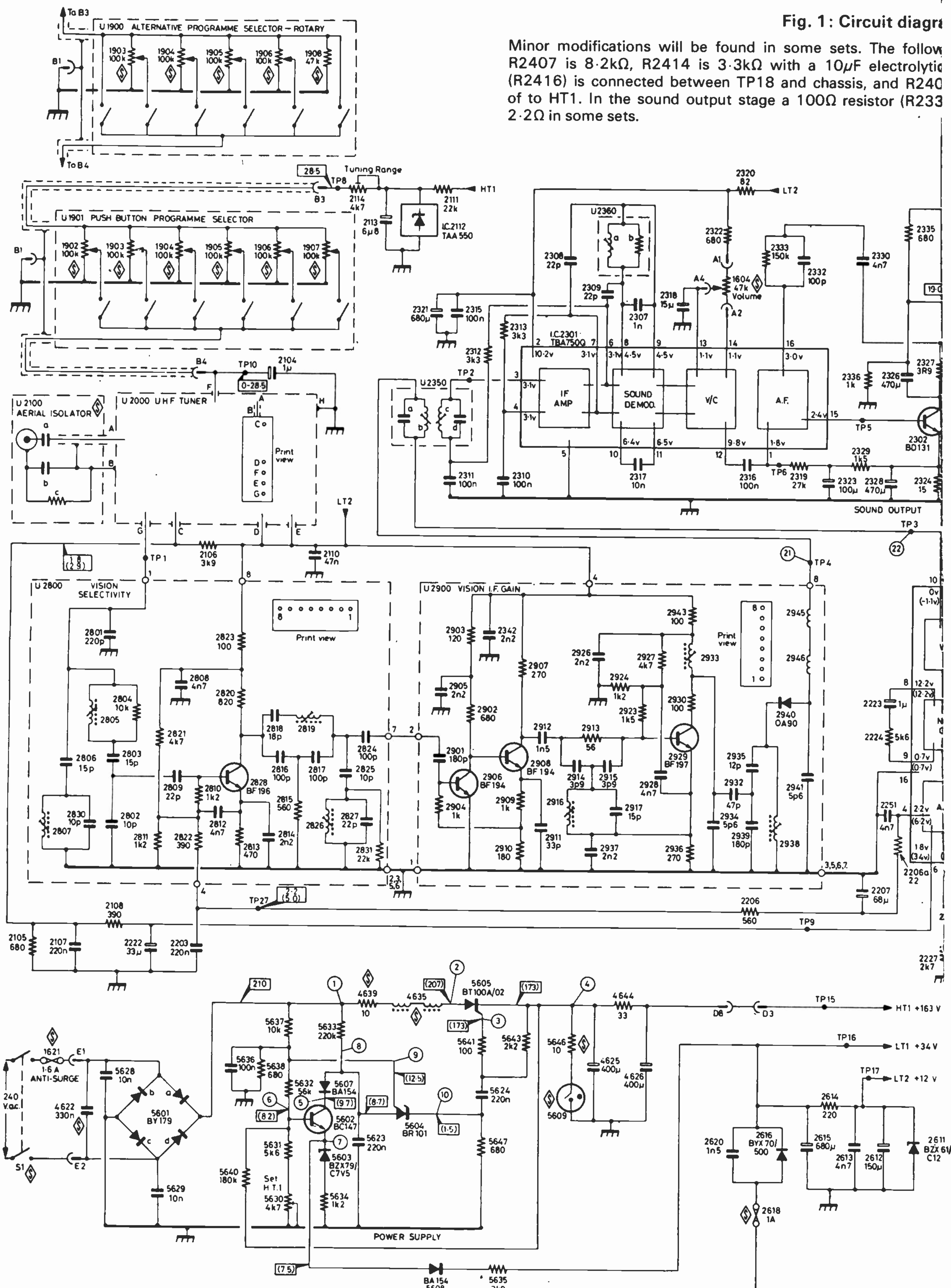
General Handling

The panel is hinged on the left and once the right side fixing screws are removed it can be swung open to enable most items to be got at. There are times when it is more convenient to turn the set on its side and carefully let the panel down, supporting it where necessary so that no strain is imposed, or to remove the panel altogether. Note that some receivers have a small subpanel with four diodes in place of the bridge rectifier. If a replacement BY179 is used, capacitors C5628 and C5629 must be fitted to the main panel. The chassis of the smaller (17in.) set is hinged at the bottom, with the two fixing screws at the top.

COMPLETE CIRCUIT OVERPAGE ➡
MORE NEXT MONTH

Fig. 1: Circuit diagra

Minor modifications will be found in some sets. The follow R2407 is 8·2kΩ, R2414 is 3·3kΩ with a 10μF electrolytic (R2416) is connected between TP18 and chassis, and R240 of to HT1. In the sound output stage a 100Ω resistor (R233 2·2Ω in some sets.

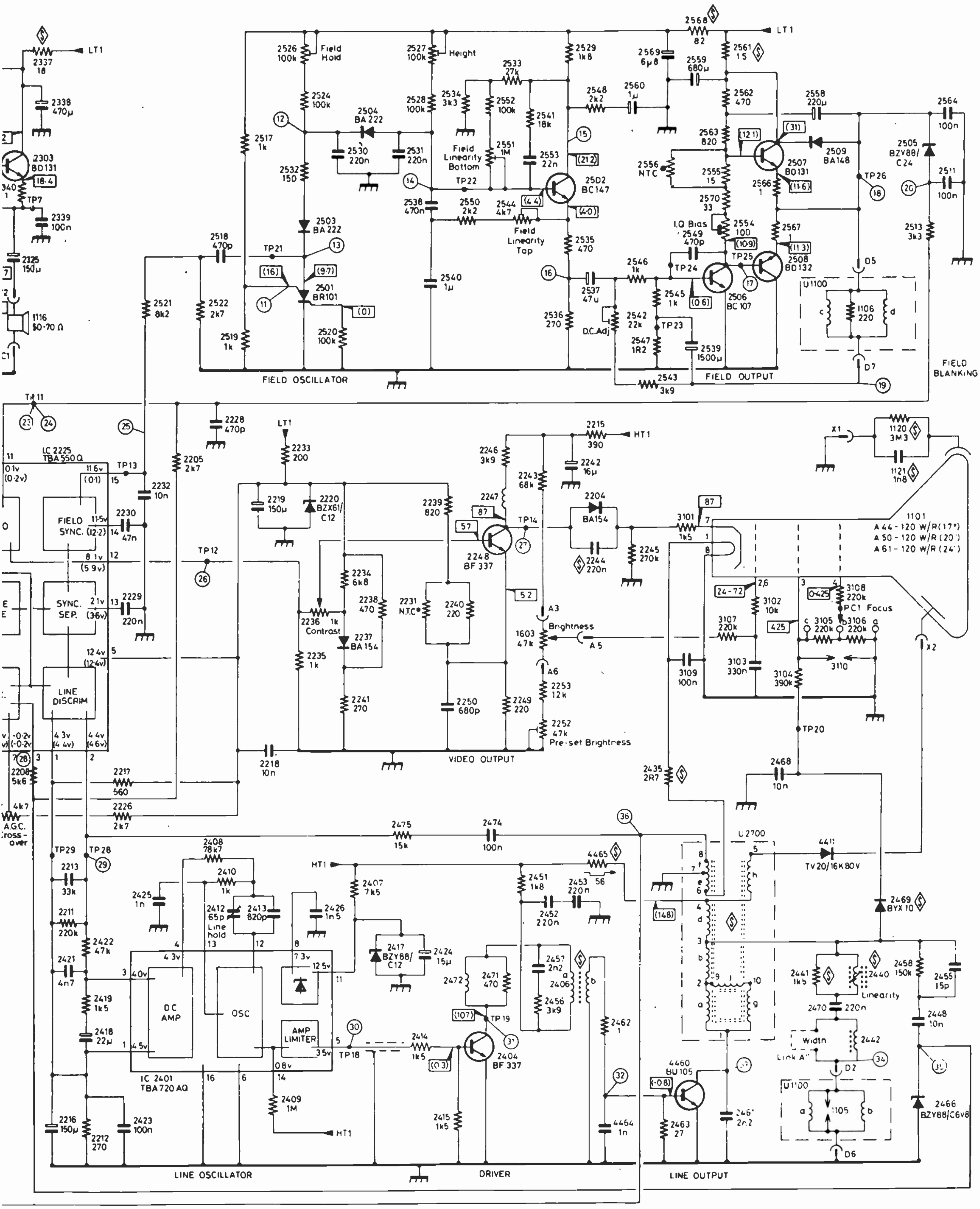


ı, Philips 320 chassis

ȷ points should be noted. Where IC2401 is type TBA720Q, apacitor (C2420) in parallel, R2415 is 1kΩ, a 10kΩ resistor is either 2·7kΩ or 3·9kΩ and is connected to chassis instead is connected in series with the base of T2303 and R2337 is

NOTES

1. Voltages and waveforms – refer to Section D, notes 11 and 12
2. (21) Denotes waveform.
3. ◊ Safety component. Refer to Section D, note I before replacing.
4. Thermal fuse



Progress with Oracle

John Hedger

THE ITV "Oracle" Teletext service, which has been running since July 1975, is provided jointly by London Weekend Television, Thames Television and ITN, under the overall control of the Independent Television Companies Association. Thames Television provides the Oracle signals for the London transmitter on weekdays, LWT taking over at the weekends. Both companies also provide an Oracle feed for the ITV network, so that the regional companies can add the Oracle Teletext service to their transmissions.

Three digital computers, one each at ITN, LWT and Thames, are used to generate the Oracle data signals. They are backed by 1·2 million word disk units and are linked together via 1200 baud PO circuits. The editors at ITN produce their own news magazine while LWT produces the general information content of the service – weather, travel, consumer news etc. The data produced by ITN and LWT is stored on the LWT and Thames computers so that it is available for transmission.

System Control

Data is fed into the computers via purpose built visual display units (VDUs) whose operators can call up any page for editing or amendment, using the comprehensive text manipulation facilities built in. One row is used to provide the operator with information about the page – whether it's on transmission, which control bits have been set and so on. In addition, the VDUs act as input/output control devices for the system. Any system faults or errors – for example faults on the interlinking data circuits or sync disturbances to the insertion equipment – are reported to the VDUs.

Special interfaces are required to insert the data from the computers on to the normal video signal. They are driven by one-second buffers which enable the computers to carry out other operations whilst a continuous stream of output data is maintained. The insertion interfaces identify the four lines during the flyback blanking intervals used for the Oracle transmissions. They operate at 6·9375MHz (444 times line frequency), the basic pulse train being provided by a digitally-phased oscillator which is locked to the incoming sync pulses. The computers continuously scan through the stored pages and feed out to the one-second buffers those pages selected for transmission by the VDU operator.

Page Access Time

The Oracle transmission cycle, i.e. the time taken to transmit the sequence of pages, is around 30-35 seconds, depending on how many pages are being transmitted. The pages are not sent out in strictly numerical fashion however, a priority system being used so that the viewer has much quicker access to pages, such as news, carrying important information. The index pages (100, 200 etc.) are transmitted out of sequence once every 50 pages during the cycle. The magazine pages are transmitted twice each complete cycle – thus access time to these pages should be half the worst case cycle time.

The quick access priority page system results in a slight increase in the access time for non-priority pages, since the total cycle time is increased. To reduce access time further, multipages (self-changing pages) are transmitted once only each cycle, so even if they are magazine pages they cannot be displayed faster than thirty seconds after selection. The sequence in which the multipages appear is fixed but the point at which the viewer starts to receive them is random – he may get page B first, followed by pages C and then A for example. For this reason information which is strictly sequential editorially is not usually assigned to multipages.

Specification Improvements

The ITV engineering and editorial teams have been experimenting with a number of improvements to the basic Teletext specification. These are shown in the accompanying photos and are as follows:

Hold: This enables horizontal transitions to be made from one colour to another in graphics displays without the normal black band caused by the space occupied by the control character for the new colour. The hold system instructs the decoder to repeat the previous graphic character in the new colour control character space, giving uninterrupted colour changes.

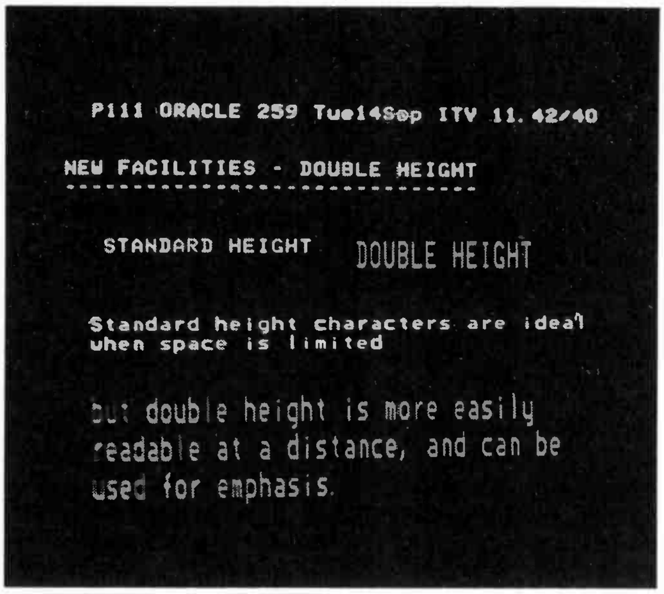
Double height: Rows of characters can be displayed at twice the normal character height – but with the normal width. This could be of great help in subtitling television programmes, since the double-height characters can be read at a distance much more easily.

Non-contiguous graphics: This technique uses the graphics mode to display characters as discrete blocks within the basic graphics cell.

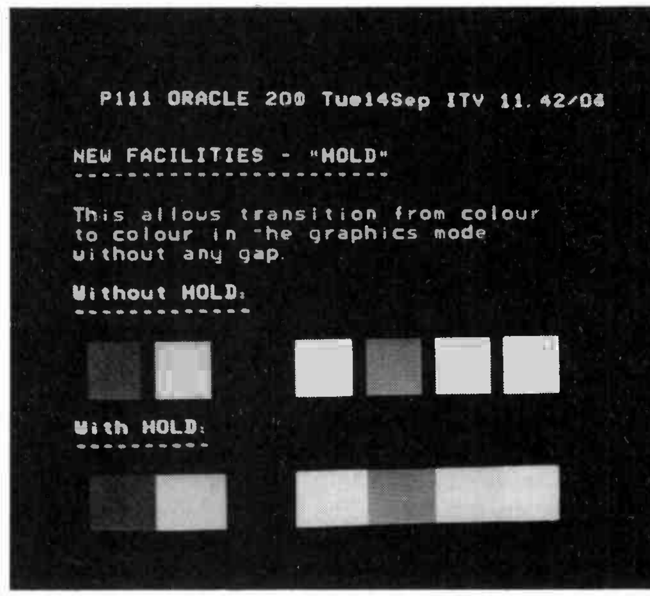
Background colour: This enables graphics and alpha-numeric characters (i.e. letters and figures) to be displayed separately on different background colours.

