

Charleston X

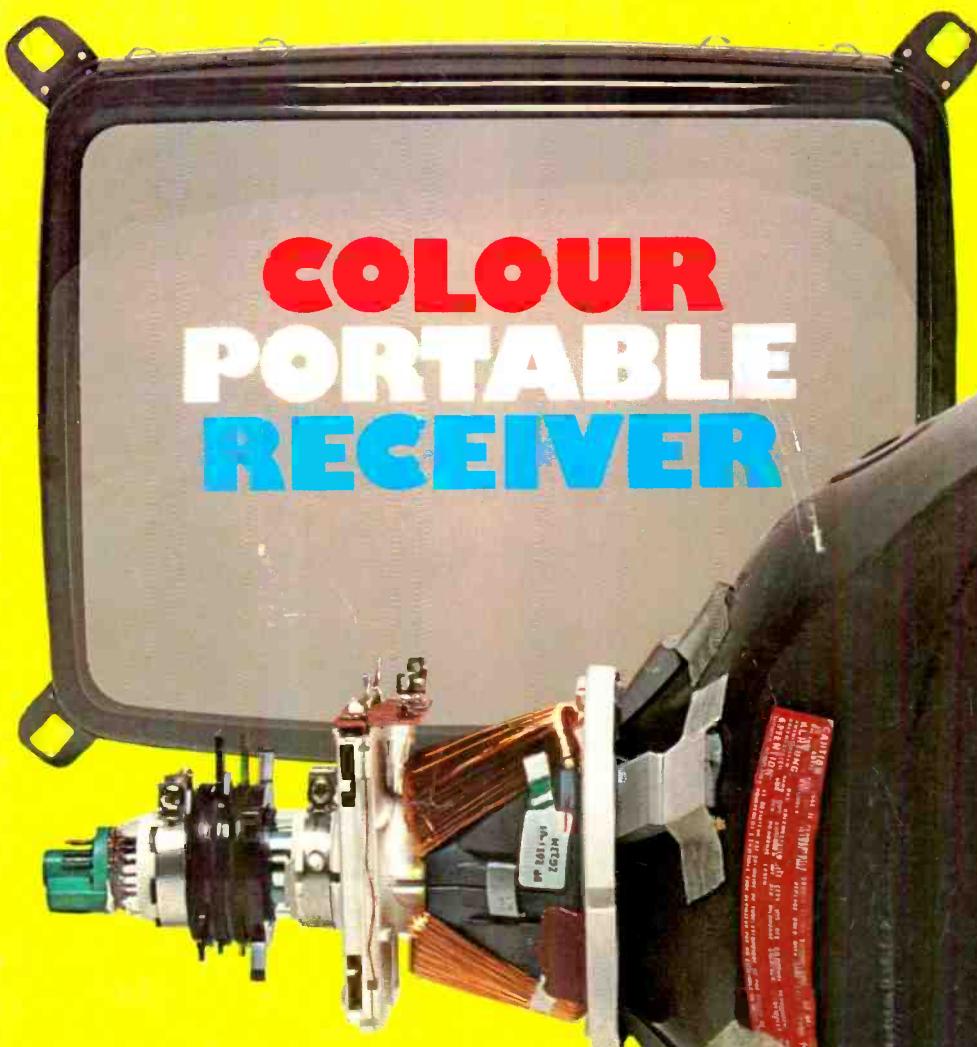
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# TELEVISION

SERVICING • VIDEO • CONSTRUCTION • DEVELOPMENTS



**SONY COLOUR  
CAMERA REVIEW**

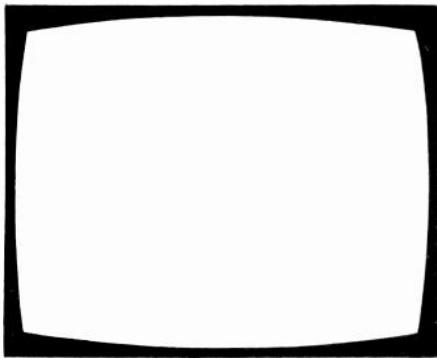
**CRT REACTIVATION**

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SEMICONDUCTORS										EHT MULTIPLIERS	
AA113	0.16	AU113	3.00	BF273	0.20	TBA396Q	2.00	TCE950 Doubler	2.00	TCE950/1400 Tripler	5.04
AA116	0.16	AL103	3.00	BF274	0.25	TDA440	2.50	TCE1400 (Piped System Only)	4.56	TCE1500 Doubler	4.16
AA117	0.16	AY102	3.00	BF336	0.50	SN76001N	1.50	TCE1500 Tripler	4.64	TCE1600 1/2 Wave	3.95
AA119	0.16	BC107	0.20	BF337	0.50	TBA520	2.00	DECCA CS 1730/1830 Doubler	4.23	DECCA CS 1910/2213 Tripler	6.61
OA91	0.12	BC108	0.20	BF338	0.50	TBA120S	1.00	DECCA 30 Series Tripler	6.01	DECCA 80 Series Tripler	6.43
OA95	0.12	BC109	0.20	BF355	0.80	TBA396	2.00	DECCA 100 Series Tripler	6.68	GEC Hybrid 2028 Tripler	6.43
OA202	0.18	BC113	0.15	BF459	1.00	TCA270SQ	2.00	GEC 2110 Tripler Pre JAN77	7.21	GEC 2110 Tripler Post JAN77	6.43
BA100	0.18	BC114	0.15	BF459	1.00	TDA2030	8.00	ITT CVC 5.8.9 Tripler	6.51	ITT CVC 20/25/30	6.45
BA102	0.10	BC116	0.20	BF473	0.50	TDA2140	6.00	Philips 520 Tripler	6.51	Philips 550 Tripler	6.42
BA130	0.15	BC117	0.20	BFX29	0.50	TDA2150	6.00	Philips G9 Tripler	6.63	PyE 691/693/697 Tripler	6.68
BA154	0.10	BC118	0.20	BFX84	0.50	TDA2160	6.00	RRI 1823 Tripler	5.48	RRI 179/823	6.68
BA155	0.20	BC119	0.50	BFX88	0.50	TDA2120	3.00	TCE 3000/3500 Tripler	5.51	TCE 4000 Tripler	8.00
BA164	0.12	BC125	0.20	BFY50	0.50	TDA3089	2.00	TCE 8000 Doubler	3.53	TCE 8500 Tripler	5.60
BA165	0.16	BC126	0.20	BFY51	0.50	TDA1054M	2.00	TCE 9000 Tripler	7.28	TVK 76/13 Continental Sets	5.50
BAX16	0.08	BC136	0.20	BFY52	0.50	MC1349P	1.50	TVK 52 ITT Replacement	6.68	Korting 90% Tripler	6.50
BAY38	0.16	BC137	0.20	BFY90	1.20	SAA661	0.60	Autovox Tripler	6.50	Redifusion MK 1 Tripler	6.00
BY206	0.20	BC138	0.40	BF381	0.50	SAS560S	2.00	RRI TV 25 Quadrupler	4.00	RRI T20	7.04
IN4148	0.04	BC139	0.40	BFR39	0.30	SN570S	2.00				
BY126	0.20	BC140	0.40	BFR79	0.30	SN7400N	0.40				
BY127	0.15	BC142	0.40	BFR81	0.30	SN7413N	0.90				
BY133	0.22	BC143	0.40	BFR89	0.50	SN74122N	1.00				
BY164	0.50	BC147	0.15	BFS29	0.25	SN74141N	1.00				
SKB2/08	1.00	BC148	0.10	BDX32	2.50	TBA395	1.80				
BY238	0.15	BC149	0.15	BW206	1.60	TBA950	4.00				
BYX10	0.18	BC153	0.15	BW208/02	2.80	TCA800	4.00				
IN4001	0.10	BC154	0.15	BW326S	1.00	TCA8000	4.00				
IN4002	0.10	BC157	0.15	BW406	2.00	TDA180	3.00				
IN4003	0.12	BC158	0.15	BW406D	2.50	TDA1190	3.30				
IN4004	0.12	BC159	0.15	BW407	1.70	TDA2002H	3.60				
IN4005	0.12	BC160	0.40	BW407D	2.50	TDA2590Q	5.00				
IN4006	0.14	BC161	0.40	R2008B	2.60	TDA260	5.00				
IN4007	0.16	BC170	0.15	R2010B	2.50	TDA2540	3.30				
IN5407	0.33	BC171	0.15	R2540	3.00	TDA3950	3.00				
BR100	0.30	BC172	0.20	ME0402	0.20	TAAC621 AX1	2.00				
BR101	0.60	BC177	0.20	ME0412	0.20	TBA625X5	2.00				
BRY39	0.60	BC178	0.20	ME4003	0.15	TCA830S	2.00				
TIC1160N	1.50	BC179	0.20	ME6002	0.20	TDA2020/AZ	5.00				
BT119	2.00	BC182L	0.15	ME8001	0.20	TDA2020P	5.00				
BT120	2.00	BC183L	0.15	MJE2955	1.50	TDA2030V	3.60				
BYX71/600	0.80	BC184L	0.15	MJE3005	1.30	TDA2010/BZD	4.50				
ZN444	1.50	BC184LC	0.15	MP8113	1.00	TDA2002V	5.00				
TV106/2	1.50	BC186	0.30	MPSU05	1.20	TCA940E	3.00				
BYX88 2V7	0.10	BC187	0.30	TIP2955	1.30						
BYX88 3V0	0.10	BC203	0.15	TIP3055	1.30						
BYX88 3V3	0.10	BC204	0.15	TIS90M	0.30						
BYX88 3V6	0.10	BC205	0.15	TN2904	0.50						
BYX88 3V9	0.10	BC206	0.15	TN2905A	0.50						
BYX88 4V3	0.10	BC207	0.15	TN2905	0.50						
BYX88 4V7	0.10	BC208	0.15	TAA350	0.80						
BYX88 5V1	0.10	BC209	0.15	TAA450	0.50						
BYX88 5V6	0.10	BC212L	0.15	TAA570	1.80						
BYX88 6V2	0.10	BC213L	0.15	TAA611	1.75						
BYX88 6V8	0.10	BC214L	0.15	TAA630S	2.50						
BYX88 7V5	0.10	BC225	0.40	TAA630S	2.00						
BYX88 8V2	0.10	BC237	0.15	TAA630S	0.80						
BYX88 9V1	0.10	BC238	0.15	TAA630S	0.50						
BYX88 10V	0.10	BC239	0.15	TAA630S	0.50						
BYX88 11V	0.10	BC301	0.40	TAA630S	1.75						
BYX88 12V	0.10	BC303	0.40	TAA661B	2.50						
BYX88 13V	0.10	BC307	0.15	TAA661B	2.00						
BYX88 15V	0.10	BC308	0.15	TAD100	2.00						
BYX88 18V	0.10	BC327	0.15	TAD100	0.75						
BYX88 20V	0.10	BC328	0.15	TBA10AS	1.20						
BYX88 22V	0.10	BC337	0.15	TBA231	1.20						
BYX88 27V	0.10	BC338	0.15	TBA480Q	2.20						
BYX88 33V	0.10	BC547	0.15	TBA520Q	2.00						
BYX61 1V5	0.20	BC141	0.10	TBA530Q	2.00						
BYX61 1V8	0.20	BD115	0.50	TBA530Q	2.00						
BYX61 1V9	0.20	BD124	0.18	TBA540	2.00						
BYX61 1V9	0.20	BD131	0.70	TBA540Q	2.20						
BYX61 1V9	0.20	BD132	0.60	TBA550	3.00						
BYX61 1V9	0.20	BD133	0.70	TBA550Q	3.00						
BYX61 1V9	0.20	BD134	0.70	TBA560C	2.20						
BYX61 1V9	0.20	BD144	2.50	TBA560CQ	2.20						
BYX61 1V9	0.20	BD159	0.80	TBA570	2.50						
BYX61 1V9	0.20	BD238	0.50	TBA570Q	2.50						
BYX61 2V0	0.20	BD380	0.70	TBA641BX	3.00						
BYX61 2V2	0.20	BD441	0.70	TBA641B11	4.00						
BYX61 2V4	0.20	BD537	0.70	TBA651	3.00						
BYX61 2V7	0.20	BD538	0.70	TBA720A	1.50						
BYX61 3V0	0.20	BD507	0.70	TBA730	1.50						
BYX61 3V3	0.20	BD508	0.75	TBA750	2.00						
BYX61 3V6	0.20	BD1681	1.20	TBA750Q	2.00						
BYX61 3V9	0.20	BD1682	1.20	TBA800	1.00						
BYX61 4V7	0.20	BD709	1.00	TBA810S	1.50						
BYX61 7V2	0.20	BD710	1.00	TBA820	1.50						
AC107	0.35	BD442	0.70	TBA920	2.00						
AC127	0.50	BD379	0.50	TBA920Q	2.00						
AC127/01	0.60	BD115	0.60	TBA990	2.00						
AC128	0.60	BD118	0.60	TCA2205A	3.00						
AC128/01	0.60	BD152	0.40	TCA4900	1.00						
AC141	0.50	BF154	0.20	TCA490	1.00						
AC141K	0.60	BF157	0.70	TCA940	2.00						
AC142	0.40	BF158	0.40	TDA170	2.00						
AC142K	0.60	BF160	0.60	TDA1200	3.00						
AC176	0.60	BF163	0.60	TDA1270	4.00						
AC176/01	0.60	BF167	0.50	IDA1412	1.00						
AC186	0.40	BF173	0.50	TDA2020	4.00						
AC187	0.40	BF177	0.50	SN76115N	2.00						
AC187K	0.60	BF179	0.50	SN76227N	1.20						
AC188	0.40	BF180	0.50	SN76530P	1.00						
AC188K	0.60	BF181	0.60	SN76651N	1.50						
AD140	1.50	BF182	0.50	SN76003N	3.00						
AD142	1.50	BF183	0.50	SN76013N	2.00						
AD143	1.50	BF184	0.50	SN76013ND	2.00						
AD145	1.50	BF185	0.50	SN76013ND	2.00						
AD149	1.00	BF194	0.20	SN76023N	2.00						
AD161/2	1.50	BF195	0.20	SN76023ND	1.00						
AD162	0.70	BF196	0.20	SN7603N	2.00						
AD262	1.50	BF197	0.20	SN76110N	2.00						
AF121	0.60	BF198	0.15	SN76226N	2.00						
AF124	0.60	BF199	0.15	SN76227N	1.20						
AF125	0.60	BF200	0.15	SN76532N	2.00						
AF126	0.60	BF224	0.15	SN76533N	2						



# TELEVISION

May  
1981

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Issue 367

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## QUERIES

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

Requests for advice in dealing with servicing problems should be directed to our Queries Service. For details see our regular feature "Service Bureau". Send to the address given above (see "correspondence").

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OUR NEXT ISSUE DATED JUNE WILL  
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# P.V. TUBES

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**TRADE COUNTER OPEN MON-FRI 9a.m.-4.30p.m.**

SAT. MORN. 9.30a.m.-12 NOON.

NEW MONO TUBES		NEW VALVES						RECTIFIER TRAYS						TRANSFORMERS		
Mullard A31/5 10 12" 110°	£17.00	30FL2	1 21	EV86/7	68	PCLB4	81	Thorn 950	£4.25	GEC 2110 before Jan 77	£6.95			Type	Price (p)	
Mullard A34/5 10 14" 110°	£18.50	DY802	72	EV500A	1 33	PCLB5/805	79	Thorn 1500 1580	£3.85	GEC 2110 after Jan 77	£6.65			Bush A774	£11.75	
Hitcha A31/300 12" 110°	£15.00	DY86/7	66	E280 I	56	PCLB6	81	Thorn 1500 5 stick	£4.25	GEC 1028, 2028 1040	£5.64			Replacement Tripler for A774	£10.75	
Vega 12" 90°	£15.00	ECC81	60	GY501	1 45	PO500	2 93	Thorn 1600	£3.45	ITTKB CV5/7/8/9	£5.35			Decca 80	£8.58	
Vega A50/120 20" 110°	£13.50	ECC82	68	G234	1 56	PO200	1 35	Thorn 3000 3500	£6.89	ITTKB CV20/25/30	£5.35			Decca 100	£8.58	
Vega A61/120 24" 110°	£15.00	ECC83	60	K1T66	6 98	P136	1 15	Thorn 1400	£3.85	Korting (similar to Siemens TVK1)	£6.65			Decca 1730	£8.58	
1 year warranty except Mullards which have 2 years warranty.		ECC84	80	K1T88	10 00	P181	94	Thorn 8000	£3.51	Philips 3113 550/1/3	£5.85			Decca 2230	£8.58	
REBUILT COLOUR TUBES		ECC85	98	PCP86	81	P182	46	Thorn 8500/8800	£5.40	Philips G8	£5.85			GEC 2040	£9.20	
17", 18", 19", 20"	£28.00	ECC86	135	PCP88	81	P183	143	Thorn 9000	£7.43	Philips G9	£6.33			GEC 2110	£8.99	
22"	£30.00	ECH84	80	PCP92	80	P184	84	Decca CTV 19/25	£5.35	Pye 691/3	£5.13			ITC CV25/30/32	£7.80	
25" 26"	£34.00	ECL80	84	PCP85	85	P1509	2 39	Decca CS1730/3 CS1830/5	£3.68	Pye 731/25	£5.40			Philips G8	£10.00	
26" 110°	£36.00	ECL82	77	PPC88	82	P1519	2 78	Decca 30	£5.92	Panu BM AB23 A/V	£6.89			Philips G9	£7.15	
Glass for glass exchange		ECL86	84	PPC89	79	P182	2 15	Decca 80	£6.28	Peddleson MK1	£6.04			Philips G11	£13.50	
2 year warranty.		ECP86	78	PPC189	102	P133	61	Decca 100	£6.04	Universal Tripler	£5.40			Pye 691-693	£14.00	
MULLARD COLOUREX/OR		EF80	68	PPC805	140	P188	81						Pye 697	£14.00		
THORN NEW LIFE		EF86	68	PPC80	75	P1500A	140						Pye 731	£10.15		
18"	£45.50	EF89	143	PCF200	123	UCB80	67						Scan AC EHT Transformer	£5.00		
19"	£46.00	EF183	68	PCFB800	1 38	UCH81	143						Thorn 8000	£9.00		
20"	£50.00	EF184	68	PCFB81	1 13	UCL82	84						Thorn 8500	£10.00		
22"	£40.00	EH90	1 02	PCF802	86	ULC83	94						Type MAINS TRANSFORMER	Price (p)		
25"	£50.00	EL34	1 63	PCF805	1 63	UL84	1 02						Thorn 3000 3500	£10.50		
26"	£52.00	EL81	86	PCF806	1 30	UZ6	1 30						PYE LABGEAR			
26" 110°	£55.50	EL84	68	PCF808	1 63	U191	95						Mast Head Amp WB 12V			
Glass for glass exchange		EL90	82	PCF200	1 45	UF23	85						26db gain	£12.00		
1 year warranty 4 year optional.		EL509	2 22	PCLB2	78	UV85	80						Power Unit for above	£11.25		
Carriage incl. VAT on carriage				PCL83	2 00								Behind the Set second set amp	£10.06		
MONO	£5.00												Below the Set UHF amp (manns)	£10.73		
COLOUR	£5.00												Teletext Adaptor (Colourout)	£20.06		
PORTABLE	£3.50												VHF/UHF 8+1 distribution amp	£32.35		
SEMICONDUCTORS		SEMICONDUCTORS						INTEGRATED CIRCUITS						REPLACEMENT ELECTROLYTICS		
Type	Price (p)	Type	Price (p)	Type	Price (p)	Type	Price (p)	Type	Price (p)	Type	Price (p)	Type	Price (p)	Type	Price (p)	
AC126	22	BC212	9	BF160	27	BUD326A	£1.42	CA3065/ET6106/1	TBA120U	£1.00	AA119	7	BXY71/600	40	Type	Price (p)
AC127		BC212L	9	BF167	24	BUD407	£1.25	ML232B	TBA396	80	AA102	17	DA47	9	Decca 3D/400 400/350V	£2.82
AC128	20	BC213	9	BF173	22	E1222	28	ETTR6016/	TBA4800	£1.25	AA115	13	DA90	5	Decca 80/100/400/350V and 800/250V	£3.00
AC128K	32	BC213B	10	BF178	26	MU340	40	ML231B	TBA510	£3.00	AA145	17	DA91	6	Decca 1700 20 20 2420 (200/200 400/350V)	£3.00
AC141K	30	BC213L	9	BF179	34	PCF237	10	MC1340	TBA530	£1.20	AA154	6	DA020	11	Philips G 6 160/300V	£2.11
AC142K	30	BC214	9	BF180	36	PCF237	10	MC1349	TBA5300	£1.28	AA155	14	IN914	3	Rank A 23/25 (250/250 300V)	£2.28
AC176	25	BC214L	10	BF181	36	PCF237	10	MC1349	TBA5400	£1.49	AA156	15	IN4001	4	Thorn 950-150 (100-100-100-150/320V)	£1.50
AC176K	32	BC237	9	BF182	30	R20088	£1.80	MC1351	TBA5500	£1.58	AA157	4	IN4002	4	Thorn 1400 (150-100-100-100-150/320V)	£2.80
AC187	26	BC238	8	BF183	30	R20108	£1.80	MC1352	TBA5600	£1.59	AA16	5	IN4003	4	Thorn 1500 (150-150-150/300V)	£1.92
AC188	25	BC2518	12	BF184	30	R20265	£1.40	SAS5605	TBA570	£1.00	BB1058	30	IN4004	5	Thorn 3000 (100-100-200/350V)	£2.61
AC188K	37	BC252A	12	BF185	30	R20322	£1.50	SAS5705	TBA5700	£1.20	BB1059	30	IN4005	5	Thorn 3000 3500 (100-63V)	£6.2
AC140	75	BC252B	12	BF195	11	R20323	67	SL901B	TBA5700	£1.39	BB126	10	IN4006	5	Thorn 3000 3500 (100/70V)	£6.3
AC143	82	BC261A	18	BF196	10	R20461	£1.50	SL917B	TBA5800	£1.25	BB127	11	IN4007	6	Thorn 3000 3500 (150/70V)	£8.0
AC149	79	BC261B	15	BF197	11	RCA16334	90	SL3270	TBA5900	£1.20	BB164	45	IN4148	2	Thorn 3500 (175-100-100-400 350V)	£2.34
AC161	42	BC262A	15	BF198	18	RCA16335	80	SN76030N	TBA6100	£1.50	BB165	10	IN4448	10	Thorn 8000/8500 2500+2500 70V	£1.47
AC161/2	£11.5	BC262B	15	BF199	15	TIPI295	43	SN76103N	TBA6100	£1.50	BB166	22	IN4501	12	Thorn 8000/8500 400+350V	£2.20
AC162	42	BC300	30	BF200	30	TIPI30C	43	SN76103ND	TBA6200	£1.50	BB167	22	IN4502	14	Thorn 8000/8500 400+350V	£2.44
AF124	34	BC301	28	BF224	16	TIPI31C	41	SN76023N	TBA6200	£1.25	BB170	20	IN4503	12	CAPACITORS DOUBLE ENDED	
AF127	32	BC303	28	BF241	15	TIPI32C	42	SN76023NO	TBA6200	£1.25	BB171	22	IN4504	12	Volts MFD Price (p) Volts MFD Price (p)	
AF139	42	BC307	10	BF257	28	TIPI41C	46	SN76033N	TBA6300	£1.53	BB172	10	IN4505	13	10 22 7 63 4 7 10 22 14	
AF239	45	BC307A	10	BF258	25	TIPI42C	47	SN76110N	TBA6300	£1.99	BB173	11	IN4506	13	10 47 7 63 10 9 22 14	
AL102	£2.00	BC327	11	BF259	26	TIPI47	70	SN76131N	TBA6300	£1.30	BB174	10	IN4507	15	10 47 7 63 10 9 22 14	
AL103	£2.00	BC328	8	BF271	24	TIPI2955	90	SN76226N	TBA6300	£1.55	BB175	10	IN4508	16	10 47 7 63 10 9 22 14	
AU110	£2.00	BC337	11	BF273	12	TIPI3055	13	SN76227N	TBA6400	£1.10	BB176	10	IN4509	11	10 47 7 63 10 9 22 14	
AU113	£1.49	BC338	9	BF274	13	ISEP3055	63	SN76532N	TBA641/1	£1.50	BB177	10	IN4510	11	10 47 7 63 10 9 22 14	
BC107	12	BC546	7	BF337	36	TI91	21	SN76533N	TBA641/1	£1.30	BB178	10	IN4511	11	10 47 7 63 10 9 22 14	
BC107B	13	BC547	10	BF338	34	2N696	19	SN76650N	TBA641/1	£1.35	BB179	10	IN4512	11	10 47 7 63 10 9 22 14	
BC108	11	BC548	10	BF355	37	2N2905	22	SN76660N	TBA64200	£1.20	BB179	10	IN4513	11	10 47 7 63 10 9 22 14	
BC108A	12	BC549	7	BF362	37	2N3054	60	SN76666N	TBA64200	£1.20	BB179	10	IN4514	11	10 47 7 63 10 9 22 14	
BC108B	7	BC563	33	BF363	20	TAAT505	60	TAAT550	TBA64200	£1.20	BB179	10	IN4515	11	10 47 7 63 10 9 22 14	
BC108C	14	BC557	7	BF371	30	TAAT3702	11	TAAT570	TBA64200	£1.80	BB179	10	IN4516	11	10 47 7 63 10 9 22 14	
BC109	14	BCY72	13	BF458	23	TAAT3703	10	TAAE661B	TBA64200	£1.20	BB179	10	IN4517	11	10 47 7 63 10 9 22 14	
BC109A	14	BCY72	13	BF458	24	TAAT3704	10	TAAT700	TBA64200	£1.70	BB179	10	IN4518	11	10 47 7 63 10 9 22 14	
BC109B	13	BD115	30	BF459	35	TAAT3705	10	TBA120B	TBA64200	£1.30	BB179	10	IN4519	11	10 47 7 63 10 9 22 14	
BC109C	11	BD116	65	BF412	28	TAAT3706	10	TBA120S	TBA64200	£1.70	BB179	10	IN4520	11	10 47 7 63 10 9 22 14	
BC114	12	BD124P	60	BF413	27	TAAT2954	38	TBA120AS	TBA64200	£1.70	BB179	10	IN4521	11	10 47 7 63 10 9 22 14	
BC116A	12	BD124-2N3054	60	BF416	60	TAAT2956	48	TBA120SD	TBA64200	£1.70	BB179	10	IN4522	11	10 47 7 63 10 9 22 14	
BC140	32	BD131	33	BFX29	30	TAAT2958	38	TAAT2958	TBA64200	£1.20	BB179	10	IN4523	11	10 47 7 63 10 9 22 14	
BC141	26	BD132	35	BFX84	27	TAAT2958	53	TAAT2958	TBA64200	£1.20	BB179	10	IN4524	11	10 47 7 63 10 9 22 14	
BC142	21	BD133	40	BFX85	28	2SCG434A	£1.50	TAAT2958	TBA64200	£1.20	BB179	10	IN4525	11	10 47 7 63 10 9 22 14	
BC143	24	BD135	26	BFX86	28	2SC1172Y	£2.20	TAAT2958	TBA64200	£1.20	BB179	10	IN4526	11	10 47 7 63 10 9 22 14	
BC147	9	BD136	27	BFX88	25	CRYSTAL	£1.30	TAAT2958	TBA64200	£1.20	BB179	10	IN4527	11	10 47 7 63 10 9 22 14	
BC148	9	BD137	23	BFY50	20	4 43MHZ	£1.30	TAAT2958	TBA64200	£1.20	BB179	10	IN4528	11	10 47 7 63 10 9 22 14	
BC149	9	BD138	23	BFY51	20	Crystal	8 pin	TAAT2958	TBA64200	£1.20	BB179	10	IN4529	11	10 47 7 63 10 9 22 14	
BC157	11	BD139	28	BFY52	20	TAAT2958	14 pin	TAAT2958	TBA64200	£1.20	BB179	10	IN4530	11	10 47 7 63 10 9 22 14	
BC158	9	BD140	28	BFY90	75	TAAT2958	16 pin	TAAT2958	TBA64200	£1.20	BB179	10	IN4531	11	10 47 7 63 10 9 22 14	
BC159	10	BD144	120	BR100	17	VA1104	52	TAAT2958	TBA64200	£1.20	BB179	10	IN4532	11	10 47 7 63 10 9 22 14	
BC160	25	BD182	70													

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THORN 3000 25"	£23.00 each	£20.00	£38.00
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PCL82	0.10	30C1	0.10	PCC189	0.10	EF183	0.10	PL504	0.25	ECL80	0.10
PCL83	0.25	30C17	0.10	30C15	0.10	EF184	0.10	6/30L2	0.10	PL509	1.00
PCL84	0.10	PCF802	0.10	30C18	0.25	6BW7	0.10	30PL1	0.25	PY500	1.00
PCL85	0.10	PCF805	0.25	PC97	0.20	EH90	0.10	30PL13/4	0.10	GY501	1.00
PCL86	0.10	PCF806	0.10	PC900	0.10	DY802	0.10	30FL1/2	0.25	PL508	0.50
PFL200	0.10	PCF808	0.25	EF80	0.10	PY800/1	0.10	ECC82	0.10	PCF200	0.50
PCF801	0.10	PCF80	0.10	EF85	0.10	PL36	0.25	ECC81	0.10	EY51	0.15

Please note there is 25p Postage and Packing per order.

