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TELEVISION

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MODERN TUNING TECHNIQUES Pt.1

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TELEVISION

March 1979

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Issue 341

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this month

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AC107	0.48	AU103	2.40	BC192	0.56	BC377	0.29	BD234	0.68	BF222	†0.51	BPX29	1.62	MPSU05	0.66	ZTX500	†0.18	2N3819	†0.47
AC117	0.38	AU107	2.75	BC204*	†0.39	BC394	0.39	BD235	0.63	BF224 & J	†0.22	BR101	0.53	MPSU06	0.76	ZTX502	†0.22	2N3820	0.72
AC126	0.36	AU110	2.40	BC205*	†0.39	BC440	0.52	BD236	0.63	BF240	†0.32	BR103	0.64	MPSU55	1.26	ZTX504	†0.28	2N3866	1.08
AC127	0.54	AU113	2.60	BC206*	†0.37	BC441	0.59	BD237	0.68	BF241	†0.31	BR303	1.06	MPSU56	1.32	2N404	1.30	2N3904	†0.20
AC128	0.46	BC107*	0.16	BC207*	†0.39	BC461	0.78	BD238	0.68	BF244*	†0.51	BRC4443	1.76	MPSU60	0.82	2N696	0.46	2N3905	†0.20
AC128K	0.55	BC108*	0.15	BC208*	†0.37	BC477	0.30	BD253	1.58	BF245*	†0.43	BRY39	0.60	MPU131	†0.59	2N697	0.46	2N3906	†0.20
AC141	0.65	BC109*	0.16	BC209*	†0.39	BC478	0.25	BD410	1.65	BF254	†0.48	BRY56	†0.44	OC26	1.90	2N706A	0.33	2N4036	0.94
AC141K	0.70	BC113	†0.22	BC211*	†0.36	BC479	0.33	BD433	0.65	BF255	†0.58	BSS27	0.92	OC28	1.49	2N708	0.29	2N4123	†0.17
AC142	0.60	BC114	†0.22	BC212*	†0.17	BC547*	†0.13	BD435	0.70	BF256L*	†0.49	BT106	1.50	OC29	1.60	2N914	0.32	2N4124	†0.17
AC142K	0.65	BC115	†0.24	BC212L*	†0.17	BC548*	†0.13	BD436	0.71	BF257	†0.44	BT109	1.99	OC35	1.25	2N916	0.46	2N4126	†0.17
AC151	0.31	BC116*	†0.25	BC213*	†0.16	BC549*	†0.15	BD437	0.74	BF258	0.52	BT116	1.45	OC36	1.25	2N918	0.54	2N4236	2.20
AC152	0.36	BC117	†0.30	BC213L*	†0.16	BC550	†0.24	BD438	0.75	BF259	†0.54	BT119	5.18	OC42	0.90	2N930	0.29	2N4289	†0.32
AC153	0.42	BC118	†0.24	BC214*	†0.18	BC556	†0.23	BD519	0.88	BF262	0.73	BU102	2.85	OC44	0.68	2N1164	8.29	2N4292	†0.32
AC153K	0.52	BC119	†0.34	BC214L*	†0.18	BC557*	†0.16	BD520	0.88	BF263	0.88	BU105	†1.80	OC45	0.63	2N1304	1.40	2N4416	0.85
AC154	0.41	BC125*	†0.30	BC225	†0.42	BC558*	†0.16	BD599	0.87	BF270	0.47	BU105/02	†1.95	OC70	0.65	2N1305	1.29	2N4444	1.90
AC176	0.45	BC126	†0.30	BC237*	†0.16	BC559*	0.17	BD600	1.23	BF271	0.42	BU108	†2.98	OC71	0.73	2N1306	1.49	2N4921	0.80
AC178	0.51	BC132	†0.20	BC238*	†0.15	BCY10	0.30	BD663BR	0.86	BF272A	0.80	BU126	†2.91	OC72	0.73	2N1307	1.32	2N5042	1.65
AC179	0.55	BC134	†0.22	BC239*	†0.22	BCY30A	1.06	BDX18	1.55	BF273	†0.33	BU204	†2.50	OC81	0.83	2N1308	1.53	2N5060	†0.28
AC187	0.56	BC135	†0.21	BC251*	†0.25	BCY32A	1.19	BDX32	2.95	BF274	†0.34	BU205	†2.78	OC81D	0.95	2N1711	0.47	2N5061	†0.30
AC187K	0.65	BC136	†0.22	BC252*	†0.26	BCY34A	1.02	BDY16A	0.63	BF336	0.63	BU206	†3.09	OC139	1.30	2N1893	0.52	2N5064	0.63
AC188	0.52	BC137	†0.30	BC253*	†0.38	BCY72	0.27	BDY18	1.55	BF337	0.65	BU208	†4.88	OC140	1.35	2N2102	0.71	2N5086	†0.49
AC188K	0.61	BC138	†0.35	BC261A*	†0.28	BD115	1.35	BDY20	2.29	BF338	0.68	BU407	†1.38	OC170	0.80	2N2217	0.55	2N5087	†0.50
AC193K	0.70	BC140	0.36	BC262A*	†0.28	BD123	1.50	BDY38	1.38	BF355	†0.72	BUY77	2.50	OC171	0.82	2N2218	0.38	2N5208	†0.59
AC194K	0.74	BC141	0.44	BC263*	†0.26	BD124	1.85	BF115	0.48	BF362	†0.49	C106D	0.80	OC200	3.90	2N2219	0.42	2N5294	0.66
ACY17	1.20	BC142	0.35	BC267*	0.20	BD130Y	1.56	BF117	0.45	BF363	†0.49	C106F	0.43	OC201	3.95	2N2221A	0.26	2N5296	0.68
ACY19	0.95	BC143	0.38	BC268*	0.28	BD131	0.58	BF120	0.55	BF367	†0.29	C111E	†0.46	OC202	2.40	2N2222A	0.41	2N5298	0.71
ACY28	0.98	BC147*	†0.12	BC286	0.40	BD132	0.68	BF121	0.85	BF451	0.43	D40N1	0.64	OC205	3.95	2N2369A	0.40	2N5322	1.16
ACY39	2.02	BC148*	†0.12	BC287	0.49	BD133	0.70	BF123	0.48	BF457	0.46	E1222	0.47	OCP71	1.98	2N2401	0.80	2N5449	†0.18
AD140	1.79	BC149*	†0.13	BC291	0.27	BD135	†0.37	BF125	0.68	BF458	0.49	E5024	†0.19	ON236A	0.94	2N2484	0.35	2N5457	†0.46
AD142	1.90	BC152	†0.42	BC294	†0.37	BD136	†0.38	BF127	0.51	BF459	0.52	GETB72	0.46	R2008B	†2.92	2N2570	0.74	2N5458	†0.40
AD143	1.78	BC153	†0.38	BC297	0.36	BD137	0.40	BF137F	0.78	BF594	†0.16	MC140	†0.36	R2010B	†2.79	2N2646	0.82	2N5459	†0.58
AD149	1.92	BC154	†0.41	BC300	0.62	BD138	0.42	BF152	†0.19	BF596	†0.17	ME0402	†0.18	R2322	†0.75	2N2784	1.15	2N5494	0.85
AD161	0.66	BC157*	†0.13	BC301	0.38	BD139	0.46	BF158	†0.25	BF597	†0.27	ME0404/02	†0.18	R2323	†0.85	2N2869	2.08	2N5496	1.05
AD161/162	1.22	BC158*	†0.12	BC302	0.86	BD140	0.50	BF159	†0.27	BFR39	†0.30	ME6001	†0.18	ST2110	0.49	2N2894	0.45	2N6027	0.55
AD162	0.71	BC159*	†0.14	BC303	0.64	BD144	2.24	BF160	†0.20	BFR40	†0.29	ME6002	†0.18	ST6120	0.48	2N2904*	0.40	2N6107	0.71
AF114	0.35	BC160	0.52	BC304	0.44	BD145	0.75	BF161	0.84	BFR41	†0.30	MJ2955	1.30	TIC44	†0.25	2N2905*	0.39	2N6122	0.60
AF115	0.35	BC161	†0.58	BC307*	†0.17	BD150A*	†0.51	BF163	†0.65	BFR50	†0.29	MJ3000	1.58	TIC46	†0.35	2N2906*	0.36	2N6178	1.07
AF116	0.41	BC167B	†0.15	BC308*	†0.14	BD155	†0.90	BF164	†0.95	BFR52	†0.33	MJE340	0.68	TIC47	†0.45	2N2926G	†0.15	2N6180	1.39
AF117	0.42	BC168B	†0.14	BC309*	†0.18	BD157	0.51	BF166	0.50	BFR61	†0.29	MJE341	0.72	TIP29A	0.47	2N2926O	†0.14	2N6211	2.74
AF118	0.98	BC169C	†0.15	BC317*	†0.15	BD158	0.75	BF167	0.38	BFR62	†0.28	MJE370	0.74	TIP30A	0.50	2N2926Y	†0.14	2SB337BP	4.28
AF121	0.68	BC170*	†0.15	BC318*	†0.15	BD159	0.68	BF173	0.35	BFR79	†0.30	MJE371	0.79	TIP31A	0.51	2N2955	1.12	2SC458C	0.78
AF124	0.38	BC171*	†0.15	BC319*	†0.19	BD160	2.69	BF177	0.36	BFR80	†0.29	MJE520	0.85	TIP31C	0.67	2N3053	0.48	2SC643A	2.25
AF125	0.38	BC172*	†0.14	BC320	0.17	BD163	0.67	BF178	0.46	BFR81	†0.30	MJE521	0.95	TIP32A	0.56	2N3054	0.86	2SC930D	1.50
AF126	0.36	BC173*	†0.22	BC321A&B	†0.18	BD165	0.66	BF179	0.58	BFR88	†0.42	MJE2955	1.20	TIP32C	0.72	2N3055	0.72	2SC1061	1.45
AF127	0.86	BC174A & B		BC322	†0.28	BD166	0.88	BF180	0.53	BFT41	0.48	MJE3000	1.95	TIP33A	0.77	2N3250	0.52	2SC1172Y	3.55
AF139	0.58		†0.26	BC323	1.15	BD175	0.90	BF181	0.53	BFT43	0.55	MJE3055	1.22	TIP34A	0.84	2N3254	0.58	2SD234	1.48
AF147	0.52	BC176	0.22	BC327	†0.16	BD177	0.58	BF182	0.44	BFW11	1.02	MPF102	†0.40	TIP41A	0.72	2N3391A	0.38	3N128	1.60
AF149	0.45	BC177*	0.20	BC328	†0.18	BD178	0.92	BF183	0.52	BFW30	2.58	MPS3702	†0.33	TIP42A	0.80	2N3633	12.70	40250	0.98
AF178	1.35	BC178*	0.22	BC337	†0.17	BD181	1.94	BF184	0.44	BFW59	†0.19	MPS3705	†0.30	TIP2955	0.77	2N3703	†0.17	40251	1.14
AF179	1.36	BC179*	0.28	BC338	†0.17	BD182	2.10	BF185	0.42	BFW60	†0.20	MPS6521	†0.36	TIP3055	0.58	2N3704	†0.19	40327	0.67
AF180	1.35	BC182*	†0.15	BC340	0.19	BD183	1.34	BF186	0.42	BFW90	†0.65	MPS6523	†0.36	TIS43	†0.44	2N3705	†0.17	40361	0.48
AF181	1.33	BC182L*	†0.15	BC347*	†0.17	BD184	2.30	BF194*	†0.14	BFX29	0.38	MPS6566	†0.44	TIS73	†1.36	2N3706	†0.16	40362	0.50
AF186	1.48	BC183*	†0.14	BC348A & B		BD187	1.20	BF195*	†0.13	BFX84	0.42	MPSA05	†0.30	TIS90	†0.23	2N3707	†0.18	40410	0.94
AF202	0.27	BC183L*	†0.14		†0.17	BD188	1.25	BF196	†0.14	BFY50	0.38	MPSA06	†0.32	TIS91	†0.28	2N3708	†0.17	40429	0.88
AF239	0.73	BC184*	†0.15	BC349B	†0.17	BD189	0.71	BF197	†0.15	BFY51	0.37	MPSA55	†0.43	ZTX108	†0.14	2N3715	1.70	40530	0.79
AF240	1.40	BC184L*	†0.15	BC350*	†0.24	BD222	0.91	BF198	†0.29	BFY52	0.36	MPSA56	†0.45	ZTX109	†0.16	2N3771	2.39	40595	1.39
AF279S	0.91	BC185	0.36	BC351*	†0.22	BD225	0.91	BF199	†0.29	BFY53	0.36	MPSA93	†0.56	ZTX213	†0.23	2N3772	2.58	40603	1.13
AL100	1.30	BC186	0.25	BC352A*	†0.24	BD232	0.91	BF200	†0.25	BFY90	1.98	MPSL01	†0.33	ZTX300	†0.16	2N3773	3.90	40636	1.25
AL103	1.58	BC187	0.27	BC360	0.59	BD233	0.62	BF218	†0.42	BPX25	1.62	MPSU01	0.61	ZTX304	†0.26	2N3794	†0.40	40654	0.89

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For matched pairs add 20p per pair.

LINEAR IC's

Type	Price (£)
BRC1330	†0.93
CA810QM	2.44
CA3005	1.85
CA3012	1.45
CA3014	2.23
CA3018	0.71
CA3020	1.89
CA302BA	0.80
CA302BB	1.09
CA3045	3.75
CA3046	0.70
CA3065	1.74
CA306B	1.90
CA3130S	1.57
FCH161	†2.40
FCJ101	†3.32
LM309K	1.98
LM380N-14	1.65
LM1303N	3.08
MC1307P	†1.82
MC1310P*	†1.94
MC1312P	2.34
MC1327P*	†1.86
MC1330P	†0.93
MC1350P	†1.22
MC1351P	†1.42
MC1352P	†1.42
MC1357P	†2.92
MC135BP*	†2.30
MC145BG	1.43
MC1496L	1.15
MC3051P	0.58
MFC400B	0.85
MFC4060A	0.98
MFC6040	1.11
MIC1P	2.58
ML231	†3.57
ML232	†3.57
NE555	0.72
NE556	1.34
NE566	1.95
SAA1024	†5.70
SAA1025	†10.35
SAS560A	†2.01
SAS570	†2.01
SC9503P	†1.40
SC9504P	†1.38
SL414A	1.91
SL432A	2.52
SL450	5.10
SL901B	†4.20
SL917B	†5.60
SL918A	†5.95
SN72440N	†2.21
SN76001N	†1.67
SN76003N	2.22

Type	Price (£)
SN7600BKE	1.56
SN76013N	1.56
SN76013ND	1.40
SN76018KE	1.56
SN76023N	1.56
SN76023ND	1.40
SN76033N	2.22
SN76110N	1.20
SN76115N	†1.62
SN76116N	1.78
SN76131N	†2.10
SN76226N	†2.60
SN70227N	†1.61
SN7622BN	†1.80
SN76502N	†1.92
SN76530P	†0.97
SN76533N	†1.38
SN76544N	†1.85
SN76546N	†1.85
SN76570N	†1.81
SN76620AN	†0.99
SN76650N	†1.48
SN76660N	†0.64
SN76666N	†0.96
TA7073P	†3.51
TAA263	†2.20
TAA300	†3.85
TAA320	1.10
TAA350A	†2.48
TAA370A	3.18
TAA435	†1.70
TAA450	†3.39
TAA521	1.10
TAA522	2.09
TAA550	0.45
TAA560	1.93
TAA570	†2.30
TAA611A	1.67
TAA611B	1.89
TAA621AXI	2.33
TAA630Q	3.91
TAA630S	4.18
TAA661A	2.39
TAA661B	1.75
TAA700*	†2.80
TAA840	†3.38
TAA861A	0.95
TAA930A	1.43
TAA930B	1.43
TAA960	†2.25
TAA970	†2.48
TAD100	†2.66
(Filter)	0.98
TBA120A	†0.90
TBA120S*	†0.99
TBA120SA	†1.02
TBA231	1.12

Type	Price (£)
TBA240A	†3.98
TBA281	†2.07
TBA395*	†2.58
TBA396	†2.40
TBA400	†2.20
TBA480Q	†1.84
TBA500*	†2.21
TBA510*	†2.21
TBA520P*	†3.40
TBA530P	†2.24
TBA540*	†2.88
TBA550*	†3.13
TBA560C*	†3.18
TBA570*	†1.29
TBA611B	2.68
TBA641	2.55
TBA641A12	2.35
TBA641B11	2.61
TBA651	†2.12
TBA673	†2.19
TBA700*	†2.50
TBA720AQ	†2.38
TBA720Q	†2.38
TBA750*	†2.18
TBA800	1.65
TBA810AS	1.69
TBA920*	†3.80
TBA940	†3.52
TBA950	†2.78
TBA990*	†2.90
TCA270A*	†3.55
TCA280A	1.43
TCA290A	3.46
TCA420A	1.98
TCA440	1.67
TCA640	2.76
TCA650	2.76
TCA660	2.76
TCA730	3.54
TCA740	3.04
TCA750	2.53
TCA760	1.52
TCA820	3.29
TDA440	†4.16
TDA1003	1.52
TDA1004	2.73
TDA1005	3.04
TDA1022	6.89
TDA1024	0.97
TDA1034	1.98
TDA2610	2.86
TDA2640	2.86
ZN414	1.45

* Indicates Q version is also available.

DIODES

Type	Price (£)	Type	Price (£)
AA113	0.17	BY114	0.60
AA119	0.21	BY118	1.10
AA129	0.28	BY126	0.20
AA143	0.18	BY127	0.21
AAY30	0.28	BY133	0.35
AAZ13	0.42	BY140	1.40
AAZ15	0.35	BY164	0.75
AAZ17	0.28	BY176	2.80
AY102	3.85	BY179	0.83
BA100	0.24	BY182	1.14
BA102	0.36	BY184	0.44
BA104	0.19	BY189	5.30
BA110	0.80	BY190	4.90
BA111	0.70	BY206	0.26
BA115	0.17	BY238	0.25
BA116	0.56	BYX10	0.30
BA121	0.85	BYX38/600	0.70
BA129	0.45	BYX70/500	0.53
BA145	0.19	ITT44	0.08
BA148	0.19	ITT210	0.63
BA154	0.06	ITT827	0.80
BA155	0.17	MCR101	0.43
BA156	0.12	MRB54	1.10
BA157	0.25	OA5	0.88
BA158	0.28	OA10	0.58
BA159	0.40	OA47	0.20
BA164	0.14	OA81	0.19
BA170	0.18	OA90	0.13
BA182	0.27	OA91	0.15
BA201	0.13	OA95	0.20
BA202	0.14	OA200	0.13
BA203	0.14	OA202	0.13
BA216	0.08	OA210	0.89
BA219	0.11	TIL209	0.14
BA243	0.45	TIL211	0.18
BA317	0.06	TV20	2.25
BA318	0.07	IN914	0.06
BAV10	0.10	IN916	0.06
BAV21	0.18	IN4001	0.06
BAW62	0.06	IN4002	0.07
BAX13	0.07	IN4003	0.08
BAX16	0.10	IN4004	0.08
BAX17	0.19	IN4005	0.09
BAY72	0.16	IN4006	0.10
BB104B	0.52	IN4007	0.12
BB105B	0.33	IN5400	0.15
BB105G	0.30	IN5401	0.17
BR100	0.40	IN5402	0.20
BY100	0.35	IS920	0.09
BY103	0.35	IS921	0.11

ZENER DIODES

400mW plastic	3.0-33V	14p each
1/1.3W plastic	3.3-180V	18p each
1.5W flange	4.7-75V	£1.26 each
2.5W plastic	7.5-75V	67p each
20W stud	7.5-75V	£1.31 each
75W stud	7.5-75V	£7.95 each

VDR's, etc. (†)

Type	Price (£)
E295ZZ	
/01	0.28
/02	0.28
E298CD	
/A258	0.25
E298ED	
/A258	0.22
/A260	0.22
/A262	0.22
/A265	0.22
/P268	0.22
E298ZZ	
/05	0.25
/06	0.22
E299DD/P116-P354	all 0.23
E299DH	
/P230	0.72
R53	1.75
VA1015	0.92
VA1026	0.79
VA1033/34/38/39/40/53	all 0.20
VA1055s/56s/66s/67s	all 0.23
VA1074	0.20
VA1077	0.31
VA1091	0.29
VA1096/97/98	all 0.20
VA1103	0.32
VA1104	0.46
VA1108/09/10/11/12	all 0.24
VA8650	1.20
2322 554 02221	0.59
2322 662 98003	0.88

VALVES (†)

Type	Price (£)
DY86/87	0.75
DY802	0.75
ECC81	0.78
ECC82	0.95
ECC83	0.78
ECH81	0.83
ECL80	0.82
EF80	0.60
EF183	0.75
EF184	0.75
EH90	0.94
EL34	3.08
EY51	1.20
EY86/87	0.67
PCC84	0.61
PCC85	0.79
PCC89	0.74
PCC189	0.94
PCF80	1.20
PCF86	0.87
PCF200	2.32
PCF801	0.74
PCF802	1.20
PCF805	3.37
PCF808	2.00
PCL82	0.93
PCL83	1.12
PCL84	0.65
PCL86	1.27
PCL805/85	1.00
PD500	3.75
PFL200	1.40
PL36	1.20
PL81	0.94
PL84	0.79
PL504	1.50
PL508	1.85
PL509	3.10
PL519	3.10
PL802	3.25
PY81/P810	0.60

BRIDGES

Rating		Price (£)	Rating		Price (£)
1½A	50V	0.27	2A	100V	0.36
	100V	0.28		200V	0.40
	200V	0.32		400V	0.47
	400V	0.40		600V	0.53
	600V	0.50		800V	0.60
	800V	0.58		1000V	0.87
3A	100V	0.52	6A	100V	0.66
	200V	0.55		200V	0.68
	400V	0.61		400V	0.74
	600V	0.67		600V	0.80
	800V	0.80		800V	0.86
	1000V	1.20		1000V	0.95

10A and 25A ranges also stocked.

RESISTORS

Carbon Film (5%) (†)

	Ea	10 of one value	Mixes of a minimum of 10pcs of any value: 50pc	100pc	500pc
¼W 5.6Ω-330kΩ (E12)	3p	25p	95p	£1.49	£5.40
½W 10Ω-10MΩ (E24)	3p	25p	95p	£1.49	£5.40
1W 10Ω-10MΩ (E12)	5p	45p	£1.95	£3.40	£15.25
2W 10Ω-10MΩ (E6)	9p	80p	£3.60	£6.40	£26.90

Wirewound (5%)

2½W 0.22Ω-270Ω	18p
4W 1.0Ω-10kΩ	22p
7W 0.68Ω-22kΩ	24p
11W 1.0Ω-22kΩ	28p
17W 1.0Ω-22kΩ	33p
Vertical mounting pillars	3p

Presets (†)
0·1W (Vertical and Horizontal)
100, 220, 470Ω, 1, 2·2, 4·7, 10, 22, 47, 100, 220, 470kΩ, 1, 2·5, 5MΩ **all 14p each**
0·2W (Vertical and Horizontal)
Values as 0·1W **all 14p each**

FUSES (all packs of 10)

20mm Time Delay (BEAB)

40mA	£3.68
50, 63mA	£2.55
100mA	£1.86
160, 200, 250mA	£1.44
315, 500, 800mA, 1, 1.25, 1.6, 2, 2.5, 3.15, 5A	all £1.19

20mm quick-blow (BEAB)

100mA	68p
200, 250, 315, 500, 630, 800mA, 1, 1.25, 1.6, 2, 2.5, 3.15, 5A	all 56p

2A circuit breakers metal £1.52, plastic £1.48

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Giro A/c 23 532 400. *A/c facilities available*

CAPACITORS

Metallised Paper (†)

2n2F	1500V DC	60p	10nF	500V AC	80p
2n2F	600V AC	24p	15nF	300V AC	30p
3n6F	1700V DC	60p	22nF	300V AC	32p
4n7F	1500V DC	60p	100nF	1000V DC	20p
10nF	1000V DC	22p	470nF	1000V DC	60p

H.V. Disc Ceramic (†)

1kV	1.5nF	18p
3kV	1.5nF	20p
8kV	10, 22, 47, 82, 100, 120, 150, 180, 200, 220pF	30p
8kV	250, 270, 300pF	39p
10kV	1nF	67p
18kV	1nF	73p

CONVERGENCE POTENTIOMETERS
5, 7, 10, 15, 20, 50, 100, 200, 500Ω †38p each
Spindles for above 5p each

VHF to UHF CONVERTER CM6022/RA. "Televerta" for DX-ing or uhf receiver use on relay systems, Eire etc. †£24.40

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FRONT COVER
Our thanks to Mullard Ltd., who provided us with the i.c. mask transparency used as the background for our front cover design this month.

PUBLICATION DATES
We apologise to readers, advertisers and the trade for current publication delays. The February issue was held up due to distribution difficulties, and at the time of going to press it is not possible to say exactly when the present, March issue will be available.

Financing TV

The question of how the television services are to be financed has always been a controversial and difficult one. Those of us who recall the furore that preceded the establishment of ITV in the early fifties will need no reminding of this. In more recent times we've had the Annan committee on the future of broadcasting recommending the establishment of an OBA, but finding the problem of how to finance it the most tricky aspect of the proposal. The IBA doesn't have to worry about finance – ITV has been doing very nicely thank you over the last few years – while the OBA is still only a gleam in some broadcasters' eyes. No: the problem facing us right now is how to finance the BBC.

Before the rate of inflation rose to double figures and, in 1975, threatened to reach the sort of hyper-inflation rates one reads about in South American states, the BBC charter would come up for renewal every so often and some minor adjustment would be made to the licence fee which provides its main source of revenue. A high rate of inflation has put an end to such a simple, painless process however, as it has done in so many fields. There's no doubt that the BBC has been going through a very difficult period. The whole ITV system is virtually proofed against inflationary problems: advertisers aren't going to stop advertising, and are prepared to accept increased rates, while the IBA itself exists on a levy which automatically adjusts for inflation. The BBC, with its largely fixed revenues, has however to compete with the ITV system in purchasing expensive capital equipment, in paying for staff with the same skills and technical qualifications, and in purchasing programme material. There has been increased revenue from colour licences of course, but this was a once only boost and didn't take place quite as rapidly as the BBC had at one time hoped. The BBC in fact has not in recent times been able to pay comparable salaries to those the ITV companies have been able to offer, and in consequence has been suffering from a shortage of skilled staff along with some understandable unrest. Since the government rather than the BBC determines the licence fee, there's only one course open to the BBC, to go to the government to ask for more.

This is a most unsatisfactory procedure from every point of view. The whole point about the BBC is that it's supposed to be independent. In practice it is, but in so far as its financial resources depend upon the government of the day there is always a danger to this much esteemed independence. And whether or not the government of the day has any inclination to intervene in the BBC's affairs, its control over the BBC's finances is something of an embarrassment – the public gets upset with any government that increases the licence fee, while the government tends to be held responsible for any shortcomings in the BBC's performance arising from a shortage of finance. A simple alternative way of providing the BBC with the finances it requires would be a boon to one and all.

A surprisingly simple alternative has in fact recently been proposed – to replace TV licences with a levy on National Insurance contributions. These have to be adjusted from time to time to take into account inflation, so the BBC would automatically have its revenue adjusted without having to apply to the government of the day directly.

Are there any major objections? The BBC could still find itself under pressure from any government that found the BBC's independence not to its liking, since it would still ultimately hold the BBC's purse strings. On balance however the BBC's independence would probably be greater, while once the system became established it would probably be difficult to change. Perhaps more to the point is the objection raised by those who don't possess television sets. One can understand the feelings of those few who for their own reasons don't approve of television. But probably all of us object to some or other of the ways in which governments spend our money. Pacifists don't approve of expenditure on arms; others object strongly to some forms of government research; some get livid over expenditure on lame ducks, or on white elephants like Concorde. There's probably very little government expenditure that someone somewhere doesn't object to. But we've learnt to tolerate this, and there's no reason why TV through a National Insurance levy should be any different. There are of course the ITV only addicts: but they have to have a licence anyway, while it's worth recalling that we all in fact contribute to ITV via our high street purchases.