Networking

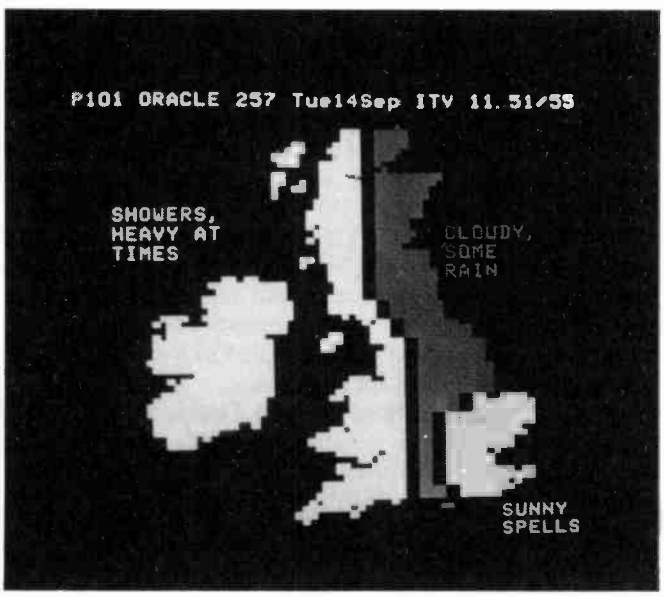
At present, Oracle Teletext signals are being transmitted seven days a week during normal transmission hours in the London ITV service area. As mentioned at the beginning Oracle is also available via the network to ITV regional stations. There is no problem where the regional station is simply taking a programme feed from London. Where Oracle has to be added to a local video signal however special equipment is necessary. For this purpose a "data bridge" has been developed. Basically this consists of a data regenerator which takes the Oracle signals from one video source and retimes them to the local syncs so that they can be added to the local video signal. Since there are a number of stand-by lines from London to many of the regional stations the Oracle signals can be sent down these lines while regional stations are transmitting locally-generated programmes and inserted on to the local video via the data bridge. Data bridges are already in operation at Anglia TV and ATV Birmingham, and as part of the current experimental Oracle service it is intended to install data bridges in all programme companies, enabling Oracle to be transmitted nationwide during the normal transmission hours. ■



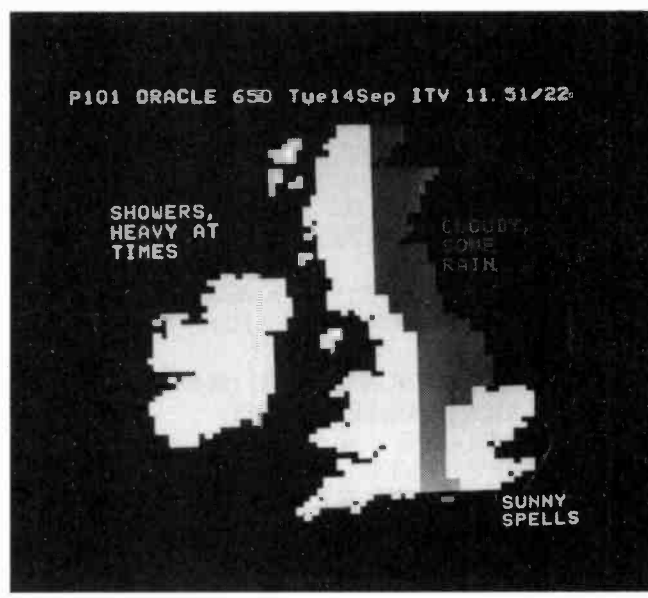
Double height characters are easier to read at a distance.



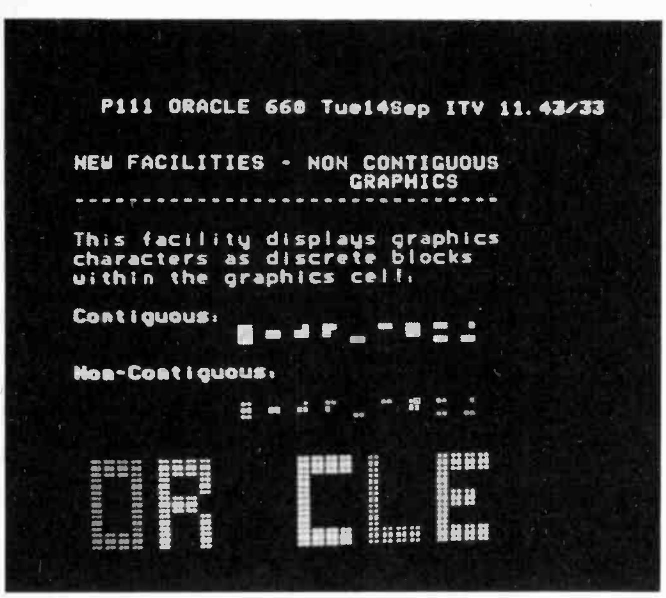
Showing the principle of "hold", which gives colour transitions without a gap between.



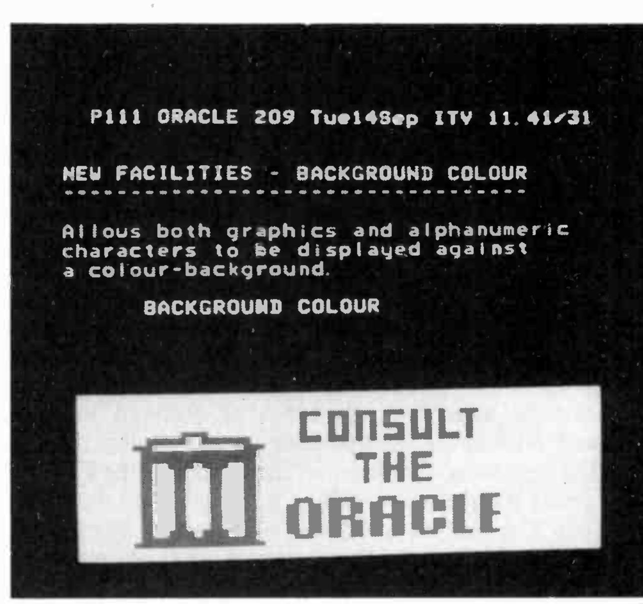
An example of graphics without "hold".



The same display with "hold".



Non-contiguous graphics.



Background colour.

LONG-DISTANCE TELEVISION

ROGER BUNNEY

SEPTEMBER brought a considerable slowing down in reception conditions. Signals received here were mainly via MS (Meteor Shower) though there was a little Sporadic E early in the first week. The hot dry weather has ended and during the past two weeks there has been a lot of rain with thunder storms at times. I for one played safe and switched off whilst lightning was in the vicinity, rather than trying my luck at lightning scatter reception!

My log reflects the unspectacular reception over the past four weeks. Hopefully others may have fuller logs.

1/9/76 DFF (East Germany) ch. E3, 4; TVP (Poland) R1 – all MS.
2/9/76 DFF E3, 4; DR (Denmark) E3; CST (Czechoslovakia) R1 – all MS.
3/9/76 RTVE (Spain) E2, 4; RTP (Portugal) E3 – all Sporadic E.
4/9/76 DFF E4; TVP R1 – both MS; TVP R2; RAI (Italy) IB – both SpE.
5/9/76 DFF E4 – MS.
8/9/76 DFF E4; TVP R1 – both MS.
10/9/76 DFF E4; ORF (Austria) E2a – both MS; CST R1 – SpE.
11/9/76 DFF E4; DR E3, 4; WG (West Germany) E2; NRK (Norway) E4 – all MS.
12/9/76 DR E4 – MS.
13/9/76 DFF E4; CST R1 – both MS.
15/9/76 DFF E4; TVP R1; RTVE E2 – all MS; unidentified SpE signal on R1.
17/9/76 DFF E4 – MS.
18/9/76 DFF E4; TSS (USSR) R2 – both MS.
20/9/76 DFF E4 – MS.
22/9/76 DFF E4; TVP R1 – both MS.
23/9/76 DFF E4; DR E3 – both MS.
24/9/76 DFF E4; DR E3; RTVE E2 – all MS.
27/9/76 DFF E4 – MS.
28/9/76 DFF E4; CST R1; TVP R1; ORF E2a; RTVE E2 – all MS.

The Tropospherics improved on the 21st towards the South and South-East, assisting the usual low-level reception of French stations at u.h.f. and producing one new transmitter – Cherbourg FR3 on ch. E62. Generally, the log shows that the trend towards the quieter months is settling in, with little to break the monotony of the "usual" stations. Here at least, as in previous years, the DFF outlet on ch. E4 can usually be received most days prior to 0800, albeit weakly.

One must hope that we can look forward to some sustained Autumn Trop openings in the coming months. With the approach of winter, so the m.u.f. via the F2 layer rises, giving the possibility of low v.h.f. reception over great distances. The sunspot number is still very low however, so it's not very likely we will experience such reception this season. The reason for mentioning the subject is that some prominence has been given recently to sunspots in a Sunday newspaper. We must stress that on no account should the sun be examined directly with a telescope, binoculars or indeed the naked eye, since permanent damage will be caused. A telescope can be used to project the sun on to a white card in order to observe such spots, but in doing this the telescope must *not* be sighted by looking towards the sun via its lenses.

News Items

Mauritania: We understand that a television service is to be established within the next two years, operating in Band III. A TV centre and facilities are to be established at the capital of Nouakchott. This country is SW of the Spanish Sahara.

Libya: Further expansion of the television service is planned within the next year or so, with several new transmitters throughout the country and the introduction of colour.

USSR and Thailand: "Viddo" magazine reports that Vladivostok in the far east has commenced transmitting in colour (SECAM). The same source reports that Thailand will be changing some of its transmissions to system B 625 lines, from the present system M with 525 lines. The change will start in the Surat Thani province.

Iraq: A reader tells us that the Iraq Television Service has been transmitting PAL colour since early 1976. We are hoping to obtain further information on this topic.

ARA – A New Propagation Mode?

East German Radio (Radio Berlin International) publishes a regular journal in English. A page from the Autumn issue was recently sent to me, describing a possible mode of signal propagation which was mentioned in this column some while back. It arises from heating effects in the E Layer by high powered radio transmissions. To summarise the article very briefly: The Earth is surrounded by layers which assist the propagation of radio signals. At times – particularly during periods of high sunspot activity – flares occur on the Sun's surface, causing severe radiation. The radiation eventually reaches Earth and causes a blackout in the Ionosphere after about 8-10 minutes, followed some 18 hours later by a magnetic storm at the Earth's Poles – known as an Aurora. Tests have been carried out in several parts of the world with a view to influencing the Ionosphere by man-made means. This has resulted in the generation of an artificial cloud of free electrons within the E layer, and this is capable of reflecting v.h.f. signals. The cloud is formed by using a high-power radio signal to heat the E layer. The effect was first noticed over the high-power Droitwich LW transmitter – the electron temperature was found to be 45°C higher than normal. One experiment in the USA involved the use of a 5MW 5MHz radio signal beamed directly upwards to heat the gas. This caused expansion and increased ionisation along the Earth's magnetic lines, allowing low v.h.f. reflection between Phoenix, Arizona, and Socorro, New Mexico. The heating effect has come to be known as ARA – Artificial Radio Aurora.

Tropospheric Signs

To conclude our recent notes on Tropospheric reception conditions in various parts of the country, Keith Hamer and Garry Smith have provided information on signal conditions in Derby when the Trops open up. The first indications of this are improved reception from Lille, N. France, on ch. F8a, with BRT (Belgium) chs. E2, 10 slightly behind. NOS (Holland) then starts to lift on chs. E5 and 6, also Langenberg (West Germany) ch. E9. By this time Belgian u.h.f. signals on chs. 25, 28 and 43 should be present along with most NOS channels. As with Band III however the first u.h.f. signal to come in is Lille.

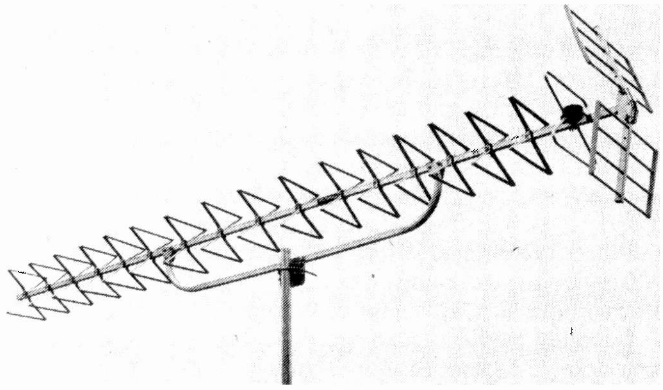
Signals then continue to improve, and the North German Band III and v.h.f. stations are received, with DR, DFF and if very good TVP on ch. R9. Early morning usually gives DFF on chs. E6, 11 and at times E8, and WDR E9, 10, 11. DR is commonly received on all the Band III channels, and if early morning conditions are good then NRK (Norway) will appear on chs. E5, 6, 9, 11 and it's suggested that SR (Sweden) is looked for at u.h.f.

As can be seen, the Tropospheric characteristics differ considerably in the various parts of the UK, depending not only on area but also on local terrain. Generally one must be vigilant, certainly if new to this hobby, but those with several years' experience can often judge when signals will be in. Personally, the best Tropospheric reception at Romsey is usually during the period prior to 1000 local time and at such times signals can become very strong.

One must be aware of the effects of ducting, when for example DFF will be received in Band III whilst there is absolutely no sign of West Germany. At times Band III will be very active with little on u.h.f., often vice versa, while at times both are equally well received. Judging by recent photographs seen here our friends in Holland have succeeded with u.h.f. reception of TSS (USSR) over an extremely long path, and unlike recent years I feel we must revise our terms of reference regarding distances. Perhaps this year may see Yugoslavia or Italy received at u.h.f. in the UK!

Australian TV Channels

Bob Copeman (Sydney, NSW) has sent us a copy of the new proposed channel allocations for Australia. The v.h.f. channels remain as listed in my DX-TV book but the u.h.f. allocations differ somewhat. Bands IV and V are restricted compared to the UK, with Band IV consisting of chs. 28-34 (526-582MHz limits) and Band V chs. 39-63 (614-814MHz). Signal characteristics are identical for both v.h.f. and u.h.f. – 625 lines with a 5MHz video bandwidth and sound – vision spacing of 5·5MHz.



The new High Gain Multiple Yagi array, Type HG.36.
Wolsey Electronics, Rhondda

New UHF Aerial

We are showing a photograph of an interesting new aerial being introduced by Wolsey Electronics, type HG36. It has 16 director assemblies which are similar to the bowtie type dipole used. This gives high gain for grouped operation, i.e. there are group A, B and C/D versions. No wideband (i.e. all Band IV and V) version is available. A full specification is awaited.

From our Correspondents . . .

Despite the rather dismal conditions of late we've had another full mail bag. An interesting letter came from a Polish TV engineer working in Tripoli, Libya. Kajetan Adamski has installed several wideband yagis and obtained a Sanyo TV receiver. With this set up he's received many European stations via Sporadic E, several Arabic and Italian signals in Band III via Tropospheric reception. He expects improved results when his new system (double stacked u.h.f. arrays) is erected. Unfortunately Kajetan didn't include his address on the letter, only on an envelope, and by the time the letter arrived here the envelope had long since disappeared! Can you write again please?

Jonathan Brisley (Peterborough) has had considerable success using an Ekco Model T415F – with both Sporadic E and Tropospheric signals, judging by the long list sent in. Ch. E4 is blocked in his area by a local ch. B5 relay – we've suggested a notch filter which should remove the sound splatter.

Geoffrey Hunt (Hull) also has a problem with i.f. selectivity when his Bush Model TV161 is switched to 625 lines. One approach is to cut the i.f. switching mechanism, allowing the detector switching to continue to change the video polarity but retaining the 405-line i.f. bandwidth. Another approach to the problem is to make use of separate i.f. video selectivity panels such as the surplus G8 units currently on offer at 25p each (see this column, March 1976). Such units can be inserted between the tuner i.f. output and the input to the main i.f. strip. Suitably aligned (or in this context suitably misaligned!) they can narrow the i.f. pass band considerably. These should be so arranged that they can be switched out of circuit.

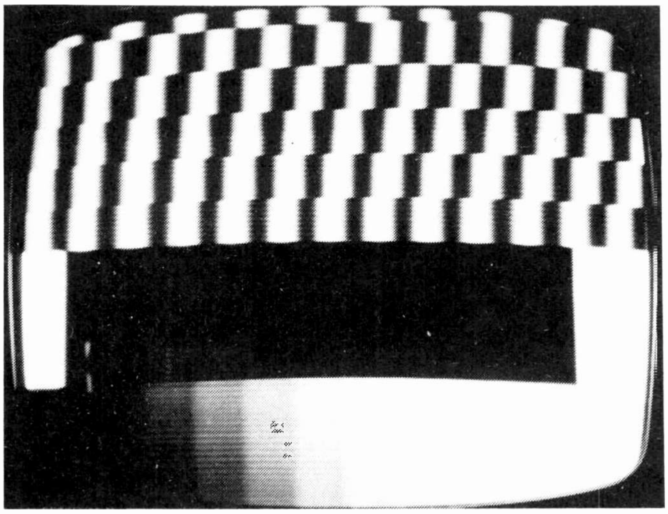
Finally Dr. E. Duncan (St. Andrews, Fife) has been using a BRC 900 chassis for monochrome DX and an indication of his recent good Trop reception is the accompanying shot of a Danish test card received on Band III at over 550 miles. Eric comments that this year Sporadic E was at a consistently high level from May 4th to August 27th. During this period he logged RTVE (Spain) on 53 days, with TSS (USSR) a close second at 51 days!