### D/STANDARD COLOUR SPARE PANELS

	IF	LUM	CHROMA	EHT	REG	CON	S/OUTPUT		POWER	L/TB	F/TB
Bush/Murphy	5.00	5.00	6.50	—	—	5.00	1.50		5.00	—	—
GEC/Sobell	5.00	5.50	—	—	—	5.00	—		—	—	—
Philips	5.00	7.00	—	—	—	5.00	—		—	—	—
Decaa	5.00	9.00	9.00	—	—	5.00	2.00	(19" only)	—	—	7.50
Thorn 2000	5.00	5.00	5.00	6.50	6.50	7.00	—		6.00	—	5.00
Pye	7.00	6.00	7.00	—	—	5.00	—		—	—	—
Baird	6.50	8.50	7.00	—	—	5.00	—		6.50	10.00	5.00

Postage & Packing £1.25

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	IF	LUM	CHROMA	VIDEO	CON	POWER	L/TB	F/TB
Bush 184	9.50	—	12.00	—	6.00	6.00	12.00	—
GEC Hybrid	6.00	6.50	9.00	—	5.00	—	—	12.00
Philips G6 S/S	9.50	—	10.00	—	5.00	—	—	6.00
Thorn 3000	6.00	6.00	6.00	—	5.00	20.00	20.00	6.00
Pye 691/693	6.00	6.00	8.00	—	5.00	—	15.00	5.00
Thorn 3500	6.00	6.00	6.00	6.50	12.00	20.00	20.50	6.00

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Kotring and other foreign panels available on request.

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17" £15.00  
18" £15.00  
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19" A49/192 £18.00  
20" £18.00  
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Plus P&P £6.00  
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GEC £5.00  
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Pye 691 £5.00  
Thorn 3000 £5.00  
Some new tuners in  
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Scancoils from £5.00.  
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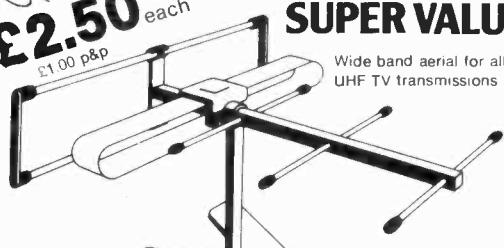
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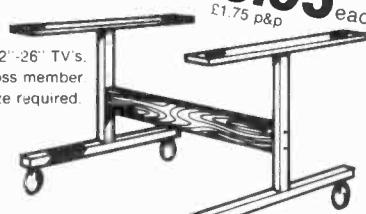
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AC107	0.24	AF181	1.00	BC179	0.12	BD137	0.30	BF218	0.12	OC36	0.90	2N3053	0.21						
AC113	0.22	AF186	0.90	BC182L	0.09	BD138	0.31	BF219	0.12	OC38	0.90	2N3054	0.60						
AC115	0.23	AF239	0.46	BC183L	0.09	BD139	0.40	BF220	0.12	OC42	0.45	2N3055	0.60						
AC117	0.30	AU113	1.40	BC183LA	0.10	BD140	0.37	BF221	0.21	OC44	0.60	2N3442	1.00						
AC125	0.23	BA130	0.08	BC183LB	0.10	BD144	1.39	BF222	0.12	OC45	0.50	2N3702	0.15						
AC126	0.23	BA145	0.14	BC184L	0.09	BD145	0.50	BF224	0.18	OC46	0.39	2N3703	0.12						
AC127	0.22	BA148	0.21	BC186	0.21	BD177	0.50	BF256	0.37	OC70	0.39	2N3704	0.18						
AC128	0.22	BA155	0.08	BC187	0.21	BD178	0.50	BF258	0.30	OC71	0.39	2N3705	0.18						
AC131	0.13	BAX13	0.05	BC209	0.11	BD203	0.40	BF259	0.30	OC72	0.39	2N3706	0.14						
AC141	0.24	BAX16	0.08	BC212	0.09	BD204	0.70	BF260	0.25	OC74	0.39	2N3707	0.14						
AC142	0.24	BC107	0.11	BC212L	0.09	BD222	0.73	BF262	0.28	OC75	0.39	2N3708	0.14						
AC141K	0.31	BC108	0.11	BC213L	0.09	BD233	0.36	BF263	0.25	OC76	0.39	2N3772	2.00						
AC142K	0.31	BC109	0.11	BC214L	0.09	BD234	0.34	BF271	0.27	DC77	0.50	2N3773	2.50						
AC151	0.21	BC113	0.11	BC237	0.09	BD237	0.44	BF272	0.27	OC78	0.23	2N3813	0.30						
AC165	0.21	BC114	0.11	BC238	0.09	BD238	0.44	BF273	0.16	OC81	0.26								
AC166	0.21	BC115	0.11	BC240	0.31	BDX22	0.73	BF336	0.30	OC810	0.14								
AC168	0.22	BC116	0.11	BC249	0.35	BDX32	1.98	BF337	0.29	OC82	0.26								
AC176	0.22	BC117	0.12	BC251	0.22	BDY18	0.80	BF338	0.29	OC820	0.20								
AC178	0.23	BC125	0.15	BC262	0.18	BDY60	0.80	BF479	0.27	OC83	0.30								
AC186	0.26	BC126	0.15	BC263B	0.20	BF112	0.29	BFT	0.27	OC84	0.30								
AC187	0.23	BC136	0.15	BC267	0.19	BF154	0.12	BF8X4	0.27	OC85	0.28	DY87	0.60						
AC188	0.23	BC137	0.17	BC281	0.24	BF158	0.19	BF8X5	0.27	OC123	0.25	DY802	0.64						
AC187K	0.30	BC137	0.23	BC300	0.27	BF159	0.24	BFX	0.30	OC170	1.20	ECC82	0.60						
AC188K	0.30	BC139	0.23	BC301	0.27	BF160	0.23	BFY37	0.22	OC171	0.92	EF80	0.55						
AD130	0.58	BC140	0.24	BC302	0.30	BF163	0.30	BFY50	0.21	O91	0.07	EF183	0.70						
AD140	0.68	BC141	0.27	BC303	0.27	BF164	0.30	BFY51	0.21	BRC4443	0.65	EH90	0.75						
AD142	0.80	BC142	0.27	BC307	0.11	BF167	0.30	BFY52	0.21	R2008B	1.50	PC66	0.85						
AD143	0.70	BC143	0.27	BC307A	0.11	BF173	0.21	BFY53	0.27	R2009	1.30	PCC49	0.65						
AD145	0.70	BC147	0.10	BC308A	0.12	BF177	0.26	BFY55	0.33	R2010B	1.50	PCC89	0.80						
AD149	0.64	BC148	0.10	BC309	0.14	BF178	0.24	BFX	0.26	R2265	1.50	PCF40	0.80						
AD161	0.42	BC149	0.10	BC337	0.12	BF179	0.28	BHA0002	1.90	R2305	0.38	PCF16	0.72						
AD162	0.42	BC153	0.12	BC338	0.15	BF180	0.30	BSX20	0.23	R2305	0.37	PCF401	0.70						
AD161	0.12	BC154	0.12	BC487	0.20	BF181	0.34	BSX76	0.23	BD222	0.37	PCF802	0.85						
AD162	1.00	BC157	0.12	BC547	0.10	BF182	0.30	BSY84	0.36	R2540	2.50	PCL32	0.75						
AF106	0.42	BC158	0.12	BC548	0.11	BF183	0.29	BU105	1.00	S2802	—	PCL84	0.80						
AF114	0.37	BC159	0.12	BC549	0.11	BF184	0.27	BU105 02	1.50	SCR957	0.65	PCL86	0.85						
AF118	0.45	BC160	0.26	BC557	0.12	BF185	0.29	BU105 04	2.00	TIP31A	0.38								
AF121	0.37	BC161	0.26	BCX33	0.10	BF186	0.32	BU126	1.40	TIP32A	0.36	PCL805	0.82						
AF125	0.30	BC167	0.11	BD112	0.39	BF192	—	BU205	1.20	TIP3055	0.53	PLF200	1.00						
AF126	0.30	BC168	0.11	BD113	0.65	BF194	0.15	BU206	1.60	TIP31B	0.39	PL36	£1.10						
AF127	0.30	BC169	0.11	BD115	0.32	BF195	0.13	BU208	1.60	TIS90	0.23	PL84	0.80						
AF139	0.40	BC171	0.10	BD116	0.47	BF196	0.13	OC22	1.10	TIS91	0.25	PL504	0.30						
AF150	0.27	BC171A	0.10	BD124	1.30	BF197	0.13	OC23	1.30	TV106	1.09	PL508	1.50						
AF151	0.30	BC172	0.10	BD131	0.36	BF198	0.12	OC24	1.30	MJE340	0.50	PL509	2.45						
AF170	0.92	BC173	0.12	BD132	0.36	BF199	0.14	OC25	1.00	MJE520	0.45	PL802	0.75						
AF172	1.00	BC177	0.12	BD133	0.37	BF200	0.28	OC26	1.00	2N2219	0.40	PY88	0.75						
AF178	1.00	BC178	0.12	BD135	0.30	BF216	0.12	OC28	1.30	2N2646	0.40	PY500A	1.60						
AF180	1.00	BC178A	0.12	BD136	0.30	BF217	0.12	OC35	1.00	2N2926	0.15	PY81800	0.70						

All transistors, IC's offered are new and branded. Manufactured by Mullard, ITT, Texas, Motorola etc.

Please add 15% VAT to all items and overseas at cost. Cash with all orders. All prices subject to alteration without notice.

P & P UK 50p per order, overseas allow for package and postage. Cash with all orders. All prices subject to alteration without notice.

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PYE 691	22" @ £55.00
PYE 691	26" @ £55.00
PYE 697	22" @ £65.00
PYE 697	26" @ £65.00
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BUSH 184	22" @ £70.00
BUSH 184	26" @ £70.00
GEC 2040	19" @ £55.00
GEC 2040	22" @ £55.00
GEC 2040	25" @ £55.00
GEC 2040	26" @ £65.00
KORTING	22" @ £70.00
KORTING	26" @ £80.00
THORN 3000	19" @ £70.00
THORN 3000	25" @ £60.00
Good working mono's Pye, GEC, Bush etc.	
20" & 24" S/S	£20.00
20" & 24" D/S	£18.00
19" & 23" D/S P/Button	£15.00
19" & 23" D/S Rotary	£12.00

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Please note there is 15% VAT on all the above prices. Plus £10.00 p & p for colour TV. £5.00 for mono ENGLAND, WALES and SCOTLAND  
Ireland N & S IRELAND £15.00 for colour £7.00 for mono.

TYPE	PRICE £	IC's	TYPE	PRICE £	DIODES & THYRISTORS	TYPE	PRICE £
BTT6018	1.00	CA3605	TBA810	1.50	BY227	0.12	950 MK2
MC7/c	1.20	MC14016	TBA920Q	1.50	BY206	0.14	1400 4.20
SN76003N	1.40	SN76013N	TBA990Q	1.50	1N4001	0.04	1500 18" 19"
SN76023N	1.20	SN76023N	TCA270Q	—	1N4002	0.05	stick 3.80
SN76023ND	1.20	SN76023ND	TCA270Q	—	1N4003	0.06	1500 24" 5
SN76110N	1.00	SN76226N	TCA270Q	—	1N4004	0.07	stick 4.25
SN76227N	1.20	SC9503P	TCA327B	1.00	1N4005	0.08	Single Stick
SN76532N	1.30	SC9504P	TCA800	2.00	1N4006	0.08	Thorn TV
SN76550N	0.30	SL901B	TDA1010	—	1N4007	0.08	11, 16K 70V 0.75
SN76666N	0.70	SL917B	TDA1327B	1.00	1N4148	0.05	TV 20 2 MT 0.75
TAA570	1.38	SBAT50	SBAT50	1.75	1N4751	0.14	18V 0.75
TBA10AS	1.00	SC9503P	SC9504P	1.20	1N5401	0.12	BUSH 718 1.30
TBA120S	0.75	TA395	TA395	2.20	1N5403	0.12	
TBA120SQ	0.75	TBA341	TBA341	0.97	1N5404	0.14	
TBA395	2.20	TBA520	TBA520	1.40	1N5405	0.14	
TBA341	0.97	TBA520Q	TBA520Q	1.10	1N5406	0.14	
TBA520	1.40	TBA530Q	TBA530Q	1.10	1N5408	0.25	
TBA520Q	1.10	TBA540	TBA540	1.30	BR100	0.22	
TBA530Q	1.10	TBA540Q	TBA540Q	1.45	BR101	0.28	
TBA540	1.30	TBA540Q	TBA540Q	0.97	BT106	1.19	
TBA540Q	1.45	TBA540Q	TBA540Q	0.97	BT108	1.23	

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A774 single std mono	9.48	691 692 693 697 series colour	
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Z712 T16a T16b mono portable	10.43	Wired in version	21.41
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Z179 Z722 series colour	18.06	713 715 570 series colour	12.32
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MS1700 2001 2020 2401 mono	9.26	950 mk2 1400 mono	8.50
MS2404 2420 2424 mono	9.26	1500 20" 1500 24" 1580 mono	8.50
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CVC30 CVC32 series colour	10.00		
CVC40 series	15.90		
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HYBIRD 717 1500 3010 colour	12.57	691 to 697 EHT overwind*	3.07
5010 6010 5011 6011 6022		691 to 697 primary*	4.60
2222		*Please state printed circuit or wired	
1510 2210 2252 5012 colour	12.57	version	
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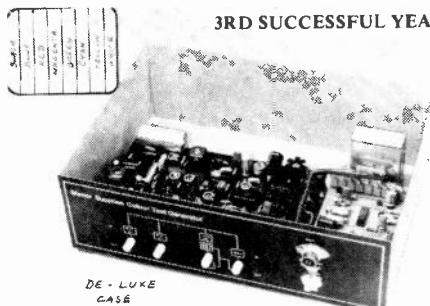
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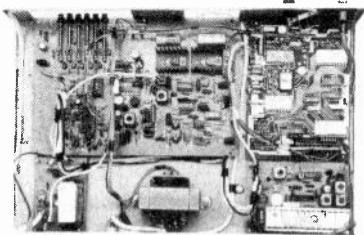
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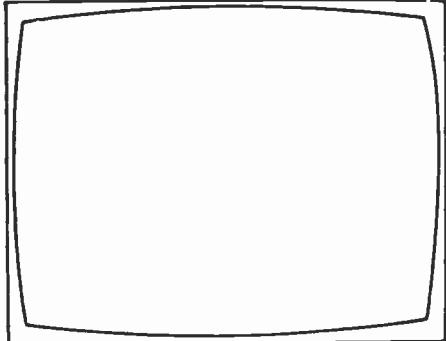
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AC117	0.38	AU107	2.75	BC204*	0.39	BC394	0.39	BD235	0.63	BF224 & J	0.22	BR101	0.53	MPSU06	0.76	ZTX502	0.22	ZN3820	0.72
AC126	0.36	AU110	2.40	BC205*	0.39	BC440	0.52	BD236	0.63	BF240	0.32	BR103	0.64	MPSU55	1.26	ZTX504	0.28	ZN3866	1.08
AC127	0.54	AU113	2.60	BC206*	0.37	BC441	0.59	BD237	0.68	BF241	0.31	BR303	1.06	MPSU56	1.32	ZN404	1.30	ZN3904	0.20
AC128	0.48	BC107*	0.16	BC207*	0.39	BC461	0.78	BD238	0.68	BF244*	0.51	BR303	1.06	MPSU60	0.82	ZN696	0.46	ZN3905	0.20
AC128K	0.55	BC108*	0.16	BC208*	0.37	BC47	0.30	BD253	1.58	BF245*	0.43	BR303	0.60	MPU131	0.59	ZN697	0.46	ZN3906	0.20
AC141	0.68	BC109*	0.16	BC209*	0.39	BC478	0.25	BD410	1.65	BF254	0.48	BR356	0.44	OC26	1.90	ZN706A	0.33	ZN4036	0.94
AC141K	0.70	BC113	0.22	BC211*	0.36	BC479	0.33	BD433	0.65	BF255	0.58	BS527	0.92	OC28	1.49	ZN708	0.28	ZN4123	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	ZN914	0.32	ZN4124	0.17
AC142K	0.65	BC115	0.24	BC212L*	0.17	BC548*	0.13	BD436	0.71	BF257	0.44	BT109	1.98	OC35	1.25	ZN916	0.46	ZN4126	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	ZN918	0.54	ZN4236	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	ZN930	0.29	ZN4289	0.32
AC153	0.42	BC118	0.24	BC214*	0.18	BC556	0.23	BD519	0.88	BF262	0.73	BT102	3.35	OC44	0.68	ZN1164	10.29	ZN4292	0.32
AC153K	0.52	BC119	0.34	BC214L*	0.18	BC557*	0.16	BD520	0.88	BF263	0.88	BT105	1.80	OC45	0.63	ZN1304	1.40	ZN4416	0.85
AC154	0.41	BC125*	0.30	BC225	0.42	BC558*	0.16	BD599	0.87	BF270	0.47	BT105/O2	1.95	OC70	0.65	ZN1305	1.29	ZN4444	1.90
AC176	0.45	BC126	0.30	BC237*	0.16	BC559*	0.17	BD600	1.23	BF271	0.42	BT108	2.98	OC71	0.73	ZN1306	1.49	ZN4921	0.80
AC178	0.51	BC132	0.20	BC238*	0.15	BCY10	0.30	BD663B	0.86	BF272A	0.80	BT126	2.91	OC72	0.73	ZN1307	1.32	ZN5042	1.65
AC179	0.55	BC134	0.22	BC239*	0.22	BCY30A	1.06	BDX16	1.55	BF273	0.33	BT204	2.50	OC81	0.83	ZN1308	1.53	ZN5060	0.28
AC187	0.56	BC135	0.21	BC251*	0.25	BCY32A	1.19	BDX32	2.95	BF274	0.34	BU205	2.58	OC81D	0.95	ZN1711	0.47	ZN5061	0.30
AC188	0.52	BC137	0.30	BC253*	0.38	BCY72	0.27	BDY18	1.55	BF337	0.65	BU206	2.59	OC139	1.30	ZN1893	0.52	ZN5064	0.63
AC188K	0.61	BC138	0.35	BC261A*	0.28	BD115	1.35	BDY20	2.29	BF338	0.68	BU407	1.38	OC140	1.35	ZN2102	0.71	ZN5086	0.49
AC193K	0.70	BC140	0.36	BC262A*	0.28	BD123	1.50	BDY38	1.38	BF355	0.72	BUY77	2.50	OC170	0.80	ZN2217	0.55	ZN5087	0.50
AC194K	0.74	BC141	0.44	BC263*	0.26	BD124	1.85	BF115	0.48	BF362	0.49	C106D	0.80	OC200	3.98	ZN2219	0.42	ZN5294	0.66
ACV17	1.20	BC142	0.35	BC267*	0.20	BD130Y	1.56	BF117	0.45	BF363	0.49	C106F	0.43	OC201	3.95	ZN2221A	0.26	ZN5296	0.68
ACV19	0.95	BC143	0.38	BC268*	0.28	BD131	0.58	BF120	0.56	BF367	0.29	C111E	0.46	OC202	2.40	ZN2222A	0.41	ZN5298	0.71
ACV28	0.98	BC147*	0.12	BC286	0.40	BD132	0.68	BF121	0.85	BF451	0.43	D40N1	0.64	OC205	3.95	ZN2369A	0.40	ZN5322	1.16
ACV39	2.02	BC148*	0.12	BC287	0.49	BD133	0.70	BF123	0.48	BF457	0.46	E300	0.42	OC271	1.98	ZN2401	0.80	ZN5449	0.18
AD140	1.79	BC149*	0.13	BC291	0.27	BD135	0.37	BF125	0.68	BF458	0.49	E1222	0.47	ON236A	0.94	ZN2484	0.35	ZN5457	0.46
AD142	1.90	BC152	0.42	BC294	0.37	BD136	0.38	BF127	0.51	BF459	0.52	E5024	0.19	R200BB	2.72	ZN2570	0.74	ZN5458	0.40
AD143	1.78	BC153	0.38	BC297	0.36	BD137	0.40	BF137F	0.78	BF594	0.16	GET872	0.46	R2010B	2.79	ZN2646	0.82	ZN5459	0.58
AD149	1.42	BC154	0.41	BC300	0.62	BD138	0.42	BF152	0.19	BF596	0.17	ME402	0.18	R2322	0.75	ZN2784	1.15	ZN5494	0.85
AD161	0.66	BC157*	0.13	BC301	0.38	BD139	0.46	BF158	0.25	BF597	0.27	MF0404/02	0.18	R2323	0.85	ZN2869	2.08	ZN5496	1.05
AD161/162	1.22	BC158*	0.12	BC302	0.86	BD140	0.50	BF159	0.27	BF39	0.30	ME6001	0.18	ST110	0.49	ZN2894	0.45	ZN6027	0.55
AD162	0.71	BC159*	0.14	BC303	0.64	BD144	2.24	BF160	0.20	BF480	0.29	ME6002	0.18	ST6120	0.48	ZN2904*	0.40	ZN6107	0.71
AF114	1.32	BC160	0.52	BC304	0.44	BD145	0.75	BF161	0.84	BF481	0.30	MJ2955	1.30	TIC44	0.25	ZN2905*	0.39	ZN6122	0.60
AF115	1.26	BC161	0.58	BC307*	0.17	BD150A*	0.51	BF163	0.65	BF485	0.29	MJ3000	1.58	TIC46	0.35	ZN2906*	0.36	ZN6178	1.07
AF116	1.28	BC167B	0.15	BC308*	0.14	BD155	0.90	BF164	0.95	BF488	0.33	MJE340	0.68	TIC47	0.45	ZN2926G	0.18	ZN6180	1.39
AF117	1.32	BC168B	0.14	BC309*	0.18	BD157	0.51	BF166	0.50	BF491	0.29	MJE341	0.72	TIP29A	0.47	ZN2926O	0.14	ZN6211	2.74
AF118	0.98	BC169C	0.15	BC317*	0.15	BD158	0.75	BF167	0.38	BF62	0.28	MJE370	0.74	TIP30A	0.50	ZN2926Y	0.14	ZS337P	4.28
AF124	0.38	BC171*	0.15	BC319*	0.19	BD160	2.68	BF177	0.36	BF870	0.29	MJE371	0.79	TIP31A	0.51	ZN2955	1.12	ZSC458C	0.78
AF125	0.38	BC172*	0.14	BC320	0.17	BD163	0.67	BF178	0.46	BF881	0.30	MJE520	0.85	TIP31C	0.67	ZN3053	0.48	ZSC643A	2.25
AF126	0.36	BC173*	0.22	BC321A & B	0.18	BD165	0.66	BF179	0.53	BF882	0.42	MJE521	0.95	TIP32A	0.52	ZN3054	0.68	ZSC930D	1.50
AF127	0.86	BC174A & B	0.18	BC322	0.28	BD166	0.88	BF180	0.58	BF888	0.42	MJE2955	1.20	TIP32C	0.72	ZN3055	0.72	ZSC1061	1.45
AF139	0.58	BC176	0.22	BC323	1.15	BD175	0.90	BF181	0.53	BF741	0.48	MJE3000	1.95	TIP33A	0.77	ZN3250	0.52	ZSC172Y	3.55
AF147	0.52	BC176	0.22	BC327	0.16	BD177	0.58	BF182	0.44	BFV11	1.02	MPE102	0.40	TIP34A	0.84	ZN3254	0.58	ZSD234	1.48
AF149	0.45	BC177*	0.20	BC328	0.18	BD178	0.92	BF183	0.52	BFV30	2.58	MPS3702	0.33	TIP41A	0.72	ZN3391A	0.38	ZN128	1.60
AF178	1.35	BC178*	0.22	BC337	0.17	BD181	1.94	BF184	0.44	BFV59	0.19	MPS3705	0.30	TIP2955	0.77	ZN3703	0.17	ZD251	1.14
AF179	1.36	BC179*	0.28	BC338	0.17	BD182	2.10	BF185	0.42	BFV60	0.20	MPS621	0.36	TIP3055	0.58	ZN3704	0.19	ZD327	0.67
AF181	1.33	BC182L*	0.15	BC347*	0.17	BD184	2.30	BF194*	0.14	BFV90	0.65	MPS656	0.36	TIS43	0.44	ZN3705	0.17	ZD361	0.48
AF186	1.48	BC183*	0.14	BC348A & B	0.18	BD187	1.20	BF195*	0.13	BFX84	0.42	MPSA05	0.30	TIS73	1.36	ZN3706	0.16	ZD362	0.50
AF202	0.27	BC183L*	0.14	BC349B	0.17	BD188	2.30	BF196	0.14	BFY50	0.38	MPSA06	0.32	TIS90	0.23	ZN3707	0.18	ZD4010	0.94
AF239	0.73	BC184*	0.15	BC349B	0.17	BD189	1.25	BF197	0.15	BFY51	0.37	MPSA55	0.43	TIS91	0.28	ZN3708	0.17	ZD429	0.88
AF240	1.40	BC185*	0.15	BC350*	0.17	BD221	0.91	BF198	0.29	BFY52	0.36	MPSA56	0.43	ZTX108	0.14	ZN3715	1.70	ZD5030	0.79
AF240*	0.91	BC185	0.36	BC351*	0.24	BD222	0.91	BF199	0.29	BFY53	0.36	MPSA93	0.56	ZTX109	0.16	ZN3771	2.09	ZD5055	1.39
AL100	1.30	BC186	0.26	BC352A*	0.24	BD232	0.91	BF200	0.25	BFY90	1.98	MPSL01	0.33	ZTX213	0.23	ZN3772	2.08	ZD6063	1.13
AL103	1.58	BC187	0.27	BC360	0.59	BD233	0.62	BF218	0.42	BPX25	1.62	MPSU01	0.61	ZTX304	0.26	ZN3794	0.40	ZD6054	0.89

Alternative gain versions available on items marked \*.