On the face of it there seem to be no serious reasons for not adopting this simple solution to a problem that's caused more than a little heart searching in recent years. Worth a try we'd say.

Teletopics

WHICH? LOOKS AT COLOUR TV SETS

In the January 1979 edition of *Which?*, the Consumers' Association reports on the latest of its periodic assessments of TV sets. It's interesting that this time the two models picked out as good value are both UK produced sets, the Bush BC6330, a 22in. set that *Which?* says should be obtainable for around £260, and the Ferguson 3732, a 20in. set that should be available at around £290 (this set has now been superseded by the 3742). One might have thought the 22in. Ferguson 3749 at around £260 would have offered better value, but *Which?* found that the picture geometry with the larger tube was not so good. Once again *Which?* suggests that Japanese sets are more reliable than European (UK and continental) produced ones, though the reliability of modern chassis is so greatly improved that it must be difficult now to establish much of a reliability differential – assuming that modern techniques of testing and assembly are being used. From the prices *Which?* quotes, it seems that Japanese produced sets now cost around £100 more than UK produced ones, a margin of 30 per cent or so, presumably the result of the appreciating yen. This of course throws an interesting light on the desire of Japanese setmakers to set up production in the UK. The survey was of sets in the 20-22in. range.

One point that did surprise us a little was that most sets needed the grey scale setting up: we'd have thought that if everything else could be got right "ex-carton" this could have been as well. There was little to choose between sets regarding picture quality however.

The Bush Model BC6330 is a version of the BC6340 (T20 chassis) available through Comet and McOnomy. The Ferguson 3742 uses the 9000 chassis and features a remote control unit for channel change and volume control.

PHILIPS LAUNCH VIDEODISC SYSTEM

Philips has started to market its videodisc system in the USA and hopes to introduce the system in the UK next year. The player is being manufactured and marketed by Philips' North American subsidiary Magnavox, under the trade name Magnavision: the discs are being produced and marketed by MCA under the trade name MCA Discovision. At a retail price of around $695 (about £350) the player will be around half the cost of a videocassette recorder, while the price suggested by MCA for a half hour disc is $5·95 – a complete two-hour feature film of recent vintage would retail for about $15·95. A wide range of film material is available to MCA for issue in videodisc form, and in addition educational and specialist – such as cooking – programmes will be released. The system is based on laser-scanned discs, and has been described in these pages before (see June 1974). Philips also has under development a twin-laser disc system that would enable users to record as well as play back discs.

ANOTHER "UNIVERSAL" TRIPLER

Following our mention of the "rationalised" e.h.t. tripler introduced by Phab Electronics Ltd., we understand that Anglia Components (Burdett Road, Wisbech, Cambs., PE13 2PS) has introduced a similar system – the Anglia Components Eurotray, based on the Siemens TVK76-14 e.h.t. tripler. Anglia claim that the tripler will fit most popular colour receivers, and have produced a comprehensive wall chart guide to assist servicemen in making up the tripler required.

UHF TV NETWORK

Phase I of the UK u.h.f. TV network, covering communities of more than 1,000 people, is now nearing completion and a number of Phase II (communities of 500-1,000) stations have already been opened. During 1978, some 52 new u.h.f. transmitters came into service, bringing 200,000 more people within the u.h.f. service areas. A further 70 or so relay stations a year are planned for the period 1979–83. The only transmitter brought into service since our last issue is: **Wester Erchite** (Lock Ness), BBC-1 ch. 21, Grampian Television ch. 24, BBC-2 ch. 27. Receiving aerial group A. Polarisation vertical.

NEW LOPT FOR THE RANK A774 CHASSIS

Rank have introduced a new replacement line output transformer for their A774 hybrid monochrome chassis. An interesting aspect of the new transformer is that a silicon diode voltage multiplier is incorporated in place of the e.h.t. overwinding which, Rank say, was a common cause of failure in earlier versions of the transformer. Extensive field trials have shown the unit to be reliable and efficient, and Rank provide an 18-month guarantee from the date of invoice instead of the customary 12-month guarantee offered on similar wound components. The improved performance is the result of the transformer operating at a much lower temperature, with lower power losses and peak flyback waveform. It can be fitted directly in place of earlier versions, without any modifications, and now supersedes all previous types. The trade price is £10·50 (part no. 9502 5170).

RENTING VIDEOTAPES

A contract between Radio Rentals and IPC Video has now been completed. The final set of a quarter million pound order for pre-recorded videocassettes – the first large UK order for such home entertainment material – has been handed over. The set of videocassettes, packaged in library style, will be available for rental through Radio Rentals' 500 UK showrooms at £3 per day, or for sale at £37·80. The subjects covered are described as "special interest", i.e. sport, sailing, etc.

THE PHILIPS KT2 CHASSIS

We've been taking a look at the circuitry employed in the Philips KT2 chassis – the one used in the small-screen colour sets in the Pye and Philips ranges. Well, at those parts actually shown on the circuit diagram. The circuit itself is clear enough, but all the small-signal sections have disappeared into little modules.

The interesting bit however is the power supply/line output stage arrangement. The regulated power supply is based

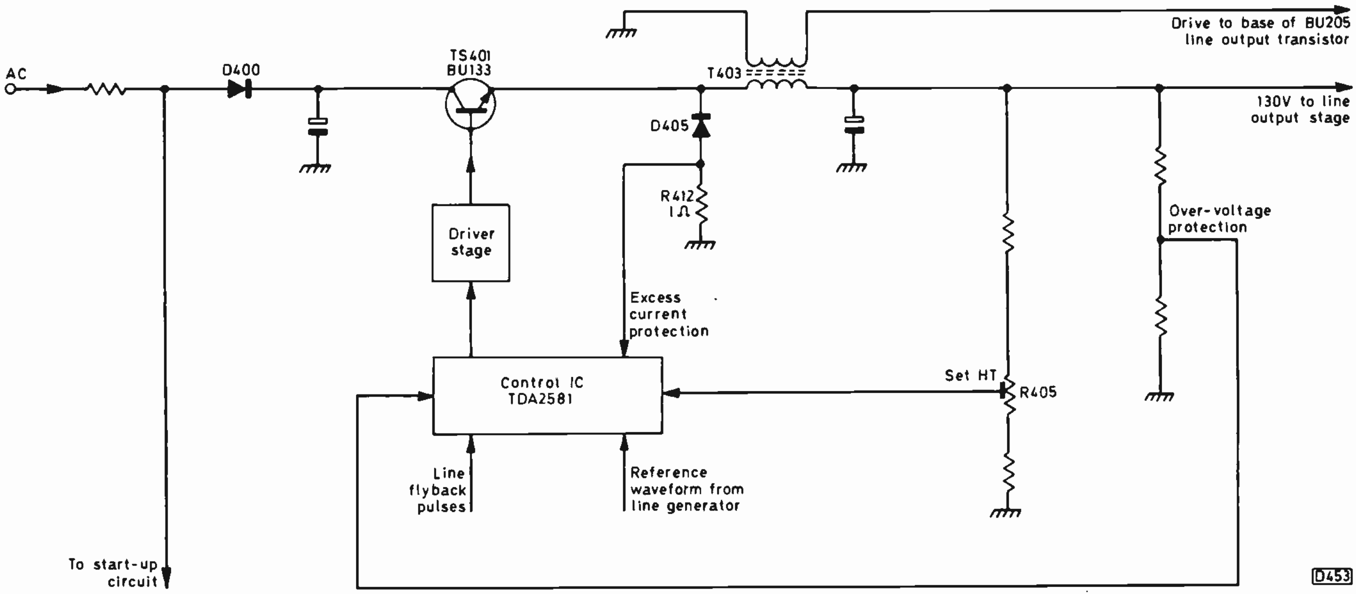


Fig. 1: Simplified circuit of the switch-mode power supply used in the Philips KT2 small-screen colour TV chassis. In practice an additional secondary winding on the chopper transistor's load transformer T403 feeds a rectifier that provides a 20V line for the audio circuits. The output from the line oscillator i.c. is used as a reference waveform for the TDA2581 chopper circuit control i.c., which incorporates a pulse-width modulator circuit providing a variable mark-space ratio squarewave drive waveform for the chopper transistor. The primary winding of the chopper transformer T403 is used as the energy store: when the chopper transistor TS401 is switched off, the current flow is maintained by D405 which provides an efficiency diode action. Excess current demand is detected by the 1Ω resistor R412. The start-up circuit provides the 12V supply required by the TDA2581 i.c.

on a series chopper circuit (see Fig. 1) of the type familiar since the days of the Thorn 3000 chassis. A difference from the 3000 however is that the base of the line output transistor (BU205) is driven from a secondary winding on the chopper transistor's load transformer. We have seen this done once before, in the Berryvision 510 chassis which was produced in small quantities during the great colour boom period. A TDA2581 i.c. provides the control actions – including overload and excess voltage protection – in the chopper power supply, the power consumption being a lowly 70W. The transistor line output stage is conventional, with a high-level diode EW modulator, and as a result of the line output stage/switch-mode power supply link the line oscillator output is taken to the power supply control i.c. One result of this is that there are two presets to control the line frequency, one in the line oscillator section and the other operating on the oscillator in the power supply control i.c.

The c.r.t. (A37-550X) is of the PIL variety, with its cathodes driven by class AB RGB output stages. The first anode is fed from a potentiometer connected in the lower end of the focus resistor chain. Complementary-symmetry class B field and audio output stages are used.

HIGH PERFORMANCE DIODE

Mullard have introduced a new diode for use as an efficiency diode or diode modulator in colour receiver line output stages. The repetitive peak reverse voltage rating of the BY228 is 1·5kV maximum, the peak repetitive forward current 10A and the total recovery time less than 20μsec.

AN ELECTRICAL QUERY

Perhaps one of our electrician readers might care to comment on a problem that both Luke and I have had with 3kW fan heaters – overheating at the mains plug, followed by blowing of the 13A mains plug fuse. Examination shows that a marked chemical change occurs at the junction of the live mains lead and the fuse, with overheating presumably due to the resultant high-resistance connection. Why this chemical change should occur – under rating or impurities in the copper? – puzzles us. A hefty dose of aerosol contact cleaner seems to have helped, but with BEAB approved appliances and plugs this sort of thing shouldn't happen. The overheating is such that we feel a distinct fire hazard exists.

ELECTRONIC PROJECTS INDEX

The Libraries and Arts Department of the North Tyneside Metropolitan Borough Council has published a descriptive guide, under the above title, to over 2,500 DIY projects published in *Electronics Today International, Elektor, Everyday Electronics, Practical Electronics, Practical Wireless, Radio and Electronics Constructor, Television* and *Wireless World*, covering the years 1972-77. Good value at £1·50 for 1-2 copies (discounts are available for larger quantities) including post and packing from M. L. Scaife, Central Library, Northumberland Square, North Shields, Tyne and Wear, NE30 1QU. Telephone enquiries can be made to North Shields (08945) 82811. There are 113 large pages.

JAPS HALT TV EXPORTS TO THE USA

In our opening item we commented on the increasing price differential between UK and Japanese produced TV sets. The rise in the value of the yen seems to be having a similar affect in the US market. Toshiba have ended colour set exports to the USA, and will be doubling the capacity of their Memphis, Tennessee plant instead. National Panasonic, Sanyo, Sharp and Hitachi are understood to be contemplating similar action.

PEOPLE

Ingertone Ltd., used TV set wholesalers, inform us that Rajinder Singh Verdi (Roger) has been appointed general manager and a director of the company. Mr. Verdi has been in the industry since leaving school and has been associated with Ingertone Ltd. since it started operating.

We regret to announce the death of F. J. Tommy Tomlin, chief research engineer of Antiference. Tommy Tomlin had been with Antiference for 27 years, and was responsible for many important developments in TV aerial technology.

Letters

TRANSLATED SERVICE DATA

In the December issue Les Lawry-Johns reported difficulty in identifying a component from a *Trader* service sheet when servicing a Finlux Peacock colour set. Having at last found the offending component, which was incorrectly labelled on the p.c. board diagram, he made a note to amend the service sheet.

Good. At least, as the service sheet's writer, I know that someone has examined it in detail. But I wonder if Les realised the amount of eye-straining research and head-scratching that was required to get the sheet nearly correct – for 100 per cent correct no service sheet ever is or can be.

The original service data provided by the Finnish maker was not only difficult to follow due to the circuit having been reduced to minuscule proportions, but there were also many differences between the p.c. board diagrams, the circuit and the actual set, one of which I had to work with. Also, the instructions were in what I can only refer to as "Finnglish".

Those of us who have spent many years as Technical Authors and Journalists know only too well the extraordinary and sometimes comical statements and errors that crop up in makers' service manuals, especially those originating from Europe and the Far East. Even overlooking the problems of translation, one wonders whether the original native language writer really knew what he was writing about. The problem is not confined to service manuals – equally hairy howlers appear in user instruction books and even in publicity brochures – and in press handouts!

I can personally remember a brochure which proudly announced an amplifier frequency response of *minus* 25Hz to 25kHz, and a record player which could actually distinguish automatically between "12 inch and 1 inch records" (I wonder where the label went?). I also recall the portable set booklet which advised the new owner to "first insert four HP2 batteries in your rear" (hmm . . .).

To a large degree the makers themselves are to blame, for not only do they frequently rely on outside agencies of dubious technical ability to produce their literature, but, failing that, delegate the job hurriedly to some hapless junior engineer to carry out in his "spare" time. Good engineers who have had no technical authorship training rarely produce good manuals.

Translated manuals appear in three "languages": "Minglish" (Japanese English), "Conglish" (Continental or European English) and "Yankish" (US English). The first two suffer mostly from translation problems, while the third presents the problem of differing terminology ("ground" for "earth", etc). This is further confounded by the fact that many items of Japanese equipment are of US design and specification, so that the instructions and manuals are in a combination of Yankish and Minglish.

Then there's the use of idioms. Both Far Eastern and European writers try to express English servicing terms literally, without actually understanding their meaning. Here are a few examples:

"Set the set to the south and soak it for ten minutes." (Stand by to replace fuses!)

"It is forbidden to remove the picture tube unless properly attired." (A suit of armour, or morning dress? – that one was from a Russian manual.)

"Release the field hold, let the blank part appear on the screen, and stand still as possible you can." (Believe it or not, this is part of an instruction on how to set up the preset brightness.)

My favourite concerns a tape recorder instruction on setting up reel spool shafts:

"If your thruster is wobbling it is being improper."

These are translation and idiom errors – the factual ones are less humorous and very frustrating.

Apart from reducing diagrams to illegible proportions, as I said before, not checking them against p.c. board diagrams (presumably because the writer has not kept up to date with drawing office mods), there are also those instructions written by an engineer who has not actually tried to perform them. He lists adjustments in an impossible sequence, tells you to turn pots that aren't there, and very rarely tells you how to get at them, but expects you to search for them on his tiny diagram, mentally transfer their location to the set itself, which may or may not resemble the diagram, and then adds insult to injury by telling you afterwards to hang about three lots of instruments on various inaccessible, so called test points and read them all off together.

Comparatively rarely does the manual writer tell you how to get that heavy awkward chassis out of its wooden box without either wrecking something or ripping off vital wires, or how to reach that internal carefully concealed part without virtually disembowelling the chassis.

So the next time, Les, you curse a trade journal's service sheet for a mistake, just thank your lucky stars you didn't have to interpret the original maker's manual!

Mike Lewis, FSERT, FISTC,
Electrical and Electronic Trader.

Methinks thou doest protest a little too much! We wouldn't have bothered over some minor technical inconsistency. But the two resistors mentioned were wirewound ones (rated at 55W and 35W) in the h.t. supply circuit, just the ones most likely to give trouble. So it was important to draw this error to readers' attention, especially as the Finlux Peacock is an unusual set in some respects – one of the earliest in Europe to feature a thyristor line output stage, operating in conjunction with a thyristor regulated power supply to boot. As regards differences between actual sets and official data, it is of course common and accepted practice for setmakers to introduce production changes.

It's simple, harmless fun to draw attention to defective translations into English. I sometimes wonder however what howlers get into English technical material translated into foreign tongues. As a nation, we're not all that hot at languages (the world after all is *supposed* to be able to speak English, we've spent long enough trying to teach 'em!). There is however a problem in finding people who have both the technical and linguistic knowledge required to translate technical material accurately, though why translations seem to be so seldom checked by someone technically competent is a bit of a mystery. – *Editor.*

RENOVATING COLOUR RECEIVERS

I read with interest Mike Phelan's recent article on reconditioning colour receivers, but would like to make one or two points regarding reliability. I've had many years' ex-

perience in renovating such sets, my favourites being the Pye hybrids, and I usually adopt the same course described by Mike Phelan, going through each panel one at a time and ending up with a good set for sale. Sets of this age still aren't as reliable as their modern counterparts however. The famous bathtub curve plotting the reliability of electronic equipment against time shows that failure rates are at maximum during the burn in and wear out periods. It seems to be generally accepted that the average useful life of a colour receiver produced during the early seventies was approximately six years. Despite preventive maintenance and replacing all the stock fault components on each panel, most of the receivers I've sold have had an average failure rate of once approximately every thirteen months. I can confirm this from the service records I keep on each set. So, when selling renovated receivers you must still expect problems despite all the hard work put into renovation.

Good grey scale, convergence etc. can be achieved, but the tube has usually lost some of its emission. The rest of Mike's article is excellent, and I'd say he sums up the renovation process admirably. The only other point I'd add is that the secondhand set market can be very profitable indeed, especially if you work for yourself and hit one of those thumb-twiddling periods waiting for the phone to ring.
P.G. Dixon, MRTS,
Crawley, Sussex.

YOUR PROBLEMS SOLVED

On re-reading the problems section in the September issue I came across a letter describing a fault which both I and a colleague came across recently, i.e. a confetti line two-thirds from the right, running vertically, *or* a pink band 2in. wide, hum on sound and the picture shimmering all over, giving the appearance that the i.f. alignment was a mile out (Pye 697 chassis). In both cases the fault turned out to be due to internal arcing – not visible – in brand new Mazda PL509 line output valves.

Another nasty fault we recently encountered on this chassis was complete lack of brightness, with –60V at the c.r.t. grids instead of 60V. All the voltages around the PL802 luminance output valve and at the grids and cathodes of the PCL84 triode clamp stages were correct. The problem was eventually traced to a defective 300μF h.t. smoothing electrolytic, as a result of which there was 70V of ripple on the h.t. line. No other symptoms were observed.

I hope these comments will be helpful to anyone else faced with these problems.
D. Jefferies,
Halesowen, W. Midlands.

VINTAGE GEAR

I was interested in Ian Sinclair's article on the Murphy V200 in the January issue. I too have the original service manual for this set, fortunately in almost mint condition, which is more than I can say for the receivers. I used to have both the console and table models, and a couple of spare chassis, and I managed to keep them going – one at a time – for a number of years.

To improve the usefulness of the V200, I ran it from a linked pair of Sterling Band III converters (mentioned by Chas E. Miller last August). This gave switchable channels 1, 6 and 9 for BBC-1, Anglia TV and London ITV. I boosted channel 9 using an equally elderly Apex valve aerial preamplifier.

I still have one of the Sterling converters, while the Apex casing now houses a coaxial relay for remote switching between two u.h.f. aerials. I ditched the last of the V200 chassis only last August! How about the Murphy V240 next: I still have one of these, with the original service manual.
Martin K. Thompson,
Biggleswade, Beds.

EXPERIENCES OF A REP

As a representative selling electronic components, I've gathered some strange and funny stories. One of the funniest concerned a customer in the potteries. Two weeks earlier, he'd bought a pair of very expensive sidecutters from me. Whilst showing a colleague how good they were, he proceeded to pick up a length of twin cable and cut it. You've guessed it: shorting out the mains didn't exactly do his new sidecutters much good. At a later date, I was asked if I'd change them!

I'm still amazed at the number of experienced servicemen who cut out shorted mains filter capacitors and don't bother to replace them, though I can't say I'm familiar with the reason for their presence – my interest is in selling them!

A while ago I called on a Thorn dealer customer of mine and noticed a GEC colour set on his bench (a C2110 series set). On asking what the fault was, he told me that the sound wasn't right. Having just come from another customer who was working on the same set with the same fault and had ordered some zener diodes off me, I told him what I knew. To cut a long story short, he borrowed a zener from my sample case and tried it. After switching on again the sound came booming out and he ordered a couple of packets for stock. Two weeks later the same customer greeted me with a helpless expression on his face. When I enquired after his health, he asked me into the back. There was another C2110 on the bench. When I looked blank he said "you're the GEC expert, aren't you" and proceeded to describe the trouble (no line scan). I keep my big mouth shut now.

A subject that does annoy me is ionisation-free disc ceramic capacitors, which most engineers seem to regard as being 12kV working types. As far as I know, the vast majority are marked 12kVT, which means that they're tested at 12kV. So please ask for 8kV types in future, i.e. 8kV working.

One component that generates a lot of interest, though for different reasons, is the 352 series of Mullard capacitors. The old number C280 is probably better known to engineers as the liquorice allsorts type. I'm always told that the colour code is not known but must disagree, the code having been used for years. Reading from the top, i.e. opposite the leads, the first three colours read the same as the standard resistor colour code, e.g. black-brown-yellow is 100nF (100kΩ) or 0·1μF; yellow-mauve-orange is 47nF (47kΩ) or 0·047μF. The two lower colours indicate tolerance and voltage. Mullard in fact publish small cards showing these colour codes etc.: why not ask your representative for a copy?
Clive R. Dempster,
Tamworth, Staffs.

Editorial comment: The mains filter capacitor, connected across the mains input to a TV set, is there for two reasons. To prevent interference generated by the set passing out into the mains supply, and to protect the receiver against high-voltage transients on the mains supply. Though removing it produces no noticeable effect, it's clearly bad practice to do so. The sound problem mentioned on the GEC C2110 series is due to the 24V zener diode D603, which stabilises the supply to the audio i.c.

The Körting 20'' Colour Receiver

John Coombes

THE Körting 20in. colour receiver was one of the first sets to appear on the UK market fitted with a PIL in-line gun c.r.t. (type A51-160X or A51-162X). It's an all solid-state chassis, with a thyristor line output stage. The construction consists of a large number of plug-in sub-panels mounted on the main mother board. To assist in servicing, the plug-in panels can be removed from the component side of the chassis and plugged in on the print side instead, making voltage checks and adjustments much easier.

There are two protection circuits. One, in the h.t. rectifier circuit, comes into operation in the event of a short-circuit in the line output stage commutation circuit. This results in a tripping action at a frequency of approximately 2Hz. If the fault persists, one or other of the two mains fuses eventually blows. The other protection circuit is on the power supply regulator board and shuts down the 12V l.t. supply in the event of excessive e.h.t., an overload in the line output stage such as shorting turns in the output transformer, or excessive beam current due to a faulty e.h.t. tripler, defective RGB output stage, etc. The 12V supply is restored if the set is switched off and then on again after a brief period (at least one second), the trip operating once more if the fault is still present. This latter protection circuit can be made inoperative to assist in servicing.

Mains Input Circuit

The mains input circuit is shown in Fig. 1. One of the most common faults here is a blown fuse. Usually the cause is a short-circuit mains filter capacitor (C690). There are other possibilities however: the mains rectifier thyristor Th601 and its series protection diode D601 can both go short-circuit, as can the decoupling capacitor C601. These components are all mounted on the mains panel.

The use of a thyristor as the mains rectifier is associated with the excess current protection circuit. C603 and R602 couple the mains a.c. input to the thyristor's cathode gate, so that it conducts on the positive-going excursions of the mains waveform. The output is developed across C606a and is smoothed by R606/C606b. In the event of excess current demand, due to a short in the line output stage commutator circuit, the voltage at the junction of R606/C606b and consequently at the base of the pnp transistor T601 will decrease. As a result T601 will conduct, shorting the thyristor's cathode/cathode gate so that it no longer conducts. As the circuit voltages fall, T601 will switch off and Th601 will conduct again. The circuit will continue to trip and if the set is left in this condition one or other mains fuse (Si1/Si2) will blow.

A simple way to check whether the mains rectifier thyristor is in order is to short the service point pair "S": this should

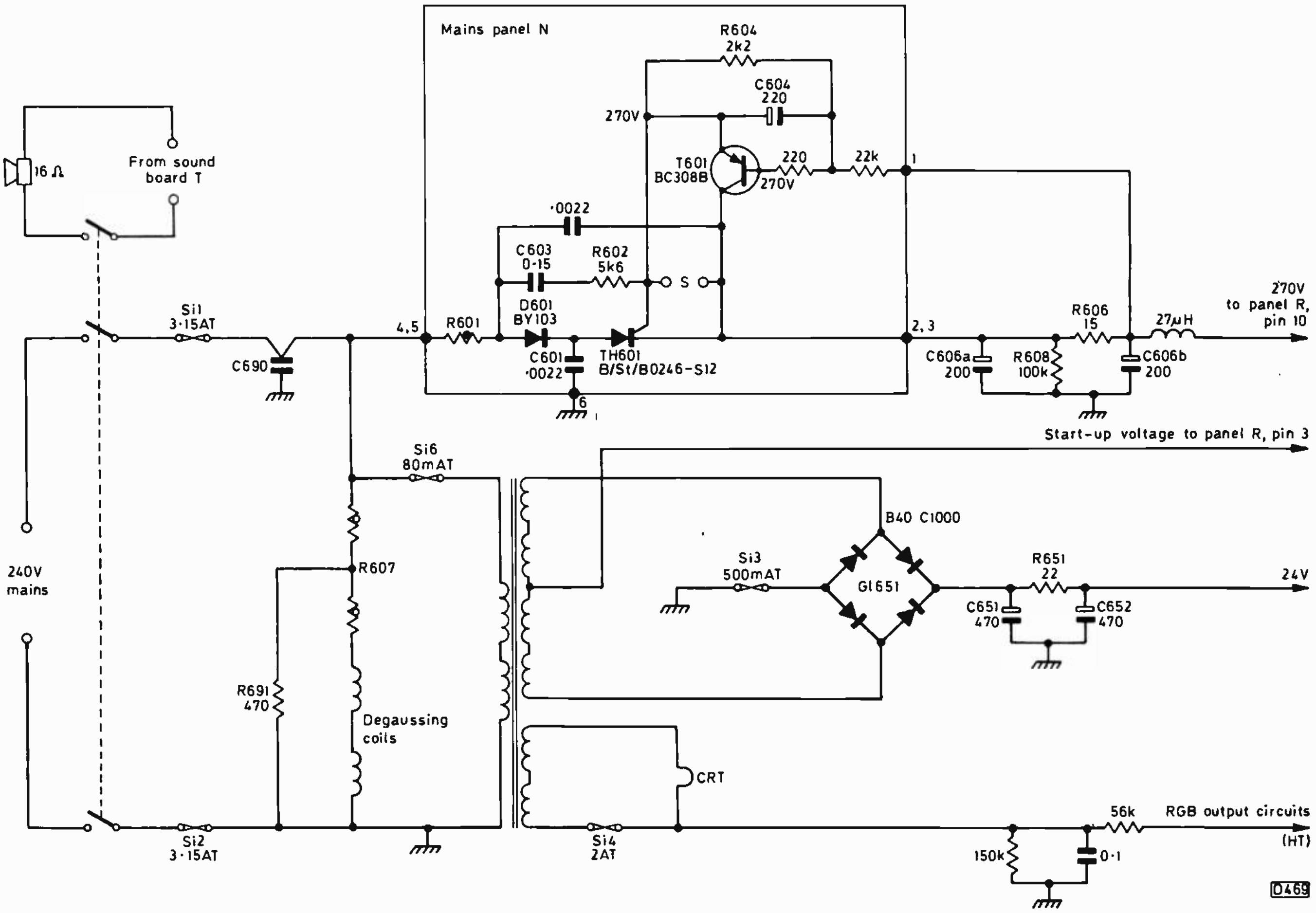


Fig. 1: The mains input circuitry, including the excess current trip on panel N.