Chinese Television

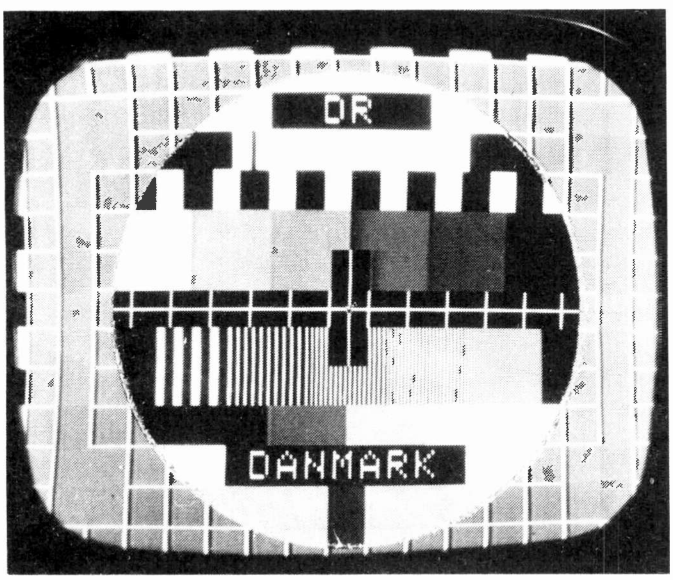
Video and Audio-Visual Review recently published a survey of television in mainland China. Some of the more important details are summarised below.

The Chinese television service has been received in Australia via both F2 and TE, and until recently has been noted using both the 0249 type test card (the old monoscope card used by Russia) and a small checkerboard. Hong Kong can readily monitor Chinese television of course but as yet we have no contacts there. Our main sources of information are the World Radio TV Handbook and observations of reception by DXers – mainly in Australia.

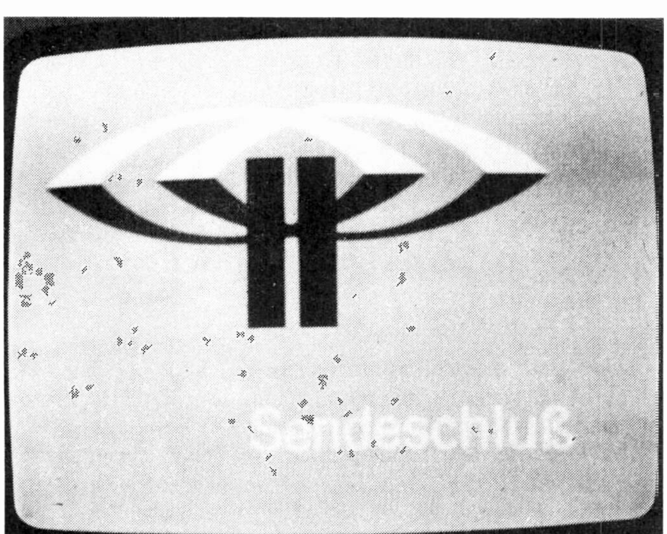
Because of its vast size TV transmissions in China are on



Modified EBU bar, Caen ch. E25 – early morning in August 1976. Courtesy David Martin, Shaftesbury



Danmarks Radio, Band III tropospheric reception at 550 miles. Courtesy Dr. Duncan, St. Andrews



End of ZDF transmissions, West Germany. Courtesy Dieter Scheiba, Brussels

the v.h.f. channels, below 100MHz. As in Eastern Europe, the OIRT standard is used, on channels R1-5 inclusive plus an additional channel just l.f. of ch. R2 (57·75MHz vision, 64·25MHz sound). Colour is being transmitted on an experimental basis from Peking and several other centres, the system, at least for the present, being a form of PAL. China is understood to be still considering the eventual system to adopt, both PAL and SECAM systems having been subject to considerable experimental evaluation in Peking.

Peking has two channels, ch. R1a (as above) and ch. R3, both using 5kW transmitters. Other cities have only one Band I channel available and from powers given in the WRTVHB the effective coverage would be relatively small.

Canton now relays Peking-2 (in colour) in Band III, in addition to the Canton-1 transmissions on ch. R1a. Programmes are limited to three hours during the evening period on the first programme with only four evenings of Canton-2 programmes from Peking.

Dependence seems to be placed on the use of relay transmitters rather than microwave links between stations for much of the networking of programme material. This is seemingly one-way, from Peking outwards. An example is Shanghai which has a local TV production centre but inserts Peking programmes when the occasion demands. Considerable development has taken place in Shantung, with programme origination from Tsinan and programmes relayed from Peking. Both Shensi and Sinkiang provinces have had television available for over five years. The latter originates from a centre at Urumchi. Tibet now appears to have a form of TV service, though still in an experimental stage.

The Anhwei province service is centred on Hefei, with a number of mountain-top relays. Hefei again produces its own programmes and also inserts Peking (Colour). The Hangchow transmitter in Chekiang province on ch. R1a relays Shanghai and in turn Peking, again using RBR techniques (rebroadcasting off-air pickup). The Shanghai transmitter is listed as being on ch. R5, with only 500W, but has an active production centre producing considerable programme material for its own area, again with network insertion of important Peking output. Nearer to Peking, Shantung has developed TV relays quickly with material provided from either Tsinan or Peking.

South west of Peking in the mountainous province of Chinghai TV has been in operation since 1971. Numerous relay transmitters have been built to relay the output of the main centre at Sining. North of Peking in Heilungkiang province (Manchuria) some 20 transmitters/relays centred on Harbin carry the local or Peking programmes. The situation in Hopeh, south of Peking, is the same. Wuhan and Kansu similarly relay local or Peking programmes whilst Kiangsi is covered from the Nanchang centre. Kiangsu province, with the main TV centre at Nanking, has over 50% coverage, relaying both local and Peking outputs. Kwantung Television is monitored off-air in Hong Kong from the ch. R1 output at Nanking.

The programme material tends to be rather dull to Western taste. The main themes are education, instruction and political awareness. Films and locally produced programmes reflect the ideals of Chairman Mao Tse Tung, and there are numerous stage shows depicting the triumphs of Communist workers and attacking various groups. There are no domestic soap operas or "westerns".

Once the colour system has been finally decided upon a considerable expansion in local receiver production should commence. There is already a thriving industry, based on a "cottage type" production.

Faults Encountered . . .

Dewi James

THE last few weeks have been busy ones for us. Being at a popular holiday resort, we get plenty of holiday makers' sets which have broken down, mostly portables. The common trouble here is when the battery connections have been reversed. "I only connected it that way for a second." Diagnosis is relatively simple, just follow the burn marks... But many other and varied faults come our way.

Low Brightness

We were recently called to attend to an ITT Model CK402 suffering from low brightness. The set is fitted with the CVC2 wired chassis, and had been doing sterling service at a local hotel – having had all its front control knobs removed to prevent fiddling. As in later ITT colour chassis, the reference voltage for the beam limiter circuit is the PL509 line output valve's cathode voltage. The bypass capacitor here (Ch29, 200μF) was found to be open-circuit, upsetting the operation of the beam limiter circuit. Similar symptoms on other sets fitted with this chassis have been traced to a faulty beam limiter transistor – TXh1, BC116. It's also worth checking the two 50μF electrolytics Cp2 and Cp3 in the –20V line when brightness difficulties are experienced on this chassis, since this line is used in the beam limiter circuit. These electrolytics are now getting old and drying out. If the brightness limiter circuit is working correctly on these sets, the brightness control should be at approximately two thirds of the way round its travel for a normal picture, and it should be possible to black out the screen with the "set limiting" control Rh3.

ITT Colour Sets

There seem to be a lot of ITT colour sets in this area, and receivers fitted with the later CVC5 and CVC8 chassis often come our way. Though we say that, it should nevertheless be pointed out that our experience of these sets has been very favourable. They have proved to be relatively trouble free, those faults that have appeared mostly having fallen into the simple stock fault category. The pivoted chassis with component identification on both sides of the panel is a great help.

Curious EHT Discharge

In one recent case however we had a rather trying fault. The problem was severe high-voltage discharge from the e.h.t. cap, damaging the tripler, the cap itself and the e.h.t. lead. The first time it happened we thought a new tripler assembly was all that was required – after cleaning the tube flare and checking for excessive e.h.t. Within a couple of weeks however the same thing occurred. This time we again collected the set, giving our customer a loan set, and made a thorough investigation. We could find no fault other than the obviously defective tripler. We had no alternative therefore but to return the set and check for dampness in the house. None could be seen to our unpractised eyes, but we made sure that the set was moved away clear of the wall. You've guessed it of course, within a short time we were presented with the same failure. This time we returned the set to the regional ITT depot for examination. It came back with the comment "no fault found, may be due to dampness . . ." In the meantime the loan set, of the same type, displayed exactly the same symptoms and had to be replaced. After discussion with ITT's representative – whose interest and help in this difficult situation must be acknowledged – it was decided to fit a larger e.h.t. cap and a sleeve over the e.h.t. lead from the tripler. This finally cured the trouble. I have not come across another set of this type – except the loan one – that reacted quite so violently to what must have been a case of dampness.

LT Regulator Modification

From time to time we are called upon to replace the AD161 20V regulator transistor on sets in this series – usually because of a hum bar on the picture. There is now a modification kit (no. 12682) in which the AD161 is replaced with either a 2N5296 or a TIP31. The modification is already incorporated in later CVC9 chassis. The associated transistor T45d is changed to type BC171B, R372d is changed from 820Ω to 390Ω and, on the CVC9 chassis *only*, R373d is changed from 36kΩ to 22kΩ and R374d from 75kΩ to 82kΩ. Assemble the 2N5296 or TIP31 as follows. Lightly smear both sides of the mica washer (see Fig. 1) with silicone grease and place the washer on the inside of the heatsink, followed by the transistor, with its metal body downwards. Then fit the solder tag and bush – the thin part of the bush goes through the tag and the transistor's mounting hole. Insert the screw, ensuring that the bush is correctly positioned so that the transistor and its tag are isolated from the screw and the heatsink. Screw the nut on the outside of the heatsink, and ensure that the assembly is securely tightened. Replace the red wire from the board with a 3½in. lead of similar type, fit the plastic spacer on to the transistor's leadout pins, and attach the wires as shown – ensuring that the joints are

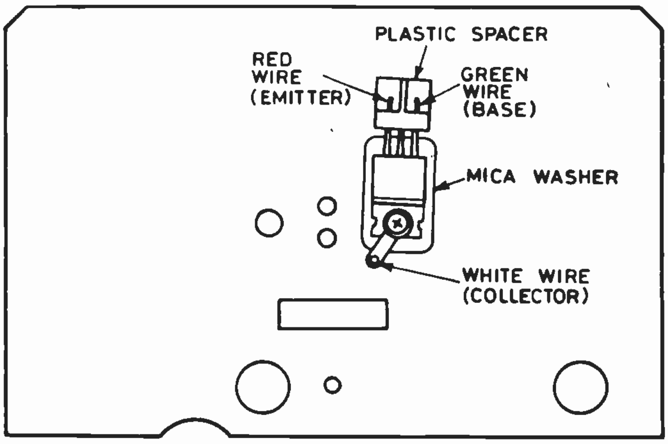


Fig. 1: Fitting a 2N5296 or TIP31 transistor in place of the AD161 20V supply regulator transistor in the ITT CVC5 and later chassis in the series.

large enough to prevent the spacer falling off. Solder the white wire (on some chassis this is an r.f. choke) to the solder tag. If the 2N5296 has a centre leadout wire, clip this off. In the case of the CVC9 chassis check the setting of R41d, adjusting if necessary for 20V on the regulated supply VI. In other sets adjust R41d for 31·2V at the junction of R41d/R373d and check the setting of the tuning presets.

No Luminance

A non-stock fault we encountered recently on a set fitted with the CVC8 chassis was no luminance. We traced the luminance signal with a scope and found that no signal was present at the emitter of the luminance emitter-follower T23d. The base-emitter junction of this transistor is protected by a 1N4148 diode (D20d), which turned out to be the culprit.

Multiple Symptoms, Single Cause

The symptom on another CVC8 we were called to recently was sound coming on normally, but once the line whistle could be heard the sound cut off abruptly, and all that could be seen on the screen was a barely discernible horizontal white line. So we were presented with no sound, no field scan and very low brightness. The connection between these faults is the link between the boost rail and the sound muting circuit – see Fig. 2. The idea is to mute the sound during the warm up period, i.e. before the line pulse gated a.g.c. circuit comes into operation, when the i.f. stages are operating at full gain. Muting is effected by returning the audio amplifier triode's grid leak resistor R75d to chassis via diode D57h. When the set has warmed up, forward bias from the boost rail holds this diode conductive. During the period between the line oscillator starting up and the line output stage coming into operation however, the line drive waveform is fed via R407h and C298h to the junction of the v.d.r. R409h and D57h. As a result of the action of the v.d.r. a negative potential is developed at this point. This negative potential reverse biases D57h and biases off the triode section of the valve,

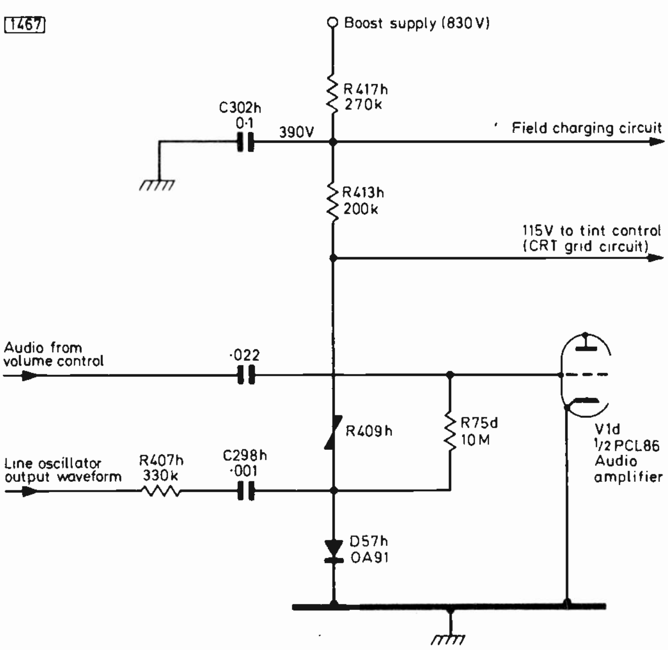


Fig. 2: This circuit links the boost, field charging, audio and tint control circuits in the CVC5 and subsequent ITT chassis.

thus muting the sound channel. In this particular set C302h was found to be short-circuit at full boost voltage. In consequence the voltage to the field charging circuit was removed, hence no field scan; the reverse bias remained on D57, hence the sound cut off; and no voltage to the tint control in the c.r.t.'s grid circuit, hence reduced brightness.

Disappearing Picture

On yet another CVC8 the picture would disappear after about two to three minutes, the line whistle and sound remaining although there was no brightness. The line drive measured at the grid of the line output valve became progressively less and less, until it became so low that the PL509 was showing signs of distress. Suspicion was first directed at the feedback width stabilisation circuit since this part of the circuit has been responsible for such symptoms in the past. It follows the usual arrangement, with flyback pulses fed back to a v.d.r. in the valve's control grid circuit, the v.d.r. establishing a negative bias proportional to the amplitude of the flyback pulses. The bias is offset by a positive voltage derived from the boost line – via the dealer and factory width controls. Fault finding here is usually relatively simple, most troubles being due to high-value resistors increasing in value. In this instance however nothing wrong could be found in this part of the circuit, so we decided to investigate the line oscillator circuit. This consists of a PCF802 acting as a sinewave oscillator. We found that the voltages in the pentode section were all wrong: the cathode was low at 15V instead of 37V, the anode high at 215V instead of 165V and the screen grid low at 160V instead of 220V. Clearly the pentode section wasn't passing its normal current, due to the low screen grid voltage. It turned out that the 220Ω screen grid feed resistor R399f had increased in value to 75kΩ. This massive increase in value had had less effect on the screen grid voltage than one might suppose because of the very low screen grid current being passed. The moral is, just because there's a reasonable voltage on the screen grid, don't assume the feed resistor is o.k.

