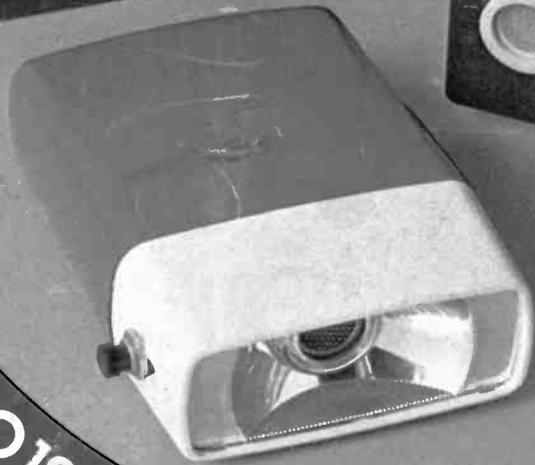


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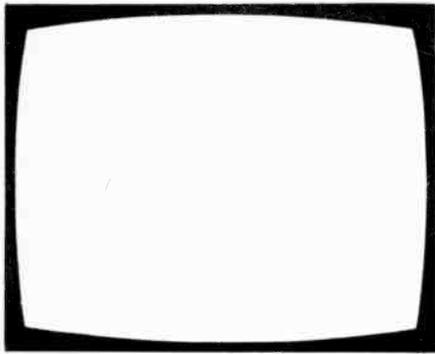
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# TELEVISION

November  
1976

Vol. 27, No. 1  
Issue 313

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## CORRESPONDENCE

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

## BINDERS AND INDEXES

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## QUERIES

We regret that we cannot answer technical queries over the telephone nor supply service sheets. We will endeavour to assist readers who have queries relating to articles published in *Television*, but we cannot offer advice on modifications to our published designs nor comment on alternative ways of using them. All correspondents expecting a reply should enclose a stamped addressed envelope.

Requests for advice in dealing with servicing problems should be directed to our Queries Service. For details see our regular feature "Your Problems Solved".

## this month

- 7 **40 Years On**  
Leader
- 8 **Teletopics**  
News, comment and developments.
- 12 **Servicing Grundig Colour Receivers** *by A. Denham*  
Notes on the 5010/5011/6010/6011 series of 110° solid-state receivers which feature a thyristor line output stage.
- 15 **Ultrasonic Remote Control Unit** *by Alan Willcox*  
A new system by A. Willcox based on his earlier designs but featuring minimum consumption and number of connections so that it can be added to the receiver with the minimum amount of work and modification.
- 18 **Servicing Television Receivers** *by L. Lawry-Johns*  
Concluding the account of fault conditions experienced on the Philips K70 colour chassis.
- 24 **Intercarrier Sound Pick-up** *by Hugh Cocks*  
A review of the system available from Manor Supplies for extracting the 6MHz intercarrier sound signal from a TV set for feeding to a high fidelity installation.
- 25 **Next Month in Television**
- 26 **Servicing the Indesit Model T12LGB** *by John Law*  
A large number of these 12in. monochrome portables were imported over a period of several years. Some of the circuitry, for example the chopper mains power supply system, is unusual. A guide to the chassis and fault finding procedures.
- 32 **The Sony VO1810 Videocassette Recorder, Part 1** *by M. P. Riley*  
In the first of this two-part account of the Sony VCR the signal processing techniques in both the record and playback modes are described.
- 40 **Service Notebook** *by G. R. Wilding*  
Notes on faults and how to tackle them.
- 42 **Video Circuits for the Experimenter** *by Luke Theodossiou*  
Luke Theodossiou describes the various video output circuits he has tried out in the solid-state monochrome receiver he first built four years ago.
- 44 **Long-Distance Television** *by Roger Bunney*  
Reports of DX reception and conditions, and news from abroad. Plus an account of Tropospheric propagation and reception, to prepare enthusiasts for the start of the new season.
- 49 **Your Problems Solved**  
A selection from readers' queries.
- 51 **Test Case 167**  
Can you solve this fault? Plus the answer to last month's problem.

**Held-over:** We regret that due to shortage of space we have had to hold over until next month Dewi James's column on some less usual fault conditions.

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**TOTAL** 84p  
**£7.59**

<p><b>BUSH</b></p> <table border="0"> <tr><td>TV102C</td><td>TV128</td><td>TV183 or D</td></tr> <tr><td>TV103 or D</td><td>TV134</td><td>TV183S</td></tr> <tr><td>TV105 or D</td><td>TV135 or R</td><td>TV183SS</td></tr> <tr><td>TV105R</td><td>TV138 or R</td><td>TV185S</td></tr> <tr><td>TV106</td><td>TV139</td><td>TV186 or D</td></tr> <tr><td>TV107</td><td>TV141</td><td>TV186S</td></tr> <tr><td>TV108</td><td>TV145</td><td>TV186SS</td></tr> <tr><td>TV109</td><td>TV148</td><td>TV191D</td></tr> <tr><td>TV112C</td><td>TV161</td><td>TV191S</td></tr> <tr><td>TV113</td><td>TV165</td><td>TV193D</td></tr> <tr><td>TV115 or C</td><td>TV166</td><td>TV193S</td></tr> <tr><td>TV115R</td><td>TV171</td><td>TV198</td></tr> <tr><td>TV118</td><td>TV175</td><td>TV307</td></tr> <tr><td>TV123</td><td>TV176</td><td>TV312</td></tr> <tr><td>TV124</td><td>TV178</td><td>TV313</td></tr> <tr><td>TV125 or U</td><td>TV181 or S</td><td>TV315</td></tr> </table>	TV102C	TV128	TV183 or D	TV103 or D	TV134	TV183S	TV105 or D	TV135 or R	TV183SS	TV105R	TV138 or R	TV185S	TV106	TV139	TV186 or D	TV107	TV141	TV186S	TV108	TV145	TV186SS	TV109	TV148	TV191D	TV112C	TV161	TV191S	TV113	TV165	TV193D	TV115 or C	TV166	TV193S	TV115R	TV171	TV198	TV118	TV175	TV307	TV123	TV176	TV312	TV124	TV178	TV313	TV125 or U	TV181 or S	TV315	<p><b>DECCA</b></p> <table border="0"> <tr><td>DR1</td><td>DM35</td><td>DR123</td></tr> <tr><td>DR2</td><td>DM36</td><td>DR202</td></tr> <tr><td>DM3</td><td>DM39</td><td>DR303</td></tr> <tr><td>DR3</td><td>DR41</td><td>DR404</td></tr> <tr><td>DR20</td><td>DM45</td><td>DR505</td></tr> <tr><td>DR21</td><td>DR49</td><td>DR606</td></tr> <tr><td>DR23</td><td>DM55</td><td>666TV-SRG</td></tr> <tr><td>DR24</td><td>DM56</td><td>777TV-SRG</td></tr> <tr><td>DR29</td><td>DR61</td><td>MS1700</td></tr> <tr><td>DR30</td><td>DR71</td><td>MS2000</td></tr> <tr><td>DR31</td><td>DR95</td><td>MS2001</td></tr> <tr><td>DR32</td><td>DR100</td><td>MS2400</td></tr> <tr><td>DR33</td><td>DR101</td><td>MS2401</td></tr> <tr><td>DR34</td><td>DR121</td><td>MS2402</td></tr> <tr><td></td><td>DR122</td><td>MS2420</td></tr> </table>	DR1	DM35	DR123	DR2	DM36	DR202	DM3	DM39	DR303	DR3	DR41	DR404	DR20	DM45	DR505	DR21	DR49	DR606	DR23	DM55	666TV-SRG	DR24	DM56	777TV-SRG	DR29	DR61	MS1700	DR30	DR71	MS2000	DR31	DR95	MS2001	DR32	DR100	MS2400	DR33	DR101	MS2401	DR34	DR121	MS2402		DR122	MS2420	<p><b>MURPHY</b></p> <p>V843 ... all models to V979</p> <p>V153 V159 V173 V179 V1910 V1913 V1914 V2014 or S V2015D V2015S V2015SS V2016S V2017S V2019 V2023 V2027 V2310 V2311C V2414D V2415D V2415S V2415SS V2416D V2416S V2417S V2419 V2423</p>	<p><b>PHILIPS</b></p> <table border="0"> <tr><td>17TG100u</td><td>19TG170a ...</td><td>21TG106u</td></tr> <tr><td>17TG102u</td><td>all models to</td><td>21TG107u</td></tr> <tr><td>17TG106u</td><td>19TG179a</td><td>21TG109u</td></tr> <tr><td>17TG200u</td><td>G19T210a</td><td></td></tr> <tr><td>17TG300u</td><td>G19T211a</td><td>23TG111a ...</td></tr> <tr><td>17TG320u</td><td>G19T212a</td><td>all models to</td></tr> <tr><td></td><td>G19T214a</td><td>23TG164a</td></tr> <tr><td></td><td>G19T215a</td><td></td></tr> <tr><td>19TG108u ...</td><td></td><td>23TG170a ...</td></tr> <tr><td>all models to</td><td></td><td>all models to</td></tr> <tr><td>19TG164a</td><td>G20T230a ...</td><td>23TG176a</td></tr> <tr><td></td><td>all models to</td><td></td></tr> <tr><td></td><td>G20T328</td><td></td></tr> <tr><td></td><td></td><td>G24T230a ...</td></tr> <tr><td></td><td></td><td>all models to</td></tr> <tr><td></td><td></td><td>G24T329</td></tr> </table>	17TG100u	19TG170a ...	21TG106u	17TG102u	all models to	21TG107u	17TG106u	19TG179a	21TG109u	17TG200u	G19T210a		17TG300u	G19T211a	23TG111a ...	17TG320u	G19T212a	all models to		G19T214a	23TG164a		G19T215a		19TG108u ...		23TG170a ...	all models to		all models to	19TG164a	G20T230a ...	23TG176a		all models to			G20T328				G24T230a ...			all models to			G24T329
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<p>PLEASE QUOTE PART NO. NORMALLY FOUND ON TX. BASE PLATE: 4121, 4123, 4140 OR 4142.</p> <p><b>BAIRD</b></p> <table border="0"> <tr><td>600</td><td>628</td><td>662</td><td>674</td></tr> <tr><td>602</td><td>630</td><td>663</td><td>675</td></tr> <tr><td>604</td><td>632</td><td>664</td><td>676</td></tr> <tr><td>606</td><td>640</td><td>665</td><td>677</td></tr> <tr><td>608</td><td>642</td><td>666</td><td>681</td></tr> <tr><td>610</td><td>644</td><td>667</td><td>682</td></tr> <tr><td>612</td><td>646</td><td>668</td><td>683</td></tr> <tr><td>622</td><td>648</td><td>669</td><td>685</td></tr> <tr><td>624</td><td>652</td><td>671</td><td>687</td></tr> <tr><td>625</td><td>653</td><td>672</td><td>688</td></tr> <tr><td>626</td><td>661</td><td>673</td><td></td></tr> </table>	600	628	662	674	602	630	663	675	604	632	664	676	606	640	665	677	608	642	666	681	610	644	667	682	612	646	668	683	622	648	669	685	624	652	671	687	625	653	672	688	626	661	673		<p><b>GEC</b></p> <p>BT454 BT455 BT455DST</p> <p>2000DST ... all models to 2044</p> <p>2047 ... all models to 2084</p> <p>2104 or /1 2105 or /1</p>	<p><b>KB-ITT</b></p> <p>By Chassis:</p> <table border="0"> <tr><td>VC1</td><td>VC52</td></tr> <tr><td>VC2</td><td>VC52/1</td></tr> <tr><td>VC3</td><td>VC100</td></tr> <tr><td>VC4</td><td>VC100/2</td></tr> <tr><td>VC11</td><td>VC200</td></tr> <tr><td>VC51</td><td>VC300</td></tr> </table> <p>Or quote model No.</p> <p><b>INDESIT</b></p> <p>20EGB 24EGB</p>	VC1	VC52	VC2	VC52/1	VC3	VC100	VC4	VC100/2	VC11	VC200	VC51	VC300	<p><b>PYE</b></p> <table border="0"> <tr><td>11u</td><td>40F</td><td>58</td><td>64</td><td>81</td><td>93</td><td>161</td></tr> <tr><td>31F</td><td>43F</td><td>59</td><td>68</td><td>83</td><td>94</td><td>150</td></tr> <tr><td>32F</td><td>48</td><td>60</td><td>75</td><td>84</td><td>95/4</td><td>151</td></tr> <tr><td>36</td><td>49</td><td>61</td><td>76</td><td>85</td><td>96</td><td>155</td></tr> <tr><td>37</td><td>50</td><td>62</td><td>77</td><td>86</td><td>97</td><td>156</td></tr> <tr><td>39F</td><td>53</td><td>63</td><td>80</td><td>92</td><td>98</td><td>160</td></tr> </table>	11u	40F	58	64	81	93	161	31F	43F	59	68	83	94	150	32F	48	60	75	84	95/4	151	36	49	61	76	85	96	155	37	50	62	77	86	97	156	39F	53	63	80	92	98	160	<p><b>SOBELL</b></p> <p>ST196 or DS ST197 ST290 ST297</p> <p>1000DS ... all models to 1102</p>	<p><b>THORN GROUP</b></p> <p>Ferguson, H.M.V. Marconi, Ultra</p> <p>By Chassis:- 800, 850, 900, 950/1, 950/2, 950/3, 960, 970, 980, 981, 1400, 1500, 1500 (24"), 1580, 1590, 1591.</p> <p>Or quote model No.</p>																																									
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AC107	0.35	AF186	0.40	BC170	0.15	BD131	0.45	BF195	0.15	BFY18	0.53	ME6002	0.17	TIP30A	0.58	2N2369A	0.42	2N3904	0.16
AC117	0.24	AF239	0.40	BC171	0.15	BD132	0.50	BF196	0.15	BFY40	0.40	MEB001	0.16	TIP31A	0.65	2N2401	0.60	2N3905	0.18
AC126	0.25	AF279	0.84	BC172	0.14	BD135	0.40	BF197	0.17	BFY41	0.43	MJE340	0.68	TIP32A	0.67	2N2484	0.41	2N3906	0.15
AC127	0.25	AL100	1.10	BC173	0.20	BD136	0.46	BF198	0.20	BFY50	0.25	MJE341	0.72	TIP33A	0.99	2N2470	0.18	2N4032	0.43
AC128	0.25	AL102	1.10	BC174B	0.26	BD137	0.48	BF199	0.20	BFY51	0.23	MJE370	0.65	TIP34A	1.73	2N2646	0.53	2N4033	0.54
AC141	0.26	AL103	1.10	BC176	0.22	BD138	0.50	BF200	0.35	BFY52	0.23	MJE520	0.85	TIP41A	0.80	2N2712	0.12	2N4036	0.52
AC141K	0.27	AL113	0.95	BC177	0.20	BD139	0.55	BF218	0.35	BFY57	0.32	MJE521	0.95	TIP42A	0.91	2N2894	0.77	2N4046	0.37
AC142	0.20	AU103	2.10	BC178	0.22	BD140	0.62	BF222	1.08	BFY64	0.42	MJE2955	1.20	TIP43A	1.30	2N2904	0.22	2N4058	0.15
AC142K	0.19	AU110	1.90	BC179	0.20	BD145	0.75	BF224J	0.15	BFY72	0.31	MJE3000	1.85	TIS73	11.36	2N2904A	0.26	2N4123	0.13
AC151	0.24	AU113	2.40	BC179B	0.21	BD163	0.67	BF241	0.22	BLY15A	0.79	MJE3055	0.74	TIS90	10.23	2N2905A	0.28	2N4126	0.20
AC152	0.25	BC107	0.12	BC182L	0.11	BD183	0.56	BF244	0.18	BPX25	1.90	MPS6566	10.21	TX109	10.12	2N2926G	0.13	2N4236	1.90
AC153K	0.28	BC107A	0.13	BC183	0.11	BD122	0.78	BF254	0.45	BPX29	1.70	MPSA05	10.47	TX300	10.16	2N2926Y	0.12	2N4248	1.12
AC154	0.20	BC107B	0.14	BC183K	0.12	BD234	0.76	BF255	0.45	BPX52	1.90	MPSA55	10.50	TX304	10.22	2N2926O	0.12	2N4284	1.09
AC176	0.25	BC108	0.12	BC183L	0.11	BD410	1.65	BF256	0.45	BRC4443	0.68	MPSU05	0.66	TX310	10.10	2N2955	1.12	2N4286	1.19
AC178	0.27	BC108B	0.13	BC184L	0.13	BD519	0.76	BF257	0.49	BRY39	0.47	MPSU06	0.76	TX313	10.12	2N3012	0.91	2N4288	1.03
AC187	0.25	BC109	0.13	BC186	0.25	BD520	0.76	BF258	0.66	BRY56	10.40	MPSU56	1.26	TX500	10.17	2N3019	0.75	2N4289	1.02
AC187K	0.26	BC109C	0.14	BC187	0.27	BD599	0.75	BF259	0.93	BR101	0.47	MPSU55	1.26	TX502	10.17	2N3053	0.21	2N4290	10.14
AC188	0.25	BC113	0.13	BC208	0.12	BDX18	1.46	BF262	0.70	BSX19	0.13	OC26	0.38	TX504	10.42	2N3054	0.55	2N4291	10.18
AC188K	0.26	BC114	0.20	BC212L	0.12	BDX32	2.55	BF263	10.70	BSX20	0.19	OC28	0.65	TX602	10.24	2N3055	0.60	2N4292	10.20
AC193K	0.30	BC115	0.20	BC213L	0.12	BDY18	1.78	BF273	0.16	BSX76	0.15	OC35	0.59	2N525	0.86	2N3133	0.54	2N4392	2.84
AC194K	0.32	BC116	0.20	BC214L	0.15	BDY20	0.99	BF336	0.35	BSY19	0.62	OC36	0.64	2N696	0.23	2N3134	0.60	2N4871	10.24
AC228	0.25	BC117	0.20	BC238	0.12	BF115	0.20	BF337	0.35	BSY19	0.62	OC42	0.55	2N697	0.15	2N3232	1.32	2N4902	1.30
AC239	0.88	BC119	0.29	BC261A	0.28	BF117	0.45	BF458	0.60	BSY41	0.22	OC44	0.25	2N706	0.12	2N3235	1.10	2N5042	1.05
AD140	0.50	BC125	0.22	BC262A	0.18	BF120	0.55	BF459	0.63	BSY54	0.50	OC45	0.32	2N706A	0.15	2N3250	1.02	2N5060	10.32
AD142	0.42	BC126	0.20	BC263B	0.25	BF121	0.25	BF596	10.70	BSY56	0.80	OC70	0.32	2N708	0.35	2N3254	0.28	2N5061	10.35
AD143	0.51	BC132	0.15	BC267	0.16	BF123	0.28	BF597	10.15	BSY65	0.15	OC71	0.32	2N744	0.30	2N3323	0.48	2N5064	0.45
AD149	0.50	BC134	0.20	BC268C	0.14	BF125	0.25	BF639	10.24	BSY78	0.40	OC72	0.32	2N914	0.19	2N3391A	0.23	2N5087	0.32
AD161	0.48	BC135	0.19	BC294	0.37	BF127	0.30	BF641	10.30	BSY91	0.28	OC73	0.51	2N916	0.20	2N3501	6.99	2N5294	0.35
AD162	0.48	BC136	0.20	BC300	0.60	BF158	10.25	BF661	10.30	BSY95A	0.27	OC75	0.25	2N918	0.42	2N3702	10.13	2N5296	0.67
AF114	0.25	BC137	0.20	BC301	0.35	BF159	10.27	BF679	10.24	BT106	1.60	OC76	0.36	2N930	0.35	2N3703	10.15	2N5298	0.58
AF115	0.25	BC138	0.20	BC303	0.60	BF160	10.22	BF743	0.55	BT116	1.20	OC81	0.53	2N1164	3.60	2N3704	10.15	2N5322	0.85
AF116	0.25	BC142	0.30	BC307B	0.12	BF161	0.45	BFW10	0.65	BU105/02	1.95	OC81D	0.57	2N1304	0.21	2N3705	10.11	2N5449	1.90
AF117	0.20	BC143	0.35	BC308A	0.10	BF162	0.45	BFW11	0.65	BU108	3.25	OC139	0.78	2N1305	0.21	2N3706	10.10	2N5457	10.30
AF118	0.50	BC147	0.13	BC309	0.15	BF163	0.45	BFW16A	1.70	BU126	2.99	OC140	0.80	2N1306	0.31	2N3707	10.13	2N5458	0.35
AF121	0.32	BC148	0.12	BC323	0.68	BF167	0.25	BFW30	1.38	BU204	1.98	OC170	0.25	2N1307	0.22	2N3715	2.30	2N5494	0.85
AF124	0.25	BC149	0.14	BC377	0.22	BF173	0.25	BFW59	10.19	BU205	1.98	OC171	0.30	2N1308	0.26	2N3724	0.72	2N5496	1.05
AF125	0.25	BC152	0.25	BC441	1.10	BF177	0.30	BFW60	10.20	BU207	3.00	OC200	1.30	2N1309	0.36	2N3739	1.18	2N5627	0.65
AF126	0.25	BC153	0.20	BC461	1.58	BF178	0.33	BFW90	10.28	BU208	3.15	OC211	0.92	2N1613	0.34	2N3766	0.99	2N6178	0.71
AF127	0.25	BC154	0.20	BCY33	0.36	BF179	0.33	BFX16	2.25	BU209	2.55	OC271	0.65	2N1711	0.45	2N3771	1.70	2N6180	0.92
AF139	0.35	BC157	0.15	BCY42	0.16	BF180	0.35	BFX29	0.30	BUY77	2.50	ORP12	0.55	2N1890	0.45	2N3772	1.90	2SC643A	1.38
AF147	0.35	BC158	0.13	BCY71	0.22	BF181	0.33	BFX30	0.35	BUY78	2.55	R2008B	2.05	2N1893	0.48	2N3773	2.90	Z5C1172Z	2.80
AF149	0.45	BC159	0.15	BCY88	0.42	BF182	0.44	BFX84	0.25	BUY79	2.85	R2108B	2.95	2N2102	0.61	2N3790	4.15	3N1440	1.21
AF178	0.55	BC161	0.48	BD115	0.65	BF183	0.44	BFX85	0.26	BUY80	2.85	TIC44	0.29	2N2217	0.36	2N3794	10.20	40250	0.60
AF179	0.60	BC167B	0.15	BD123	0.98	BF184	0.28	BFX86	0.28	E1222	0.55	TIC46	0.44	2N2218	0.60	2N3819	10.35	40327	0.67
AF180	0.55	BC168B	0.13	BD124	0.80	BF185	0.28	BFX87	0.28	E5024	10.20	TIC47	0.58	2N2219	0.50	2N3820	10.49	40361	0.48
AF181	0.50	BC169C	0.13	BD130Y	1.42	BF194	10.15	BFX88	0.24	ME6001	10.16	TIP29A	0.49	2N2221A	0.41	2N3823	1.45	40362	0.60
														2N2222A	0.50	2N3866	1.70	40429	0.80
														2N2270	0.41	2N3877	0.25	40439	2.67

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MC1310P	2.94	TAA630S	14.18	AZ13	0.30	OA90	0.08	7406	0.45	7475	0.59			2W 0.2 Ω-270 Ω	17p				
MC1327PQ	1.86	TAA661B	1.32	AZ17	0.12	OA91	0.07	7408	0.25	7478	0.49			4W 1.0 Ω-10K Ω	18p				
MC1330P	0.93	TAA700	14.18	AA100	0.15	OA95	0.07	7410	0.20	7490	0.65			1W 1.0 Ω-22K Ω	20p				
MC1351P	0.75	TAA840	12.02	BA102	0.25	OA200	0.10	7411	0.25	7491	1.10			1W 1.0 Ω-22K Ω	20p				
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AC126	0.16	AF118	0.40	BC139	0.20	BC249	0.30	BF115	0.20	BF251	0.20	OC28	0.60
AC127	0.16	AF121	0.40	BC140	0.20	BC251	0.16	BF121	0.24	BF256	0.35	OC35	0.45
AC128	0.16	AF124	0.22	BC141	0.20	BC262	0.18	BF154	0.12	BF258	0.40	OC36	0.58
AC131	0.12	AF125	0.20	BC142	0.22	BC263B	0.18	BF158	0.18	BF259	0.47	OC38	0.43
AC141	0.19	AF126	0.25	BC143	0.22	BC267	0.17	BF159	0.18	BF260	0.23	OC42	0.45
AC141K	0.32	AF127	0.26	BC147	0.10	BC301	0.28	BF160	0.17	BF262	0.30	OC44	0.18
AC142K	0.32	AF139	0.32	BC148	0.10	BC302	0.28	BF163	0.30	BF263	0.23	OC45	0.18
AC151	0.16	AF147	0.25	BC149	0.10	BC303	0.27	BF164	0.18	BF271	0.15	OC46	0.35
AC165	0.16	AF150	0.23	BC153	0.14	BC307A	0.11	BF167	0.20	BF273	0.15	OC70	0.22
AC166	0.16	AF170	0.16	BC154	0.14	BC308A	0.11	BF173	0.20	BFX84	0.25	OC71	0.22
AC168	0.16	AF172	0.16	BC157	0.14	BC309	0.13	BF177	0.24	BFX85	0.25	OC72	0.30
AC176	0.16	AF178	0.50	BC158	0.13	BC547	0.10	BF178	0.30	BFX88	0.24	OC74	0.35
AC186	0.15	AF180	0.55	BC159	0.13	BC548	0.10	BF179	0.28	BFY37	0.20	OC75	0.35
AC187	0.21	AF181	0.40	BC160	0.20	BC549	0.10	BF180	0.30	BFY51	0.23	OC76	0.35
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AC188	0.21	AL100	0.80	BC167	0.12	BD112	0.50	BF182	0.34	BFY53	0.25	OC78	0.13
AC188K	0.35	AL102	0.90	BC168	0.12	BD115	0.50	BF183	0.30	BFY55	0.25	OC81	0.20
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AD140	0.50	AL113	0.60	BC171	0.12	BD131	0.35	BF185	0.22	BR100	0.30	OC82	0.20
AD142	0.50	BC107	0.12	BC172	0.12	BD132	0.35	BF186	0.30	BSX20	0.22	OC82D	0.13
AD143	0.50	BC108	0.12	BC173	0.14	BD133	0.35	BF194	0.11	BSX76	0.22	OC83	0.22
AD145	0.50	BC109	0.12	BC177	0.16	BD135	0.30	BF195	0.11	BSY84	0.34	OC84	0.28
AD149	0.50	BC113	0.10	BC178	0.16	BD136	0.35	BF196	0.12	BT106	1.05	OC85	0.13
AD161	0.43	BC114	0.10	BC179	0.16	BD137	0.35	BF197	0.12	BTX34	1.80	OC123	0.20
AD162	0.43	BC115	0.10	BC182L	0.10	BD138	0.40	BF199	0.16	BU105/041.90		OC169	0.20
AD161	1.00	BC116	0.12	BC183L	0.10	BD139	0.40	BF200	0.28	BU126	1.50	OC170	0.22
AD162		BC117	0.12	BC184L	0.10	BD140	0.40	BF216	0.12	BU208	2.20	OC171	0.22
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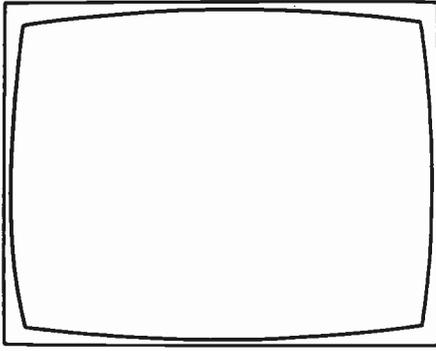
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## 40 YEARS ON

Last month it was ITV's 21st anniversary. This month it is again appropriate to look back. For November 2nd 1936 saw the official opening of the BBC's high-definition television service from Alexandra Palace. From the optimism then expressed, just 40 years ago, to the present gloom in the industry tells more than a little about the UK's ups and downs. Let's first record the situation in late 1936 however.

At the start of the BBC service there were two hours of programmes a day, from 3-4 p.m. and 9-10 p.m., except on Sundays. And there was a thing that was to dog us again many years later - dual-standard operation. At the time the service commenced, the Television Advisory Committee had yet to decide between Baird's 240-line, 25Hz non-interlaced system and the Marconi/EMI 405-line, 50Hz interlaced system. So the earliest sets on sale had to have dual-standard timebases - field as well as line! The TAC finally reached the decision that the 405-line system should be adopted for the Alexandra Palace transmissions in mid-February 1937, pushed somewhat it seems by the BBC.

There had been regular TV transmissions since August, but November 2nd marked the official start of the world's first high-definition TV service. Experiments were being carried out elsewhere. There had been experimental transmissions in Germany for some three years, using a 180-line non-interlaced system, and at the 1936 Berlin Radio Exhibition there were experimental 375-line interlaced transmissions from Witzleben near Berlin and Brocken in the Hartz mountains. Philips in Holland had been experimenting with the German 180-line system, then adopted the Marconi/EMI 405-line system. In the USA, RCA had been transmitting experimentally from atop the Empire State Building, using a 343-line interlaced system. But there is a great deal of difference between experimental transmissions and a regular service. For one thing, with a regular service you start to get the essential build up of operational know how, both at the transmitting and receiving ends. In fact the initial transmissions suffered from a number of shortcomings, though these were overcome within a matter of weeks.

Writing in these pages, Thermion commented "And so, inconspicuously, we see the dawn of a new industry..." The UK was ahead in pioneering TV, though from the public's point of view TV was but a small thing - there were estimated to be only some 1,000 sets at the start of the service, and there were still only some 20,000 sets at the outbreak of the war.