RESISTORS		Mixes of a minimum of 100cs of any value:		
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# TELEVISION

## The Year of the Video Disc

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The video disc era seems to have lasted a lifetime already, yet unless one includes Baird's early 78 r.p.m. discs – and their programme content was negligible – none have yet been marketed in the UK. Although they've not been on sale, they've been endlessly talked and written about for a good many years. This demonstrates the long lead time required to develop a technologically complex product. It doesn't apply to electronic equipment only of course. From the amount of attention it's received in the press over the years, one might be forgiven for thinking that the advanced passenger train for example has been in service for some time, though its introduction remains as always that little bit farther in the future than one can reliably see. The modern plane also seems to take an awful time acoming, and there's at least one major case where development work stopped altogether, the project being revived a couple of years later when market conditions had changed. Now as development work progresses, leaks inevitably occur, publicity officers issue press releases from time to time to ensure that the project is not forgotten about, and sometimes, as with nuclear power stations, endless arguments seem to go on as to whether the whole's thing's worthwhile anyway. There's always the possibility therefore that excessive prepublicity will leave the public bemused, and blunt the impact of a product's eventual launch. Unless of course a really major publicity effort is mounted to accompany this – and I think we can safely say that the introduction of video discs will see publicity campaigns surpassing those we're used to in the TV/video fields.

Just to summarise the present position, the Philips LaserVision discs are to be launched in the UK this autumn, having been on sale in the USA since 1978; the RCA CED SelectaVision discs were launched on the US market on March 22nd; the JVC VHD disc system is to be launched in Japan this October, in the USA next January, and in the UK in June 1982. So during the next twelve months or so it'll all be happening.

It seems to this observer at any rate that the disc represents the last great opportunity in the consumer TV/video field. TV sets themselves are nowadays low-key items, something people just have and replace as and when necessary. Part of the domestic wallpaper you might say. Teletext or remote control may be added when the next set is bought, but they are not things that most people will go out of their way to get. Satellite TV will eventually come, but a point that's often overlooked here is whether the quality of the available TV programme stock will make an appreciable increase in transmissions worthwhile.

The domestic VCR has now established itself however, and the time seems right to add discs. In a way, the VCR has done the job of getting the public used to the fact that there's more to TV than the channel selector switch. It's interesting to consider the course of the public's acceptance of VCRs. The first system to be introduced, Cartrivision in the USA in the early 70s, was a total failure, lasting for only a few months. Whether the trouble was primarily one of reliability, lack of software or poor marketing is difficult to say: probably a bit of each. The subsequent Philips N1500 system and its successors was much more of a success story, though for a long time it seemed to be looked upon mostly as an educational/commercial system. It was not until the Japanese manufacturers really got going that the European VCR market was given much of a stimulus. A significant point here one feels is that the Japanese machines appeared at a time when Japanese consumer electronics products generally had established a reputation for reliability. With the price right and the reliability taken for granted, the public was prepared to go out and spend its money.

For the time being the Japanese manufacturers seem to be in command of the domestic VCR market and its spin-offs – video cameras and so on. The advent of discs will see a return to large-scale international competition in the video field. It may still be asked whether, with the present hard international economic climate, the time is right for the introduction of a major new consumer product. But, since the VCR has broken the ice and achieved acceptance, it's logical to follow through with a product that's cheaper, easier to use and capable of superior performance, though offering playback only.

The video enthusiast who wants a versatile system will probably have little time for discs. But it's worth bearing in mind that the gramophone was the first major home entertainment product, and that it has retained its popularity undiminished for seventy years or so. In a sense, the video disc has been just waiting to happen. And all of a sudden it's going to. We shall be very surprised if it proves to be a flop, though failure to agree to a common standard is going to make the sales effort difficult, and means that someone at any rate will end up having made a rather wasteful investment.

# Teletopics

## ENTER LUCY

Mullard have developed a new purpose-designed chip which should give a technical stimulus to the development and production of viewdata receivers/adaptors. The chip, type number SAA5070, has been given the name Lucy (which somehow stems from Line Coupling Asynchronous receiver/transmitter), and is already in production. Its purpose is to combine in a single chip the functions provided by a number of chips in earlier viewdata decoder designs: it carries out all the routine tasks associated with viewdata decoding, whilst also providing features not previously incorporated in viewdata decoders. Mullard regard it as the definitive solution to viewdata decoder design for the current decade. It's certainly a remarkable example of the art of large scale integration, with some 12,000 active devices (diodes, transistors, etc.) on a chip area of 30 sq. mm in 4.8 micron geometry.

Fig. 1 shows a simple viewdata system using the chip. The telephone line is linked to the rest of the system by the terminating unit, which includes the safety/isolating components, dialling relays and filtering. The Lucy module provides data acquisition and control, driving the display signal generator section which could be common to a teletext facility. The Lucy module contains just four chips, the SAA5070, a non-volatile memory (e.g. an ER1400 ROM i.c.), a microprocessor i.c. and a chip containing some TTL gates. The microprocessor controls the basic operation of the system, the control programme being stored in the memory chip. The Lucy chip links these and carries out the basic viewdata signal processing.

An interesting facility provided by the Lucy i.c. is the ability to store complete viewdata or teletext pages (or data from other sources) using almost any low-cost audio cassette recorder. Since this facility operates independently of the input from the terminating unit, one data stream can be recorded whilst another is being received via the phone.

The Lucy chip has been designed to provide system flexibility. It will operate in conjunction with a teletext

decoder, and can be linked to an alphanumeric keyboard for message writing and editing, and to a multi-page memory to give rapid access to and easy manipulation of stored pages. All this in addition to having a tape recorder interface built in. The display generator system can drive a print-out unit. The Lucy system can thus be used in simple or complex set-ups, which can be tailored to cater for different user requirements. An interesting lady!

## CED DISC SYSTEM LAUNCHED IN USA

RCA have now launched their CED video disc system in the USA – it went on sale at some 5,000 stores from coast to coast on March 22nd, backed by a massive advertising campaign on television and in the press. The suggested price for the player units is \$500, the initial disc catalogue containing 100 titles selling at \$15 to \$28. Further titles are to be added to the catalogue in May and September, and the plan is to add ten titles a month thereafter. The advertising campaign for the system lays emphasis on the programme range, the low cost and ease of operation. The main element in the catalogue consists of feature films: other items include TV shows, sports, music, childrens' features and educational programmes.

RCA intend to spend \$20 million in the promotional campaign for their SelectaVision disc system in what's claimed to be the biggest product launch in business history. The players will also be marketed in the USA by Hitachi, Radio Shack, Sanyo, Sears Roebuck, Toshiba and Zenith. Target sales for 1981 are 200,000 players and two million discs. The European launch is planned for late 1982. It will be on show at Berlin this November.

## TRADE RESULTS FOR 1980

The latest figures released by BREMA enable one to see how trade developed during 1980. The most significant feature was the vast increase in the deliveries of VCRs, which increased over two and a half times compared to 1979, to a record total of 414,000. And most of them were sold (or rented out), since stocks held at the end of the year were low. Total colour TV set deliveries increased by 2%, with UK setmakers maintaining an overall 76% share. Small-screen sets increased their proportion of the colour TV market, up from 20% to 25%. Here, UK setmakers increased their share from 24% to 36%, which is largely attributable to the success of the Thorn TX9 chassis. Total deliveries of monochrome portables rose by 19%, with imports increasing by 30% to take 64% of the market, the share taken by UK setmakers falling from 52% to 36%. As we've reported recently, there have been complaints about monochrome portables from various far eastern countries being dumped on the European market.

## 3D TV

A Californian subscription TV company has carried out the first cable distribution of 3D films. As when viewing the films themselves, the viewer has to wear polarised glasses. The system developed by 3D Television Systems transfers the original 3D films electronically on to a master 3D videotape.

## PRESTEL – WHERE NOW?

A recent report, with which British Telecom is said to be in agreement, suggests that Prestel should concentrate on the business market. The problem here however is that private

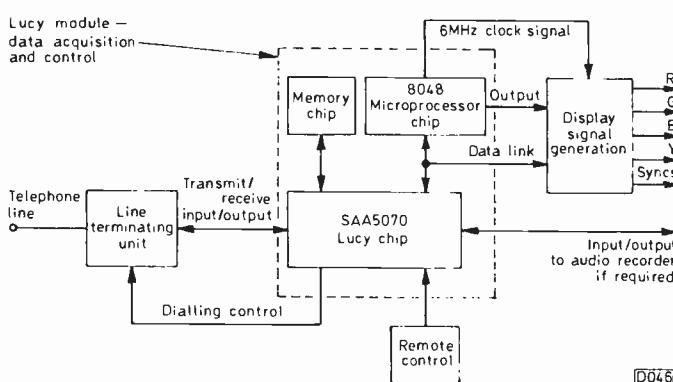


Fig. 1: Basic Lucy viewdata system. An audio tape recorder can be used with the Lucy chip as an external store. The tape data modulation system used by the Lucy chip is a modified form of the "Kansas City" standard – a high is represented by one cycle at 1.3kHz and a low by two cycles of 2.6kHz. As a result, the modulator output requires only minimal external low-pass filtering to produce data suitable for an audio tape recorder. The record/replay bit rate is 1,300 baud, i.e. 1,300 bits/sec.

data systems may be able to cater for the needs of many businesses better than Prestel can. Prestel can nevertheless be used to provide data networking between private computer data stores, something that's being accomplished with the introduction of the Prestel Gateway facility.

The latest Prestel development is a moving graphics system called Prextend, which is said to be a vast improvement on the previous technique of simulated movement. Prextend should provide Prestel with a graphics system as good as anything competing systems can offer.

### VCR TRAINING COURSE

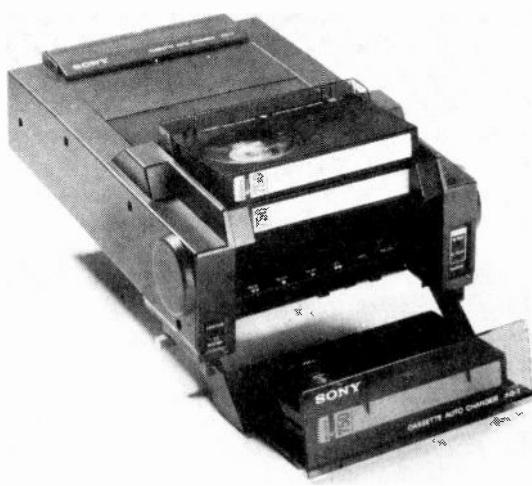
Steve Beeching's next VCR training course will be held on June 6/7th. Details from the Newark Video Centre, 108 London Road, Balderton, Newark, Notts NG24 3AQ.

### SUBSCRIPTION TV

Five firms, covering eleven areas, have been given licences to start pilot subscription TV services over existing cable networks. British Telecom will be providing the service in the Milton Keynes area, Greenwich Cablevision in Greenwich, Philips Cable Television in Northampton and Tredegar, Radio Rentals Cable Television in Swindon and the Medway Towns, and Rediffusion in Burnley, Hull, Pontypridd, Reading and Tunbridge Wells. The service will consist mainly of feature films – nine or ten a month, with three screened each night from 5 p.m. Films carrying an X certificate will not be shown till after 10 p.m. Subscribers will probably pay an initial connection charge plus a monthly fee of around £6. The Pay TV trial period will be for two years. Why the Home Office has pussyfooted over the years on Pay TV has always been hard to understand, though there are of course things one wouldn't like to think that others are able to sit and watch uncensored, would one?

### SONY EXTEND BETA PLAYING TIME

Sony have introduced a videocassette autochanger unit, called the Betastack, which enables their SLC7UB VCR to provide up to 13 hours of unattended recording. The unit, type AG7, can handle four cassettes, so the combination can be programmed to record up to four TV programmes automatically on four separate cassettes of appropriate length. Not only that, but the user can conveniently record



The Sony AG7 cassette autochanger unit for use with the SLC7UB videocassette recorder.

over tape no longer required while saving programmes he wishes to see again. The unit can be fitted to the machines by dealers (some early versions of the VCR may require minor adaptation) at a charge for supplying and fitting of less than £150. New recorders can be obtained already fitted with the autochanger unit for an extra £129.

### HIGH-RESOLUTION TV

CBS (Columbia Broadcasting Systems) recently demonstrated in the USA a high-resolution 1,125-line TV system developed by NHK in Japan. Ikegami provided the camera, Matsushita the TV sets and Sony the VTR. CBS is advocating the adoption of a high-resolution system for future TV services. The traditional problem has been bandwidth of course, but CBS suggest that microprocessor technology now makes signal compression/expansion possible at a reasonable cost.

### N1700 CONVERSION

Evans Video Services have developed a kit which enables the Philips N1700 VCR to be converted to dual-standard operation. Once converted, the machine will give up to five hours' recording time using normal cassettes, i.e. the LVC180 will give five hours and the LVC150 just over four hours, while at the flick of a switch the machine will run at the normal N1700 speed. The modified machines give excellent picture and sound reproduction, and with the speed reduced to 3.9cm/sec (6.56cm/sec in the normal mode) there's an improvement in tape consumption of around 60 per cent.

The parts used in the kit are all standard items. The main criterion in developing the kit has been minimum alteration to the machine: the result is an extra electronic module which is available in kit form at £65 including VAT, post and packing.

Evans Video Services (283 Bramhall Lane South, Bramhall, Cheshire) can also provide modifications to obtain longer playing time from N1500 series machines, also video input/output modifications for Philips VCRs

### CASSETTE CATALOGUE

Thorn-EMI have issued a detailed, illustrated catalogue of their current range of pre-recorded videocassettes. And quite a mouth-watering range it is. At this rate, even the editor might be tempted to stop chuckling over Steve Beeching's writings and buy one of the things. Details from EMI Video, 5 Dean Street, London W1V 6QD.

### LCD TV

Both Toshiba and Hitachi are working on the development of miniature monochrome TV sets using liquid-crystal display panels. The latest panel has been announced by Hitachi and has 160 vertical and 120 horizontal picture elements, the overall dimensions being 60 x 45mm. Since the panel works on the external light reflecting principle, an external light level of 500 lux or more is required. Hitachi's prototype set has a power consumption of only 1.3W, and will operate for four hours on four dry batteries.

### NEW AVOMETER

The latest addition to the AVO range is the DA118, an advanced auto-ranging digital multimeter. Though the meter has been designed specifically for use on the

laboratory bench, the inclusion of mains/battery facilities makes it suitable for field servicing as well. There's fast response on the d.c. and resistance ranges, less than a second, and the manually selected 20mV d.c. range has a resolution of  $10\mu V$ . There are five functions, with a basic 0.3% d.c. accuracy, all fully protected against overload. Auto-ranging is provided on the voltage, current and resistance ranges. In addition, a junction test is provided. The  $3\frac{1}{2}$  digit LCD display automatically indicates the unit of measurement and decimal point, and provides range hold, polarity, over range and low battery information.

### NEW SETS

Toshiba's latest release, the 14in. Model C1400B colour set, incorporates their new X55 chassis and a  $90^\circ$  Toshiba blackstripe SSI Mk. II tube. Doric (Rediffusion) have also released a 14in. mains portable colour set, Model CU36502D. This appears to be the first fruit of the co-operation agreement between Sharp and Rediffusion announced last year.

One firm that still seems to have plenty of optimism left is Panasonic, whose parent firm Matsushita has announced that colour TV set production in S. Wales is to be doubled (to 100,000 sets a year). An additional plant is to be built alongside the existing one.

### RANK SELLS MURPHY TRADE MARK

The interment of Rank Radio International seems almost complete. The latest development is that the well known Murphy trade mark has been sold to J. J. Silber, an import and distribution company which is a wholly-owned subsidiary of Great Universal Stores. Silber's specialises in audio and photographic equipment, and intends to market a comprehensive range of Murphy branded products.

Meanwhile the Co-op, which has bought its TV sets from Rank in recent years, is understood to have placed a substantial order with Philips.

### NEW VCRs FROM SANYO

Two new Beta format VCRs have been introduced by

Sanyo. The VTC9300PN is a restyled version of the VTC9300P, which it will replace – the suggested price remains the same however at £399.95. The VTC5600P is a more complex machine offering a number of extra features, including a clock/timer system which will record five programmes over a period of up to seven days, infra-red remote control, a pause/slow function for easy editing, programme search at three times normal speed, a lock switch to prevent accidental channel change, a microprocessor controlled transport system, audio dubbing and an anti-dew detector.

### STATION OPENINGS

The following relay stations are now in operation:

**Culm Valley** (Devon) BBC-1 ch. 39, TV4 ch. 42, BBC-2 ch. 45, Westward Television ch. 49.

**Downderry** (Cornwall) BBC-1 ch. 55, Westward Television ch. 59, BBC-2 ch. 62, TV4 ch. 65.

**Duncraig** (Inner Sound, Western Highlands) Grampian Television ch. 41, BBC-2 ch. 44, TV4 ch. 47, BBC-1 ch. 51.

**Kirkmichael** (Strathclyde) BBC-1 ch. 39, BBC-2 ch. 45, Scottish Television ch. 49, TV4 ch. 52.

**Looe** (Cornwall) BBC-1 ch. 40, Westward Television ch. 43, BBC-2 ch. 46, TV4 ch. 50.

All the above transmissions are vertically polarised.

### DIGITAL AUDIO DISC STANDARD?

Though no one working in the video field ever seems to be able to agree on a common standard, the same firms when they put their audio hats on seem to manage much better. At any rate, we've got one LP audio disc and one cassette standard, and it now looks as if we shall have one standard for digital audio discs as well. That at any rate is how we read the announcement that Matsushita, JVC's parent company, has decided to adopt the compact disc system developed by Philips. This system has been further developed recently in collaboration with Sony. Matsushita comment that the Philips disc is the most suitable one to adopt as a world standard due to its compactness and the possibilities for future development and applications.

## SERVICE NOTES FROM ITT

Some notes have been issued by ITT on their recently introduced CVC800 ( $90^\circ$ ) and ITT80 ( $110^\circ$ ) colour chassis. First the CVC800 (Euro 1). Some cases of failure of transistor T301 in the beam limiter circuit have been reported. In this event, check whether C517 ( $0.047\mu F$ ) is fitted in parallel with R515. If C517 is fitted, but the  $1k\Omega$  surge limiting resistor R517 between the junction of R515/C517 and connector D2 pin 4 is missing, remove C517. A  $1k\Omega$  resistor (R653) has been added in series with C652 to reduce crosstalk between the degaussing circuit and the field scanning. In later production designated CVC800/1R, the c.r.t. first anode supply is derived from a separate rectifier instead of from the focus supply. The rectifier and associated components are mounted on a small panel on the c.r.t. base. The coincidence muting circuit (transistors T1051/T1061 and associated components) is deleted in later production. To improve the dynamic width stabilisation, R501 is changed to  $6.8\Omega$ , C704 to  $0.0068\mu F$  and R1077 to  $22k\Omega$ , C517 and R517 (see above) are added, also C613 ( $33pF$ ) from pin 6 of IC600 to chassis.

Secondly the ITT80 (Euro 2) chassis. No results have been traced to a defective horizontal shift transformer TR404 and to the efficiency diode D456 being short-circuit. In cases of varying width, check the 20V zener diode D406 in the switch-mode power supply control circuit. If there's a faint horizontal white bar near the top of the picture, check C467 ( $0.01\mu F$ ) which decouples pin 11 of the TDA1170S field timebase i.c. for leakage: if this is all right, suspect the chip itself. Random channel change has been traced to mains born interference affecting the 18V line on the remote control receiver unit: the cure is to increase the value of C3 to  $1,000\mu F$ . In cases of tuning drift, check C203 ( $0.047\mu F$ ) by substitution. In cases of sound buzz on teletext, check whether C235 ( $3.3\mu F$ ) is fitted, connected to pin 7 of the TDA1035T sound i.c. If so, remove it (leave pin 7 open-circuit).

Finally, ITT recommend Evostick resin W woodwork adhesive for use on all chassis as a suitable material for treating whistling line linearity coils etc. Observe the usual precautions, i.e. don't get it all over your fingers etc.

# Video Handbook!

by

Ru van Wezel

Edited by

Gordon J. King

A practical book on all aspects of the subject intended for the serious enthusiast and the semi-professional in video as well as technical personnel in small video/television production companies.

## Master Control

The master control desk is dealt with in detail, including trick effects such as wiping and keying, and a simple self-build control desk is described. Later chapters cover transmission and reception systems, cables, video recording and editing (open reel and cassette) and audio recording and playback.

## TV & Camera

Early chapters cover television standards, transmissions, the structure of the complete video signal, cameras and tubes including a build-it-yourself monochrome camera.

## TV Production Techniques

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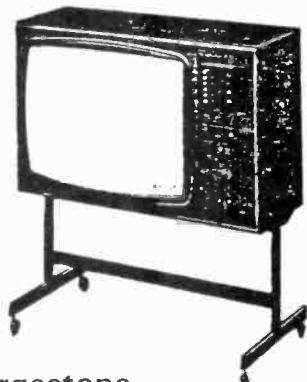
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# **TV Sound Tuner Kit**

Hugh Cocks

**SENDZ COMPONENTS** have recently introduced a TV sound tuner kit that converts the u.h.f. band to an i.f. output of 88-108MHz for feeding into an f.m. radio receiver. The result is very good quality TV sound. When completed, the unit is extremely compact and smartly finished.

The adaption of u.h.f. TV tuners to feed into an f.m. radio receiver is by no means a new idea of course. The advantage with this kit is that a very small Japanese rotary tuner unit is employed and requires a minimum amount of modification to enable it to operate at the higher i.f. than was originally intended.

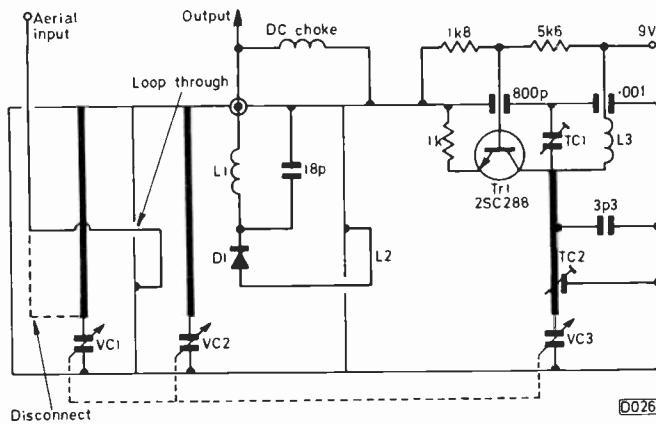
The circuit of the tuner is shown in Fig. 1. There's no r.f. amplifier stage, simply a transistor local oscillator and diode mixer. This arrangement is unusual by UK standards, but was commonly used in the USA before the adoption of varicap tuners there.

When a conventional type of u.h.f. tuner is modified to give an i.f. output at a higher frequency, problems arise because of the need to retrack the r.f. amplifier stage and to adjust the i.f. output coil to peak to the new frequency. This simple tuner is easily adapted however, due to the absence of an r.f. stage and the use of a passive mixer. There's no i.f. peaking coil in the mixer stage, just a u.h.f. blocking choke. In fact plugging the tuner straight into an f.m. radio set will produce signals! It's worth making one or two refinements however to optimise the performance on the f.m. band. These are as follows.

The u.h.f. blocking coil L1 consists of about eight turns, and is taken to a phono socket on the tuner's body. Reduce the coil to four turns to reduce its reactance at the higher frequency required.

The u.h.f. aerial input is taken to an input tuned circuit consisting of a small lecher line which is tuned by VC1. Adjustments to this circuit are minimal however, so it's simpler to bypass the tuned circuit and couple the input straight into the mixer tuned circuit in the next screened compartment. This is easily done by disconnecting the soldered end of the input feed, bending it so that it passes through the hole in the screening, pushing it through into the second compartment, bringing it adjacent to the mixer lecher line, and soldering it to the wall of this compartment – as shown on the circuit diagram.

For proper mixing, the mixer diode D1 requires a d.c. return to chassis. This was provided in the original design.



*Fig. 1: Circuit diagram of the tuner, showing modifications.*

by the input transformer in the i.f. strip. In this application, you can solder the v.h.f. choke provided with the kit to the coaxial socket on the case during construction. If your f.m. tuner has such a choke across its own aerial input however this modification is unnecessary.