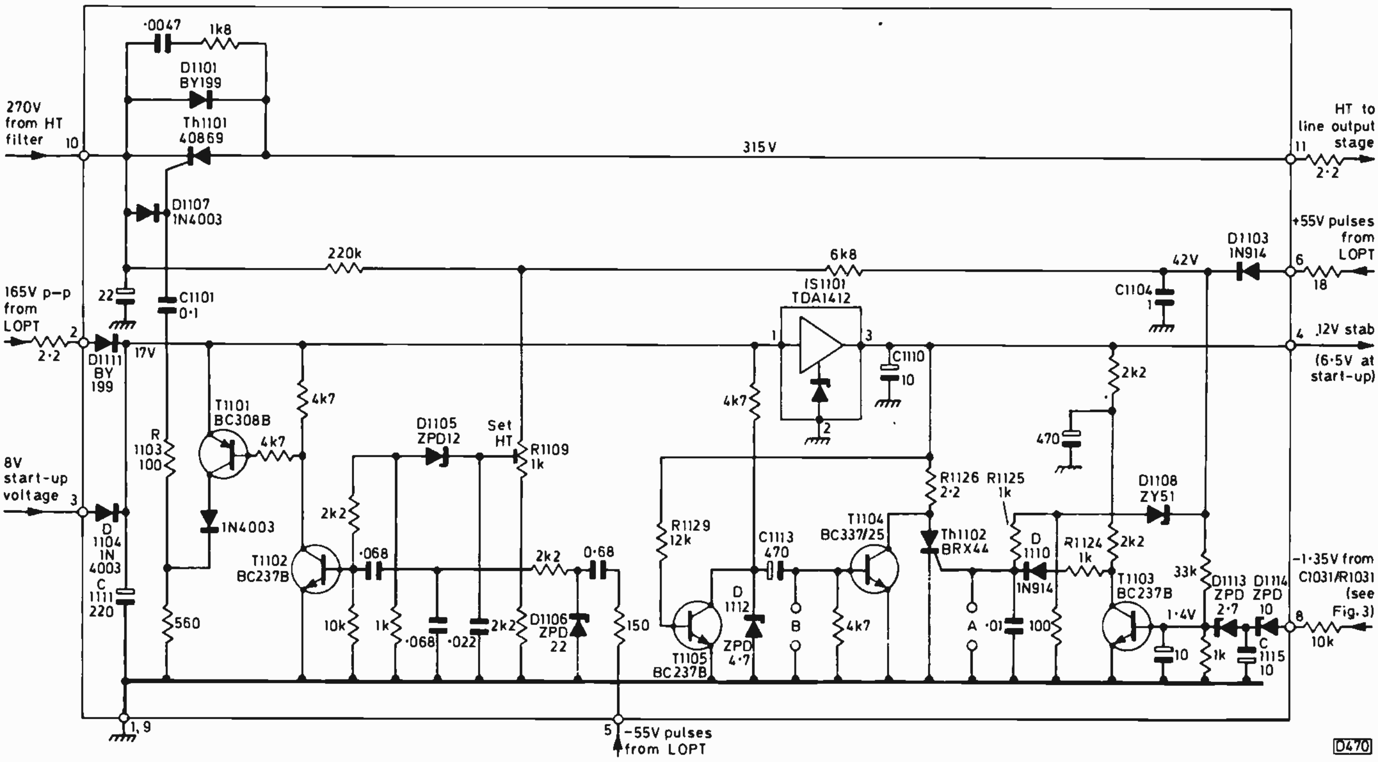


Fig. 2: Circuit of the regulator board (R), including the external feeds. The board incorporates the 12V regulator IS1101, the width stabilisation circuit T1102/T1101/Th1101, the slow-start circuit T1104/T1105 and the electronic trip circuit T1103/Th1102 which removes the 12V supply in the event of excessive e.h.t., an overload in the line output stage, or excessive beam current. Excessive e.h.t. means excessive pulse voltages in the line output stage: should the 42V line provided by D1103/C1104 rise to 51V, the zener diode D1108 will conduct firing Th1101. Excessive h.t. or a fault in the width stabiliser circuit can lead to excessive e.h.t. If there's an overload in the line output stage, e.g. shorting turns in the line output transformer, the pulse voltages will fall. If the 42V line falls below 21V, T1103 will cut off and the pulse at its collector will fire Th1102. Excessive beam current – due to a defective tripler or a fault in the tube or the RGB output stages – will result in the voltage across R1031 in the e.h.t. current chassis return path increasing. At 5mA beam current zener diode D1114 conducts, charging C1115 negatively. As the charge increases, D1113 conducts and T1103 cuts off, again firing Th1102.

result in the h.t. falling to zero. A defective thyristor can result in the h.t. supply rising, so that the regulator panel trip operates, removing the 12V supply.

The only trouble we've had with the mains transformer is its tendency to vibrate, resulting in an annoying buzz. There are two secondaries. One feeds a bridge rectifier which produces a 24V line: it also provides a start-up voltage which is fed to the starting diode D1104 on the regulator panel. This starting voltage is approximately 8·5V. The other secondary feeds the c.r.t. heater, and is fused by Si4. When this blows, there's no picture of course. Replacing the fuse will usually restore the picture – the fuse seems to blow occasionally due to flashovers within the tube.

Regulator Board

The circuit of the regulator board is shown in Fig. 2, including the electronic trip protection circuit. Thyristor Th1101 is used to stabilise the width. It's anode voltage is higher than its cathode voltage, and it's fired just before the commutating circuit in the line output stage comes into operation to initiate the line flyback. When Th1101 is fired, surplus charge on the flyback tuning capacitors in the line output stage is returned to the h.t. filter circuit. The firing of Th1101 is varied to provide the width stabilisation action. Briefly, a line-frequency sawtooth is applied to the base of T1102, which conducts at a point along the sawtooth. The d.c. conditions at the base of this transistor depend on the h.t. voltage, which varies with changes in the mains voltage, and the amplitude of the line flyback pulses. Variation in the mains supply or the e.h.t. thus moves the sawtooth at the base of T1102 up or down, so that it conducts earlier or later to provide the stabilisation action. The pulse it produces when it conducts is fed to the cathode gate of Th1101 via the buffer transistor T1101.

A stabilised 12V supply is provided by the i.c. stabiliser IS1101 (TDA1412). When the set is first switched on, this i.c. is fed with an 8·5V start-up voltage and produces sufficient output voltage (about 6·5V) to get the line oscillator working. Once the line output stage comes into operation, D1111 produces 17V across C1111 by scan rectification. Over-voltage etc. protection is provided by firing the crowbar thyristor Th1102. Transistor T1103 or diode D1108 fires Th1102, sampling the conditions previously mentioned. Transistor T1104 provides a slow-start action, shorting out the 12V line until C1113 in its base circuit has charged. When this occurs, the 12V supply appears and T1105 is biased on via R1129, ensuring that T1104 remains cut off.

If there's no raster or sound and the voltage at pin 4 of the regulator panel is very low, over-ride the protection circuit by linking service pin pair A. If the voltage then rises, there's a fault in the line scan/e.h.t. circuit, the width stabilising circuit or excessive beam current. If the voltage remains low or is absent, the most likely suspect is the regulator i.c. IS1101.

The Line Timebase

Probably the most common fault in the line output stage is a defective tripler (type TVK52). This can go faulty in several ways. An open-circuit diode for example will result in no e.h.t. This can be confirmed by checking the e.h.t. and, if absent, then checking the voltage at tag K on the line output transformer (unsolder the lead to the tripler and use a long-probe e.h.t. meter). About 8·4kV should be recorded here. Sometimes however the diodes or capacitors in the tripler go short-

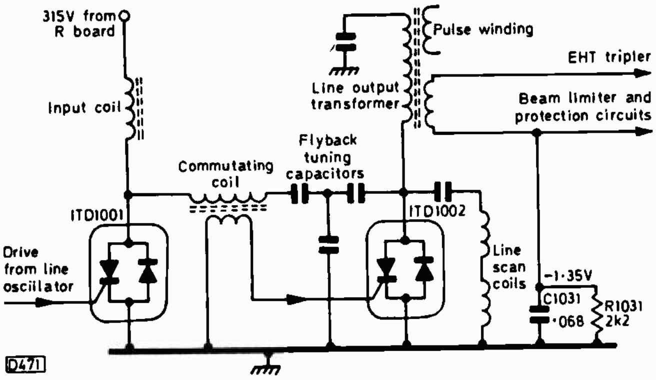


Fig. 3: Simplified circuit of the line output stage.

circuit. If this doesn't result in the electronic trip protection circuit operating, the result will be overheating leading to breakdown of the insulation and e.h.t. tracking to chassis. This can be a frightening symptom! Tracking can also be due to dampness around the final anode connection – a condition that can be encountered on any make of set. The remedy is to discharge the tube and wipe off around the tube connector with a dry cloth. It may also be necessary to use an aerosol spray which prevents damp. This sort of fault is more common in winter, often because the set is next to a window and/or there's a paraffin or gas heater in the room.

Another common line output stage fault is poor focus or even intermittent focus. The usual cause is the focus VDR R1032. It can break at the ends or where the slider is in contact with the rod, or it can start to flake along its length, eventually breaking in pieces. Other causes of poor focus are the 1MΩ series resistor R1210 on the tube base panel and the associated spark gap KA7.

If there's no raster, switch the set off and connect pins 10 and 11 on the regulator panel. This renders the width regulator circuit inoperative, and as a result the line output stage will work at reduced power. On switching on therefore there should be a raster with reduced scan if the line output stage is in order, indicating that the fault is in the width stabilising circuit. If there is no raster on switching on again, check the l.t. voltage at pin 4 on the regulator panel. Low voltage here could be due to the 12V regulator, or to operation of the electronic trip due to a fault in the line output stage (see Fig. 3) or excessive beam current.

A common fault in the line output stage is failure of either the scan thyristor (ITD1002, type BT129/750R) or the flyback thyristor (ITD1001, type BT128/700R) – note that the associated diodes are encapsulated with the thyristors. They can go short-circuit or open-circuit. Let's summarise the possibilities. If the flyback thyristor goes short-circuit, the excess-current protection circuit operates. If the flyback thyristor goes open-circuit, or the scan thyristor goes open- or short-circuit (simply earthing the flyback tuning capacitors), there are no results and the voltage at pin 4 on the regulator panel remains at about 6·5V (the start-up voltage). The voltage at pin 4 of the regulator panel will also remain at about 6·5V if the line scan coils are open-circuit – since there will be no resonant action in the line output stage. The voltage at pin 4 on the regulator panel is a key test on this chassis therefore. If you're lucky, open-circuit scan coils can be repaired – otherwise, or in the event of shorting turns, the tube will have to be replaced.

We've also had to replace several line output transformers. Faults have included shorting to the core, shorting turns, and breakdown of the insulation. We've also had dry-joints on the pins which penetrate through the paxolin board and are then soldered to the printed circuit.

To set the line oscillator, connect pin O1 on the line oscillator module (O panel) to chassis, then adjust the line frequency control R440. Loss of sync or no oscillation is usually due to the TBA920 sync separator/line oscillator i.c. (IS401).

Field Timebase Faults

The field timebase – and the raster correction circuitry – were described in the May 1976 issue of *Television*. The field timebase faults we've had have been simple enough: no field scan due to defective field output transistors (T351 and T352, both type 2N3055/5-6); lack of height due to a defective height control (R335, 100kΩ); and the picture flicking in and out of correct linearity due to defective linearity controls (R329, 10kΩ, or R344, 250Ω). The linearity controls can also be responsible for bottom cramping and/or expansion at the top of the picture.

Defective Tubes

We've had to replace several tubes in this set. The usual symptom is a completely purple or very pink picture, though we've also had the odd green and blue picture due to loss of red gun emission. Before condemning the tube however the RGB output stages should be checked. If the tube has to be replaced, it must be returned complete with the scanning yoke and the magnets. Before returning it, remove leads with plugs and R366 and R367 which are connected in parallel with each other in series with the field scan coils. These resistors do not come with the tube, and without them it's difficult to adjust the height.

Service Switch

The service switch makes setting up the grey scale easy. A normal picture is obtained when the switch is in the centre position; in the right-hand position there's a blank raster for setting up the RGB gain controls R257/R255/R251; moved the other way the switch gives field collapse so that the grey-scale controls R857/R855/R853 can be adjusted for the correct black levels.

Signal Faults

Loss of one colour, or an all red, green or blue raster, is generally due to the appropriate BF459 output transitor going open- or short-circuit respectively. Open-circuit gain controls can also be responsible for loss of one colour. Another cause of loss of one colour, sometimes intermittent, is a defective matrixing/preamplifier i.c. – the TBA530 (IS803). It can be difficult when the i.c. is intermittently faulty, but a spray of freezer helps. Unfortunately a faulty tube can also be the cause of an all green, red or blue raster: checking the tube base voltages will show whether the fault is due to the tube or its drive circuitry.

There are three other i.c.s in the decoder, which is of the Philips/Mullard four-chip type. The TBA560 i.c. IS701, which is on a separate panel, provides luminance and chrominance signal processing. The TBA540 i.c. IS802 provides the reference signal, while the TBA990 i.c. IS801 demodulates the chrominance signals.

The TBA560 can be responsible for loss of colour, loss of luminance, or the colour flicking on and off. The loss of colour or luminance can be intermittent. The TBA540 i.c. can also be responsible for loss of colour.

The main tuner faults we've had are loss of oscillation due to a defective AF267 oscillator transistor, and the odd press button breaking due to the plastic splitting. The tuner can also be responsible for intermittent loss of colour, the picture intermittently flicking, or in some cases an intermittently grainy picture – generally due to dust or dirt on the carbon preset track of the press-button assembly.

The sound panel has two i.c.s, a TBA120S (IS501) intercarrier sound i.c. and a TBA800 (IS502) audio i.c. No sound or intermittent sound can be due to the TBA800, but before condemning it check the pin voltages carefully. The TBA120S can be responsible for poor sound or intermittent sound.

I've found that the neatest way of removing faulty integrated circuits is to use the Philips desoldering device, which removes them in minutes leaving a nice, clean set of holes in the solder on the printed board. It's particularly useful in the field.

Loss of volume or sound can also be caused by a faulty volume control (R2075). It's a slider control and can be cleaned using a contact cleaner aerosol, but replacement is better. The speaker is also responsible for its share of sound faults – loss of sound, intermittent sound, or distortion due to a misaligned cone. Loss of or intermittent sound may be due to one of the pigtails being broken – the pigtails can also be responsible for the sound going off and coming on again in loud bursts.

22in. Model

The same basic chassis, with the addition of a convergence control bank, is used in a 22in. model fitted with a delta-gun tube. ■

Video Notebook

CCTV Camera Faults

The following rather peculiar fault was experienced with an Hitachi HV40S CCTV camera fitted with an RCA silicon diode tube. This type of tube needs a large range of f adjustment, so the camera was fitted with an auto-iris lens. The contrast could be accurately set, but on a change of ambient light the tube was being over driven (flaring on highlights). Two further lenses were tried, both with the same results.

The conclusion reached was that the camera's auto-target control circuit (a kind of a.g.c.) was faulty, with the lens over-compensating for the fault when the lighting changed. With an auto-iris lens, a circuit samples the mean video signal amplitude, then sets the iris accordingly. An auto-iris preset control is provided and, once set, all levels are referred to this. The fault was eventually traced to 1C18 being leaky, giving poor d.c. restoration and in consequence poor auto-target action. Replacement effected a complete cure.

Another HV40S we came across recently gave no picture, though there was noise when the gate of the f.e.t. video amplifier was touched and all the tube voltages were present. Oh dear! This one had to be cured by fitting a new tube. **A.D.**

Baird 8201 VCR

Our establishment has some students doing HNDs and ONCs at the local polytechnic on "industrial training release" in our workshop. They've done part of a theoretical course when they come to us for experience of what happens in real life. This can, and does, lead to some interesting situations . . .

A Thorn 8201 VCR (that's the composite video in/out, no tuner, no timer, no modulator version of the Philips N1500) came into the workshop with the complaint that the "threading mechanism doesn't thread and this large spring has fallen out!" One of the students was given the problem to sort out, and sure enough on plugging in the lace up mechanism kept oscillating on and off. A closer examination showed that the large spring was part of the tensioning mechanism concerned with the lace up, and when it was replaced the machine threaded perfectly. Problem solved, and student feeling quite happy.

When the case was replaced however the VCR still laced up but gave no sound or video output. The somewhat perplexed student removed the lid, when all was fine again. Quite correctly, he started to replace the case a bit at a time, watching to see what happened. The VCR carried on working perfectly, and by this stage perplexity was turning to confusion. The case had been dismantled and carefully reassembled: as the main lid was dropped on, the VCR ceased to function.

At this point I was dragged in and we went through the same rigmarole, again with the same results: the video and sound outputs went completely dead when the lid was on, appearing fine as soon as it was removed. Most odd. What had we missed?

Ah, the audio/video meter bulb L4 went out when the lid was on, and at this point another light lit up in my head: the meter is held in place in the lid by means of a nasty spring wire clip, supposedly covered with insulating plastic to prevent accidents. What had happend was that the insulation had been damaged, setting up a high-resistance path (but not a dead short) across the bulb's terminals. This was just enough to shut the 12V supply down, but not to cause the 3·1A fuse Z101 in the power supply to blow. Thus the 12V supply was removed, though the tape transport system still worked. The sleeving was replaced with some stouter stuff, and the VCR went back to its owner. As the student said, "I prefer theoretical classes to that!" **D.K.M.**

Philips N1700 VCRs

Here are one or two official Philips notes on the N1700 VCR. In the event of transistor TS76 on the friction motor control panel 7 failing, the associated zener diode D85 (BZX75 C2V1) in its base circuit should also be replaced. If the machine is used in close proximity to a colour receiver, the tape servo system may pick up field timebase and/or thyristor pulses from the receiver. An improvement can be effected by making the following changes on the power supply panel 11. Disconnect the inner and outer connections of the screened lead to pin 3 of plug 1. Then cut the print track close to the negative end of C124. Reconnect the screened lead with the inner to the negative end of C124 and the outer to the chassis end of R133 at the edge of the panel. This change does away with the use of a length of printed track crossing the panel.

In a few cases the screw securing the cleat holding the leads to the head amplifier to the underside of the chassis is too long, with the result that the lower drum can catch on it. If this trouble with the threading action is experienced, check the length of the screw and if necessary replace with an 8×3mm. type.

Modern Tuning Techniques

Part 1

Harold Peters

"There are more electronics in the front end of a modern teletext set than there were in the whole of South East England before the War" – Bernard Rogers, RRI.

One result of certain recent developments in integrated circuits and other components is that the front end has suddenly become the most complex part of a television set. It has become a specialist section in fact, and the one which at the moment is the least understood.

These notes, an attempt to redress this imbalance, are aimed at the engineer or enthusiast who has spent much of his time on what is now called the "analogue" section of the set, and who finds that the events "up front" have outpaced him. Because it means starting all over again, like we did when transistors first appeared on the scene, explaining modern front ends is best tackled by going back to see how they evolved, discussing the separate sections – the "building bricks" – and then looking in as general way as possible at a few examples of modern techniques. After that you can, if keen enough, go deeper into the individual systems which affect or interest you most. By then the set maker's manual will hopefully make a little more sense.

Historical Background

About nine years ago the first varicap tuners were introduced in the UK. Until recently they have hardly changed, while virtually ousting all other types of tuner. Varicap tuners cover Bands IV and V by means of a varying voltage of between 0V and 30V. From the setmakers' point of view this means that at long last the tuner need not be on the control panel, or be attached to any mechanical moving parts. It was a short step on from this to produce a handset on a length of multicore cable so that channels could be changed from the chairside. Dynatron were one of the forerunners in this field, and their first remote-control, varicap-tuned set gave the choice of four channels and the ability to vary volume, colour, and brightness.

The next significant step forward was the "touch tuner", where finger moisture is used to close a contact to a section of an i.c. (or to bias a transistor) which latches on and presents a predetermined voltage to the varicap tuner. This then promptly selects the chosen channel.

Once a channel could be selected by such a very small current, it became possible to cause this to happen by means of a cordless remote control system, expressed in its simplest terms by the "pinger" on the Philips G9 series chassis. Here the handset simply contains a small ultrasonic tuning fork which resonates at about 40kHz when plucked, which happens when you press the button. A microphone in the TV set picks up the "ping", amplifies it, and applies the pulse thus derived to a common resistor on the touch tune i.c. Pulsing this resistor clocks the latch in the i.c. round from one channel to the next. Other simple handsets generate their ultrasonic signals by means of a battery, transistor, and transducer, and usually include sound muting as well as channel changing.

It was at this point that people like me lost their will to keep up with the pace of events, as a multitude of remote control systems of ever increasing complexity invaded the market. The "Golden Age" of TV seemed to have ended, and all the set makers seemed to need some sort of gimmick in order to maintain their share of the market. So we find ourselves with ultrasonic and infra-red systems, with facilities not only for adjusting the brightness, volume and colour, but also for sound muting and turning the set off to a standby position – when only the remote control receiver is left working so as to be able to tell the set to come on again.

The modern system takes all these demands in its stride, and often throws in a "granny button" as well so that when the user has got into a right tangle with all these variables the set can be made to revert instantly to average brightness, colour and sound. Just as a semblance of stability seemed to be creeping in, along comes Large Scale Integration (LSI) – the ability to compress circuits of unforeseen complexity into a single chip.

LSI arrived on the TV scene just in time to satisfy the needs of two communities: here in the UK, where we wanted to add sufficient controls to the handset to operate teletext; and in continental Europe, where the grass is always greener on the other side of the border and the choice of six channels is not considered to be enough. The ability to select more from the armchair, or even to tune right through the bands, is attractive to Europeans. In some areas system switching is also needed, as there are positive vision modulation, a.m. sound, Secam colour, and 819 lines to contend with.

The latest systems do the lot, and to understand their operation stretches one's comprehension. It's best to tackle the subject by breaking the whole system down into smaller units, understanding each of them in turn. We'll start with the varicap tuner.

Varicap Tuning

If a reverse voltage is applied to a semiconductor diode, no current flows and a charge develops at the junction. The result is that the device appears to be a capacitor, whose capacitance can be varied by altering the applied voltage. The varicap diodes used in TV tuners typically change from 10pF with no voltage (or nearly so) applied, to 2pF with 30V applied. The higher the voltage, the less the capacitance. The lowest Band IV channel is number 21 (471·25MHz) and the highest Band V channel number 68 (847·25MHz). The circuit is arranged therefore so that about 0·5V tunes in channel 21 and say 28V tunes in channel 68.

The relationship is not linear (see Fig. 1). It takes a greater voltage change to tune through one channel at the top end of the band than it does at the bottom end. This explains why there is only about 0·5V leeway between ch. 21 and the band end by comparison with the 2V allowed at ch. 68.

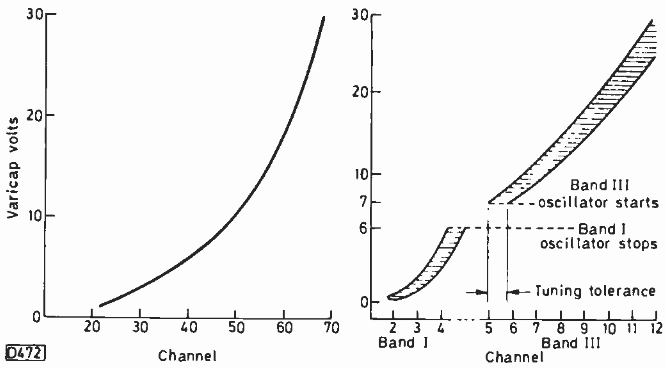


Fig. 1 (left): Relationship between the tuning voltage applied to a varicap tuner and the selected u.h.f. channel.

Fig. 2 (right): Tuning characteristics of a modern v.h.f. varicap tuner with automatic band switching. The Band I oscillator stops at a certain tuning voltage: a few volts higher, the Band III oscillator starts.

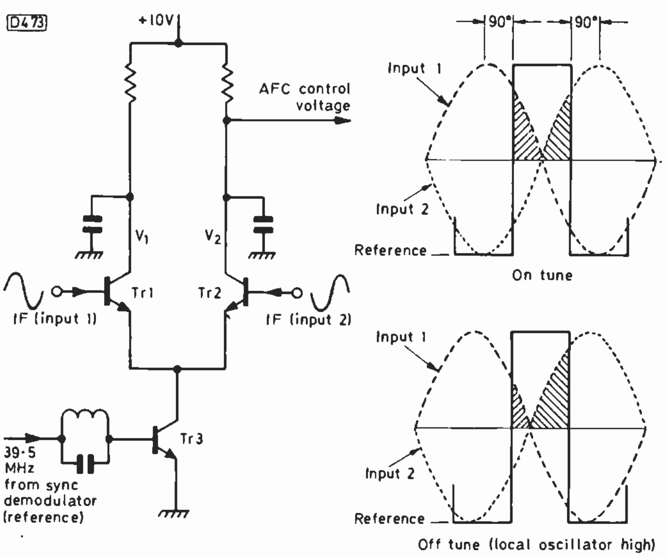


Fig. 3: An i.c. a.f.c. discriminator. Transistors Tr1 and Tr2 are fed with opposite polarity i.f. signals and conduct only when the reference pulse fed to Tr3 is positive-going. When the set is on tune, Tr1 and Tr2 conduct equally, so the voltages V1 and V2 are the same, say 5V. Off tune high, the signal appears to move to the left so that Tr1 conducts less and Tr2 more. Voltage V1 increases therefore while voltage V2 falls. The latter is used as the a.f.c. for the oscillator, returning the set to the on-tune condition.

An important point is obvious: every channel can be represented by a voltage. Every time you feed that voltage to the tuner's tuning pin, you get a particular station. Thus if your set needs 3·7162V to tune in ch. 33, every time you apply 3·7162V ch. 33 is what you will get. The entire circuitry of modern touch tuning is dedicated exclusively to ensuring that 3·7162V is applied to the tuner pin when you ask for ch. 33.

Note the precision with which the voltage has been stated. If you think I'm exaggerating, try this simple check: channels 21-31 = ten channels of 8MHz bandwidth each = 80MHz total. 3V will tune from ch. 21 to ch. 31, which is 26.6MHz per volt, or 0·0375V per MHz. Now we need to be within 100kHz of correct tuning, so the voltage to the varicap diodes needs to be within 0·00375V of the correct figure. This means that a very stable power supply is required for the control voltage line, along with automatic frequency control (a.f.c.) to pull in any variation. Details follow, but remember that these voltages are with respect to chassis and the l.t. supply. Chassis does not alter, but the l.t. voltage can and does. On some sets it is possible to detune the station by increasing the sound to the extent where the l.t. voltage falls from 12V to 11.75V.

Within the tuner, tracking is needed to make sure that all the tuned circuits alter together. Having lost his traditional split end vanes, the designer resorts to selecting his diodes in groups, sometimes introducing preset resistors in some of the diode feeds.

Before leaving varicap tuners we should mention the v.h.f. types. A lot of them use two series of wound coils to cover Bands I and III respectively. Band switching is performed by a separate set of diodes which either conduct or don't, depending upon the application of 12V to the tuner's band switching pin. This makes remote control bandswitching possible, and to add a u.h.f. tuner to complete matters simply involves taking its local oscillator l.t. supply, which is always separately pinned, to the switching centre as well.

To avoid bandswitching, some tuners have local oscillators which work in two modes – one below 6V, the other above 7V and below 30V. Below 6V the Band I tuning is in circuit, and above 7V the oscillator "flips" to Band III. There's a no man's land at the flipover point (see Fig. 2), and the tuning is somewhat cramped. Its simple and effective nevertheless.

Control Voltage Supply

The conventional means of obtaining the extremely stable voltage required is to use a zener i.c. such as the TAA550. This device and its equivalents will stabilise the supply adequately for domestic television with 2-3mA of "zener current" passing through it. To ensure that the current is constant, the zener i.c. is fed from the h.t. rail via a suitable high-wattage resistor. Six control potentiometers in parallel across the zener produce a load of the order of 270,000 ÷ 6 = approximately 47k Ω, or a current of 0·7mA which must be added to the zener current if you are calculating the feed resistor value needed. You would be surprised at the number of setmakers who get this sum wrong.

Automatic Frequency Control

The more you add to a circuit the more it's likely to drift. In considering tuners we established that 3mV or 100kHz is the maximum drift that can be tolerated if we are not to be troubled with colour or teletext faults. Now even the best of sets will, if uncorrected, detune over four times that amount in the first hour of use, so a.f.c. is essential. Its working in discrete form was outlined by E. Trundle in the February 1978 issue, but we're much more likely to meet it coming out of an i.c. since it can be easily added into the synchronous demodulator chip. Assume then that we have a synchronous demodulator happily detecting away at the standard i.f. of 39·5MHz, and that right next to it there's an identical circuit. From the detector circuit, a small amount of the reference frequency (39·5MHz) is taken and phase shifted to suit our needs. The circuit will look something like Fig. 3.