Why didn't the UK capitalise on its lead and maintain its pre-eminence in the industry? For one thing, by the time the war brought everything to a halt no one had managed to make money out of television. It was the familiar dilemma of set prices being high until large-scale production could start. Television in the UK resumed in 1946. Meanwhile, only in the USA had regular transmissions started - in 1941, on the 525-line system. The US TV industry was still small however, its main advantage lying in the improvements which the 525-line system had brought with it.

The growth of TV in the UK was slow: it wasn't till 1949 that the second transmitter, Sutton Coldfield, came into operation. A decade later however most homes in the UK had TV. But the industry tended to be introspective, bound by the 405-line standard.

The ensuing years saw the spread of television to most countries, but with little participation by the UK industry, certainly on the receiver side. It's the Japanese who have dominated the world TV receiver market in recent years, and it's precisely this that is causing our setmakers so much alarm at the present time. Our radio industry gave up some years ago, following the onslaught from the Far East. Our high fidelity industry is but a shadow of its stature in the early 50s, the time of the Leak Point One amplifier, the Ferranti ribbon pickup and the Quad full-range electrostatic loudspeaker, to mention only a few of the achievements of those days. Monochrome tube production has ceased in the UK, and colour tube production is threatened. Very few portable monochrome sets are now being produced and imports rise steadily. The question is whether our so far fit and competitive colour receiver industry can survive? It has a reasonable chance if the government keeps a careful eye on international trading conditions and the industry itself goes for an international market. But today, 40 years on, the outlook is difficult and uncertain, and one can't help feeling that a lot of opportunities have been lost.

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# teletopics

## VIEWDATA TRIAL EXPANSION

More than 70 organisations are now participating in the pilot trial, started at the beginning of the year, of the Post Office Viewdata system. All four branches of the Post Office are taking part in addition to television companies, news organisations, consumer groups, travel organisations and educational establishments. The Post Office Telecommunications department is providing all the necessary technical requirements of the service as well as supplying telephone, telex and data transmission information.

Major TV setmakers taking part included GEC, ITT, Philips, Pye, Rank and Thorn. Their main concern at present is whether viewdata receiver terminals can be manufactured at reasonable cost on existing production lines. The setmakers, along with component manufacturers such as Texas Instruments and Mullard, are also investigating the circuitry required for the decoders – much of this is common to both Viewdata and Teletext.

Editing terminals are not at present available and in consequence information has to be given to the Post Office for insertion into the data base. Eventually, the aim is to rent editing terminals to users who would then be able to insert their information without involving the Post Office. If the service gets underway subscribers will have access to a number of computer centres throughout the country. During the trial all the information is stored at the Post Office research centre near Ipswich.

## OVER-VOLTAGE PROTECTION ADDED TO THORN 8000 SERIES CHASSIS

The power supply used in the Thorn 8000 series chassis has been modified to incorporate over-voltage protection. The new power supply panel – PC846 – can be easily recognised by the presence of an extra subpanel (PC837) attached to it. It can be fitted to the 8000A, 8500 and 8800 chassis but not to the original 8000 chassis (with two-section mains dropper). The basic modifications are shown in Fig. 1, and the circuit is interesting in having two modes of operation.

First is a conventional crowbar action. If the h.t. regulator thyristor W703 goes short-circuit the HT1 line will rise excessively and as a result zener diode W711 will conduct. The pulse appearing at the gate of the protection thyristor W710 will then fire it. The short-circuit across the h.t. line via W710, W708 and R727 results in the thermal cut-out at the back of the set operating.

The second, recycling mode comes into operation if W703 is intact and the h.t. rises to an excessive level due to

some other cause, such as misadjustment of the set e.h.t. control, or component failure in the ramp control circuit or in the 25V stabiliser circuit which is used as a reference. In this event W710 fires and discharges the ramp capacitor C712 via W707. It will be recalled (see our coverage of the chassis in the January 1976 and subsequent issues) that C712 charges from the 25V line, and that when the voltage across it reaches 8V a pulse is produced to fire the h.t. regulator thyristor W703. On the negative mains half-cycles W705/W706 conduct and C712 discharges. With W710 discharging C712 via W707 however the voltage across it does not rise sufficiently to result in W703 being fired. The receiver thus trips, and if the disturbance is temporary – caused by flashover etc. – normal picture and sound will be restored automatically. If the fault persists however the tripping will continue until the fault is cleared or the receiver is switched off.

The period of the trip cycle is set by the crowbar thyristor's holding current. Because this varies with production tolerances, R736 is included in the circuit. The main reservoir/smoothing capacitors C706/C704 discharge during the negative mains half-cycles, while at the same time a ballast current is drawn through R736: when this current is equal and opposite to the discharge current to C704/C706, W710 cuts off removing the short-circuit across C712. Normal circuit action is then restored. The trip period varies between 2-5 seconds depending on component tolerances.

R733 prevents crowbar action due to leakage in the zener diode W711, while C717 prevents spurious tripping due to

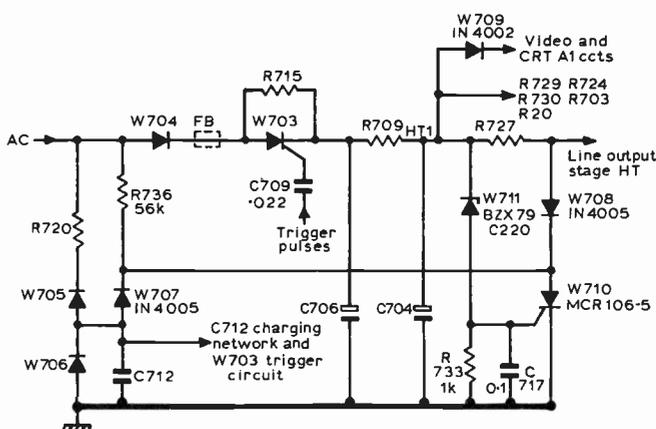
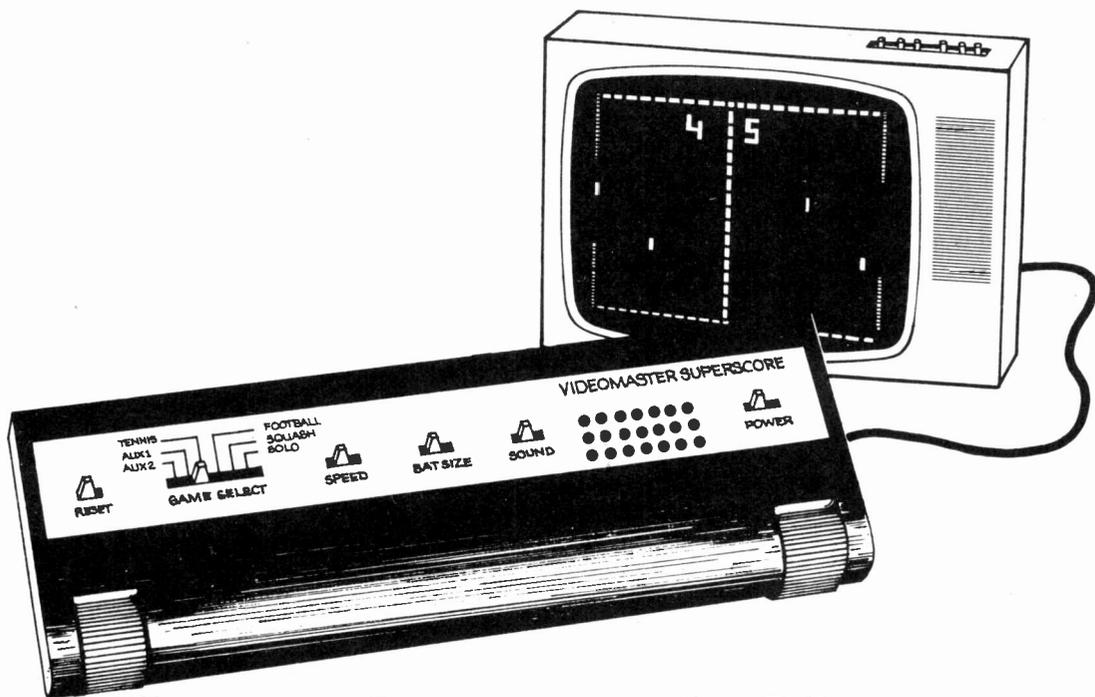


Fig. 1: Over-voltage protection circuit now used in the Thorn 8000 series chassis. The following components have been added: R736, W707, W711, R733, C717, W708, W709 and W710.



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line noise or flashover noise. W708 isolates the ramp capacitor from the h.t. rail during the trip cycle in order to allow the regulator thyristor triggering action to start. W709 is added to limit the reverse current in this leg of the supply. In addition, to allow for low-sensitivity regulator thyristors the triggering pulse coupling capacitor C709 is increased in value from 0.01 $\mu$ F to 0.022 $\mu$ F, while to extend the set e.h.t. control range to allow the trip circuit operation to be checked the series resistor R726 on its chassis side is reduced from 12k $\Omega$  to 8.2k $\Omega$ .

### PIL TUBE GUN CHANGE

One feature of the original PIL tube was that the centre gun was the red one. This has subsequently been changed, the green gun now being the centre one as in other in-line gun tubes. Thorn state that PIL tubes with a green centre gun have a green dot on the label – if in doubt, check the screen with a magnifying glass to see whether green is the centre colour. The change affects the purity and static convergence adjustments to the 9000 chassis. With the later production tube, purity adjustments should initially be made with the red and blue guns switched off. The instructions inside the back cover still apply, except that in the illustration and text green must be substituted for red and vice-versa – the same applies to cyan and magenta.

### MORE TUBES

In addition to the 90° PIL tube used in the Thorn 9000 chassis and some Continental sets, RCA has now introduced a 22in. 110° version, type A56-610X. This is at present being evaluated by setmakers. A 26in. version has been in production in the USA for some time – type A67-610X – but it is not certain whether this will be imported.

On the monochrome tube front, Philips have introduced six new tubes, making a total of twelve in current production. For portable receivers, a new 9in. 90° tube, and 14in. and 17in. 110° tubes, are now available in addition to the existing 12in. tube. All have the narrow 20mm diameter neck. For table and console sets there are new 20 and 24in. types with 110° deflection angles and the wide 28.6mm diameter neck. All the new tubes feature guns designed to operate with a first anode voltage of 130V, and quick-heating cathodes. The new tubes reduce manufacturing costs due to savings in both assembly time and components. This is because in mains-operated sets the new tubes can be supplied direct from the receiver h.t. rail instead of from a high voltage rail derived from rectified line flyback pulses.

### MORE TV ICs

ITT Semiconductors have announced additions to their range of i.c.s for television receivers, mainly for use in the front end. First the company is offering an i.c. set for controlling TV tuners. It consists of two MOS i.c.s which provide all the data required for tuner control, such as tuning voltage, switching voltage for band selection (where applicable) and the a.f.c. signal. The set comprises the storage i.c. type SAA1020, which functions as a static shift register and has an extremely low current consumption, and the control i.c. type SAA1021, which performs the data processing duties. The low current consumption of the SAA1020 enables the channel data to remain stored for almost a year, even when the TV is switched off. Power is provided by a small 1.5V battery. This i.c. set also facilitates electronic station searching, with silent tuning. This method of station selection obviates the need for any mechanical tuning/storage devices (such as tuning potentiometers).

Also new is a 30-channel ultrasonic transmitter/receiver combination, the SAA1024 and SAA1025. An alternative receiver circuit, the SAA1130, offers programme store as an additional facility. The latter can be used to drive the new SAA1008 character generator which enables the selected channel to be displayed on the screen.

There is also a sound channel i.c. The ITT TDA1035 is a combined intercarrier sound plus audio output i.c. suitable for use in mains and/or battery operated receivers, and is encapsulated in a plastic package similar to the TO116, with thirteen pin connections. The cooling tabs on the case are sufficient for 2W output without any further heat-sinking, but if the tabs are soldered to a sufficiently large copper-clad area of the printed circuit an output power of 4W can be obtained. The device has thermal limiting. One attractive feature of the i.c. is the low number of external components (see Fig. 2). The circuit itself comprises a limiting i.f. amplifier, coincidence demodulator, electronic (d.c.) volume control system, audio preamplifier and push-pull audio output stage. The i.f. section has excellent limiting characteristics, offering high a.m. suppression. For connection to a video recorder, the device also offers a direct a.f. output which is not affected by the volume control. The i.f. section can be switched off by a d.c. voltage to enable the audio amplifier to be driven from an external signal source, e.g. from a video recorder.

A similar device has been announced by National Semiconductor. This is type LM1808. The i.f. section of this i.c. is similar to the LM3065. An improved volume control circuit is included (providing 75dB range) so that the recovered audio is a linear function of the volume control

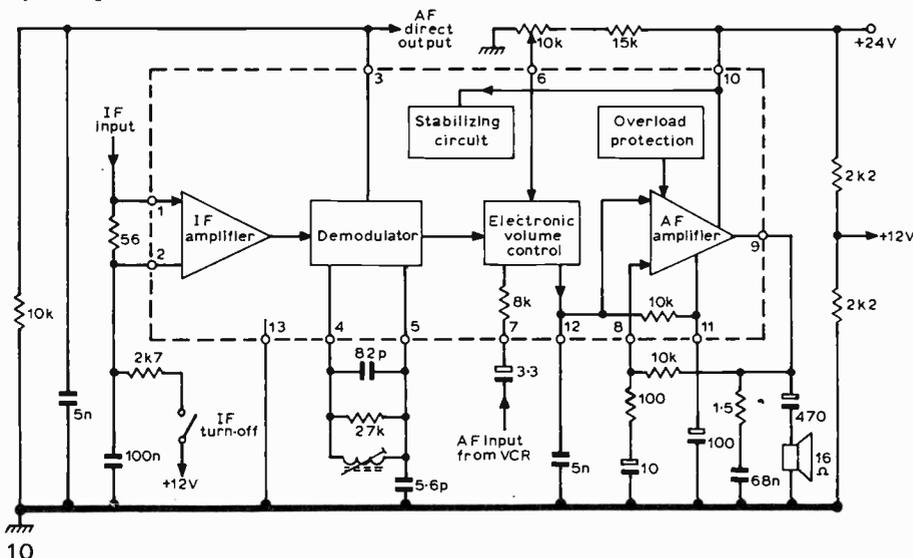


Fig. 2: Functional block diagram of the ITT TDA1035 sound channel i.c. shown here with the components required to make a complete sound channel. The input would normally be connected to a ceramic 6MHz filter.

potentiometer. The power amplifier section is similar to the popular LM380 i.c., featuring both thermal and short circuit protection. The unit can provide 2W output at low distortion using the copper-clad printed board as a heat-sink. In order to reduce the number of external components, the power amplifier has a fixed voltage gain. The chip is housed in a standard 18-pin dual-in-line package.

### MODIFICATIONS

A second important modification has been made to the field output circuit used in the Thorn 1600 17in. monochrome chassis. The original driver/output stage consisted of an SN76033N-07 i.c. Subsequently a resistor/diode/transistor combination was added to the output circuit to protect the i.c. In the latest version of the chassis the i.c. and its associated circuitry have been replaced by a field output module, part number 06M4-622-001. This has a driver i.c., RCA type CA3094AE, followed by a discrete transistor field output stage consisting of a complementary pair of RCA transistors, types 17377 and 17376. These transistors are selected ones from types 2N6290 and 2N6109 respectively and must be obtained from Thorn.

In the Philips G9 chassis, as in the G8 chassis, a waveform squaring transistor is included between the sine wave line oscillator and the line driver stages. A production change to overcome line jitter in the G9 chassis has recently been introduced and consists of the addition of a capacitor (code number C5105) between the base of the squaring transistor T5102 and chassis. The value may be 150pF or 180pF.

A v.d.r. is available from Thorn service depots for fitting across the receiver side of the mains on/off switch on the 3000/3500 chassis to prevent destruction of W602 due to abnormal mains-borne switching transients. W602 is the mains rectifier which provides the 300V feed to the chopper transistor.

### TRANSMITTER OPENINGS

The following relay stations are now in operation. All transmissions are vertically polarised:

**Abercraf** (Powys, Wales) ITV channel 25 (HTV Wales). Receiving aerial group A.

**Ilfracombe**: BBC-1 channel 58, ITV channel 61 (Westward Television), BBC-2 channel 64. Receiving aerial group C/D.

**Larne** (Antrim) ITV channel 49 (Ulster Television). Receiving aerial group B.

**Long Mountain** (Powys, Wales) ITV channel 61 (HTV Wales). Receiving aerial group C/D.

**New Galloway** (Scotland) ITV channel 23 (Border Television). Receiving aerial group A.

### THE US SCENE

With sales forecasts suggesting that more than seven million TV receivers will be sold in the USA during the course of the year, it was rather surprising that this year's Consumer Electronics Show, which was held at Chicago's McCormick Place, did not see more extensive participation from the setmakers.

Several new Zenith models were introduced incorporating the close-up "zoom" feature which the company introduced last year. In addition, the new sets feature a "picture" control which adjusts the contrast, brightness and colour level simultaneously. GE are to use an automatic colour intensity and tint control on some of their forth-

coming models. They call this Vertical Interval Reference (or VIR). It makes use of the coded reference signal which is transmitted during a field blanking interval line. Automatic brightness compensation to suit varying ambient light conditions is featured by most setmakers, for example RCA, Motorola, JVC, Panasonic and Zenith.

Admiral have introduced an optional remote control unit which is intended to be installed by the customer. All that is required is to remove the receiver's front panel and plug it in. Time and channel displays are being introduced on many new models which use electronic tuning (this is relatively new in the US).

All in all the market is fairly buoyant. Setmakers are introducing new features on most of their new models to entice the buying public.

### LONG-DISTANCE TV BOOK

The new (third) edition of Roger Bunney's *Long-Distance Television* book is now available – at £1.11 including postage from Weston Publishing, 33 Cherville Street, Romsey, Hants SO5 8FB. A quick glance at an advance copy reveals that it has been extensively revised and substantially increased in size. We shall be reviewing the book in greater detail shortly.

### "OLD" NEW EHT CONCEPT?

Following our report on the new e.h.t. concept – a combined multiplier/line output transformer – being developed by General Instruments (see *Teletopics*, July 1976 issue, p. 456), we have since learnt that the idea was first patented by E. K. Cole of Southend back in March 28 1966! Varo Semiconductor, a US firm which has recently established a sales office in the UK, is now selling this transformer/diode combination. Since most UK setmakers have their own line output transformer winding facilities the company is at present selling the transformer overwinding (with the diodes built in) which is attached to the transformer core during manufacture. Varo also say they can supply complete units if required – assuming the quantity is right.

Mullard is also active in this field and has now announced its DST (diode-split transformer). Over 100,000 of these units have apparently been produced in the UK and on the Continent, where they are already in use in some colour receivers. During long-term tests Mullard have logged more than 750,000 device hours without a single failure. This indicates that a long life can be expected. British setmakers are at present evaluating them, and if accepted you could be meeting them in 1977's models.

### MARKET FORECAST

The Henley Centre for Economic Forecasting in its latest research publication *UK Leisure Markets* forecasts that by 1981 nearly 80% of UK households will probably have a colour set. Good news for the BBC at any rate, since its finances are so dependent on the number of colour licences. But the prospects for setmakers are not very optimistic. Colour set deliveries for 1977 and 1978 are estimated as likely to be around 1.4 and 1.6 million respectively – in other words hardly any upswing compared to the depressed trading during the last couple of years. Finally, the forecasters point out that the replacement colour TV market will be of growing importance by 1980-1, while if Teletext and the video market get going by then dealers should be in for a fairly rosey time.

# Servicing Grundig Colour Receivers

A. Denham

THE group of models covered by these notes consists of the 5010, 5011, 6010 and 6011. The 5010 and 5011 feature touch-button tuning and the 6010 and 6011 ultrasonic remote control – they are all 110° 26in. models. These sets were the first all solid-state Grundig models and use a thyristor line output stage. A quick look at the line output stage circuit (see Fig. 1) shows that everything to the right of C518 is a.c. coupled to the h.t. line: how this fact can be made use of in servicing will be described later.

The power supply circuitry is shown in Fig. 3. With the exception of the 24V “E” supply to the field generator circuit all the l.t. rails are derived from the line timebase. The h.t. rails are unstabilised, being derived from the mains bridge rectifier Di605 and the various series resistors.

The supply to the line oscillator is also derived from the line output stage. This means that a start system has to be provided so that the line oscillator can get going before the line output stage comes into operation. For this purpose rectifier Di638 is fed from a winding on the mains transformer. Once the scan-derived “F” supply is established Di638 is reverse biased and cuts off.

The c.r.t. drive system is somewhat unusual, with a luminance output transistor (Tr375, BF459G) driving the cathodes and three BF459G transistors (Tr571, Tr581 and Tr591) providing colour-difference drives to the three grids.

The i.f. circuit is housed in a plug-in can at the bottom of the main printed board. It contains a single transistor i.f. preamplifier and a TBA440 i.c. which provides the i.f. gain, demodulation and the a.g.c. action.

The sound channel follows common continental practice, with a TBA120S intercarrier sound i.c. and a TBA800 audio i.c. There are just two coils to tune, the input and quadrature coils.

The luminance output transistor is driven by a TBA970 luminance signal processing i.c. on which the contrast and brightness controls operate.

There are two i.c.s in the decoder. A TBA510 provides chrominance signal gain, saturation control (d.c.), burst blanking and gating, chrominance delay line drive and colour-killing, while a TAA630 provides chrominance signal demodulation, PAL switching and G–Y matrixing. Four transistors act as burst and ident amplifiers and reference oscillator and buffer stages.

So much for a quick look at the circuit arrangement, now for the faults.

At one time every engineer must have scratched his head and cursed the new-fangled idea of the thyristor line output stage. That they are awkward to service is a fallacy however. The usual symptom of a fault in the line output stage is the cutout tripping. In this event remove the back and locate the point marked +A on the main board – to the right of the c.r.t. opening, roughly in the centre of the right-hand section of the board. Look 45° to the right, and observe the vertical row of soldered joints. These are the connections to the line output stage input/commutating transformer. Usually one of the connections will be found to be dry-jointed and the cause of the trouble.

If all appears well here we can make use of the fact mentioned at the start, that the two halves of the line output stage circuit are a.c. coupled. Short-circuit the anode and

cathode of the scan thyristor Ty518 and switch on. If normal sound returns with no e.h.t., the fault is in the scan thyristor's trigger circuit. Replacing C515, R515 and L515 will usually effect a cure, though Di504 and R504 in series with the stabilising transducer can also cause this fault.

If the cutout still trips, remove the line oscillator board and try again. If this action cures the tripping look for a dry-joint around the flyback thyristor Ty511, its parallel diode Di511, the “KA” coil L516 or the line output stage coupling/tuning capacitors C516 and C518.

If this does not cure the tripping remove the anode lead from the flyback thyristor Ty511 to check whether it is short-circuit. If not, check the mains bridge rectifier Di605, or for an h.t. short.

Sound but no e.h.t., without tripping, indicates that either the scan thyristor Ty518 or its parallel diode Di518 is short-circuit or that fuse Si521 associated with the e.h.t. tripler is open-circuit.

Lack of width with the e.h.t. control R508 (HS potentiometer) inoperative should lead to an examination of this area for dry-joints and a check on the stabiliser feedback sensing transistor Tr506 in case it is faulty. I use a BFY50 as a replacement in this position.

A peculiar fault occurs when L515 in the scan thyristor's trigger circuit goes short-circuit. The centre of the picture becomes folded, the e.h.t. rises to in excess of 30kV, and R545 and R546 in series with the c.r.t. first anode controls cook along with one or sometimes all three of the first anode potentiometers themselves. The fault is due to the scan thyristor being triggered on early.

The focus v.d.r. R522 occasionally burns out, giving poor focus.

On some later sets the line output stage thyristors and their parallel diodes are incorporated in a common encapsulation. If one of these is replaced with the earlier types (TA16091 flyback thyristor, TA16090 scan thyristor) then the associated diode (TA16093 and TA16092 respectively) must also be fitted.

A blank screen with no sound or picture but a faint raster is usually due to a dry-joint on the line output stage input/commutating transformer – the l.t. supplies for the signal circuits are derived from one of the windings on this transformer. Alternatively the rectifier diode (Di631) which is fed by this winding may be defective – sometimes its reservoir capacitor C632 is damaged as well.

I have only rarely had any bother with the TBA920 line oscillator/sync separator i.c.

The field timebase seldom gives trouble. The main fault in this area is cracks in the main board due to rough handling. The output stage is slightly unusual: there are two GD241 power transistors, the second acting as an emitter-follower to provide a low-impedance output which is capacitively coupled to the scan coils etc. Lack of height is usually due to one or both of the GD241 transistors being faulty – with the BD135 emitter-follower driver transistor getting very hot.

Another unusual feature of the field timebase is the use of a unijunction transistor (type TIS43) as the field oscillator. This is preceded by a BC238 sync pulse amplifier. Field jitter is usually due to one or other of these two transistors.

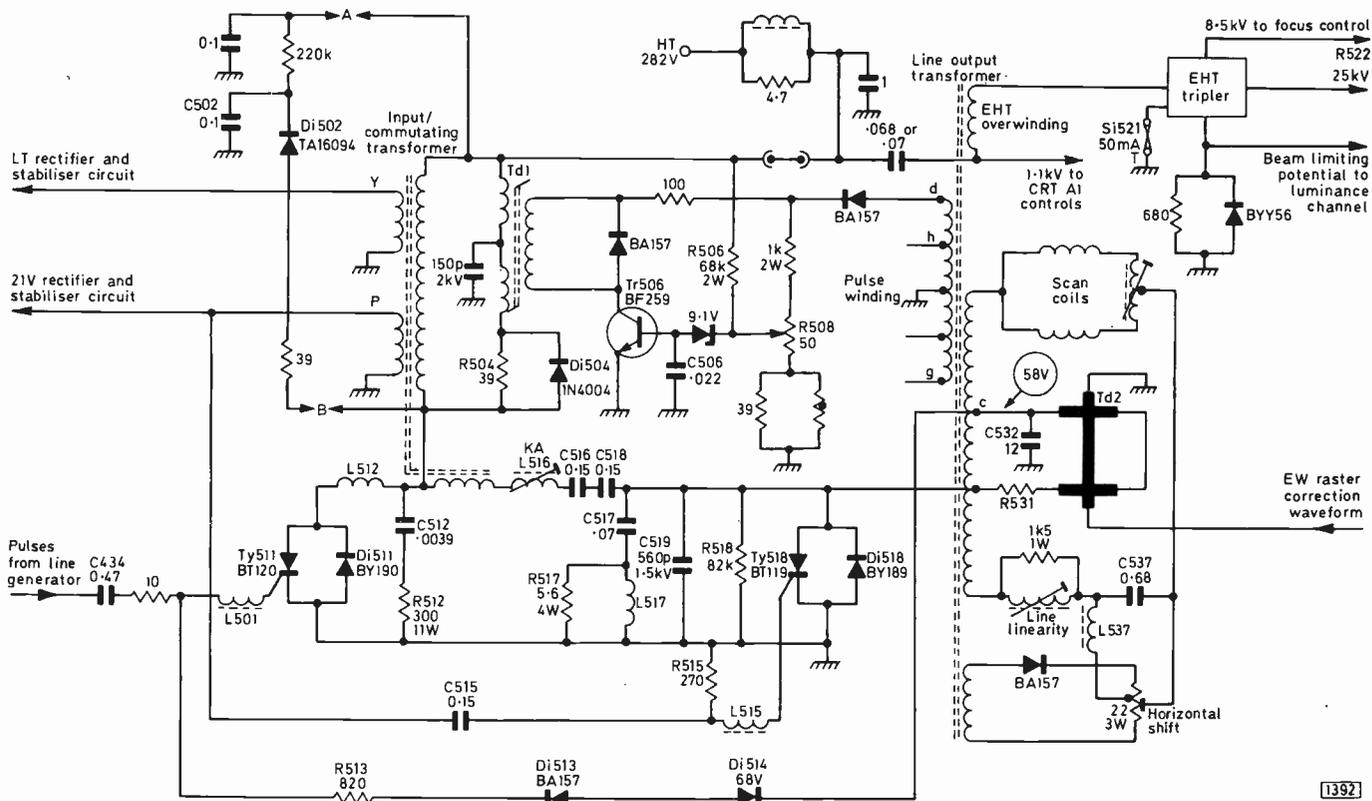


Fig. 1: Simplified circuit of the thyristor line output stage, Models 5011 and 6011. The following differences apply to the earlier Models 5010 and 6010: C434 0.18 $\mu$ F, C506 4.7nF, C516 and C518 0.14 $\mu$ F, C512 3.3nF, R512 220 $\Omega$  9W, C513 560pF in parallel with C512/R512, C517 75nF, R517 1 $\Omega$ . In addition there are five connections to the line output transformer primary winding, R531 and the thyristor circuitry being connected to separate tags. R531 is 220 $\Omega$  11W on the 5011/6011; on the 5010/6010 it's 10 $\Omega$  9W while between Td2 and C532 there is a parallel diode (Di532)/resistor (R532 2.2k $\Omega$ ) combination.

**Protection circuitry:** The safety circuit R513/Di513/Di514 is on the later models. If the voltage at tag c on the line output transformer rises above 68V Di514 and Di513 conduct, triggering Ty511 so that the cutout Si604 goes open-circuit. In the earlier models the network shown between A and B is included to protect the flyback thyristor Ty511. This operates as follows. Di502 charges C502 to approximately 620V: in the event of a flashover the circuit acts as a clamp so that the pulse appearing across Ty511 does not exceed 620V.