No Results

We also encountered a defective ITT Model FT110 recently. This is the imported 110° set with the combined line timebase/switch-mode power supply circuit. The fault was no sound or brightness and the tube heaters out. Line whistle could be heard however and the switch-mode power supply was working normally since the stabilised 230V, 163V and 28V lines it provides were all present. There were no 20V or 24V supplies however. These are derived from the EW diode modulator circuit in the line output stage, and we discovered that one of the modulator diodes, D507, was defective – showing the same d.c. reading forwards and backwards. The c.r.t. heaters are fed from another winding on the line output transformer: it seems that they were not alight due to the loading effect of the defective D507 on the transformer.

No Line Oscillator Supply

I've moaned before in these pages about the convoluted way in which Sony circuit diagrams are drawn, making it difficult to see the circuit action when trying to track down an awkward fault – or even in some cases quite simple faults. Here are a couple of recent cases. The first case was a Sony Model KV1330UB with no sound or raster. A number of supply rails are derived from the line timebase,

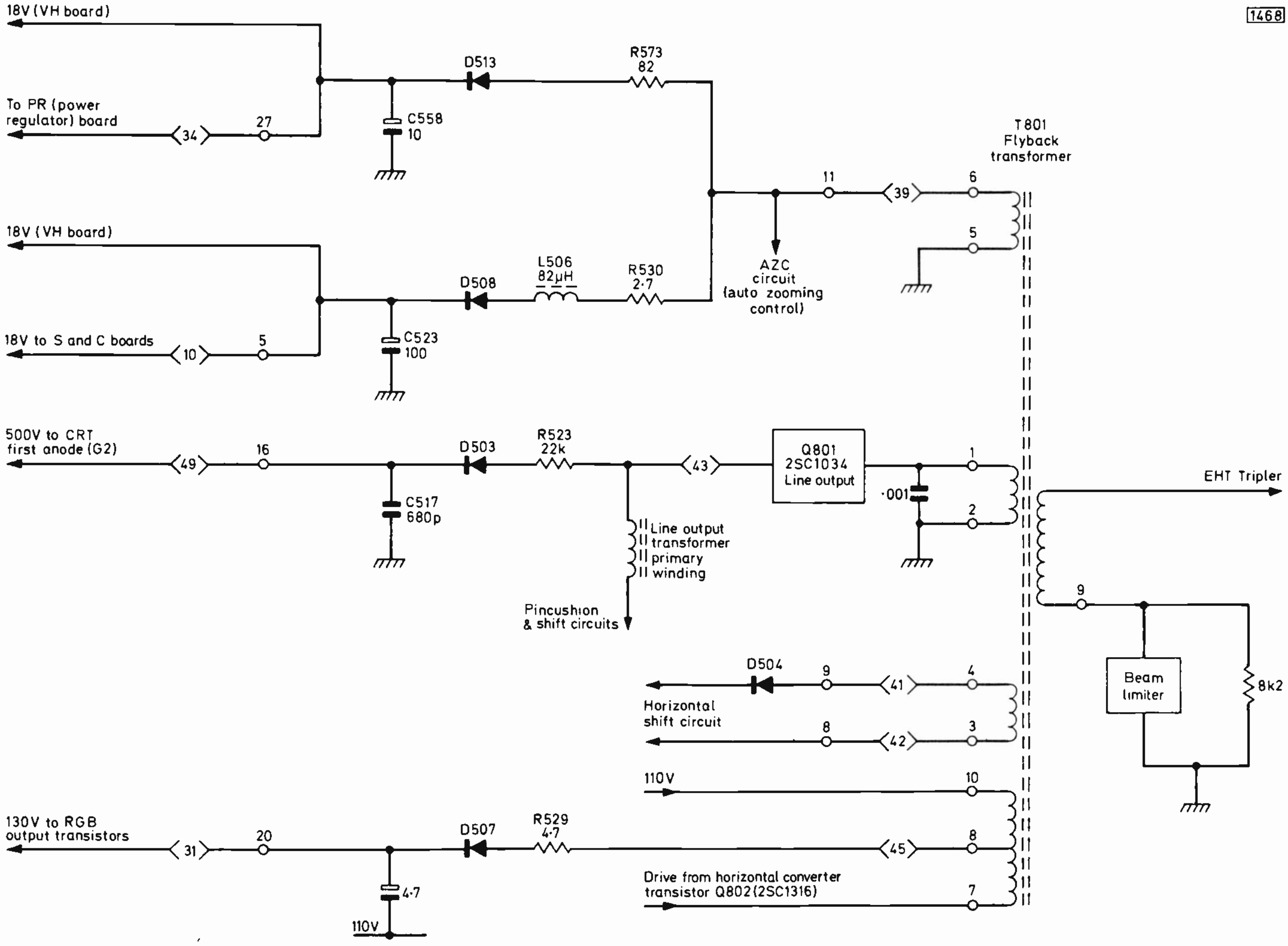


Fig. 3: Supplies derived from the flyback transformer in the Sony Models KV1310UB and KV1330UB. Diodes D503, D504, D507, D508 and D513 are all on the VH board. The 12V line oscillator supply is dropped from the 18V output from D513/C558 – there is a kick-start circuit, powered from the 110V h.t. supply, in order to get the line oscillator working before the line timebase comes into full operation.

and if the line oscillator stops working so does everything else. During normal operation the line oscillator's supply comes from the flyback transformer (this is not the line output transformer, which is separate), but there is a start up supply to get the oscillator working before the later stages in the line timebase come into operation. In fact the line oscillator did start up momentarily after switching on. It's a relatively simple matter to connect an external 12V supply to get the oscillator started again, and then proceed in the normal manner to trace the fault. In this case the rectifier (D513) which provides the line oscillator's supply after "warm up" was faulty. Not a difficult one, but a clearer circuit would have made things a lot easier. In this connection I hope that the simplified circuit shown in Fig. 3 will save the time of other engineers confronted with this sort of trouble.

Dark Area on Screen

The second case was a Sony Model KV1800UB which displayed a picture the top half of which was very dark with the bottom half relatively normal. There was no noticeable effect on the sound. The symptoms were intermittent, but became progressively worse until the complete screen was dark, colour only being visible, i.e. no luminance, although from time to time the brightness level would suddenly increase to normal. The fault was eventually traced to the blanking transistor Q508 (see Fig. 4). In our diagram the relationship between the fault symptoms becomes obvious – but take a look at the Sony circuit where Q508 is quite remote from the luminance transistors Q151/Q153 and the interconnection is far from obvious.

Poor Resetting and Drift

Perhaps the only weak point on the Hitachi Model CFP470 and related models is a tendency towards poor resetting, sometimes accompanied by tuner drift. Usually a new tuner unit is required, but beware when fitting the replacement tuner since the connections to plug A differ. When used in Models CFP470 and CSP680 the pink lead is connected to A4 and the white lead to A5. When the same tuner is used in Models CAP160 and CEP180 however the connections are the reverse, i.e. the pink lead should go to A5 and the white one to A4. Since the white lead is the a.f.c. lead and the pink one the a.g.c. lead, reversing the connections produces very similar symptoms to those you started off with, i.e. tuner drift and low gain. In fairness, Hitachi now send these tuners out with a different A plug – the pink and white leads are now separate and are not part of one big plug as they were originally – and a clear diagram and explanatory note are enclosed. This is not the case with older replacement units however, and one we received the other day nearly caught us out.

Dead Set

A local dealer brought along a Grundig Model 5011GB recently, saying that it was dead, i.e. no sound or raster though the tube heaters were alight – the channel selector

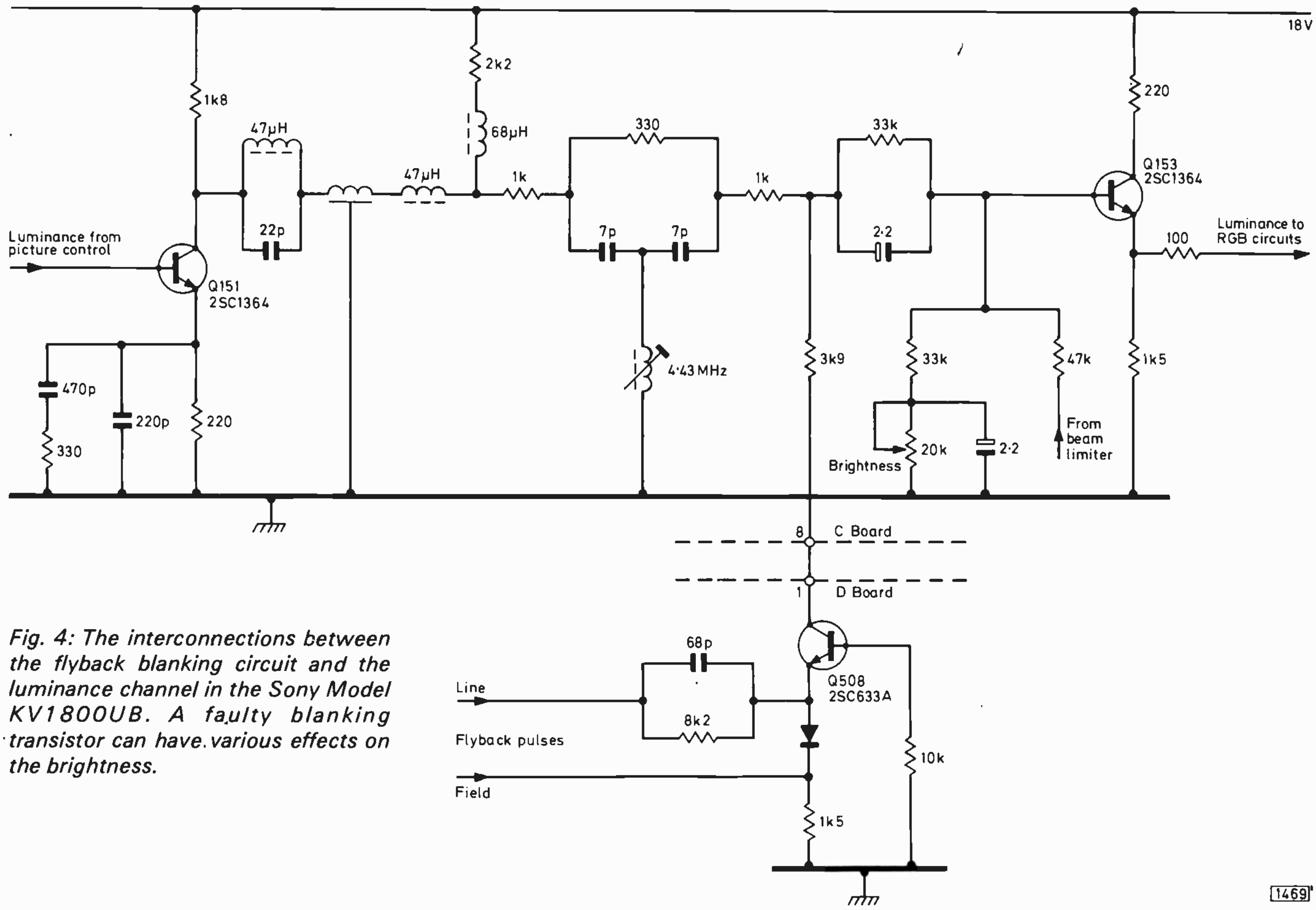


Fig. 4: The interconnections between the flyback blanking circuit and the luminance channel in the Sony Model KV1800UB. A faulty blanking transistor can have various effects on the brightness.

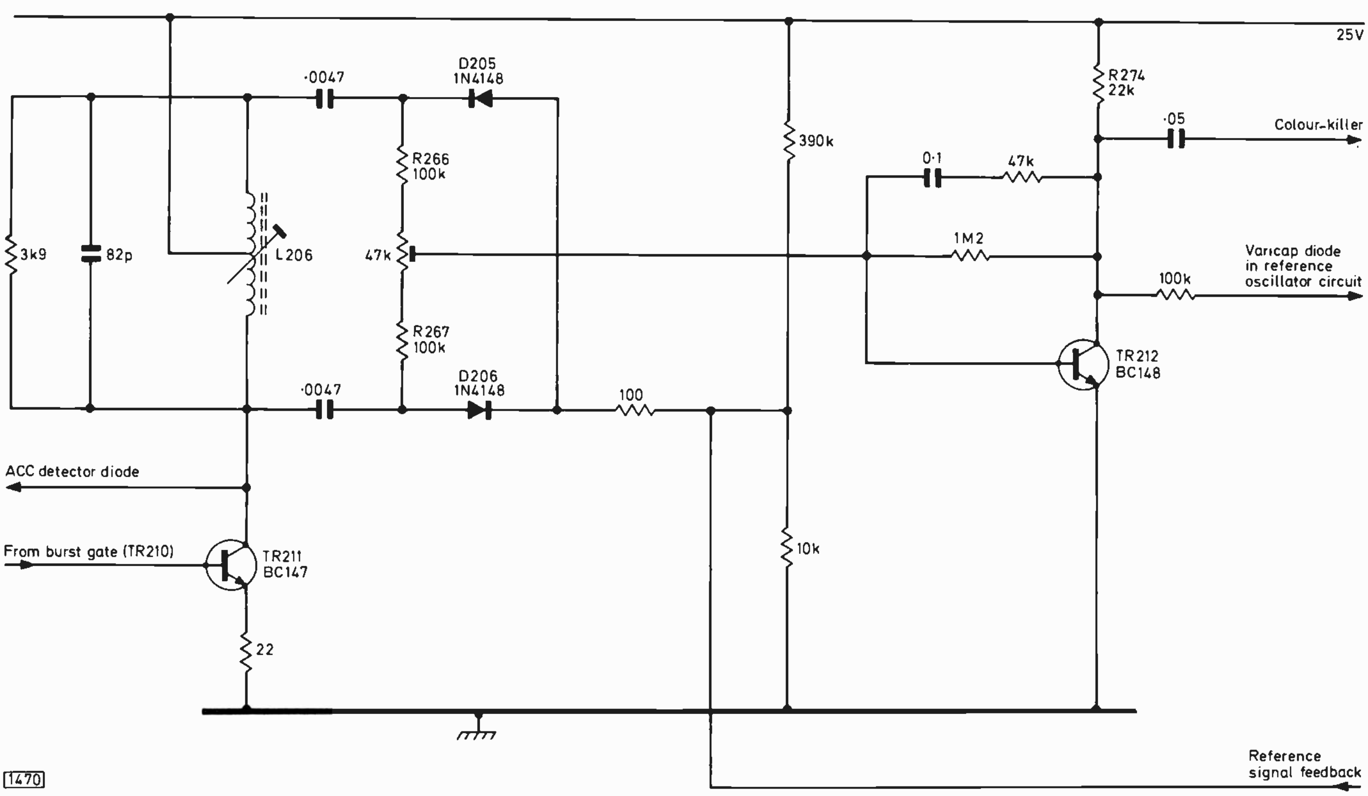


Fig. 5: Burst discriminator and following d.c. amplifier used in the Decca 30 series chassis.

numbers were also illuminated. His engineers had discovered that the scan-derived low voltage supplies were missing and, assuming that this was due to the line oscillator not working, had replaced the line oscillator module. This hadn't done the trick, neither had replacement of the two thyristors used in the line output stage. Now the scan-derived supplies, including that to the line oscillator module, are obtained from a winding on the line output stage input/commutating transformer, and for this reason the line oscillator has to have a start supply to get it going. It seemed to us that the start voltage was missing, and this proved to be the case. The start supply is provided by

Di638 which turned out to be open-circuit. A replacement put the set to rights.

No Colour

Intermittent no colour was the complaint on a Telefunken Model 633. By the time it had been brought into the workshop however the colour had gone altogether – a much better state of affairs for fault finding. We disabled the colour killer – by linking together TP205 and TP206 – and discovered that there was no colour sync. Attention was turned to the burst amplifier/phase detector section of the decoder therefore, and the scope was brought into action. This revealed that the chrominance signal and gating pulses were reaching the burst stages, and that amplified bursts only were present at the collector of the phase discriminator driver transistor TR211. So these stages were cleared of suspicion. The next step was to check the d.c. voltages in the following d.c. amplifier TR212 (see Fig. 5), and the collector voltage here was found to be low at only 1V instead of 10V. TR212 itself turned out to be o.k., as did its load resistor R274 and the capacitors in the circuit. The fault in fact turned out be be due to imbalance in the phase discriminator circuit, as a result of which TR212 was being incorrectly biased. Replacing the two discriminator diodes D205/D206 and their 100kΩ load resistors R266/R267 restored normal operation. And in case you think there is something vaguely familiar about this Telefunken circuit – yes, it's the Decca 30 chassis!