Building the unit is a simple business. An aluminium angled bracket is provided for mounting the tuner into a predrilled steel box. A push on-off switch is mounted on the same bracket, both the switch and the tuner shafts protruding through the front of the case.

All that's now needed is to bolt on the coaxial sockets and solder the connections. A PP3 battery connector is provided, and this should be soldered to the switch. The positive side goes to the large pin at the front of the tuner and the negative side to chassis.

A channel indicator plate, calibrated from 1 to 10, goes on to the tuner shaft before the main tuning knob. The end result looks very smart, the box being approximately  $5 \times 3 \times 2$  in. and covered with a black material.

Despite the lack of an r.f. amplifier stage, the performance is very good. I found that all the local and semi-local stations could be heard using just a short length of wire plugged into the inner section of the coaxial aerial socket.

Set the f.m. radio to a convenient place on the dial, free from local signal breakthrough. Tuning a signal in is rather sharper than on a TV set of course, as the virtues of the intercarrier sound system are lost! The radio itself can be used to fine tune in a signal, the drift once set being negligible.

One point to note is that, because of the untuned input, signals – mainly in the group B/C region – tend to be received in their normal place and also in the group A region, being mixed above and below the local oscillator. This is a minor point in practice, unless one lives in an area with strong group B/C local signals and wishes to receive some group A DX signals. If the two signals do coincide, retune the radio set by about 2MHz. The i.f. will then be different, and the wanted signal should be obtained. A preselector ahead of the tuner should cure this problem.

The use of the passive mixer means that little noise is heard when one switches on – indeed the writer's set seems to give off less noise when the tuner is on! Any ideas on that?

The PP3 battery required does not come with the kit of course. It should last a long time, since the current consumption is low (3mA). A mains unit could be included, using a miniature transformer, and due to the lack of space a 7812 i.c. regulator would be best to reduce the size of the electrolytics should hum be heard.

From a DX point of view the unit is useful for receiving the 5.5MHz W. European sound, which is not normally obtainable on UK sets (also the 6.5MHz OIRT sound, should you receive it at u.h.f.). The French a.m. sound will probably not be heard too well, due to rejection by the radio set – if the set's discriminator is deliberately detuned however the sound will come in very well. With an up-converter, the v.h.f. bands may also be received using this unit, though I haven't personally tried this to date.

The kit is available from Sendz Components at £10 plus VAT and 50p postage. ■

# Servicing the ASA 6000 Series

Paul Coles

THE ASA CT6000 was the solid-state successor to the hybrid CT5003/CT5004 series which we covered in the September 1980 issue. Amongst the main features are a thyristor line output stage and a 110° thin-neck delta-gun tube (type A67-150X) with toroidal yoke. Also incorporated are two on/off switches – the one at the back switches everything off, the front one leaving the tube heaters on at reduced power due to Ra2 then being in circuit. Most of the circuitry is conventional, though there are a couple of unusual features. The thyristor which provides the regulated h.t. line (U2) is driven by a unijunction transistor (Ta1) for example, while a f.e.t. (Ta11) is used to reduce the red drive during monochrome transmissions so that the display is then more like that obtained on a monochrome tube.

## Power Supply Arrangements

The set is unusual for one with a thyristor line output stage in using a thyristor regulated h.t. supply instead of a regulating transductor in the line output stage. The power supply is shown in Fig. 2. The mains input is fed to the degaussing circuit, to bridge rectifier Da1-4 which supplies 100Hz pulses to the anode of the regulation thyristor Da10, and to the mains transformer which supplies the c.r.t. heaters and the l.t. bridge rectifier Da5. A trip circuit, transistor Ta2 and its associated components, provides excess current protection in the event of the flyback thyristor or diode (De3/4) in the line output stage going short-circuit – transistor Ta2 then conducts, shorting the regulator thyristor's cathode and cathode gate. Variations in the h.t. voltage are sensed by the operational amplifier i.c. IC9, which in turn adjusts the triggering of the unijunction transistor Ta1. The other main supply in the set is obtained from the commutating transformer Trel – diodes De1/2 produce 32V across their reservoir capacitor Ch25 (2,200μF). This voltage is fed directly to the 24V regulator

circuit (Ta3 etc.), and via Rg45 (2.7Ω, 7W) to the field output stage. Rg45 drops the 32V line to 28.6V, and this supply is also fed via Rg37 (22Ω, 4W) to the 12V regulator which supplies most of the signal circuits (see Fig. 1).

## Common Faults

Most of the sets I've had to attend to have been suffering from either a short-circuit diode in the bridge Da1-4 or dry-joints around the commutating transformer. The following notes summarise the majority of faults I've come across.

**Set completely dead, with the neon GL8 extinguished:** This usually indicates that one of the diodes in bridge Da1-4 has gone short-circuit, blowing one of the mains fuses.

If you get a loud clinking noise followed by blown mains fuses, it's likely that there's a dry-joint on the commutating transformer or that one of the 32V rectifier diodes De1/2 (type BYX55) is short-circuit.

**Dead set with the neon GL8 and the c.r.t. heaters alight:** The usual culprit is the front on/off switch, due to burnt l.t. contacts – the set may come on intermittently when the contacts are pressed. Most of these switches have a second pair of unused contacts alongside, and I've often paralleled these up as a temporary measure when a replacement switch has not been to hand.

Other common causes of these symptoms are fusible resistor Rel (1.5Ω), which is mounted at the top left-hand side of the line timebase screening cover, open-circuit, thus removing the h.t. supply to the line output stage, and the 24V regulator transistor Ta3 open-circuit, since there is then no supply to the line oscillator and driver transistors.

**Set dead with the c.r.t. heaters out:** The l.t. bridge rectifier Da5 is probably short-circuit and the 100mA l.t. fuse open-circuit.

**Excessive picture movement (flicker) or lack of width:** The former fault looks like a maladjusted over-voltage preset on the Philips G8 chassis and can usually be cured by replacing Ra9 (10MΩ). Lack of width with low voltages occurs when Ra9 goes open-circuit.

**Sound but no e.h.t.:** This is usually due to the scan thyristor De5 or its parallel diode De6 being short-circuit. In some sets these two components share a common encapsulation, a point which should be born in mind when using replacements of a different type to those fitted.

**Non-linear line scan:** A defective line scan coupling capacitor, Ce13 (2.7μF), produces right-hand side cramping with the left-hand side stretched. Ensure that you use the correct type of replacement – ordinary paper ones don't last long.

**Focus faults:** The focus VDR seems to get up to its usual tricks on this chassis.

**Field collapse:** The most common cause of this is absence of the 28.6V supply to the field output stage due to dry-

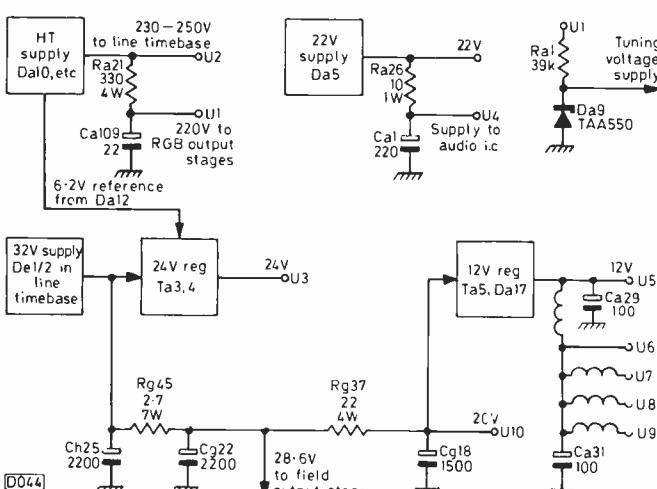


Fig. 1: Power supply arrangements. Note that there's a start-up feed, not shown above, from the 22V supply via Ra28 (2.7Ω) and Da14 (1N4448) to the 24V regulator circuit to get the line oscillator and driver circuits working when the set is first switched on.

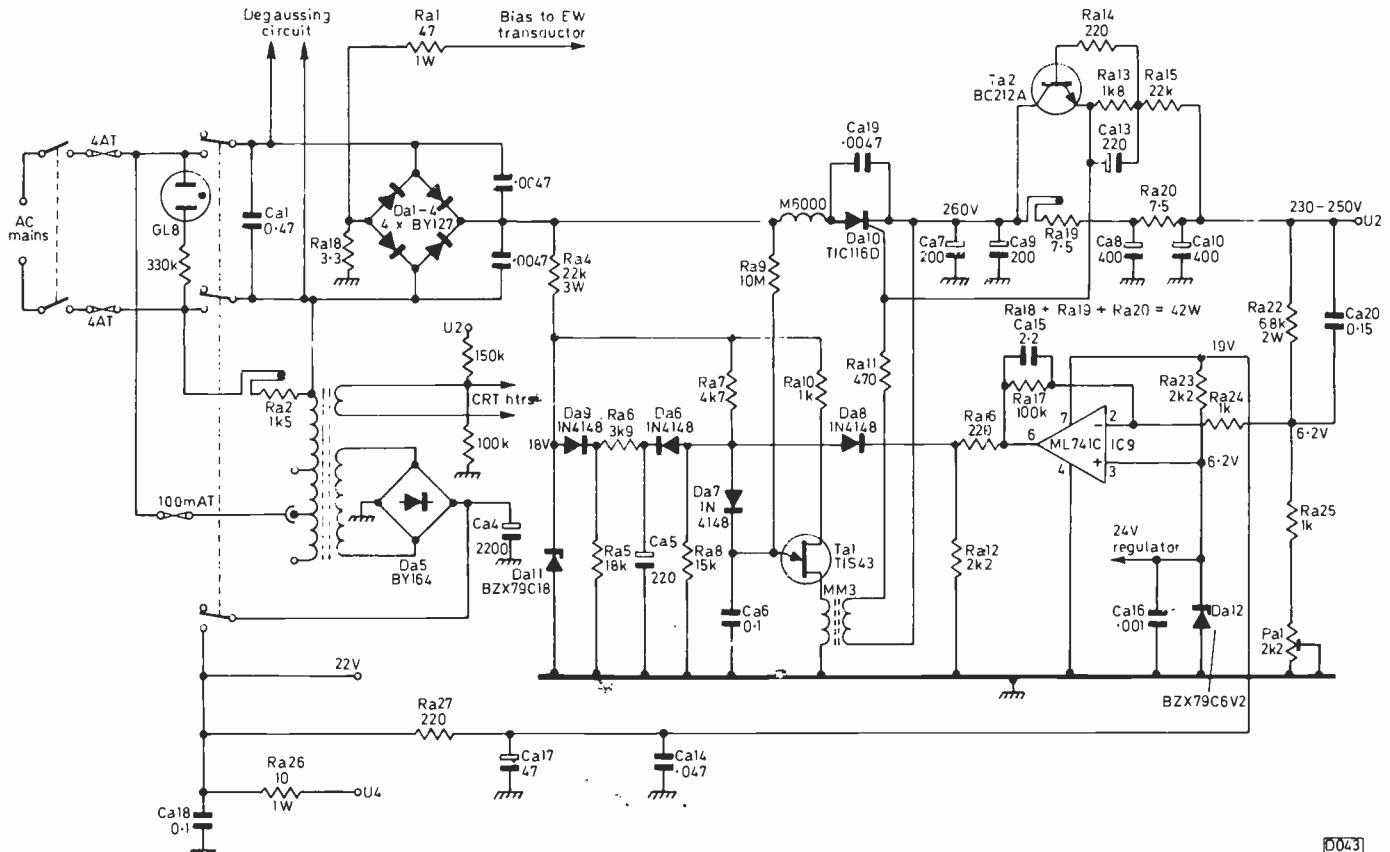


Fig. 2: Mains input and regulated h.t. supply circuitry used in the ASA 6000 series.

joints on pins 1 and 7 of the commutating transformer in the line timebase. Tg6 (BC302), one of the driver transistors, sometimes goes faulty though it reads o.k. on the meter. Replace it with a BC142, BFY51, etc. Its partner Tg7 (BC327) occasionally goes short-circuit, with Rg29/30 running warm. I've had almost every transistor (Tg1-9) in the field timebase fail at one time or another. Careful voltage checks will usually reveal the culprit.

**Lack of height:** If there's foldover at the bottom when the height control is advanced, the usual cause is the output stage feed resistor Rg45 ( $2.7\Omega$ , 7W) going high in value, with the result that the 28.6V rail is low. Replace with a  $2.2\Omega$  11W resistor. Another common cause of this fault is the field scan coupling capacitor Cg20 ( $3,300\mu F$ ) – it runs warm if leaky. If necessary, check Rg41 ( $0.56\Omega$ , 4W) via which the scan circuit is returned to chassis.

If the fault is simply lack of height with the height control fully advanced, check the setting of the 24V U3 rail (Pa2). If this is correct, change Rg45 and Rg41.

**Miscellaneous field faults:** The field hold and height presets can become intermittent, causing troubles such as partial field collapse and speed variations.

## Signal Circuits

The signal stages and the decoder are reliable. The i.f. strip uses two rather unfamiliar i.c.s – an SN76650 as the i.f. amplifier and a TCA540 as the demodulator. The former is equivalent to the better known Motorola MC1352P. The decoder is of the Mullard/Philips four-chip variety (TBA560A, TBA540, TBA520 and TBA530). The only decoder fault I've ever had was intermittent loss of colour due to the TBA540's holder being faulty. I've never had to replace any of the i.c.s themselves, nor any of the BD115

RGB output transistors. The RGB output stages are of the class A variety, with  $5.1k\Omega$ , 9W load resistors and BA148 beam limiter diodes.

No sound with an unmodulated white raster was traced to the TCA540 i.c. on one occasion. Another cause of these symptoms is the 12V regulator transistor Ta5 (BC140).

The varicap tuner gets up to its usual tricks, but the push-button unit seems to be much more reliable than the one used in the hybrid sets.

## Convergence Faults

Convergence problems are generally caused by poor soldering on the convergence panel. On a couple of occasions I've seen a major burn-up on this board, with numerous coils and presets shrivelled up. The quickest answer to this one is to fit a new panel.

## Conclusion

An expensive fault that can occur is short-circuit scan coils. The usual symptoms in this case are no e.h.t., with a much reduced spark at the input to the tripler, and the NS amplitude control Ph1 ( $220\Omega$ , 2W) overheating.

Those have been my experiences, but I'd like to hear from any other readers who have handled these sets. Perhaps, also, someone would care to comment on the effect on the life of the c.r.t. of leaving the heaters in operation when the rest of the set is switched off.

## Spares

Spares are available from Asaradio Television, 4 Victoria Street, Bristol BS1 6BN – telephone 0272 25266. The chassis covered in this article was also used in Models CT6000A and CT6200 (22in. version).

# *Vintage TV: McMichael Model 909*

*Vivian Capel*

DURING the immediate post-war years McMichael, then an independent company, built up a reputation for quality radio receivers. Naturally when television transmissions restarted, a range of TV sets was added. Amongst the earliest was the 909, a console with a 9in. c.r.t. - there was also a 12in. version, in a totally different cabinet and including a broadcast radio section.

*The Cabinet*

The 909 had several interesting features, not least of which was the cabinet. This had an up and over front panel to cover the screen and the controls when the set was not in use, making it an ideal set for those who didn't want their living rooms dominated by technology – there was quite a strong feeling about this at the time, and one wonders what the reaction then would have been to some of the modern hi-fi units! The bottom part of the console cabinet formed an acoustic chamber for the loudspeaker, which was an 8in. unit mounted so that it faced downwards into this chamber. This meant that the sound quality was good – while the speaker grille was concealed.

When you were called to service one of these sets, it was common to find that the bottom chamber was in use to house books and various domestic oddments, much to the detriment of the sound quality. I personally owned one of these sets – it was my first TV set in fact. The cabinet still resides in my living room, though the upper part has long since been converted into a compact and useful record cabinet – large books that won't fit elsewhere repose in the lower chamber.

## *Tuning*

There were two versions, one for the London transmissions and the other for the Birmingham service – suffixed L and SC respectively. As a superhet circuit was used, the only circuit difference was the value of the oscillator tuning capacitor C12 – 50pF for London, 30pF for Sutton Coldfield. Conversion for use with other transmitters could be easily performed by altering C12 to a suitable value and retuning the r.f. coils. The frequency changer consisted of an ECC91 double triode, with one section as the oscillator and the other the mixer. Control of the set's gain was achieved by means of a 5kΩ potentiometer which adjusted the cathode bias applied to both the r.f. and the first i.f. amplifier valve. It was called the contrast control.

## *Oscillator Drift*

The oscillator frequency was set by means of a large thumbwheel beneath the chassis. One of the problems with the set was oscillator drift, which was mainly due to displacement of the frequency changer valve. To minimise this problem, the valve was secured in position by means of a strip across the top with a centre hole for the valve pip: a felt washer beneath protected the glass. The strip was held

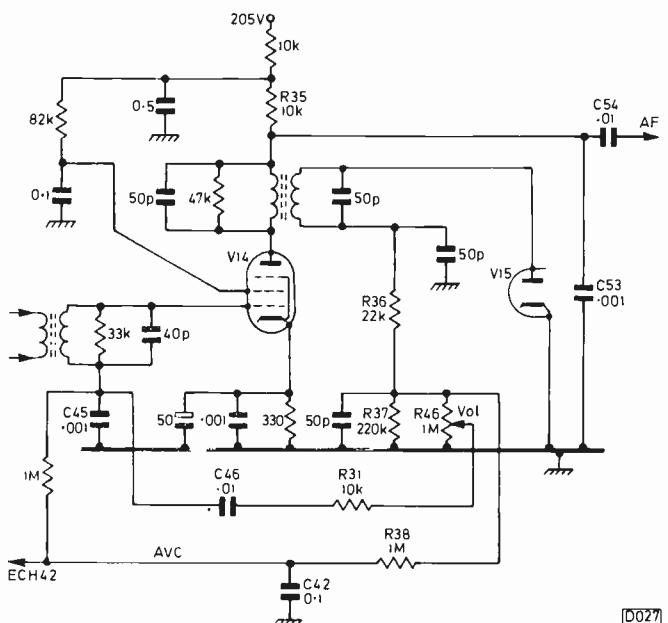
at both ends by screwed pillars, and if the nuts were not tight drift would surely follow.

### *The Sound Channel*

The set designers of those days did not, as many modern ones seem to, regard the sound as a necessary nuisance. Mention has already been made of the 8in. speaker and acoustic chamber – the 12in. version had a 10in. speaker. An unusual feature was the fact that the sound channel started with a second frequency changer stage. The ECC91 vision/sound frequency changer produced i.f. outputs at 23.5MHz vision and 27MHz sound, the ECH42 triode-hexode sound frequency changer, which functioned in a similar way to a broadcast radio mixer, converting the 27MHz sound signal to 2MHz. This was amplified by a single EF41 valve (V14).

This made alignment rather complicated. The 2MHz i.f. coils had to be aligned first, then the oscillator section of the ECH42. This had two peaks, the one with the core halfway out being the correct one. The final adjustment was made to the first oscillator.

Perhaps the use of a second converter made the designer feel that some economy should be exercised elsewhere in the sound channel. This was done by operating the EF41 in the reflex mode – as both an i.f. and an audio amplifier. Reflex circuits were occasionally found in the radio receivers of the period, and in one or two other TV sets, but were not all that common. They could have you running around in



*Fig. 1: The reflex sound i.f./a.f. stage. The detected sound appears across the volume control and is fed back to the pentode's control grid, in turn being developed across R35 in the anode circuit. C53 removes the i.f. signal from the audio feed. Sound a.g.c. (a.v.c.) is also applied to the valve's control grid, via the high-value ( $1\text{M}\Omega$ ) filtering resistors.*

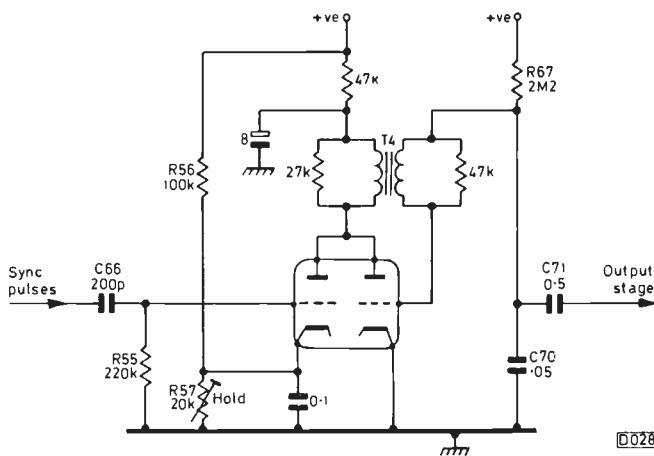


Fig. 2: Field sync pulse clipper and blocking oscillator circuits. The pulse clipper triode removed the line sync pulses and produced at its anode sharp, differentiated field sync pulses. These were used to trigger the blocking oscillator, being coupled to the triode oscillator's grid via the transformer.

circles when trying to fault-find – unless you knew what was going on.

The circuit is shown in Fig. 1. The detected audio signal was developed across the detector diode's load resistor R37, the volume control R46 being connected in parallel with this. The signal tapped from the slider of the volume control was fed back to the EF41's control grid via R31 and C46. In addition to the i.f. output transformer, the valve also had an a.f. load resistor (R35). Comprehensive filtering ensured that everything worked very well – until a fault occurred!

### The Field Timebase

Conventional pentode video and sync stages were used, so we come next to the timebases. The set used Mullard valves, with one exception. This was a Brimar 6SN7, a twin triode with an octal base. It was used as the field blocking oscillator and sync pulse clipper (see Fig. 2). The sync pulses were partially differentiated by C66 and R55 and fed to the grid of the clipper stage, whose cathode bias was set by the hold control R57. The hold control thus set the clipping level. The two anodes were strapped together, and the sync pulses appearing here were coupled to the grid of the blocking oscillator section of the valve via the

transformer, triggering the oscillator just before the time set by the time-constant network R67/C70. The latter acted as both the basic timing circuit and the field charging circuit, the waveform developed across C70 being coupled to the output stage via C71 and a linearity network. Incidentally, it's not relevant to think of field synchronisation in terms of pulse integration with this type of circuit: the oscillator was triggered by the first slope that occurred when it was susceptible to being triggered. The idea was to achieve good interlace, which was difficult using pulse integration with the 405-line system due to the lack of equalising pulses in the waveform. The field output stage consisted of an EL33 pentode with choke-capacitance coupling to the high-impedance scan coils.

### The Line Timebase

The line timebase also used a blocking oscillator, with a triode-connected EF42.

The line output stage (see Fig. 3) used an EL38 as a sawtooth amplifier. The EZ35 double diode was not used as a boost diode, instead acting as a damping device across the section of the line output transformer that fed the scan coils. There were, unusually, two linearity controls, coarse and fine. The coarse one affected the overall linearity and consisted of a variable resistor in series with the line scan charging capacitor C76. Since this affected the line oscillator's time-constant, it tended to change the line frequency. The fine control affected the left-hand side of the picture, and consisted of the variable resistor in series with the EZ35.

The e.h.t. was 6.5kV, and was obtained by flyback rectification using a voltage doubler circuit with two EY51 valves. The arrangement is not quite what one nowadays expects. Briefly, V19 charged its reservoir capacitor C80 in the normal manner – to 3.7kV. The flyback pulse was also applied to V18, via C81. Between pulses, part of the charge on C80 passed via R84-6 to C81. The anode of V18 was thus presented with a higher voltage than the flyback pulse alone, and charged its reservoir capacitor C79 to this higher voltage. With C80 and C79 in series, the circuit produced some 6.5kV. The rectifier heaters were fed from separate windings, each having a 39Ω series resistor. Cases of poor e.h.t. regulation could often be traced to one of these resistors increasing in value.

### Heater Supplies

All the other heaters were parallel fed from the mains transformer, which provided mains isolation. A full-wave circuit was used to provide the h.t. The transformer was generously proportioned and was mounted, along with the GZ32 rectifier and smoothing choke and capacitors, on a separate subchassis. This was situated at the bottom of the set, behind the acoustic chamber, the weight of the power unit in this position giving the cabinet extra stability. The power supply was connected to the main chassis via a 12-pin plug and socket, which also carried the mains supply to and from the double-pole switch on the volume control. As a result, removing the plug disconnected the mains and avoided high off-load voltages in the power unit.

### Front Controls

There were four front controls – volume plus on/off, brightness, focus and contrast. The focus coil carried the h.t. supply to various parts of the receiver, and was shunted by the focus control plus a series resistor.

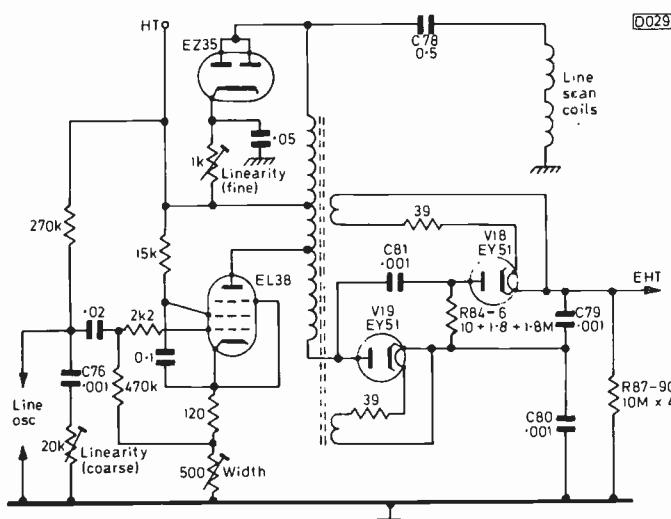


Fig. 3: The line timebase consisted of a pentode waveform amplifier, a double-diode to provide damping, and a voltage-doubling e.h.t. rectifier circuit (V18/V19 etc.).

# *It Started to Say Something . . .*

**Les Lawry-Johns**

I WAS busy sitting at the typewriter wondering what on earth to write about when this young lady came in carrying a small colour portable. A corker and no doubt about it: a vision of loveliness with that elusive quality called style. As she approached I suddenly remembered what life was all about. None of that twaddle about what we are here for and the hidden meaning of life.

"I wonder if you can help me?" she asked quite unnecessarily. "This is our second set, but when we switch it on it starts to say something then stops. We switch it off and on and it just about comes out with another word then packs up again. I know that sounds silly, but I'd be very grateful if you could get it to say a sentence at least." Plus a sense of humour . . . "It's a Philips. K9 I think."