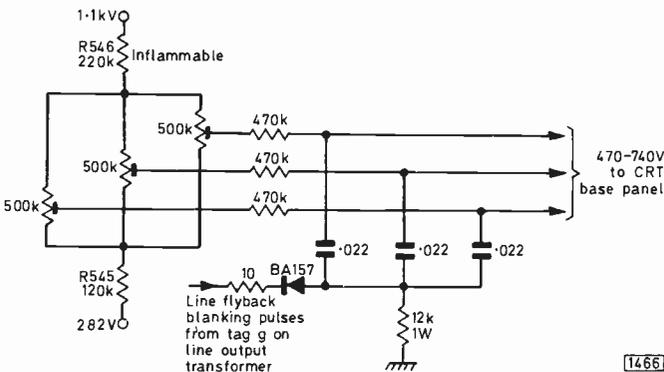


Fig. 2: The c.r.t. first anode supply and line flyback blanking circuit.

The decoder is very reliable and I've yet to experience faults here. For future reference however, to over-ride the colour killer short-circuit TP13 to TP15. To set the reference oscillator frequency, over-ride the colour killer, short TP16 to chassis and set R871 (RN) for zero beat.

Peculiar colours with flyback lines on one colour is usually due to a dry-joint on the colour-difference amplifier panel or one of the three BF459G transistors being faulty. I use MJE340 transistors for replacement purposes. On one occasion however one of the TD190A clamp diodes (Di575/Di585/Di595) turned out to be open-circuit. BA148 or BY206 diodes are suitable replacements. The 50 $\Omega$  preset gain controls (R573/R583/R593) in the emitter circuits of

the output transistors can give such troubles as intermittent loss of one colour with lines at the top of the screen.

Absence of the luminance signal can be due to the luminance delay line, the BF459G luminance output transistor (Tr375), the TBA970 luminance signal processing i.c. or even a fault on the service switch mounted on the tube base.

I.F. faults have also been rare – limited to one case of poor definition due to a dry-jointed coil and a case of a.g.c. overloading due to the TBA440 i.c. being faulty.

Sound faults are more common however – usually weak sound with buzzing as the TBA120S intercarrier sound i.c. goes faulty, or distortion due to the TBA800 audio i.c.

The tuners were at one time plagued by drift. This was when the TAA550 tuning voltage stabiliser was replaced by the ZKT33. Fit a TAA550 to troublesome panels.

Problems with the touch-tuning or remote control systems are best left to Grundig (UK) Ltd unless a touch with the soldering iron can help – yes, even this board gets dry-joints, especially around the stabiliser feed resistor R252 (33k $\Omega$ ) which tends to run hot (on Model 5011 this resistor is R202, 22k $\Omega$ , on Model 6011 it's again coded R252 but the value is 27k $\Omega$ ).

Problems with the tuning resistors being intermittent can be solved on later panels by removing the carbon tracks and cleaning them with Servisol or similar cleaner. This cannot be done on earlier models, so the board has to be replaced.

Dry-joints in the tuner itself can often be the cause of low gain. The judicious use of a *small* iron will often cure this fault.

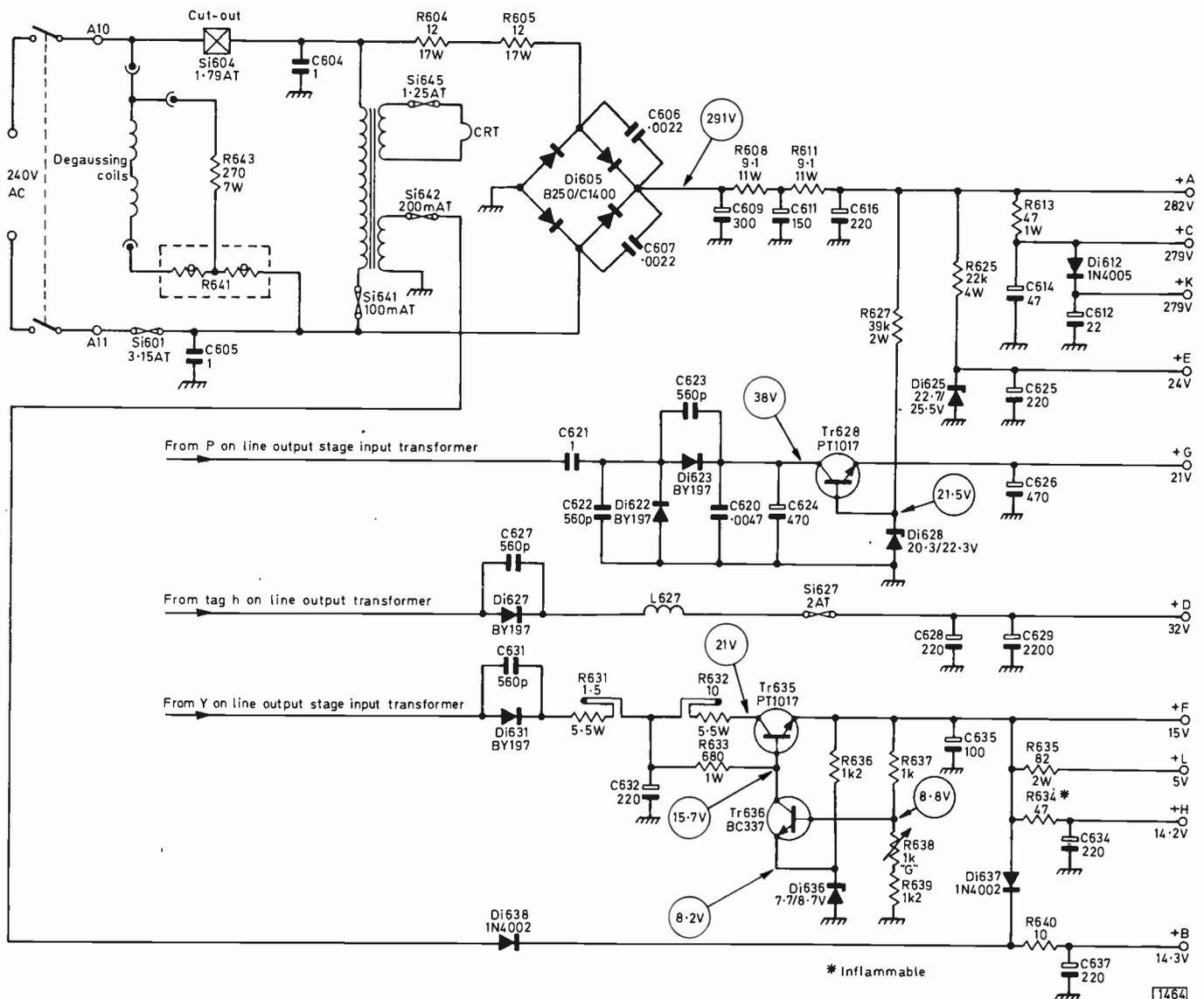


Fig. 3: Power supply circuitry, Model 5010. R640 is not on earlier sets. Differences with the remote control Model 6010 are shown in Fig. 4 (see below). In the later 5011/6011 models there is no +K supply; Si601 is 4AT, Si641 125mA and Si645 1.6AT; diode D629 (TD190) is added between the base and emitter of TR628 (cathode to base, anode to emitter); a 1Ω resistor and 0.1μF capacitor in series are added across the input from tag h on the line output transformer; Tr635 is type TE404 with R632 6.8Ω and R633 470Ω. Note that T in the fuse rating indicates a surge-resistant type. The mains filter capacitors C604 and C605 should be rated at 250V a.c. (grey coding).

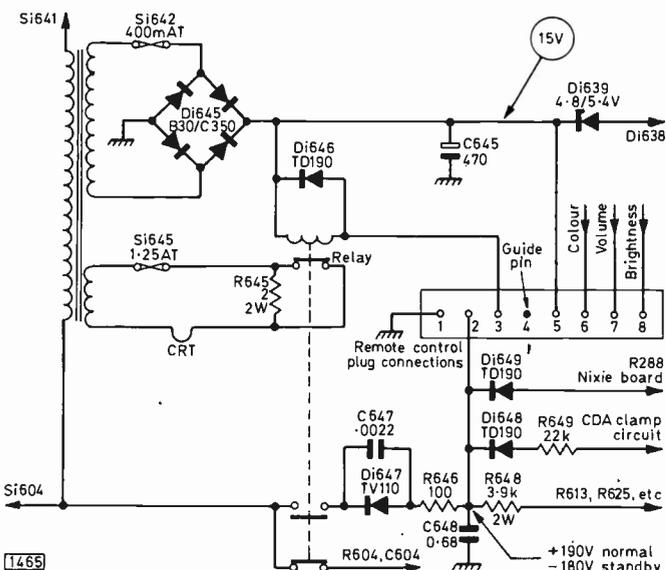


Fig. 4: Power supply circuit changes in the remote control Model 6010. In the later Model 6011 R645 is rated at 7W.

The hand-held remote control unit has proved very reliable – except for one instance where a heavy fist had broken off the contact springs on the remote on/off position.

To set up the grey-scale, turn all the c.r.t. first anode potentiometers fully anticlockwise and set the service switch for field collapse. Adjust the Sp control R562 until a faint line of one colour is just visible, then set the two other colours for equal brightness lines with the respective first anode controls. Return the service switch to normal and turn the brightness and contrast controls to give a high brilliance level. Then adjust the c.r.t. cathode drives (R684 and R685 on the c.r.t. base panel) for optimum peak white. Repeat the procedure until the best results are obtained.

Fuses abide in plenty on these chassis. Si604 is the cutout while Si601 is the mains supply fuse. Si641 gives a dead set – no line oscillator start bias and the c.r.t. heater out. Si642 gives the same condition but with the c.r.t. heater alight. Si645 gives no picture – c.r.t. heater not alight. Si627 protects the field output stage and Si521 the e.h.t. tripler.

One further point, for c.r.t. booster fans: for some unknown reason it doesn't seem to work very effectively with 110° tubes.

# Ultrasonic Remote Control System

A. Willcox

THE design philosophy behind the present development was to produce a remote control channel selector requiring the minimum of connections and modifications to the TV set. With this end in mind it was decided to power the unit from the 33V stabilised line already existing in a varicap tuned receiver. To do this without upsetting the supply to the stabiliser i.e., the current requirement of the unit should be similar to that of the conventional bank of tuning potentiometers which it replaces (approx. 2mA). With only a few milliamps to spare, the choice of suitable station indicator lamps presents something of a problem. Neon indicators are often used in this application, but are out of the question in this case because only 33 volts are available. However, a solution offers itself in the form of an RS Components miniature l.e.d. These devices are extremely efficient, and are found to give a reasonable light output when supplied with only 1mA.

## Circuit description

Transistors Tr1 and Tr2 (Fig. 1) form an amplifier for the ultrasonic signal picked up by the transducer X1. The response is tailored by the use of low value coupling capacitors and, combined with the natural selectivity of the crystal transducer, the unit is insensitive to sounds other than those from the transmitter (40kHz).

The output from the amplifier is applied, after detection

by D1, D2, to the complementary bistable pair Tr3, Tr4. The result is that the pair are turned on whenever a signal is picked up by X1. They switch off, however, when the signal ceases because insufficient holding current is available due to the high value of R9. Capacitor C6 is normally charged to supply voltage, and supplies enough energy to ensure a rapid turn-on of the pair.

Turning to the rest of the circuit for the moment, it will be seen to be made up of similar stages, but with the difference that sufficient current is available through the common feed resistor R13 to ensure that if a stage is turned on, then it remains on. When the receiver is first switched on, the pair Tr5, Tr6 turn on because forward bias is supplied to Tr6 from R13 and R12. So at this stage the tuning potentiometer VR1 is connected to the 33V stabilised line via Tr6. This pot is therefore effective, and whatever tuning voltage is selected by it is passed on to the tuner via D12.

When a signal is received and Tr3-Tr4 switch rapidly on, capacitor C7 is connected via D3 and Tr4 to the positive supply rail. When this occurs the current through R13 is momentarily diverted through C7 as it quickly charges. Tr5 and Tr6, unable to find sufficient holding current in this brief instant, promptly switch off, and Tr6's collector voltage falls in the process. This fall is transferred to Tr8's base and provides *forward bias* (pnp transistor) for long enough to ensure that as C7 charges and current is again available via R13, the pair Tr7, Tr8 turn on. This again is a

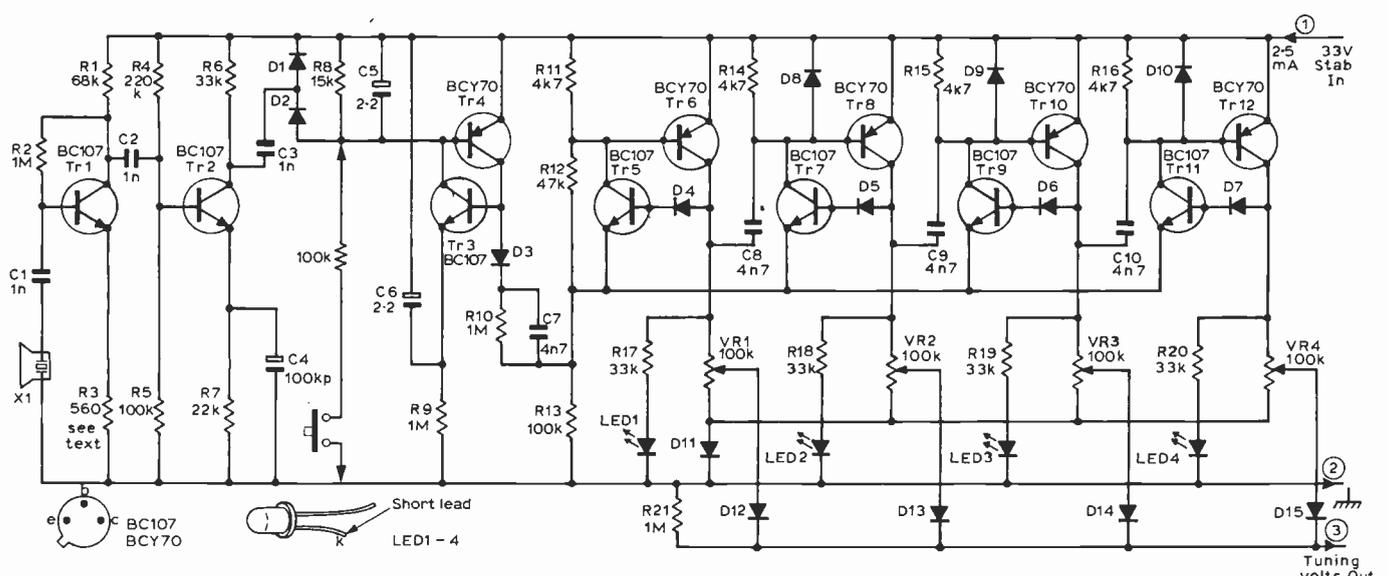


Fig. 1: Circuit diagram of the receiver. The 100kΩ resistor and the push-button switch shown from Tr4 base to chassis may be added if it is wished to provide manual stepping channel selection.

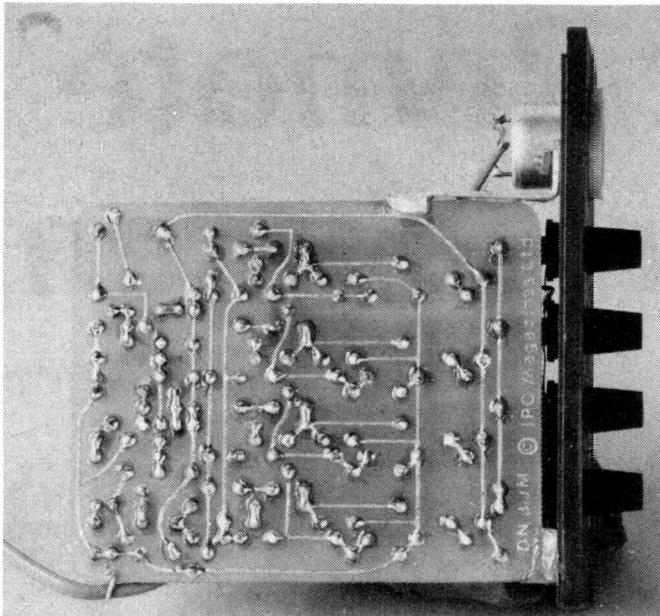


Fig. 2: Underside view of the receiver as made to fit inside a TV set. Note that the p.c.b. used was a prototype unit. The one shown in Fig. 3 is the correct one.

stable state, and this time VR2 is the pot in circuit. The process continues thus along the line each time a signal from the ultrasonic transmitter is received.

It will be helpful at this stage to note that the voltage at the junction R12, R13 is held to within 1 volt of the positive supply rail by whichever pair of transistors is conducting. However, when the end of the line is reached and Tr11-Tr12 turn off, this voltage is allowed to fall (exponentially, as C7 charges). This fall is arrested when 0.6V is developed across R11, causing the pair Tr5, Tr6 to turn on once again. It is easy to see from this that the number of stages (stations) could be increased as desired, although only four were required on the prototype.

As described above, when a transistor pair switches off a negative pulse is produced which forward biases the next stage. It will be realised that, conversely, when a pair turns on a positive pulse occurs which reverse biases the following stage. Under this condition the next stage is off in any case and so this pulse has no effect. However, the pulse amplitude is in the order of 30V, while the base-emitter reverse breakdown voltage of a silicon transistor is only 5 or

### ★ Components list

#### Resistors (all $\frac{1}{8}$ W 5%)

R1	68k $\Omega$
R2	1M $\Omega$
R3	560 $\Omega$
R4	220k $\Omega$
R5	100k $\Omega$
R6	33k $\Omega$
R7	22k $\Omega$
R8	15k $\Omega$
R9	1M $\Omega$
R10	1M $\Omega$
R11	4k7
R12	47k $\Omega$
R13	100k $\Omega$
R14, R15, R16	4k7
R17, R18, R19,	
R20	33k $\Omega$
R21	1M $\Omega$
VR1-VR4	100k $\Omega$ Helical Tuning Pots.

#### Capacitors

C1, C2, C3	1n miniature ceramic 100V
C4	100n tantalum bead
C5, C6	2.2 $\mu$ F 35V tantalum bead
C7, C8, C9, C10	4n7 miniature ceramic 100V

#### Semiconductors

Tr1, Tr2, Tr3, Tr5, Tr7 Tr9, Tr11	BC107
Tr4, Tr6, Tr8, Tr10	BCY70
D1, D2	Germanium (OA90 or similar)
D3-D15	Silicon 1N4148 etc.
LED1-LED4	R.S. Comps. red miniature LED only. Stock no. 586-447.
X1	SE05B 40R
Transducers available from: Hall Electronics, 48 Avondale Road, London E17 8JG, at £3.75 including VAT and postage & packing.	

#### Transmitter

IC1	555 timer i.c.
R1	10k $\Omega$
VR1	10k $\Omega$ miniature horizontal preset
C1	1,000pF 5% Polystyrene

#### Miscellaneous

Ever-Ready torch case	
PP3 battery	
X1	SE05B-40T (Hall Electronics)

6 volts. Diodes D8, D9 and D10 are introduced so as to safely bypass the pulse to the supply line. The npn transistor emitters of the non-conducting pairs are tied to the positive supply rail by the conducting pair, while the bases are connected to the negative line via the pots and the i.e.d. circuits. Under these conditions reverse breakdown of the base-emitter would occur, and this is prevented by the diodes D4-D7. Diodes D12-D15 serve to isolate the potentiometers from each other, while D11 temperature compensates for their inclusion.

When the first prototype was constructed diode D3 was not included, and although the unit functioned well in all respects it did insist on coming on with channel two selected, instead of channel one, when the set was switched

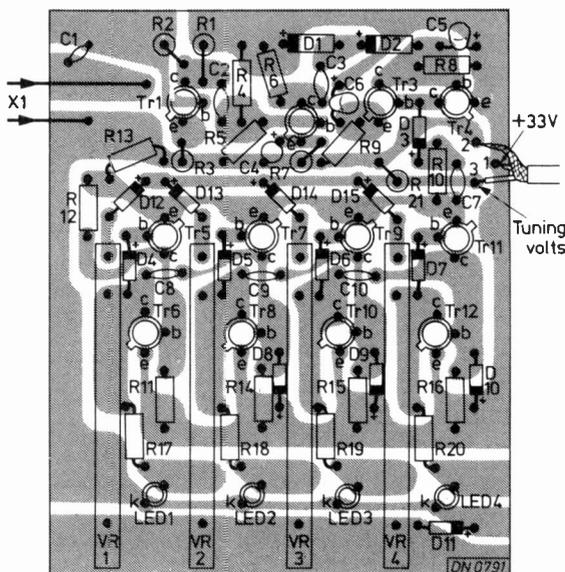
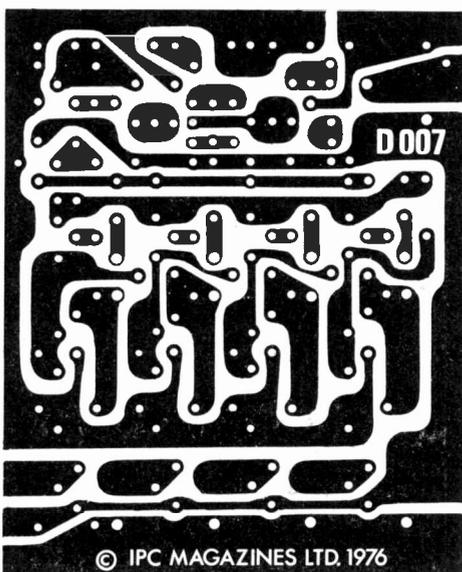


Fig. 3: Track details and component location for the receiver p.c.b. The board is available from Readers PCB Services Ltd, PO Box 11, Worksop, Notts. This also applies to the transmitter board shown in Fig. 4.

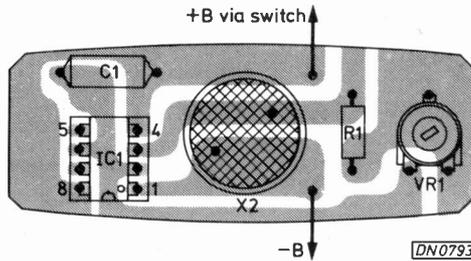
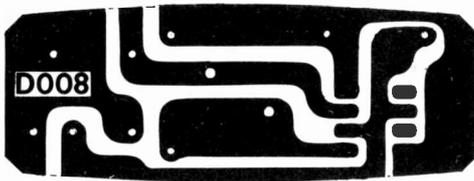


Fig. 4: Track details and component location for the transmitter p.c.b. The board is cut to fit inside an Ever Ready torch case. The i.c. socket is optional.

on. This caused some head-scratching at first; but then the writer did not have the advantage of knowing that a diode at this point would clear things up. Perhaps the more inquiring reader may like to figure out why this should be so.

### Construction and installation

If the unit is built into a separate case, rather than panel mounted, care must of course be taken to fully insulate it. This is made easier by the fact that no ventilation is required. On the prototype, the body of the case was made from "Daler board" (available from art shops); and a visit to the local C.E.S. branch provided a suitable piece of plastic for the front panel and a washing machine water filter for the transducer grille.

A short length of twin screened wire is used to connect up to the TV set, and it is important that the supply to the

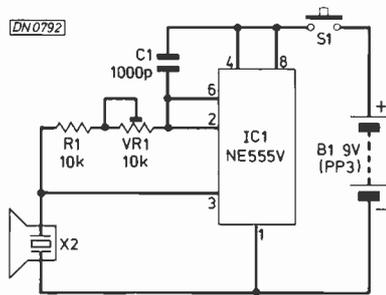


Fig. 5: Circuit diagram of the transmitter unit.

unit is taken from directly across the electrolytic capacitor which decouples the stabiliser i.c. (Fig. 7). It is particularly important that the earth connection is not made elsewhere on the chassis. The lead to the unit should be dressed well away from the line timebase. These precautions are necessary to avoid interference from the line timebase being introduced into the unit via the supply leads. The resistor which is usually in circuit between the stabiliser i.c. and the decoupling capacitor (R1, Fig. 7) should be left in circuit, and indeed decoupling is improved if it is increased in value to one or two k $\Omega$ .

The gain of the ultrasonic amplifier is set by the value of R3 which can be between 100 $\Omega$  and 2k $\Omega$ . With this resistor

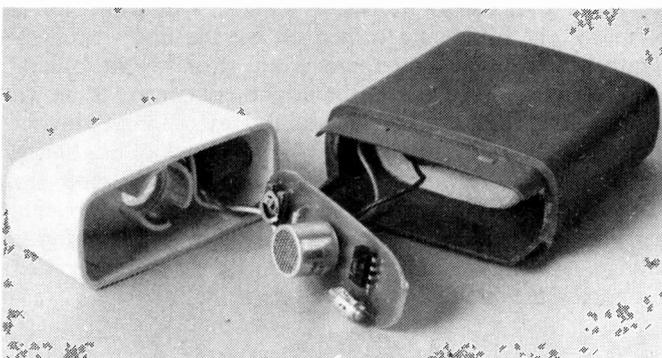


Fig. 6: The transmitter shown with the cover removed. Note that the transducer protrudes through the opening in the cover which normally takes the bulb.

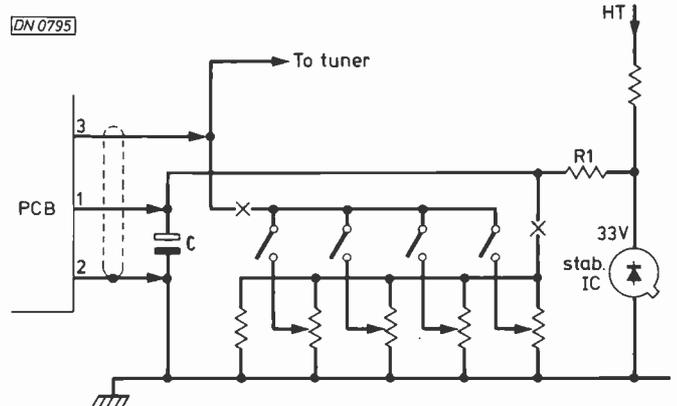


Fig. 7: Connection details for installing in the TV set. The connections in the set marked X must be broken. Add C (100 $\mu$ F) and R1 (1k $\Omega$ ) if not already present. It is important that connections to the unit are made across C rather than to a separate earth point.

at 100 $\Omega$  the range will be about 60ft, and of course this is far greater than will be required. Even with this sensitivity no trouble should be experienced if the unit is used with a monochrome receiver; but in the case of a colour set radiation from the line timebase may be sufficient to interfere with the unit and keep Tr3, Tr4 held on. A good compromise between gain and immunity from interference should be achieved with R3 at 560 $\Omega$ , but it may be more convenient to fit a 2.2k $\Omega$  miniature preset in its place on the print side of the panel.

### Transmitter

For simplicity a timer i.c. is used in the transmitter, connected to operate in the astable mode (Fig. 5). The output at pin 3 switches between the supply rails at a rate set by VR1 to 40kHz. In practice VR1 can simply be adjusted to give maximum range, but the peak is quite sharp, and so it is more satisfactory to monitor the ultrasonic receiver when setting up. A PP3 battery is used to power the unit, held in place with foam plastic.

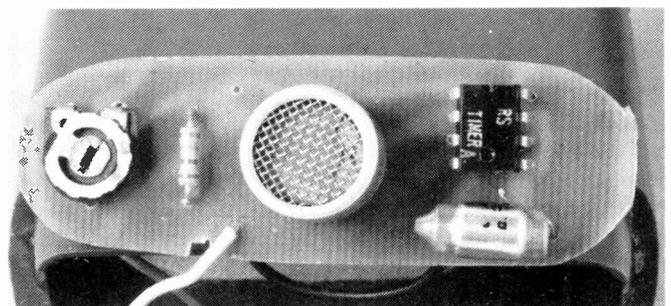
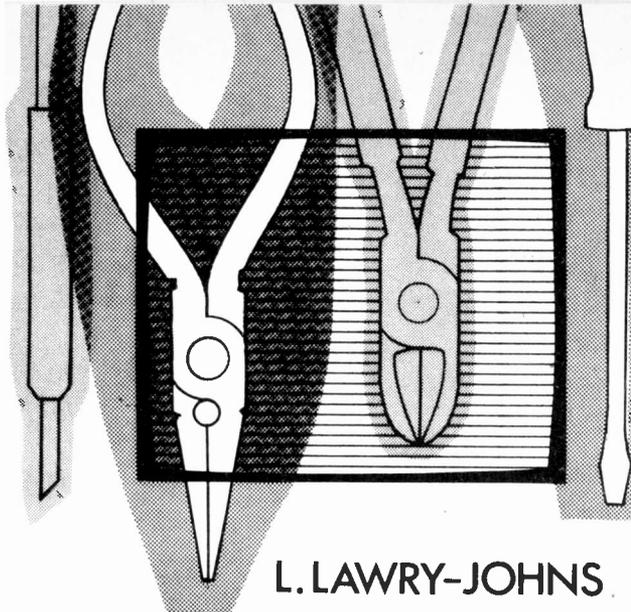


Fig. 8: Photograph of the transmitter p.c.b.

### Correction

Please note that in the Veroboard layout of the In-Situ Transistor Tester in last month's issue, a break in the track should be made to separate the base of Tr2 from D2.



# SERVICING TELEVISION RECEIVERS

## PHILIPS K70 CHASSIS

continued

L. LAWRY-JOHNS

### HT Supply Faults

The next most common fault is rather more awkward. It will be seen that the h.t. supply is drawn from a pair of BY127 diodes situated at the lower rear (rather than on the same panel as the fuses and bridge rectifiers). There are two surge resistors below the diodes, R891 and R892. These have a value of  $4.7\Omega$ , are wirewound and in rectangular white housings.