The vision i.f. signal is applied to input 1, with an inverted i.f. signal being fed to input 2. The squared-off reference frequency switches Tr3 on and off at 90° to Tr1 and Tr2. Because Tr3 is in the emitter circuit of Tr1 and Tr2, when Tr3 is "off" the other two are both off as well. When Tr3 is "on", assuming that the set is on tune, Tr1 will be on for only the first half of the period and Tr2 for only the second half. So the smoothed voltages (V1 and V2) at their collectors will be about equal.

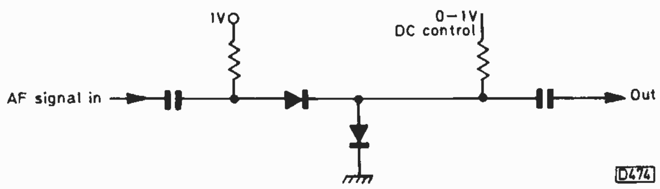


Fig. 4: A basic d.c. operated volume control. The two diodes act like a potentiometer, depending on the d.c. applied to their mid-point. At 1V the left-hand diode is non-conductive, the chassis-connected diode is short-circuit, and there's no volume. At 0V the left-hand diode is conducting and the chassis-connected diode is open-circuit: the volume is then at maximum.

If the local oscillator tends to drift upwards in frequency the i.f. will change correspondingly, and from the same starting point the inputs 1 and 2 will take less time to produce one cycle, or put another way appear to move to the left. As a result, Tr1 will conduct for a shorter time and Tr2 for a longer time, making V1 rise and V2 fall. Should the oscillator drift low the inputs will appear stretched: Tr1 will conduct more and Tr2 less, so V1 will fall and V2 rise.

To raise the oscillator frequency, the tuning capacitance must be reduced. Therefore the tuning voltage must be increased. So the V2 output is selected to add into the 30V line to pull the oscillator back. If you need to check that this figures, work out the case for a high oscillator frequency which needs lowering.

This is all very fine in theory, but in practice there are difficulties. The simplest approach is to add the control voltage from the a.f.c. circuit in series with the 30V line, but what we have not told you yet is that the a.f.c. available from an i.c. is in the order of ±5V – enough to pull in from ten channels away at the bottom end of the band and even from two channels away at the top end! The a.f.c. voltage needs to rationed out somewhat therefore, which accounts for the forbidding looking Kirchhoff networks found around the 30V line.

Another problem is the relatively high impedance of the 30V line, which lays it wide open to pick up of stray fields. C.R.T. P-band radiation for example can hop over and completely detune the set during the field flyback period. Early remote control systems which used unscreened multiway cables suffered if the cable was taken past a household gadget with a strong field ("my picture kinks when I use the vacuum-cleaner"). Complete screening being dear and unsafe resulted in the makers fitting decoupling across the line.

The trouble with decoupling is that too large a capacitor value will produce a "hang-up" on channel change. Going from a high channel to a low one quickly can be physically complete before the decoupling has discharged through the resistor network.

Because the sound channel is higher in frequency than its vision mate, the a.f.c. can latch on to the sound on the way down and produce symptoms similar to a.g.c. lockout. Modern circuits mute the a.f.c. during channel change. Provision is also made to mute the a.f.c. whilst tuning in a station for the first time. Typical ways of doing this are to fit a switch in the tuner drawer or make the button mute the a.f.c. whilst being fully held in.

If the pull-in range is greater than ±0·5MHz, the action will be asymmetrical due to the i.f. response falling off towards 40MHz, especially on weak signals. Unfortunately some modern tuning systems require a pull-in range greater than this, and means must be found to restrict the range to under 2MHz to prevent the control from settling on the response "pop-up" after the adjacent sound trap at 41·5MHz.

A novel way of doing this, and at the same time of making sure that the channel's own sound is not captured by mistake, is incorporated in the latest Philips G11 chassis. Field sync pulses are detected in such a way that their absence mutes the a.f.c. Since only the vision carrier contains sync pulses, there's thus no danger of the set latching on to either of the sound carriers just mentioned, and the only limit to the pull-in range is the "a.f.c. ratio".

This is defined as the change in carrier frequency needed to produce a unit change of i.f., and a normal figure is 10:1. In other words, if the a.f.c. has to pull the carrier in from 1MHz away, the i.f. will end up 100kHz off tune. There's nowadays sufficient swing in hand to improve on this ratio, and for normal colour use the range is sufficient to free the user from having to tune the resistors for a number of years. With teletext however, a difference in eyeheight can be seen between a set which is spot on tune and one which is being pulled in from way out by the a.f.c.

Analogue Control Functions

Before proceeding to touch tuning principles we can dispose of the analogue controls – normally brightness, volume and colour. On sets with i.c. circuitry the simple application of a variable d.c. to the right pin of the chip is all that's required. At switch on these voltages are preset to a mid-position which the setmaker thinks is just about right for normal use, or else to the position to which the user has set his control panel knobs. The former facility allows the remote control to incorporate the aforementioned "granny button" to get a muddled user back to square one as soon as possible.

If you mistrust thinking about what goes on inside i.c.s, we'll show you instead how the same result can be obtained using discrete components. This is not setting a precedent, it's simply that some i.c. innards are so involved that you have to take the designer's word for it. In the circuit (Fig. 4) the signal path is from left to right and the diodes are the sort that are fully on with 1V applied between their anode and cathode and fully off with 0V. If 1V is applied to the junction of the two diodes, the top diode is off (open-circuit) and the bottom diode is on (short-circuit). No signal can get from the input to the output therefore. If the control line feeding the diode junctions is at 0V, the bottom diode is open-circuit and the top diode short-circuit. So the full signal passes from the input to the output. If the characteristics of the diodes are gentle enough, at mid-voltage (0·5V) they will conduct equally and let half the signal through. Many variations of this circuit will be found, and its basic principle also applies to the modern pin diode tuners.

The voltages from i.c. remote control systems come in steps. Early types had about eight steps from maximum to minimum and started out at step four on switch-on. Later systems produce anything up to 60 steps, which vary by such small increments that there appears to be a continuous variation. Nevertheless there will always be some units which give an abrupt action at the top of the range or fail to extinguish the signal completely at the bottom. Investigation of these usually discloses a device tolerance spread in the i.c. being controlled rather than a fault in the remote control itself.

Remote On/Off

To make the remote control system switch the set off completely is difficult. It can also be highly dangerous.

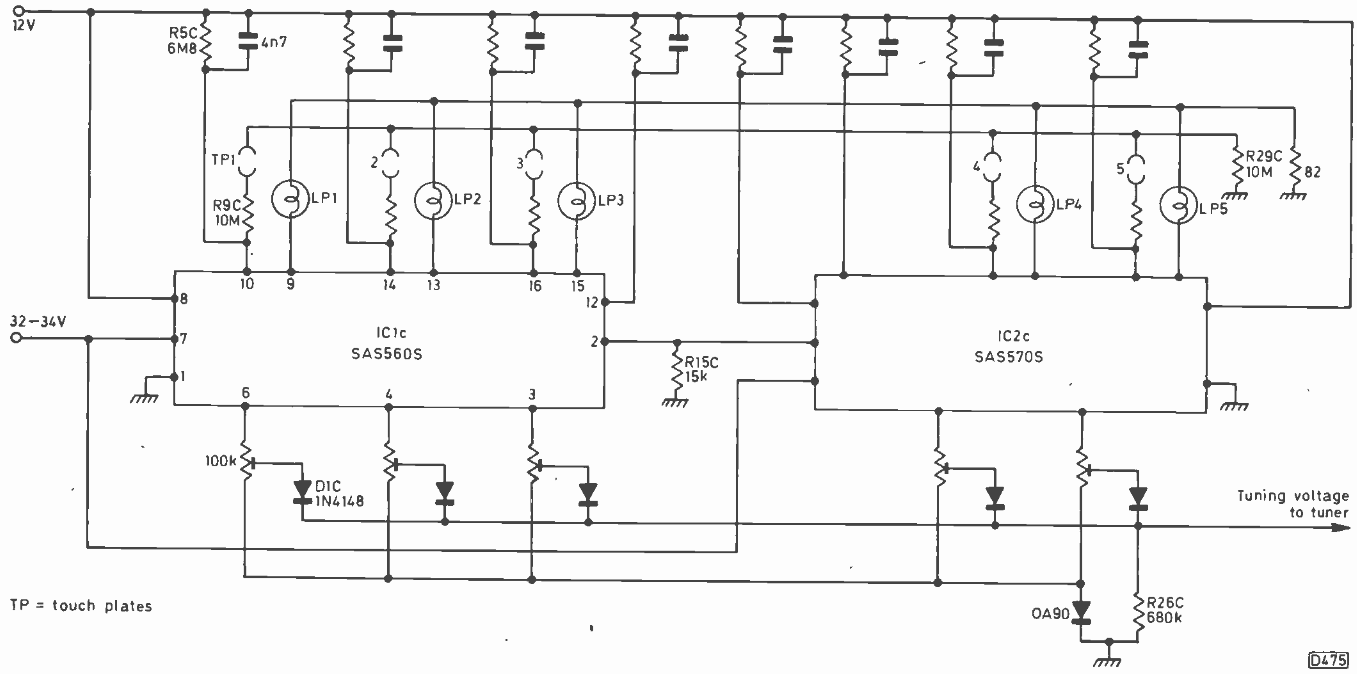


Fig. 5: Circuit of the ITT "Feathertouch" touch-tuning system used in the CVC9 chassis. Touching one of the touch contacts earths the associated i.c. pin, activating an electronic switch within the i.c. This connects the 33V line to the associated tuning potentiometer and 12V to the related channel indicator lamp. The voltage across the common 15kΩ resistor R15C rises momentarily when a touch-button is touched, unlatching the previously selected circuit.

Some safeguard must be provided to prevent accident or misuse. What some brands call their "remote on-off" facility is really a standby position. In the early versions this was a relay which turned the TV power supply off on the secondary side of the mains switch but left the remote control facility still running. Nowadays the same operation is performed by making the remote receiver generate whatever signal or voltage the set's power supply needs to tell it there's an overload or fault condition: this operates the excess voltage protection circuit, shutting down the power supply. Because the mains supply is still present at the TV set and the remote receiver is still powered up, a warning lamp or indicator must be provided to show that the set is in fact still on.

Touch Tuning

Touch tuning started out as an i.c. designer's way to help you push a button, but has come to be the heart of the modern remote control system. In simple terms, a touch tune i.c. converts a digital instruction (whichever way you look at it) into a predetermined voltage between 0V and 30V. The easiest way to get the hang of things is to look at an early example, such as the ITT Feathertouch system shown in Fig. 5. There are two i.c.s, the SAS560S which is operated by touch buttons 1, 2 and 3, and the SAS570 operated by touch buttons 4 and 5.

All five button sections are identical, as is the pinning of the two i.c.s. So by explaining button 1 we will have explained them all. Pin 10 is the input to an amplifier normally held "off" by the 12V line applied to pin 10 via R5C. Touching the channel 1 button effectively grounds pin 10, via R29C, and the resultant voltage change is amplified to the extent that the final stage, which provides an electronic switch-on action, operates. This causes two separate transistors to conduct: one connects the 30V line to the control pin 6, and the other connects the 12V supply to pin 9 for lighting an indicator lamp and/or bandswitching.

The electronic switch latches on, its emitter current passing through the 15kΩ resistor R15C. This is in a common emitter feed to all the six touchbutton stages (only five are used). The number 1 stage stays on – supplying tuner volts and switching etc. volts – until the user touches another button. The action just described will then be repeated, putting the selected amplifier hard on. At the instant the touch button is activated the voltage across the common 15kΩ resistor momentarily rises, unlatching the previous channel. This action leads us on to selector stepped tuning.

Selector Stepped Tuning

The principle used in most simple remote systems relies on the aforementioned common resistor. If the l.t. supply pin for channel 1 band and lamp is connected by either an external or an internal capacitor to the touch button circuit of channel 2, the action of extinguishing the channel 1 lamp will pass a negative charge to channel 2, switching it on. Applying a brief pulse to the common 15kΩ resistor will do this, so by connecting a remote control receiver output across it the tuner can be stepped through the channels sequentially, one step per remote pulse.

You may have wondered why, if the SAS560S and SAS570 operate identically, one carries a different number from the other. The reason is that channel 1 of the SAS560S carries an extra stage in its input amplifier. This is to ensure that on switching the set on, voltage surges, noise etc. turn this channel on in preference to the others. Thus from cold the set will always come up on channel 1. If you were to use two SAS570 i.c.s, the channel appearing at switch on would be as random as Ernie. The extra stage is called the picture initiation circuit.

The pin shown lighting the lamp or band switching is often called the "switching pin" – since band switching is its main function on the continent.

Thus three pins per i.c. channel are needed with this system, while the i.c. also has to be connected to chassis, l.t., 33V and the common latching resistor. A 16-pin i.c. operating on these lines can at the most accommodate four channels therefore, and since most tuners have six buttons

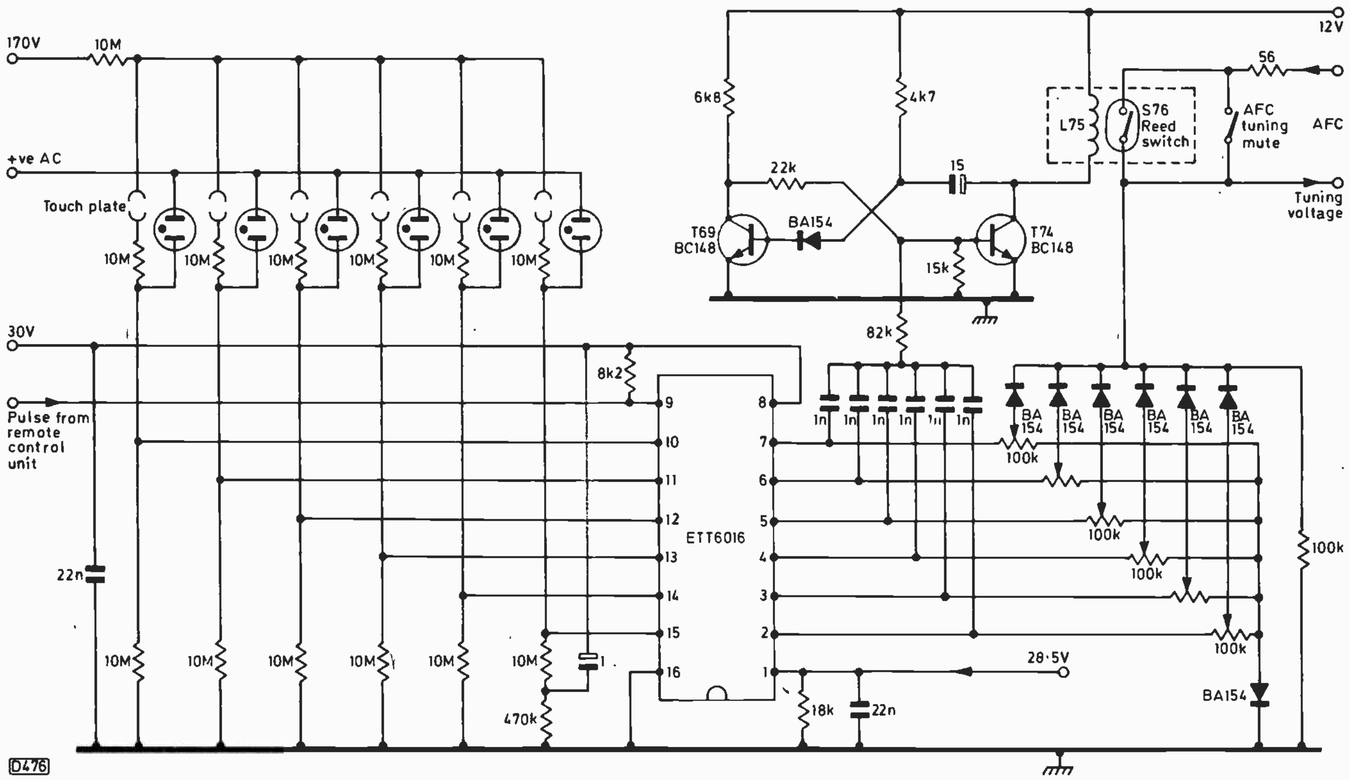


Fig. 6: The simple touch tuner/remote control system used in the Philips G9 chassis. This is similar to the previously described ITT arrangement, but uses an m.o.s. i.c. and has the added refinement of an external monostable multivibrator T69/T74 which operates a reed relay L75/S76 during channel change to mute the a.f.c., thus reducing the possibility of lockout.

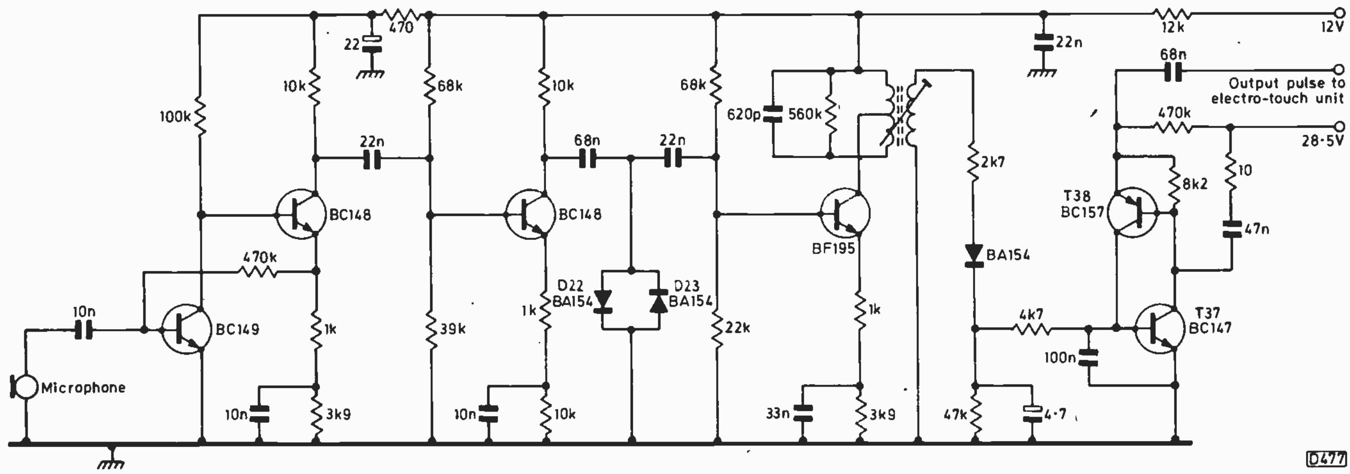


Fig. 7: The simple remote control receiver used in the Philips G9 chassis. The output pair T37/T38 are connected as a thyristor, assuring a clean output pulse. The remote handset is non-electrical, consisting of a tuning fork which is plucked when the button is pressed.

there will be either two separate i.c.s, as we have seen, or a single device with 24 pins.

A circuit which works in a similar way is the *Television* project featured in the September 1977 issue. A slightly more involved circuit is employed in the Philips G9 chassis. Here, to prevent lockout, the a.f.c. is muted during channel change. A two transistor monostable circuit (see Fig. 6) is triggered by the charge which appears on any 30V outlet as soon as a channel is selected. The right hand transistor (T74) conducts, energising the reed relay and muting the a.f.c during channel change. These circuits employ MOSFET i.c.s, with just two pins per i.c. channel, giving selection of six channels from a 16-pin i.c.

Simple Remote Control Systems

Passing over wired remote control systems, which are too straightforward to merit further description, we'll continue with cordless remote control. Market research has revealed that the most needed feature is channel change, with sound muting, so as to be able to converse during commercials or trailers, running second. The only rule necessary is that for licensing reasons the cordless handset must not be a transmitter in the electromagnetic sense.

Most systems at present in use employ ultrasonic methods of transmission. Electrical signals are converted into inaudible ultrasonic "sounds" in the 30-60kHz range within the handset, using a crystal transducer. At the set end, a receiver using a similar transducer as a collector converts the ultrasonic signal back into an electrical instruction.

The codes used for the instructions can be many and various. Different frequencies can represent different commands, or a single frequency can be transmitted in pulses, the duration of the pulse being used to indicate the code.

For example, a long pulse might mute the sound and a short one change channels. The more complex systems, which we shall consider later, use combinations of both these techniques.

The transducers used have similar properties to gramophone pick-up cartridges, with a natural resonance in the 35-40kHz region. This accounts for the absence of a tuned circuit close to them – it's not needed. The resonant frequency is followed at about 2kHz by an antiresonant frequency. The former is a voltage maximum and the latter a current maximum. For this reason many transducers are used in matched pairs, with the receiver being run at resonance (maximum voltage) and the corresponding transmitter being run at antiresonance (maximum current), its resonance being the odd kilohertz below the one in the receiver. Used thus the combination will provide maximum immunity from stray signal triggering and worry domestic animals the least.

Ultrasonic systems are easy to understand, robust and relatively cheap. They are however susceptible to echos round the room simulating incorrect instruction, and some of the simpler ones can be triggered by key jangling, bats and other spurious noises. The hiss from the set's loudspeaker as the set is tuned past empty channels will swamp the receiver, and care has also to be taken to avoid harmonics of the line frequency. To avoid ambiguity, commands must be given slowly. A snag unwittingly caused by mounting the transducers in metal cases is that to conform to BEAB requirements they must be mounted a fair way back in the receiver. This reduces the angle of use somewhat: you generally need to aim the handset right at the receiving microphone.

Infra Red Remote Link

Now that it's possible to produce infra-red emitting LEDs at prices suitable for use in domestic equipment, systems using this method of propagation are beginning to appear. In fact most modern coding arrangements are designed to work either with infra-red or ultrasonic beams.

The transmitter incorporates a group of special LEDs arranged behind a plastic lens and filter to concentrate their output in the general direction of the set. At the set end another filter and lens (which strangely enough look dark blue when held to the light) direct the beam on to a phototransistor or diode. From thence on the electronics are similar to the ultrasonic ones. The beam is usually frequency modulated around a 30kHz subcarrier. Infra-red systems have a higher immunity from echos, and a considerable range. They can be swamped by strong light of any kind close to the receiver. As well as remote control applications, the systems can be used for supplying cordless headphones from TV or radio sets – even in stereo.

Some Examples

An easy example to begin with is the Philips G9 chassis, (see Fig. 7). The transmitter is non-electrical, consisting of a mechanical tuning fork which is plucked whenever the user presses the button. At the set end, a transducer relies on its own resonance for tuning bandwidth. This is followed by a four-stage amplifier, with amplitude limiting by two diodes connected back-to-back (D22/23). The two output transistors T37/38 are connected as a thyristor, so that the amplified signal is turned into a good pulse for application to the common resistor associated with the touch tune i.c.

The handsets of some simple remote control units use so little current, and will still work within the confines of an ordinary room with the battery voltage down to a quarter of the nominal figure, that battery life is the same as its shelf life. The battery in such a handset will still work the system even when it's leaking and making the inside of the set all gooey. (This is a characteristic inherited from those TVs that still keep giving a picture with smoke pouring from their backs.) In units like this it's good economics to remove the battery cover and fit a polythene bag over the battery inside, saving the works from unwanted corrosion.

Full Remote Control

It wasn't long before a market appeared for a system where instant selection of any channel was provided together with chairside control of brightness, colour and volume. These last three are now called the "analogue functions". Other niceties to be included were sound mute, standby and reset.

We can now tabulate these requirements, to provide a standard specification to cover all full remote control systems:

(1) On switch-on the set should display the No. 1 channel at nominal brightness, colour and volume.
(2) Sound must be variable from zero to maximum undistorted.
(3) Brightness must be variable to a greater amount than is initially needed, to compensate for drifts and variations over a night's viewing.
(4) Colour must be variable from almost nothing to 6dB over correct saturation.
(5) Channel selection should be instant, without stepping through.
(6) Sound to be instantly muted and restored.
(7) The main TV can be switched off, either completely – involving getting up to turn it on again – or to a standby mode when the remote receiver is still operating. In this mode a light should warn the user that mains still enters the set.
(8) A reset button should be provided to enable the viewer who has got into a mess with the controls to get back to the nominal settings. This is affectionately known as the "granny button".

Philips System

Continental Europe is the source of most of these types of remote control. They vary from the fairly simple to the very complicated. To ease the reader in gradually, we've chosen the Philips system as our example. Its handset contains all discrete components, and the receiver has only "discrete" i.c.s (no special LSI ones) which gives us an opportunity to see the works and to understand some of the techniques employed to get all the instructions listed above across the room from the armchair to the set.

Although introduced some four years ago, this system is still in production in a modified form and is to be found in many Dynatron receivers in this country. It uses three basic frequencies (37kHz, 39kHz and 41kHz) to transmit messages from the handset, and each of the handset buttons makes two contacts simultaneously. One starts a one-shot (monostable) multivibrator, the other shorting out part of a chain of resistors.

Pressing a channel selector button transmits a burst of 37kHz of duration according to which button was pressed (see Fig. 8). Button one gives a 70 millisecond burst, button two a 110msec burst and so on to button eight for 350msec. The one-shot multivibrator then changes the frequency to

Channel selection D478

Programme	1	2	3	4	5	6	7	8
Duration of 37kHz signal	70ms	110ms	150ms	190ms	230ms	270ms	310ms	350ms

Stop frequency 41kHz

Analogue controls

Control	Vol+	Vol−	Bright+	Bright−	Col+	Col−	On	Off
Duration of 39kHz signal	70ms	110ms	150ms	190ms	230ms	270ms	310ms	350ms

Operating frequency 41kHz in 100ms steps to maximum or minimum

Fig. 8: Philips full remote control system – pulse frequencies and durations.

41kHz, denoting the end of that particular instruction regardless of the users finger being kept on the button.

Pressing an analogue control button, such as "volume down", transmits a burst of 39kHz, of a duration corresponding to the button pressed. The range as before is from 70msec for volume up to 350msec for remote off. Also as before the one-shot multivibrator then changes the frequency to 41kHz, signalling the end of the instruction type. This time however finger dwell on the button does matter, for on brightness, colour and volume a multivibrator inside the receiver "pulses" or steps the selected function up or down in steps as long as the button on the transmitter is held down or until maximum or minimum is reached. In the original system there were only four steps up from nominal and four steps down, giving a somewhat jerky control. The later version has many more steps so that the control feels to be continuously variable. To explain the system quickly, we've jumped ahead a little. We'll retrace our path therefore and return to the receiving microphone. The receiver is shown in block functional form in Fig. 9.

A four-stage amplifier follows the ultrasonic microphone (transducer). This is untuned – apart from the resonance of the microphone itself. Some limiting and filtering follows, mainly to prevent or reduce interference from getting into the counting systems. Three separate tuned circuits filter out the three frequencies, prior to individual detection. We thus have at three separate points l.f. pulses corresponding to the transmitted 37kHz channel selection, 39kHz analogue function selection, and the 41kHz "stop" signal which also raises and lowers the selected analogue function.

A 40msec (25Hz) multivibrator is triggered by both the 37kHz and 39kHz signals, and keeps going until the 41kHz "stop" signal is received. While the 40msec multivibrator is going it "clocks round" the output pins of two TCA810 i.c.s, the top one selecting any of eight channels and the bottom one any of eight analogue functions – including stand-by on/off.

The 41kHz signal, by stopping whichever of the other two signals has been doing the instructing so far, determines which channel or function the system comes to rest at. At the same time it triggers a slower multivibrator which runs at roughly 2Hz or 500msec. Like the others, this steps round the output i.c. of the chosen analogue function, selecting any of a number of different fixed resistors to bridge across the appropriate user front control.

To make it a little clearer, take the following example. We are changing to IBA, and then want to mute the commercials. IBA is on button three, so we first press that handset button. This results in the transmission of a burst of 37kHz, 150msec long, followed by the operation of the handset's one-shot which changes the signal to 41kHz. This stays on till we let go of the button.

The receiver routes the first signal through the 37kHz channel and starts the 40msec multivibrator. Partway through the fourth "flop", the 41kHz signal arrives and stops the 40msec multivibrator.