I looked at her carefully. It was a KT2 actually, which is not far removed from the current KT3. Not at all like a robot dog. All good fun, so I grabbed the pad.

"Could I have the name, address and telephone number please?"

"My name's Knell. E. Knell." The pen nearly fell from my hand. Could this be the legendary . . . Had she come all these thousands of miles to test me? But I kept my cool.

"Could you call back in a couple of hours, please. We'll have it done to your complete satisfaction er . . . well, done. Never fear . . ."

"All right then. I'll get my husband to pop in later to collect it."

After she'd gone I pulled myself together. What a fool I'd been. What rot to think . . . Anyway, I'd rather rashly promised to have it ready in a couple of hours, talking normally and hopefully showing a picture as well. So off came the back cover. Plug in aerial and select BBC-1. Switch on. It came on, said "well", then lapsed into silence. Obviously the protection circuit was protecting something or other against something or other . . .

So I turned it on its face and switched it on again, noticing this time that with the volume turned down so that it couldn't speak there was a hiss and a subdued crack from the top of the cabinet around the e.h.t. connector. Switch off, remove e.h.t. connector and suspend it well clear, then switch on again. This time it continued to function, even to talk when the volume control was turned up.

There was no deterioration on the e.h.t. cap, and thorough cleaning of the top of the tube (very little clearance) showed no muck that might have promoted a discharge. So we put the cap back and tried again. The set remained on, but a hiss could be heard and with the lights out a faint blue haze could be seen from the top of the tube to the Rimband. Off came the connector again, and we renewed our efforts around said area with silicone. This time there was hardly any hiss when we refitted the connector, and what there was stopped when we reduced the chopper-regulated h.t. supply from 131V to just under 130V with R405. We now had a set that talked and produced a splendid picture as well.

You won't believe this, but an hour or so later a little grey-faced man crept into the shop and enquired as to whether his set was ready.

"What name sir?"

"Knell. My wife brought it in earlier."

So there you are. Here am I, a fine strapping figure of a man bursting with health, and here is he, an empty shell of a man, sapped of his manhood, old before his time. Lucky man.

## **Enter Jacko**

You may recall Jacko. I have great difficulty keeping him away from Honey Bunch because he always thinks it's New Year's Eve, even in the middle of May, and Honey Bunch thinks it's great fun to hop around keeping at arm's length but always manages to get caught before Jacko gets puffed out. Anyway Jacko turned up with his Pye 697 (hybrid colour chassis) complaining that all he could get was a white line.

"Good" I said, "it shows what perfect convergence you have."

"Let's not talk about me" said Jacko, "it's the set I'm on about." Which spoilt my little joke.

Now field collapse on a Pye hybrid colour set doesn't necessarily mean that the field timebase has ceased to function, i.e. the trouble need not be on the field timebase subpanel at all but in the long interconnections via which the supplies and the field drive come and go. Our first step was to ensure that the positive and negative 20V supplies were present at the output transistors. Yes. So we connected an audio signal tracer to the field output tag D in order to hear the field buzz. Loud and clear. The separate 20V supply to the height control is not important in cases of field collapse incidentally, since if it's absent – as it often is when the zener diode D52 on the main panel goes short-circuit – the effect will be lack of height rather than complete loss of scan. Complete collapse more often means an open-circuit somewhere in the long path from output tag D to chassis. This embraces many connections, tracks and leads.

Since there was a nice healthy buzz at tag D, we followed the green lead up to the top right edge connector on the power board, then down and across to the side edge connector. This is fairly easy if you know these sets, but is a bit tricky for those who don't because of the jump leads on the component side of the board – these are not marked on the print side. The circuit is then from the side edge connector to the scan coils, back to the edge connector and up to the convergence panel edge connector, with a link from here to the shift control on the power board. All this gives plenty of scope for poor contacts or hair cracks in the print runs.

By the time we'd proved the continuity to and from the scan coils the scan had opened up and no amount of pulling or pushing, tapping or bending would make it collapse again.

Whilst I was thus engaged, Jacko informed me that two (of the six) buttons were unusable. I told him he still had four, but he took the view that if two were gone the others would not be far behind. So out came the tuner head or selector unit (or whatever you like to call it), and we settled down to fit the replacement which had been up on the shelf for some time, together with ten million other bits and pieces which we order just in case they might be needed

(this is the reason for our destitution, and why H.B. and I have great difficulty in getting our ends to meet). Fit selector unit and switch on to align buttons.

There was a white line across the screen of course.

"We haven't got very far, have we?" commented Jacko.

I decided on another line of attack, since the first effort didn't seem to have been very rewarding. Switch the set off and make continuity checks from tag D through to the edge connectors, through the scan coils, then up to the convergence panel. Here my eyes crossed and I got mixed up a bit, but the reading down to the slider of the shift control seemed pretty low. The field coupling capacitor C455 on the convergence panel looked all right and anyway doesn't give trouble. All in all then a pretty fruitless exercise.

I made an unkind comment about the parentage of the Pye 697 range in general, and Jacko reminded me that I'd recommended and sold him the set in the first place. So we switched it on again and of course there was a full scan. It was Jacko's turn to query the set's parentage.

By now I'd convinced myself that on this occasion the trouble was not to do with the print or connections on the

power board, and that as the field coils are in parallel the most likely suspect was the convergence panel. Further checks here revealed that the slider of the field R/G symmetry control RV40, which is in series with the scan coils, was dry-jointed. When this was made good harmony was restored all round.

"Took you a long time" said Jacko unkindly.

"That's true" said Honey Bunch, appearing briefly on the scene. "Most things seem to take him longer lately." So saying she vanished as quickly as she'd come.

"That'll cost you fifteen quid" I snarled at Jacko. "Pay up and clear off."

"You blokes must be making a fortune. I'll do it myself next time." Exit Jacko.

### Interlude

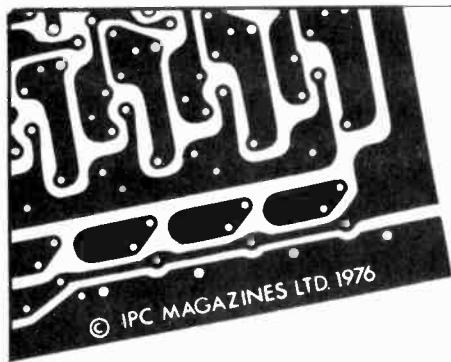
Enter small boy.

"Have you any plugs mister?"

"Lots son."

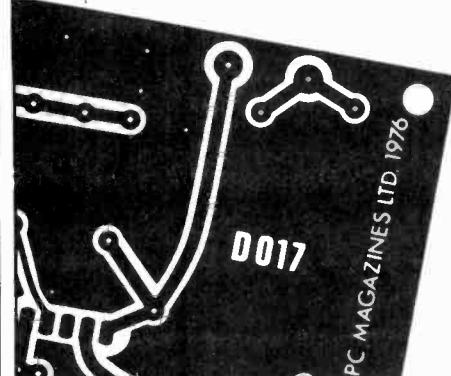
"Stick 'em up your socket then!"

Bring back the stocks I say.



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# Long-distance Television

Roger Bunney

MOST DX enthusiasts experienced a prolonged spell of enhanced tropospheric reception during the late January/early February period. There was also some F2 reception, and isolated sporadic E openings. In all it was quite a busy time, which is unusual at this time of the year. Near record SpE conditions have been experienced in Australia, which gives us hope for things to come – though an active spell in one part of the globe is not a sure pointer to enhanced conditions elsewhere.

Tropospheric reception during the period January 28th–February 2nd produced really excellent French, Belgian and Dutch signals throughout much of the UK. There were also W. German signals and signs (just) of DFF (E. Germany). At my own location (Hampshire) the Dutch v.h.f./u.h.f. signals were relatively strong but signals from just a little farther to the east (W. Germany) were quite noisy and not of the strength one would expect. Cyril Willis (Cambridge) logged the strongest Dutch/W. German signals he'd ever seen – so much so that Sandy Heath (group A) was unviewable on the evening of January 31st. Both Cyril and Mark Baldwin (Rugby) logged RTE (Ireland) transmitters on chs. IG, IH and IJ and in Band III – most people tend to neglect reception from the west.

One source of excellent signals, on chs. E7 and E21, was CLT (Luxembourg). The signals – with 625 lines and positive vision modulation – were present on most days. Brian Fitch (Scarborough) logged many good u.h.f. signals throughout this period, including French teletext from Lille on ch. E21.

Hugh Cocks (East Sussex) and Ryn Muntjewerff (Holland) received system M (525 line) signals from the new AFRTS outlet at Shape, Belgium during this opening. They're on ch. E34, with vertical polarisation – the transmitter e.r.p. is 4.5kW. Several 430MHz amateur TV transmitters were logged at over 300 miles in various places. The conditions faded on February 2nd.

There was a further though limited tropospheric opening on February 7-9th. Hugh received Swiss, Spanish and E. German signals while T. Ampi (London E6) logged several Swiss and German stations, also Luxembourg – all at u.h.f. There was another slight improvement during the 13-17th, with some of the above transmitters being logged along the south coast. Chris Harnett (Southampton) also received German Band II f.m. signals.

SpE propagation had its moments, particularly on January 24/25th when prolonged signals from RAI (Italy) chs. IA and IB, JRT (Yugoslavia) ch. E4 and RTVE (Spain) chs. E2, 3 and 4 were received. Arthur Milliken (Wigan) and Brian Fitch both report reception of these signals. There were also short-lived SpE openings during the early part of February, with signals mainly from Scandinavia.

There was further F2 propagation on several days during February. The openings were unfortunately generally short (less than an hour). Distant Russian signals were received on January 28th and 29th and on February 5th, 16th, 17th

and 18th. Gwelo (Zimbabwe) ch. E2 was logged again in Sussex on January 18th and 24th, and Ghana ch. E2 put in an appearance on February 5th and 6th. The Australian ch. A0 produced signals of sorts at Hugh Cocks' location on the 24th, at 1015GMT, and for five minutes at a much earlier time on the 29th.

On January 29th I logged a new test pattern via MS (meteor scatter) – on ch. E4 at 0759GMT. It was similar to the Fubk pattern, but with two rows of prominent black/white squares across the central area – not unlike the old PM5540 pattern. I've not seen it since.

So much then for an unusually active February.

## From our Correspondents . . .

Congratulations to Robert Copeman and Todd Emslie who received the BBC ch. B1 in Sydney, Australia on the 15th and 31st January via F2. On the former occasion there was test card music (no schools' programme on that day) from 0900-0915GMT, while on the latter occasion "Swap Shop" was received. Wenlock Burton (Melbourne) reports logging the 104.1MHz Brisbane f.m. radio station 4MMM via SpE on December 31st at 1602-1705 local time – this is a "first" in Australia. Anthony Mann (Perth) reports excellent SpE conditions, with TVQ0 and ABSQ1 (Brisbane area) and a coincident system M signal on ch. A2 – this suggests American Samoa, a distance of some 4,700 miles! F2/TE reception on January 31st–February 1st gave him ch. B1 sound and vision, Malaya ch. E2, China ch. R1, Russia ch. R1, and unidentified communications signals.

Alexander Wiese (Munich, W. Germany) reports that a pirate TV station broadcasting in Catalonian is to start shortly – Radio Television Cardedue (near Barcelona).

Brian Williams (Penarth) is using a modified Thorn 950 chassis for DXing. He's disconnected the 405-line section and uses the system change solenoid to receive either positive- or negative-going vision. During recent tropospheric openings he received several French (system L) u.h.f. transmitters using an indoor group A aerial in the loft.

Gareth Foster (Isleworth, Middx) raises an interesting point. Whilst receiving Lopik, Holland on ch. E4 he found that he was getting the accompanying sound signal on his standard System I receiver – though the sound-vision spacing for system I is 6MHz, while that for the B/G system used by Holland is 5.5MHz. After some thought, Gareth established that the ch. B4 Manningtree BBC-1 relay's 61.75MHz vision carrier was beating with the Lopik 67.75MHz sound carrier, producing a 6MHz difference signal. This effect was checked with BRT (Belgium) ch. E10, whose sound carrier is at 215.75MHz, and the Membury 209.75MHz ch. B12 vision carrier – again the sound was resolved. The same "trick" could be tried using a signal generator, though difficulty with adjusting the generator's output may be experienced in view of the fluctuating signal levels.

George North (Sussex) recently returned from a holiday in Sri Lanka. Whilst there he viewed the 714MHz signals from the Stat-T satellite – they are providing local viewers with entertainment quality pictures. For this purpose multiple-director aerials with some 30 director assemblies are used, plus a couple of cascaded amplifiers giving a gain of 70dB. The receiver has to be modified to resolve the Russian TV standard. The total cost of the receiving system is around £100. Programmes are received in Colombo from 0800-0930 and 1530-2300 local time (plus five and a half hours GMT). The ch. E12 Colombo transmissions are widely received, the programmes being sponsored as in the

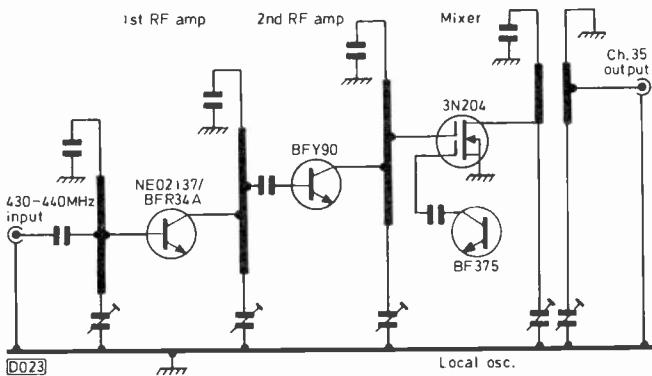


Fig. 1: Skeleton circuit of the Microwave Modules MMC435/600 ATV converter. Typical gain figure 25dB, noise figure 1.9dB. Bandwidth 20MHz at the -3dB points.

USA. Transmissions are from 1700-2300, with a closedown from 2115-2130.

### ATV Converter

Reception of amateur TV transmissions has been mentioned in this column in recent months since it seems that several enthusiasts have been monitoring the 430-440MHz amateur band, using standard varicap tuners. Many tuners cannot be tuned down to give coverage of this band however. The solution lies in the recently introduced Microwave Modules Ltd. converter unit, which raises the 435MHz signals to about 600MHz for feeding into the aerial socket of a standard receiver.

I've recently had one of these units for trial. It's a high-performance, low-noise converter (the overall noise figure is less than 1.9dB) that outperforms a modified varicap tuner. The incoming signal is fed to a low-noise first r.f. amplifier stage (see Fig. 1), then to a second r.f. amplifier stage. The mixer stage uses a dual-gate mosfet with the second gate driven by a separate oscillator stage. The power requirement is 11-13.8V at 80mA. Cable connections are via BNC 50Ω sockets, following standard amateur radio techniques. In my experience BNC plugs tend to be difficult to wire: the makers say that the unit can be supplied with Belling-Lee type 75Ω chassis-mounted coaxial sockets at no extra cost – please specify clearly when ordering.

The converter is built on a high-quality glassfibre PCB and is housed in a black diecast box. The performance is excellent, with good gain and low noise. For the enthusiast seeking an easy method of covering the ATV band, the converter is highly recommended. A descriptive leaflet is available on request (include SAE). The price is £27.90 including VAT, plus 80p postage – the unit can be obtained from: Microwave Modules Ltd., Brookfield Drive, Aintree, Liverpool L9 7AN.

### Labgear UHF Preamplifiers

The latest Labgear preamplifiers operate with a 12V supply instead of the 16V or 24V used by earlier models. Of particular interest are a couple of masthead preamplifiers with extremely low noise figures. The CM7060 is a single-stage unit with a 470-860MHz bandwidth, a gain of 10dB (+2dB), a noise figure of only 1.8dB and a consumption of 7mA. The higher gain CM7066 has the same bandwidth, a gain of 26dB, a noise figure of "less than 2dB" and a consumption of 16mA. The claimed maximum signal handling capability is some 50mV with four input signals.

Labgear provided a sample of the CM7066, with a 23mA power supply (CM7061), for evaluation. I was certainly

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impressed with the results, particularly the noise performance. With an Antiference XG21W aerial and Wolsey Orbit amplifier, Oxford ch. 60 is just about usable here at Romsey, though the aerial orientation is critical to avoid co-channel interference from the Salisbury relay. The improvement in gain, and particularly the lower noise, with the CM7066 was very obvious, as also was the lower noise when receiving Mendip ch. 61. This amplifier has much to commend it for weak signal working therefore. From a DX viewpoint, I decided to see how it performed on channels adjacent to the local ones (group A, Rowridge). The lower signal handling capability (compared to the Orbit's 100mV figure) meant that there was a tendency for the local channels to spread to adjacent channels, particularly with the aerial directed towards the transmitter. This may be considered an unfair test, but when DXing one may be attempting to receive weak signals on channels adjacent to strong local ones.

The amplifier is housed in the familiar circular plastic container, and my conclusion is that for fringe or weak signal reception – or for receiving a second ITV channel not in the local group – the CM7066 is an excellent unit. For DX use however, the signal handling capability proviso mentioned above must be born in mind. In view of this I'd be reluctant to recommend it for DX-ing.

### **The Plustron TVR5D**

In recent issues I've reviewed, after a period of field testing, two small-screen dual-standard TV sets – one from JVC and one from Panasonic. A third readily available set of this type has now been evaluated – the Plustron TVR5D. It's an unusual looking set, with protruding tuning knobs at each side, one for radio and one for TV. There's a 5in. c.r.t., and a single varicap tuner covers the v.h.f./u.h.f. bands (chs. E2-12 and 21-69). The radio section covers LW, MW and f.m./v.h.f. Three large key switches on the front panel give selection of Band I/III/u.h.f., radio/TV and on/off. The set can be operated from a 240V a.c. mains supply, a 12V car battery or an internal battery pack. Two windows in the front panel give radio and TV tuning readouts, a red hairline indicating the frequency. Either an external or the rear telescopic whip aerial can be used, with switching between the two. Further switching at the rear enables 5.5MHz or 6MHz (systems B/G or I) sound circuits to be selected. Further items at the rear are the contrast, brightness and hold controls, and a low-impedance audio output/earphone socket.

Operation is simple. The Band I and III calibration on the circular tuning drum was found to be inaccurate, but the Plustron manual clearly indicates the varicap presets to adjust and after this had been done the readout was accurate. With the test receiver the radio and u.h.f. calibrations were spot on.

Unusually, the instruction booklet gives detailed performance figures. The Band I/III sensitivity is given as 20 $\mu$ V for example and the u.h.f. sensitivity as 30 $\mu$ V, though there's no indication of what these figures relate to. The LW sensitivity is given as 630 $\mu$ V/m, MW as 200 $\mu$ V/m and v.h.f. 8 $\mu$ V. The power consumption is 14W and the sound output power 7W. Detailed information on construction, alignment, component and cabinet hardware etc. is given in the manual.

The receiver's performance is good, though with a 3in. speaker the audio output cannot be regarded as "hi-fi". Of the three small-screen TV sets I've tested, this one undoubtedly has the best gain and overall performance. The problem of using a wide i.f. bandwidth for DX reception



*The Plustron Model TVR5D.*

remains of course, and has been discussed sufficiently in past issues.

During the two months that I had the set for testing, it was tried out with strong SpE, F2 and tropospheric signals and during the more active MS periods. The problem of ch. E2 and R1 signals floating over one another was only to be expected of course, but what did surprise me was the lack of spread from the local ch. B3 into ch. R2. The ch. B3 signal is particularly strong here, but ch. R2 could be tuned in without any spread from the ch. B3 vision signal.

The line and field sync was good on both strong SpE and weak tropospheric signals once the appropriate controls had been range centred. On strong, brief MS bursts the set would lock immediately – which was impressive. It pays to ensure that the two hold controls are correctly set up.

The v.h.f. gain was such that weak tropospheric signals could be displayed without the need to use preamplifiers – it was interesting to note the increased noise on the screen as soon as an aerial was connected (indicative of a high gain r.f./i.f. section). The u.h.f. performance was satisfactory, though the selectivity seemed to be less – a fringe ch. 23 signal from Crystal Palace would show slight adjacent channel breakthrough from the local ch. 24 signal even when the aerial was completely off-beam to the local transmitter.

In conclusion, the Plustron TVR5D is a versatile, compact receiver capable of good performance over Bands I, III and at u.h.f., with excellent gain. For the traveller, it's the ideal answer for both domestic and DX reception, with the bonus of an integral radio receiver and operation on both systems B/G and I. The front controls are clearly marked and easy to operate, and those at the rear can similarly be adjusted with ease (though I'd have preferred front mounted contrast and brightness controls). For DX work the set is easy to use and gives good results. If you've decided you want a small-screen, dual-standard set, this one is certainly worth consideration – it was the best performer of the three sets tested so far in this series.

For further details of this and other sets in the Plustron range, write to Plustronics Ltd., Sales Office, Hempstalls Lane, Newcastle, Staffs ST5 0SW. My thanks to them for the extended loan of the test receiver.

# Fault Report

Robin D. Smith

As regular readers will know, Rank sets form a fairly substantial proportion of the sets we handle. Here are some recent experiences.

## Rank T20 Chassis

First a receiver fitted with the T20 chassis and with the "dead set" symptom. The voltage at the collector of the line output transistor 5VT4 was found to be only 60V instead of 200V, so we disconnected the switch-mode power supply module and checked its output off load. A measurement of some 200V proved that the power supply was in order, so it seemed likely that the line output stage was loading it down. Sure enough the line output transistor was faulty, but a replacement lasted only two hours. A careful check was made on the associated components, and as nothing seemed to be amiss another transistor went in. This also lasted for only two hours. So we consulted Rank, and the moral is that a BU208A must be used – BU208s, which we'd been using, are not man enough for this chassis.

The subject of poor focus on these sets (T20/22 chassis) due to the tube base socket breaking down (pin 9) has been mentioned before in these pages. The remedy is to remove the base and clean the offending pin. A word of warning however. Great care should be taken when removing the tube base, since if the pin is very badly corroded you can accidentally break the tube pin.

## A823 Series

There are still a great many A823 series sets around. A well known fault with these is intermittent field collapse due to a dry-joint on the pincushion phase coil 6L20 or the transductor 6T3. Just recently however we've had several cases where the trouble has been due to the pincushion amplitude control 6RV4 burning out, replacement curing the fault.

Teletext lines at the top of the screen is a problem with many of these sets. If the trouble can't be eliminated by adjusting the field linearity etc., adjusting the mid-point bias control will remove these annoying lines (5RV5 in early sets, 5RV4 in later ones).

The line hold on a set incorporating the A823A chassis had drifted, and on resetting the line oscillator coil 5L1 line pulling was evident. The supply to the flywheel sync circuit is stabilised by zener diode 5D3, but the voltage turned out to be correct at 15V. Our experience with these sets is that the decoupler 5C2 (10 $\mu$ F) can cause this trouble. Sure enough it measured leaky, a replacement curing the fault.

The customer's complaint on another of these sets was that the brightness reduced drastically after an hour or so. On test we discovered that the first anode supply was low, by about 150V, when the fault was present. The supply is provided by rectifier 6D2, which charges its reservoir capacitor 6C13. These two components were removed but read o.k. So the originals were put back and we started testing again. We noticed that when we connected the AVO across 6C13 with the fault present the brightness would

revert to its correct level. This renewed our suspicion of 6C13, and a replacement cured the trouble. We can only assume that it was going open-circuit under load. We've had several of these capacitors go short-circuit, but this is the first time we've had one apparently go open-circuit.

The "dead set" symptom on one of these receivers, with a varicap tuner, ended up with a rather strange fault. The 600mA h.t. fuse 8F3 had blown, due to defective line output transistors. All straightforward so far. Replace transistors and fuse, also flyback tuning capacitors 6C5/6 (as a precaution), and balance line output transistors (6L4/5). Reset the e.h.t. to give 25kV, then run set on soak. A little while later the set started to arc badly – evident around the focus VDR. I could see that it was arcing to earth, and checks showed that the e.h.t. had risen to 30kV with the h.t. at 230V instead of 200V. Maybe the regulator thyristor was leaky? I thought I'd replace the surge-limiting thermistor 8TH2(VA1104) however, since it's notorious in these sets. For some reason (any ideas?) this completely cured the fault.

## Rank-Toshiba Sets

Now to a very recent set, one carrying the Toshiba label (Model C2090 – Rank T24 chassis). I delivered the set to the customer and a few days later he complained about a bad buzz after an hour or so. I didn't hear what he was on about during my first visit, but on the second visit, when the set had been on for a few hours, I did. The line output transformer possibly? No amount of prodding made any difference however. I asked the customer to listen, and he suggested that the noise was coming from the scan coils. A little careful probing here revealed the cause of the trouble.

There are three very small metal discs on the housing of the coils. They are glued to the plastic, and one had become loose. Moving the plate back and forth confirmed the diagnosis, and after reglueing it the buzz problem had been cleared.

A few days later the customer complained that the set now hummed. This was the mains transformer, which I changed just in case, though in my opinion the hum was normal. He still complained, but decided he'd have to live with it. Some time later he phoned to say he'd cured the problem – by fitting rubber tap washers between the cabinet and the plastic mount and between this mount and the transformer.

On the 22in. version of this chassis incidentally there's a small modification on the sound panel to overcome hum (panel T150A) due to an earth loop – cut the print between loudspeaker plug 29 and plug 26, and between the junction of R631 and D637/639 (preferably near R631), and connect a wire link between the junction of C638/C632 etc. and the earth point close to pin 4 of the sound i.c.

## Rank T16A Portable Chassis

Finally on the Rank front a Bush monochrome portable fitted with the T16A chassis. The customer complained that his set smoked and said that the boost diode D7 kept going short-circuit – he'd replaced it several times. I fitted a new MR854 diode and monitored the 11V l.t. and 25V boost lines. These were correct, as was the picture size. Later there was a hum and the diode started to get very warm. The 11V rail was still correct, but the 25V rail was dropping fast. Quickly switch off and disconnect the field timebase, which is fed from the boost rail. Switch on and wait. Ten minutes later the diode began to get warm again. Well, at any rate we'd eliminated the field timebase. There wasn't

much else to suspect apart from the boost reservoir capacitor C27 ( $220\mu F$ ), though it seemed to be all right. Anyway replacing it and fitting a new diode cleared the trouble, and I can only assume that the capacitor was breaking down under load.