Capacitor Troubles

Which brings us back to UK chassis. We have recently had to deal with a couple of intermittent faults on the Bush Model CTV1222 – the A823AV chassis. The first was another case of intermittent chrominance. This time the set would work normally for hours at a time, but the colour would eventually disappear and could be persuaded to return again only when the set was switched off and left to cool down. During the investigation we discovered that when pin 2 of the SL917A chrominance processing i.c. was touched the colour returned. This is the 4·43MHz reference signal input pin, the signal coming straight from the 4·43MHz crystal. The fault was eventually traced to the 27pF tuning capacitor 3C9 in the oscillator circuit.

The second intermittent fault on one of these sets was sudden alteration of the line frequency – the line speed would suddenly change for no apparent reason. Again the trouble was due to capacitor failure, in this case 5C14 (250pF) which is the quadrature feedback capacitor in the reactance transistor section of the sinewave line oscillator circuit.

Sound Buzz on One Channel

In another of these sets there was a definite buzz on the sound when channel 63 was tuned in, but only if the a.f.c. was in the on position. There was normal operation on the other two channels available here. The fault was cleared by careful readjustment of the cores of the coils (1L14/5) in the a.f.c. discriminator circuit.

Tuning Drift

Tuning drift on this chassis has predictably been caused by the TAA550 tuning voltage stabiliser i.c. The stabilised voltage at pin 8 of 1Z3 – or across the i.c. itself if this is more easy to measure – should be 33V ±1V. The Rank service department tell us that when working on this unit the following modifications may assist. If necessary, alter the value of 1R27 to 470Ω, 1R34 to 2·2kΩ, and 1R36 to either 1·2kΩ or 2·7kΩ.

The SCS Field Oscillator

Finally, the silicon controlled switch field oscillator circuit. We've had several problems with these in recent times. The symptom most often encountered is no field scan, but I've also known the s.c.s. to be responsible for intermittent low field amplitude. Apart from direct replacement of the component little can be done to check it since direct connection of test instruments to an s.c.s. is not advised. So diagnosis is confined to eliminating associated components and substituting the s.c.s. itself. Perhaps a simple explanation of the operation of a typical circuit may assist. That shown in Fig. 6 is used in the Philips G8 chassis.

During the forward scan the s.c.s. W445 and the discharge transistor TR448 are off. The charging capacitors C451 and C452 charge from the 45V line via R449 and the height control to produce the basic scan waveform. The flyback occurs when W445 is suddenly switched on. The resulting voltage developed across R446 switches TR448 on to provide a discharge path for C451/2. The switch-on of W445 is controlled basically by the timing circuit R444 and C442 (R441 forward biases W443). When C442 has charged sufficiently for W445's anode to be positive with respect to its anode gate (the voltage here being set by the field hold control R439) it will switch on. The exact firing of the s.c.s. however is controlled by the arrival at its anode of a positive-going field sync pulse via C530. W525 is included in the circuit to prevent the field sync pulses being short-circuited by C442 and W443. During the flyback W443 cuts off and C442 discharges via R446, W445, W525, R441 and R455. C442 and R441 determine the flyback time.

We have also encountered this device in RRI receivers.

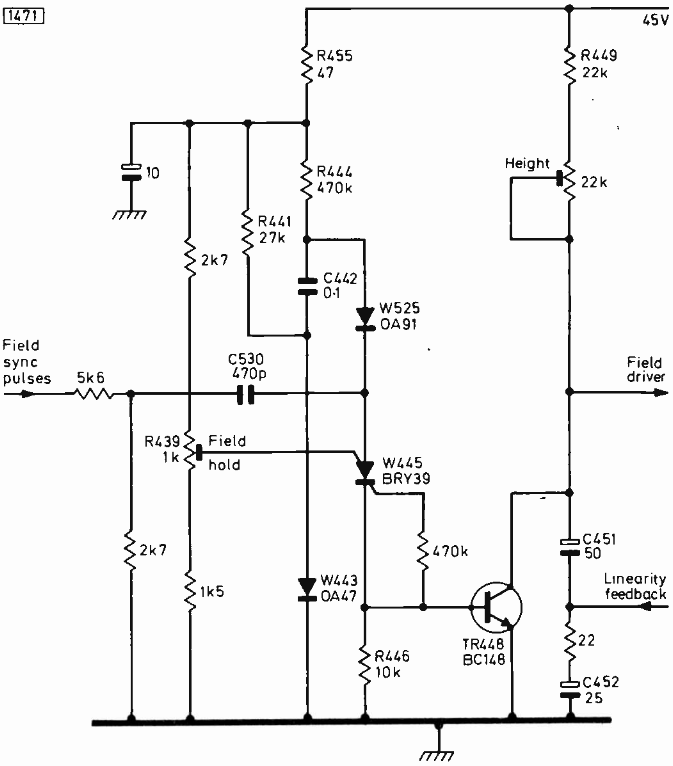


Fig. 6: Silicon controlled switch field oscillator circuit used in the Philips G8 chassis.

Development of the
ITT CVC20 chassis

Peter DAVIS, B. Sc., Colour TV Section Head, ITT

In early 1974 the Chief Engineer at ITT's Hastings television factory called a meeting of a small group of his colour TV engineers. He told them that the company planned to market a fully solid-state chassis by Christmas of the following year to supersede the long popular CVC5-CVC9 series of hybrid chassis, and that it was their job to design it. The objectives laid down were not modest. The new chassis had to be ultra-reliable, easy to service, and simpler to make than its predecessor. Reliability headed the list because of the reports of the problems other setmakers had had when changing from hybrid to solid-state colour chassis. It was considered vitally important that the new chassis should be without reproach in this respect.

TYPE OF TUBE

The first point that had to be agreed upon was the type of tube to use. The previous chassis had been fitted with 90° delta-gun tubes and had established a reputation for above average picture quality. These tubes are difficult to converge and set up however. Worse, particularly from the viewpoint of rental organisations, is the need to readjust them for best results as the convergence circuits age. The c.r.t. selected for the new chassis was the RCA 90° Precision-in-Line (PIL) tube which has the great advantage of being already fully converged and purified, requiring no adjustment throughout its life. It has been described in some detail in previous issues of this magazine, so we won't go over the principles again here. Briefly, it's an in-line gun tube with a slotted shadowmask and vertical RGB phosphor stripes, and with a precision toroidal scanning yoke which is permanently fixed to the tube. Except for the cathodes, the guns have common electrodes, giving high axis-to-axis efficiency and almost eliminating the effects of differential thermal changes between the guns. The only slight problem with this arrangement is that the cut-off points of the three guns cannot be matched by the conventional technique of adjusting the first anode controls. So a slightly different technique is used – varying the d.c. levels at the three cathodes.

BALANCED LINE OUTPUT CIRCUIT

One aspect of the toroidal scanning yoke troubled ITT's engineers – the fact that although the enamelled wire is multi-coated the line and field coils touch. Because of this RCA recommend a maximum voltage rating of 750V peak on the line coils relative to the field coils, though when questioned it was said that the yokes had been satisfactorily tested at much higher voltages. It seemed therefore that the problem – that the line flyback pulses, at about 900V, were 150V above the recommended maximum – was not so great as anticipated at first. Nevertheless it was decided to play safe and run the line output stage in a balanced arrangement, i.e. with a split line output transformer primary winding (see Fig. 1). If the field coils are considered to be at about chassis potential, the balanced arrangement means that no part of the line scan coils will be at more than 450V peak relative to the field coils. This gives a handy safety margin which fully justifies the extra expense involved.

A transistor rather than a thyristor line output stage was chosen for two reasons. First it's well known and understood in the UK, and secondly it uses fewer high-current capacitors and wound components. Another consideration was that by operating a transistor line output stage from a regulated h.t. line fully stabilised l.t. supplies can easily be derived from the stage.

LINE GENERATOR IC

There are several different sync separator/line oscillator i.c.s on the market: there is also the alternative of using discrete transistor circuitry. The cost differentials between these alternatives are low enough not to affect the choice unduly. Since i.c.s offer more facilities however it was decided to make a practical study of the different i.c.s available – no matter how good a particular device may seem to be on the basis of its technical specification and the performance of a few samples, there is no substitute for production experience. Only after buying several thousands of a device, with supplies taken from several production batches, can a considered judgement be passed on it. For this reason the TBA920 seemed a tempting choice. It's used

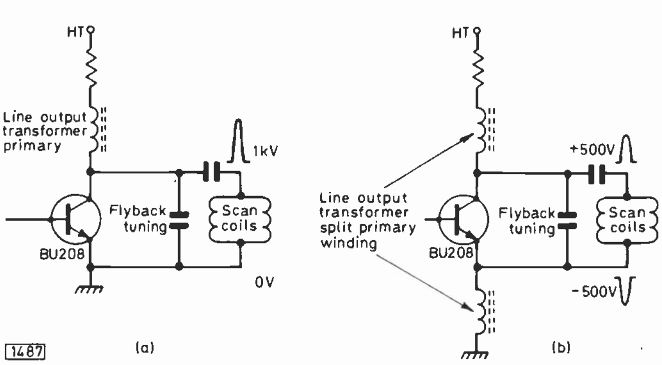


Fig. 1: (a) Conventional unbalanced transistor line output stage configuration. (b) Balanced line output circuit. This arrangement was adopted in the CVC20 chassis to reduce the peak amplitude of the line flyback pulses to a safe level: since the line and field scan coils touch there was the possibility otherwise of arcing.

by many setmakers in the UK and on the continent, while ITT's German sister company SEL already had considerable production experience with it. After consultations with SEL it was decided to adopt the TBA920, which although originally of Philips design is now made by several semiconductor manufacturers, giving the advantage of multi-source availability.

DIODE MODULATOR

Width stabilisation and east-west pincushion distortion correction can be applied in a variety of ways. It was decided to use the well-known diode modulator which does both, modulating the line scan current at field rate to correct the raster for east-west pincushion and trapezium distortion while adjusting the line scan to give width control without varying the flyback time. The latter is important since the shorter the flyback time the greater the flyback pulse amplitude and the e.h.t. To work properly the diode modulator has to be loaded – to ensure that the diodes do not stop conducting. This is no inconvenience however since the diodes can be used to provide stabilised l.t. supplies – 24V for the field timebase, dropped to 12V for the decoder and i.f. strip.

SWITCH-MODE POWER SUPPLY

The next decision required was the type of power supply to use. It should supply the line output stage with a well-regulated line since any ripple will modulate the width. To save power it was decided to use a class B audio circuit, and this would need a separate rail. The problem was not easy and there were three possible solutions – a thyristor regulated supply, an auto-transformer with series regulator, and the switch-mode type of circuit.

The use of an auto-transformer was discounted because with an expected set dissipation of about 150W the transformer would be bulky while the series regulator transistor would have to dissipate a lot of power. A thyristor supply could have been used but with the need for a 125V rail to feed the line output stage a huge dropper resistor would have been required. In consequence the switch-mode approach was adopted, though inclined to be expensive. This is an excellent supply technically however and provides several advantages that helped to offset the extra cost.

The decision to adopt a switch-mode power supply was helped by Mullard's announcement of a new i.c., type TDA2640, which acts as a switch-mode power supply control device. This is a single-source item, but previous experiences with Mullard devices have led to considerable respect for them amongst ITT engineers. Another factor was that the i.c. provides over-voltage and excess current protection, tripping the set in the event of an overload. This safety factor weighed heavily in its favour so far as ITT were concerned. In this connection it must be remembered that in the early days of colour television some sets on the market displayed a disturbing tendency to catch fire, with the result that setmakers were made legally responsible for the safety of their sets. A further useful feature of this supply was that it continuously monitors the e.h.t., automatically tripping the set if this exceeds 28kV. Modern tubes are safe up to 33kV without giving off appreciable X-ray radiation, but it was felt that a good set should incorporate a safety circuit to prevent the voltage reaching that level.

The switch-mode power supply is preceded by a mains

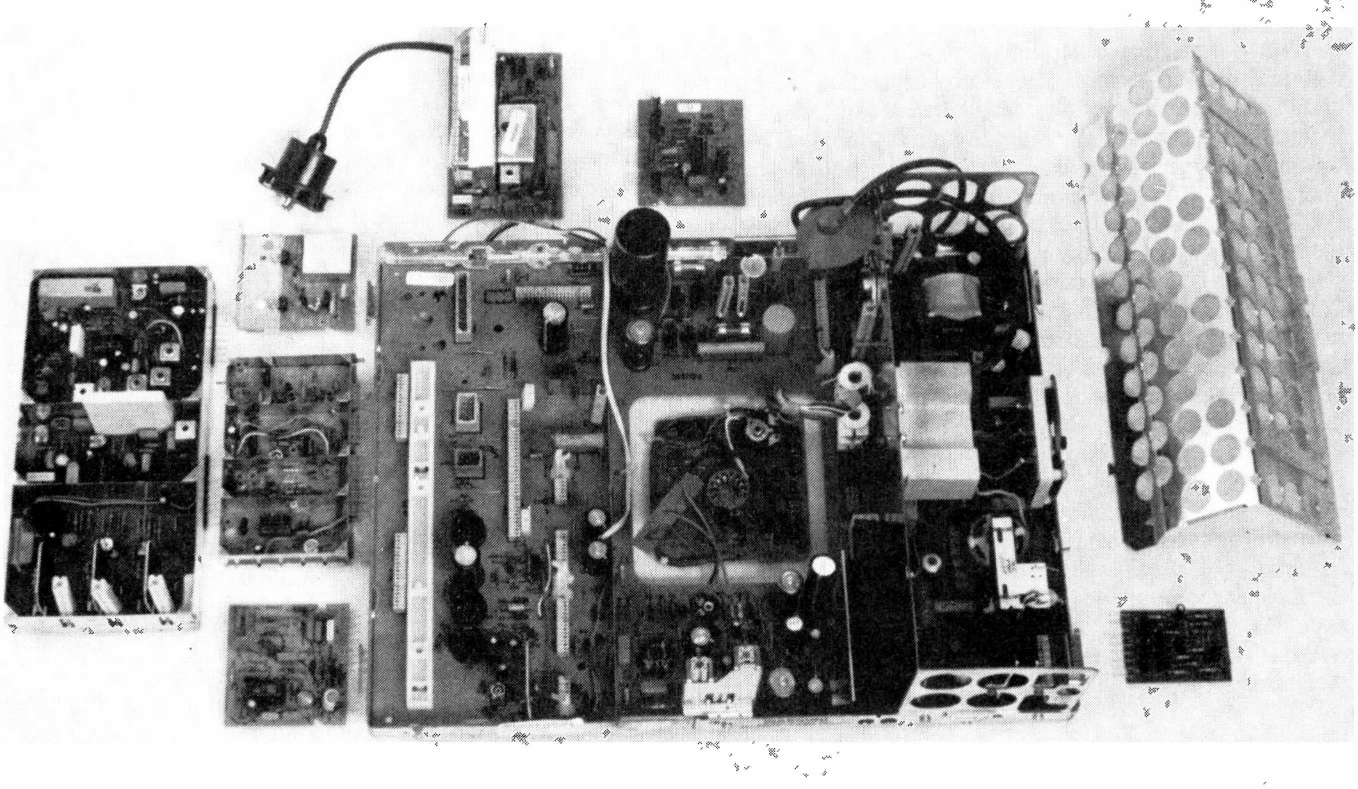


Fig. 2: General view of the mother board which forms the basis for the CVC20 with the various modules removed. This, coupled with the retention of the "swing-down" service position as used in previous ITT chassis, makes for easy accessibility. Another advantage is the ability of the modules to be plugged onto the reverse side of the mother board so that in-situ module repair is simplified.

rectifier and partial smoothing, which provides an unregulated 300V supply. The heart of the switch-mode power supply consists of a high-voltage switching transistor and a reservoir inductor, the control circuit switching the transistor on and off at high frequency – in this case line frequency – in order to reduce the size of the inductor and simplify the output smoothing. When the chopper transistor is switched on, energy is stored in the inductor. When the transistor is off energy passes from the inductor to the smoothing circuit to provide the set's supply. The longer the transistor's period of conduction the more energy is stored and the higher the output voltage obtained. Accurate regulation is achieved therefore by varying the duration of the transistor's on periods.