The sequence of events is (I believe) as follows. One wirewound resistor becomes open-circuit as wirewounds are apt to do, and this shuts off the supply to one BY127. The other manfully struggles on, bearing the load until it registers its objection by burning up. This damages the panel which may also ignite to add further heat before the diode shatters and shuts off the current and (hopefully) the minor blaze goes out of its own accord, leaving a nice old mess to clear up. Now one may think that a small cut away job and the fitting of new diodes and a surge limiter together with the replacement of any other damaged components would be the sum total of the work involved, but this is rarely so.

If the thermal cut out R897 is open, proceed with caution and check for h.t. shorts. Even if none are found, fireworks may still occur as the line timebase warms up after R897 has been resoldered and the set switched on. The fireworks may come from R916. The trouble is that the BA148 previously referred to has been subjected to heat and it doesn't like it. Since it's not supplied from the h.t. line the short will not show up unless you check across the diode or from the +20 line.

### Burn ups

There are several variations on this theme of burn ups on the lower panel and we once found the beam limiter preset control R1212 burnt out together for some reason with R1209 (we never did find out why but suspect a short between tracks which had burned away thus destroying the evidence). Again we found R916 cooked up due to the BA148 shorting and we had to put this down to local heat. The moral of this is to check the BA148 for shorts whenever there has been excessive heat in the vicinity.

### Weak Sync

A common occurrence is gradually weakening sync pulses until a point is reached where the line is pulling one way or the other with no positive hold, the field being

lockable but only just. A word of caution here though. If the field sync is solid but the line cannot be locked, try another PCF802. If however the field sync is weak as well as the line it saves an awful lot of trouble if a couple of resistors are checked before chasing the sync pulses back along the line.

The suspect resistors are R1145 and R1147. These are situated on the upper left side and are connected from the +3 (250V) line to the collector of TS451. Their values are  $47k\Omega$  and  $39k\Omega$  respectively but they tend to change value (going high), giving wrong voltage readings all around the area of the sync transistors. When these resistors have been replaced one voltage may be found at variance with the service information. This is the collector voltage of TS453. It's given as 13V on the circuit but we haven't been able to record this figure and about half is more likely to be found.

### Dark Picture

A dark picture is normally due to a low-emission PL802 luminance output valve. In the unlikely event of a new valve not curing the condition, check the tube base voltages to ensure that the cathodes, grids and first anodes are about right, then follow the trail provided by these readings. Give or take a few volts, the cathodes should be at about 200V, the grids at about 88V and the first anodes at about 350V depending upon the settings of the background controls.

### Luminance Output Stage

If the cathode voltages are high, the PL802 is probably not passing normal current and if the valve is not at fault its cathode and grid components should be checked, including the black-level clamp transistor TS429. This transistor is normally cut off, being turned on by the line frequency clamp pulses. Note that there is an error on the official circuit – where the slider of the brightness control is shown connected to chassis – and also on the printed board layout where GR473 is identified as GR493 . . . Lack of brightness could be centred around TS429 and the components in the PL802's cathode and grid circuits – say due to TS429 being leaky or short-circuit, thus increasing the valve's cathode voltage. We say could because so far as we are concerned this part of the circuit has behaved itself.

### Panel Decomposition

What hasn't behaved itself is the panel around the base of the PL802. This decomposes, with resulting shorts

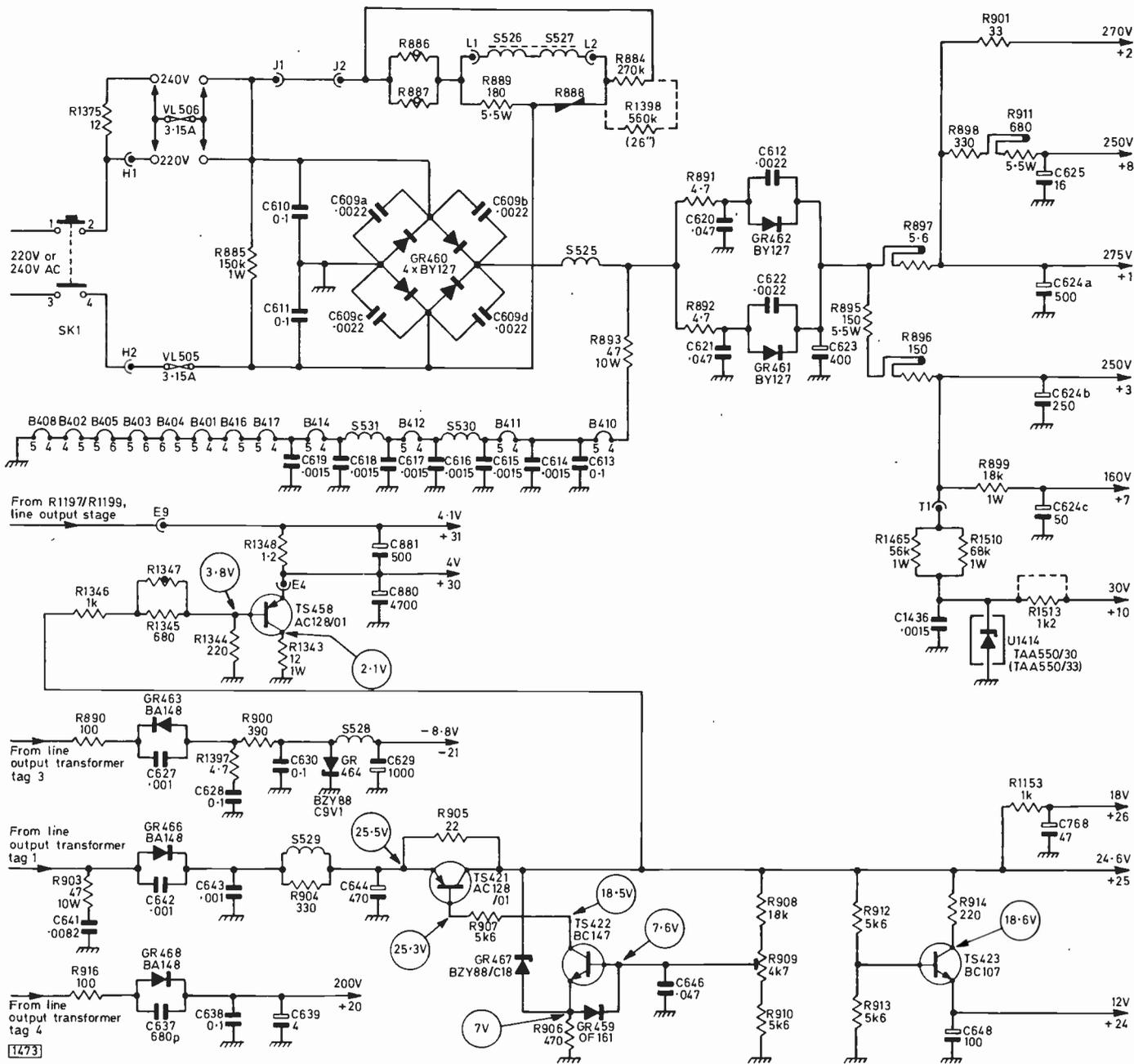


Fig. 3: The power supply circuits. Some of the feeds come from the line output stage.

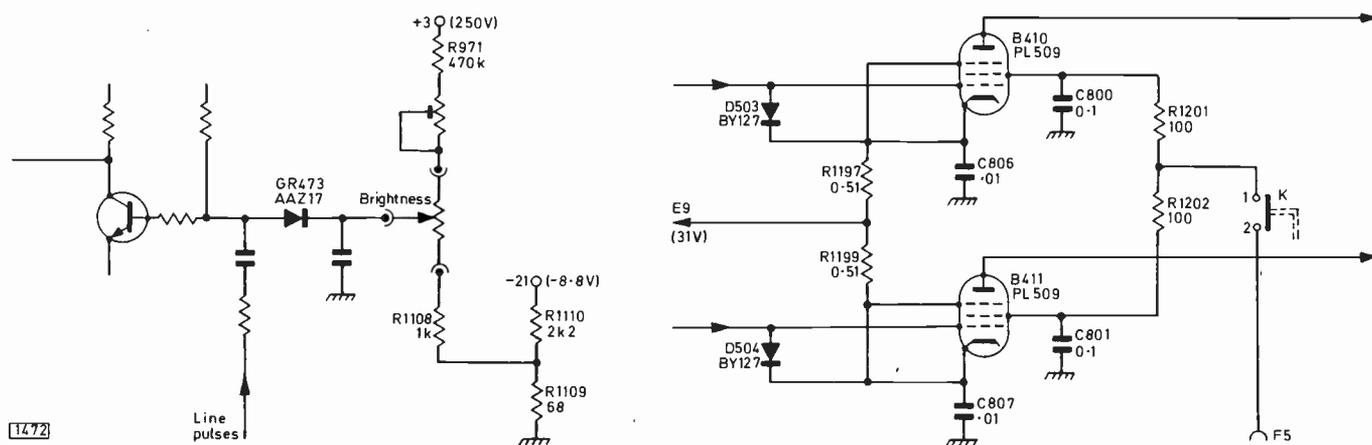


Fig. 4: Modifications to the brightness control circuit (left) and to the line output circuit (right).

between tracks causing various conditions including a burn out of the heater track so that the initial symptom is no heaters glowing. Once again a judicious cutting away job with little bridges to complete the circuits is called for.

### Colour Problems

Fortunately the decoder is pretty well trouble free so that the majority of colour problems are not serious and are



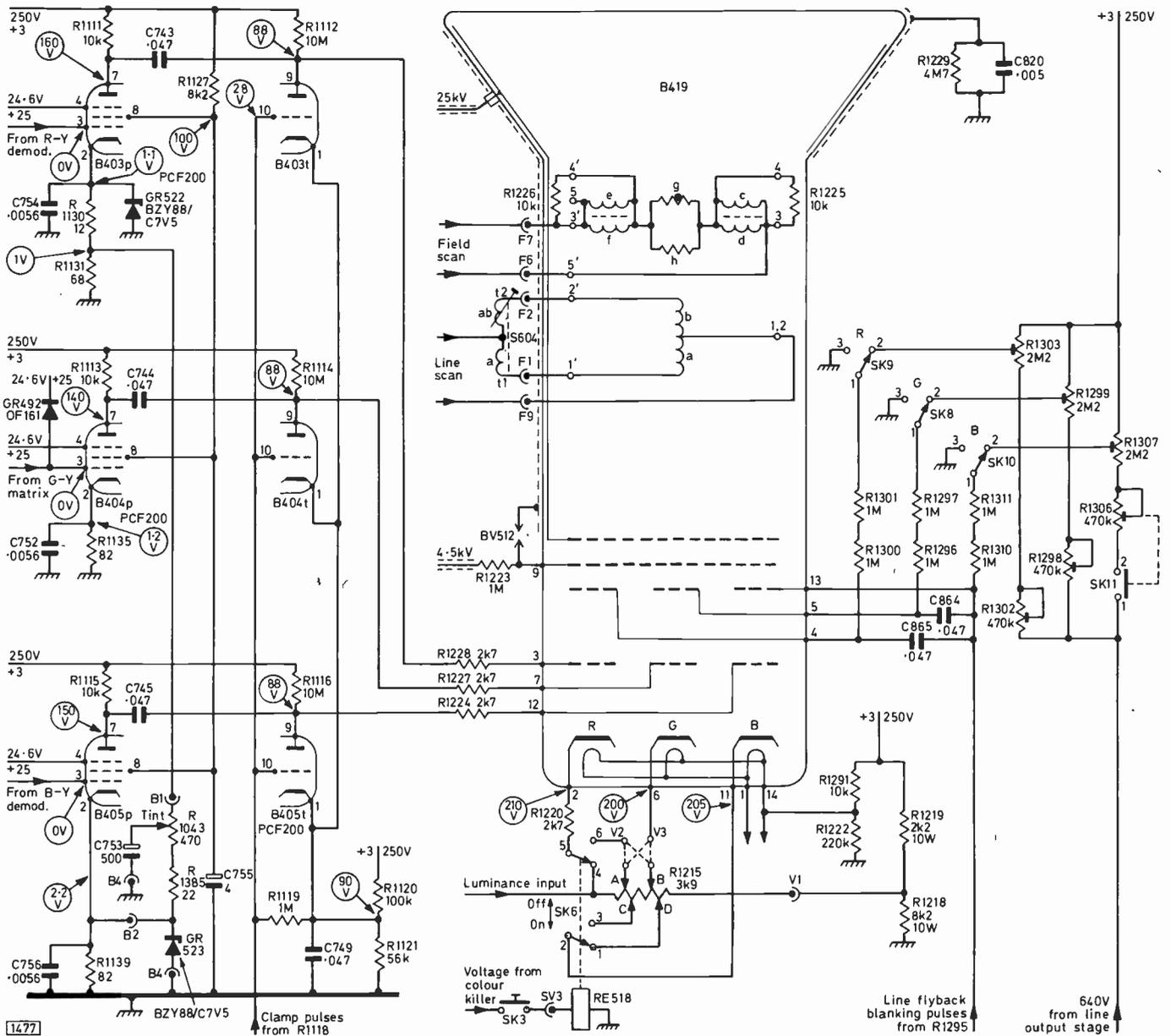


Fig. 7: The colour-difference amplifier and c.r.t. circuitry.

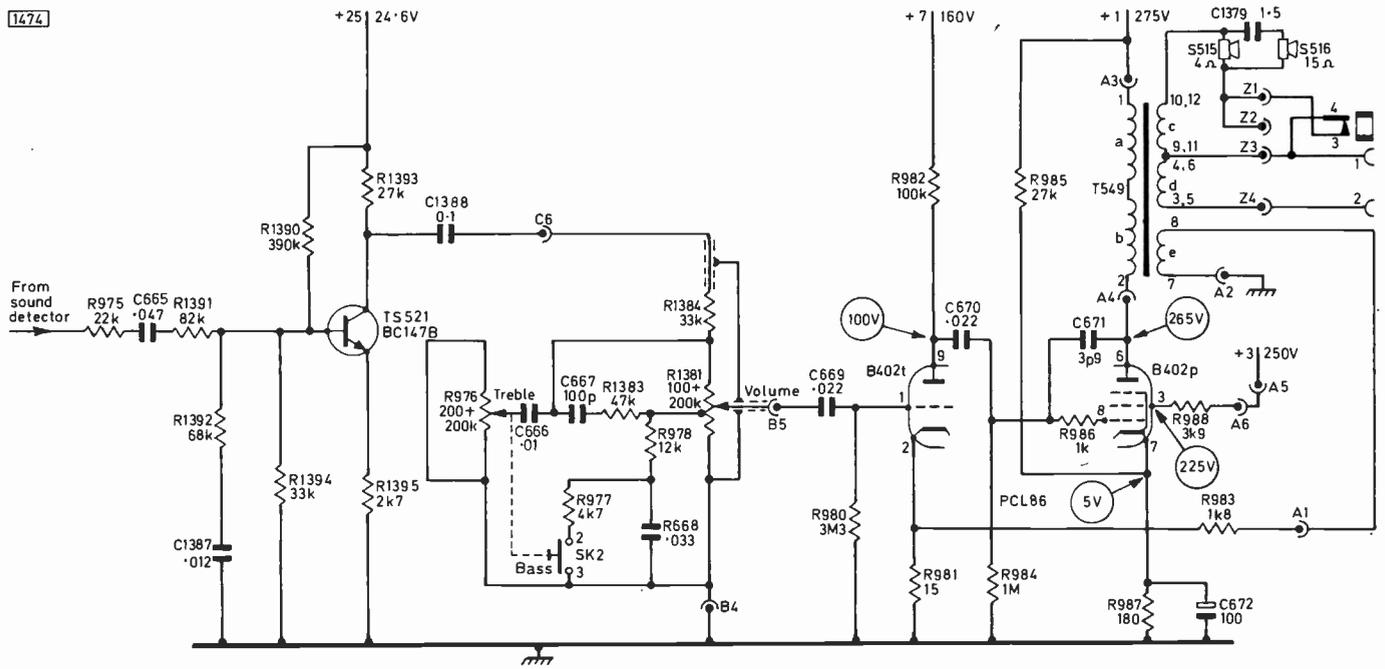


Fig. 8: The audio channel.

heartache if a logical approach is adopted, working from the tube base back.

There are rare occasions when the first anodes are o.k. but the grid voltage(s) stay stubbornly wrong even when a new PCF200 has been fitted in the relevant stage. Here one must appreciate that the grids are clamped to the triode anodes, and that the  $10M\Omega$  resistors can go high or the coupling capacitors can leak. If necessary check the value of R1120 which should be  $100k\Omega$  – this affects all three clamps when it changes value.

## No Picture

In cases of no raster, switch on and wait for the line timebase to warm up, carefully listening for the “rustle” as the e.h.t. charges the tube envelope. If this rustle is heard there is most certainly e.h.t. present and the cause of no screen illumination should be looked for elsewhere (check the tube base pins as previously described).

If there is no audible sign of an e.h.t. build up, bring your trusty neon near the PL509 etc. If it lights up, the line output stage is functioning and an e.h.t. probe should be applied under the tube cap to see how near to 25kV the voltage is.

If there is little or no e.h.t., remove the screening around the right side compartment and accept the fact that removal of the cover allows the top right switch to spring out switching off the line output stage (cuts off the screen grid supplies).

If there is no e.h.t., the switch can be operated by hand without risk of X-ray radiation. Either the GY501 e.h.t. rectifier or the PD500 stabiliser triode is likely to be faulty. The GY501 can sometimes die without fuss so that a replacement is all that is required. But it is often the case that this and the PD500 die anything but quietly and leave little doubt as to where the trouble lies, often with the demise of the beam limiter control R1212 (previously mentioned) as well.

The PD500 is held by a frame secured by three screws at the top (slacken and lift, first removing the two screws securing the little coil can above which prevents complete lifting of the PD500 assembly). With the PD500 out, there are two screws holding down the GY501 holder. Check the sockets and clips for corrosion.

We haven't found a defective line output transformer yet (having said that we'll probably have a run of them) but this is only our own experience – that most of the line output stage troubles concern the PY500, PL509 and PL504 (or a second PL509, whichever version is met) valves. These cause the no e.h.t. condition, lack of width, poor focus and dreadful convergence (remember, no magnets for static convergence).

We have also not yet had a burn up in the focus network, but no doubt this pleasure is to come when the BY176 focus rectifier and/or its 50pF reservoir capacitor decide to short. The spark gap (“at” on the circuit) may save the resistor and control etc. but this is in doubt. Deterioration of the series  $3.3M\Omega$  or shunt  $30M\Omega$  resistors will cause variation of focus, but so far they have been remarkably good.

## Fault Summary

Sound troubles have been confined to defective PCL86 audio output valves. No tuner troubles to date, but one must expect at least to have to replace an r.f. amplifier transistor sooner or later if the picture becomes grainy with “difficult” colour.

The AC128/01 voltage regulators (TS421 and TS458)

have behaved themselves but it is as well to study the lines controlled by them so as to anticipate the effect of a failure since the +25 line is the main transistor supply source.

The signal sections and the decoder have not presented us with any problems, though at one time we primed ourselves to meet such situations by studying the circuitry and dreaming up all sorts of permutations of “if this” and “if that” only to find such fault symptoms on other sets but not on this one.

Faults will be encountered time and time again on these models, but will almost always be in the power supply lines and the valved circuits.

We haven't said much about the field timebase. Such problems as we have met have concerned the PL508 or the PCF80, also the polystyrene capacitor C836 which can collapse the field or cause rolling depending upon whether it shorts out or just sits there doing nothing. At the top centre, it's the only silver one around.

## Front Controls

Trouble may also be experienced with the front controls. These have a plug of carbon inserted in the centre rotor to wipe the carbon track. If turned too violently (it wasn't me mum) the plug may part company with the rotor and the control is then ineffective. The control panel is secured by two screws and doesn't present much of a problem if the right replacements are to hand.

## Modifications

An  $8.2k\Omega$  resistor (R1312) has been added between pin 2 of the c.r.t. and the V1 end of R1215, modifying the blue/green adjustment.

R1209 in the e.h.t. circuit was changed to a safety resistor (part number 4822 111) to give improved protection against c.r.t. flashover.

R906 in the l.t. stabiliser circuit was changed to  $680\Omega$  to give improved stabilisation.

The following modifications were introduced to decrease brightness fluctuations due to mains voltage variations. The earthy end of the brightness control is taken via R1108 to the junction of R1110/R1109 (see Fig. 4), these resistors having been added. R1110 is taken to the -21 supply. R900 in the -21 supply changed to  $330\Omega$ . In the top end of the brightness control network R971 was changed to  $470k\Omega$  and taken to the 250V h.t. rail (+3) instead of the 160V h.t. rail (+7). GR473 was changed to type AAZ17.

To reduce the dissipation in the PL509 line output valve (B410) the other pentode in the stage (B411) was changed from a PL504 to a PL509 (see Fig. 4). The positions of the B410 and B411 heaters in the heater chain were transposed and R893 ( $47\Omega$ ) was removed. BY127 diodes were added as shown between the control grids and cathodes of the two valves. R1199 was changed to  $0.51\Omega$ . In the line oscillator circuit R1181 was increased to  $47k\Omega$  and a  $220k\Omega$  resistor (R1180) was added between pins 3 and 8 of the PCF802.

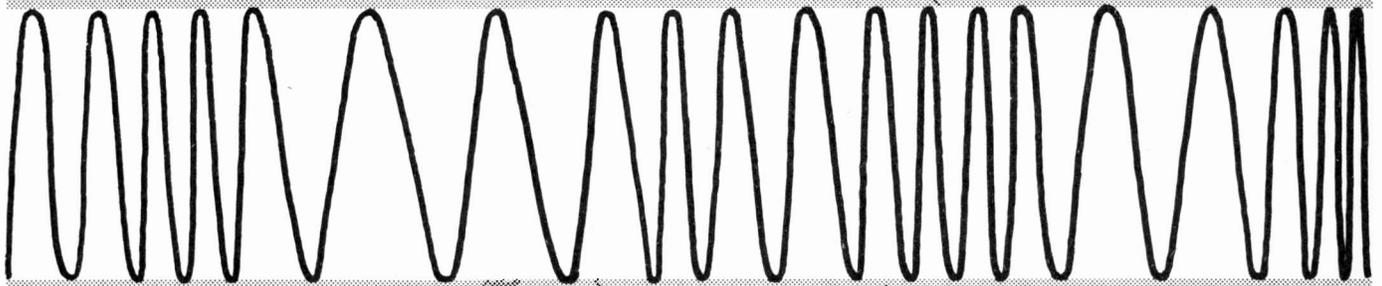
R899 in the +7 (160V) supply was changed from  $18k\Omega$  to  $1.8k\Omega$ .

---

*A. Denham comments on the K70:* The main bugbear has always been the power supply, and the chassis is noted for destroying the BY127s and their surge limiters, along with lots of spidery print and circuit board – and a few capacitors just for luck! All these bits are on the vertical power supply board, above the smoothing cans. These latter have a nasty habit of leaking white goo all over the best



# Intercarrier



# Sound Pick-up

HUGH COCKS

SOUND reproduction from a television set is generally rather poor considering the high quality of the signal itself. The space in a TV set is limited, and the loudspeaker is one of the first things to suffer from this restriction. It can be frustrating to have an excellent picture but only mediocre sound.

What can be done about this? It's possible to delve into a television set and obtain an audio output to feed into a hi-fi system. The problem of the set's live chassis arises however, while the technique cannot be used where the set is rented.

An extra tuner and i.f. strip can be used to obtain an audio output. This involves splitting the aerial signal however and an extra button to push on changing channel.

## Intercarrier radiation

Another alternative is to pick up the stray intercarrier signal which all sets radiate and to amplify and demodulate

this to provide a signal suitable for feeding into a good quality amplifier. This approach has the advantage of no direct connection to the TV set and no aerial signal splitting. Until recently however building a 6MHz pick-up unit from scratch was a tricky business if alignment equipment was not available since one unknown optimum position had first to be found for the external pick-up wire. The unit then had to be lined up to 6MHz. A difficult procedure to say the least!

## Prealigned unit

Fortunately help is at hand in the form of a ready aligned 6MHz unit now available from Manor Supplies. This consists of a U500 sound selectivity module as used in the Philips G8 chassis followed by a TAA570 intercarrier sound i.c. The circuit is shown in Fig. 1.

Testing the unit is relatively easy. Attach a length of

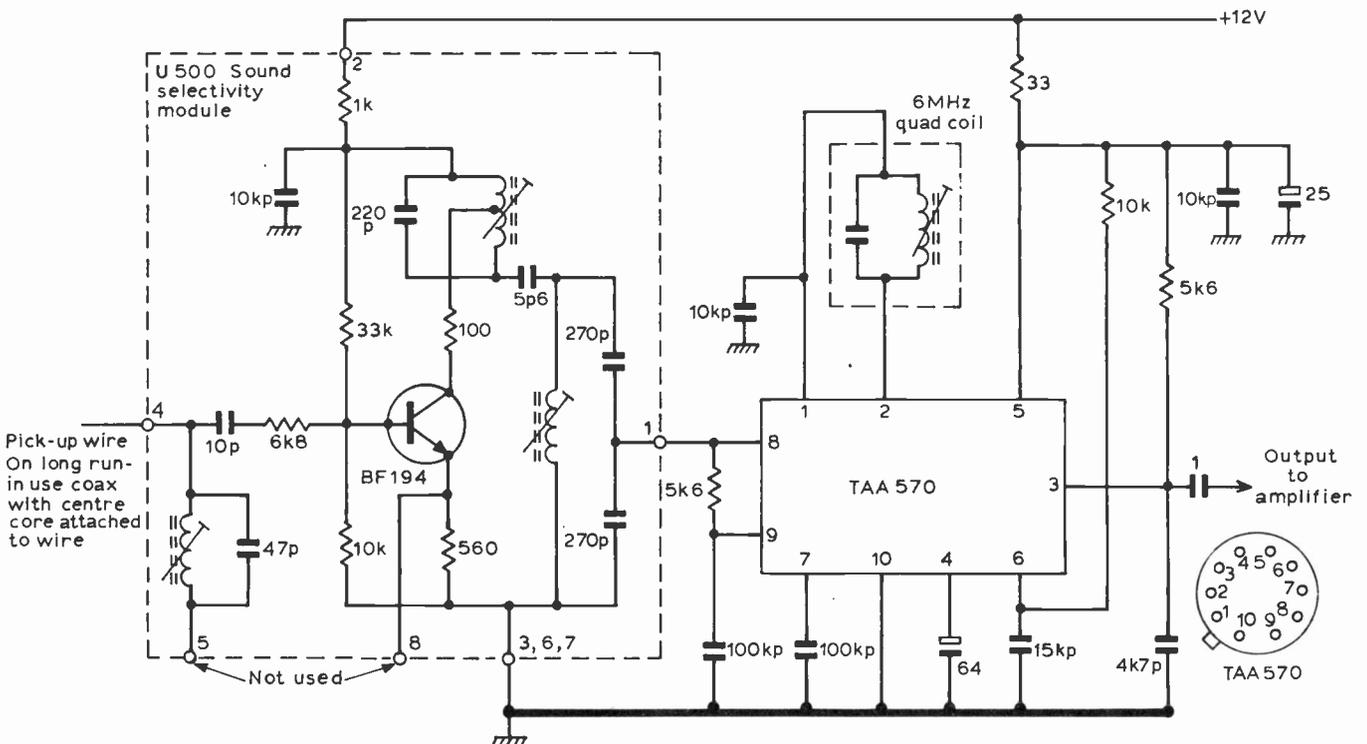


Fig. 1: Circuit diagram of the Manor Supplies intercarrier sound pick-up unit.

single wire to the input (pin 4) of the module and place it as close as possible on the back of the set to the i.f. strip. If a long run is necessary between the television set and the pick-up unit however the pick-up wire should consist of a foot of single-stranded wire connected to the inner conductor of a length of coaxial lead, with the braiding earthed at one end to prevent pick up of h.f. signals (heard as a background murmur, due to the f.m. limiting).

The a.f. output can be fed to the "auxiliary input" socket of a hi-fi amplifier, and on applying power (12V) some sound should be heard immediately. Move the pick-up wire around to obtain maximum intercarrier signal pick up and tape it to the position thus found on the back of the set.

### Trimming

Once the strongest signal has been obtained, the 6MHz quadrature coil next to the TAA570 on the board can be trimmed slightly for minimum buzz and maximum sound, and the three coils in the U500 module can be peaked for the strongest audio output.

If the audio output is still insufficient the bare end of the piece of pick-up wire can be attached to the braiding of the coaxial aerial feeder going to the set. This should increase the signal. It should be stressed however that if this is done you should ensure that the aerial isolating capacitors are not leaky.

The aerial input to the set should be as strong as possible since the unit does not work well with weak signals. Weak in this context means below entertainment value however, so no problems should be experienced.

After testing, the unit can be fitted inside the amplifier's case if there is sufficient room. The 12V supply can be obtained from the amplifier, or any alternative arrangement that suits particular requirements can be adopted.

### Other standards

The unit should also be of use to DX enthusiasts wishing to receive European 5.5MHz or 6.5MHz intercarrier signals using a 6MHz UK TV set.