The detected 37kHz signal also resets the top left TCA810 to zero output from whatever channel it was previously tuned. This i.c. then awaits the four pulses from the 40msec "flip-flop". These clock it on four pins to pin 5, which is programme number 3. The voltage on this pin then disappears, which message is passed to the touch tune circuit to select the appropriate channel and to light the relevant indicator lamp. We now have the channel: let's go on to mute the sound.

We press the "sound down" button and hold it down. The handset emits a burst of 39kHz for 110msec, followed by 41kHz for as long as we hold the button down. In the receiver, the 110msec burst of 39kHz passes through the middle filter, then triggers the 40msec multivibrator which "flops" thrice before being told to stop by the 41kHz signal. This clocks the lower left TCA810 round to output four, which is "volume down", and the grounding of this pin operates a number of digital "gates", enabling yet another TCA810 (top right), which controls the sound. For simplicity we've "cooked" the resistor values at the output pins, but you can see at a glance that depending on which pin is grounded so the total volume control value is correspondingly varied.

We kept our finger on the volume button this time, so the 500msec multivibrator will have started by now and will be pulsing the volume TCA810, which will begin to reduce the sound in half-second steps. We next have to tell it when to stop.

In between the two TCA810s (analogue and sound) is one of the aforementioned gates. Being TV rather than digital men, the first thing we want to know about this is "what's in it?" Never mind what's in it. It's an unwritten law of digital work that you concern yourself only with what it does, not with how it does it.

This is a nand gate with three inputs. It delivers a logic zero at its output only when all its three inputs are at one: in TV parlance, when there's something going to all three inputs, nothing comes out. The three inputs are the detected 39kHz signal (via the analogue i.c.), the 500msec multivibrator output and the voltage appearing on the lowest pin (2) of the volume i.c. All the while the volume is somewhere between maximum and minimum the nand gate will deliver a pulse every time the 500msec multivibrator flops. As soon as minimum is reached, the output pin 2 of the i.c. goes to zero which stops the nand gate and holds the i.c. at the low volume setting. A similar arrangement applies for "volume up", and also for the two brightness and colour analogue functions.

The "stand-by on/off" facility merely applies or removes the voltage at a connection taken to the protection circuit in the receiver's power supply. As a result, the power supply is fooled into thinking that a fault has turned up somewhere, and promptly shuts down until it is released. This means that the remote control receiver needs an independent power supply to keep it going until it is commanded to turn the set on again. This can sometimes give a little trouble when the whole set, including the remote receiver, is off at the mains supply and the user turns the set on again. If the remote power supply warms up first at this initial switch-on the set could go to stand-by before displaying a picture. To overcome this lockout condition, an extra pair of contacts, which make only momentarily, is fitted to the mains on-off switch to effectively tell the power supply that it's "safe to come out now".

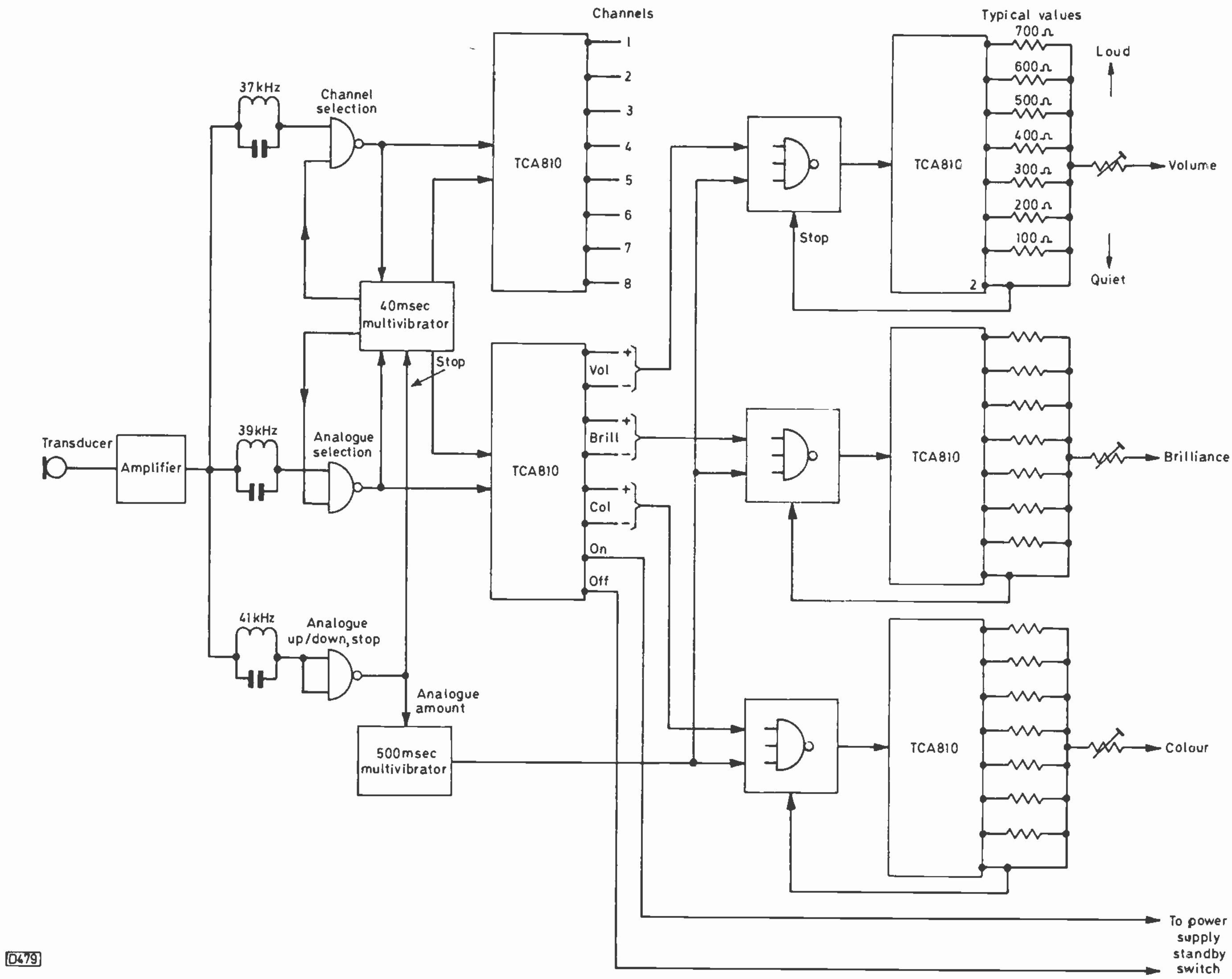


Fig. 9: Simplified diagram showing the operation of the Philips full remote control receiver. Three ultrasonic frequencies are used, with selection by time intervals. See text for further details.

Summarising: All the commands needed to remotely control the set are made by triggering slow-running multivibrators for definite periods of time so that they send any number of pulses from 1 to 10 to step round i.c. outputs until the correct one is reached.

Servicing

Fault finding on this system can be done "blind" by using the algorithm chart in the manual. A multitude of handset faults can be cured by fitting a set of new batteries – selecting the wrong channel or function being two of them.

Phase Three: LSI

If the edicts which emanate from the EEC HQ in Brussels are any guide, mainland Europeans are never content for long with something fairly simple. The fact that here in the UK we run three high-quality services in full colour to most of the population nearly all the time cuts no ice with them. They are bent on getting as many different stations from as many different countries as they possibly can. Before decrying our tenacious maintenance of the old 405-line system, remember that they have to cope with 819-lines in two countries, two colour systems, positive and negative picture modulation, a.m. and f.m. sound with four different spacings, and four bands.

In continental Europe, 24-channel selection from the handset is becoming commonplace. In some systems this is done by keying the number of the required channel: other systems permit the user to sweep up or down the bands. The close ties between some UK setmakers and their continental associates ensure that such complications will arrive here as soon as a demand is established, but the writer's view is that our own brainchild, the teletext service, will set the pattern of any improvements in front-end engineering in the near future.

Large scale integration (LSI) makes it all possible at a reasonable cost. By comparison with the now commonplace intercarrier sound i.c. with its 50 odd transistors, some of the i.c.s used in teletext, and in synthesised tuning, contain the equivalent of over 20,000 transistors. So as we've said before, the question "what's inside?" will remain unasked and unanswered.

When fault finding, a multimeter and oscilloscope are just as effective as they are in the rest of the set, and will probably tell you just as much as some of the more expensive items given in books as digital "musts". It's very difficult, even with first class gear, to capture a train of pulses emitted by a handset so that they can be counted and checked. If they are there at all, they are usually correct. You can spot a pulse train which is lying through its teeth by what it *does* (or doesn't) do as much as by what it is.

CONTINUED NEXT MONTH

Colour Receiver Project

Part 6

Luke Theodossiou

Constructing the timebase board

THIS month we shall deal with the remainder of the timebase board circuit and describe its construction. We'll start with the raster correction circuitry.

Raster correction

The 110° PI yoke introduces pincushion distortion of around 9% in the east-west direction and 8·5% in the north-south. A diode modulator could provide very accurate east-west correction but it is complicated and uses quite a number of components. In addition, a separate north-south correction circuit is required, making this solution rather complicated and therefore unattractive.

We decided to use a single transductor circuit which corrects the pincushion effect in both directions. The horizontal windings of transductor T2 are connected in parallel with the primary winding of the line output transformer. A field parabola is injected into the vertical winding of the transductor, and this modulates the horizontal scan current at field rate to provide east-west correction. Conversely, the field scan current is modulated at line rate to provide north-south correction.

The transductor is nothing more than a transformer with three windings, one on each of the three legs formed by two ferrite E-cores with the limbs facing each other. The magnetic characteristics of the ferrite material used, coupled with a gap between the two cores and the number of turns in the windings, result in an easily saturated core, and it is this property of the transductor which is used to provide the raster correction. Diode D11 in conjunction with resistor R53 provides a d.c. bias current which sets the core saturation characteristics. R55 in parallel with the integral thermistor on T2 sets the degree of E-W correction and the latter compensates for the temperature rise in the transductor which would cause a reduction of the saturation point and alter the degree of correction.

As the field parabola current applied to the centre winding increases, the inductance of the outer limb windings increases and shunts the line output transformer primary winding. The field windings on the deflection yoke are connected in series via the transductor and N-S phase coil L3. As the inductance in the centre winding decreases at line rate, the field is modulated to produce the required north-south correction. The resonant circuit produced by L3 and C37 (in conjunction with the transductor) alters the phase of the line current and provides a convenient way of adjusting the symmetry of correction. The degree of north-south correction is adjusted by VR8.

The transductor incorporates a permanent magnet on the top which can be moved across so that it exerts more influence on one limb than the other. In this way the saturation characteristics of each transductor limb can be altered slightly to compensate for inequalities due to manufacturing tolerances. The magnet is adjusted during setting up for best symmetry of east-west correction.

This system of raster correction is very modest in its power requirements since it actually dumps energy back into the line output transformer whenever the flux in the line output transformer changes direction. This is very desirable since it keeps the transductor dissipation low and enables a small core to be used (economy!).

Line linearity correction is provided by L4, damped with R56. The line coils are returned to earth via terminal 6 on connector B.

The supply for the field timebase is scan derived from pin 10 on the line output transformer via surge limiter R70 and rectifier D14. Negative-going flyback pulses required by the teletext decoder module are taken from pin 12 of the line output transformer via R67. The resistor is shunted by C44 which compensates for signal delays and ensures a horizontally centred text display. Negative-going gating pulses for the i.f. strip are also taken from terminal 12 via a potential divider comprising R68 and R69.

The line output transformer also supplies the tube heater current from pins 7 and 8 via surge limiting resistor R62. In the interests of tube reliability, one side of the heater supply is taken to around 100V d.c. derived from the 220V video supply rail via the potential divider formed by R64 and R65. This minimises the stress voltage between the heaters and cathodes of each gun.

E.H.T. generation

The e.h.t. is derived in the usual way from an overwind on the line output transformer by way of a tripler – the Remo type T30-A115 which incorporates a clipper diode at the input. The latter serves two purposes: firstly it reduces the e.h.t. source impedance by clipping the oscillations which are set up at the end of the flyback period; secondly, it provides a way of obtaining the tube A1 supply which is independent of beam current. This voltage is developed across R59 and is then tapped down by R60, VR9 (the A1 voltage or 'background' control) and R61.

Beam current limiting

All these components are returned to earth via D13 which is normally biased on but performs a very important function – beam limiting. It is biased on from the 220V video supply rail via R63 and R71. The junction of these resistors is taken to the tube grids. The potential divider formed by the two resistors determines the grid voltage under normal operating conditions (around 10V). Now the tube beam current is flowing in the opposite direction through the

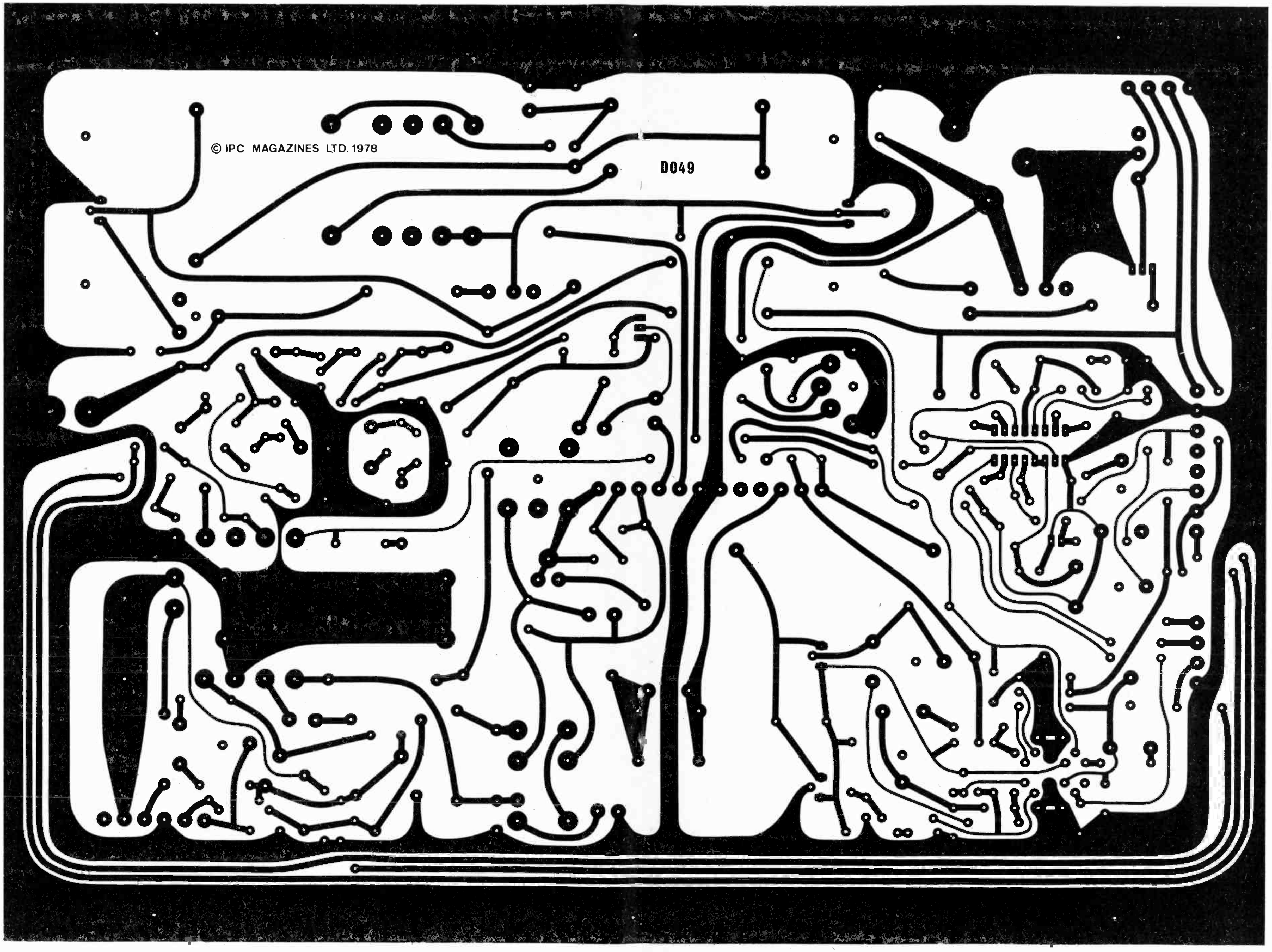


Fig. 1: Copper track pattern for the timebase board reference D049, shown full size.

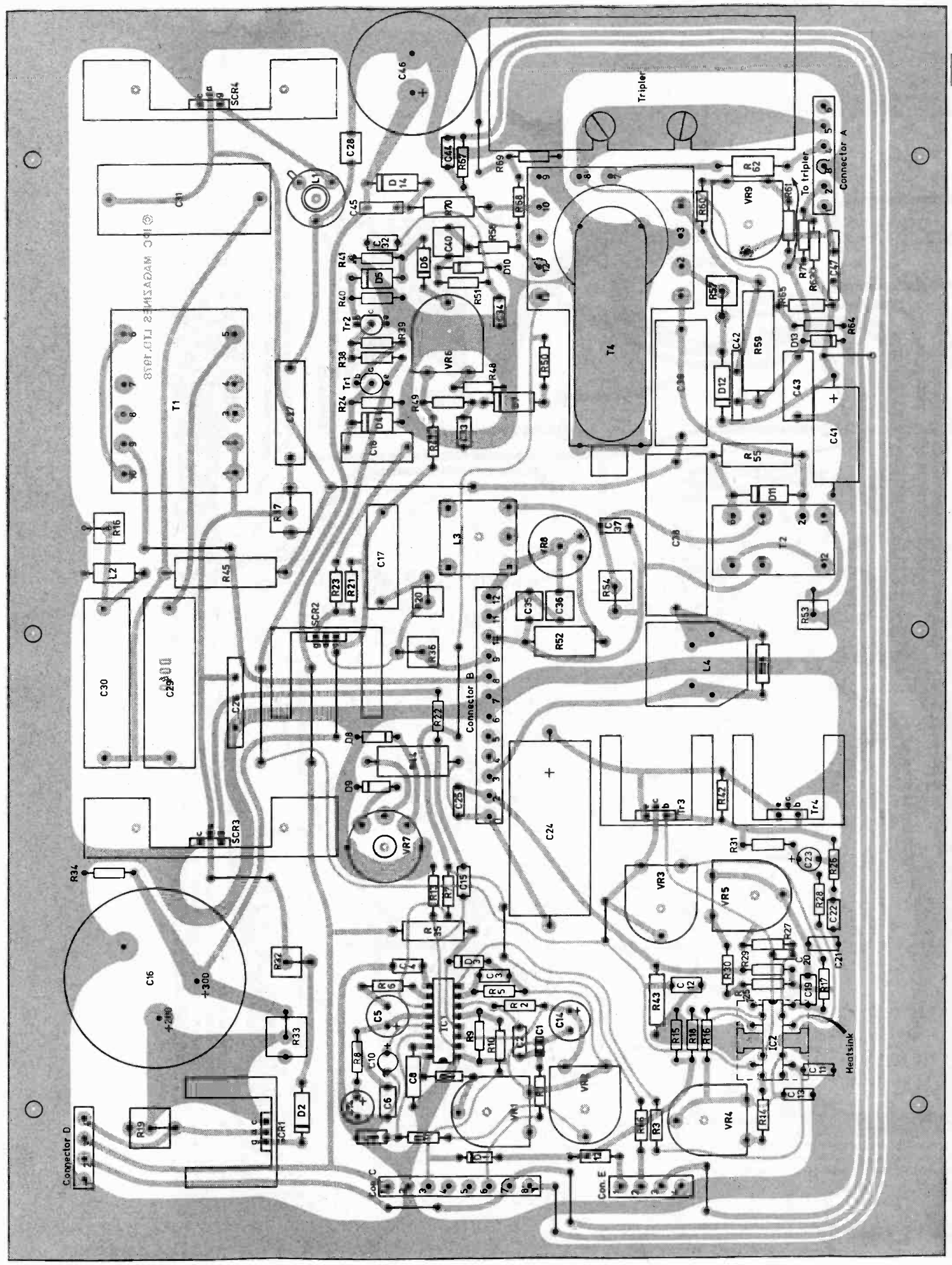
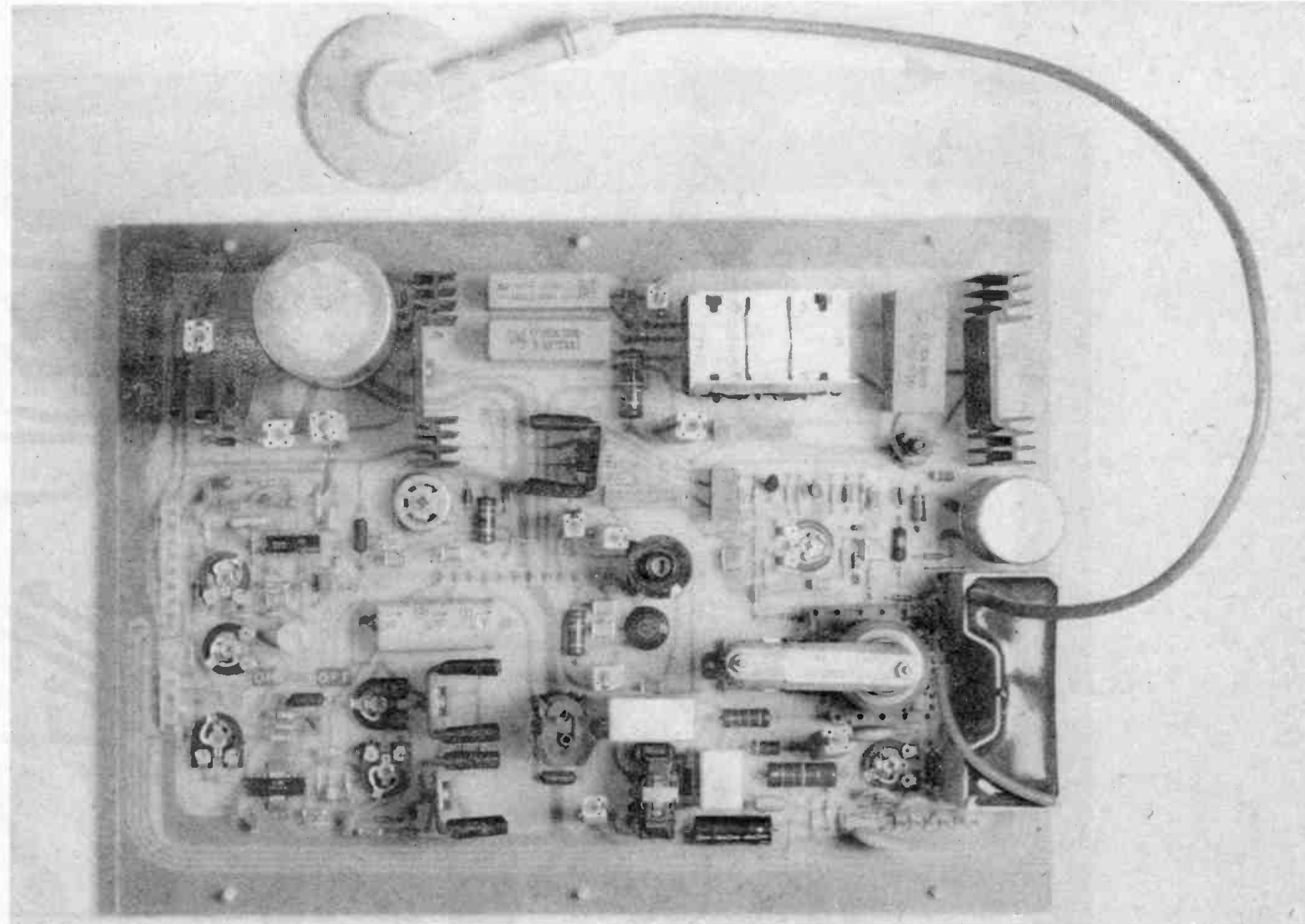


Fig. 2: Component location diagram for the timebase board.

TME21



General view of one of the prototype boards. Note that some slight differences exist between this and the final version of the board.

same diode. When the beam current exceeds the current set by resistors R63 and R71, the diode switches off and a negative voltage appears across C43 which is proportional to the beam current. This is then passed on to the grids and causes the tube to tend towards cut-off, which reduces the beam current. This is a very effective way of beam current limiting and also has the advantage of using only a few components.

Construction

The circuit is constructed on one printed board (reference number D049) and care must be exercised when handling this board towards the end of construction (it does carry a reasonable weight) to avoid flexing it too much, since this might cause it to crack or some of the copper tracks to lift. It's also important to check and double-check the construction – errors in this area can be disastrous.

We suggest that all the passive components lying down (not forgetting the links) are soldered in first, starting with the lowest profile ones and progressing on to the larger ones. Next attach the heatsinks to the semiconductor devices which need them (see components list and circuit diagram), then solder the semiconductors into the board. Heatsink compound should be used to ensure maximum heat transfer. IC2, the field timebase i.c., is an exception however. This needs to be inserted into the board first, and then its pins, but not the tabs, soldered. The heatsink tabs are then inserted into the p.c.b. slots, and the i.c. and heatsink tabs soldered simultaneously onto the board. This soldering operation must be done with great accuracy: it is very easy to end up with either a dry joint, or with a dead i.c. from excess heat.

Thyristors SCR3 and SCR4 each use one half of an RS Components type 401-497 heatsink, so this will have to be sawn in half. To ensure good mechanical stability and reduce the risk of damage to the thyristor leads, the heatsinks are screwed to the board from the underside with two self-tapping screws. Guide holes are provided on the board for this.

Another area which needs a little attention is the double-section capacitor C16. This has tags and is not really intended for p.c.b. mounting, but it can be done quite safely if you bend the tags with a pair of pliers after inserting the capacitor into the board, then solder, making sure the joints are in good order to minimise resistance.

It's also advisable to use an i.c. socket for IC1. Stand-off support pillars are used for all 11W resistors, and holes are provided for these on the board. The tripler unit is secured to the board with two 4BA nuts and bolts, and we also advise using shakeproof washers for maximum safety. The yellow lead from the tripler is soldered directly into the board. A small piece of e.h.t. cable can be used to link the tag on the side of the line output transformer winding to the corner tag on the tripler (adjacent to the yellow wire). It is advisable to insulate these two connections for safety; there's around 8·6kV at this point. Heat-shrinkable or some other type of sleeving is the ideal, but even insulating tape will be better than nothing. The remaining tag on the tripler is for the focus voltage and we shall deal with that next month.

Corrections

A couple of errors occurred in the circuit diagram shown last month. Capacitor C46 (2200μF 40V) was wrongly designated C42. Capacitor C7 should read 4μ7/35 and not 47/35.

Next month we shall deal with the tube degaussing components and the tube base panel.

★ Components list: timebase board

Resistors:

All 0·5W ±5% unless otherwise stated.