SIGNAL CIRCUITS

In considering the overall design it was decided to up-date the decoder and the i.f. strip.

The Siemens TBA440N was chosen for the i.f. strip. It contains a vision i.f. amplifier, synchronous vision demodulator and a gated a.g.c. system. It is quite widely used on the continent and we've found no reason to regret the choice.

Several decoder kits were available to choose from, and here again the experience of SEL proved invaluable. They already had several months' experience of the Philips TBA560C and TBA540, and by adding the Mullard TCA800 a three i.c. decoder package with the minimum of external components was obtained. This makes the set easier to manufacture and service, with the simplification automatically leading to greater reliability.

DESIGN DEVELOPMENT

With the electronic arrangements established in outline the time had come for engineers to crystallise the precise design of each area of the set, with careful liaison being maintained. There are a great many pitfalls that can trap the unwary designer – like designing the line output stage to operate at 140V and finding that the power supply gives 100V. Obvious things like this are easy enough to avoid, but there are plenty of sneaky problems that can arise if careful cooperation is not maintained.

Once the various sections had been built and all decisions taken about the major components to be used in the final design the next step was to build the whole thing as a "bird's nest" and then progress towards the panel layout.

At this point the drawing office becomes involved. Everything from the c.r.t. to each individual piece of wire has to be specified exactly and precisely drawn. Only if this is done can the production engineers and purchasing staff – who are concerned with the multiplicity of built-in parts required – be sure that the set is being built correctly with the proper components. Also important at this stage is expertise in designing mouldings, metalwork and printed boards. If this work is well done manufacture is greatly facilitated.

MECHANICAL CONSIDERATIONS

The next decision required was whether to retain or discard the well known swing-down chassis used in the previous chassis. This had earned considerable popularity with service engineers. The swing-down approach was retained since the ease of servicing it gives was amongst the major objectives laid down at the start. There were two problems however, size and the considerable amount of interconnecting wire required. To overcome this a modular approach seemed logical. In the past however modular systems had suffered from a serious shortcoming – faults due to troubles in the plug-and-socket arrangements. What was required if the modular approach was to be adopted was a connector system that could be relied upon without reservation. Once again the German experiences were useful. The factory there had for some time been using with complete satisfaction a new connector system designed by ITT Cannon for such applications – and also used in Concorde. This solved the problem and the modular approach was adopted.

REVERSE PLUGGABILITY

There was an extra bonus, the connector system's reverse pluggability. This allows any module to be removed from the top of the "mother" board – its normal working position – and plugged into the back of the board so that it continues working but is in a more convenient position from the service engineer's viewpoint.

Design of the printed circuit boards required even greater care than usual since the company had decided to invest in computer-controlled automatic component insertion machines to replace the slower and laborious process of component insertion by hand. These depend on the boards being absolutely precise. They are efficient and costly, but have already proved to be a worthwhile investment.

PILOT RUN

The next step was to produce a number of working models for testing, assessment and modification as necessary. Once the set was considered good enough it was released to the production specialists. A batch of sets was built and soak tested, and for use as pre-production models in various specialist areas. At the same time a production line was being prepared. The production of the first, large pilot batch inevitably produced problems, but these were encouragingly few and of no more than a minor mechanical nature.

QUALITY CONTROL

With this first pilot supply to "play" with, the company's quality department took over. Sets were soak tested, dropped, shipped about and generally maltreated to ensure that they could stand up to anything that could happen to them in production, in transit, in dealers' shops or in the home. This long and expensive exercise was particularly important because it was a radically new set.

The go ahead signal that followed these searching tests was a climax to two years of concentrated, coordinated work by several teams of dedicated specialists. Their combined efforts are already yielding handsome rewards not only in home sales but also in substantial export orders, especially from Scandinavia and the Far East. A particularly big demand in Hong Kong proves that coals to Newcastle situations are still possible! ■

Test Report

Manor Supplies Signal Strength Meter

Hugh Cocks

THERE can be nothing quite so frustrating as lining up an aerial in a fringe area without a signal strength meter. Short of taking a portable set up on the roof, the old "left a bit, right a bit" routine is the order of the day. Even in moderate signal strength areas requiring ten element aerials or less it is still best to be able to see the signal peak exactly on a meter when the aerial is on beam. Any imbalance on the three channels due to standing waves can be spotted immediately. A signal strength meter is also useful to DX enthusiasts to measure the strength of incoming long-distance signals.

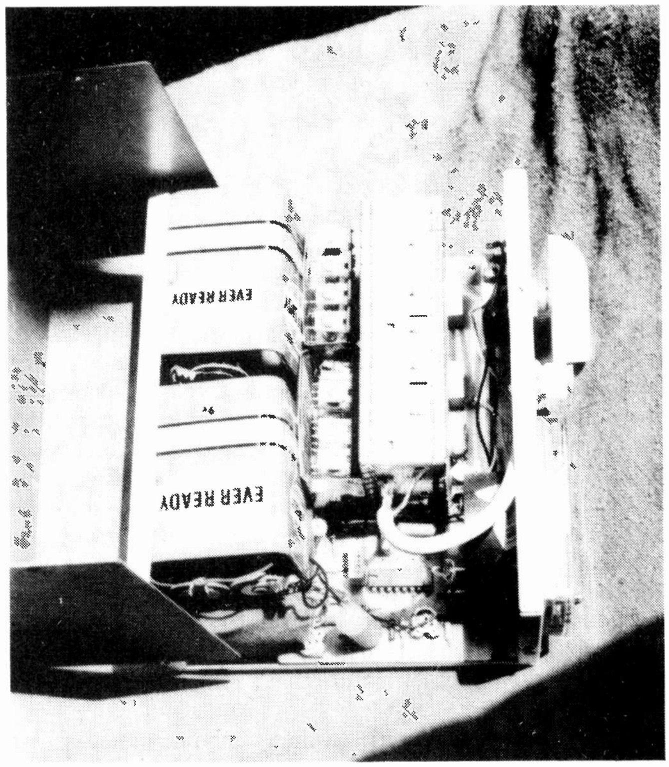
One disadvantage of commercially made models is that they tend to be expensive: unless one is a full-time aerial rigger or an extremely dedicated DX enthusiast the expense of such an instrument is likely to be unjustified.

The Manor Supplies signal strength meter kit is considerably cheaper than any commerical model however and one has the satisfaction of building the unit oneself. Construction of the kit is relatively easy. All the components are mounted on one printed circuit board and only three holes need be drilled in the case for the on-off switch, the input socket and the meter itself. Comprehensive instructions are given, together with a detailed explanation of the circuitry.

The meter supplied with the kit is small (one inch) but Manor Supplies point out that a large meter would unjustifiably increase the cost of the basic kit. There is no reason why a larger meter cannot be used instead however.

Once the unit is built, the job of calibrating it against the known local channels is relatively easy. A light emitting diode is used to identify the vision carrier, and in practice this was found to work well.

The unit is powered by two of the larger 9V batteries in series, plus a smaller PP3 9V battery in series to obtain the required voltage to tune to the top of the u.h.f. band. The current consumption is 60mA. With battery prices what they are today a small mains transformer could be incorporated if the unit is not intended for hard life among the chimney pots.



Photograph showing the internal layout of the original Manor Supplies signal strength meter demonstration unit.

Signals of up to 10mV can be measured. Above this figure a.g.c. is applied to the tuner to avoid damaging the meter movement. The scale of the meter is logarithmic, with 10μV to 10mV being covered in one sweep. For aerial rigging purposes the meter could either be calibrated or a mark could be made to denote the minimum usable picture quality. We calibrated our unit against a commercial meter since it is to be used mostly for DX purposes where accurate signal level readings are required. We found that very low signals could be measured, somewhat lower perhaps than with commercial meters.

The unit has been used here for three months with very encouraging results. All in all we'd say it is well worth buying.

The price at present is £18 plus VAT at 8% and 75p postage and packing. ■

NEW ITT CHASSIS

Three new monochrome portable chassis have been introduced by ITT. The three are largely the same but while the VC400 will be used in 12in. models the VC401 and VC402 are for use in 15in. sets. The differences in fact are confined mainly to minor mechanical changes. It's interesting to note that the i.c. count is less than in the previous VC300 series chassis, the sync separator, line generator and audio sections all reverting to discrete transistor circuitry. The video drive is applied to the grid of the c.r.t., with line and field flyback blanking being carried out at the base of the XK6201/BSY79 video output transistor. The line generator circuit is highly unusual, employing a complementary pair of transistors in the line oscillator circuit, acting as a regenerative switch, controlled by a f.e.t. d.c. amplifier. This type of oscillator circuit – a discrete component version of the silicon controlled switch – has previously been restricted to the field timebase in TV chassis.

There is also a new colour chassis, the CVC9/1. This is a modified version of the well known CVC9, with remote control and automatic contrast control added and the tuner control drawer unit modified for use with remote control switching and for VCR operation. The automatic contrast control arrangement uses a differential amplifier and a light-sensitive resistor. At the same time modifications have been introduced to reduce striations on the left-hand side of the screen. These consist of a 210pF capacitor across tags 10 and 12 of the line output transformer and a 330pF capacitor and 1·8kΩ resistor in series across tags 6 and 9. The 210pF capacitor was previously connected between tag 12 and chassis.

Faults on the Philips G8 Colour Chassis

A. Denham

HOW can one summarise a chassis which has been around now for over six years? The latest versions bear only a superficial resemblance to the earliest models. Nevertheless although much modified the sections where you'd expect to find most faults – the power supply and the line output stage – still follow the same basic arrangements, a thyristor regulated h.t. supply in the former case and a two-transistor line output circuit in the latter. The first set to be fitted with the G8 chassis was the G22K520, released in the autumn of 1970. This was followed very quickly by modified versions suffixed /01 and /02. The design then settled down until the 550/02 versions appeared on the scene in 1974/5. These incorporated a new combined i.f./decoder board along with various modifications to allow easy connection of a videocassette recorder and to reduce the video drive required. The G8 chassis also introduced varicap tuning to the UK market, another feature that's remained throughout the series.

The recurrent snag with so many modifications is that even when working on two new stock receivers quite often the individual panels have been found to be different. The latest G8 manual is a worthwhile investment, covering most of the panels likely to be encountered, with the 550 supplement covering the very latest boards.

The Decoder

Let's start with the decoder. To over-ride the colour-killer connect TP26 to TP80 in order to forward bias the second chrominance amplifier transistor. When the decoder is operating normally TP26 is at about 14V. In the absence of the burst signal this voltage drops to about 2V. Incidentally, over-riding the colour-killer removes the ident amplifier output.

In most panels there are two i.c.s, a TBA520 and a TBA530. The former provides chrominance signal demodulation and incorporates the PAL switch. When faulty the usual symptom is no colour. Once I had the fault no PAL switching due to the two 0·01μF capacitors C7284/5 which feed positive-going line-frequency drive pulses to the bistable circuit in this i.c. being faulty. The TBA530 acts as a primary-colour matrixing and driver stage. The colour-difference signal inputs are d.c. coupled from the TBA520, associated with which are three potentiometers which set the d.c. levels of these signals. Adjust these for 140V at the collectors of the RGB output transistors, after removing socket E and setting the contrast and brightness controls to zero. The supply to these potentiometers comes via coil L7312: if this goes open-circuit there is an excessively bright unmodulated raster with the brightness control having no effect, due to the output transistors being driven hard on. The supply is stabilised by a 12V zener diode (D7315) which can be responsible for intermittent brightness variations.

There is a discrete BF194 transistor reference oscillator (T7173), also discrete transistor burst and chrominance amplifier channels on this decoder. The procedure given in the manual for setting up the decoder when it's misaligned is the best I've come across.

Total lack of one colour, or a blank red, green or blue raster, is usually due to the trap coils in the signal feeds between the two i.c.s going open-circuit, but the latter symptom can be caused by the 47kΩ resistors or the 5·1kΩ load resistors in the RGB output stages or alternatively the transistors themselves – BF337s in later decoders, BD115s in earlier decoders (see Fig. 1).

No vision with a blank white screen and flyback lines is frequently due to no h.t. supply to the decoder, generally as a result of a break in the print or the edge connector's pins failing to enter the socket fully. This same fault can also be due to the BC148 black level clamp transistor T7220, the BC158 pulse inverter transistor T7227 or, as previously mentioned, L7312 or alternatively L7317 being open-circuit – in the latter case there is no d.c. supply to the TBA530 i.c.

No luminance is commonly due to the luminance delay line or coil L7240 which is in series with it being open-circuit. The trouble may be intermittent in the case of L7240.

The ham-fisted attempts made by some engineers to fit the back often results in the soldering between the contrast control and the print being damaged. The result can be no, low or excessive contrast.

Intermittent colour, with unlocked colour on over-riding the colour-killer, can be due to C7132 and C7133 which feed the burst detector diodes, while the decouplers C7272 and C7265 in the second chrominance amplifier/delay line driver stage can cause blinds with reduced saturation. Another fault I came across once was a damaged delay line – the print inside was open-circuit. Apart from these points however few decoder faults have come my way.

IF Board

One or two faults on the i.f. board have become standard over the years. Sound buzz is usually due to the intercarrier sound i.c. (TAA570 on earlier boards, TBA750 on later ones). The TBA750 can also be responsible for excessive hiss. Note that if transistor T2505 in the sound selectivity

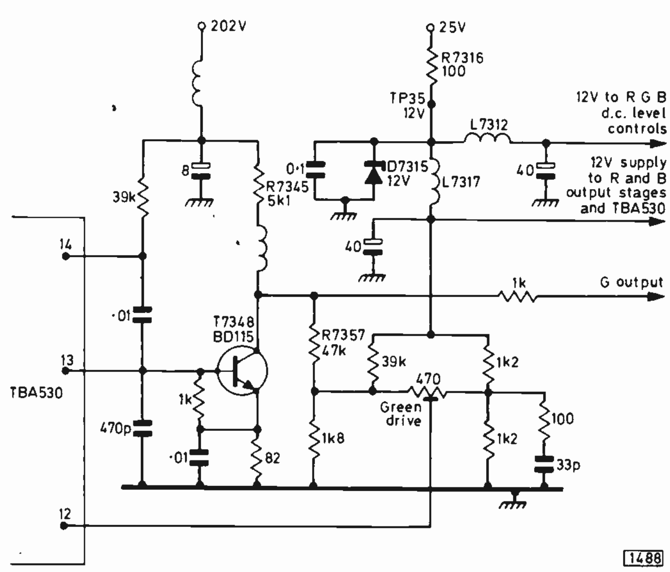


Fig. 1: Circuit of the green output stage. The blue output stage circuit is identical but the red output stage has fixed feedback, i.e. a fixed potential divider replaces the preset drive control. Also showing l.t. feeds in this area.

can U500 goes open-circuit there will be no colour either.

The supply to the tuning system comes via a 33kΩ 1W resistor (R2143) which is mounted on the i.f. panel. This is a common cause of drift when it increases in value. Drift can also be due to the a.f.c. can while the switching head, particularly the later flap type, is prone to intermittent contacts. Cleaning the earlier type with Servisol and a soft brush will cure the fault, but with the later type I have found that if the head is split apart and *gently* cleaned with a light rub of dry Vim on the print, then left to dry (no grease or contact oil), the trouble rarely recurs. In one or two cases drift has been traced to the 4μF reversible electrolytic C6150 on the tuner panel.

No sound is frequently the TBA750 i.c. on the later signal panel, or the two BD131 sound output transistors on either panel.

No or weak field sync with a tendency to line jitter has always in my experience been the "jungle" i.c. on the i.f. board – type TAA700 on earlier panels, TBA550Q on later ones. In both cases I use the TBA550Q for replacement purposes.

Apart from these points there have been few faults in the signal section. Low gain can be due to dry-joints in the tuner.