Used for this purpose it is necessary to obtain a strong intercarrier signal from inside the set. The easiest way of doing this is to connect a small-value capacitor to the last 6MHz sound i.f. stage anode or collector, with the capacitor connected to a length of coaxial cable whose braiding is connected to chassis via a similar capacitor. This may cause problems for normal use however due to the capacitive loading of the take-off feed. The solution to this would be to build an extra 6MHz stage in the set. Alignment is straightforward. Tune in a strong Sporadic E signal (check that the signal contains both vision and sound information – some don't!). Then readjust the quadrature coil and the U500 module to either 5.5MHz or 6.5MHz as appropriate. If you wish to be able to receive both these European intercarrier sound standards two units will of course be required.

### Price

The cost of the unit assembled and tested is £5.60 plus VAT at 12½% and 60p post and packing. Alternatively the basic parts untested can be supplied at £3.80 plus VAT etc., but Manor Supplies tell us that if testing and other attention is subsequently required the balance must be paid. ■

next month in

# Television

## ● THE ART OF ALIGNMENT

Many people are shy about receiver alignment. Amongst possible causes are the absence of any standard work on the subject, the confusing instructions so often found in service manuals, and the fact that if you don't know what you're doing you can end up in a right mess. Harold Peters sets out to cure this state of affairs, giving a down to earth account of the principles along with practical examples and hints.

## ● THE PHILIPS G8 COLOUR CHASSIS

We are often asked about the popular Philips G8 colour chassis introduced in 1970. A. Denham describes the fault conditions he has commonly encountered on the various versions of it.

## ● TV SOUND CIRCUITS FOR THE CONSTRUCTOR

It is sometimes desirable to be able to monitor the TV sound through a separate system to that in the set. Recent TV sound i.c.s make the construction of a complete TV sound channel particularly simple – using just one i.c. and a handful of components. A practical, tested design is given, also an output stage which can be used to replace obsolete i.c. sound output stages.

## ● SERVICING TELEVISION RECEIVERS

Les Lawry-Johns reports on his experiences with the Philips 320 solid-state monochrome chassis.

## ● MINIATURE VHF AERIALS

When Bands I and III are re-engineered the question of new v.h.f. TV aerials will arise. Need they be such massive structures as the present generation? Recent developments indicate that much smaller types are practicable. Pat Hawker reports.

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# Servicing the INDESIT T12LGB

John Law

THE Indesit Model T12LGB is a 12in. solid-state mains/battery monochrome portable receiver which was imported in appreciable numbers over a period of several years. It's housed in a moulded plastic case with carrying handle and weighs around 14lb. Of Italian manufacture, the set features a couple of i.c.s in the sound channel in addition to the transistors and diodes. A two-pin plug-in aerial is supplied. The 300Ω aerial input socket is fitted with an external plug-in adaptor to enable the standard 75Ω coaxial feeder to be connected.

## Access

The outer case splits into two equal halves. To obtain access, remove two Phillips screws from the bottom, ease the back half away from the panel and lift it out and up over the plastic clips which secure it at the top. This exposes the printed panel, which contains the tuner and most of the components. To remove the panel, remove two further screws from the bottom and two from the top, pull off the tuner knob and withdraw the panel gently to the extent of the scan, speaker and e.h.t. leads. The field scan coils are plugged on to two pins numbered 51 and 52: the line scan coil connection pins are numbered 41 and 42. The tuner unit is screwed to the bottom of the panel, the knob protruding through the side of the case. To remove the panel completely, pull off the scan, speaker and e.h.t. leads and ease the panel over the c.r.t. base.

The neck of the c.r.t. is under an inch in diameter: it looks and is vulnerable. Handle it with great care when removing the plug-on base. With the exception of the c.r.t. and its base panel, all the components are mounted on the front of the panel.

Looking at the back, the arrangement is roughly sound, video and i.f. components above left, with the field timebase below, while the right-hand side of the panel contains the fuses, line output and chopper transistors and associated components. The tuner is bolted to the bottom left-hand side. The audio i.c. is above the c.r.t. aperture, slightly to the left.

## Different Versions

There are different versions of the set, but the changes are only minor. The main one is that earlier sets are fitted with a pnp line output transistor (AU110) while later models use an npn line output transistor (BU311 or BU109A). The field output transistors were also changed, see later.

## Signal Stages

The two-transistor tuner unit has a single-transistor i.f. preamplifier panel bolted to its side. The signals from this

pass via a coaxial lead to the main panel. There is a 12V supply to the tuner via a white non-reversible plug nearby. This area of the panel contains the i.f. cans, bandpass shaping circuits, etc.

The main circuit is shown in Fig. 2. The signals from the detector diode D1201 are fed via C302 to the TBA120A intercarrier sound i.c. and to the video driver stage TR201. The latter feeds the sync and a.g.c. circuits and, via the contrast control, the video output transistor (TR205).

The audio channel consists of the TAA611B i.c. IC301.

## AGC System

There are three transistors in the a.g.c. circuit. The first, TR202, acts as a grounded-base stage with the input to its emitter. The second stage TR203 is gated at its base by line frequency pulses fed via C209. This stage provides the a.g.c. for the first i.f. amplifier transistor TR1201. The final a.g.c. transistor TR204 provides a delayed a.g.c. feed for the tuner unit.

## Sync Circuitry

The sync separator transistor is TR402. TR401 in its base circuit provides noise limiting by removing interference pulses which exceed the amplitude of the sync pulses. The following pulse amplifier stage TR403 drives the field integrating network R501/C501 and the ringing/phasing circuit L401/C407. A secondary winding on the coil feeds the centre connection of the flywheel sync discriminator diodes D403/D404. Antiphase reference signals are applied to the diodes via C410 and C411 respectively. The emitter-follower TR404 matches the high-impedance discriminator output to the low-impedance input of the reactance transistor TR405 which in turn controls the sinewave line oscillator TR406.

## Line Output Stage

A conventional driver transistor TR407 is transformer-coupled (T401) to the line output transistor TR408. The latter drives the scan coils via the scan-correction capacitor C422. C421 is the flyback tuning capacitor and the D405 the efficiency diode. The supply to the line output transformer T402 on mains operation is via the chopper transistor TR902 about which more shortly.

## Field Timebase

TR501 and TR502 in an astable multivibrator circuit form the field oscillator. When TR502 conducts, D502 switches on and the charging circuit capacitors C504/C505 are discharged, giving the flyback. TR503 is there primarily to provide linearity correction: R513 in its emitter circuit is

the in scan coil earth return path and the signal developed across this resistor is fed back via R512 (the linearity control) and R510 to the junction of the charging resistors. TR503's collector is d.c. coupled to the driver transistor TR504 which in turn drives the d.c. coupled complementary-symmetry output transistors TR505/TR506. C509 couples the output to the coils. D.C. feedback via R519 to the emitter of TR503 stabilises the circuit against changes due to temperature.

The output is also fed to the emitter of the common-base transistor TR409 which is driven into saturation during the flyback to provide a negative-going field flyback blanking pulse for the grid of the c.r.t.

### Chopper Supply

On mains operation the a.c. supply is rectified by D902, smoothed by C902/C903/R908/C904, dropped to 220V by R909 and fed to the collector of the regulator chopper transistor TR902. This transistor is driven by winding 2-3 on the line output transformer. During the forward scan it's held cut off, but the positive-going flyback pulse via D904 and C916 switches it on during the line flyback. The charge developed across C916 during this period leaks away via R911 (coded R927 in early versions) and R926 which acts as the width control. The discharge time sets the conduction period of TR902, and as these are dependent on the flyback pulse amplitude, and thus the line output stage consumption, regulation is achieved. This enables a stabilised 17V rail to be obtained from tag 7 of the line output transformer, the supply being topped up by TR902 during the line flyback periods to overcome the losses in the circuit.

### Scan-derived Supplies

The 17V rail is dropped to 15.5V via R903 to feed the field timebase circuit, and to 12V via R904 to feed most of the other circuitry, with regulation by the shunt stabiliser transistor TR901. 120V for the video output transistor and brightness control circuit is provided by D907/C908, 240V for the c.r.t. first anode and 360V for its focus electrode are provided by D908/C911, while D909/C910 provide a negative l.t. rail which is used in the a.g.c. and i.f. circuits. 12kV e.h.t. is supplied by D406, a stick rectifier mounted on the line output transformer.

### Start-up System

Since the line oscillator is powered from a supply obtained from the line output transformer it may be wondered how the set starts up on mains operation. On first switching on however a voltage builds up across the potential divider R906/R907, C902/C903. D903 switches on and a starting voltage is then present via the 17V line

enabling the line oscillator to come into operation. Until this happens there are no flyback pulses to activate the chopper transistor TR902. Once the 17V supply is established D903 cuts off.

### Battery Operation

The chopper is not in circuit on battery operation, when 12V is supplied direct to the junction R921/R920/C906/C905. For battery operation remove the mains socket and lead and fit the battery socket and lead. The set consumes around 2A so a car type battery is required. Ensure that the leads and contacts are clean and secure in order to avoid low output voltage and low or no results from the receiver. On battery operation the 17V line is obtained through the action of D906 which then acts as a boost diode, charging C905/C906 to establish the same conditions as on mains operation.

### Fault Finding

There are two fuses, a 2.5A one in the chassis side of the mains and battery input and a 250mA fuse in the feed to the chopper transistor. R903, R905 and R909 may be thermal fuse resistors which can be resoldered after the fault that caused them to open has been cleared. In earlier versions they are ordinary resistors however. Where R903 has been an ordinary  $\frac{1}{2}$ W resistor we have found it reduced to a charred relic in the event of field collapse due to emitter-collector shorts in the AC141K/AC142K field output transistors. To improve the reliability of this circuit heavier output transistors – types BC286 and BC287 – were used in later sets. When replacing the original germanium transistors with these the link HD between the two base connections should be replaced with a  $68\Omega$   $\frac{1}{2}$ W resistor. Note that open thermal resistors indicate only the area of the fault, springing open because of an excessive current flow through them.

### Diode Troubles

Miniature diodes can develop open- or short-circuit defects. Since there are 21 diodes scattered throughout this circuit there is scope for quite a variety of symptoms. When D903 goes open-circuit for example the 17V line will not be developed on mains operation, while D906 will have the same effect on battery operation.

Mismatch between the flywheel sync discriminator diodes D403/D404 may give poor or no line hold.

To check the diodes use an Avo Model 8 (20k $\Omega$ /V) switched to the ohms range. Connect the meter's negative lead (red on resistance ranges) to the diode's cathode and the positive lead (black) to its anode. A reading of under 1k $\Omega$  should be obtained. On reversing the leads a much

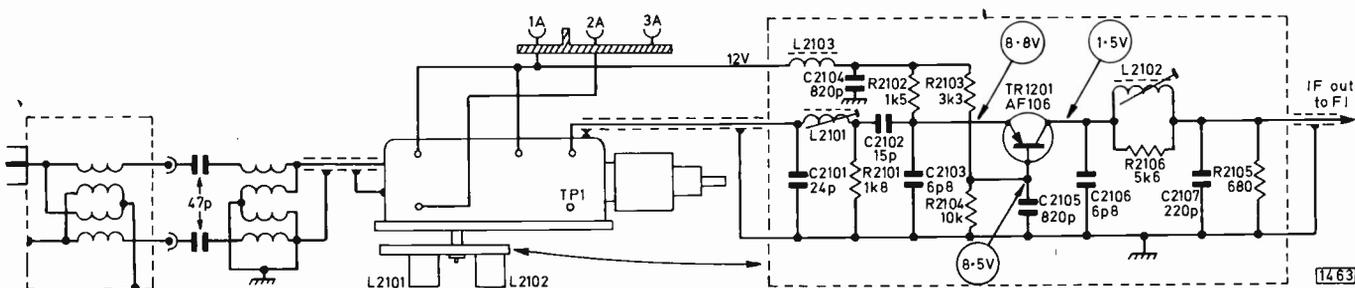


Fig. 1: Aerial and tuner connections, and the circuit of the i.f. preamplifier.

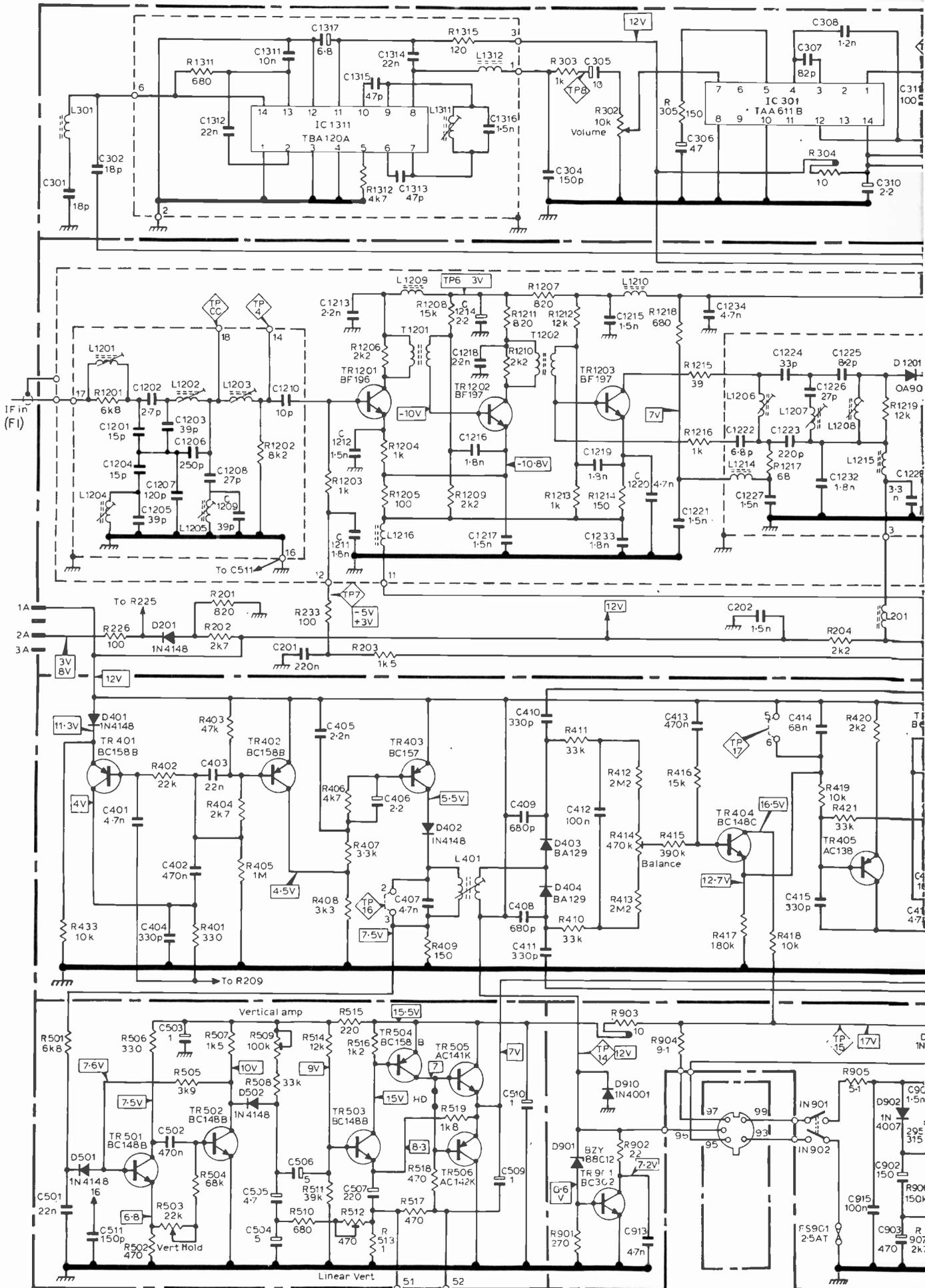
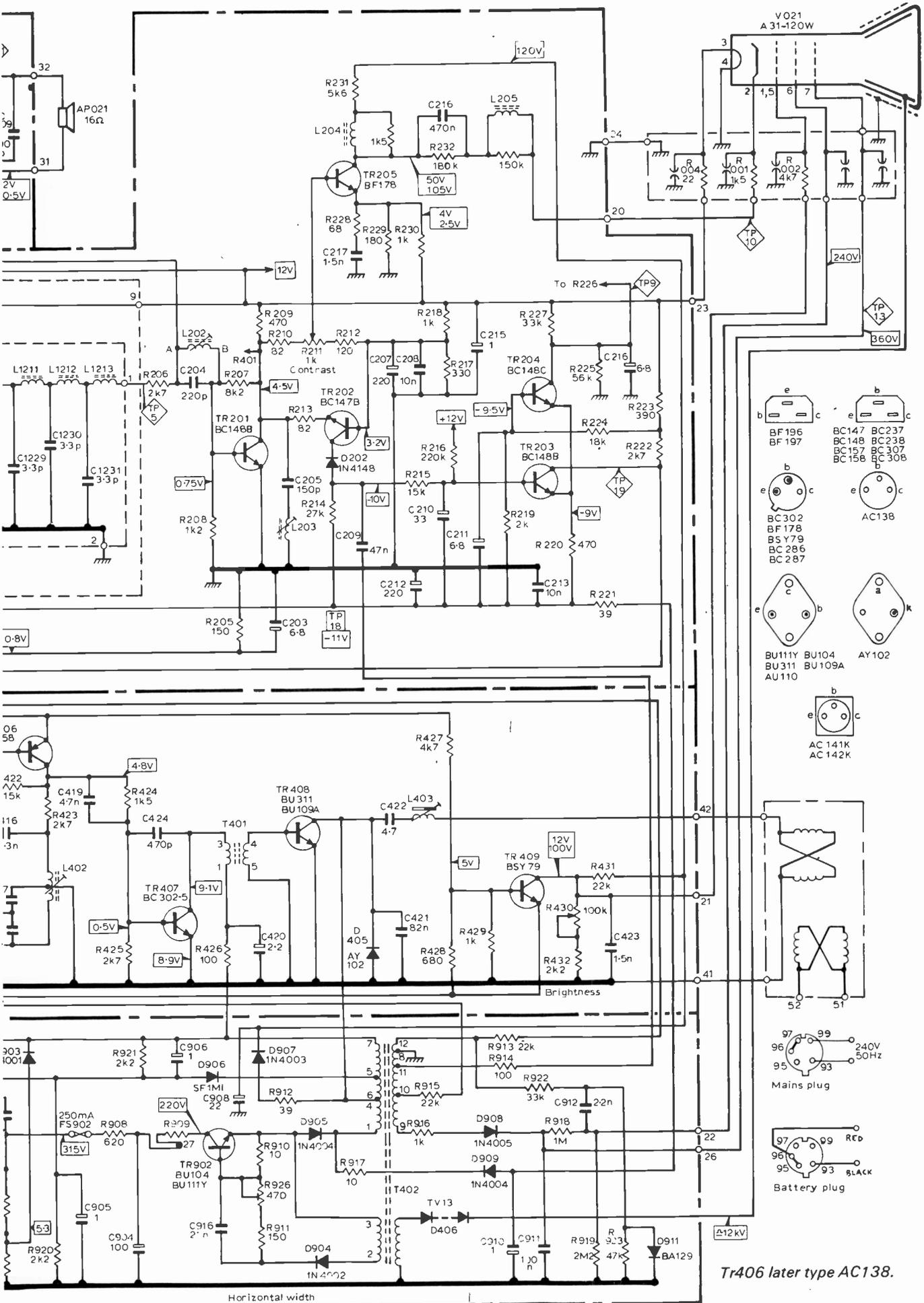


Fig. 2: Circuit diagram, Indesit Model T12LGB monochrome portable. Earlier versions used a pnp line output transistor, type AU1 BC286 (TR505) and BC287 (TR506) field output transistors. TR205's voltages vary with the setting of the contrast control; some



Tr406 later type AC138.

10, with its collector connected to chassis and its emitter to the junction of T401 (tag 6)/T402/C422/D405/C421. Later sets use voltages vary with signal. When present, the tone control switch introduces C312 (0.047μF) from TP8 to chassis.

higher reading should be present. In case of doubt check with the circuit to see whether there is a low-value resistor across the diode. It may be necessary to unsolder one end of the diode in order to isolate it. Diodes are cheap items: when in doubt, replace them. The e.h.t. stick diode cannot be tested in this manner – a BY176 or BY182 is a substitute in an emergency.

## Capacitors

Electrolytic capacitors in general and miniature ones in particular are suspect. These can usually be checked only by replacement – apart from a complete short-circuit which will show up on the meter.

Tantalum bead capacitors are intolerant of overloads. C505 in the field charging circuit sometimes fails. Access to the components in this part of the set can be improved by removing two Phillips screws from the bottom of the black plastic frame to which the printed panel is secured. The panel and frame can then be separated gently, allowing work to be carried out behind the tuner, aerial and power sockets.

## Transistor Checks

The line output transistor TR408, efficiency diode D405 and chopper transistor TR902 are clamped to a common and substantial heatsink on the printed panel beside the line output transformer. All three are relatively heavy duty items. They can nevertheless short and can damage the transformer.

Transistors can be checked using the Avo 8 on its resistance range. To check the chopper transistor for example it is necessary to isolate the emitter, base and collector from each other – the base and emitter are linked together via the  $10\Omega$  resistor R910 which would give a permanently low-resistance reading. A clean cut across the tracks leading to the base and emitter will provide the necessary isolation. Connect the black meter lead to the base: touching the emitter and collector with the red lead in turn should give readings of around  $500\Omega$ . A much higher or lower reading suggests that the transistor is faulty. Connecting the leads the other way round should result in readings of more than  $100k\Omega$  if the transistor is o.k. This test can be used on any transistor provided the pins are isolated.

Efficiency diode D405 can be similarly checked for forward and reverse resistance. The forward resistance should be around  $200\Omega$  and the reverse resistance  $100k\Omega$ . Cut the cathode track in order to isolate the diode.

## The "Easybuild" VIDEO-WRITER

Are you following the Video-Writer series in *Practical Wireless* (started in the August issue)?

The Video-Writer resembles a typewriter but displays the text directly on the screen of a domestic TV set or a video monitor. Each page of text on the screen comprises 16 32-character lines.

A page can be held in the memory whilst a second is being written in. Uses include information display, advertising, displaying scores, silent paging, etc.

Generally speaking, accurate voltage measurements will reveal the cause of faults: the set is well provided with test points. It's worth pointing out however that the set is rather more complex than many popular mains/battery portables.

## Line Sync Circuit

One area where difficult faults can occur is in the line sync circuit. We've already mentioned the flywheel sync diodes. Another cause of weak line hold, with the picture floating sideways on channel change, is when the tuning capacitor C407 in the ringing/phasing circuit goes short-circuit. A puzzling fault with its cause in the flywheel sync circuit is moderate cramping at the right-hand side of the screen. This occurs when the high-value resistors ( $2.2M\Omega$ ) increase substantially in value. R413 for example has been found to have risen to over  $15M\Omega$ , with incorrect buffer stage (TR404) emitter voltage as a clue. Another clue is that adjustment of the width and linearity controls affects the sync. This fault seems to be an occasional feature of this type of flywheel sync circuit – see Test Case 154 last year where the set was a Grundig Model R500E/GB.

## Line Timebase Setting up Procedure

With the number of controls in the line timebase the correct setting up procedure is worth noting. First short-circuit C414 (TP17 5/6) and adjust the line oscillator coil L402 for best sync, using a non-metallic screwdriver. Remove the short-circuit from TP17 and then short-circuit C407 (TP16 2/3). Adjust the line sync balance control R414 for best sync, then remove the short-circuit. Adjust the line linearity coil L403 for minimum width, then adjust the phasing coil L401 to centre the picture. Readjust L403 for optimum linearity. The width control R926 should be set for best formation of the test card centre circle. Ensure that there is not excessive scan.

## The CRT

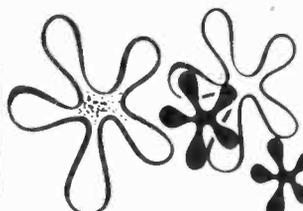
The c.r.t.'s protective screen curves out beyond the line of the cabinet, making it vulnerable to scratches – a hazard with portables. A loose slip-over cloth cover – like a tea cosy – will give some protection while the set is being transported, but to maintain adequate ventilation must be removed when the set is on.

## Modifications

The different line and field output transistors used in different versions have already been mentioned. With the earlier (AU110) line output transistor the driver (TR407) is type BC302 and C420 is  $0.1\mu F$ . Tag 4 of T401 goes to the base of the AU110 and tag 6 to its emitter. The following variations may be found in the chopper circuit: R911  $220\Omega$  and coded R927; R926  $250\Omega$ ; R910  $15\Omega$  and coded R925. Some sets are fitted with an A31-410W c.r.t. R004 is then a  $50\Omega$  n.t.c. thermistor and R904 is  $7.5\Omega$ . Alternative equivalent diodes may be found and some electrolytic capacitor values vary slightly.

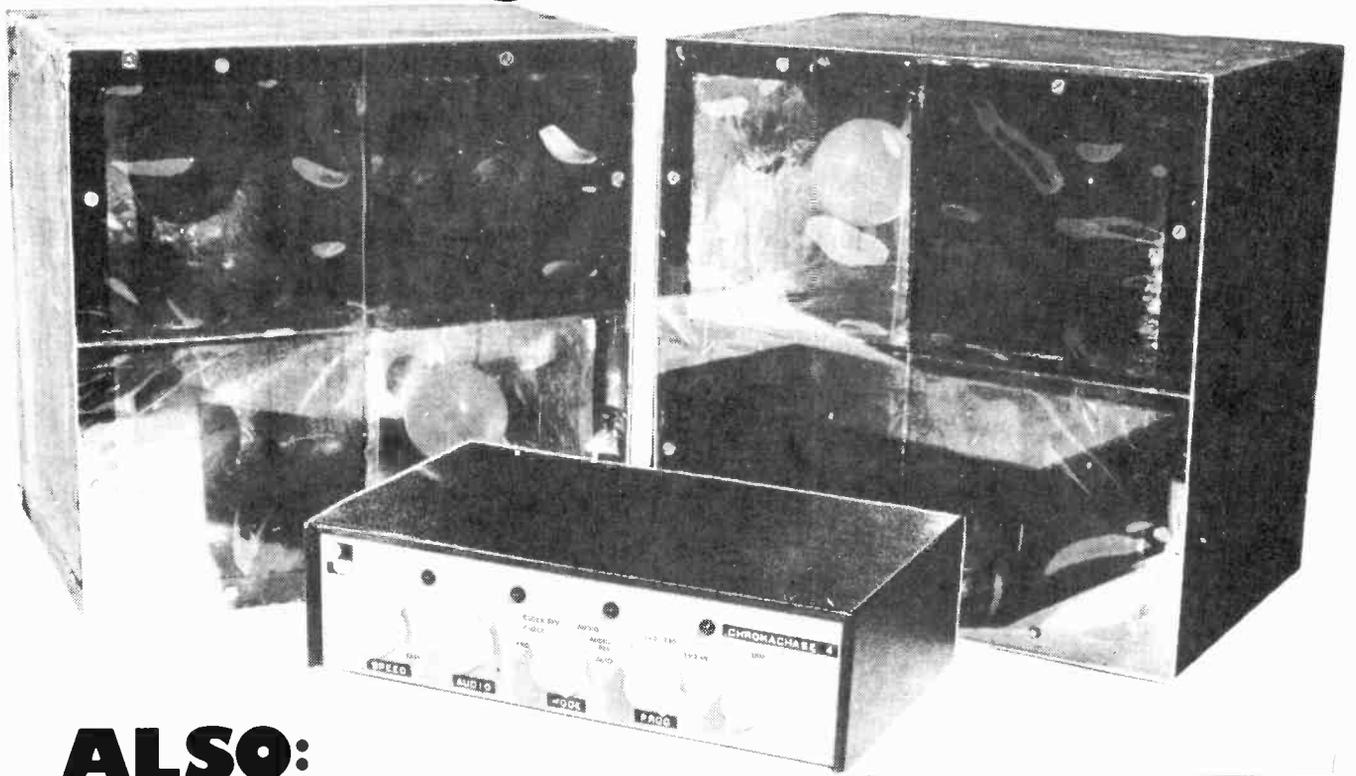
## Sensitivity

The receiver is sensitive, but there are situations where reception is weak. Give the set a chance by employing the best possible aerial. ■

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# The SONY VO1810 VCR

Part 1

M. P. Riley

DURING August–November 1975 we published a series of four articles on videotape recording, particular attention being paid to the Philips VCR. Following a number of requests we are now going to examine closely the Sony VO1810 videocassette recorder which was designed for the industrial and educational television markets. Readers unfamiliar with videotape recording techniques will find the basic principles described in the series of articles published last year.

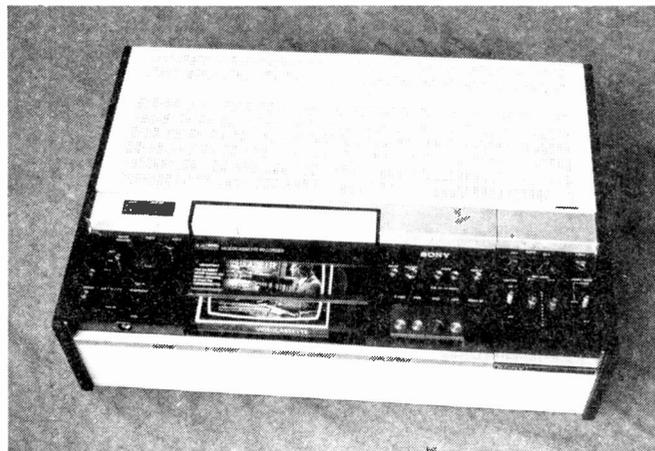
The  $\frac{3}{4}$ in. U standard tape format used in the Sony VO1810 is compatible with the JVC Nivico CR6000E tape recorder – these are the only videocassette recorders on the market at the time of writing whose tapes can be interchanged. Both the Sony and JVC recorders offer similar video and audio facilities, the main difference between the two being in their size and operational modes. The JVC CR6000E recorder is rather smaller and lighter than the Sony machine and includes feather-touch electrical switching for the record, playback and wind modes, video and audio editing facilities, remote control and separate audio record controls in the two audio channels.