R1	1k5
R2	1M5
R3	2k2
R4	4k7 ±2%
R5	1k8
R6	330
R7	33k
R8	1k2
R9	1k5
R10	1k
R11	220k
R12	1k
R13	100
R14	150k
R15	1k
R16	12k
R17	330k
R18	1k2
R19	1k5 11W fusible
R20	1k8 7W
R21	220
R22	4R7
R23	100
R24	560
R25	47k
R26	3R3
R27	220k
R28	18k
R29	5k6
R30	39k
R31	18k
R32	12k 7W
R33	15 11W
R34	270k
R35	180 2·5W
R36	2R2 7W
R37	150 11W
R38	4k7
R39	6k8
R40	12k
R41	10k
R42	10
R43	OR47 2·5W
R44	18 1W
R45	100k 2W
R46	4R7 7W
R47	560k
R48	820
R49	6k8
R50	10
R51	1k8
R52	68 1W
R53	39 7W
R54	15 7W
R55	220 1W
R56	150 2·5W
R57	47 7W
R58	330
R59	820k 2W
R60	47k
R61	680k
R62	OR47 2·5W
R63	120k
R64	220k
R65	220k
R66	2k2
R67	33k
R68	5k6
R69	1k
R70	1R 2·5W
R71	5k6

Potentiometers:

Standard horizontal mounting unless specified

VR1	1k
VR2	10k
VR3	1M
VR4	100k
VR5	47k
VR6	470
VR7	100 3W wirewound
VR8	1k 1W cermet
VR9	1M

Capacitors:

C1	150p ceramic plate
C2	330n Siemens polyester
C3	330n Siemens polyester
C4	100n Siemens polyester
C5	22µ 16V tantalum bead
C6	68n Siemens polyester
C7	4µ7 35V tantalum bead
C8	10n 1% polystyrene
C9	100n Siemens polyester
C10	1µ 35 tantalum bead
C11	10n Siemens polyester
C12	100n Siemens polyester
C13	150n Siemens polyester
C14	220µ 16V pluggable electrolytic
C15	470n Siemens polyester
C16	200µ+300µ 350V
C17	3n3 1·5kV polypropylene ERO type KP1836-233/15 ±5%
C18	100n 400V polyester Mullard 344 series
C19	100n Siemens polyester
C20	47p ceramic plate
C21	100n Siemens polyester
C22	100n Siemens polyester
C23	4µ7 35V tantalum bead
C24	2200µ 25V electrolytic
C25	100n Siemens electrolytic
C26	270p 1kV ceramic
C27	3n3 1·5kV polypropylene ERO type KP1836-233/15 ±5%
C28	56n Siemens polyester
C29	100n ±5% 1kV polypropylene Ero type KP1836-410/10
C30	56n ±5% 1kV polypropylene Ero type KP1836-356/10
C31	220n ±5% 1kV polypropylene Ero type KP1836-422/10
C32	68n Siemens polyester
C33	680n Siemens polyester
C34	68n Siemens polyester
C35	470n Siemens polyester
C36	470n Siemens polyester
C37	220n Siemens polyester
C38	2µ2 250V metallized polypropylene Ero type MKP1841-522/25 ±10%
C39	680n 250V metallized polypropylene Ero type MKP1841-468/25 ±10%
C40	680n Siemens polyester
C41	10µ 250V electrolytic
C42	10n 1kV ceramic
C43	100n 400V Mullard 344 series
C44	220p ceramic plate
C45	In 750V ceramic
C46	2200µ 40V pluggable electrolytic
C47	10n 1kV ceramic

Semiconductors:

Tripler: Remo T30-A115

D1	1N4148
D2	BA158
D3	BZX61 C12
D4	BA158
D5	BA158
D6	BZX83 C6V8
D7	BA158
D8	1N4001
D9	1N4001
D10	BZX83 C24V
D11	BY298
D12	BY298
D13	BA158
D14	BY298
Tr1	BC212L
Tr2	BC182L
Tr3	TIP41A with RS 401-964 heatsink
Tr4	TIP42A with RS 401-964 heatsink
IC1	TDA9400
IC2	TDA1370 with Staver V8-800 heatsink
SCR1	S2062M with RS 401-964 heatsink
SCR2	S3901S with RS 401-964 heatsink
SCR3	S3901S with half of RS 401-497 heatsink
SCR4	S3900SF with half of RS 401-497 heatsink

Wound Components:

L1	Orega 58121
L2	2µ2 choke
L3	Orega 58111
L4	Orega 55336
T1	Orega 83554
T2	Orega 82536
T3	Orega 3165

Miscellaneous:

Molex 0·2" pitch connectors
16 way i.c. socket for IC1.
P.c.b. ref. no. D049

It Went Bang!

Les Lawry-Johns

WE'RE getting quite a few Pye group sets in lately, of the 725 series ilk – CT223, 225, etc. From a practical servicing point of view there's not much to separate the 731, 725 and 741 series. All have the vertical panels in moulded frames, two on the left of the tube, one on the right.

Depending upon the symptoms reported, one either leaps for the left side signal panel which houses the tuner, the i.f. strip etc. on the lower part, and the decoder and colour drive circuits at the top; the more central line timebase panel; or the right side field timebase, power supply and convergence panel.

One gave us a distinct shock the other day however – one which is worth bearing in mind. It happened like this . . .

A Woman of Distinction

The moment Mrs I. Glass walked in I could tell that she was a woman of distinction. A real big spender. Good looking, so refined . . .

"My name's Glass, Ida Glass. My husband put it in before he left for work. Perhaps you could get it out for me to save me straining." She had deliberately left out the words car and TV, but I could see through her. I never mix business with pleasure. For one thing, it makes giving estimates difficult, if one is asked for.

"No trouble madam," I gave quite a bow, thus allowing full vertical scan. With a huff and a puff the CT223 was whisked from the rear seat and into the shop.

I remembered her now. She was the one who brought an amplifier in and said she was dead on one side, and I'd said it was probably due to lack of drive, not being turned on or some such rubbish. Oh yes, cheeky type. Think they can get away with murder. Usually can.

"It's the on/off switch"

"It's the on/off switch," she proclaimed with certainty. "It blew the fuse over on the other side."

My eyebrows shot up. Whilst the centre h.t. fuse is in full view with the rear cover removed, the 3·15A mains fuse is partially concealed over on the right, behind a vertical strut.

"How do you know all this?' I asked. "Mind you, you've got it round your neck, but that's not a bad place to be."

With a quick nod and smile, she acknowledged the import of the latter part but took up the challenge.

"We took the back off and followed the mains lead to the switch and then over to the other side where we saw the fuse was all black, and since the switch is the only thing between the mains and the fuse, we knew it had to be the switch."

Amazing, isn't it? Such logic. Nice but so wrong.

I didn't take the trouble to explain that the cause must be after the fuse in order to blow it, but since the mains filter capacitor is only a small item it wasn't worth an argument.

"Never mind dear. You've got it a little bit wrong, but only a little bit, and we don't want to quibble over a little bit, do we? You pop off and do your shopping or something and I'll have it sorted out by the time you come back."

So she started up her motor, and with hips swinging went out to her car. Nice movement. Nice class. Cut glass.

Now the set. Sure enough the fuse was shattered and the filter capacitor was a dead short, with a bit of the plastic blown off the side to show its innards. In went a new capacitor and a new 3·15A anti-surge fuse. Apply mains, and all hell broke loose.

There was an ear-splitting howl from the loudspeaker, which sounded like a beserk foghorn, and funny noises from the back of the set. The dog fled in one direction and the cat in another. I punched in the on/off switch but it didn't function. The racket continued until I switched off at the mains. At the same time I caught a glimpse of the tube heaters. Like three 100W bulbs.

With shaking hands, I rolled myself a cigarette. The dog's head peeped round one corner and the cat's round another. "Cowards" I accused them.

I reviewed the situation. Obviously the voltages were sky high everywhere. But why all this, after a simple blow out of the mains filter capacitor? And what damage had been done?

Let's have a look at the print around the capacitor. Nothing wrong, and we would have seen it anyway when the new one was fitted. Have a look on the component side. This preset control looks a bit queer. The wiper's not contacting the track. There isn't any track. It's gone. And it's RV917, the coarse set h.t. control.

Of course! The side of the filter capacitor had blown off, and had sliced off the track of the control on it's way into orbit. Ah well.

New 4·7kΩ control fitted and set midway. Stand back. Switch on. Normal sound hiss, tube heaters normal. Check h.t. 170V at centre fuse. Dead on. Well, well.

Picture on, but only a few inches high. Not much voltage on the field output transistor VT688. Peer over the back of the line output section. Thermal resistor R686 in the feed to VT688's collector unsprung. Solder up to restore 25V supply line.

Looks good, except for the on/off switch that is. She did mention that. Nickers.

Bang, bang, Wallop!

Having had my nerves strained already, I didn't deserve the next one. Mr. Crabtree said on the phone that his Bush colour set had gone pop and he was bringing it in. I assumed that it would be a dear old A823 chassis with a shorted BT106 thyristor h.t. rectifier or something. No such luck. It was one of these new-fangled BC something or the other models fitted with the Z718 chassis. You know the one. Long thin panel, which swings down, across the rear.

With this down one can see the power unit, supported by a strut on the left and a clip over the main electrolytic on the right. It has two fuses, a 2·5A anti-surge one on the right of the panel and a 5A HRC type on the left. The former was

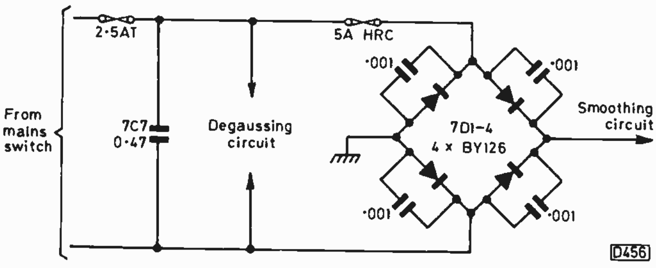


Fig. 1: Mains input circuit, Rank Z718 chassis. Note that the chassis is live whichever way round the mains plug is connected.

blown and blackened, which tended to direct suspicion on the 0·47μF 1kV mains filter capacitor 7C7 (see Fig. 1). The capacitor was not at fault however.

A meter check next showed that one of the bridge rectifier diodes was shorted, the others being OK. So full of confidence we replaced the offending BY126, made sure there were no more shorts, fitted a new 2·5A fuse and switched on. On came the sound and up rustled the e.h.t., but with a spitting noise. BANG! There was a blinding flash of sheet lightning generally from the centre of the set.

The dog took off as usual, but the cat had known something was afoot and had left as soon as we switched on. How do they know? How much more of this can one be expected to stand?

Shaking from head to foot, I waited for my eyes to recover from the flash. Both fuses had shattered this time. Two BY126s had bit the dust. Don't panic I told myself. But I just can't help it.

"Can I have two HP7 batteries", asked the dear old lady handing me a pound note. I gave her change for 50p, and the dear old lady turned into a spitting and snarling Gorgon.

Oh dear. Can't I do anything right?

Now what about that spitting noise just before the explosion? With recent experiences in mind, I investigated the e.h.t. surround on the tube. Whatever it was, it wasn't nice and clean. So we made it so and cleaned off the lead and rectifier (no tripler, the transformer has an overwinding).

Out came the power panel and in went the BY126 replacements and fuses. Check to make sure that the diodes are the right way round – I'd fitted them and don't trust myself. I then disconnected the mains supply at source, switched everything else on, and retreated to the hideout where the mains supply control switch is. With the cat and dog. I next restored the mains supply, shutting my eyes and covering my ears.

The sound hissed on and a nice noisy raster appeared. No spitting noise, no lightning. Incidentally, I'm not kidding about the blinding white flash. That the air between the e.h.t. and the power panel can ionise to this extent is somewhat alarming, but I've seen such flashes before, even where there's been no e.h.t. to trigger it off, merely mains and h.t. Any comments?

We told Mr. Crabtree to move the set away from the window to avoid condensation (central heating, no paraffin stoves this time), and hope there will be no repetition of this unpleasant experience.

Help!

We wanted something easy after this, so we started on a Thorn 3500 chassis which needed attention. The complaint was no results, funny whistle. Being of unsound mind, I decided that the power pack was at fault. But the spare was still awaiting attention with a queer fault around the monostable (I think) so I couldn't change it.

On switching on, the whistle started and so did I, taking voltages on the power pack. The 30V line was OK, but the 60V chopper line was down to 20V. I then wasted a lot of time as I wasn't thinking straight at all. There were lots of other things happening by now, and time was pressing. I decided to consult my friend Ray who has this irritating habit of being able to think straight.

"Hallo uncle Les" he said when I phoned him. "You in trouble?"

"Yes I am. I've got a 3500 that whistles at me."

"Does it? The line oscillator must be running at the wrong speed then, mustn't it? But you've checked that of course."

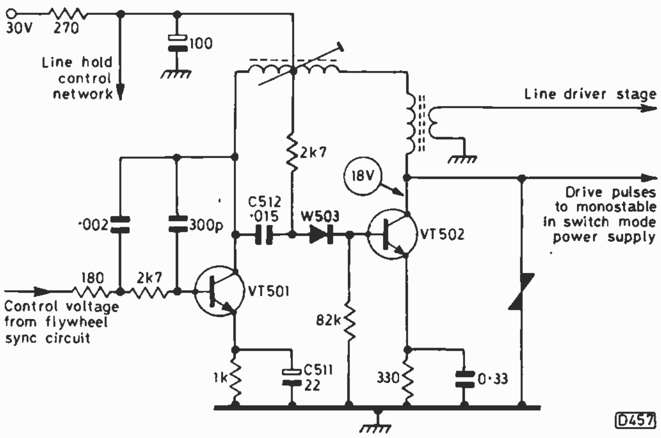


Fig. 2: Line oscillator circuit, Thorn 3000/3500 chassis. The output goes to the driver stage and also triggers the monostable multivibrator in the switch-mode power supply circuit. The trouble was no results, with a funny whistle. As a result of the tuning capacitor C512 going short-circuit, VT502 was excessively biased with about 10V at each of its electrodes.

"Er, well I was just going to Ray, but I thought I'd ring you to see if you're all right."

"Of course. Thank you Les. Oh, while you're there, Don wants to know the the value of the resistor across the line linearity coil on an old Philips 210 chassis. Have you got the circuit?"

"Don't need the circuit Ray. It's a 1kΩ. Bung in a 2W one and keep it clear of the line output transformer winding."

"Thanks Les, bye."

"Thanks Ray, bye."

Line oscillator. Why didn't I think of that? It's so obvious. It's just that you get used to the power pack making funny noises.

Voltage checks showed that although the 30V line was OK, the line oscillator transistor's collector voltage wasn't 18V as it should be (see Fig. 2). The transistor was OK, but the tuning capacitor C512 proved to be a dead short. In went a replacement, and everything came back to normal as correct line pulses were now being fed back to the power pack. Easy. When you've got friends.

And More Help . . .

We had recently repaired an ITT CVC5 chassis, fitting a new boost capacitor, a PY500 and a PL519, to cure (a) fuse failure when the boost capacitor shorted and (b) failing width after some hours' use. Now Mrs. Twintub had reported something very funny happening. Everything would be perfect for hours, then the sound and vision would go off leaving only a couple of vertical spikes in green and red, roughly in the centre and to the right of the screen. The fault would clear after a few moments, returning later. Investigation showed that the condition could only occasionally be promoted by disturbance of the main panel – but not in any particular spot.

So we spent some time resoldering the main frame tags to the panel at all likely places, on the assumption that it was bad earth returns that were causing the weird effect. This appeared to be successful, as disturbance failed to promote the condition. Several hours later however we were back to square one, with the condition never staying long enough for us to get any useful voltage readings anywhere.

Once more I felt panic gnawing away at my vitals.

The phone rang. It was our very own editor. What a nice man he can be.

"Hallo Les. Everything all right down there?"

ell not really John, but I'll say it is just to be brave."

"Getting a nice lot of material to rave on about then, are you?"

"Yes but I don't know the answer to some of them and I don't like ITT any more." And before you could say knife I had poured out the whole sorry tale.

"Well now Les, we can't have you getting upset, can we? Spikes in green with red edges? Well, well, sounds like you're scoping a waveform, doesn't it?"

"That's it John, just like a waveform. But I'd rather have a picture."

"Don't worry Les, I'll phone you back later." And he did. Late in the evening, would you believe it? He's ever such a nice chap.

"Put the lights out Les, and when the fault occurs, look at the base of the line output transformer where the tags come through to the sub panel. You'll see a little spark, then you'll know what to do."

I did put the lights out, I did see a spark, and I did make good the soldering of the transformer's earthing tags, which are also used to earth the winding which provides the gating pulses. I did say "thank you" as well!

I get by, with a little help from my friends.

(The editor's face is red, and his legs are twisted like barley sugar. What an embarrassment this fellow Les is! It's our old friend E. Trundle who must take the credit here however, putting his finger on the cause of the trouble before I'd even finished describing it. Thanks Trudge!)

Service Notebook

George Wilding

EW Tinting

There are times when it's difficult to know what it is you've done that's cured a fault! Take the case of a Pye hybrid colour chassis we had in recently. The complaint was that the picture was severely tinted towards blue in a gradual manner from left to right, and it was mentioned that the fault had got worse over a period of weeks. On switching the set on, the fault was just as described and remained so even when the colour control was set at minimum. We switched off all guns to black out the screen, then checked each individually on the test card then being transmitted. Switching on the red gun gave perfectly even reproduction – and likewise with green and blue! Switching them all on then gave a perfectly good picture which required only slight adjustment to the first anode presets and the focus control for optimum results. Even after a prolonged soak test and repeated switching on and off there was no sign of the fault. Each first anode is decoupled by an 0·02μF capacitor, so we're wondering whether the action of switching the guns off and on produced a spark that sealed one of them up.

The same fault, though not with the same severity, was present on another of these sets that came our way recently. This time our gun switching tests showed that the B–Y output was not being properly clamped – the chassis uses colour-difference drive. The most common cause of this is a marked change in the value of the clamp triode's 8·2MΩ anode load resistor, or alternatively a defect in the associated 680pF coupling capacitor. The resistor seemed to measure about right, but replacing it along with the capacitor completely cured the EW colour drift.

Line Frequency Shift

A sudden change in the line frequency does not necessarily imply the sudden breakdown or change in value of a component in a time-constant network. A defective diode or other component in the flywheel sync discriminator circuit, or in the following d.c. amplifier where one is incorporated, can produce similar symptoms.

We recently came across a dual-standard monochrome ITT set with a variety of line generator faults. The picture would sometimes lock correctly, but would need hold control adjustment following channel change; sometimes line lock would be very critical; while on other occasions there would be such a marked change in the oscillator frequency that the hold control became useless. Changing the PCF802 line oscillator valve produced no improvement, so the two flywheel sync discriminator diodes were next checked. Both seemed to be o.k., but on repeating the test, since prod connection wasn't all that good, one of them appeared to be open-circuit. Inspection then showed that one end of it, also the lead of an associated resistor, were just twisted around a soldering tag, having apparently missed being soldered during assembly. On soldering up and readjusting the line oscillator coil, perfect line sync was obtained.

It was then found that the top push-button needed retuning after each operation, while the bottom one was so stiff to turn that optimum adjustment couldn't be obtained. These ITT u.h.f. tuners are far from ideal, the three-legged aluminium castings associated with each push-button plunger often developing cracks, causing mistuning after each channel change. Replacements can be obtained from ITT, but are tedious to fit. The castings were all right in this case, but only one spring was fitted to the catchplate. A similar but longer spring was found in our "nuts and bolts" box, and when this was cut down and fitted the mistuning of the top push-button was cured. The bottom push-button's stiffness was apparently due to it never having been used: normal operation was obtained on applying a little thin oil to the threaded push rod and then gradually turning the button in both directions.

Width Variations

The trouble with a monochrome GEC set fitted with the Series One chassis was spasmodic slight but annoying width variations. Valve replacements made no difference, so attention was turned to the resistors in the width circuit as the next most likely possibility. The first suspect was R228 (10MΩ) from the boost line to the width circuit, but the spasmodic width variations continued after replacing it. The next suspect was the 2·2MΩ resistor R226 between the width circuit and the line output valve's control grid, and this turned out to be the culprit.

Contrast and Sound Level Variations

The trouble with a Decca hybrid colour set was that the picture contrast and, to a lesser extent, the sound level spasmodically varied. The odds were against a tuner fault, since there was no increase in background grain when the contrast level reduced, and there was no suggestion of mistuning. The sound take off point is in the vision detector's output circuitry, so the gain variation was almost certainly occurring in the three-stage i.f. strip, due either to a fault in this section or in the two-stage a.g.c. circuit. The latter consists of a two-transistor circuit, with the output smoothed by a 25μF electrolytic. The a.g.c. voltage (measurable at TP5) was found to vary marginally with the contrast changes, throwing suspicion on the electrolytic. Replacing this produced no improvement however, and further tests showed that the voltage changes were occurring at the collector of the first, peak-detector transistor. A replacement BC147 made no difference, so we decided to check the a.g.c. reservoir capacitor C58 (0·01μF) which is connected from the collector of this transistor to chassis. It was found to have a definite though slight leak, replacement restoring stable contrast.

We've found these sets to be very reliable on the whole, loss of raster usually being due to a flashover in the PY500 boost diode blowing an h.t. fuse, while loss of sound is usually due to an open-circuit wirewound resistor feeding the PCL82 audio valve.

Collapsed Raster

Picture collapse was the complaint on a Thorn monochrome set fitted with the 1500 chassis, and on switching it on the expected brilliant horizontal white line appeared. On switching off however this momentarily returned to a nearly full-sized raster. The first move was to fit a new PCL805 field timebase valve. It was then found that a full-sized raster would develop, then collapse, at regular intervals of about a second. Intermittent field collapse is common enough, but not this recurrent cycling. Voltages were checked but weren't much help since naturally they varied with the fault. We decided to examine the output pentode's cathode components, and this turned out to be the correct move since the bias resistor R103 had risen in value from 300Ω to several kilohms. As a result, it seemed that the pentode had been repeatedly discharging the associated 160μF decoupling electrolytic to produce the symptom. Replacing the resistor completely cured the fault

No Colour

A solid-state Bush colour set (A823 chassis, A807 decoder) was brought in with the complaint no colour. A quick check showed that the colour-killer transistor 3VT1 was not being switched on, due to lack of drive from the R – Y switch sync transistor 3VT11. This transistor is a pnp type, with its collector returned to chassis via a 22kΩ resistor. The collector voltage should be about 0·6V on monochrome, rising to about 17V on colour. Checking the transistor revealed an open-circuit base-emitter junction, and on replacing it and adjusting the associated bistable phase control 3RV7 quite a good picture was obtained.

At high settings of the colour control however there was annoying streaking. The control was checked but seemed to be in order, so we went on to make other component tests. The decoder is unusual in that the bursts are used directly to drive the 4·43MHz crystal rather than being fed to an oscillator phase control loop. Before being fed to the crystal however they have to pass through a phase switching circuit (see Fig. 1) so that the burst phase swings (±45° about the – U axis) are removed. One of the 1N4148 diodes (3D11) in the phase switching circuit was eventually found to be responsible for the trouble, due to impaired forward/reverse resistance. As a result, an unbalanced signal was being fed to the following crystal driver transistor 3VT8.

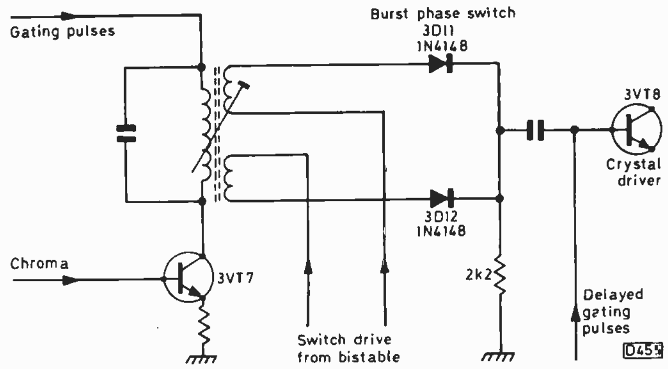


Fig. 1: Simplified circuit of the burst phase switch used in the Rank A807 decoder (the single chip one).

Poor Reception

The complaint on a Bush colour set fitted with the A823 chassis was poor colour – especially on ITV. On inspection we found that a reasonable picture could be obtained with the colour control at minimum, though the contrast was only just adequate. On advancing the colour control however the degree of noise, especially on the ITV channel, was intolerable. Though in a poor recection area – at the foot of a steep hill – there was a good outdoor aerial which appeared to be in order. So the internal aerial connections were remade, and the preset tuner a.g.c. delay and i.f. gain controls adjusted. This produced some slight improvement, but reception was still below standard. We next tried a new i.f. panel, since this simply plugs in, but again there was negligible improvement. It seemed therefore that there was a tuner or aerial installation fault.

The owner then mentioned that he had a mains/battery portable which he used as a second set upstairs, fed from a tapping on the aerial downlead going past the window. Trouble solved! The feed had been taken off with no splitter. Removing the tap and fitting the portable with a good set-top aerial gave normal results on both sets.

No Line Lock

The complaint with a GEC hybrid colour set was that the picture had suddenly become a mass of lines, i.e. no line lock. A new PCF802 line oscillator valve produced no improvement, and it was then noticed that the line oscillator coil's core was well above the top of the can. On setting the line hold control to mid-travel and screwing the core in with the fingers, a solidly locked picture was obtained. The core had probably never been properly adjusted, necessitating the hold control being set to one end of its travel. Component and valve ageing had then gradually shifted the oscillator's working point until it had reached the end of the pull-in range. Anyway, no further trouble has been experienced with this set.

A word of warning about line oscillator coils on all makes: never attempt adjustment without the correct tool, usually a hexagonal nylon trimmer. Attempting to use a screwdriver can easily result in the core cracking and becoming jammed, and even if you subsequently think you've got all the broken core out you'll probably find that a grain or two are left, or the internal thread is damaged, thus jamming the new core. It's not worth chancing.

Long-Distance Television

Roger Bunney

THE year 1978 certainly proved to be noteworthy from the long-distance television point of view. Amongst other things, there were the first 12GHz satellite transmissions directed to Europe, though few enthusiasts to date have been able to participate in the experiment. Perhaps the major factor however has been the massive increase in sunspot activity, with the attendant really long-distance television reception in the UK and continental Europe of signals from Africa, the USSR (Alma Ata region), possibly Malaysia and a tentative suggestion of reception from Australia. With sunspot activity due to increase over the coming year, we can hope for even more significant reception via the F2 layer.

There were several excellent tropospheric openings, particularly on November 7-12th with reception from middle Europe in Band III and at u.h.f. The Sporadic E season was interesting though average, but on July 30th there was the dramatic reception by no fewer than four enthusiasts of North American signals on channels A2 and A3. It seems that the TFL identification then heard may actually have been a reference to TEL, a commercial radio station (WTEL, 860kHz) operating in Philadelphia: the town mentioned in this commercial, Telford, is twenty miles north west of Philadelphia.

Whilst satellite reception is rather beyond most of our capabilities for the present, it's cheering to note that certain South African enthusiasts are resolving signals from the Russian Stat-T satellite at 714MHz using quite simple equipment. In fact in the October *EBU Technical Review* there's a report of such reception on a conventional a.m. vision receiver, along with a clear but noisy shot of the BPEMR caption (f.m. vision modulation is used).

There was some interesting reception during December here in Romsey. RTVE (Spain) ch. E2 appeared on the 2nd and 5th, via Sp.E. On the 14th there was excellent meteor (Geminids) scatter reception in Band I. In the early morning period on the 19th TSS (USSR) chs. R1 and 2 and YLE (Finland) ch. E2 came in via Sp.E, while on the following day there were really strong signals (peaking at 550μV) from TVP (Poland) on ch. R1. Further Sp.E reception brought SR (Sweden) ch. E4 on the 29th. Most days produced MS signals of sorts.

A cold front on December 6th brought signals from West Germany, Belgium and Holland to the north east of the UK via tropospheric ducting – reports came from Kevin Jackson (Leeds) and Brian Fitch (Scarborough).

Dramatic reception from the USSR occurred during the 1000-1200 period on December 14th. Both Hugh Cocks (Honiton) and Derek Waller (Consett) report reception of a ch. R1 programme consisting of a piano recital followed by ice hockey. The 0249 test card was also seen, with an offset, i.e. l.f. of the nominal 49·75MHz vision carrier, peaking just below the main programme. The clock couldn't be resolved, due in part to the characteristic smearing. It's likely to have originated from the Tashkent area – or eastwards of there.

N. Parkes, who lives half way up a tower block in Co. Antrim and is unable to use an outdoor aerial, reports reception of ghosty coloured people on ch. E2 for fifteen minutes on November 12th, using just a half-wave dipole. Other sightings confirm this to have been reception from Rhodesia, indicating the strength such signals can attain – especially as the dipole can give optimum reception only on an east/west path.

A letter from Anthony Mann on December 10th gives news of continuing BBC and TDF TV sound reception in Australia. The offset frequencies of several relay transmissions have been measured, and on December 8th the MUF over the Europe-Australia path reached 43MHz. This day produced several ch. B1 sound signals, one with a –32kHz offset, two with no offset and two with 18kHz offsets. A good day!