Timebase Board

The timebase panel contains the field timebase, the line oscillator, the flyback blanking transistors and the pincushion distortion correction transductor L4485.

The field timebase suffers from similar treatment to the contrast control, i.e. ham-fistedness. What usually happens is that the BD124 (BD131 in later sets) field output transistors go short-circuit due to the field oscillator stopping. The same damage is easily caused by touching the gate of the BRY39 s.c.s. field oscillator with a meter prod.

No field scan generally means defective output transistors and their low-value series resistors, and sometimes the AC128 driver transistor as well. Wherever possible check with a 'scope that the oscillator is doing its job – BD124s are expensive.

From the a.c. viewpoint, the field deflection coils are returned to chassis via a large electrolytic (C4479, 400μF) and the convergence circuits. C4479 going open-circuit results in severely reduced field scan.

Smoke from the rear indicates that the transductor is imitating an electric fire – along with the ½W 120Ω resistor near it (R4484). Change them both and soak test the set while keeping an eye on the h.t. rail – more than once we've had the power supply thyristor with a gate-cathode short-circuit, putting 300V or more on the h.t. rail instead of 205V.

The line oscillator circuit on this board has never yet given me any problems. Full marks to Philips here. If you're wondering where the flywheel sync discriminator is, it's in the jungle i.c. on the signal board.

No flyback blanking gives the misleading syptoms of a blank white raster with flyback lines and a faint red band about 2in. from the left. In most cases the trouble is due to one or other of the blanking transistors T4488 or T4524 (both type BC148), or to the edge connectors.

Line Output Stage

Snags lie in wait for the unwary in the line output stage. All the power supply lines except for the h.t. rail itself are obtained from rectifiers fed from the line output transformer. In most sets four BA148 diodes provide a 45V rail which is used for the field and sound circuits, another two BA148 diodes providing a 25V rail which is used in the low-voltage sections of the receiver. There's a 1·25A fuse in series with the 45V supply rectifiers. When the field collapses this fuse blows and there is no sound either.

The line drive from the timebase board is first squared by T5514 and then fed to the driver transistor T5519 which is transformer coupled to the two BU105/02 line output transistors. There's a balancing coil in the base circuits of these transistors and if a line output transistor has to be replaced it is essential to carry out the rebalancing procedure as follows: spray the core of the balance coil L5003a/b with switch cleaner or lubricant and leave to soak. This is necessary because the core tends to glue itself to the former, with the result that attempts to move it unaided usually end up with it being broken. It's situated at the top centre of the line output assembly, on the drive board. Set the core to its centre position, turn the h.t. to its lowest setting, connect a voltmeter across the 47Ω anti-breathing resistor R5535, then set the core for maximum voltage across this resistor. Finally reset the h.t. to the normal level.

The 205V h.t. supply to the line output stage is first smoothed by a 600μF capacitor (C5536) which is mounted on the front of the assembly and then goes to the rest of the circuit via an 800mA fuse (FS5557). At one time the 600μF smoother seemed prone to blowing up, for no apparent reason, covering the innards with white goo. The fuse will blow when the line output transistors go short-circuit. Results of sorts – an oversize picture with poor focus and convergence – can be encountered if only one of the output transistors has gone short-circuit or if one of the tuning capacitors (C5545/C5546) in parallel with the output transistors has gone open-circuit.

The tripler used is no more nor less reliable than other types, but if one does go it is quite usual to have one or both output transistors duff into the bargain.

Two other supplies are obtained from the line output transformer, the usual line shift voltage and an 835V boost supply for the c.r.t. first anode potentiometers. No c.r.t. first anode supply is usually due to the BYX10 boost diode (D5533) going kaput, along with its reservoir capacitor C5534 (0·01μF).

Beam Limiter Circuits

The beam limiter is on this board, and there have been two versions. In the later two-transistor circuit (T5581/T5587) there is a 12V zener diode (D5582) which has always been prone to drifting, causing fluctuations in the brightness level. When replacing it (type BZY88/C12) leave the leads as long as practicable. The diode can go as far as causing complete loss of raster. In the earlier single-transistor beam limiter circuit the transistor (T5569, BC147) can go short-circuit, giving very low brightness.

Focus Arrangements

The earlier, chassis mounted, focus assembly consisted of a VDR with 4·7MΩ resistors in series on each side. These two resistors sometimes change value, giving poor focus. The later focus unit is on the c.r.t. base panel and has given me no trouble at all.

First Anode Controls

The 2MΩ first anode potentiometers can go open-circuit, giving the picture a tint corresponding to the missing

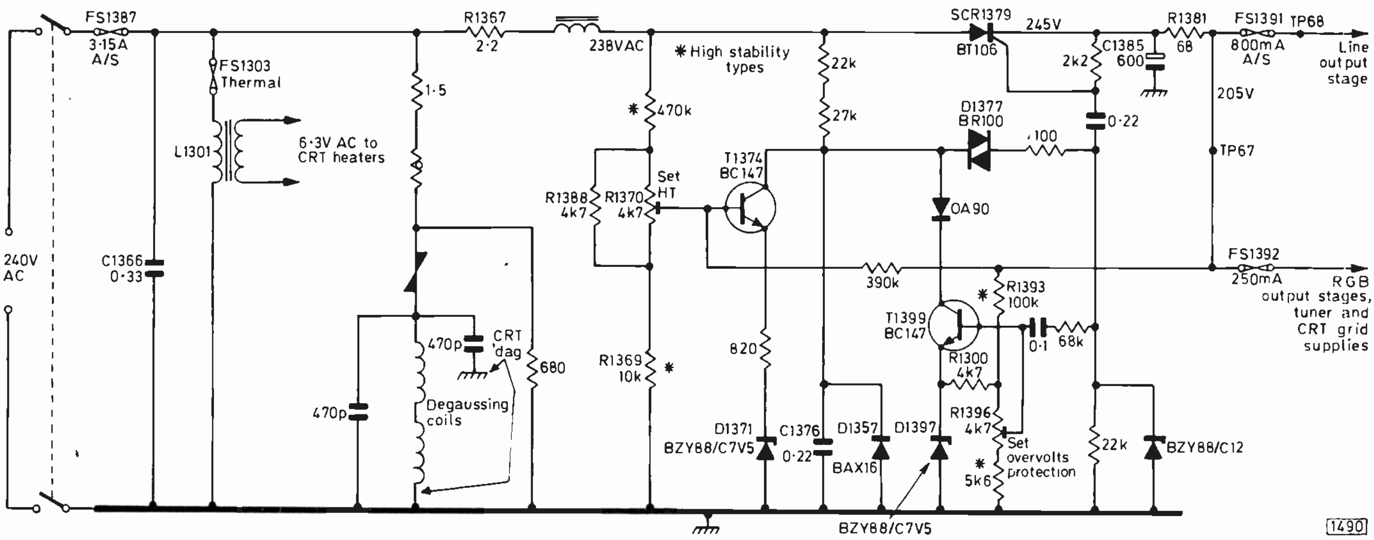


Fig. 2: The power supply circuit. This is the current circuit – variations will be found in earlier versions.

voltage, e.g. cyan when the red first anode potentiometer is open-circuit.

Power Supply Board

The power supply consists of a thyristor rectifier which provides a stabilised 245V output. This is dropped to 205V via a 68Ω wire-wound resistor. There are also the degaussing components, and a transformer to provide the c.r.t. heater supply. The thyristor is triggered by a diac and there are two transistors, T1374 which controls the triggering and T1399 which provides over-voltage protection. The symptom when the over-voltage protection circuit operates is a very obtrusive picture flutter. The circuit is shown in Fig. 2.

HT Flutter

The most common fault is h.t. flutter which setting up the h.t. usually cures. In persistent cases the BR100 diac (D1377) may need to be replaced. If the supply refuses to flutter when being set up one or either of the zener diodes D1371 or D1397 or the BC147 over-voltage protection transistor may be faulty.

Dropper Troubles

The dropper (68Ω section plus a 2·2Ω surge limiter section, R1381 and R1367 respectively) has given problems. No a.c. at the anode of the thyristor is due to the lower 2·2Ω section being open-circuit while h.t. at the cathode of the thyristor but not at the 800mA fuse is due to the upper 68Ω section having gone. Always discharge the h.t. reservoir capacitor C1385 before replacing the dropper – 300V on a 600μF can tends to surprise . . .

Fuses

If the 250mA h.t. fuse goes there is no h.t. to the RGB output transistors and no supply to the tuner. The symptoms are a blank white screen and noise but no sound.

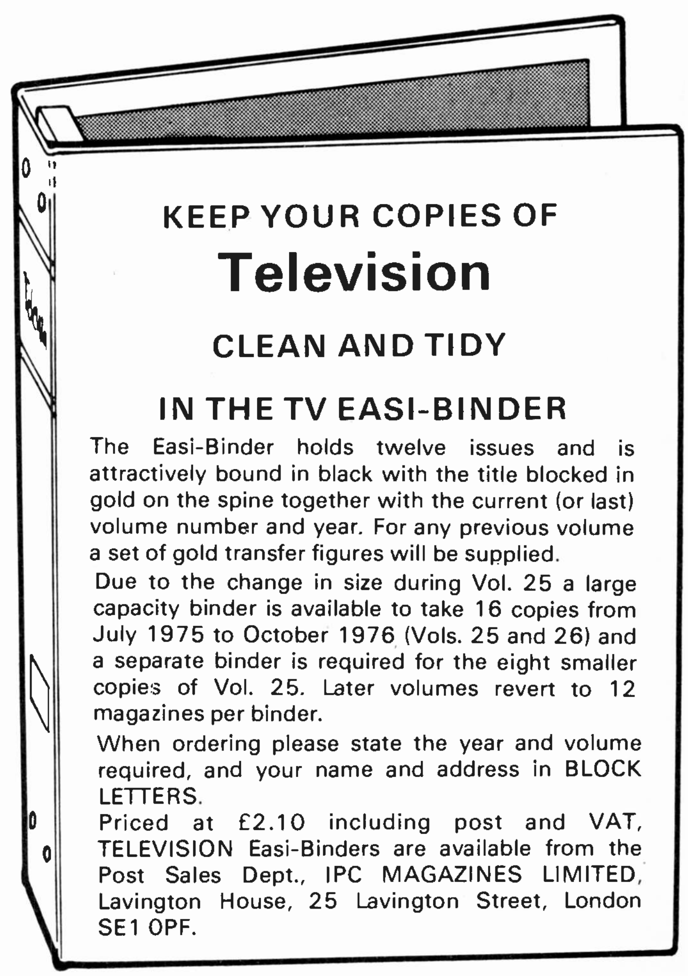
Repeatedly with the G8 chassis the mains fuse blows for no apparent reason. Nine times out of ten a new fuse clears the trouble, but if it persists try a new BT106 thyristor.

Intermittent CRT Heaters

If the c.r.t. heaters operate intermittently check whether the heater supply plug on the power supply panel is making poor contact.

HT Adjustment

To set up the h.t., set the "set h.t." control R1370 to mid-travel and the over-voltage protection control R1396 fully anti-clockwise. Connect a meter to either of the h.t. fuses and set the h.t. to 225V. Set the over-voltage protection control so that the h.t. is reduced to 220V. The picture should then flutter. Finally reduce the h.t. to 205V with the set h.t. control ■



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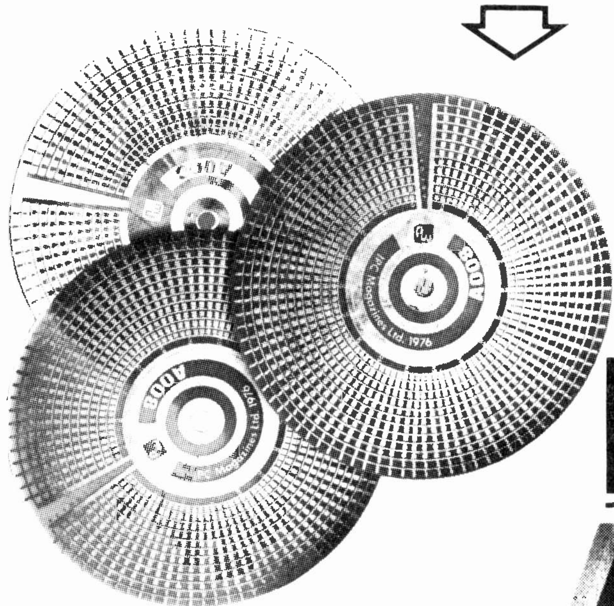

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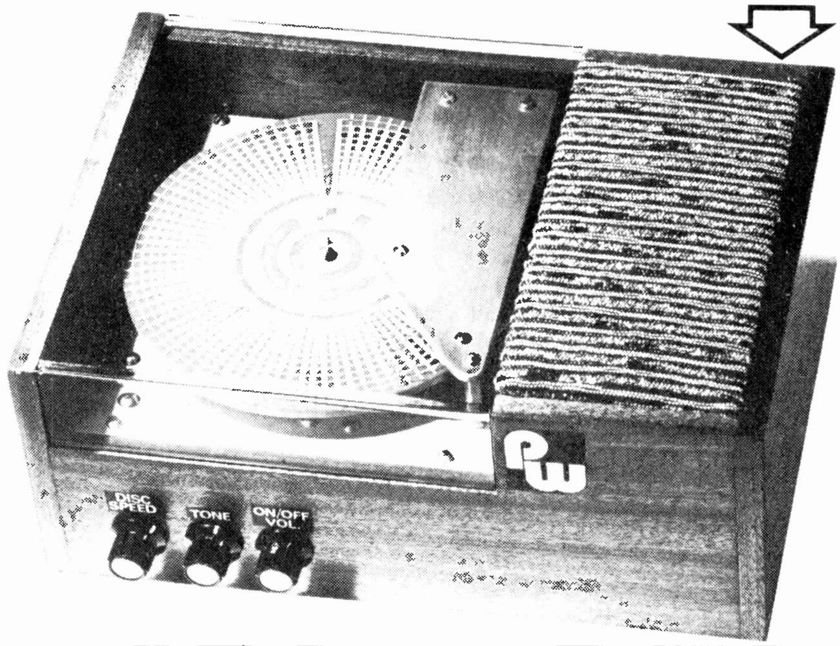

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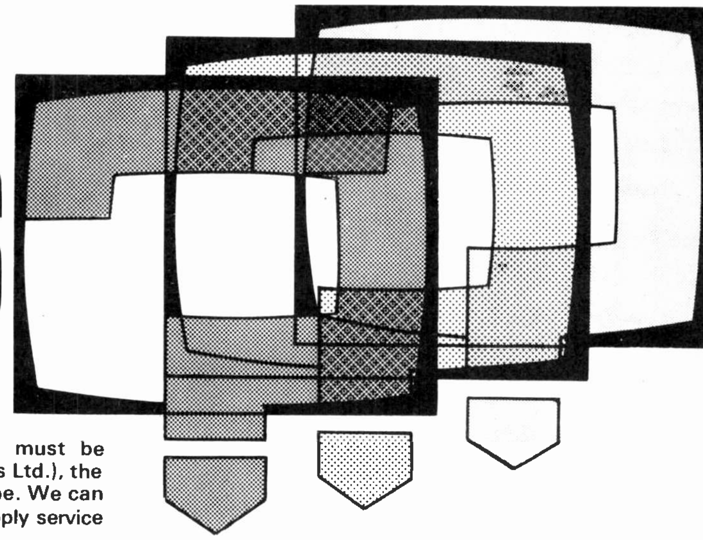

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ULTRA 6715

There is random horizontal jitter of the whole picture. When this happens the picture appears to remain locked. The average shift is approximately ¼in. though on some occasions it seems to be more. There is also a certain amount of breathing on the picture.

If you are lucky the fault is due to a noisy line shift potentiometer (R523, 50Ω). As a check, the entire shift circuit can be eliminated by removing the a.c. blocking choke L504. If the fault persists, it is due to line oscillator jitter and can be caused by almost any component in the flywheel sync/line oscillator circuits. Prime suspects are the electrolytics C506 and C511, the discriminator diodes W501 and W502, the reactance transistor VT501 and the supply decoupler C508 (100μF). Picture breathing is commonly due to the multiple electrolytic C602/3/6 on the power supply board drying up. (Thorn 3500 chassis.)