The cassette tape used by both these machines is  $\frac{3}{4}$ in. wide and is housed in a reel-to-reel cassette that is similar in design to the type widely used in audio cassette recorders. A photograph of the cassette is shown with the lid removed. Because the Sony machine is specifically designed for use in educational and closed circuit installations, the technical specification is considerably fuller and to a higher standard than the domestic Philips VCR. A closer look at the specification will give the reader an idea of the technical standard and the complexity of the electronics involved.

## VCR Specification

The machine is designed to work with 625-line PAL signals in the record and playback modes, or 525-line (modified) NTSC signals for playback only. Video resolution is 300 lines on monochrome and 240 lines on colour, with a signal-to-noise ratio greater than 40dB. Colour or monochrome operation is self sensing but mechanical switching is used between the PAL and NTSC standards. The machine operates with a video input signal of 1V peak-to-peak into  $75\Omega$  unbalanced. Should off-air recordings be required a separate off-air receiver must be used to provide the necessary audio and video signals. Two outputs are provided, one a direct video output (standard level) and the second a u.h.f. output which can be adjusted to lie anywhere between channels 50 to 54.

Two audio inputs can be used, one from a microphone at  $-72$  to  $-30$ dB into  $600\Omega$  unbalanced, or a line input at  $-22$



to  $+10$ dB unbalanced into  $100k\Omega$ . There are two audio channels on the tape, giving the user the option of stereo sound with a colour programme or mono sound with the second sound track containing instructions for possible editing procedures or a second language. Audio outputs are 0dB into  $10k\Omega$  unbalanced with the added facility of a headphone output designed to work into  $8\Omega$ . The audio frequency response is between 50Hz and 12kHz with a signal-to-noise ratio of 42dB, using a tape speed of  $3\frac{1}{4}$  i.p.s. and with wow and flutter better than 0.25%.

Apart from the much improved specification compared with the domestic Philips N1500 VCR there are also additional operating features worthy of mention. Programmes can be continuously repeated, i.e. the operator can play back the same cassette over and over again without having to operate the machine manually. This is of particular use where the machine is being used to provide visual displays at exhibitions and conventions. Mode switching between record, playback and wind is selected by key controls which utilise a combination of mechanical and electrical switching. Much of the electronics involved with the switching is relatively complex: with a little more ingenuity on the part of Sony's designers I am sure that a completely electronic switching system could have been devised at very little extra cost.

Whilst in a critical mood I feel I must comment on the technical description and block diagrams supplied in the workshop manual. During the course of research into the electronics of this VCR I found a total of 12 errors in either the block diagram or the circuit description. The technical description was much too brief and lacked the detail that



The videocassette, shown with the lid removed.

one would expect for a machine of this complexity. Circuit diagrams, voltages, waveforms and printed circuit layouts are excellently presented however. It is a pity that the overall standard of the service manual was lowered by mistakes in the descriptive text. Having had this little grouse, let's settle down to the task in hand and examine the techniques employed in this VCR.

### Block Diagram

The block diagram shown in Fig. 1 includes all the record/playback electronics together with the servo and audio sections of the machine. Tape servo and control circuits will be described in a following issue. To start with we will deal with the audio and video signal paths.

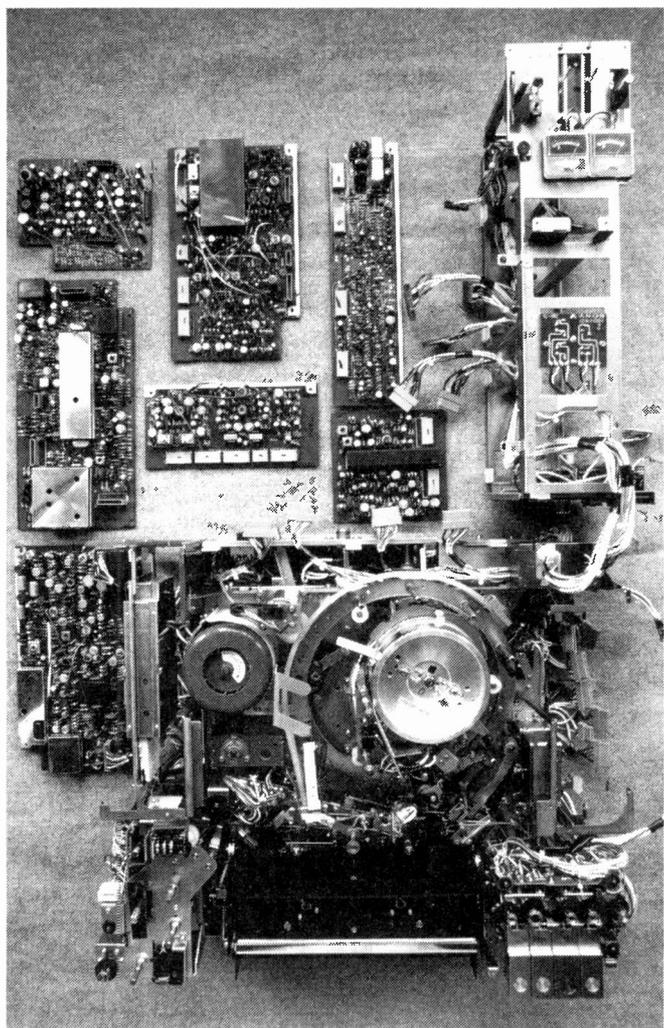
Modular construction is used for the major sections, and in this respect Sony should be given a very big pat on the back for using plugs and sockets on the boards rather than the directly soldered interconnections one is used to finding in their domestic TV and audio equipment. Having pulled one of these machines apart – a photograph has been included to show how accessible most of the machine is – I must say that all the circuitry was easy to reach and in many respects is a joy to work with.

Returning to the block diagram, boards G1 and G2 contain the video record electronics, and boards HL and Ep house the audio record circuits. The video playback circuits are split between the B1 board r.f. section and the A1 board. The demodulator and dropout compensator circuits are mounted on a separate module (K1), and the audio playback circuits are on board C1.

### Video Recording

The video input to the machine is via either a u.h.f. connector (Line Input) or an 8-pin socket designed to be connected to a Sony off-air receiver/monitor. Either of these two inputs is switched via S201 to the input pins of board G1 where it is split into four separate video feeds. These will be described in the order that they appear to the video input signal.

The first is to transistor Q11 which is an emitter-follower providing isolation between the input sockets and the following chrominance filter. Chrominance information is removed by this filter and the remaining luminance signal is coupled to the electronic switch Q13 and Q14. A second signal to this switch is taken directly from the video input, and will therefore contain any chrominance information present. Colour sensing circuits on the G2 board make the electronic switch select either the filtered monochrome

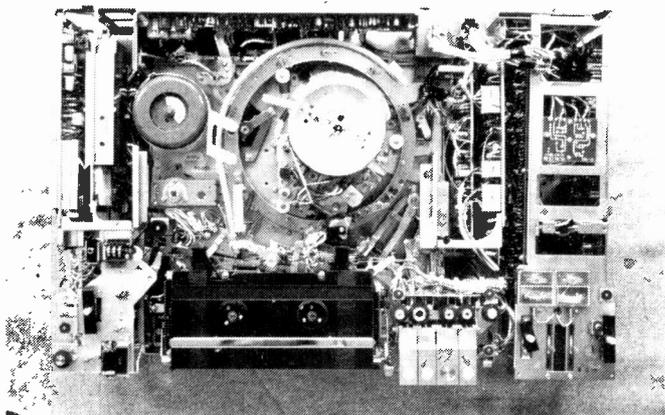


*Interior view with all the main panels removed.*

signal or the full bandwidth colour signal depending on the presence of burst on the sync pulse back porch. The selected output from the electronic switch is then fed to a video a.g.c. circuit. A third feed from the video input drives a sync separator which provides delayed line pulses for the video a.g.c. circuit, field pulses which are used to lock the head drum servo in the record mode and to provide a control track record signal, and finally a third feed which is used as a burst gating signal for the colour sensor on the G2 board. The final video input path on the G1 board is simply linked through to the colour sensor without passing through any electronic processes.

Before considering the major processing operations carried out on the G2 board we'll look briefly at the video a.g.c. circuit which is used to control the amplitude of the signal applied to the f.m. modulator. It's basically a gated a.g.c. system but contains some rather novel ideas which in practice work extremely well.

The circuit, shown in Fig. 2, consists of an a.g.c. level control stage (Q7), a video amplifier (Q8 and Q9), and a voltage doubler (D2 and D3). The selected video output from the switch previously described is coupled via C15 and R28 to the drain of f.e.t. Q7 which forms part of a potential divider between the incoming video feed and chassis. This potential divider is formed by the drain/source resistance of the f.e.t., R26 (set a.g.c. level) and R25. The load presented to the video input signal between the drain of the f.e.t. and chassis can be adjusted either by altering the value of R26 or by altering the drain/source resistance of the f.e.t. This drain/source resistance is controlled by



*Interior view of the machine.*

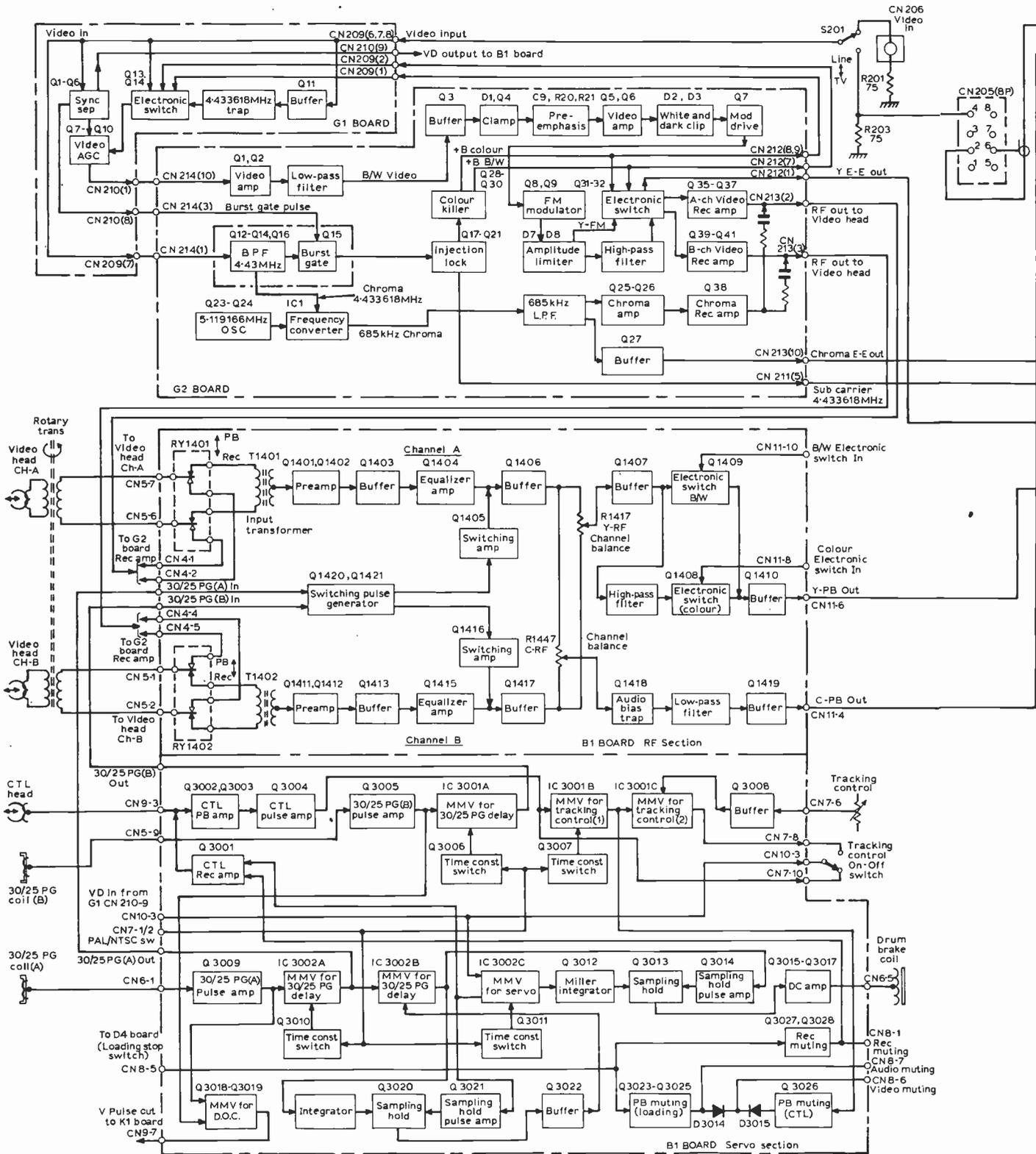
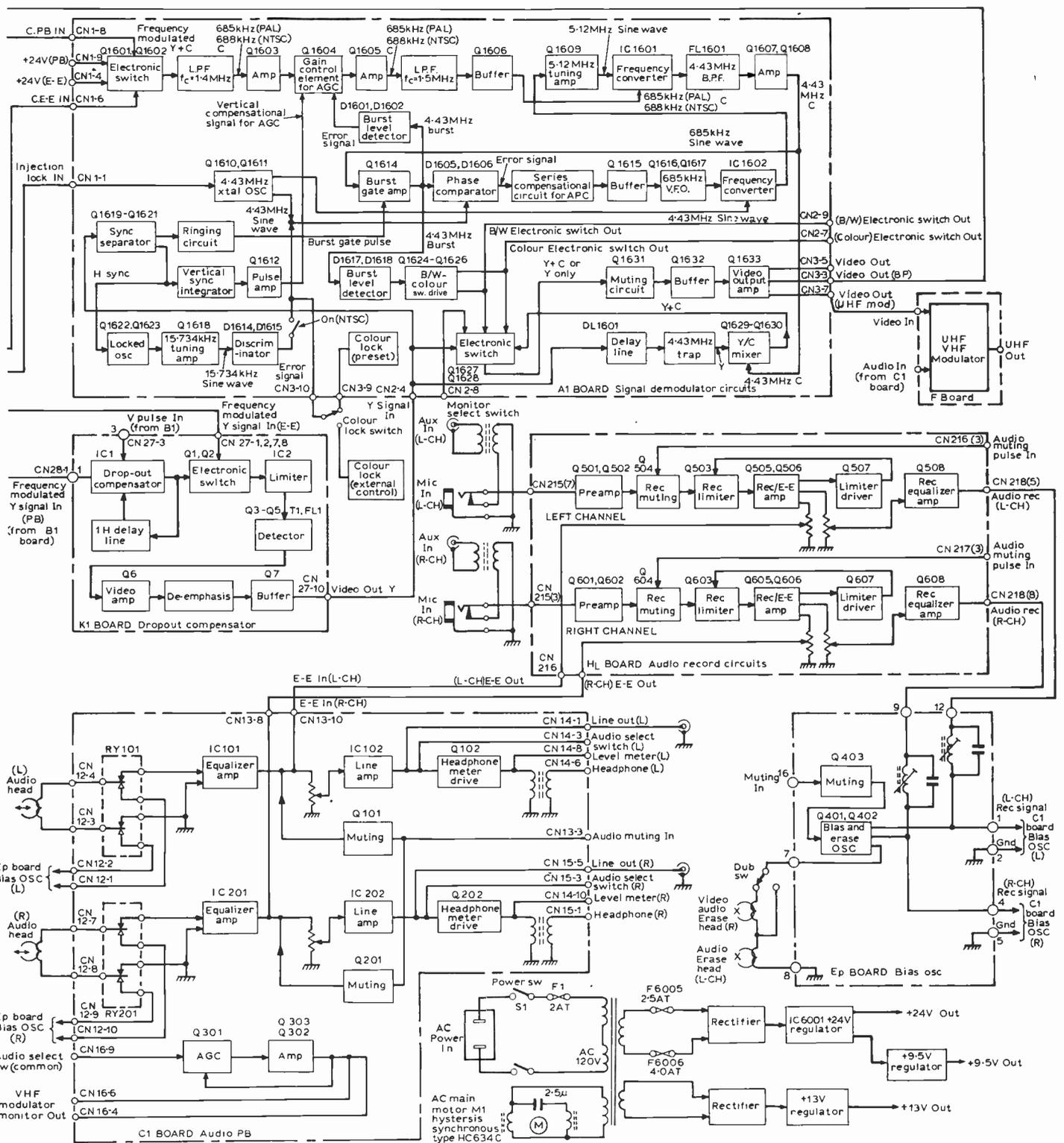


Fig. 1: Block diagram of the Sony

Some of the abbreviations used in the block diagram above may not be too clear to those not familiar with VCRs. The following list may help: CTL control head, amplifier etc.; PG pulse generator; MMV monostable multivibrator; DOC drop out compensation; Y-PB luminance playback; C-PB chrominance playback; E-E mode, record monitoring path. The operations carried out by the various boards are as follows:

- G1 board:** Video input, a.g.c. and sync circuit which provides a burst gating pulse for the G2 board and a reference pulse for the servo section of board B1.
- G2 board:** Provides r.f. signals for the video recording heads and E-E outputs.
- B1 board (r.f. section):** Initial playback circuits, providing



**VO1810 videocassette recorder.**

*luminance and chrominance outputs.*

**B1 board (servo section):** Servo control system.

**K1 board:** Dropout compensation and luminance f.m. demodulation.

**A1 board:** Accepts chrominance from the B1 board and demodulated luminance from the K1 board. Signal processing to provide video output signals.

**F board:** Modulator board. Converts video to v.h.f. and then to u.h.f. for output to the receiver.

**H1 board:** Audio recording circuits.

**C1 board:** Audio playback circuits.

**Ep board:** Bias and erase oscillator board. One erase head covers the video and right audio channel tracks, the other the left audio channel track.



maintain subcarrier oscillation throughout the length of a TV line. The output of the injection lock stage therefore is a continuous subcarrier signal. This feeds a colour sensing circuit which operates the electronic switches previously mentioned. A second output from the injection lock stage is used to lock another subcarrier oscillator in the playback circuitry of the machine. This enables the stability of the off-tape chrominance information to be compared and locked to the video input to the machine. If there is no input to the VCR the oscillator Q1610/Q1611 (A1 board) will free run.

The second output from the bandpass filter is fed to the frequency converting i.c. which is in fact a balanced modulator using the chrominance input signal as a modulating signal. A carrier input is provided by a 5.119166MHz crystal oscillator which is operational only when a colour signal is being recorded. The output from this balanced modulator will contain all the mixing products between its two input signals, therefore a low-pass filter tuned to 685kHz is required to reject the unwanted output frequencies, passing just the subtractive frequencies.

Two signal feeds are produced at the output of the low-pass filter: one is fed to the emitter-follower Q27 which provides an E to E output for the A1 board; the other feed is amplified by Q25 and Q26 and applied to the chroma record drive amplifier Q38. Here the signal is again increased in level so that enough power is produced to drive the video record heads. Sony have adopted the standard technique of using the video f.m. signal as h.f. bias for the transposed chrominance signal.

The complete frequency spectrum of the signals applied to the video record heads is shown in Fig. 3.

### Audio Recording

There are two separate audio channels which are identical. Only the left channel will be described in the following description.

Either an auxiliary or microphone input signal is selected and fed to the first section of the audio processor, a preamplifier comprising Q501 and Q502. This is a simple two-stage audio amplifier which increases the signal level, enabling the audio muting stage to be driven. This stage, transistor Q504, is a simple shunt switch across the audio feed. It removes the audio signal in every mode apart from record. This action prevents the incoming audio signal being passed through the electronics in the E to E mode and appearing at the audio output when the machine is in the stop or wind modes. It should be noted that when the machine is being used for audio dubbing the right hand channel is muted.

After the record muting switch a simple a.g.c. limiter is used to compensate for high audio levels that would cause the head to saturate the tape and produce distortion. The control signal for this limiter is derived from a simple half-wave rectifier and smoothing circuit which is fed with the audio signal – it's very similar to the conventional limiter used in audio recorders.

The next stage after the limiter is the combined record/E to E amplifier. This stage has two audio outputs. One is sent via a potentiometer to the record equalising amplifier Q508 and from there to the audio head. The second audio feed goes via another potentiometer to the line amplifier IC102 on the C1 audio playback board. This second audio path enables the operator to monitor the audio output of the machine while a recording is being made.

An audio bias and erase oscillator is situated on the Ep board, the bias oscillator being inhibited by Q403 in all

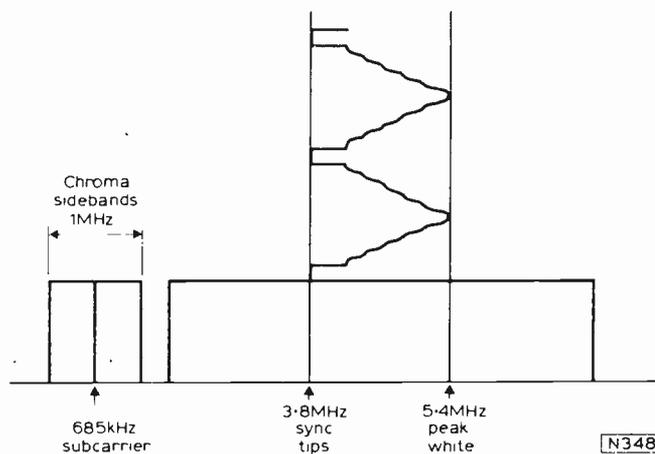


Fig. 3: Frequency spectrum of the recorded signal.

except the record mode. The oscillator output is split into two feeds. One supplies an erase signal for the two erase heads. The other is added as h.f. bias to the output of the record equalising amplifier Q508.

### Audio Playback

The off-tape audio signal from the playback head is coupled to the record playback change over relay RY101. This relay switches either the record or playback signal between the head and the audio electronics. In the playback mode the common switch is connected to the black contacts, coupling the signal to the equalisation amplifier IC101. The signal at the output of this amplifier is applied to the playback level control and from here to the line output amplifier IC102. The playback muting circuit Q101 can ground this coupling feed between IC101 and IC102 when the machine is either lacing or unlacing the cassette. This prevents random audio information from the tape appearing at the output of the VCR during tape lacing.

As well as being fed to the output of the machine the audio signal is coupled to an emitter-follower which drives the headphone output transformer and the record/playback level meter. The direct line output feeding the socket at the rear of the machine is taken directly from the output of IC102.

Finally in the audio playback path we have Q301 (a.g.c.) and Q302/Q303 (audio amplifier). These two sections are connected to a switch which selects L, R, or L+R signals, these being gain controlled in the normal way and then fed to either the u.h.f. modulator or the monitor output point.

### Video Playback

The f.m. signal from the two video heads mounted on the drum is coupled to the main board B1 via two rotary transformers. The output from the secondary of these transformers is connected to a record/playback switching relay RY1401/2. From this point to the output buffers Q1406 and Q1417 the f.m. playback path is identical for each head, therefore only one head channel will be described.

Head switching relay RY1401 is energised in the record mode. In the playback mode the signal is coupled from the head to the input matching transformer T1401. The secondary of this transformer is coupled to a preamplifier Q1401/02. These components form a low-noise cascode amplifier with an f.e.t. driving the common-base section. An emitter-follower Q1403 matches the high output impedance of this amplifier to the equalising amplifier Q1404. This is a

simple common-emitter stage with a variable collector load inductance and resistance. Hence tuning and damping of the load can be adjusted, enabling the playback equalisation to be set.

Between the equaliser Q1404 and the emitter-follower Q1406 there is a switching transistor Q1405 which shunts the output of the equaliser to earth when the head is not scanning the tape. The bistable circuit Q1420/Q1421 produces the switching pulses for Q1405/Q1416: they are timed so that as head (a) is scanning the tape Q1416 is conducting, and as head (b) scans the tape Q1405 conducts. This switching action prevents noise generated in the playback path while the head is scanning fresh air being added to the signal from the head that is scanning the tape. Pulses to steer the switches are derived from the tape servo section. The outputs from Q1406 and Q1417 are combined across two variable resistors R1447 and R1417, and from the sliders of these two controls f.m. signal feeds are supplied to the monochrome and the colour vision processing circuits.

### Monochrome Signal Processing

Q1407 acts as a buffer which drives an electronic switch and a high-pass filter. During monochrome operation the series switch Q1409 is "closed" and the f.m. signal is coupled directly to the output buffer Q1410. When the colour mode is selected Q1409 becomes open-circuit and Q1408 conducts, coupling the output from the high-pass filter to the buffer Q1410. This high-pass filter is designed to remove any transposed 685kHz chrominance information. The output from board B1 is coupled directly to board K1 which contains the dropout compensator.

Sony use the conventional dropout compensator, an electronic switch that can select either the direct off-tape signal or the feed from a 64 microsecond delay line. Switching pulses for the switch are derived from an a.m. detector which demodulates the f.m. signal thus producing a change in d.c. level every time a dropout occurs. Only dropouts which produce a voltage change of more than 26dB cause the switch to operate. Also note that the delay line is fed from the output of the electronic switch: hence if the dropout continues over a period of several lines the delayed signal continues to be reinserted in place of the off-tape signal.

Following dropout compensation the signal is fed to yet another electronic switch. This selects either the output from the dropout compensator or from the f.m. modulator on board G2. In the playback mode the dropout compensator output is selected while in the record mode the modulator output is passed through. This enables the operator to view the signal being recorded at the output of the machine. E to E signals are very helpful to the operator because, having passed through most of the electronics in the VCR used in both the record and playback modes, they enable an accurate check to be made of the performance of the equipment.

From the electronic switch Q1/Q2 the selected signal is limited to remove amplitude variations caused by head to tape pressure changes and then fed to a pulse counting f.m. detector Q3 to Q5. This counter in fact is a full-wave rectifier, integrator and smoothing circuit. As this rather novel method of demodulation is not very often met it is worth taking a closer look at the circuit (see Fig. 4).

The f.m. signal is applied to the primary of transformer T1, appearing in push-pull across the centre-tapped secondary winding. Q4 and Q5 are so biased that Q4 conducts on the positive half cycles and Q5 on the negative half cycles, the exact conduction point of the transistors

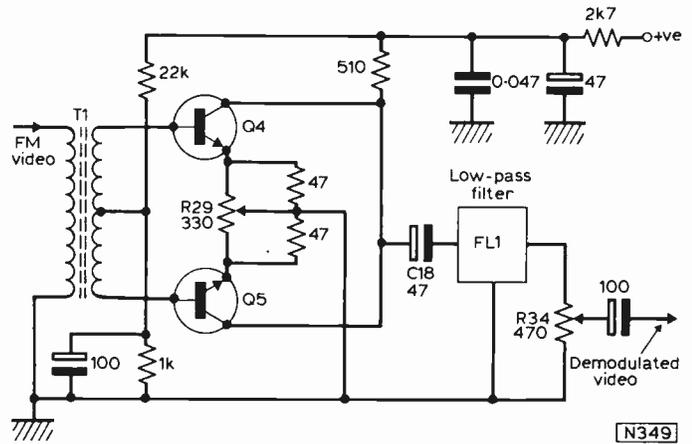


Fig. 4: The video f.m. demodulator circuit.

being set by R29. The full-wave rectified signal at the collectors of the two transistors is capacitively coupled via C18 to the low-pass filter FL1 where it is integrated. This action produces a voltage output proportional to the frequency of the pulse input. As the input pulses are negative-going the output of the low-pass filter will be at its maximum negative voltage when the carrier frequency is high, thus producing a negative-going video output signal.

Once the f.m. signal has been demodulated it is de-emphasised and fed via an emitter-follower to the output of the dropout compensator board.

### Colour Playback Path

Going back to board B1, the combined output of transistors Q1406 and Q1417 also appears across resistor R1447. From the slider of this potentiometer the f.m. signal is fed to Q1418, an audio bias trap designed to remove any h.f. bias information that could beat with the frequency transposed chrominance signal. The signal is then fed to a low-pass filter which removes the high-frequency luminance f.m. signal. Thus just the 685kHz chrominance information is passed by the emitter-follower buffer Q1419 to the output of the board.

The signal then goes to the main chrominance processing board A1, where it is retransposed back to 4.433MHz and added to the luminance signal. The first stage of chrominance processing is to select either the off-tape or E to E chrominance signal, the off-tape signal coming from Q1419 on board B1 and the E to E signal from Q27 on board G2. The electronic switch Q1601/Q1602 selects the required signal and feeds it to a low-pass filter which removes all frequencies above 1.4MHz.

The filtered signal is amplified by Q1603 and then fed to a very fast-acting a.g.c. circuit, Q1604. This circuit works in the same way as the conventional a.c.c. circuit in a colour receiver - by detecting the amplitude of the colour burst (effected by D1601/2), converting the resultant d.c. voltage into a correcting signal and using this to control the gain of the amplifier. In this particular situation a fast-acting a.c.c. stage is very important because the two heads that scan the tape will not produce two signals with the same chrominance amplitude. Hence the saturation of the picture obtained with head one would be different from that of head two. This would result in a 25Hz saturation flicker on the playback picture. Q1604 has the task of producing an output signal free from these saturation changes, hence the need for a fast-acting a.c.c. stage.

During the field sync period the colour burst is not transmitted and the a.c.c. amplifier is then inhibited by a field

sync pulse from Q1612. If this was not done large errors would be caused by the absence of the colour burst, and the time taken for the circuit to settle down would exceed the length of the field blanking period.