Perhaps the most dramatic F2 news this month comes from Kevin Jackson (Leeds) who reports receiving a blank PM5544 pattern on ch. E2 on November 13th. Other observations in the UK suggest that this may have been reception from Malaysia. For two minutes on the 19th however, from 1246 GMT, Kevin noted a weak vision carrier plus line sawtooth with an associated sound carrier (tone) above the ch. B1 vision buzz. It transpires that the channel corresponds to the Australian ch. 0 (46·25MHz vision and

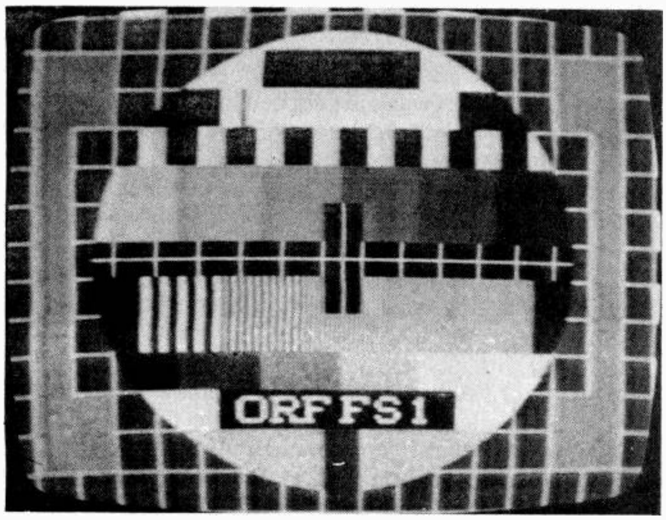


Fig. 1: The ORF (Austria) PM5544 test pattern received on channel E2a by N. Parkes, Co. Antrim, N. Ireland, using an indoor dipole. N. Parkes has also received Rhodesia on the dipole.

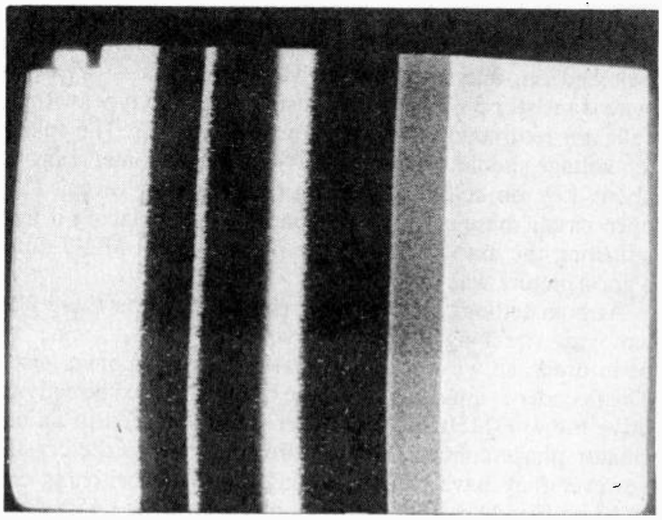


Fig. 2: The OTS-2 satellite's test pattern received by Steve Birkill. The composite waveform consists of a bar, pulse, chroma pulse and staircase.

51·75MHz sound carriers). At the same time, Russian F2 forward scatter communications signals rose to overloading levels. This report coincides with a similar one from Reg Roper (Torpoint, Cornwall). Anthony Mann was consulted and suggests reception of TV station ABMN-0 from Wagga Wagga, NSW. Our congratulations to Kevin on this possible mid-morning Malaysian and lunch time Australian reception.

Corrections

In the Nov. 1978 column reference was made to a "pussy cat" test card, thought to have come from an Italian "free" TV station. Several readers have written to me about this, including Gera Ocwar, a biology professor at Budapest University. Circa (at the top) stands for small cat and vizio for television, and it's a childrens' programme. The transmitter is atop a 400 metre hill near Budapest, Hungary. Our thanks to Mr. Ocwar.

Our mention of distant Russian TV reception in the January column should have read October 18-20th and 22nd (not 21st).

Those who've bought copies of my DX-TV book published by Bernard Babani (publishing) Ltd. should have received a correction slip with their copy. If they didn't they should write to the publishers including an s.a.e.

News Items

Sri Lanka: The broadcasting authority has invited applications from interested parties to establish private TV stations at u.h.f. (or cable).

India: The Dehli transmitter is being increased from the present 50kW to 100kW e.r.p., with a doubling in mast height to 200 metres.

Japan: The Telecommunications Ministry has announced a space programme to launch the first commercial TV broadcasting satellite during the 1984 financial year.

Iceland: Pye TVT Ltd. have completed a major contract to convert to colour the RUV studio complex at Reykjavik.

Radio Society of Great Britain: The RSGB's journal *Radio Communication* featured an interesting and important article on "Transequatorial DX contacts on 144MHz", by J. Rottger, in the December 1978 issue. It's worth study by anyone who can get hold of this particular issue.

TV-DX Lecture: I'm informed that there will be a lecture on DX-TV at the Northern Radio Mobile Rally, to be held at The Victoria Park Hall, Keighley, West Yorkshire on Sunday May 22nd after 1400. Doors open at 1130 for the event.

Commercial Corner

I've been musing recently over a small but interesting publication, *Home-Satellite TV Reception.* It's a basic guide to the technology and theory relevant to the 4GHz satellite service, and is available in the US to anyone who wants to invest in a backyard terminal. The simple text ensures that the principles and practice of setting up a terminal are understood, but there's no circuitry or constructional data. I found it very absorbing as general background reading, being written in the characteristic casual US form. There are 52 pages plus a soft cover, measuring $5\frac{5}{8}$in. × $8\frac{1}{2}$in., with diagrams and photographs. It costs $5 in the US, but is available in the UK at the rather high price of £3, inclusive of postage, from Real-World Technology, 128 Cross House Road, Grenoside, Sheffield S30 3RX. Only a very small

Fig. 3: Impressive u.h.f. DX-TV by Ryn Muntjewerff, Holland.

quantity of these books has been imported from the US, as a service to satellite enthusiasts and available only from the above address – not through bookshops.

Astra Aerials sent us for evaluation a small u.h.f. notch filter, type RSPK. It's about 1½in. long, for in-line use, with a small blister housing for the peaking adjustment. Measurements proved interesting. My own calculations (and some rusty exercise with log tables!) indicated an on-channel insertion loss of 26dB using the Band IV unit on ch. 24 (local BBC-2), a 2·6dB loss on an adjacent channel (measured vision carrier to vision carrier) with maximum loss of 3dB, and an 0·6dB insertion loss three channels away from the preset notch. The West German Polytron catalogue lists the RSPK4 filter as having an insertion loss of 24dB ± 4dB on notch, and an insertion loss off notch of 1dB. The metal casing is robust, and it's suitable for UK coaxial plug sizes. Adjustment is by means of a brass slug within the metal blister, which is an integral part of the casing. Versions are available for Band III, IV and V use and, at £5·95 including VAT, post and packing, are recommended.

From our Correspondents . . .

Gosta van der Linden, now returned to his Rotterdam home, has written to report on his extended stay in Israel.

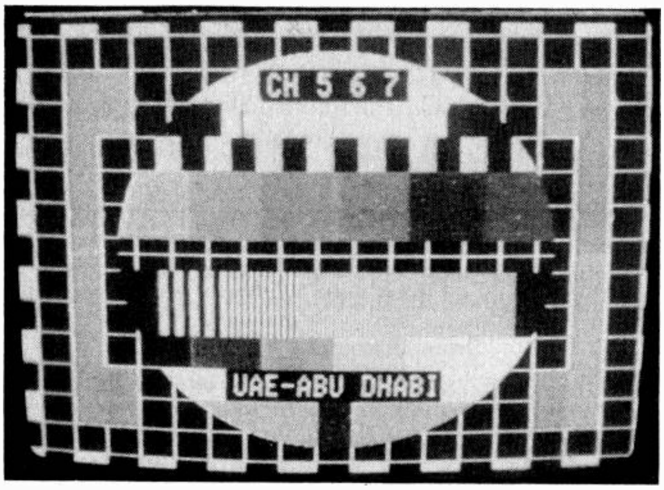


Fig. 4: The PM5544 test pattern received at Cork University from the OTS-2 satellite. Tests are being carried out in conjunction with various Middle Eastern countries. Frequency 11·64GHz.

He was able to receive Jordan chs. E3 and 6, Israel TV and Egyptian TV in his Jerusalem hotel. Another Arab programme was noted on ch. E3 following the close of Jordanian TV. This is thought by locals to be Port Said, though the EBU understand that this outlet has been closed. There's nevertheless severe interference on certain days to the Jordanian ch. E3 TV transmissions. The signals present in the Galilee and Samaria regions are IBA Israel, Syrian TV, and Lebanon TV1 and TV2, while Cyprus is present at u.h.f. in Haifa. Jordan TV uses the PM5544 pattern with the identifications JTV and AMMAN: the English language service includes News at Ten!

Allan Latham and John Steel both write from Abu Dhabi. With the arrival of winter the excellent tropospheric signals have departed but Bahrain, at 250 miles, is present all the time. Sp.E signals have included Pakistan ch. E4 at good quality on November 26th, and Baku chs. R1 and 2. F2 signals from Switzerland, Spain and Poland have been identified.

Ryn Muntjewerff (Holland) has sent an impressive report of tropospheric reception during the period November 7-12th. Czechoslovakia was received on chs. R6 (two transmitters), 7, 9, 10 and 12, with the second chain being received on chs. 22, 24, 26, 31, 33, 34, 35, 36 and 38; Poland was received on chs. R3 (!), 9, 12, 25 and 29; Austria on chs. E8, 21, 32, 49 and 59; also many E. German transmitters. An interesting reception was the 200W British Forces Broadcasting Service outlet at Verl, on ch. E44.

This magazine certainly seems to get around nowadays. We've mentioned reception of the Nigerian Sokoto ch. E3 transmitter, and have since received from Riyadh a letter from a senior RCA engineer previously stationed at Sokoto! The transmitter is actually at Jaredi, some 30km SW of Sokoto in NW Nigeria. The PAL transmissions are radiated by two RCA type TT25FL transmitters derated to 18kW to take into account the wider PAL bandwidth. The omnidirectional aerial has a gain of 10 and is mounted atop a 1,000ft. mast. The ch. E9 transmitter (also noted on the caption received) is at Gusau and uses an RCA TT12EHS transmitter derated to 9·8kW, feeding an aerial with a gain of 10 atop a 500ft. mast: it receives Sokoto off-air on an aerial mounted at 300ft. on the mast. Apparently the Canary Isles ch. E3 signal often disrupts the one from Sokoto, so Gusau goes on to local programmes at such times. The caption "Stay Tuned" shown in the December 1978 issue is used to cover up problems when the programmes start late or finish early. Many thanks to Mr. Watson, who is now stationed at Riyadh to provide assistance with the Saudi Arabian TV Service's engineering operations. The transmitters in this network are of 5kW maximum, and operate with SECAM colour signals.

Satellite Latest

An interesting letter has arrived from University College, Cork, Ireland, reporting the installation of an X-band receiving terminal to study new techniques in low-noise receiver design and microwave propagation. A 2·4m diameter prime-focus feed linear-polarised aerial system feeds a gallium arsenide f.e.t. low-noise amplifier, with down conversion to 70MHz. The OTS-2 ch. 4 signals at 11·64GHz are being resolved, giving good quality pictures.

Steve Birkill reports making further improvements to his OTS-2 12GHz receiver, and comments that he's been observing "just about every TV waveform known to man." I hope to be able to give more detailed information on both these systems next month.

TV Servicing: Beginners Start Here...

Part 18

S. Simon

WE have spent several months now examining the various bits and pieces that go to make up the average monochrome TV set. As one of our friends in Singapore has so rightly pointed out, we should now put the pieces together in block form to see how they fit together. Because of our mail bag, we are probably in a better position than most to gauge how far off the mark we are in presenting a series like this, and it seems that a touch on the tiller is required to get us back on course. We're going to be as practical as possible therefore as we examine the complete receiver with the aid of our block diagram (see Fig. 1).

The Cabinet

What better than to start with the receiver cabinet, which embraces the whole thing, needing only an aerial signal and a potential difference from the mains or a battery supply – the power requirement becoming lower and lower as the efficiency of modern circuits improves – in order to present a picture on the screen and sound from the loudspeaker or headphones.

We already know that there are quite a few high voltages in various parts of the receiver, also the fact that the majority of mains-operated sets have the mains connected directly or indirectly to the metal work, so that the chassis is always live with respect to true earth. The user must be protected from accidental contact with the metal work therefore. Thus the control knobs are made of plastic, and hopefully fit on to plastic spindles whether these protrude through the cabinet or not. We say hopefully because we've seen examples of sets (admittedly older ones) in need of repair with the control knobs missing and metal spindles protruding, inviting severe shock or death to whoever contacts earth (plenty of earth points around in the average house) and the spindle should the chassis be live.

So the cabinet is not there merely to make the thing look presentable, but also to protect the user from the possibility of shock. This object must not be defeated. How could it be, you may ask? Many times we've seen the original aerial socket, which is isolated from the receiver by capacitors (whether they are apparent or not), removed and replaced by a straight through coaxial coupler or just twisted wires. We will never do such things, will we? Another common safety defeat is to fit legs to the set, using wood screws which go straight through the wood and touch the metal chassis. This is a death trap for children, and sadly has been on more than one occasion.

So there's more to a cabinet than meets the eye.

The Front End

The first item in our block diagram is the tuner unit. The transmitted signals induce into the aerial current variations which are coupled to the tuner, hopefully without too much loss, by a cable, a plug and socket, and then a short length of cable to the tuner's input point.

Right away we have a very common cause of no signals, or of severely attenuated signals resulting in a noisy picture with hissy sound or merely a mass of "mush" with little to commend it from an entertainment point of view.

This can result from a fault in the aerial itself, or more likely be due to a poor connection at the plug or socket. The plug itself is a prime cause of poor results, and is easily checked but often overlooked. The main trouble seems to be that quite a few people are in the habit of removing the plug "as a safety precaution". This leads to a general loosening up and the braiding tends to unravel itself, ending up with a few whiskers touching the inner conductor so that the signal is shorted out. The unplugging procedure also tends to loosen the socket itself, and this may have to be resoldered or replaced in order to restore normal working.

The lead from the socket to the tuner is not usually suspect, but in some models it's doubled back on itself at the point of entry to the tuner and this is a common trouble spot worth checking as the inner tends to force its way through the insulation and touch the outer braiding.

If the trouble is weak, noisy reception and the above points are in order, it's likely that the first stage in the tuner, i.e. the aerial signal amplifier or r.f. amplifier as it's called, is at fault. This can be due to several factors: a mechanical fault such as fouling rotor vanes (touching the stator at one or more points if the tuner is mechanically tuned); excessive a.g.c. if this is applied to the tuner, possibly due to a defective or incorrectly set local-distant control; or, more likely, failure of the first stage transistor which can be affected by the build up of static charges on the aerial. A quick way of checking this is to apply the aerial signal to the output of the first stage rather than to its input. We must assume that the usual precautions have been taken to ensure that the chassis is not live – you'd have done this in the first place of course for your own safety. Even so, the output of the first stage could have a voltage on it, so we remove the aerial plug and connect a small capacitor to the inner lead only. Apply the capacitor first to the input, and note the resulting signal. Then apply it to the output of the first stage (say the collector of the first transistor). If the resulting signal is stronger, the stage is proved to be at fault – be it a faulty transistor or some other defect – and the fault localised.

The IF Strip

Weak reception is not necessarily due to the first stage however, or the tuner unit. It could well originate in the early stages of the i.f. strip (our next block). The output of the tuner is usually taken to a filter unit so that unwanted signals can be tuned out before the signal is applied to the main amplifier. This filter unit can be a trouble spot, mainly because of poor soldered joints on coils or small capacitors. Do not attempt to alter the tuning of any coil, i.e. don't move the coil slugs. Merely check and remake any suspicious looking soldered connections. Plugs and sockets on the i.f. board are also suspect.

All this relates to a noisy (grainy) picture. Faults farther along the i.f. strip can cause noise due to lack of a.g.c. action (everything working flat out elsewhere to make up for the loss of gain in the faulty stage), but the result in this case is more likely to be a weak picture (if any) on an overall grey screen, with the sound weak or also absent. A misleading fault is where the sound gets through at fair strength but there's no picture, casting suspicion on the video circuits though the fault is in the i.f. section. The weak spot in most i.f. strips is the final i.f. stage (just before the detector), where the transistor is subjected to larger voltage swings (higher current) than in the earlier stages. A transistor such as the BF197 will be found in this position.

In some receivers the whole i.f. strip is contained in one separate unit which can be replaced as such (or removed for service). So our blocks are not too far from the actual physical arrangement used in some types of receiver. In others, the i.f. amplification is carried out by an integrated circuit. As far as we are concerned however the essentials are that the aerial signals have been amplified and processed by the tuner unit, emerging as the same signals but now in an envelope of a lower frequency band to which the i.f. strip is pretuned. We've already described this process in some detail in previous issues, also the methods of "detecting" or demodulating the amplified i.f. signals and sending them to their respective channels to produce the required variations of sound or light output. We are concerned here with identifying the sections which carry out the various functions, where they are, and what happens when they fail to operate.

No Sound

If for example the picture is perfectly presented on the screen but there is no sound, we would not waste time in checking the tuner unit or the main i.f. strip but would concentrate on those circuits which follow the point of separation, so we can say that this fault is likely to be in the sound i.f. amplifier (intercarrier sound channel), audio stages or loudspeaker – including any such things as an earphone socket (included on most portables). The action to take depends upon several factors. Do we know this type of set well, or is it a stranger? If it's a stranger, do we have servicing information which gives the circuit and layout diagram?

If not we have to adopt a logical approach, depending upon the facts known. If little is known we would have to start from the loudspeaker and work back from this, proving each section as we go. The loudspeaker is fed from the sound output stage or audio unit, which is in turn fed with detected signals derived from the sound i.f. strip. A handy check point is the volume control, which should produce some sort of noise from the speaker when rotated or otherwise advanced, indicating that the audio stage is in order. The volume control tags will provide a more positive indication when touched with a screwdriver blade – if a signal injector is not to hand – but if the on/off switch is incorporated with the volume control it's prudent to ascertain which tags are which.

The Line Timebase

In some ways lack of picture is easier to trace than lack of sound. This is because we have a tube face to look at, and this acts as a visual display provided it's properly supplied. Of all the blocks which make up the whole, the line timebase is the most vital. Without it the tube cannot function at all and therefore cannot tell us anything. The line oscillator provides the drive waveform which switches the line output valve or transistor on and off, in turn energising the line output transformer and scanning coils in order to deflect the tube beam horizontally from the centre to one edge. The beam then flies back at high speed, creating large energy pulses in the line output stage. These are used for many purposes – indeed it's quite possible for the line output stage to provide all the power required by the rest of the set. This is another story however, and we must confine ourselves for the present to the commonplace designs of recent years, assuming that the line output stage will be used to provide – apart from the horizontal scanning action – the high potential (e.h.t.) needed for the c.r.t.'s final anode, from about 10kV for a portable to 25kV for a colour tube; the c.r.t.'s first anode supply of up to 1kV; the second anode (focus) supply, the requirement here varying according to the tube from zero up to 5kV; and in addition various gating or blanking pulses, reference pulses etc. required to time or trigger various circuits. The line output stage may also have to supply the tube's heater, and in the case of portables powered from a 12V battery any other part of the receiver requiring a higher voltage.

Although we show the power supply as a separate block, as indeed it is in most past designs, there are many present generation receivers where the power supply and the line timebase must be treated as a whole, the mains merely being rectified before being embraced by the unified power and line timebase unit, this concept being further complicated by the necessity to protect it from overloads. Our no picture condition could therefore be a complicated one to solve in some designs. For the sake of simplicity however we'll stick to our block diagram, which is representative of the majority of sets.

No Picture

The term "no picture" is a very loose one and we should be more precise about it. One can have a fully illuminated screen, i.e. a raster is displayed, but with no modulation on it. In basic terms this means that there are no signal voltage swings to vary the voltage difference between the tube's grid and cathode, i.e. all supplies are there but there are no voltage swings coming from the video stage. These voltage swings are generally applied to the tube's cathode, occasionally to the tube's grid instead (the ITT VC200 chassis). A lot of words, but all this can be confirmed at a glance.

So if there's a raster (screen illumination) one knows many things almost without thinking about it. To confirm that the fault is outside the tube and its supplies, operate the brightness control to prove that it (the tube) is capable of responding to variations of voltage between its cathode and grid. This done, and if the sound is in order, we have to turn our attention to the video stage(s).

No Raster

If the screen is not illuminated at all however, there are several factors to consider. We would carry out a few simple tests based on likelihood more than anything else. The neon screwdriver is a handy device here, because if the line output stage is functioning the neon will light up when brought near to the line output transformer (not touching it). If the neon lights, it's likely that the line output stage is functioning reasonably well (not necessarily well enough) and that e.h.t. could be present on the tube's e.h.t. connection cap.

Older sets using a valve e.h.t. rectifier provide another useful clue. Since the heater of such a valve (say a DY802 or similar) is supplied from the line output transformer – usually by a single loop of heavily insulated lead – the fact that the valve is alight means that the line output stage is functioning and that e.h.t. is likely to be present at the tube cap.

The presence of e.h.t. can often be confirmed by presenting the back of the hand to the front of the tube face. If a tingle is felt (your hair stands on end) no further proof is needed. This simple check is dependent upon several conditions however as by now you may have charged up with static yourself. We'll leave this business of static charging for another time however, as we must get on.

If the neon doesn't light or there's no e.h.t. there's no point in making any further preliminary tests: we must go straight to the line timebase block to find out why it's not functioning. The procedure required depends upon the type of receiver being checked. If valves are used, it's helpful to observe whether they (particularly the line output valve) are running hot or cool.

If the line output valve is very hot indeed this could well imply that it's not receiving any drive from the line oscillator stage. A voltmeter applied to the line output valve's control grid should record a negative voltage of some −30V or more if full drive is present. This voltage can be attenuated to zero if the line output valve itself is faulty, so a recheck should be made with a new valve fitted. If the drive is still absent, the line oscillator stage should receive detailed attention, also the coupling between the oscillator and the output stage. The two stages are not always near each other and there could well be a fault in a panel track leading from one to the other.

If the line oscillator in an all transistor circuit fails to function, or its output is not being applied (probably via a driver stage) to the line output transistor, the latter will not overheat because it will not be being switched on. This is a basic difference between valve and transistor line output stages.

Still with valve line output stages however, the line drive could be present but the valve may still overheat (not so severely) because there is an overload in the output stage. This could be due to many possibilities, which should be checked by unhooking as many lines as possible. The distinct probability however is either a shorted e.h.t. rectifier or shorted turns in the line output transformer.

This latter condition is a very common one but is sometimes difficult to prove. Every other possibility should be checked first (before obtaining and fitting a replacement transformer). Try new valves (a defective efficiency diode can often cause the line output valve to overheat), disconnect the e.h.t., disconnect any diodes feeding other supply lines – in short merely leave the bare essentials.

Line output transformer trouble is sometimes easier to detect. For example, some transformers have a tendency to short between adjacent windings rather than between adjacent turns. In valve line output stages, removal of the top cap of the efficiency diode (say PY800) should result in no h.t. supply at the top cap of the line output valve (say PL504). If the PL504 continues to work when it shouldn't, one must conclude that the h.t. supply is reaching it via another path. This could be the result of a shorted boost supply capacitor (hopefully), in which case it can be identified and disconnected. If the supply is still present and there is no other avenue, an ohmmeter test on the line output transformer should show that there is a short between the windings. This was or is a common failing in certain Philips and Pye receivers.

Some transformers tend to develop shorted turns in the e.h.t. overwinding (the slab that feeds the top cap of the e.h.t. rectifier). In fact the timebase can continue to work in some cases in this condition, but at much reduced efficiency. A spark drawn from the top cap of the PL504 will be of a certain intensity: a spark drawn from the top cap of the e.h.t. rectifier should of course be far more intense (multiplied by the overwinding). If it's less intense or is not amplified, one has to conclude that there are shorted turns in the overwinding. This presumes that one has removed the e.h.t. rectifier valve, which could be responsible if shorted. Failure of this type is very common in many Bush-Murphy receivers for example.

When it's found that the line output valve is running cool, attention should first be directed to its screen grid supply. This is usually derived from the h.t. line via a 2·2kΩ wirewound resistor, which could be open-circuit. There will be no output from the line output valve if its screen grid supply is missing. Some wirewound resistors used in this position incorporate a thermal cut out: when the resistor overheats, the solder holding a spring melts, the spring flying open to prevent any further current flow. In this event one should suspect the line output valve of passing excessive current and proceed accordingly, replacing the valve, checking the line drive, and ensuring that the efficiency diode is operative.

If the line timebase is working properly and the e.h.t. is present, the rest of the tube's supplies will have to be checked. You will remember that we need a first anode supply which is derived from the boost voltage line. It's taken via a high-value resistor (as the current drawn is small) and may also feed the focus electrode. There is usually a capacitor decoupling this supply line, and it could well be that this is short-circuited, thus depriving the tube of its first anode voltage. In some old sets the feed resistor tended to increase in value, resulting in a dark picture.

A voltage check at the tube base will reveal whether the first anode supply is present. For the average monochrome table model (say 20in. or 24in.) the tube base pin to check will be pin 3.

Having established that the e.h.t. and first anode supplies are present we must next see whether the cathode voltage is too far above that at the grid. If the tube is as above, the cathode is pin 7 and the grid is pin 2 and 6. A quick check is to short these (pins 7 and 6) together. If the screen lights up fully it should be concluded that the cathode voltage is excessive, so that the tube cannot be turned on. Checks must then be made to find out why this is so.

The particular design dictates the course of action required, and reference should be made to the circuit diagram if there is any doubt. In some receivers the tube's cathode is connected to the video output stage directly: if the latter is not drawing current through its load resistor(s) the tube cathode voltage will be high. The tube's grid could be under supplied on the other hand, possibly due to a fault in the brightness control supply. By and large, with the brightness control fully advanced there should be very little difference in the voltage at the cathode and the grid.

So there we have some examples of no picture faults. We already know much of this, from what's been said in previous issues, but it's no bad thing to repeat it.

The Field Timebase

Similarly, we already know what happens if a fault develops in the field timebase blocks. Briefly, the probabilities are as follows.

First a narrow white line across the screen, denoting complete failure of the field timebase or an open-circuit between the timebase and the field deflection coils. Whilst this path is pretty direct in most monochrome sets, it's devious in many colour receivers and may not be so simple to follow through.

Lack of height, a gap at the top and bottom, normally indicates a fault in the supply from the boost line to the field charging circuit – either the height control itself, or a resistor or capacitor associated with this feed, may be defective – assuming that the loss is even at the top and bottom.

Common causes in the Thorn 1500 chassis for example are a leaky 1μF capacitor (C89) which decouples the boost feed to the height control, leaving the voltage here low or varying. Or the control itself may have a dud spot. In other receivers there tend to be series resistors which go high in value.

More common still is sudden bottom compression, due to an electrolytic capacitor becoming open-circuit. It's a simple matter to bridge a test capacitor across the suspect and note the effect.

All these points and more have been covered in detail in previous issues.

This leaves us with three blocks: the sync sections and the power supply. These should be fresh in your minds. However...

Synchronisation

The composite vision signal is applied to the sync separator, whose job is to remove the picture information and pass on to the timebases only the sync pulses. This implies that the signal can be distorted before it reaches the sync separator, and it's as well to bear this in mind since a goodly amount of sync trouble occurs in the video circuitry or even before this. So if our picture is less than perfectly steady we must not confine our suspicions to the sync separator only.

A close look at the picture often pays dividends. It may for example remain steady until there's a change of scene or brightness level, when it may tend to pull sideways or roll. Any departure from ideal conditions in the video stage will or can impair the line or field locking.

Common causes of such impairment are the a.g.c. conditions and the video stage itself. A fully advanced contrast control for example can overload the video stage, so that its response is less than linear as far as the sync pulses are concerned. The result is sync pulse crushing. Merely reducing the setting of the contrast control could restore normal working, but it's often necessary to reset the operating conditions of the video stage and perhaps the a.g.c. circuit. Faulty electrolytic capacitors in the a.g.c. line can affect the sync pulses more than the vision and sound signals.

Fortunately however most sync troubles can be overcome by a careful check on the resistors associated with the sync separator. The magic symbols 47K are relevant as far as many Thorn group monochrome sets are concerned. The same applies to many GEC series one models.