BUSH TV125

There is no scan or line whistle on this set. All line timebase valves have been replaced, also the boost capacitors, but there is still no e.h.t. The problem is present on both systems.

Since you don't mention overheating it would seem that the trouble is that the line output valve is passing little current due to lack of screen grid voltage. Check the 2·2kΩ wire-wound resistor on the tag strip beneath the PL36. It's probably open-circuit.

GEC C2103

The fault on this set, the field hold control locking the picture (P501, 250kΩ) at only one end of its travel, was found to be due to the control itself falling in value.

Thanks for the tip! The other suspect would be the ECC82 valve (V507) of course. (GEC single-standard hybrid colour chassis.)

HMV 2803

After replacing the tube a very good picture was obtained but the sync will not lock. All the valves have been replaced. The video output transistor's collector load resistors and the sync separator's screen grid feed resistor have been checked, also the following capacitors, the electrolytics C32 and C37 in the video channel and C41 and C42 in the sync separator circuit. Have I overlooked anything?

Yes! The HT2 feed to the video output transistor is smoothed by a 12μF electrolytic (C38) which will cause this trouble when it goes open-circuit. (Thorn 1500 chassis.)

BUSH CTV25

There is smearing across the screen on this set. It takes the form of light or dark horizontal bands which are more noticeable on close-ups. The bands are of the background colour or darker. If someone in a close-up raises or lowers their hands the colour band moves with them. There are also striations on the left-hand side of the screen.

Assuming that the contrast and colour controls are not over-advanced, the trouble is likely to be in the colour-difference clamps. Check the PCL84 valves, and the clamp pulse input coupling capacitor 6C17 and the associated resistors. An oscilloscope would be invaluable. Further possibilities are 6C16 which decouples the clamp potential and 6C18 which decouples the screen grids of the three PCL84s. The striations could be caused by 3R52 (1·5kΩ) which damps the linearity coil or the harmonic tuning capacitor 3C37 (180pF).

ULTRA 6700

This set works very well apart from the following aggravating fault. Often at the right-hand side of a white portion of the picture – such as a shirt or collar – there is a smear of pink followed by green, the green overshooting the white. The only way in which this can be reduced is by lowering the contrast control setting – but this results in a dim and misty picture which is hardly worth watching. Almost every permutation of c.r.t. first anode and grid voltages has been tried without improving matters.

In our experience almost every Thorn 2000 chassis still fitted with the original tube exhibits this symptom – it's invariably due to a tired c.r.t. If you are lucky the tube might respond to reactivation. If not, a new or regunned tube is the only cure. (Thorn 2000 chassis.)

BUSH TV176

There is a dark patch, about 6in. in diameter, at the centre of the screen, with the brilliance control at maximum. When the control is turned back by a quarter of its rotation the screen goes blank.

The line output transformer is usually responsible for this symptom, which is basically due to low e.h.t. First however check the PL504 line output valve, the PY88 boost diode and the width control circuit. (Bush TV161 series.)

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TELEVISION DEC 1976

GEC C2147

The 12V supply fusible resistor R601 (on the line output panel) goes open-circuit after the set has been on for an hour or so, leaving a blank raster on the screen. Before the fault occurs the picture will expand and shrink rapidly and at the same time increase in brightness. The h.t. voltage is normal at switch-on (190V at the junction R66/R67) but when the picture instability occurs rises to 250V – then R601 opens.

It seems almost certain that the problem is due to a faulty thyristor in the regulated power supply (SCR701 BT106). If not the trigger diac D701 (BR100) could be defective. (GEC C2110 solid-state colour series.)

MURPHY V1914

The problem with this set is that the left-hand third of the picture is lighter than the rest, with a light line marking the division. It's not so noticeable with a normal picture, but with dark scenes or with no picture being transmitted it shows up plainly. The line timebase and video valves have been replaced.

The two most likely causes of the condition are that either the c.r.t.'s first anode decoupling capacitor 3C51 (0·1μF) or the line flyback pulse coupling components 3R29 (470 kΩ) and 3C26 (0·01μF) are defective. (Bush TV161U series.)

BRUNSWICK CSB2205

The problem with this colour set, which uses a Decca hybrid chassis, is persistent hum or buzz on sound on all channels. It does not matter whether the aerial is connected or disconnected. The fault is not due to the main smoothing electrolytics nor the sound output section but appears to be in the r.f. or i.f. stages. Could the alignment have been interfered with to produce the effect?

The i.f. alignment is unlikely to be responsible if the buzz persists with the aerial disconnected. The l.t. supply smoothing electrolytics C604 and C606 on the bottom printed panel are the most common cause of the fault. If you are sure that these are o.k., suspect heater-cathode leakage in the PCL82 audio output valve. Short-circuit turns in the h.t. smoothing choke L600 are not unknown, but the ripple is then present on the timebases as well.

CROSSHATCH GENERATOR CONNECTIONS

I recently bought the Bi-Pre-Pak crosshatch generator Mk. II and wish to use it with a Pye Model CT73 (691 hybrid chassis). Can you tell me where the pulse pick-up lead and the video output lead should be connected.

The line pulse pick-up lead need only be dangled near the line output transformer – without any electrical connection. Connect the video lead to any terminal (other than earth!) of the luminance delay line.

PHILIPS G24T306

The picture is very dark when the set is switched on, and takes about half an hour to reach the correct brightness level. The brightness can be brought up by adjusting the brightness control, but must then be turned down again when conditions become normal. The voltages at the brightness control remain correct and there is little appreciable variation in the c.r.t. voltages. All valves have been tested and the electrolytics seem to be in order. The picture is of full size and perfect linearity from switch on, and once the brilliance has stabilised is of splendid quality.

The video output section of the PFL200 is d.c. connected to the c.r.t. cathode in these sets and the problem is usually caused by a change in the valve's anode voltage, due either to a defect in the valve or an associated component. If you are sure that the c.r.t.'s cathode and grid voltages remain constant under the low and normal brightness conditions we suggest you check the first anode feed components – resistor R2175 (1·2MΩ) and its associated decoupler C1556 (0·047μF). (Philips 300 chassis.)

FERGUSON 3712

The sound on this set popped and crackled every time the volume control was adjusted. The control was replaced, but with no success. Now however the sound pops and goes off completely. It can be restored by switching the set off and on.

Check by substitution C138 (1μF) which decouples the d.c. from the volume control to the intercarrier sound/a.f. preamplifier i.c. It's connected from pin 6 to chassis. If the fault is still present replace the i.c. itself – IC2, type CA3065, MBRC1358 or SN76666N. (Thorn 8000 chassis.)

PYE 21UF

The pitch on the line output transformer was melting so I replaced it, thinking that there might be shorted turns. After two weeks the wax on the new transformer started to melt. The DY87 e.h.t. rectifier and PY800 boost diode have been replaced.

A shorted turn on the line output transformer would give you no raster at all. The symptoms suggest that the PL36 line output valve is passing excessive current due either to the valve itself, the input coupling capacitor C87 (0·01μF) being leaky or a fault in the drive circuit. (Pye 11U series.)

FERGUSON 3707

The picture goes from normal to an all over green raster, with the brightness and colour controls having no effect. The preset brightness control on the beam limiter board also has no effect, but adjustment of the beam limiter preset control R903 does alter the intensity of the green raster so that a faint, defocused picture is visible. Disconnecting the aerial leaves a noisy green raster. The fault originally came on for short periods, but now appears to be there to stay.

You will almost certainly find that the c.r.t. green cathode voltage (pin 6) is at zero potential. It should be at approximately the same voltage as the other cathode pins 2 and 11, i.e. about 160V. If this voltage is low or absent, check back to the video board at point 15/1 and to the green output stage peaking coil L207. If there is 200V at one end and little voltage at the other check this coil which could be dry-jointed or not soldered. If there is little voltage at either end of the coil check the 12kΩ load resistor R264. If this is cold, change it. If it's hot, change the BF179 transistor (VT212). (Thorn 3000 chassis.)

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.

After several years of excellent performance a Grundig Model 717GB arrived at the workshop with the complaint slip marked "picture turns red intermittently". After the receiver had been set up in the symptom checking bay perfect results were obtained, and the receiver was still behaving itself after running for a couple of days. Before returning the set to the customer however it was decided to subject the chassis to one or two mechanical tests. The back cover was removed and, with the receiver operating, a suitably long insulated rod was used to apply mild pressure to the printed circuit board and the components around the colour demodulator (TAA630) and the colour-difference output stages. No evidence to suggest that a dry-joint or poorly soldered i.c. or transistor could be found however. As similar symptoms can be caused by an intermittent picture tube the neck of this was also subjected to mild mechanical vibration, but still no sign of the symptom.

The workshop technician decided to accompany the receiver back to the customer to see whether an installation fault could be responsible. Good pictures and sound were obtained but, just as the technician was about to leave, the picture slowly turned red and became mildly unstable – something like hum modulation on the red raster. With the symptom still present the back cover was carefully removed and three measurements were made at the base of the picture tube. After making these tests the technician had a fair idea of the location of the trouble.

The receiver employs colour-difference drive to the tube grids, with the Y signal going to the cathodes in the usual way. Transistor colour-difference output stages and diode clamping circuits are employed, while the colour-difference signals come from a TAA630 i.c.

What was the most likely cause of the trouble and what were the three measurements made by the technician? See next month's Television *for the solution and for a further item in the* Test Case *series.*

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6AG7	0.60	6J5GT	0.50	50CD6G	1.20	ECH84	0.50	PC88	0.62	UAF42	0.70
6AH6	0.70	6J6	0.35	85A2	0.75	ECL80	0.45	PC97	0.39	UBC41	0.50
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6AN8	0.70	6K8G	0.50	5763	1.65	ECL86	0.45	PCC85	0.47	UBF89	0.39
6AQ5	0.47	6L6GC	0.70	AZ31	0.60	EF22	1.00	PCC89	0.49	UC92	0.50
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6BA6	0.40	6V6G	0.30	E180F	1.15	EF89	0.32	PCF801	0.49	UF41	0.70
6BC8	0.90	6X4	0.45	E188CC	2.50	EF91	0.50	PCF802	0.54	UF42	0.80
6BE6	0.40	6X5GT	0.45	EA50	0.40	EF92	0.50	PCF805	1.00	UF80	0.40
6BH6	0.70	9D7	0.70	EABC80	0.40	EF183	0.36	PCF806	0.53	UF85	0.50
6BJ6	0.65	10C2	0.70	EAF42	0.70	EF184	0.36	PCH200	1.00	UF89	0.45
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6BQ7A	0.60	10F18	0.65	EB34	0.30	EL34	0.90	PCL83	0.49	UL84	0.43
6BR7	1.00	10P13	0.80	EB91	0.17	EL41	0.57	PCL84	0.46	UM80	0.60
6BR8	1.25	10P14	2.50	EBC41	0.75	EL81	0.65	PCL86	0.54	UY41	0.50
6BW6	1.00	12AT6	0.45	EBC81	0.45	EL84	0.34	PCL805	0.60	UY85	0.35
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6C4	0.40	12BA6	0.50	EBF89	0.40	EL506	1.20	PL81	0.49	U26	0.60
6CB6A	0.50	12BE6	0.55	EC86	0.84	EM80	0.55	PL81A	0.53	U191	0.50
6CD6G	1.60	12BH7	0.55	EC88	0.84	EM81	0.60	PL82	0.37	U251	1.00
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6CL6	0.75	19AQ5	0.65	ECC33	2.00	EM87	1.10	PL84	0.50	U801	0.80
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6DT6A	0.85	30C15	0.77			EY88	0.55	PY80	0.50		
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SOLUTION TO TEST CASE 167

Page 51 (last month)

The fault described last month on an oldish Sobell colour set could equally have been found in various GEC models which use the same chassis. Like most hybrid colour chassis, the line generator stage consists of a PCF802 sinewave line oscillator circuit. The pentode section of this valve is the oscillator proper, with feedback between its screen and control grids, the triode section of the valve acting as a variable capacitance in the *LC* tuned circuit. The voltage obtained from the flywheel sync circuit is applied to the triode's control grid, varying its conductance/capacitance and thus the frequency of the oscillator. Component changes in such circuits can produce curious symptoms such as vertical lines, shading effects etc. Electrolytic capacitors in this type of circuit are particularly prone to cause troubles of this sort. In the GEC/Sobell circuit the PCF802's triode anode and pentode screen grid are fed from the h.t. line via a 12kΩ and a 220Ω resistor, the junction of these components being decoupled by a 4μF electrolytic (C508). Replacing this capacitor cured the fault.

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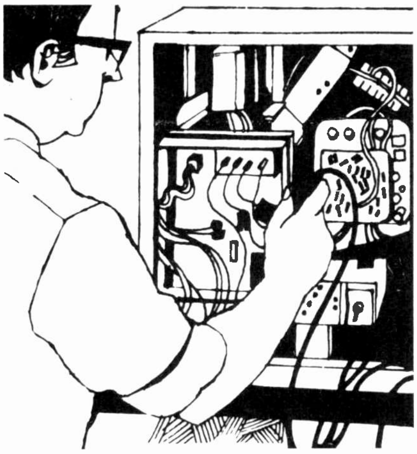

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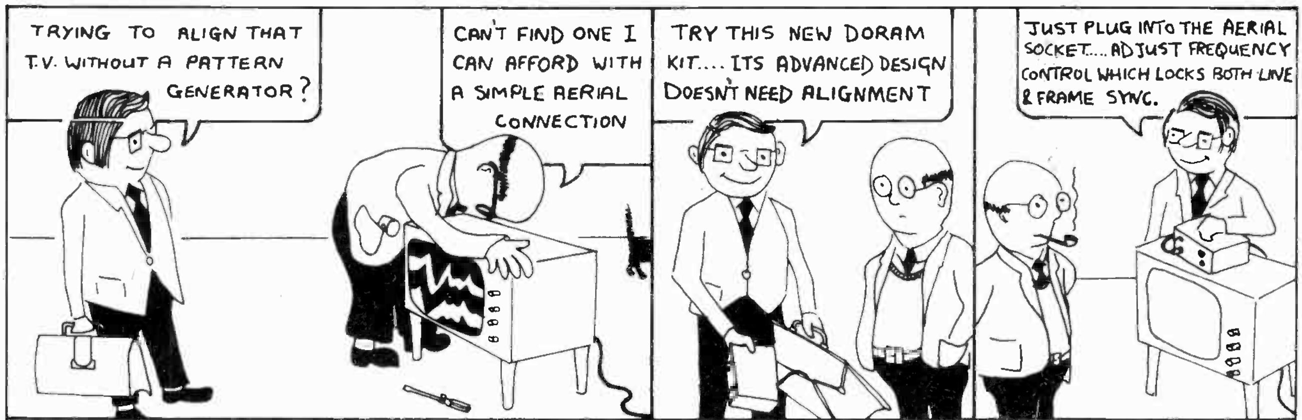

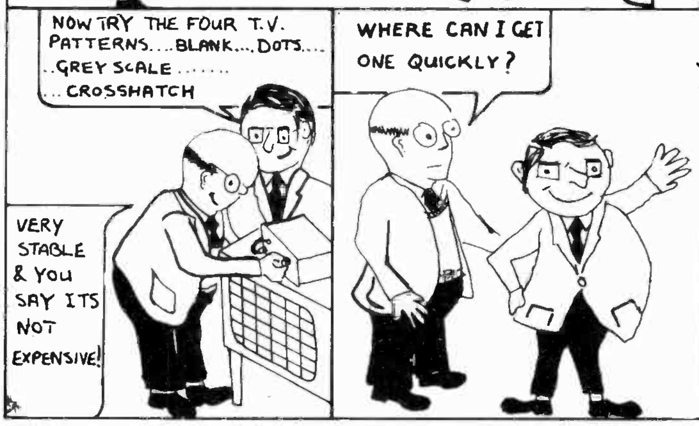

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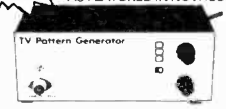

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600, 602, 604, 606, 608, 610, 612, 622, 624, 625, 626, 628, 630, 632, 640, 642, 644, 646, 648, 652, 653, 661, 662, 663, 664, 665, 666, 667, 668, 669, 671, 672, 673, 674, 675, 676, 677, 681, 682, 683, 685, 687, 688

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