## GEC Portables

Speaking of portables, we've had several GEC sets in recently (Models M1201H and M1501H – the successors to those sets with the transistor pump circuit) with the dead set symptom, due to R77 ( $10\Omega$ ) being open-circuit. This fusible resistor is in parallel with the series regulator transistor TR201 (U37000), which in each case has been the cause of the trouble. When TR201 goes open-circuit, the full current flows via R77 which thus overheats and springs open.

## GEC Colour Sets

How I hate boggers! This reflection follows an encounter with a GEC colour set (C2110 series) that came in the other day. What a state it was in! The mains lead was incorrectly wired, the on-off switch was shorted out, the components in the snubber circuit (C58 and R69) were the wrong value, the mains fuseholder had been shorted across with a one inch nail, and the fusible resistors R601 and R603 in the l.t. supply circuitry had been wrapped round. After clearing up these misdemeanours, I switched on and monitored the 40V line. This was at 46V, just a volt away from the point at which the protection zener diode D51 shorts out. So I reset the line to 40V, using the set h.t. control P701 – we find it best to use this to adjust the l.t. rather than the h.t. line – then noticed that there was no sync. A new TBA920Q sync/line oscillator i.c. cured that, and after cleaning the touch tuner head we had a good working set. Just why do people bodge when it's not necessary?

Field collapse on one of these sets was found to be due to a dead spot on the field hold control P451. Simply rotating the control a few times cleared the fault.

On another of these receivers the customer complained that the set was dead and prior to this it had smoked. The cause of the smoke was the two  $1M\Omega$  resistors R607/8 in the c.r.t. first anode supply circuit, while the set was dead because the protection zener diode D51 had gone short-circuit. Usually when I have this fault I replace the complete line output subpanel on which the zener is mounted, but this time I replaced the zener diode only. Connect the set to the mains via a variac, and build up the a.c. input slowly. At an a.c. reading of 110V, the main l.t. rail had already risen to 47V and it was obvious that if I increased the input any more the zener would simply fail again. As there was no obvious short-circuit anywhere, I suspected the line output transformer. Change the transformer and once again build up the input slowly. This time everything was o.k. – 240V a.c. input, 40V l.t. line and a correctly scanned picture. It's the first time we've had the line output transformer go on one of these sets.

Another of these sets came in with the 3.15A mains fuse blown and R607/8 burnt out. Replace these items, switch on and find that the tube heaters are out. Now the tube heaters are powered by a winding on the line output transformer, via R605 ( $33\Omega$ ). Since this resistor was intact, it seemed that something must be loading down the line output stage. That something turned out to be our first suspect, the tripler – the clipper diode D57 inside the tripler was faulty.

We've also had a couple of hybrid GEC colour sets in

recently. The fault on the first was no sync, weak colour and a bad hum bar. We concentrated on the hum bar first, since we thought that this would be simply a dried up smoothing capacitor. We were wrong however. All the faults were due to one little component – R500, which had increased in value to  $250k\Omega$  from the correct  $56k\Omega$ . It's the sync separator's collector load resistor, though you mightn't think so since the sync separator is over on one of the other panels. Anyway, a replacement restored the set to normal operation.

The other set had no sync. This time R500 and its series resistor R501 ( $33k\Omega$ , to chassis) were smoking badly. The trouble was traced to shorting turns in the flywheel line sync discriminator transformer L500 – one section of this is in series with the two resistors.

## ITT Hybrid Colour Sets

Our other main line is ITT sets. A couple of CVC9 colour hybrids have been in the workshop recently. The first had a fault we've certainly not come across before – the symptoms were intermittent colour and intermittent incorrect colour. Now as you all know, the colour-turn on voltage comes from the bistable circuit in these sets, so the combination of the two fault symptoms pointed the finger of suspicion at this area. When the set first came on, with colour, the voltages and waveforms at the collectors of the two transistors T36 and T37 in the bistable circuit were correct, but when the fault appeared the collector of T36 dropped to 4V while the collector of T37 rose to the rail voltage. I suspected the transistors, but replacing them both with the correct types failed to cure the fault. After much searching about we eventually found that one of the trigger pulse steering diodes D38/40 had a slightly higher forward resistance than the other. Replacing them both cured the trouble. One usually just checks a diode for forward and reverse resistance, and assumes that if the readings are about right the diode is o.k. These diodes should be a matched pair however, and should give very nearly identical readings.

The problem with the other CVC9 was no signals. What I tend to do when confronted with this fault on one of these sets is (if I can't see an obvious fault) to feed the output from an external tuner unit into the i.f. preamplifier transistor T13. Doing this produced a picture, so I thought that either the tuner or its supply and/or the control unit was faulty. Exhaustive checks failed to reveal anything amiss however – so why did my external tuner work? Well, when I adopt this stratagem I don't connect any a.g.c. to the external tuner, which in this case was a mistake. The fault you see was due to the inverter transistor T14 (BC172B) which supplies the a.g.c. feed to the set's own tuner.

## CVC20 Series

The complaint with a solid-state ITT colour set (CVC20 chassis) was no raster, and on inspection the fusible resistor R100 ( $390\Omega$ ), was found to have sprung open. After resoldering and switching on, the fault was line collapse – with the line linearity coil arcing at the print connection. Resolder the coil and normal results are restored. R100 damps the coil, and if the coil goes open-circuit the entire scan current flows via the resistor which then springs open.

A CVC32 was tripping, which stopped when the e.h.t. tripler was disconnected. Replacing the tripler restored the raster, but there was no contrast or colour. Now on these solid-state ITT colour sets a fault in the beam limiter circuit

can cause this trouble. So we checked the voltage at the emitter of the beam current sensing transistor T1. It was zero instead of about 3.5V, due to the clamp diode D3 being short-circuited. Replacing this didn't completely cure the fault, and it looked as if the tube was soft. The set was not very old however, so I thought that this was unlikely. Further checks in the beam limiter circuit showed that T1 was faulty, a replacement producing a correctly contrasted and coloured picture. Presumably the tripler fault had killed these two components.

### Problems with Portables

Some more portables. First a Thorn (1590 chassis) with the complaint intermittent field roll. The customer said he'd tried adjusting the field hold control. What he should have noticed was that the picture had no contrast at all. Resetting the preset contrast control R2 as per the manual produced a clean picture and cured the field roll fault.

A Thorn 1691 exhibited exactly the same symptoms, but this time we had to make voltage checks in the i.f. strip. The third i.f. transistor VT3 was found to be incorrectly biased due to its base bias resistor R12 having risen in value from 100kΩ to 1MΩ.

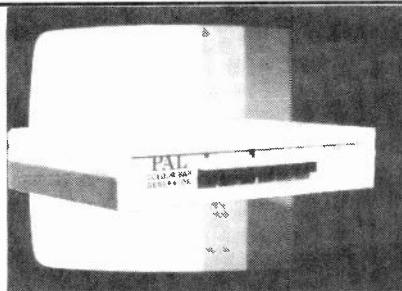
The trouble with a Pye T173 (Philips TS7 chassis) was no e.h.t. – due to the e.h.t. stick being short-circuited. A replacement produced bad arcing however, burning out the e.h.t. lead at the anode cap. We remade the lead, cutting off a couple of inches, and switched on again. This time there was tearing when the brightness control was advanced. Check with Pye, who told us that the e.h.t. lead mustn't be shortened on this particular chassis. So we obtained and fitted a replacement lead, which greatly improved the arcing, though another stick rectifier had to be fitted to

completely cure the fault. The defective, shortened lead had apparently damaged the first replacement rectifier.

### Philips G8 Chassis

Finally a couple of Philips G8s. The first displayed a fault I've never seen before on any set, yet the symptom was such that basic theory immediately suggested what was wrong. Because of the different bandwidths of the luminance and chrominance channels in a colour TV set, it's necessary to include a delay line in the luminance channel. This ensures that the luminance and chrominance signals register correctly on the display. An open-circuit luminance delay line removes the luminance signal of course, while a short-circuit line removes the delay and produces a smoky picture – this trouble is most clearly shown up on a crosshatch pattern. On this set the trouble was mismatching due to high-resistance print connections – resoldering provided a complete cure.

The second G8 was dead, with a short-circuit rectifier/regulator thyristor and blown mains fuse. We replaced these items, switched on, and were presented with an overscanned raster. The h.t. was o.k. at 200V, but the e.h.t. was low. Now this sort of thing on these sets is often due to one of the line output transistors being faulty – the other one can soldier on but will provide a low output. Both transistors were replaced, along with the flyback tuning capacitors, and the stage was balanced. This produced a very good picture, though with slightly reduced width. As the line output transformer was running a little on the warm side, I came to the conclusion that the original fault had probably weakened it. Anyway, fitting a replacement provided plenty of width to play with, and after making various adjustments we had an excellent picture.



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# Colour Portable Project

Part 1

Luke Theodossiou

It has become evident in recent years that the market trend is towards smaller screen sets. This project is our answer for readers who want either an up-to-date main set design or a portable second set. To fulfil both requirements simultaneously, a range of tubes had to be found which could be driven by the same circuitry immaterial of screen size.

The c.r.t. chosen was the new Hitachi 90° range, which is available in 14, 16 and 20in. screen sizes. The design of the tube/deflection coil combination provides for the simplest possible circuit design. Features include preset convergence and purity, high resolution gun for better focus performance, saddle/toroidal deflection coils for low power consumption, no pincushion distortion, high brightness, quick-heat cathodes and internal magnetic shield.

The choice of tube size is left entirely to the constructor, and we shall be providing further information on this in a later article.

The circuit concept is outlined in the block diagram shown in Fig. 1. Initially we shall deal with each of the p.c.b.s in turn and then with the interconnections, setting up and a fault-finding guide.

## SWITCH-MODE POWER SUPPLY

This month we are starting with the switch-mode power supply. It is a self-oscillating type based on the Siemens design concept and is similar to the one used in the Tandberg CTV2 and certain Skantic colour receivers.

Since it is not a synchronous type tied to the line frequency, it is much easier to service – being a self-contained unit, it can be isolated from the rest of the circuit to determine the fault area.

A major advantage of this design is that it provides mains

isolation without the need for a bulky and expensive mains transformer. It is also a minimum component count design which indirectly increases reliability, holds costs down, and makes for a very compact p.c.b.

### Circuit Action

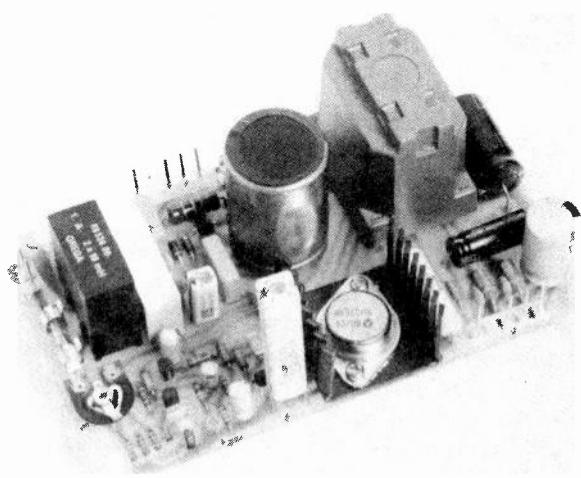
The circuit is shown in Fig. 2. The mains enters the board via connector A and mains protection fuse F1. It is fed via thermistor TH1 to the degaussing coil via connector B. Capacitor C21 shorts any induced line pulses to prevent interference with the degaussing action. Components C15, C16, C17, C18 and the bifilar choke L1 are for interference suppression. They prevent mains interference from affecting the receiver and also block any switching pulses from the power supply from entering the mains and interfering with other pieces of domestic equipment.

The mains is rectified by the bridge rectifier comprising D11, D12, D13 and D14 and a d.c. voltage of around 330V is developed across the reservoir capacitor C19. A discharge path for the reservoir capacitor is provided by R13 for safety reasons. Capacitor C20 is for high frequency decoupling. The positive side of the rectified mains is applied to the primary winding of the transformer on terminal 7. The negative side is taken to what could be termed as the common line (live with respect to the mains) via resistor R6. So we now have around 330V across the switching transistor Tr2.

The design is essentially a blocking oscillator which switches Tr2 on and off via the feedback winding across terminals 11 and 13 of the transformer. The frequency of oscillation is dependent on the leakage inductance of the transformer and therefore the load imposed on the power supply by the receiver. Regulation action is achieved by varying the mark-space ratio of the square wave which drives the base of Tr2. Since Tr2 is either on or off, its dissipation is kept low, evident by the size of heatsink used. Switching losses are reduced further by the RC combination across the transistor, comprising C8 and R9. Under normal operation, the frequency of oscillation varies between about 20kHz and 28kHz.

The base drive waveform for Tr2 is formed by D5, D6 and C9, whilst R10 limits the maximum base current during the conducting period. Base drive is removed by ScR1 switching on and shorting the base-emitter junction of Tr2.

Normally, the gate of ScR1 is held negative with respect to the cathode by a negative voltage derived from the drive winding via D4 and C6, and applied to the gate through the potential divider R5 and R7. The thyristor is turned on by a positive pulse supplied by the error amplifier Tr1 which senses changes in the rectified supply (across C2) which is derived from the winding across terminals 9 and 15 of the transformer. This winding is closely coupled to the secondary windings and therefore accurately reflects changes in the current demanded by the load. When the thyristor is turned on, it removes the base drive current



The switch-mode power supply module.

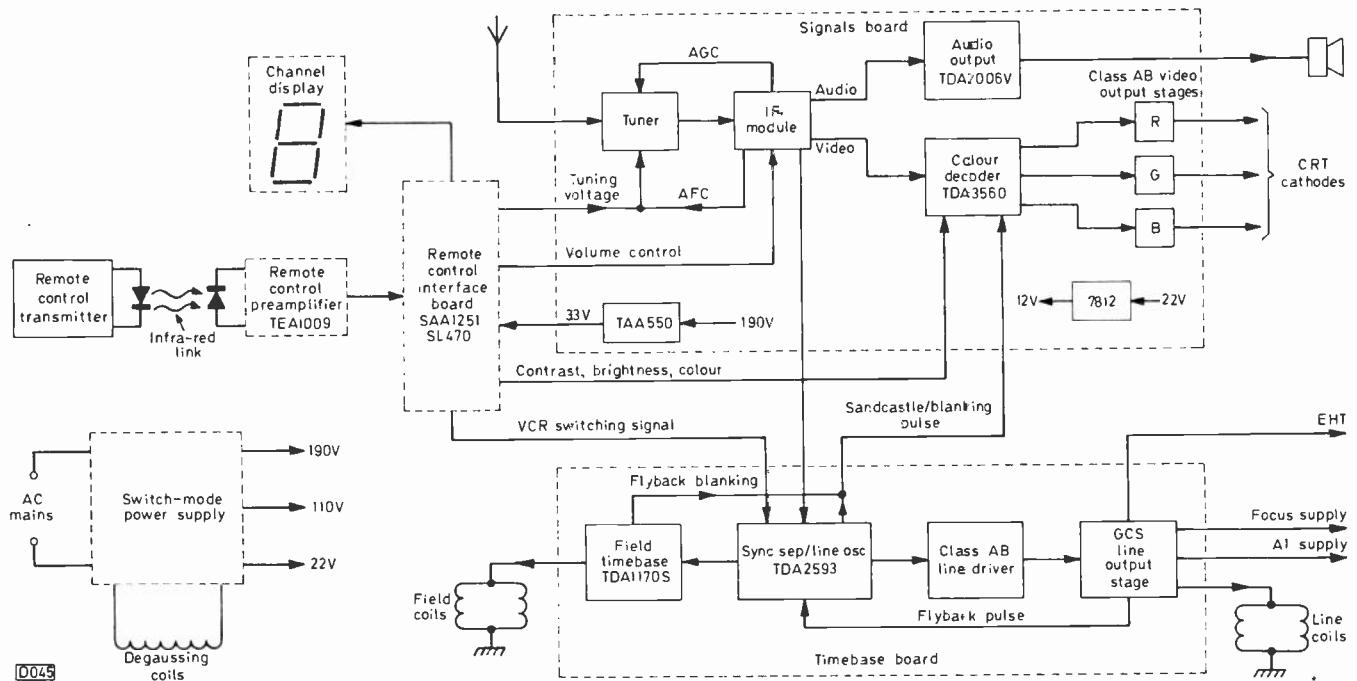


Fig. 1: Block diagram of the complete receiver, which is intended for operation with an infra-red remote control system.

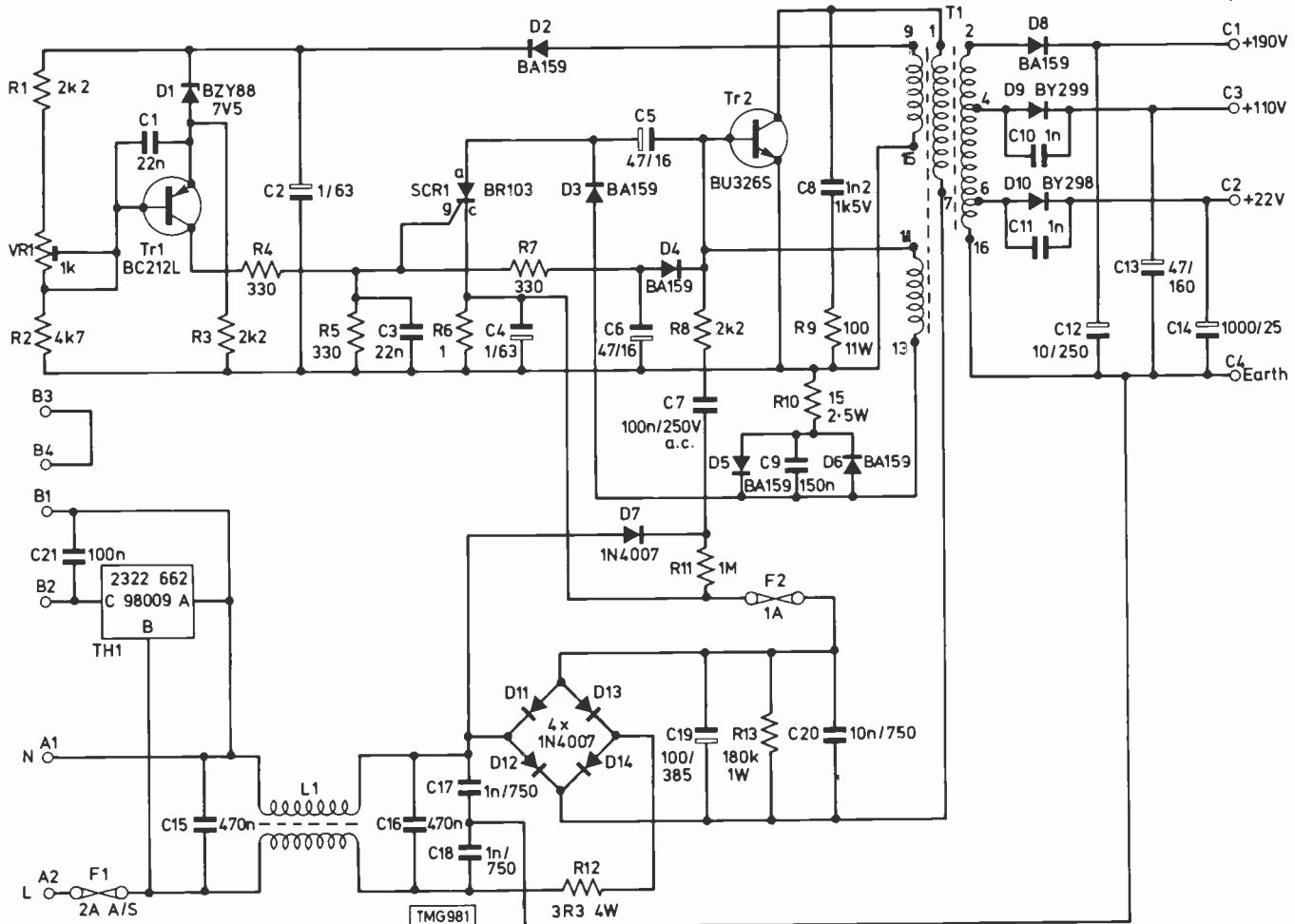


Fig. 2: Circuit diagram of the switch-mode power supply module.

from Tr2 thereby decreasing the energy stored in the transformer and thus the output voltage.

Regulation performance is very good: mains voltage fluctuations of  $\pm 2\%$  are reduced to below 1% at the output.

The receiver will operate satisfactorily with a mains input voltage of between 180V and 265V.

Defined starting pulses of 5ms duration are generated from the mains voltage by means of diode D7 and the RC

## ★ SMPS Components List

**Resistors:** ± 5%, 0.25W carbon film except where stated

R1	2k2
R2	4k7
R3	2k2
R4	330R
R5	330R
R6	1R
R7	330R
R8	2k2
R9	100R 11W wirewound + support pillar
R10	15R 2.5W wirewound
R11	1M
R12	3R3 4W wirewound
R13	180k 1W
VR1	1k horizontal mounting standard skeleton preset
TH1	Mullard 2322 662 98009

**Capacitors:**

C1	22n	63V ceramic Mullard 629 02223
C2	1μF	63V Electrolytic Dubilier CEB163
C3	22n	63V ceramic Mullard 629 02223
C4	1μF	63V Electrolytic Dubilier CEB163
C5	47μF	16V Electrolytic Dubilier CEB4716
C6	47μF	16V Electrolytic Dubilier CEB4716
C7	100n	250V a.c. polyester RS Components 114-115
C8	1n2	1500V ± 5% polypropylene Suflex SN1562
C9	150n	100V polyester Siemens B32560
C10	1n	750V ceramic RS Components 124-279
C11	1n	750V ceramic RS Components 124-279
C12	10μF	250V Electrolytic Europe Chemi-Con
C13	47μF	160V Electrolytic ITT EN32-12
C14	1000μF	25V Electrolytic Dubilier CEB100025
C15	470n	250V a.c. polyester Suflex SUF667P
C16	470n	250V a.c. polyester Suflex SUF667P
C17	1n	750V ceramic RS Components 124-279
C18	1n	750V ceramic RS Components 124-279
C19	100μF	385V Electrolytic Mullard 052 58101
C20	10n	750V ceramic RS Components 124-291
C21	100n	250V a.c. polyester RS Components 114-115

**Semiconductors:**

D1	BZY88 C7V5
D2	BA159
D3	BA159
D4	BA159
D5	BA159
D6	BA159
D7	1N4007
D8	BA159
D9	BY299
D10	BY298
D11	1N4007
D12	1N4007
D13	1N4007
D14	1N4007
Tr1	BC212L
Tr2	BU326S
SCR1	BR103

**Miscellaneous:**

L1	Orega 88536
T1	Orega 93606
F1	2A antisurge fuse
F2	1A fast fuse
	Fuseclips for F1 and F2
	Heatsink for Tr2: Redpoint TV3
	Molex 0.2" pitch connectors
	P.c.b. reference no. D089
	P.c.b. pillars

**Component stockist:**

Components may be obtained from:  
JLC Electronics,  
110 First Avenue,  
Bush Hill Park,  
Enfield, EN1 1EP.



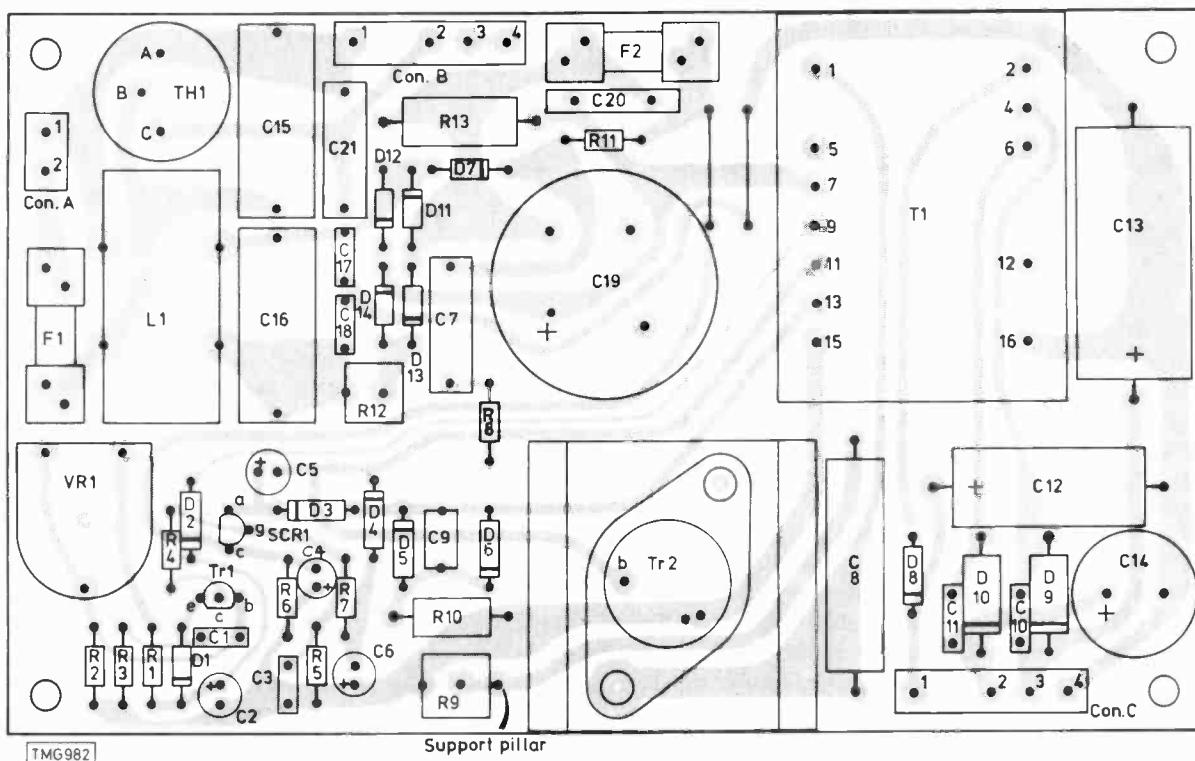


Fig. 3: Switch-mode power supply module component layout.