So if you have sync troubles be careful to observe the displayed symptoms, which can tell you much. Synchronisation can also be affected by the smoothing in the power supply, so we'll take this as the next block.

The Power Supply

Basically, the power unit must take current from a convenient source and change it into the kind of energy required by the receiver. We must stick to basics here since the infinite variation of designs it would be possible to discuss would result in us getting bogged down never to re-emerge.

Very early in this series we described the average sort of mains unit to be found in valved receivers. More recently we've dwelt upon the more complex units found in mains/battery portables, also the thyristor regulated power supply circuits used in some colour sets. Here we're concerned with fault effects, mainly in the "mid period" monochrome hybrid chassis you'll no doubt be cutting your teeth on.

Let's imagine that we've been asked to look at a set which does not work at all. The first step is to confirm that this is indeed so, i.e. nothing works. Although the set may appear to be dead, we must always proceed with caution. We remove the rear cover and with the mains applied we make the first test. What is this?

It's to ensure that the metal work or chassis is not live. This is of course proved with a neon screwdriver. If it doesn't light –

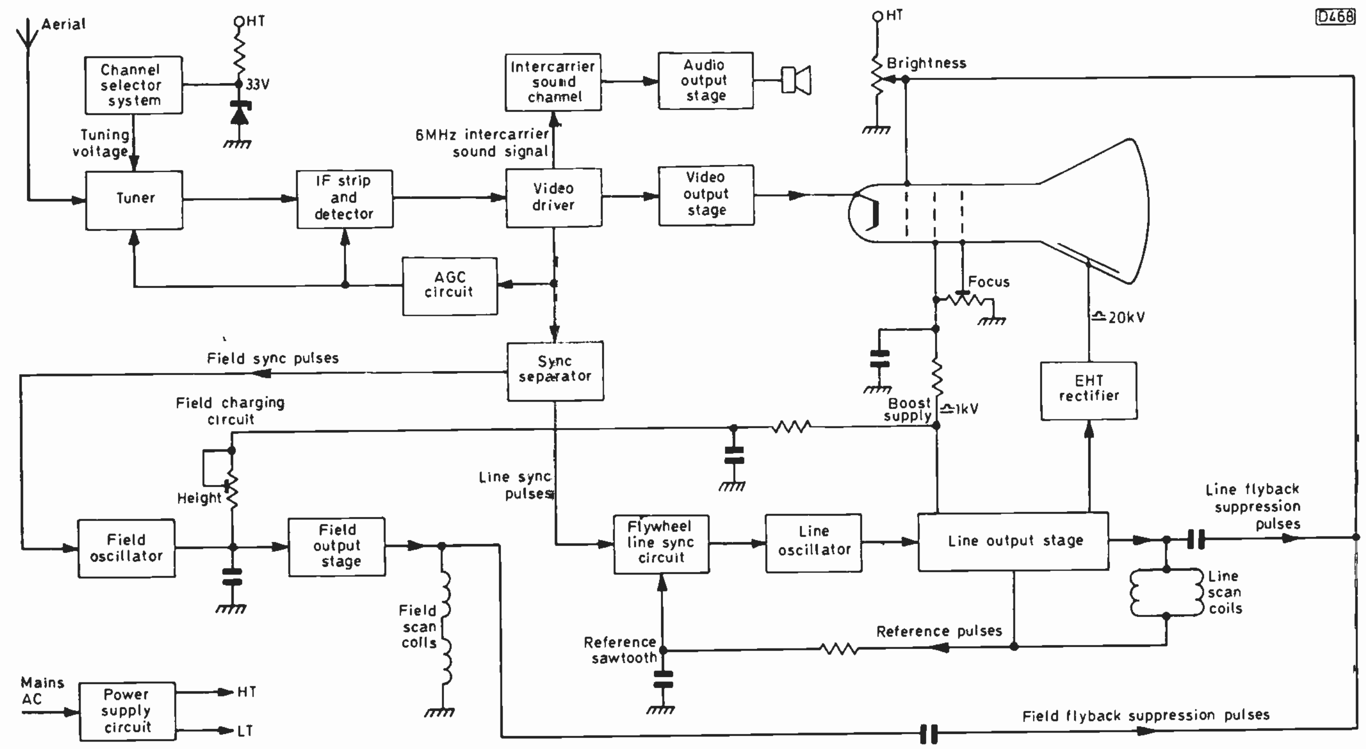


Fig. 1: Block diagram of a typical large-screen, single-standard monochrome receiver fitted with a varicap tuner. In many sets the l.t. supply is derived from the line output stage. Chassis using all solid-state circuitry incorporate h.t. voltage regulation.

and it shouldn't – switch on and repeat the test. If the neon now lights, check the mains leads, reverse or identify brown to live, blue to neutral. Note whether the valves light up. If they don't check the mains at the on/off switch if convenient, or at the set's mains fuse. Ensure that the neon lights at two on/off switch tags and does not light at the other two (neutral return). If the neon lights at only one tag, or if it lights at three, the on/off switch is defective.

If there's no light at any tag it's likely that the mains is first taken to a fuse and that this has failed. If it has failed, note its condition. Is it still intact, or has even the glass blown? If this has happened, or if the glass is blackened, suspect a dead short across the fuse (we've been over this ground before as well, but never mind) and check the mains filter capacitor. This will probably be coloured blue and white, plain blue or plain white. Also check the h.t. rectifier diode which may be shorted. Then check for blackened areas on the print where a short may have occurred between tracks across the plastic.

If the fuse is intact but the valves are not alight, check for mains voltage at any of the tags of the mains dropper. If some tags show power but others don't, identify which are which before proceeding further. If the valves are not being heated it's highly likely that a dropper section has failed. This section will probably have a value of about 150Ω. Turn the set off and check.

If the relevant (heater circuit) dropper section tags all show power, assume an open-circuit valve heater or a further heater section resistor not checked in another part of the set (e.g. the ITT VC series chassis up to VC100). Check leads or print as necessary.

If a valve heater has failed it's quite likely to be the efficiency diode, as this has the greatest stress between its heater and cathode (up to 5kV). If the diode (say PY800) is intact, the neon should light on both pins 4 and 5 and it's then a matter of following the chain along until the neon fails to light. The tube must be included in this checking if necessary.

If the valves light up but the set is otherwise dead, we know that the supplies are in order up to a certain point. If there's not an h.t. fuse we again start at the dropper, to see if a section has become open-circuit thus failing to supply the h.t. rectifier diode. Depending on the set, some of the dropper sections may be used to smooth the h.t. after the diode. So it's a matter of proving the a.c. supply up to the diode and the d.c. after it.

A smoothing section may well be open-circuit. This is a common fault, the awkward bit being that although the h.t. is not reaching the rest of the set it will have charged the reservoir capacitor, as will be recorded by the neon tester or a d.c. voltmeter. So turn the set off and discharge this capacitor. Do this by connecting a fairly low-value resistor from the capacitor to the nearest other h.t. contact or to chassis. Again, there's so much variation in practical designs that we can't offer more detailed instructions.

Once the breach has been located and repaired, check for shorts from the h.t. supply to chassis. Follow up any low readings (probes round the right way, because of the h.t. rectifier diode) and clear any shorts since the original failure may have been caused by excessive current flow.

The failure of one of our blocks to operate could well be because it's not being supplied with power. So before delving into the stage itself, first check the supply to that section of the set, if necessary checking back to the power supply to find out why this particular line is not present.

Defective reservoir/smoothing electrolytics in the power supply are a common source of troubles in all parts of the set, since the supply/supplies concerned will be reduced and no longer effectively smoothed.

Flywheel Line Sync

Returning finally to the sync side of things, you'll notice that the line timebase has its own sync block, the flywheel line sync circuit. If the picture's broken up into lines (no line sync) or the line sync is weak, attention should be directed to this section and the line oscillator. The diodes used in flywheel sync circuits are a common cause of trouble in some chassis, and can change their characteristics to such an extent that they stop the oscillator working, with overheating line output stage valves and so on.

Renovating VCRs

Faults on the Philips N1500 and N1501

D. K. Matthewson, B.Sc., Ph.D.

WITH the introduction of the Philips N1700 long-play VCR and the VHS and Betamax machines, quite a large number of ex-rental and private N1500 and N1501 VCRs seem to be appearing on the secondhand market. Prices are quite reasonable – around £200-300 as compared to the £600-700 needed to purchase an N1700 or VHS machine. At these prices the early Philips VCRs are quite fair buys, both for hard up educational establishments and also for the interested amateur. As well as working VCRs, non-workers can be picked up for considerably less – around £100. With these possibilities in mind some of the stock fault conditions will be discussed.

The N1500 and N1501 are very similar (see *Television* October 1978), differing in styling, the "still picture" facility, a tracking meter and a few other minor points. Most of the PCBs and mechanical components are common to both machines. The electronics are on the whole very reliable, most of the stock faults being due to mechanical problems.

Worn Heads

One of the problems most likely to be encountered on older machines is worn video leads. The life expectancy of the heads used on both these machines is around 1,000 hours playing time, though the manner in which they are cleaned will affect this.

This problem is fortunately one of the easiest – if rather expensive – to rectify. The two video heads are attached to a metal head disc, complete with drive spindle. The entire unit can be replaced after releasing one screw and two Allen bolts. There's no alignment in the mechanical sense at all: this is a very much quicker procedure than that required with some of the early Sony videotape machines, where head alignment can take all morning. With the Philips VCRs, the job should take no more than 30 minutes. The replacement head disc is common to both the N1500 and N1501, and is available from Philips Service at about £55 trade.

To determine whether new heads are required, the best approach is to use an oscilloscope to monitor the output from the head preamplifier PCB. Two heads in good condition should give two balanced envelopes as shown in Fig. 1. A rough estimate of head wear can be obtained by making a recording and examining the playback. The peak white areas, such as clouds, bright windows etc., will show streaking and breakup if the heads are at all worn.

After fitting a new set of heads, remember to check the setting of the head preamplifier gain control on PCB 90. The video head playback preamplifier board (PCB90) differs on different production runs of the N1500. The changeover from the old type to the later one occurred at factory code WR08, serial number 8704. With the older type of head amplifier, the luminance playback gain is adjusted with C901; in later models this adjustment is made by means of R909. Both these presets are located on PCB 90 and can be reached through a hole in the head disc. These controls need adjusting when a new head disc is installed because there's considerable variation between different heads.

This difference also necessitates adjustment of the luminance and chrominance recording currents when a new head disc is installed. R437 and R433 respectively are the two presets involved, on PCB45.

If you're really determined, it's possible to measure the current through the video heads and thus to determine the amount of wear they have suffered. This is done by connecting a 75Ω terminated h.f. millivoltmeter across MP431 and MP430 (see Fig. 1). New heads should give a reading of about 30mV: this voltage will increase as they wear. When a reading of about 55mV is reached, the heads can be considered to be out of specification and due for replacement.

Slow Running Tape Transport

Slow running of the tape transport motor is another common fault, especially on elderly VCRs or those that have been used in dusty environments such as class rooms or shops. The symptoms are picture run through: that is, a reasonable picture on playback but with a noise bar running through it, also very slow, distorted sound. This is often caused by the tape transport motor running so slow as to be out of specification. I can remember the first time one of these problems landed on our bench, and the total perplexity it caused. The fault was eventually tracked down to the motor itself, and was rectified by cleaning out the top bearing assembly, relubricating it and reassembling the unit. A quick check on this can be made by using an Avo meter to

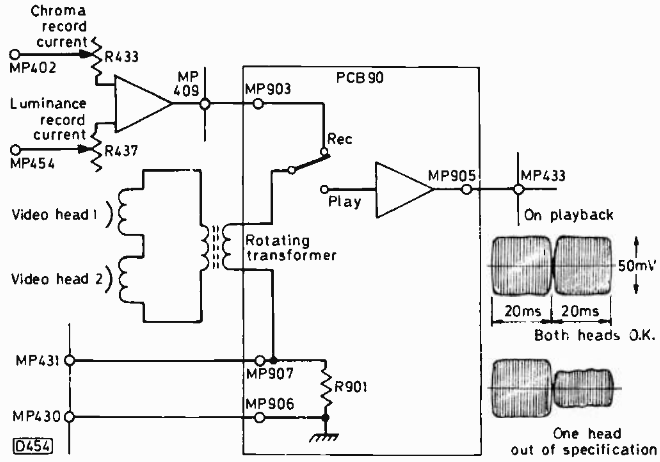


Fig. 1: Block diagram of the video head amplifier arrangement used in the Philips N1500 and N1501 VCRs.

measure the voltage across the eddy current brake coils. Normally the transport motor runs fast, about 8V being applied to the eddy current brake to slow the motor down. If only about 1-2V is detected, this is a fair sign that the motor is running well under speed so that no braking is needed.

Slipping Clutch Mechanism

Very slow or no rewind and/or fast forward is most obvious at the beginning and end of tapes, and is often associated with the slipping clutch mechanism. This system drives the take-up/supply spools, and is of the type often found in audio tape recorders. It consists of plastic clutch plates faced with felt. As old age approaches, the felt discs can get worn smooth or contaminated with oil etc. Before replacing the clutch unit, it's worth trying to adjust the tension between the two plates – Philips use a three-position circlip to alter the applied force. It's worth pointing out that all the various brake pads and surfaces will benefit from a degrease and adjustment.

Capstan Roller

The rubber capstan roller is the idler roller the capstan servo drives against – with the tape in between! After several hundred hours' use this roller gets worse for wear and can seize up on its spindle. It can also get worn away by the capstan spindle, resulting in "D" shaped grooves above and below the half-inch tape path. These can cause uneveness in the tape speed, with consequent problems.

Push-Switch Controls

The "piano" type controls sometimes won't lock down. I've seen this on several VCRs and have always found it to be due to the plastic moulding of the key snapping off. It seems that when the stop key is pressed the previously selected key (play, rewind, etc.) springs back with a bang, which eventually cracks it. The only cure is to replace the damaged key.

Summary

That sums up the common faults in elderly VCRs, though I'm sure there are some that I've not yet come across. The one-hour playing time of the N1500 series may seem to be very limiting, especially when compared with the new five hour tape available for the Grundig SVR4004, but for about £200 an ex-rental N1500 would appear to be the cheapest introduction there is to home video recording. If you're really keen, you could always try halving the tape speed, as mentioned in *Television*, February, May and August (see letters), 1978.

Good hunting!■

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PHILIPS 153A SERIES

The setting of the field hold control on this set has become very critical. The field slips slowly downwards in one direction: in the other, there's a good, high-definition picture on scenes with a light picture content, but on dark scenes the field rapidly vibrates vertically, either continuously or in regular bursts, giving a multiple image with signs of line tearing at the top. I've renewed the sync, video and field timebase valves, but the fault remains.

There are only a few items to check. First, R448 (100kΩ) which feeds the screen grid of the ECL80 sync separator valve. Then if necessary C257 (16μF) and C258 (250μF) which decouple the screen grid and cathode respectively of the PL83 video output valve (we presume that a known good replacement has been tried). Finally the sync separator's anode load resistor R447 (68kΩ) may have changed value.

DECCA 100 CHASSIS

There appear to be Hanover blinds on this set. They are most noticeable on yellow and orange areas, but are also present on cyan and under-saturated blue areas. Lack of interlacing was initially suspected, but there are no problems with a monochrome picture or when the colour is desaturated. The blinds vary in intensity, and appear to traverse the screen upwards or downwards. They are present on all three channels.

It will be necessary to set up the delay line circuit phase and amplitude controls in the decoder. The amplitude of the direct signal is set by VR241, while the phasing is set by L204 and L205. These controls should really be adjusted using an oscilloscope and a special pattern generator. If the Hanover bars cannot be eliminated in this way and the continuity of L204 and L205 is intact, the delay line itself is suspect.

THORN 1600 CHASSIS

About half an hour after the set has been on there suddenly appear increased background mush and crackles on the sound – quite loud in fact. The fault is not affected by operating the volume control, though the tone control reduces the h.f. noise in the same way as it attenuates the h.f. signal.

Assuming that there is little or no effect on the picture, the audio i.c. (IC3) is probably responsible for the trouble. The preceding intercarrier sound i.c. (IC2), the supply line smoothing electrolytic C82 (470μF) associated with IC3, or the decoupler C78 (0·001μF), could be at fault. These are less likely possibilities however.

ITT FEATHERLIGHT 12

The sound is o.k. but there's no picture on any channel. The raster is present, with a rolling flicker but no distinctive modulation. Field flyback lines can be seen, and disappear when the brightness is increased.

The presence of sound on this Japanese produced portable indicates that the tuner and i.f. strip are working correctly, so the fault is likely to be in the video circuitry, i.e. around the emitter-follower transistor TR7 (2SC460) or the video output transistor TR8 (2SC856). First see whether you get about 45V at the collector of TR8 (not 4·5V as on the official circuit diagram!). If not, check the rectifier circuit supplying the video output stage – the diode D10 and its associated reservoir capacitor C313 (3·3μF). If all's well here, check the voltages around TR7 and TR8 to find out which stage is faulty.

BEOVISION 3400

The fault on this set is intermittent loss of brightness. It occurs only occasionally, and is quite unpredictable. After an hour or two it corrects itself. I've replaced the 12V zener diode which stabilises the 12V supply to the signal stages, also the 1μF tantalum capacitor in the vision detector can, and have tried cleaning the pins of the 12HG7 luminance output pentode.

It would be helpful to know which of the c.r.t. electrode voltages changes when the fault is present. If the first anode voltages fall, the 840V supply rectifier 8D9 (BY184) and the associated network 8R22/8C32 are suspect. If the grid voltages are varying, check the clamp voltage source components 3R49/3R50/3D4/3D5, then check back to the tracking circuit transistor 3TR3 and its associated components. If the cathode voltages are varying, which is more likely, the 12HG7 valve itself is the prime suspect. The d.c.-coupled luminance channel transistors 1TR15-18 could be responsible, though failure of the rivets at each end of brightness control track is more likely. Another possibility is variations in the –210V line, due to the rectifier (8D6, BA148) or its series resistor 8R16 (2·2kΩ, 1W). These are fed from the line output transformer.

THORN 1500 CHASSIS

There's a raster, but no sound or vision – the only signal present is a slight local BBC radio one.

First make sure that the HT6 line (26V) is present and reaching the signal transistors. Then check the voltages around each of the i.f. and video transistors VT4-8. You'll probably find the voltages around one of the transistors widly incorrect. If so, check for leakage in the 0·04 F emitter decoupling capacitor where appropriate, then suspect the transistor concerned. If the voltages around VT4-5 are incorrect, check the a.g.c. transistor VT3 and the associated components.

ITT CVC30/2

This set incorporates teletext reception facilities. The teletext display is good, but on picture the white goes out of focus when a white line or letters or a very bright scene is present. The whites are perfect if the contrast control is reduced to a very low setting.

Set the a.g.c. preset control R318 for 3·3V ± 0·3V at the anode of the tuner a.g.c. delay diode D2, with a test card F input of about 1mV. Then check the beam limiter circuit, by confirming that the voltage at the cathode of D3 swings from 0·8V to 3·2V over the range of the brightness control. Finally, set the focus control R100 for optimum definition of the highlights.

ITT VC300 CHASSIS

I'm having difficulty with a no raster fault on this set. The voltages around the sync separator/line oscillator are correct, and on test both the line driver and output transistors seem to be o.k., though the latter gets hot after the set has been on for a time. A replacement has been tried, but still no luck. The diodes providing the l.t. supplies and the c.r.t. first anode supply have also been checked, and a new line output transformer tried.

We suspect loading on the line output transformer. Two items you don't mention are the e.h.t. rectifier stick and the boost diode: we've had many failures of these – and the other diodes in the line output stage – giving the symptoms described. Another possibility is a defective capacitor, especially the boost capacitor C93 and the 90V and 400V reservoir capacitors C94 and C96 respectively. If the e.h.t. returns when the scan coils are disconnected, suspect the associated capacitors C91 (part tuning and line output transistor flashover protection) and C92 (scan correction) and the yoke itself.

TANDBERG CTV2 CHASSIS

There's lack of both height and width, but I'm not sure which control to adjust. The brightness and colour rendering are both all right, as is the sound.

This chassis uses a blocking oscillator switch-mode power supply, and it would seem that the h.t. output from this is low. The easiest point to check is at R751 at the bottom of the right-hand panel. There should be 120V at one end of this resistor and 160V at the other, h.t. feed end. If the h.t. is less than 160V, locate the grommet in the screened can beneath the c.r.t. neck and, using an *insulated* tool, turn clockwise for 160V. If the picture size varies erratically, D975 inside this can is suspect.

DECCA 30 SERIES CHASSIS

Red is usually missing when the set's switched on, but full colour can be obtained by smartly tapping the cabinet in various parts. Subsequently, there's intermittent loss of red, often self-righting. I've searched for a dry-joint in the red channel, but without success.

If tapping the cabinet affects the fault, there's got to be a poor connection somewhere! Check the two miniature skeleton potentiometers VR318 and VR322 associated with the red output transistor TR217 – they commonly go junky. The transistor's collector load resistor R298 is also suspect – internally if not dry-jointed to the panel.

THORN 1590 CHASSIS

When the set's been on for about half an hour the screen goes black with white flashes across it, accompanied by crackling noises. After a short while there's a crack and a flash and the picture returns. The set then operates normally without repetition of the fault. The sound is normal when the fault is present, and the cracks are audible with the volume control turned right down.

This sounds like e.h.t. stick rectifier breakdown. Try lifting one end and running the set with no e.h.t. for a spell. If this effects a cure, replace the stick. If the fault then returns, check the capacitor (if fitted) from the output end of the stick to chassis (C115). Failing that, the c.r.t. or the line output transformer could be faulty. If the fault remains with the e.h.t. removed, check the c.r.t.'s first anode supply reservoir capacitor (C110, near the line output transformer) and the 95V supply reservoir capacitor (C111, in same area). Look for cracks and signs of arcing on the main panel, and ensure that the c.r.t.'s aquadag coating is properly earthed.

FINLUX PEACOCK

The problem with this set is no raster – just three distorted coloured loops about mid-screen. The only clue I have is that R401 and R402 are burning.

The two resistors you mention are in parallel with the field scan coil circuit, so it would seem that this is not intact. The coils are connected in series with L507 and the north-south pincushion distortion correction transductor TRD502, so there are several things to check for being open-circuit.

GEC 2010

The problem with this set is a faint white line down the screen, about $\frac{1}{4}$in. wide. It's just off centre, though the position can be altered by adjusting the line hold control. The line is visible only on dark scenes, and only when there's picture content present (disconnecting the tuner or mistuning away from the channel removes it).

The problem could be due to insufficient line flyback blanking. In later sets in this series, flyback blanking pulses are fed from pin 5 on the line output transformer to the grid of the c.r.t., via a 330kΩ resistor (R146) and 0·001μF capacitor (C195) in series. The components can be added between points SC8 and SC13 on the timebase panel.

PYE 697 CHASSIS

With the contrast control at the setting which is correct for the picture, there's a dark band across the screen whenever words such as the BBC-1 caption appear – the band is the height of the lettering. Even with no lettering, there are bands in varying shades across the screen, depending on picture content. The fault can be cleared by reducing the contrast control setting, but the picture then lacks contrast. I've replaced the colour-difference and luminance output valves, also several components in the beam limiter circuit – I had to use two 25μF electrolytics back-to-back to replace the 12·5μF non-polarised electrolytic C201 in this circuit incidentally. The TBA480 intercarrier sound i.c. was replaced because of a sound fault, and the tuner because of a noisy picture. After all this work, I'd appreciate help with the remaining fault.

There seem to be two possibilities, either a defective c.r.t. or incorrect frequency response in the luminance output stage. It would be worth checking all the decoupling capacitors in the luminance output stage – C351 (0·0047μF) in the cathode circuit, C353 (4μF) and C354 (10μF) in the screen grid circuit and C352 (32μF) in the anode circuit.

THORN 1400 CHASSIS

The receiver was working normally, then all of a sudden the raster went off, leaving the sound unaffected. On checking, I found that the fusible resistor R145 had gone open-circuit, removing the h.t. supply to the line timebase. R145 goes open every time I reconnect it, so I can't check voltages. What do you suggest?

A 220pF 8kV disc capacitor for third harmonic tuning is connected between the cathode of the boost diode and chassis. It's mounted across tags on the line output transformer. Inspect this, and if it looks upset (blackened) replace it since it has probably gone short-circuit. It must be a round disc type, not a tubular one. If this is all right, check the line output stage valves – the PL504 and PY801. If these are in order and the fusible resistor holds for several minutes, during which the PL504 overheats, the trouble is due to lack of line drive. In this case the 30FL2 line oscillator valve and the associated components will have to be checked.

ITT CVC5 CHASSIS

There's a loud crack from within this set shortly after it's switched on. There's no flash on the screen however, while the set continues to operate normally for as long as it's switched on. The crack does not occur if the set is switched off and then on again within two-three hours, but if left overnight then on switching on this "capacitor discharge" type sound occurs soon after.

The discharge is probably occurring from an e.h.t. point, and we suggest cleaning around the e.h.t. connector on the top of the tube. Then spray this with "damp start" or some other silicone compound. If necessary remove the line output stage screen to see whether the discharge can be spotted somewhere around the tripler or the line output transformer.

HITACHI CTP200

When the black content of the picture is large, or when there's no transmitted picture present, the h.t. collapses and the set goes dead. The fault can also be brought on by turning the contrast and brightness down during normal viewing. A normal picture can be obtained by switching off and on again. During normal operation there are no obvious faults.

It appears that the series regulator transistor TR901 is being cut off when the fault is present. We suggest you check, preferably by substitution, the voltage sensing resistor R904 (24kΩ), also the associated 120kΩ resistor R901. If these prove to be o.k., suspect the error amplifier transistor TR903 and its associated base-emitter diode CR908.

TEST CASE

195

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

The customer complained of dark vertical blinds at each side of the picture of his ITT CVC5 colour set. This turned out to be nothing more drastic than inadequate line scan, resulting in a scan deficiency of about 10mm at either side. The line linearity was not unduly impaired, and questioning revealed that the trouble had occurred suddenly. The sound was perfectly normal.

Having experienced the trouble before on this chassis, the technician in charge was pretty confident that replacing the PL509 line output pentode would clear the fault without further ado. This was not to be however. In fact there was no change, though the valve seemed to be running a trifle hotter than is usual. Neither was the symptom relieved by replacing the PCF802 line oscillator or the PY500 boost diode.

Attention was then directed to the passive components in the line output stage. There are two preset controls for width adjustment, one designated "dealer width" and the other "factory width". The former was already almost fully advanced, and turning it up fully gave hardly any improvement. After carefully noting the position of the other control this too was advanced: but the width was still substantially inadequate.

The controls are part of a resistive network associated with the PL509's biasing, and function along with the usual VDR which is capacitively-coupled to a tapping on the line output transformer. The resistors in the network all appeared to have the correct values, and the VDR and coupling capacitor were checked by substitution. Still the fault persisted. The service data indicates that the voltage at the control grid of the PL509 should be − 76V, but even with a high-resistance multimeter the technician was unable to obtain such a voltage reading.

The trouble was subsequently cleared by the replacement of a capacitor. Which capacitor could have caused the symptom, and why? Also, did the customer provide any information which could have given a clue to the nature of component failure? See next month for the solution and for a further item in the series.

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TELEVISION MARCH 1979

SOLUTION TO TEST CASE 194
– Page 216 last month –

The earlier sync/video repairs to the Thorn 1500 chassis mentioned in last month's Test Case were handled correctly from the circuit point of view, but during the course of the repairs the video lead to the base of the c.r.t. had become displaced, so that when the chassis was closed it was in close proximity to the line output stage.

The clue was presented by the symptom being far less apparent with the chassis fully open than when closed. With the receiver running at a low contrast setting and with the chassis open the technician found that the symptom could be considerably modified merely by shifting the position of the tube's video lead! As a matter of interest a scope was connected so as to monitor the video at the tube base, and when the lead was close to the line circuits quite large amplitude line pulses were seen riding on the video signal. These were apparently being linked to the field timebase via the sync separator circuit.

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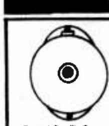

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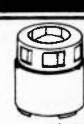

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