The amplitude controlled signal from Q1604 is further amplified by Q1605 before being fed to a low-pass filter with a cut-off frequency of 1.5MHz. This filter removes any signal that could be present above the chrominance frequency range. The band-limited output from this filter is fed via the emitter-follower Q1606 to the frequency converting i.c. IC1601. This i.c. reconverts the 685kHz off-tape chrominance signal to 4.433MHz. This is done by using the 685kHz signal as the modulating input and a 5.12MHz signal as the carrier input to a balanced modulator in the i.c. The signal produced will contain subtractive components that lie at the true chrominance frequency of 4.433MHz. Once the off-tape chrominance has been reconverted to its correct frequency it's fed to a 4.433MHz bandpass filter before being coupled to Q1607/Q1608 to produce an amplified output signal.

The 5.12MHz carrier input to the frequency converting i.c. is derived by beating two signals together, one at 4.433MHz and the other at 685kHz. This frequency mixing is carried out in IC1602, the 4.43MHz carrier input being provided by the crystal oscillator Q1610/Q1611 which is locked by the inject lock circuit we described when dealing with the record mode, the second input coming from the oscillator Q1616/Q1617. This 685kHz input signal is produced by the variable frequency oscillator Q1616/Q1617 which is controlled as follows. The phase of the 4.433MHz off-tape chrominance colour burst is compared with the stable frequency of the crystal oscillator Q1610/Q1611 in the comparator D1605/D1606. The resulting d.c. error signal is amplified by Q1615 which controls the variable frequency oscillator Q1616/Q1617.

Correction of off-tape phase errors produced by variations in the head to tape speed is automatically compensated in the following way.

If the off-tape colour burst frequency or phase increases, the reference burst to the burst gate amplifier Q1614 also increases. The resulting d.c. error signal from D1605/D1606 advances the phase/frequency of the 685kHz oscillator, in turn advancing the output of IC1602. Because one of the inputs to IC1602 has risen then the resultant beat frequency at the i.c. output will also rise. We now have a situation where both the inputs to IC1601 have risen by exactly the same amount. Therefore the *difference* frequency between the two will remain the same, i.e. 4.433MHz. Should the off-tape chrominance frequency fall then the reverse procedure will take place.

### **Output Signal Switching**

The machine automatically selects the correct output signal path. When colour operation has been established, the colour burst output from Q1614 is detected by D1617/D1618 and amplified by Q1624/Q1626 to produce push-pull switching voltages for the electronic switch Q1627/Q1628.

When monochrome operation has been established, the luminance output from the K1 board is passed by the switch to Q1631. This stage shorts the signal to chassis when the machine is either lacing or unlacing the tape. At all other times it's open-circuit. From here the signal passes via the emitter-follower Q1632 to the output amplifier Q1633.

When a colour programme is being replayed the luminance output from board K1 is passed through the

short-duration delay line DL1601 which compensates for the delay of the chrominance processing circuits due to their narrow bandwidth. The output from DL1601 is fed via a chrominance trap to the mixer stage Q1629/Q1630, where the corrected chrominance signal is added to the luminance information to produce the complete video signal. From the mixer the complete signal is fed to the second input of the switch Q1627/Q1628 and then via the signal path previously described to the output of the machine.

A manual over-ride to the electronic switch is provided so that the operator can if he wishes remove the chrominance information if a monochrome monitor is being used to display the output of the machine.

### **Pulse Generation**

During colour operation additional pulses are required to operate the burst gate, a.g.c. and NTSC stages of the VCR. These pulses are produced in the following way. The off-tape luminance signal from board K1 is coupled to the sync separator stage Q1619-Q1621. One output from this stage is coupled to a low *Q* ringing circuit which delays the line pulses to produce a burst gating pulse for Q1614. The other output is fed to an integrator circuit whose output is amplified by Q1612 before being used as a field blanking pulse for the a.g.c. stage Q1604.

### **NTSC Operation**

Throughout the service manual there is no mention at all of the NTSC sections of the machine, and everyone the author has questioned on this topic has just replied with a blank face or "your guess is as good as mine"! So the following description owes something to surmise.

The VCR is designed only to playback prerecorded NTSC tapes to a colour TV receiver which is capable of receiving a 30 f.p.s., 525-line NTSC signal whose chrominance frequencies have been transposed to 4.433MHz.

When an NTSC tape is recorded the chrominance signals are transposed down to 688kHz instead of 685kHz which is used for PAL signals. To reconvert this signal to 4.433MHz in the playback process the output of the frequency converter IC1602 has to be increased from 5.12MHz to 5.121MHz so that the difference frequency between 5.121MHz and 688kHz remains 4.433MHz. To change the output frequency of IC1602 accurately, the oscillator Q1616/Q1617 has to run at 688kHz instead of 685kHz. This is achieved by adding an offset d.c. voltage to the phase comparator D1605/D1606 that controls the oscillator frequency. This d.c. voltage is derived in the following way.

The 525-line line sync pulses from the sync separator Q1619-Q1621 are used to lock a line frequency oscillator whose output is tuned by the amplifier Q1618. The tuned output at 15.734kHz is then fed to an a.f.c. discriminator D1614/D1615 whose centre frequency is set to the 625-line frequency of 15.625kHz. Hence when the VCR is operating with a PAL signal the output of the discriminator is zero, but when the standard is changed to NTSC a d.c. voltage caused by the change in line frequency is produced. This is added to the input signal of the phase comparator D1605/D1606 as the offset voltage. The colour lock controls enable this d.c. voltage to be adjusted manually so that accurate subcarrier phasing can be achieved.

The tape path together with the servo and control systems of the Sony VCR will be described in a following issue.



### Loss of Picture

The owner of a mains/battery portable fitted with the Thorn 1590 chassis complained that the picture had gradually decreased in width, darkened and then gone off completely. As anticipated, the main 2.5A fuse was found to have blown. There was no sign of component damage nor any measurable short, so a replacement fuse was fitted and the set switched on. This produced good sound and a fair picture of normal size, though the tube appeared to be well past its best. The l.t. line was found to be slightly below the normal 11.6V, so the "set h.t." control was adjusted to restore it to normal. It's worth noting that this potentiometer (R104) is so wired that when adjusted from the top of the printed panel clockwise rotation reduces the stabilised l.t. line voltage.

To improve the poor picture definition we tried readjusting the focus control, but this brought little improvement. The set was then left on soak test, and to await the test card transmission. After about twenty minutes however the picture width gradually decreased, causing a further reduction in the brilliance and focus levels. Before there was time to check the l.t. voltage there was a loud bang, caused by one of the capacitors near the line output transformer virtually exploding. This turned out to be C110, the c.r.t. first anode supply rectifier's reservoir capacitor – the supply is also used to feed the focus control. The rectifier concerned is W13 and is fed from a winding on the line output transformer. It develops 300V across C110.

We cleaned up the chassis and checked W13 which turned out to be o.k. After replacing the fuse and C110 (10 $\mu$ F) the set h.t. control was adjusted to minimum and the set switched on. Good sound appeared immediately, but as the rail voltage was low and the tube heater is fed directly from the l.t. supply it took longer than usual for the picture to appear. On bringing the rail voltage up to 11.6V a perfect picture with normal brightness and focus was obtained. Clearly the excessive loading placed on the line output stage by the leaky C110 had resulted in the width and e.h.t. falling before the 2.5A fuse blew.

### Weak UHF Picture

The owner of an ITT dual-standard monochrome receiver 'phoned to say that the picture had suddenly gone very weak on u.h.f., though on switching back to v.h.f. normal, good results were obtained. On inspection we found that the weak u.h.f. picture was not accompanied by any grain, so that the aerial and probably the u.h.f. tuner could be ruled out. The same detector diode is used on both systems, so as the valves could be assumed to be o.k. it seemed likely that the fault was in the u.h.f. contrast control circuit. But could all the valves be ruled out? The PFL200 video/sync valve so widely used is notorious for giving a weak output when a.c. coupled on 625 lines. But this set uses a PCL84, a.c. coupled on 625. We decided to try a new one, and were immediately rewarded with perfect results. Though we have often enough changed PCL84s because of reduced gain on both systems, due to loss of emission, this is the first time

we have known one of these valves give the same symptoms as a soft PFL200.

### No Results

The complaint "no results" on an ITT colour set fitted with the CVC5 chassis turned out to be due to a blown h.t. fuse. Inspection revealed no burnt components, and there was no sign of a short-circuit between the h.t. rail and chassis. So the fuse was replaced and the set switched on. To start with the valves warmed up normally, but after about a minute, when the PY500A boost diode came into operation, its anode was seen to start to get visibly red. On switching off, the resistance from its cathode (top cap) to chassis was found to be quite low. Removing the top cap of the PL509 line output valve made no difference so clearly there was no internal short-circuit in the PL509. There's a harmonic tuning capacitor between the cathode of the PY500A and chassis (C308, 220pF 12kV) so one end was disconnected in order to check whether it was leaky. It proved to be o.k. however so the next suspect was the boost capacitor (C310, 0.47 $\mu$ F 1kV) which is returned to chassis via a winding on the line output transformer and the low-value horizontal shift potentiometer. C310 is connected between tags 9 and 10 on the line output transformer, and proved to be short-circuit. Replacing it restored normal results. This particular type of capacitor – easily recognised by its particularly large size and light blue/dark blue encapsulation – is used in several other colour chassis and breaks down quite often.

### Colour Loss

Cases of colour intermittency, fade or complete loss in the earlier 90° Rank solid-state colour chassis (with the A809 i.f. panel and A807 decoder panel) can be due to a variety of causes. Probably the most common transistor failures responsible for this fault are the BC148 chrominance amplifiers 2VT10 and 2VT11 on the A809 i.f. panel. The gain-controlled BF196 chrominance amplifier 2VT8 and the BC158 a.g.c. amplifier 2VT6 can also be defective, while on the A807 decoder panel the BF194 a.c.c. amplifier 3VT6 and the BC158 "R-Y switch sync" transistor 3VT11 probably give most trouble. The latter drives the colour

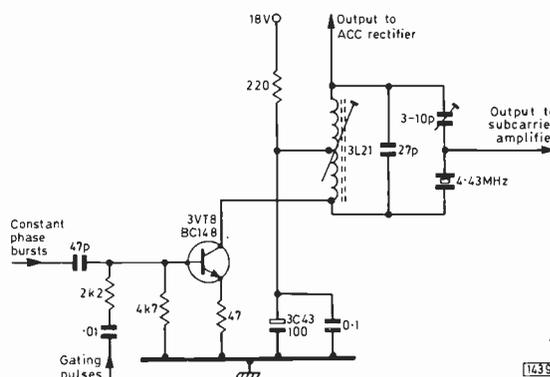


Fig. 1: Second gated burst amplifier/4.43MHz crystal driver stage, Rank A807 decoder panel.



# video circuits

## for the experimenter

Luke THEODOSSIOU

AFTER the author built a solid-state 24in. monochrome receiver, some four years ago, instead of it being used by members of his family (the original intention) it proved to be such a versatile test bed for all sorts of circuits that it was decided to put it to this better use!

One area of experimentation was the video output stage. Assuming that the i.f. strip is reasonable and that the demodulator is set up correctly, the video output stage is usually responsible for any shortcomings in the picture. After all, it is asked to provide something like 26dB of gain with a substantially flat frequency response from d.c. to several MHz!

### Single stage amplifier

The original circuit used in the receiver is shown in Fig. 1. It is a well-tried straightforward amplifier as found in many commercial sets. The video output from an MC1330 i.c. is taken via a bridge-type contrast control (VR1) to the base of a common-emitter amplifier. The collector load resistor (R3) is of reasonably low value to ensure a low output impedance — though it must of course be of a sufficiently large value to provide the required gain, which is determined by the ratio of the collector load resistor to the emitter resistor R2. A sound trap consisting of L1 and C1 is placed in the emitter circuit and tuned to 6MHz to remove the intercarrier sound signal. C2 decouples R2 at high frequencies, increasing the h.f. gain in order to compensate for the gain fall-off due to the base-collector capacitance of

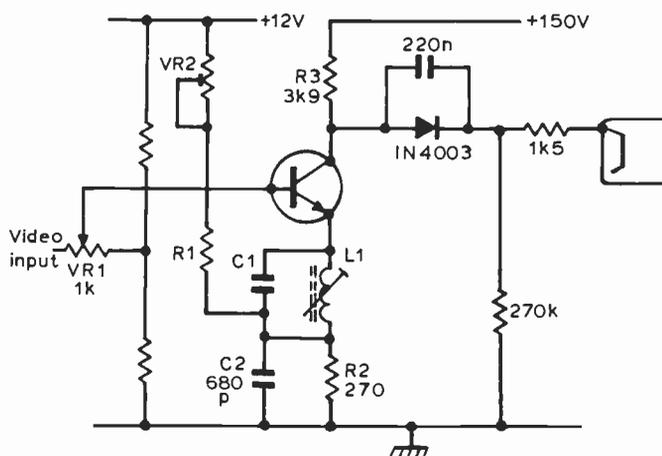


Fig. 1: The circuit of the original single-transistor amplifier. The input was derived from an MC1330 demodulator i.c.

the transistor. The working point of the transistor is stabilised by bleeding some current from the emitter to the 12V rail through R1 and VR2. The latter is adjusted for 85V at the tube cathode when a test card is being displayed. The video signal is taken from the collector of the transistor via a beam limiter diode to the c.r.t. cathode.

### Cascode configuration

A higher performance stage is shown in Fig. 2. This uses a cascode circuit and in terms of cost versus performance the configuration offers a better solution. The video signal is again fed in via a bridge contrast control, this time to the base of the low-voltage transistor Tr1. This device provides all the current gain of the amplifier and works at a relatively low collector-emitter voltage (around 8V). The high-voltage transistor Tr2 is connected in the common-base configuration. It has unity current gain but provides the large voltage swings necessary for driving the tube. This approach means that even low-beta video transistors can be used for Tr2 without affecting the performance. Another very important advantage is that this transistor's base-collector capacitance has very little influence on the bandwidth of the amplifier, since in common-base stages the Miller effect is avoided.

This circuit was used for some time and gave very

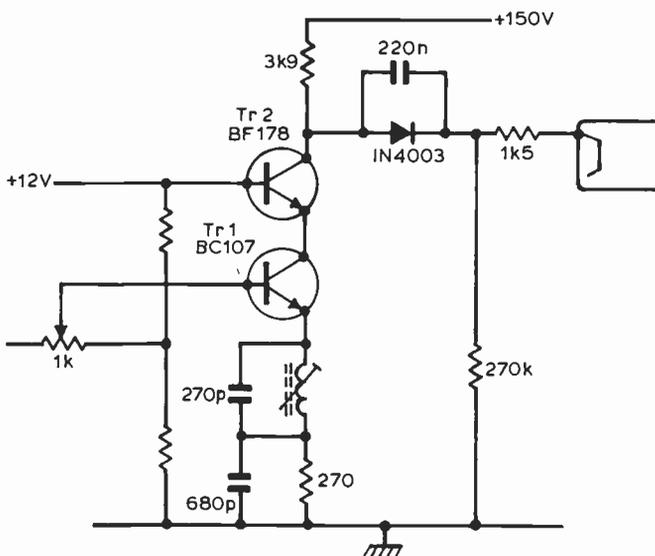


Fig. 2: Circuit diagram of the cascode amplifier. This approach gave very acceptable results and remained in the set for some time.

pleasing results. One modification tried was to use an f.e.t. in position Tr1. This gives a much higher input impedance, reducing the loading on the previous stage. In the case of a diode demodulator, the video amplifier can be driven directly from the collector of a gain stage following the detector. With this circuit the contrast control took the form of a large (1,000 $\mu$ F) capacitor in series with a 470 $\Omega$  potentiometer connected in parallel with the transistor's source bias resistor. Although this circuit worked it was not optimised and had various shortcomings. It may prompt some thoughts from readers however and the author would welcome comments or suggestions from anyone who decides to investigate this approach further.

### The class AB stage

Perhaps the most interesting circuit is the one tried only recently and shown in Fig. 3. The first thing to note is that this is a class AB output stage, unlike the other two which are class A circuits. This stage differs considerably from those normally encountered in either monochrome or colour sets and merits a fuller description.

In comparison with a conventional class A stage this circuit offers the following advantages: (1) lower dissipation, (2) no high-dissipation load resistor, (3) no heat-sinking required, (4) lower output impedance, and (5) variation in the supply voltage has little effect on the output voltage.

The 3.9V zener diode in the emitter circuit of Tr2 matches the working point of Tr2 to the d.c. level of the previous stage. Component values will have to be altered to suit particular applications. For a given d.c. level at Tr2's base, the ratio of R2 to R1 determines the stage's output voltage (black level). Tr2 may be regarded as a current-controlled voltage amplifier with negative feedback via R2. The input of the amplifier is at "virtual earth", so the gain is determined by the ratio of the contrast control (VR1) setting and the value of R2.

Transistor Tr1 forms an active collector load for Tr2. In operation, as Tr2 moves towards saturation (peak white) so Tr1 moves towards cut-off. This is because the increased current flowing through D1 increases the voltage across R3,

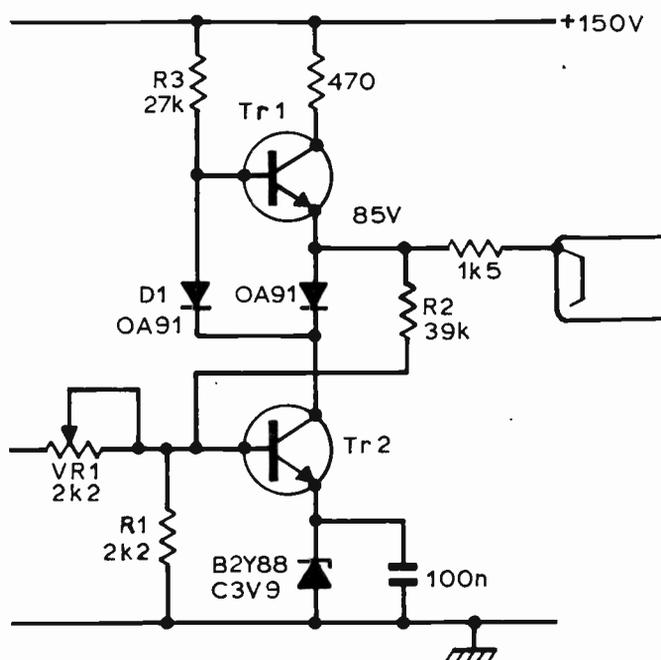


Fig. 3: The high performance class AB stage, tried recently. A suitable transistor for Tr1 and Tr2 is the BFR88.

thus reducing Tr1's base voltage and moving it towards cut-off. The converse is also true: as Tr2 moves towards cut-off, the current through D1 and the voltage across R3 decrease thereby moving Tr1 towards saturation. In practice neither transistor saturates nor cuts off. The active collector load Tr1 is thus continuously variable, dependent on the drive to Tr2.

### Results

Due to the negative feedback applied, the gain is very stable and the bandwidth is extended. Another advantage is that the two transistors can be small plastic types since the dissipation is fairly low. It must be emphasised however that they must be fairly high-gain, high voltage devices with a reasonable cut-off frequency.

This last circuit is the one favoured by the author. So far however sufficient measurements have not been taken and neither has the circuit been totally optimised. Its advantages will obviously be highlighted in a colour set, but this remains to be tried.

One last word of warning. These circuits have been tried in the original receiver with component values adjusted to suit its requirements. Readers wishing to adopt any of these circuits for use in other receivers must be prepared to spend some time at their bench, preferably with some test equipment, in order to develop the circuits as may prove necessary. ■

We regret that due to a printing error the formula for the first null bandwidth of a surface acoustic wave filter was given incorrectly on page 646 last month. The correct formula is:  $\Delta f/f_0 = 2/N$ .

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# LONG-DISTANCE TELEVISION

ROGER BUNNEY

AT the time of writing the long spell of hot weather continues. This has been a boon to DX-TV reception. Over the past few weeks a large slow-moving high-pressure system has predominated over the UK, slow moving in the sense that it tends to move around Western Europe without departing. It's thus no stranger, and the resulting "freak" weather conditions have produced a general increase in signal reception, in particular via the Tropospherics!

The August reception pattern has been one of declining Sporadic E, increased Tropospherics and a notable Perseids meteor shower period – on the 12th. We have also heard news of really exotic reception – in the form of multi-hop Sporadic E or evening Trans-Equatorial skip.

## *Exotic Reception*

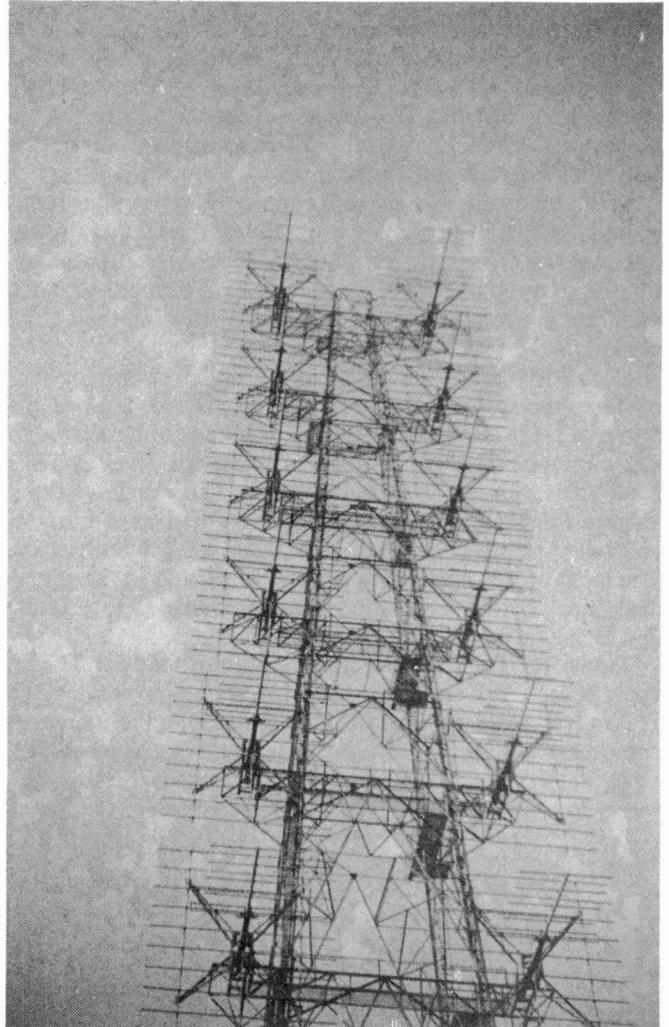
The most important reception in August was undoubtedly by Ian Beckett (Buckingham) and Hugh Cocks (nr. Honiton). The evening of August 6th produced at 1820-1840 CET from a Southerly direction a weak test card C on ch. E3. The signal didn't rise to a fantastic level, and was obliterated at 1840 by RTP (Portugal) carrying test card E. Letters have been sent to various likely broadcasting authorities and already Nigeria has replied indicating that the transmitters there would at the time be carrying programmes. It's thought that the signal originated from the ch. E3 outlet at Jamasi, Ghana. Interesting to note that this could be the second time that Ian has received Ghana in recent years. Our congratulations to them both on this quite remarkable reception.

## *Conditions at Romsey*

As so often recently, shortage of space denies me a detailed listing of my loggings here at Romsey. The following is a brief summary of the main and more interesting points.

The first few days were quiet, but between the 3rd-9th Sporadic E openings produced signals from RTVE (Spain), RAI (Italy) and JRT (Yugoslavia), with a glimpse of NRK (Norway) on the 5th. Apart from an excellent Sporadic E opening on the 12th, the Perseids meteor shower gave some quite high level "pings" in Band III and for once I was successful in logging a new station (!), TSS (USSR) ch. R6 from Vinnitsa. Fortunately the 0249 test card was being transmitted. Other MS pings were mainly of weak to fair strength PM5544 test cards – origins unknown of course. The other main Sporadic E openings were on the 15th and 22nd – other days being devoid of substantial SpE.

The Tropospherics hovered at "just about to open up" for many days, bringing in the usual just-in-the-noise type



*Stacked arrays used for 38MHz Tropospheric Scatter working on a Cross-Channel link. (See item "Temperature Inversion".)*

signals and on several occasions giving some quite good openings. The main activity seems to have been from the 17th onwards, with openings on the 19th, 20th and 24th. Signals have generally originated from Denmark, North Germany, East Germany and Holland. Denmark in fact provided some excellent signals on chs. E7, 8, 9 and 10, and conditions just allowed DFF to filter in at Romsey though I gather from other sources that both Band III and u.h.f. DFF outlets have been received. Generally Band III seems to have been favoured rather than u.h.f. I feel certain that if the present high-pressure system moves away slowly we will have an excellent opening. Summarising then, it was a good month for most types of reception.

## Points for the Notebook

Two important items, both relating to photography. Graham Harrison of St. Leonards-on-Sea tells us that until further notice he is unable to process film or make further prints due in part to a move to a new location – so please refrain from posting any film until we can advise further. Alan Damper of 144, Shaftesbury Road, Carshalton, Surrey, who you may recall was able to supply monochrome film at cut prices, tells us he now has a further consignment. Due to an earlier supply difficulty several readers may have experienced some delay in obtaining the film but we are assured that plentiful supplies are now available (Ilford FP4 36 shot, 58p for one, £1.10 for two including postage!).

## Subscriptions

A number of overseas subscribers may shortly find it impossible to renew their subscriptions. We suggest they contact Key Magazine Distributors, PO Box 34, Ongar, Essex CM5 9BP, England, who are prepared to maintain subscriptions for overseas readers. IPC Magazines Ltd. have no connection with this company.

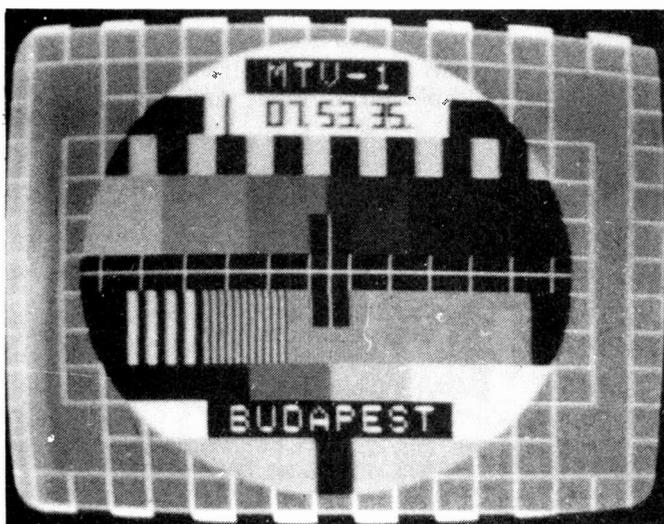
## Bargain Boards

To continue in this commercial theme, Hugh Cocks has brought to my notice an offer from Bi-Pre-Pak Ltd. of

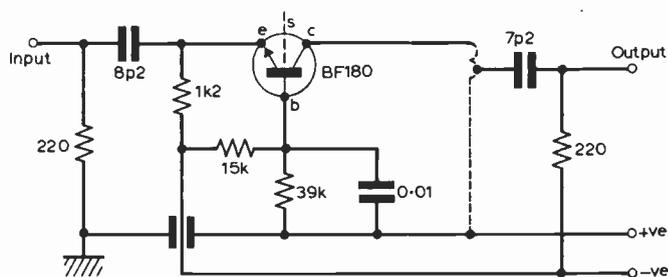


A "free" TV station – Florence Free Television, ch. 54.

Photo courtesy Michele Dolci.



New test card – MTV Hungary, with digital clock insert.



[N345]

Fig. 1: The u.h.f. amplifier board offered by Bi-Pre-Pak Ltd.

Westcliff-on-Sea. In their current advertisements a component pack No. CP16 is listed as a BF180 transistor u.h.f. amplifier board. The board contains all the components shown in Fig. 1 less the coil. This suggests that it originally served as a masthead amplifier. There are five of these boards in each pack, but in the two packs I obtained an extra board was included with a coil but less the other components. At 60p plus postage and VAT at 12½%, this is excellent value and much cheaper than buying the separate parts for an amplifier.

## New EBU Listings

*Finland:* Vuokatti ch. E56, 600kW hor. (NE of Lahti).

*France:* Paris ch. 25, 600kW hor. (first chain, 625 lines); Tours-Chiiay ch. 62, 200kW hor. (third chain – SW of Chartres).

*Syria:* Hassake ch. E4, 95kW hor. (a possible for Sporadic E!).

## News Items

*Italy:* News from Michele Dolci – all the "free" TV stations now legalised will be operating in Band V. He has received a strong signal from Tele Alto Milsuese on ch. E68, now operating from a site on Mt. Penice designed to cover all North Italy. As we have noted with the figure "1" on the monochrome card, the second chain carries a corresponding "2" in the same position.

*Balloons:* The Goodyear airship Europa has participated in propagation and radiation tests from the Saarbrucken TV tower. This is to determine the directional characteristics and signal strengths now being radiated from the tower.

*More Balloons – Nigeria:* A subsidiary of the Westinghouse Corporation (USA) – the TCMO Corporation – is to supply the Nigerian Television Service with ten balloons to increase the area served. The balloons will be moored at 10,000ft. Balloon transmissions have been successful in the Bahamas and on the Korean mainland.

*Propagation:* Some time ago we reported on the possibilities of signal reflection due to heating of the Ionosphere above a very high-powered transmitter operating in the conventional domestic broadcasting field. The Stanford Research Institute has discovered that if a "beam" of shortwave signals is directed into the Ionosphere from a landbased site heating takes place and forms a "bubble" (the press cutting describes the formation as a bubble) with the capability of reflecting v.h.f. signals. The "bubble" region is some 160km wide, with a thickness approaching 16km, and is capable of reflecting v.h.f. signals over some 1600km.