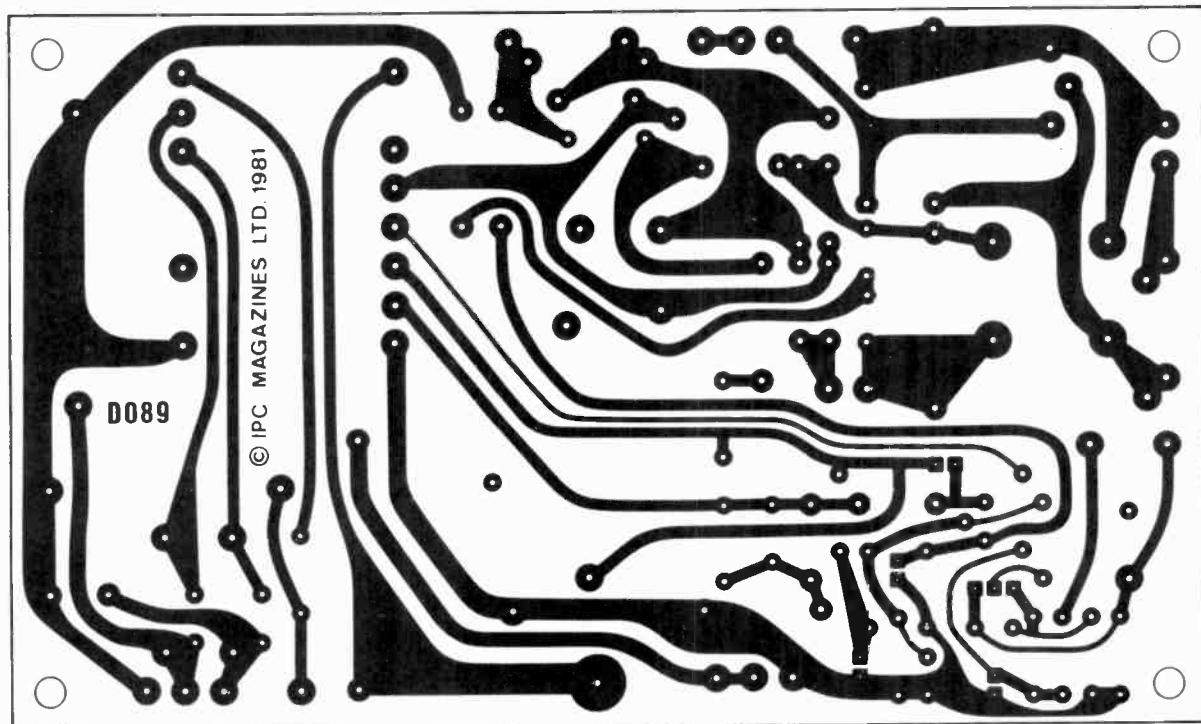


Fig. 4: Power supply PCB track pattern, shown full size.

circuit R8 and C7. These pulses are applied to the base of Tr2 to initiate oscillation.

At zero or low load levels, the power supply runs in an intermittent 50Hz operation, and the same condition applies if any one of the outputs is short circuited. The power supply is thus inherently self-protecting and in fact during many months of experimentation we have experienced only one failure and that was due to carelessness with the scope probe!

Another advantage of the design is that, due to the high operating frequency, low value (and therefore small size)

ripple filter capacitors are used on the outputs.

That completes the basic description, but we shall return to the power supply towards the end of the series with a fault-finding guide. Construction is quite straight forward, the only point worth mentioning is to start by soldering in all the small components first. It is imperative that only the specified components are used since there are a number of areas on the circuit which are very critical, particularly with regard to the frequency of operation and therefore switching times and pulse rise times.

Next month we shall be dealing with the signals board.

# Practical TV Servicing: CRT Reactivation

S. Simon

A LITTLE while ago in this series we went into the subject of setting up the grey scale etc. in order to get the best picture from a colour tube that had passed its prime. We finished up by remarking that although the results obtained would probably leave something to be desired, a large proportion of the general public were happily watching sets with tubes in a similar state.

There comes a time when second best becomes third best and something has to be done about it. Before getting involved in the mysteries of tube reactivation however, let's make one important point. Some tubes appear to have reasonable emission but still flare on one or more primary colours. By flaring we mean for example that a white flagpole may have pennants of colour flaring to the right of it when in fact there are no flags flying at all. When the scene changes to one with more subdued colours, no flaring can be detected. The effect can be made worse by advancing the settings of the contrast or colour controls, or decreased by reducing these settings.

We've often made the point that remedial action to improve a tube's emission should be delayed as long as possible, since reactivation is not a process that can be repeated several times – indeed it may not be possible at all in some cases. It's prudent therefore to reduce the tube drive so that the flaring threshold is not reached. A little experimentation with the settings of the a.g.c. and a.c.c. presets can be most rewarding, and in some receivers the effect required can be obtained by adjusting the beam limiter preset. This is particularly so with the popular 18in. colour sets in the Pye/Ekco/Philips ranges (713 and 570 etc. chassis), because on these the beam limiter preset (R221, at the front end of the i.f./tuner panel) sets the bias applied to the 12V regulator transistor VT210 which supplies the i.f. and decoder sections of the chassis. The control is thus particularly effective in reducing the c.r.t. drive, simply by reducing the supply voltage to the signal circuits. This may seem to be a funny way to reduce flaring, but it works. Up to a point of course.

## Improving Tube Emission

Now to get down to the methods that can be used to improve the general emission or even up the emission of the three cathodes in a colour tube. The point here is that the emission of all three cathodes may not be low: it's rather galling for example to find that the green cathode is perfectly healthy and giving brilliant results while one or both of the other two is in a poor way. You would of course have checked the tube base voltages first, to make sure that there are no faults in the supplies to any of the electrodes.

It's perfectly acceptable to increase the voltage applied to the tube's heaters, from the standard 6.3V to say about 8V, by fitting an isolating/boost transformer with boost tappings. In some sets (Thorn 3000/3500 chassis) the mains transformer has an extra tapping which gives a 20 per cent boost to the heater supply when properly connected. This is unlikely however to produce the effect you really want – a general improvement may be noticed, but one colour may

still predominate or be lacking.

The alternative course is to reactivate the low-emission cathodes, something that can be done simply enough by using one of the reactivator designs published in the past in these pages or a ready-made reactivator from one of our advertisers. The basic idea is to use a transformer to supply the tube's heaters with 6.3V, with a boost provision on the transformer, and an h.t. supply of say 300V which is applied to the relevant c.r.t. grid via a high-value resistor or lamp (see Fig. 1). The illumination produced by the lamp, or the voltage developed across the resistor, indicates the state of the cathode's emission. If preferred, a multimeter can be used externally to measure the current flowing (in milliamps). The c.r.t.'s cathode and grid are being operated as a diode, and as the current increases so the voltage applied to the grid will fall (because of the increased voltage developed across the series resistor/lamp).

So as not to leave anyone out, we'll cross every t and dot every i. You remove the set's own c.r.t. base connector – having first switched the set off! In the absence of an elaborate, ready-wired tube base socket you use an old one with no wires connected to it, clearly marking the relevant pins – the heater pins with an H, the cathode pins (all three) with a K, and the grid pins with a G. Ignore the first anode and focus pins.

Within the reactivator, the cathode and one of the heater connections form a common earth path. Take the appropriate connections via flying clips to one heater and one cathode tag – or alternatively to the cathode via a meter switched to the 100mA range or higher. The other 6.3V lead provides the supply to the other heater pin, and can usually be switched within the reactivator to give a 20 per cent heater boost. So you now have the heaters and one cathode connected: link the high voltage pin to the grid of the same gun as the selected cathode. Switch the unit on, and the tube heaters should glow while if a meter is being used it will record the grid-cathode current. A healthy gun will record some 60-70mA, and if this figure is achieved and remains steady there is little wrong with the tube so far as this gun is concerned. The G and K leads can be transferred to one of the other guns therefore.

The current measurement obtained on the meter is purely that of the cathode's emission – the ability of the cathode's surface to emit electrons when heated and when a positive

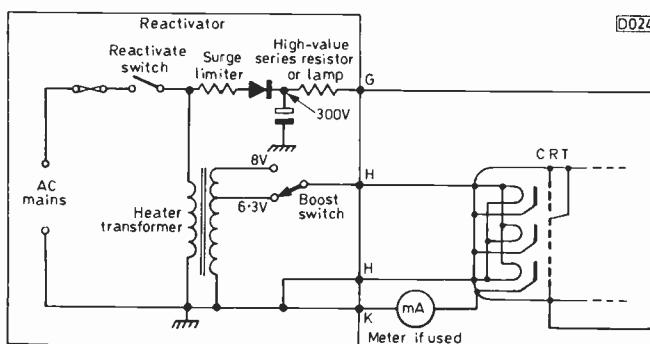


Fig. 1: Simple c.r.t. reactivator in use.

potential is applied to an adjacent electrode. It doesn't mean that the tube is free from all other defects. Since the leads would hardly have been connected to a gun that was not under suspicion however, the reading will probably be much lower – or may vary wildly as some sparking occurs. In the latter event, the cathode's coating is being disturbed and particles will short between the grid and cathode. We must point out that this involves some risk, since the short may be permanent. The risk is very slight however and as the tube is on its last legs anyway little will be lost. The figure of 60-70mA incidentally is that obtained with one particular type of reactivator, and will vary in accordance with the resistance and voltage values used in the unit. The "good" figure could well be much lower therefore.

If sparking does occur it should clear quickly and the meter reading will then fall, possibly to a very low figure, after which it should gradually climb towards the "good" figure – or alternatively the lamp, if this is the form of indication used, should gradually light up to give full illumination. If the cathode is slow to respond to this reactivation, use the boost provision (increased tube heater voltage) to help things along a bit. If there's no sign of life at all, either the connections have not been made correctly, they are not good, or the cathode's emitting surface is exhausted. The latter is often the case when reactivation has previously been used – after all, an onion has only so many layers, and you can't reactivate something that's not there! If the reading obtained is very low, say in microamperes, but shows a tendency to increase, be patient and your patience may be rewarded. A low but increasing figure is better than a "quick flash" which thereafter falls and remains low.

Some reactivators rely upon a "quick flash", and indeed actually switch off the heater supply at the moment the reactivating voltage is applied. Many claims are made for this and other elaborate designs, but in the writer's experience really lasting results can be obtained only with a process that takes some fifteen minutes or so for the reactivation of the cathode's surface to be completed. It's not necessary to achieve the full "good" current reading – what's wanted is a respectable figure, with all three guns producing approximately the same results. To have one or two guns very lively with the other two or one very low is a disappointing result to get, because an acceptable grey scale will not be obtainable.

It's better in fact for all three guns to show nothing more than say 40 per cent, which will provide a very acceptable picture for a year or so, after which a new or rebuilt tube can be fitted to give the set a completely new lease of life (if the condition of the rest of the set warrants this).

We've found that most Mullard and Thorn (Mazda) tubes respond happily to reactivation. Some imported tubes however will not respond at all, and this is a fact of life that has to be accepted. These are my own findings, and may not correspond with everyone else's – or maybe with the experiences of the vast majority, who may have used other methods to get the same result. We would like to hear from others on this subject. This will make us all the wiser, and enable us to report further on the subject in due course.

### Basic Facts of Tube Life

More recent readers who are not so familiar with TV tubes and their habits may be a bit puzzled by the foregoing comments. The following bit is for them.

A monochrome tube has a front glass screen whose rear surface is coated with carefully chosen chemicals which have the property of glowing when bombarded by an

electron beam. This beam comes from the tube's cathode, and is first focused into a narrow beam and then deflected to scan the screen in an orderly manner in order to produce the raster. By varying the beam's intensity, the raster becomes a picture. We're fooled into seeing a complete picture by the fact that our eyes retain an image after the image has passed – a phenomenon known as "the persistence of vision". This, coupled with the fact that the chemicals have a slight afterglow, turns the rapidly moving modulated spot into the picture we see.

For the electrons to travel from the cathode to the screen accurately and respond to focusing and deflection they must be in as near a vacuum as possible. A soft tube, i.e. one whose vacuum is not "hard", cannot resolve a sharp image – and may be hard put to it to resolve an image at all, due to the collisions that take place between the electrons and the gas molecules that impair the vacuum. These collisions prevent the majority of electrons from reaching the screen and spread those that do. As a result, a tube's gun may have perfectly good emission though the display on the screen is anything but good. How the vacuum becomes impaired is another story. You could say that it's the result of the tube's chemistry.

Quite apart from the problem of an impaired vacuum, the cathode eventually loses its ability to emit electrons. This is due to either a hard surface forming over the "soft" barium cathode coating, thus reducing the beam current, or to the emitting surface simply wearing away to give the same result – i.e. the "glow" becomes feeble and the whites turn silvery. It's more usual for a hard surface to form over the soft emitting surface, like a skin, and if we can "peel" this skin off, the tube will continue to give good emission for a period of time, the length of which is determined by the amount of soft surface left beneath the skin.

To achieve this "peeling" we can heat the cathode slightly more than we usually do, and apply a fairly high voltage to the next electrode to the cathode to attract the electrons thus given off, hoping that this will induce them to force off the hard covering by sheer weight of numbers, thus restoring something like the original emissive surface. The next electrode to the cathode is of course the grid, and if a high enough positive voltage (lack of electrons) is applied here a strong attraction will be exerted on the electrons milling around the heated cathode, stimulating the flow of current.

A monochrome tube has a certain thickness of coating on its cathode. This coating wears away in time – particularly if a high brightness level (high beam current) is used. If in the meantime the cathode is poisoned (a skin forms on it), this can be peeled off as described above. But the chances unfortunately are that there is precious little emitting surface left underneath. With a colour tube the cathode is a different proposition since much greater emission is required.

There are three cathodes and thus three beams in a colour tube, whose screen is coated with three phosphors to give the three primary colours (red, green and blue). The phosphors are deposited on the screen in a formation of dots (older types of tube) or stripes (more recent tubes). By varying the intensity of the three beams, an almost complete range of colours is obtained.

Behind the screen there's a thing called the shadowmask. This has either holes aligned with the phosphor dots or slots aligned with the stripes, its purpose being to ensure that the beams strike only the appropriate screen phosphors. Unfortunately the shadowmask intercepts a large proportion of the electrons given off by the tube's cathodes – this is more so with the older dot/hole system than with

the more recent stripe/slot arrangement. The obvious solution is to apply a thicker emissive coating to the cathodes to cater for the greater beam current requirements.

Despite this thicker coating, a hard surface still forms over a period. Its removal however will often leave a good emitting surface. This is why most colour tubes accept reactivation better than monochrome ones. With the stripe/slot arrangement used in more recent tubes however the electron pass rate is higher – which is why these tubes

provide brighter pictures. This higher efficiency means that the cathode coating can be reduced, and as a result reactivation seems to be less effective.

The conclusion we must arrive at therefore is that as stripe/slot tubes with in-line guns become the norm, so reactivation will in future become a less effective process. For the moment however reactivation remains a viable way of extending the useful life of a dot/hole colour tube – for a few months at least.

# Letters

## JUNCTION TESTS WITH DIGITAL MULTIMETERS

I was interested in Harold Berkley's article on field servicing in the January issue, but feel I must disagree with his comments on digital multimeters. Whilst it may not be possible to check the voltage drop across diodes and transistors using cheap multimeters of the hobbyist variety, this is not the case when using a professional multimeter.

The Beckman 3020 for example is designed to allow engineers to measure these very parameters – in addition to its many other features, including 2,000 hours battery life, an instant continuity check and single centre dial.

R. Doyle, Distribution Manager,  
Beckman Instruments Ltd., Birmingham B26 3DU.

*Harold Berkley comments:* My remarks about digital multimeters were of a general nature. One is so used to a go/no-go check with an analogue meter that a series of moving digits may simply cause confusion when one is servicing in the field. You're not looking for an absolute reading, simply a quick check. New models such as the Beckman and Thandar ones do have a semiconductor test facility, and many meters now have high and low current settings. I've not tried the Beckman meter, but it has an excellent specification and no doubt overcomes the problem.

*Editorial comment:* The Beckman 3020 digital multimeter was reviewed by Eugene Trundle in our May 1980 issue.

## DIY TEST PROBES

Many service engineers must envy the octopus when they wish to take several simultaneous measurements, with wires and clips hanging all over the place. The problem is made very much easier by the use of test probe clips, which can be easily and cheaply made from suitable empty plastic ball-point pens of the retractable kind. The larger the brass

tip at the end of the ink tube the better. The details are shown in Fig. 1.

Remove the brass tip and cut a slot in it at an angle, using a thin hacksaw. Pass the leadout wire from the very top (drill a hole for the purpose or use a hot steel wire to pierce the plastic material), through "the works" (leaving these free to move) and down the ink tube, soldering the wire to the brass tip. Where screened cable is necessary, cut a slot in the side of the barrel. The grip obtained is very good, and since the exposed tip is small there's little danger of it shorting to adjacent parts.

Victor Rizzo,  
Msida, Malta.

## VINTAGE TV

In view of the articles you publish from time to time on vintage TV, I gather that there are other readers who share my hobby – collecting and renovating old TV sets, dating from the very earliest models. So far I have seven, including two Russian sets from the 1950s, and I'm endeavouring to restore them all to good working order. I'd like to hear from those with similar interests in other countries – incidentally I'm a camera operator with Czechoslovak Television. Please write to me, in English, at the address below.

Miroslav Máté,  
708 00 OSTRAVA – Poruba,  
A. Hrdličky 1637, Czechoslovakia.

## PUB GAMES

I'd like to comment on Malcolm Burrell's article *Fun and Games* in the March issue. Having been employed in this industry for some years, I was amused to read the remarks on the supposed reliability of monitor circuitry and logic boards. Most manufacturers in this field, particularly the Japanese concerns, cut costs to a minimum by using inferior and out-of-tolerance components. This, with little or no effective production line quality control, results in appreciable quantities of unsaleable equipment accumulating in distributors' warehouses – or else a working life once on site of sometimes only weeks or even days. The most notorious examples are the table-type machines from Japan. These are often not earthed, with live monitor chassis, mains-potential connection tags and uncovered transformers being exposed when the tops are opened. This represents a considerable risk to unqualified personnel employed to clear jammed coin acceptors etc.

I'm in agreement that servicing, both on site and in the workshop, is made difficult by the lack of service data – or badly photocopied Japanese language pamphlets that often relate to a different model anyway.

It's not usual to stock complete machines for spare boards or monitors. Unfortunately however new machines may have to be broken up when the repair of returned boards and monitors proves expensive and time consuming – due to lack of information, and tubes and specialised i.c.s not being available.

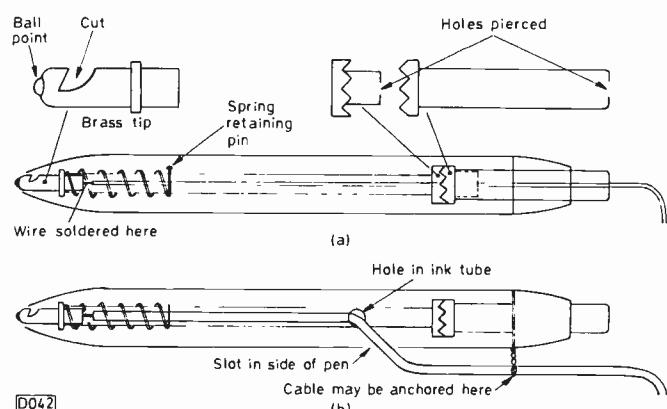


Fig. 1: Victor Rizzo's suggestion for easy to make test probe clips. (a) Ordinary wire type. (b) Screened wire type.

I've never come across a game whose coin rejector tested the coin's metal content, though perhaps Malcolm Burrell was thinking of the tiny magnet gate in some mechanisms.

My experience has been that the usual causes of logic board failure are heat-sensitive TTL and memory i.c.s, closely followed by poor PCB tracking and through plating, rather than oxidised edge connectors.

Technical support from US manufacturers is comparatively good, with clear, concise manuals and the use of standard components. This must be due to the fact that they don't turn out spin-off games, updates, copies and conversions as frantically as their Japanese counterparts.

The first machines using microprocessors appeared in 1974/5, when the Chicago firm Midway introduced their Gunfight and Seawolf games. The design of these machines was based on the Intel 8080 chip, thus introducing software flexibility, i.e. it was no longer necessary for wholesale redesign of the hardware for a fresh model, as was the case with the previous TTL-only machines.

Despite these comments, I feel that Malcolm Burrell is to be applauded for exposing the "other side" of this highly lucrative industry which, I believe, will continue to expand in popularity and revenue despite the predictions quoted. What one must hope is that future successes will go hand in hand with a vast improvement in production and engineering professionalism.

P. W. Blakenev,  
Putney, London SW15.

### TRIPPING PROBLEM

The following account of some troubles experienced with an ITT CVC32 chassis may be of interest to other readers.

The initial complaint was of an annoying whistle which had got worse over several months. The line linearity coil and NS raster correction transductor were checked in turn, by removing and linking across, but there was no improvement. The line output transformer was reluctantly condemned therefore, and on removal it was found that the overwinding was open-circuit. E.H.T. had been present however, presumably due to the voltage jumping across a small break somewhere in the winding. Anyway, a new transformer cured the whistling.

On putting everything back, we noticed that there was bad vertical bowing on the right-hand side. The width was normal, but the picture was not at the usual brightness level – though this was not realised until the bowing fault was cured. This took some time, since there was nothing amiss on the EW modulator control board. In fact the fault was our own – when replacing the line linearity coil, we'd not made the soldered connection to the second scan-correction capacitor C69, which as a result was out of circuit.

A couple of days later (Monday) we switched on again. The power supply tripped six times and shut down. What now? Unhook tripler, no change. Remove line oscillator board and fault clears. Reconnect tripler and replace line oscillator panel, this time disconnecting the scan coils. E.H.T., sound and life generally. When one set of scan coils was reconnected all was well, but when both were connected there was tripping. Things now got awkward. Remove power supply panel and plug it in on the service side – set now works! Remove panel, clean pins and replace. Switch on and we're back with tripping. Wobble the panel and we get results. Change channels and the set trips ...

Decide to investigate the power supply, and find that the voltage across test points TP801 and TP802 is nowhere near the expected 4V when the set trips. So it doesn't appear

to be tripping as a result of excess current, which was a surprise. In fact the problem was cured by slightly readjusting the voltage trip potentiometer R817. A final check on the h.t. and e.h.t. voltages revealed that these were both correct.

As a general point, I've noticed that more and more space in the magazine is being devoted to video equipment – VCRs and cameras – and less to TV sets. There must be many TV chassis for which servicing articles have not been published, or alternatively articles on them may have been published some years ago and an update might be appropriate. Perhaps reprints could be published for individual chassis? I appreciate that there are many developments coming along at present, and that you have only limited space.

B. Ross,  
Rugby.

*Editorial comment:* We try to keep a balance between developments, video and TV servicing generally. The trouble is that most of the well known older TV chassis have been covered in considerable detail in our pages at one time or another, while the newer chassis have very few stock faults to report upon. There are still a few of the less common sets to cover – like the ASA solid-state chassis dealt with on pages 352-3. The complexity of many chassis is such that we can give only brief details, the understanding being that our articles are to be used in conjunction with the relevant manual. Unfortunately it's not feasible, for production reasons, to provide reprints. Right now we feel that the situation is rather like that in the late 60s, when colour burst upon us and we had to concentrate on this. Video has been a success with consumers, and for our part we're having to get to know the whys and wherefores of this new equipment. We've had several letters commenting on these matters in recent weeks, and would welcome other readers' views. If we get a flood of letters however we'll be able to read and note them only, rather than replying individually.

### HITACHI TIP

In your August 1980 issue Mike Dutton, under the heading "Hitachi Tip", mentioned that a Bush tuning unit could be used as a replacement in the Hitachi Model CNP190. The Bush model/chassis number was not mentioned however.

E. D. Jones,  
Llangefni, Anglesey.

*Mike Dutton writes:* Sorry! The set in question is the Bush Model TV313 (Rank A774 chassis). The part number of the push-button unit is 7601 2426. One source of supply is Manor Supplies, 172, West End Lane, London NW6.

### PHILIPS N1700 MODIFICATION

Several readers have written to query the polarity of the audio coupling electrolytics shown in Fig. 2 of my article on video/audio input modification to the Philips N1700 VCR in the March issue. The value shown was 20 $\mu$ F, though any value between 10 $\mu$ F and 120 $\mu$ F will do. The polarity is a bit more complicated. The capacitors were included simply to provide d.c. isolation at the input and output. The equipment feeding the VCR will not normally have a standing d.c. level at its output, and in this case a coupling capacitor to provide isolation will not be necessary. A d.c. voltage check will show which way round the electrolytic should be fitted.

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

## REPORT FROM STEVE BEECHING:

A Philips N1700 came in last week with the complaint "intermittent spots" – it would not replay recent recordings properly, but it would replay earlier ones all right. According to Andy, the customer thought the problem might be due to the video heads, and fortunately he'd brought a tape along as well – a wise move with the N1500 and N1700 series machines. So we replayed the tape and the picture was fine. Until it got covered with spots. This cleared, then the picture went spotty again, the pattern repeating every few seconds.

The tracking control had no effect, but there was a clue in the fact that the sound was varying. This meant that the tape speed was varying. "The control track head" I said. At this point Andy was operating the recorder and the customer was watching this marvel of technology with great interest. Me? I was crawling around on the shop floor, dragging an aerial lead. Obviously some sort of lucky. So Andy and the customer looked surprised. "The control track head needs to be replaced" I repeated. So I was asked if I had one in stock. Now there are two different fixings, and it transpired that one would have to be ordered.

Later, on the bench, I confirmed the diagnosis. The replayed control track pulses were much larger with a standard replay tape than those which had been recorded and then replayed. So a control track head, with the added bonus of audio, was obtained and fitted. Alignment is critical if you want the machine to be able to replay tapes it's previously recorded – final head adjustment is best done using one of the customer's own tapes. This may not be good video practice, but the customer won't come back again!

## JVC HR3660

The next machine that caused us a bit of bother was a JVC HR3660 which "kept releasing the play button". Now this statement sums up the symptoms of roughly a million possible faults – not forgetting the fact that the play key itself could be defective. Inspection revealed that the capstan was not going round, though the heads were. Lesser mortals might go for the motor, but before doing this check the voltage applied to it – you'll usually find that this isn't present. There's an electronic switch (transistors X12/13) which mutes the motor drive – measurement of the voltages around these transistors will reveal whether they are at fault. The very large i.c. (type BA841) in this area is prone to not switching the motor on however – or, to put it another way, it doesn't remove the muting. For this purpose, there should be 0.7V at pin 38 (capstan motor CTL output) of the i.c. In this case the voltage was 0.4V, which was a good case for changing the i.c.

Unknown to me at the time, the recorder had been to another dealer and had suffered from twiddlers anonymous. After fitting the new i.c., I found that the drum servo now wouldn't lock. Measure pulses from drum flywheel (TP8) – too low. Strip off bottom and reposition flywheel. Drum servo now locks – sort of. It's at this point that I start to add a £1 per preset when I find that every one of them on

the panel is out of adjustment. It's an unfortunate fact that the cost of putting right everything that's been put wrong can be higher than that of putting right the fault the original dealer couldn't find.