## ATS Reception

We are still receiving letters from successful enthusiasts who managed to resolve signals from the ATS satellite before it finished operations on July 31st. It seems that most of those who attempted reception, with equipment ranging from the simple to quite sophisticated, were able to resolve signals. Geoffrey Chapman (Blandford) resolved good signals using a simple 2m dish array feeding a masthead amplifier which in turn fed his conventional DX receiver. Despite the lack of an f.m. demodulator the signals were easily locked.

A more elaborate system was used by Peter Jansen of Rotterdam, Holland. Also using a 2m dish, and a cut to frequency aerial, his specialised equipment enabled quite magnificent signals to be resolved – thanks to an NE561B PLL demodulator. The video output obtained from this was remodulated back to a.m. on ch. E2 and displayed on a conventional TV receiver. Fig. 2 shows a block diagram of his system. Photos illustrate the aerial and reception quality.

## From Our Correspondents . . .

Again a large pile of mail, too much in fact to report in detail but we'll pick out points of general interest. Anthony Mann of Perth, Western Australia, continues to be active and has again received the Johore Bahru transmitter in Malaya – ch. E3. During the late July period he received a great number of F2 signals from Asia, reaching into the low 40MHz region. It is interesting to note that Sporadic E has been very active during their winter season – perhaps a sign for us? On March 27th a brilliant Aurora was seen over Antarctica. Its effects reached southern New Zealand and southern Victoria but there have been no reports as yet of Auroral reception.

James Burton Stewart (Milton Keynes) has been on his travels once again, this time to Greece. Travelling by coach across Europe he noted that Fuba aerials are in use extensively both at u.h.f. and for Band III. In some locations small lattice masts are mounted on the roof tiles, with up to four Fuba's pointing in different directions. Yugoslavians use the Fuba Band III aerial and a vast number of apparently locally made u.h.f. arrays. Despite the seeming poverty, there are a great many TV installations. TV wise the Greeks are not a great race, preferring to spend their evenings out. This in turn accounts for a somewhat erratic TV service. There are Band III aerials in profusion, with some evidence of u.h.f. reception. There is no ch. E3 TV transmitter in operation at Thessaloniki – at least no Band I aerials are present.

Allan Latham (now at Abu Dhabi but previously in Southampton) has written a long letter describing TV in the Gulf. Being a DX-TV enthusiast Allan has wasted no time



The 2-metre dish used for ATS satellite reception by Peter Jansen, Holland.

in erecting a double seven system for wideband Band I/III operation, with a switched Band I/III masthead varactor amplifier coupled to a rotator unit. His receiver is an Autovox colour set with 5.5MHz sound i.f., v.h.f. tuner and a G8 vision selectivity panel fitted. The G8 unit has reduced the i.f. bandwidth to 3MHz flat with the 4.43MHz colour subcarrier some 10dB down on this with a sharp fall-off after this, consistent with sound reception. This is giving the best colour pictures seen there off-air, with a considerable drop in adjacent channel interference. Due to the conditions prevailing in the Gulf, each channel is occupied – with entertainment quality signals for much of the time. All channels are occupied with locals and semi-locals as

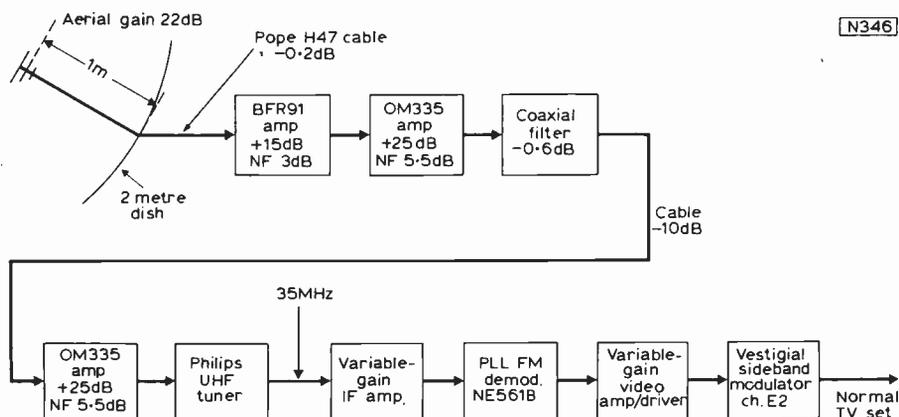


Fig. 2: Block diagram of Peter Jansen's ATS-6 receiver. The OM335 is a hybrid i.c. amplifier from Philips, with a bandwidth 40 MHz-1GHz. The NE561B is a Signetics device.

follows: E2 Dubai at 100 miles; E3 Dhahran (system M 525 line) at 300 miles; E5 Bahrain at 250 miles, Abu Dhabi (local), Kuwait at 650 miles and NIRT (Iran); E6 Saudi Arabia and Dubai; E7 Iran; E8 Iran and Kuwait; E9 Qatar; E10 Dubai, Kuwait, Abu Dhabi and Qatar. This plenitude of signals makes DX-TV reception difficult. DX signals noted so far include TSS R1, 2; Amman E3; AIR (India) E4. Allan has promised to pass on further information when time permits.

Geoffrey Hunt (Hull) has written in for the first time. Being new to the hobby he has a single rotatable ch. E3 dipole mounted indoors. This is to be replaced shortly with an omnidirectional array of crossed dipoles. Despite the simple aerial system Geoffrey has received an envious selection of signals this past season on his Bush Model TV161 – totalling 15 countries in fact. He has also been able to take some excellent shots of his reception. We can clear one query at least, the test card with “Grunten” on it is the FUBK card from the Grunten transmitter of the Bayerischer Rundfunk in West Germany (South).



*The ATS caption preceding news programme at 1500 CET, as received by Peter Jansen.*

### Satellite News

Following the recent news of the Russian Stationar T satellite which is to operate at 714MHz (ch. 51) with TV broadcasts to Northern Russia from the end of 1976, at 99°E, we have written to the authorities for more information.

### Preview – Tropospheric Propagation

“The time has come, the Walrus said, to talk of many things” – and indeed the time has come to consider the forthcoming Tropospheric season. I have covered this important signal propagation mode before but the following outline is given for the benefit of new readers.

Unlike Sporadic E, which provides us with signals reflected from the E Layer in the Ionosphere some 70 miles above Earth, Troposphericly propagated signals travel in the part of the atmosphere adjacent to the surface and extending to some 25,000 feet. Such signals are thus directly affected by weather conditions and systems extending over some hundreds of miles. I’m sure that most readers will have noticed that during very settled, warm, anticyclonic weather (i.e. high pressure) usually weak and snowy television signals from distant transmitters improve and perhaps give snow-free reception. Another symptom during such conditions may be interference to the local transmitter, resulting perhaps in an extra, floating picture. A settled high-pressure system gives the classic conditions for enhanced Tropospheric reception, in particular favouring signals which travel along the prevailing isobar pattern rather than across it. Such weather conditions can occur at any time, but generally the Autumn months provide the most noteworthy reception and it is not unusual to receive u.h.f. signals from transmitters as far away as 800 miles – often at very high levels!

### Temperature Inversion

The observable characteristics of such high-pressure systems are usually clear, cloudless days with little or no wind. At sunset the upper air cools, as indeed does the surface temperature, but at different rates. This produces a boundary or temperature gradient which allows an inversion level to form – a similar effect occurs at sunrise. The inversion is capable of allowing signal propagation far beyond the normal horizon distance, at both v.h.f. and u.h.f.

The inversion effectively reduces skyward radiation from a transmitter – normally v.h.f. and u.h.f. signals travel on into space when they reach the horizon, the refractive index of the Ionosphere preventing signal return. With temperature inversion however the signal is to a large extent refracted over the horizon rather than continuing along a direct path into space. (I’ve ignored any effect due to Tropospheric Scatter in this summary since we are concerned with enhanced Tropospheric openings. Tropospheric Scatter gives regular transhorizon reception through the use of high-power radiation and very high-gain receiving installations. Scattering of the signal takes place, irregularities within the Troposphere producing a weak field at the receiving station – perhaps up to 250 miles distant.)

### Ducting

Returning to Tropospheric inversion effects, it’s often possible to receive a signal from a distant station whilst similar stations operating on or near the same channel but much closer to the receiving site are not received. This phenomenon is known as Tropospheric ducting; as the name suggests, the signal travels via a duct within the Troposphere. Such ducts are common in the Middle East and are present for considerable periods, allowing reception of stations within a 300 mile range for entertainment purposes. Unfortunately in Europe the weather pattern is much less stable and such ducts are infrequent.

Ducts usually occur when a high-pressure system produces a thin cloud level: the upper cloud levels are heated by the sun, producing an inversion at a relatively high level with a second inversion between the base of the cloud strata and the air beneath. A signal entering the cloud level (or duct) between the two inversions can be carried for a considerable distance, often much farther than signals refracted by the lower inversion level.

Many enthusiasts will have noted how the DFF (East German) transmissions from Brocken on channels E6 and E34 are so well received when signals from West Germany are just not present. Brocken is located in high mountains and its transmissions effectively feed straight into the duct, unlike transmitters at lower heights.

### Fog

Fog also produces good Tropospheric results, again due to inversion effects. Fog occurs during high-pressure

# LONG-DISTANCE TELEVISION

weather, and if such conditions result in a large belt of fog with clear sky above, there will be heating of the upper fog level and thus an inversion. This situation often arises towards night fall, continues overnight and clears with the sunrise over a period of perhaps 4-5 hours.

## Effect of Cold Fronts

Following the delights of a good Tropospheric opening, with many of the above effects, the departure of the high-pressure system may itself produce further reception along the prevailing isobar pattern. And if the system is traversed by a cold front as it moves slowly off there is every possibility of reception along the line of the advancing front – particularly if the front is very straight and slow moving. Again the important point is the temperature difference between the two systems: the greater the difference, the more likelihood of improved reception.

## Equipment Needed

In previous columns we have discussed the aerial and receiving system essential for successful Tropospheric reception. Basically a high-gain aerial which can be rotated is required, mounted – within reason – clear of surrounding objects. For Band III we recommend a good wideband system, such as those available from Jaybeam (the Astra-beam series) or from Antiference. At u.h.f. and for general coverage a wideband system is usually most efficient. One covering the whole Band IV-V spectrum allows for operational ease and can be used with a companion wideband u.h.f. masthead amplifier. Suitable wideband u.h.f. arrays are the Wolsey "Colour King", Fuba XC391d and the Antiference XG/W range. Wideband u.h.f. amplifiers are available from Labgear and Wolsey.

Coaxial cable is the all important link between the aerial and the receiver. It should not be overlooked since an incredible signal loss can occur if poor cable is used or if it is fitted incorrectly and without soldered plugs/sockets.

## Channels to Check

Having discussed the means by which the (hopefully) strong/exotic Tropospheric signal arrives at your receiver we obviously need some indication of the channels to check for the best signs of our DX reception. When conditions are really good, most channels will be occupied. It's the condition when signals are *just* beginning to improve that requires attention however. From my own experiences and those of many other more successful enthusiasts there are certain channels/stations which always give the first signals from a given direction. I have called on several partners in crime for the observations which follow.

If you are fortunate enough to live in East Anglia – the Mecca of DX reception – you have a head start in getting into Europe with v.h.f./u.h.f. Tropospheric. Clive Athowe from near Norwich advises as follows:

Direction	Improving	Fairly good	Good	Excellent
SW	Mendip Stockland Hill	Brest	Niort Nantes	RTVE
S	Dover	Bourges	Lyon	M. Carlo

Direction	Improving	Fairly good	Good	Excellent
SSE	Luxembourg	Nancy Strasbourg	La Dole Rigi Saentis	Italian u.h.f.
SE	Schnee Eifel Donnersberg	SWF BR	Amberg Rhon Dillberg	ORF CST S.Germany
E	Lingen	Minden Hannover Torfhaus	Dequede Berlin	Szczecin
ENE	Niebull	Denmark, Flensburg Eutin Marlow	Horby Karlsham	Visby Riga
NE	Vestsyland(DR)	W.Norway W.Sweden	Sunne Vasteras Stockholm	

Hugh Cocks has moved twice in recent years. For his original Mayfield, East Sussex, location he advises:

*Just improving:* Dutch ch.E4 (fair), E6 (fair), E7 (poor), E29, E32. West Germany ch.E29 Dusseldorf, E21 E25, E30, E32, E35. Luxembourg ch.E7 and E21, the latter floating under Lille.

*Conditions better:* Dutch "in on a screwdriver" plus improved ch.E7. West German channels 21, 22, 24, 25, 27, 28, 29, 30, 32, 34, 35, 37. Swiss, probably weak on E31, E34.

*Conditions good:* ORF ch.E5, E24. Norway E7, 9, 11. Denmark usually all Band III stations. Poland R8, R10 – latter good. Czechoslovakia R10, R38. East Germany E5, 6, 11, 29, 31, 34. Switzerland E6, 7, 9, 10, 11, 12, 22, 25, 29, 31, 32, 34, 56.

Some two years ago Hugh moved to a location in South Devon (near Honiton). Here he observes:

*Just improving:* Dutch ch.E4 in the noise, ch.27 co-channel with Rowridge. French Lille 21 fluttering with Brest, also ch.24. Caen 25/28, Brest 21/24 good; Nantes 29 fair; Paris 22, 25, 28 weak. Eastern UK u.h.f./v.h.f. stations improving.

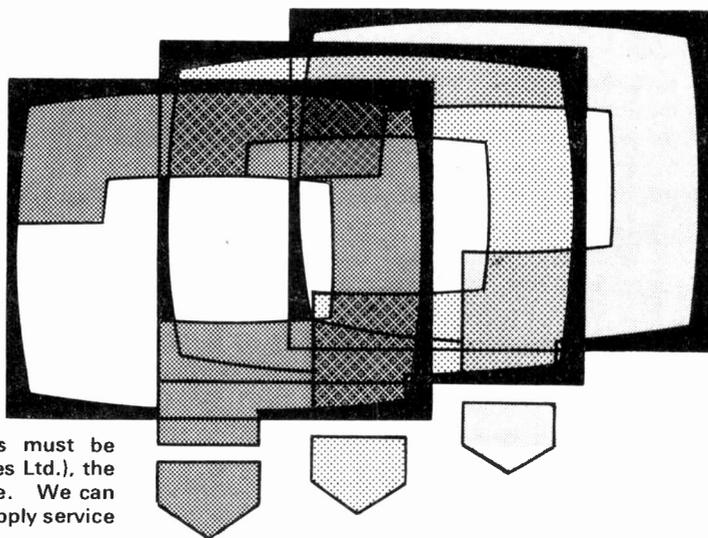
*Conditions better:* Lopik E4, also Dutch on E5, 6, 7, 27, 29, 32, 39, 45, 47 and just visible 53. West Germans E32, E46 (Kleve) and possibly ch.E5a. French v.h.f./u.h.f. saturating most channels. Possibility of weak Swiss 29, 31, 32, 34. Possible Spain ch.E4 Bilbao.

*Conditions good:* Swiss as at Mayfield. Luxembourg E7, 21 good. Denmark E5, 6, 7, 10. Sweden various u.h.f. channels, also E9, 10, 11. East Germany E5, 6 (good); E8 (fair), E9 (very weak), E11 (good), E29 Schwerin predominating. Good Dutch all channels. Poland ch.R10, R12 (poor). Czechoslovakia R10, R26. Austria E5, 6, 8, 24, 32 – all weak. French impossible to list. Spain E3, 4, 7, 11, with predominating E9, 10, E22, 24 (after France off air), E48. W. Germany many stations throughout all channels! Suggest try for RAI u.h.f. (Italy).

## Conclusions

As can be seen from these long lists a great many stations are possible, particularly if Tropospheric conditions are fair to good. It is essential to use a good station/transmitter list – such as the EBU lists – to locate and identify likely stations that have been received or for attempted reception. The list above shows the most likely channels and transmitters to be received with an improvement in Tropospheric conditions. Space permitting, we hope to conclude this section next month with details of typical reception in other parts of the country – thus building a complete pattern of enhanced Tropospheric reception conditions.

# Your PROBLEMS solved



Requests for advice in dealing with servicing problems must be accompanied by a 50p postal order (made out to IPC Magazines Ltd.), the query coupon from page 51 and a stamped addressed envelope. We can deal with only one query at a time. We regret that we cannot supply service sheets nor answer queries over the telephone.

## ULTRA 6706

The vertical lines have a habit of going zig-zag, particularly in the top half of the picture. There is also a lot of patterning, and the BBC-1 transmission is present slightly on the ITV channel – particularly noticeable when ITV goes off the air.

The patterning is probably due to cross-modulation. The usual cause is too strong a signal or an incorrect type of or badly adjusted aerial. Distortion of the verticals is commonly due to failure of C619 (140 $\mu$ F) on the top of the power supply panel – Thorn now recommend a 200 $\mu$ F, 100V capacitor in this position. A less likely possibility is either C506 (22 or 25 $\mu$ F, 25V) in the flywheel sync filter circuit or C511 (also 22 or 25 $\mu$ F) which decouples the emitter of the reactance transistor. (Thorn 3000 chassis.)

## KB WESTMINSTER

The picture is very dull – it can't be seen in normal daylight. If the brightness control is advanced more than about half way the picture starts to go negative, i.e. the black parts become lighter than the light parts. In addition, with the width control at minimum the raster is still slightly too wide. I suspect that the lack of brightness is due to low c.r.t. emission, but will replacing it cure the other symptoms?

The c.r.t. is almost certainly low-emission, causing the dullness and brightness inversion. The excessive width is not due to the c.r.t. Check whether the linearity sleeve beneath the scan coils on the c.r.t. neck is misadjusted or missing.

## THERMAL CUTOUTS

Could you explain why thermal cutouts are being increasingly used? I recently came across one in a faulty line timebase – it was between the line driver transformer and the base of the line output transistor. I can see that it's there to provide circuit protection, but why not use a fuse? Can cutouts be bypassed when checking the circuit?

There are various reasons for the use of these devices. Generally however they are preferred because they are temperature conscious and will break a circuit faster than a fuse which depends on a current overload. If an open-circuit cutout or fuse is bypassed there is always the risk that the protected circuit will be damaged by the overload that caused the initial failure.

## GEC 2103

A horizontal band of interference, about 2in. deep, moves up and down the screen. On occasions it becomes

stationary but then proceeds to move again. The trouble is not due to external interference since a GPO engineer has checked this. There is also loss of focus which can be restored only by turning the brightness and contrast controls down – but this gives a very dark picture.

The effect is probably due to arcing, and a possible cause is the dual thermistor TH501 in the degaussing circuit. This component is mounted on the timebase board. Examine the panel for any signs of arcing or component overheating. (GEC single-standard hybrid colour chassis.)

## DECCA CS2233

The trouble with this set is lack of height, with the height control having almost no effect.

Check the voltage at the anode of the PCF80 field oscillator triode (pin 1). You will almost certainly find this low – it should be about 90V. The trouble is usually that R402 (820k $\Omega$ ) which is in series with the height control has increased in value. It goes up to 2-3M $\Omega$  or more. (Decca 30 series chassis.)

## FERGUSON 3809

There is a bright white outline to the right of all black objects and a black line to the right of white objects. The i.f. alignment has not been disturbed.

The fault is in the video channel. Check the value of the video output transistor's collector load resistors R40 and R41 (2.2k $\Omega$  and 5.1k $\Omega$  respectively), and its emitter compensating capacitor C39 (0.0033 $\mu$ F) which could be defective. Then check back to the video driver stage VT8 and if necessary make a thorough examination in both the input and output circuits. (Thorn 1500 chassis.)

## BUSH TV193S

The fault with this set is that the sound and vision disappear suddenly, leaving a bright screen with just a trace of picture on some channels. When the fault is present the base voltage of the first i.f. transistor 2VT1 falls from the correct 4.5V to 1V. Momentary application of 4.5V at this point brings back the picture and sound and the receiver then functions properly for several days before the fault recurs.

Whilst 2VT1 could be defective it is more likely that the a.g.c. system is at fault. Check the voltages around the a.g.c. amplifier transistor 3VT2 – there should be 2.6V at the collector and 0.65V at the base – and the a.g.c. gating transistor 3VT3 – should be 7.3V at the collector, 3.1V at the base and 4.1V at the emitter. Some models have a preset control in 3VT2's collector circuit. This is often intermittently defective. (RRI A774 chassis.)

## GEC 2119

The fault on this set is a thin vertical line the full height of the picture. It appears only infrequently and is generally on the left-hand side of the screen – though it has been noticed on the right-hand side. The line tends to fade in and out, lasting from a few seconds to half a minute. There is no audible arcing and all other picture and sound conditions remain satisfactory.

An infrequent intermittent fault is always difficult to diagnose. However, we suggest you check the following: plug PL35 on the convergence board (panel PC470), C414 and C415 across the primary winding of the line driver transformer on the line oscillator panel (PC466) and the l.t. rectifier D601 on the line output panel (PC475). The earthing of these panels should be checked as well. (GEC 2110 series chassis.)

## PYE CT205

The picture and colour are all right except that the colour breaks into parallel horizontal bands across the screen. The trouble clears for varying periods.

The trouble is due to the reference oscillator on the decoder panel being out of adjustment. The set a.p.c. bias control RV10 on the panel should be varied until colour lock is obtained. Change channel and repeat the adjustment until colour returns at once on channel change. (Pye 697 chassis.)

## HORIZONTAL LINE

A horizontal line travels up the screen on this HMV Model 2639. There is no distortion of the displayed scene nor any audible hum. I have seen the same trouble near here on a couple of sets of other makes. A transmission problem is ruled out since the latter two receivers operate on different channels.

Being asynchronous, the band is coming from the 50Hz mains supply. If it's a broad band without sharply defined edges, check the set's main h.t. electrolytic smoothing block. If the line is narrow and sharply defined, it could be due to mains-borne interference – especially if it is intermittent.

## PHILIPS 551

The sound is normal but the picture is completely overlaid by green colour plus horizontal white lines. The picture improves when the brilliance control is turned up but the colours are wrong. Unfortunately the fault is intermittent – it can last for hours and then clear itself suddenly, and can reappear just as suddenly.

Assuming that the trouble occurs on a monochrome picture as well as on colour, we suggest you concentrate on the green output stage – transistor Tr7348 and its associated components. Tap and probe for dry-joints, and check for thermal troubles using freezer and gentle heat from a hair-drier. If this is to no avail, suspect the TBA530 matrixing i.c. (IC7002). (Philips G8 chassis.)

## HMV 2808

The picture on this set is discernible only in a darkened room. Voltage readings seem to be generally correct, though the video output transistor's collector voltage is rather high (about 110V instead of 88V). No d.c. voltage can be measured at the c.r.t. grid – is this correct? I suspect the tube but would like your opinion.

You will not read a d.c. voltage at the c.r.t. grid with a conventional meter – the grid is taken to chassis via a

couple of resistors, with the flyback blanking pulses applied to the junction of these resistors. We suggest you check the first anode feed resistor R115 (3.9M $\Omega$ ) and then concentrate on the video output stage – the collector voltage is certainly abnormally high. Check the transistor itself, its base bias resistors R38 and R39, and its emitter resistors R43 and R42. We would not suspect the tube in this case. (Thorn 1500 chassis.)

## KB SV047

The line oscillator frequency seems to run away, though the picture remains synchronised, often with three overlapping pictures. Sudden loss of line hold occurs prior to or just after the frequency runs away. A slight touch on the line hold control restores a good picture. The PCF802 line oscillator valve and the flywheel sync discriminator diodes have been replaced.

Your problem is almost always due to failure of R131 (47k $\Omega$ ) which supplies bias to the triode cathode of the PCF802 from the h.t. line. Replace it with a 2W resistor. Less likely possibilities are the line sync pulse differentiating capacitor C71 (40pF) or the flywheel sync filter resistor R130 (1.2M $\Omega$ ). (STC/ITT VC100 chassis.)

## BAIRD 8734

The initial problem was that the colour disappeared when the set warmed up, a black band appearing on the left-hand side of the screen and gradually increasing to about 1in. Removing the back of the set restores the colour as the chassis cools. Then the colour on ITV went off on camera changes from a bright to a dark scene, reappearing on a bright scene. More recently still the colour vanished on all stations and can be temporarily recovered only when reselecting the channel or adjusting the tuner. On adjusting the line hold control the picture moved across to the left and the colour reappeared – it seems to have settled down again, and the picture has been recentred with the horizontal shift control. I still have to keep the back off however.

Pulses from the line output stage are used in the decoder, and this is one of those chassis where line timebase faults can in consequence lead to loss of colour. Your problem is due to line drift, which is commonly caused by the following components (listed in order of likelihood): the 22 $\mu$ F flywheel filter capacitor C506, the 22 $\mu$ F reactance transistor emitter decoupler C511, the discriminator diodes W501/W502, the reactance transistor VT501 and the feedback capacitors in this stage, C509 (0.002 $\mu$ F) and C510 (300pF). When you have cleared the trouble, reset the line hold control while shorting the sync test point at the bottom right-hand corner of the chassis frame. (Thorn 3000 chassis.)

## MURPHY V2312

When the brightness control setting is advanced the picture size increases and the middle of the screen – already fainter than the rest of the screen – disappears. The line output stage valves have been replaced without making any difference. The boost voltage measured at the c.r.t. first anode is low at 380V. Am I right in suspecting the line output transformer?

First confirm the presence of sufficient drive – around –35V – at the control grid (pin 1) of the PL504. Then disconnect the line scan coils by snipping the wire leading to one side of the coil assembly. If the voltage at pin 3 of the c.r.t. doesn't then rise to about 600V the line output transformer is almost certainly faulty. This is not uncommon on these models. (Bush TV161 series.)

### BUSH CTV25

This set was bought untested and works satisfactorily except for slight striations down the left-hand side of the screen and slight chrominance noise. Scope waveforms indicate that the striations originate in the line output stage, but despite extensive checks the fault has not come to light.

The striations are almost certainly due to the line linearity coil damping resistor 3R25 (1.5k $\Omega$ ) being either high-resistance or open-circuit. Poor chrominance could be due to an inefficient aerial, incorrect adjustment of the preset colour saturation control 5RV4, or the first chrominance amplifier transistor 5VT9 (BC108) being noisy.

### GEC 2018

Sound is normal but the screen is grainy. The valves, including those in the tuner, have been replaced without success. There is also pulling on verticals – advancing the contrast control makes this condition worse.

If the aerial is o.k. it seems that the fault must be in the tuner. Probably the switch contacts need cleaning and adjustment.

*It was concluded that the trouble must be in some way a consequence of increasing the beam current, so attention was directed to the line output stage and e.h.t. circuits generally. A PL509 line output valve and an e.h.t. tripler are employed and, rather unusually, in this early version of the chassis a BY147P solid-state rectifier is used as the boost diode. The valve and diode were replaced without any improvement. A number of small components were then checked, including the VDR in the PL509's control grid circuit, but to no avail.*

*For beam current limiting the voltage at the cathode of the PL509 is sampled – this voltage rises as the c.r.t. beam current increases of course. The voltage is applied to a transistor in the brightness control network. An abnormal rise in the PL509's cathode current results in the transistor switching on. This action reduces the voltage tapped from the brightness control, thus pulling back the beam current. It was decided to temporarily disconnect this circuit – but the fault remained. Neither was there any significant improvement after changing the tripler!*

*The line output valve is driven by a conventional PCF802 sinewave line oscillator stage. This circuit was examined next and after carrying out a number of checks the cause of the trouble was eventually brought to light. Have you any idea which component might have been responsible? See next month's Television for the solution and for a further item in the test case series.*

### SOLUTION TO TEST CASE 166

(Page 667 last month)

The sound signal transmitted on the 625-line standard is frequency-modulated, and like the Band II f.m. sound radio signal the treble is deliberately emphasised at the transmitter. The response is some 3dB up at 3kHz, thereafter rising progressively at the rate of 6dB/octave, corresponding to the British 50 $\mu$ sec f.m. time-constant for pre-emphasis. Equalisation is required in the receiver by means of 50 $\mu$ sec de-emphasis, and in the Thorn 8000 chassis this is provided by an 0.001 $\mu$ F capacitor (C198) connected from pin 7 of the sound i.c. to chassis.

In the case under discussion this capacitor was found to be open-circuit (a mechanical fault rather than an electrical one). Replacement restored the balance of sound and eliminated the sibilance.

Transmission pre-emphasis and receiver de-emphasis are used on the f.m. system in the interest of noise reduction – providing an improved sound signal-to-noise ratio.

### QUERY COUPON

Available until 15 November 1976. One coupon, plus a 50p (inc. VAT) postal order must accompany EACH PROBLEM sent in accordance with the notice on page 49.

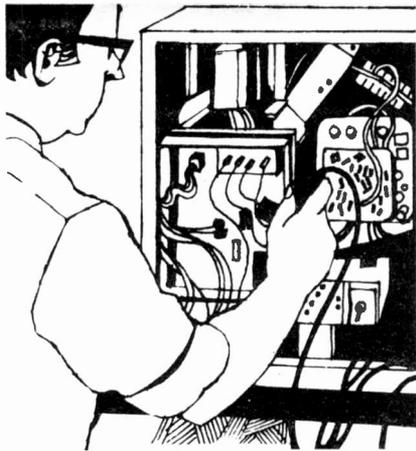
TELEVISION NOV 1976



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

*A Sobell Model 1040 colour receiver developed the following symptom over a period of several months. With increased overall screen illumination, produced either by advancing the brightness control or by the picture signal itself, a vertical band slightly brighter than the rest of the display would appear towards the middle of the screen. The effect became more noticeable – indeed, unacceptable – at signal levels corresponding to high overall brightness, yet was barely discernible at lower brightness.*

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