## More VHS Machines

Later in the month a large dealer sent in eight VHS machines. He said he'd been saving them up for me . . . Two were suffering from dirty heads. Now proprietary brands of cleaning tapes are o.k. for run of the mill cleaning, but not when the dirt, mostly oxide, is ingrained. Sometimes even AF spray and a cotton bud won't remove the dirt, and an unpublishable method is employed entailing the use of a thumb . . . If that fails, the heads are useless.

A couple of the other machines were suffering from spotty pictures due to the static discharge brushes being covered with oil. To get at them for cleaning, it's necessary to remove the flywheel on the drum shaft. If you ever have to do this, make sure that the flywheel is well down on the shaft before tightening. If not the servo won't work – a common problem if you're not aware of it.

Some VHS machines have recently been accused of damaging tapes – mostly on the lower edge and at the beginning. If this is not due to a cock-eyed pinch wheel that's not parallel with the capstan pulley, it's due to the customer being a bit rough when inserting the cassette – bashing the lid down hard and not allowing the cassette to seat properly. The serrated edge of the take up spool does the rest.

## Philips N1500

After replacing the threading cord on a Philips N1500, the customer brought the recorder back with an Elvis film that wouldn't play in it. He said he'd got some 35 films which he'd recorded. Andy mumbled something which we didn't catch about Elvis. Probably just as well. Unfortunately the recorder was up to standard, which was more than could be said about the Elvis film.

"C'est la vie" I said, after explaining that I couldn't deliberately fudge the machine so that it would play the tape. Obviously prior to the threading cord actually breaking it must have been caught around the threading pulley, so that the machine worked for some time while only partially threading up. A most unfortunate state of affairs, but "c'est la Philips" . . .

## PHILIPS VR2020 – DEWI JAMES

A Philips VR2020 VCR with an interesting fault came our way recently. It would work perfectly for about twenty minutes, after which the sound and picture would momentarily disappear. After a further couple of minutes, the sound and vision would start to disappear cyclically. When the vision went, we noticed that the screen was completely blanked out. This made us think in terms of a.g.c. etc., and we recalled that the machine has a muting

circuit to prevent sound and picture noise while it's searching the band for the selected channel. It occurred to us that the muting circuit might be coming on at the wrong time, which proved to be the case – the fault was due to the SAA1084P i.c. on the U140 sync module.

There seem to be a number of modified versions of this machine. Some unmodified/modified panels are interchangeable, others not. All this isn't going to make life easy for those who have to service the machines.

## REPORT FROM DEREK SNELLING:

The number of VCRs we've sold or rented out has risen substantially over the past few months. This in turn means an increased number of repairs. A couple of common faults have shown up, though most faults seem to be "one-offs".

### Sanyo VTC9300

One common fault we've had occurs on the Sanyo VTC9300 – the problem is the 12V regulator on the power supply board (W3). The symptoms depend on whether the series regulator transistor Q702 goes open-circuit or short-circuit.

If it goes open-circuit, the clock will work but the power light will not come on when switched from the stand-by position, and none of the cassette functions will operate. Since this is a Betamax machine, this also means that if there was a tape in the machine when the fault occurred it cannot be ejected – the tape is laced up at all times, and the unlacing mechanism requires the 12V supply. The cure of course is to replace Q702 (a TIP41 is a suitable replacement). It's mounted on a heatsink attached to the W3 board. To gain access to this, it's necessary to remove or loosen the top to enable the back to be removed. The W3 board is the one on the left, viewed from the rear, and is secured by a screw at the top right corner and the two screws securing Q702's heatsink. To remove these two screws, the left side panel has to be removed. The screws can then be seen through an oblong hole in the chassis. After removal of these screws, the panel can be withdrawn sufficiently to enable the transistor to be changed. If more leeway is required, remove the large capacitor to the left of the board.

If Q702 has gone short-circuit on the other hand, everything will work but you won't be able to switch the machine to stand-by and you may have a hum bar on the screen. This is less common than the previous fault, but is more serious. In addition to Q702 being short-circuit, any or all of the following components in the power supply may be faulty: Q703, Q701, Q705, D712 and R705. The diode is a 10V zener, and BC108s may be used to replace the transistors – but watch the pin layout. Unfortunately the trouble doesn't always stop with the power supply, as the 12V line rises to something like 17V. We've found that when we switch on after repairing the power supply, more often than not playback is o.k. but there's no sound on playthrough. In each case this has been due to failure of the sound i.c. Q906 (AN240P) on the W5 board. In one case coil L905 which feeds the i.c. had also failed. Board W5 is situated on the top of the video panel, and can be hinged upwards after releasing two clips.

### Hitachi 8000/8500 Series

The second common fault we've had is on the Hitachi 8000/8500 series. The symptoms are that the machine is

o.k. on playthrough, fast forward and rewind, but when play or record are selected the machine fails to lace up and after a few seconds switches off. The cause is R081 (2.2Ω) on the system control board – it supplies the loading motor regulators. This board is the one under the video panel. The resistor is a low-wattage type, situated on metal legs next to plug PG910. We've had the resistor fail on five machines (it usually resembles a piece of charcoal), and replacement has always effected a cure. The fault is apparently due to failure of the loading motor to switch off because of intermittent operation of the loading switch S52/3. A modification is expected.

## Ferguson 3V22

A third fault has occurred on three Ferguson 3V22 machines. These would lace up and play for a few seconds, then switch off and unlace. The machines appeared to work perfectly during the few seconds they were in operation, but they obviously thought otherwise. The thing to check is the pulses from the drum pulse head – these tell the machine whether or not the head is rotating, and in their absence the machine will switch off. We've found the pulses to be present but of low amplitude, due to the drum pulley with the two magnets not being pushed far enough on to the head shaft. As a result, the magnets were not passing close enough to the pick-up head. In one case the pulley was so far off that it was rubbing on the bottom PCB.

## Radar Interference

We've also had some problems due to the positions of machines rather than the machines themselves. The first is peculiar to certain areas of Birmingham, and occurs mostly on Hitachi machines. It takes the form of dashes going across the screen diagonally at regular intervals, and is caused by the radar at Elmdon airport. It can be avoided by tuning the video down to channel 30, and in extreme cases by fitting an attenuator.

## TV-VCR Interference

The second problem is due to interference from the TV set, and is experienced mainly with Betamax machines, particularly the Sanyo ones. It happens if the VCR is placed under the TV set, say on a shelf built into the stand. This means that it's too close to the TV set. Depending on the type of TV set, the following symptoms may be seen on playback:

- (1) Purple stripes down the left-hand side of the screen (Philips TV sets).
- (2) Loss of the bottom half of the picture (Bush sets).
- (3) Loss of colour (ITT receivers).
- (4) Patterning and loss of sound (Granada sets).

In every case moving the VCR a few more inches from the TV set has provided a cure.

## Faulty Tapes

Finally, a couple of problems due to faulty tapes. First a stationary line on the screen (usually with VHS machines). This is due to a crease, often running the length of the tape. Ferguson tapes seem to be particularly prone to this. Secondly sound normal but no picture (Betamax only), though the picture will appear on pause or slow-speed playback. What the problem is I don't know, but it's definitely the tapes and not the machines.

# Making Patterns

Malcolm Burrell

LOGIC circuitry makes it easy to produce simple patterns on a TV screen, and experimentation along these lines helps to remove some of the mystique surrounding the subject of logic gates etc. The purpose of this brief article is to give some simple examples of what can be achieved.

## Producing Bar Patterns

We have to start with a signal source. Say we have a simple astable multivibrator (see Fig. 1). If the time-constants of both sections of the circuit are the same, we'll get the squarewave output shown. It's conventional to regard the positive-going portion of this waveform as 1 and the negative-going portion as 0. What's interesting however is the effect this waveform will produce on a TV screen if it's injected into a video amplifier (see Fig. 2). If the waveform's frequency is say eight times the line frequency, we'll get sixteen bars on the screen – eight black ones and eight white ones (assuming that the video amplifier is being driven from fully on to fully off). This is not difficult to do, provided you isolate the receiver from the mains supply. The absence of sync pulses would be immaterial.

Suppose we would like fewer bars? Simple, we use the

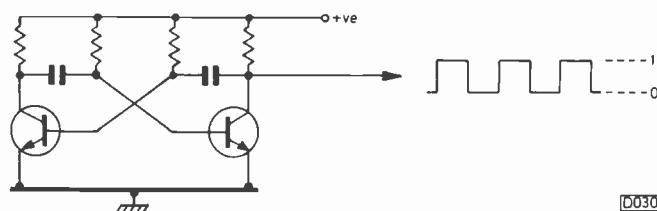


Fig. 1: An astable multivibrator with the same component values in each half of the circuit provides a squarewave output (of opposite polarity at each transistor's collector).

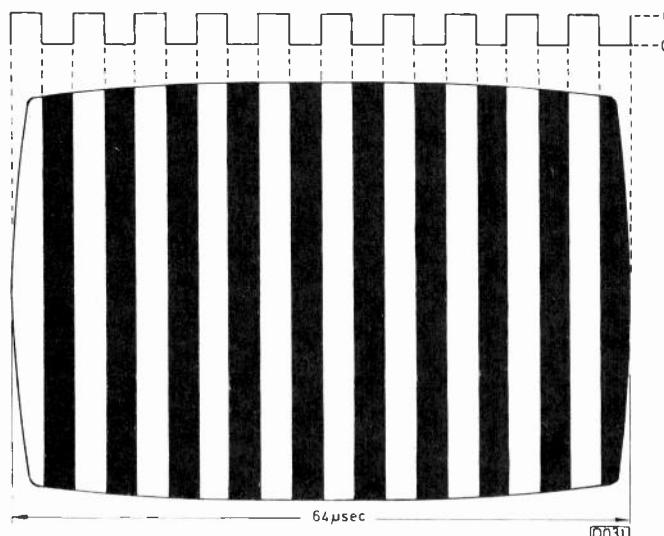


Fig. 2: A square waveform at ten times line frequency will produce twenty vertical bars on the screen if fed to a video amplifier to drive it on and off, ten white bars and ten black ones as shown here. We'd intended to show sixteen bars, but the editor's ruler got the better of him. Never mind.

output from our astable multivibrator to trigger a bistable one, and feed the output from this to the video amplifier. Since a bistable multivibrator produces one output pulse for every two pulses fed to it, it divides by two and we get half as many bars on the screen (Fig. 3). We've shown the bistable's output out of phase with its input, though this is a

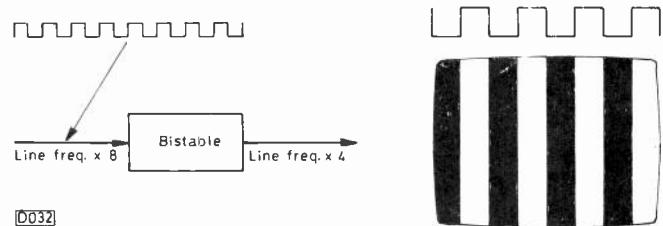


Fig. 3: If the eight times line frequency square waveform we should have shown in Fig. 2 is fed via a bistable multivibrator to halve the frequency, the result is eight bars on the screen, four black and four white.

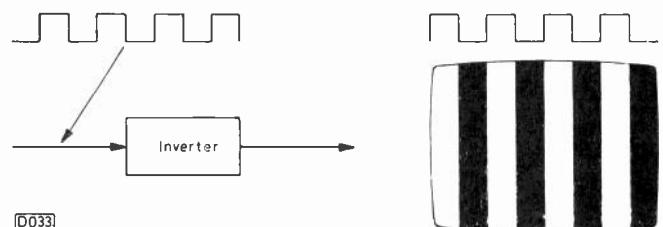


Fig. 4: Let's invert the waveform before feeding it to the video amplifier. Recognise the pattern? – the blue bars in the standard colour bar pattern.

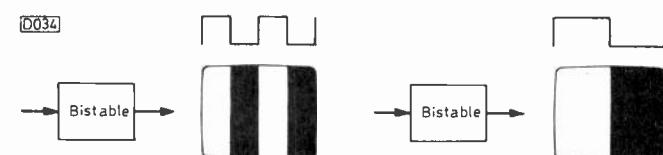


Fig. 5: A couple more bistable circuits give us the red and green colour bars.

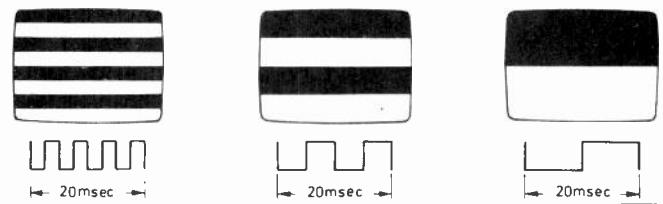


Fig. 6: Doing the same thing at field frequency gives us horizontal bars.

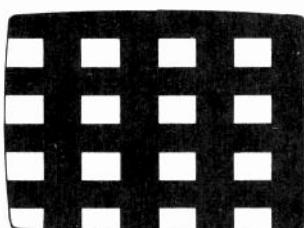


Fig. 7: Add vertical and horizontal bars and we get a simple crosshatch pattern.

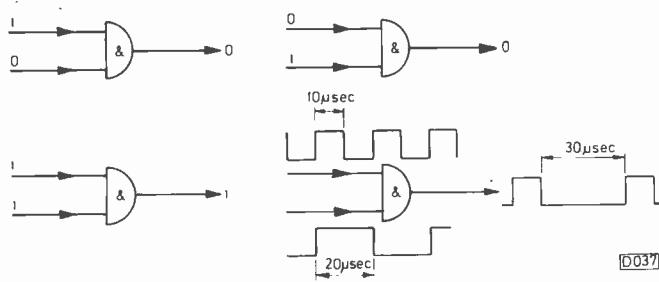


Fig. 8: Input/output characteristics of the AND gate, with a simple example of its effect.

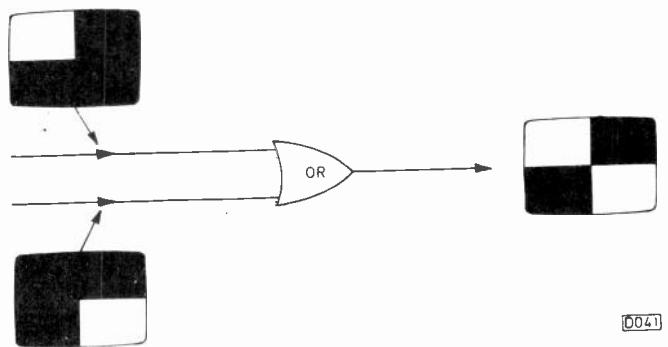


Fig. 12: Effect of using an OR gate.

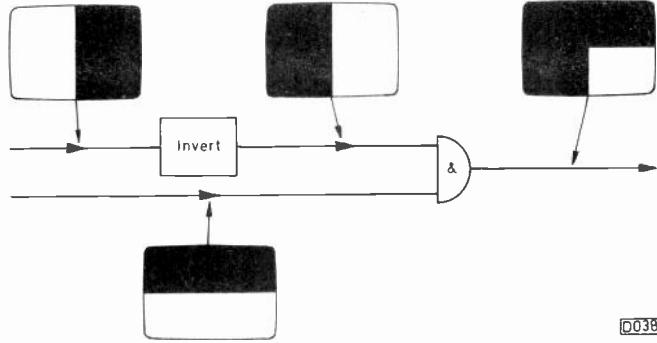


Fig. 9: Use of inversion and an AND gate to get a white square at the lower right-hand side of the screen.

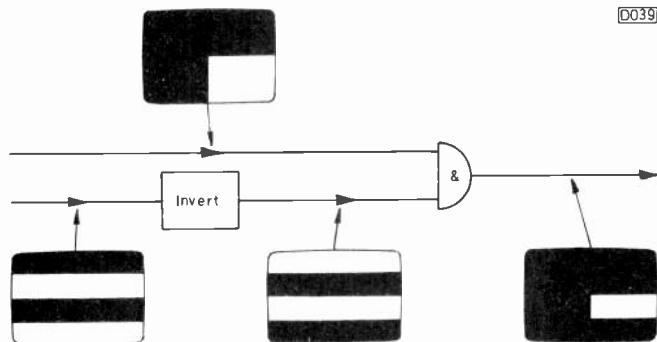


Fig. 10: Use of an additional AND gate to reduce the size of the white rectangle displayed on the screen.

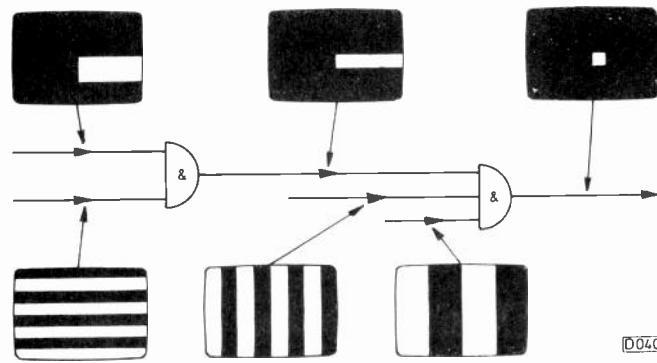


Fig. 11: Further gating to reduce the size of the white part of the display.

matter of chance unless a reference is provided.

So we now have eight bars on the screen. Do they look familiar to you? Could we use them for anything? Suppose we invert them – simply by feeding the signal via an inverting stage (Fig. 4). We've got the blue part of the standard colour bar pattern! A couple more bistables (Fig. 5) will give us the red and green parts. So we can use these signals to drive the cathodes of a colour tube to give us

colour bars – in theory anyway.

If instead we use waveforms at multiples of the field frequency, we can produce horizontal instead of vertical bars (Fig. 6).

We can do quite a lot with the six waveforms shown in Figs. 4-6. By simply adding the eight vertical and horizontal bars we get the crosshatch shown in Fig. 7. Now the point to note here is that at some points on the screen our vertical and horizontal waveforms coincide whilst at others they don't, i.e. this basic crosshatch enables us to define parts of the screen.

### Use of Logic Gates

Suppose we want to produce a small rectangle on the screen. To do this, we must be able to combine our waveforms in such a way that we can eliminate the bits we don't want. This can be done using logic gates.

One of the simplest gates is the AND gate (Fig. 8) with two inputs and one output. We get a positive-going output from this only when both inputs are positive. The practical use of this for our purposes is that if for example we feed a 10μsec pulse to one input and a 20μsec pulse to the other, the output we obtain will consist of a 10μsec pulse once every 30μsec.

To get a rectangle at the bottom right-hand side of the screen, we can use an AND gate to combine the two waveforms shown in Fig. 9 to produce the required result. To make this smaller in the vertical direction, we can use a second AND gate to combine the output from the first gate with a further input (see Fig. 10). This process can be taken further, as shown in Fig. 11, using two more AND gates, though we've cheated a little by using a three-input AND gate.

The use of AND gates enables us to eliminate parts of our initial waveforms. Suppose that instead we want to combine them? This time we can use an OR gate, which provides a positive-going output when one or other of its inputs is positive-going. Fig. 12 shows the effect.

### Experimentation

We've touched briefly then on multivibrators, inverters and gates of the AND and OR variety, seeing what can be done with them in terms of creating simple patterns on the screen. It's instructive to build a small power supply, connect a few logic circuits together and see what can be achieved. With practice and imagination, you can build up quite complex patterns. We've dealt with this here on a theoretical basis, avoiding the complexities of synchronisation etc., but a study of some of the designs that have been published in past issues will fill in the practical aspects.

# Service Notebook

George Wilding

## Intermittent Loss of Raster

The problem with a National Panasonic colour portable (Model TC42) was that the raster would intermittently black out, the sound being unaffected. Unusually for a solid-state chassis, colour-difference tube drive is used in these sets. Our first suspicion therefore was that the luminance output transistor TR303 (2SC1012A) was cutting off intermittently, thus increasing the voltages at the c.r.t. cathodes with the result that the c.r.t. would also cut off. Sure enough, we found that when the picture vanished TR303's collector voltage rose to over 200V instead of its quoted 100V or so. Further tests revealed that when the picture vanished TR303's base voltage fell to almost zero instead of 2.2-3.8V. There's a flyback blanking transistor (TR302, 2SC208) in TR303's base circuit, so it seemed possible that this was going intermittently short-circuit. Replacing it confirmed our suspicion, since there's been no further problem since.

The regulated h.t. rail in these sets is 110V incidentally, the 220V supply for the luminance and colour-difference output stages being obtained from a rectifier fed from a winding on the line driver transformer.

## Intermittent Coloured Spots

The owner of a Grundig Model 5010 complained that coloured spots would appear across the picture intermittently. On inspection we found that results were normal for about a quarter of an hour, after which some random coloured spots appeared. Their intensity could be increased by advancing the colour control, while setting the colour control to zero almost entirely removed them. The focus then suddenly deteriorated, confirming our initial suspicion – that there was internal sparking in the tripler. Replacing the latter removed all the faults.

## Power Supply Problems

Mains filter capacitors tend to go short-circuit in most types of TV sets. Their demise in Pye group hybrid colour sets may lead to further trouble however, since the mains input goes first to the large line timebase/power supply panel, where the mains fuse is positioned, before passing to the on/off switch on which the capacitor is mounted. If you've had to replace the capacitor and the shattered fuse you may find you've no continuity across the mains plug, usually because a section of the print which carries the mains input has been damaged – the relevant area is near the centre top of the board, just beneath the fuseholder.

Such was the case with a 22in. Ekco set that came our way recently. After fitting a jumper lead across the print break however we had sound and e.h.t. but a field scan only an inch or so high. Advancing the height control increased this to about six inches. Now if you're not too familiar with these sets, your reaction might be to start checking around the field timebase board. It's proved to be very reliable however, a much more likely cause of the problem being the absence of one or other of the three l.t. feeds from the power supply. In this case the 20V supply to contact A of plug PL10 on the right-hand edge of the board was missing. The

relevant filter resistor could have been open-circuit or the smoothing capacitor short-circuit, but in view of the arcing that would have occurred when the mains filter capacitor went short-circuit we decided to check the 20V zener diode D52. Replacing this and readjusting the controls produced normal field scanning.

## Intermittent Loss of Height

The trouble with an ITT solid-state colour set fitted with the CVC20 chassis was lack of height plus a small foldover at the top of the raster – both faults varying intermittently. The voltages from the vertical amplifier transistor T7 through to the output stage were all slightly out, so as these stages are d.c. coupled we decided to concentrate on T7. The input to this is coupled via a 10 $\mu$ F electrolytic (C20), so it seemed a good idea to check this by substitution. The replacement restored full height, but there was still poor linearity which couldn't be removed by adjusting the preset control R44. It seemed logical to continue to check around T7, so attention was next turned to its base bias network. This consists of three resistors, R47/8/9, the latter two of which were found to have changed value. We considered it best to change all three while we were about it, and after readjusting the linearity preset control a perfect raster was obtained.

## Blurred Picture

"The picture suddenly became blurred" was the phoned complaint with a 26in. Beovision set (3400 chassis), and when we inspected the display we found that the vertical outlines, especially in the centre of the picture, were about three times the normal width. The horizontal outlines did not seem to be affected to the same extent. Anyway the fault was clearly a focus one, which was confirmed when we found that the voltage at the focus pin on the c.r.t.'s base connector was excessive and didn't vary with adjustment of the control.

The focus circuit in these sets is a bit unusual, in that the voltage applied to the 10M $\Omega$  focus control varies with the e.h.t. to ensure optimum focusing over wide variations in the overall brightness level. Anyway, the first thing to be done, as with all focus troubles, was to check the values of the resistors in the circuit. Three of the resistors are conveniently mounted on a small paxolin panel, but they are hefty 2W types and their exterior cases were unblemished. The culprit in fact turned out to be the 30M $\Omega$ , 2W resistor which returns the earthy end of the focus control to chassis – it was open-circuit. This resistor is well hidden and thus easily overlooked if you don't have the appropriate manual with you – in fact to replace it you first have to remove the small side screening plate. Three 10M $\Omega$  resistors in series can be used to get the value and wattage required.

## Philips 210 Chassis

Normal width but grossly excessive height was the problem with an old Philips hybrid monochrome set. The height control was found to be at minimum, and while the main linearity control had some effect the top linearity control had none whatsoever. This control is fed from the tertiary winding on the field output transformer, and on checking it turned out that this winding was open-circuit.

Distorted sound with lack of volume on another of these sets did not respond to fitting a new PCL82 audio valve, but was completely cured by readjusting the slugs in the f.m. sound detector circuit.

# Video Review: Sony HVC2000P Colour Camera

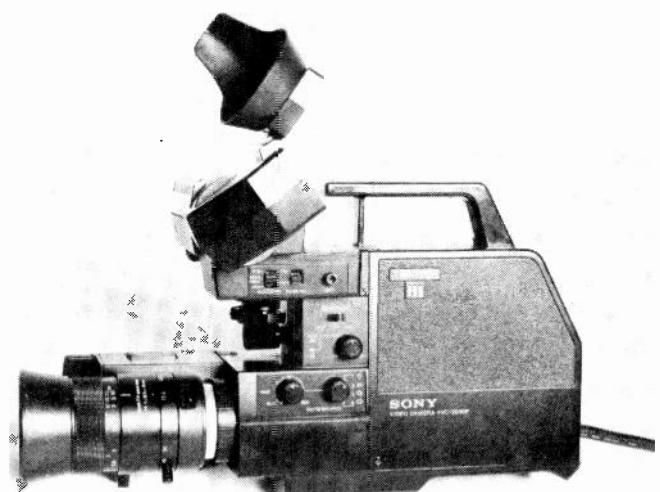
David K. Matthewson, B.Sc., Ph.D.

IN the January 1980 issue we surveyed domestic video cameras in general, outlining the usual features incorporated and the techniques used. More recently we've seen how to build a simple monochrome camera, and have also considered in some detail one manufacturer's way of achieving a low-cost colour camera — the Hitachi GP4/VKC750 series. Sony's colour camera aimed at the domestic video market is the HVC2000P, which is available at an all in price of around £575 including VAT. It should be appreciated that the HVC2000P is not an attempt to produce the cheapest possible colour camera — that isn't Sony's way.

## General Features

Probably the first thing one notices is the absence of the usual pistol grip. Instead it has a rather uncomfortable looking, though in practice quite the opposite, hand grip adjacent to the zoom lens. Your hand fits quite naturally into this, with the fingers falling on the remote tape start/stop button and the zoom control for the electrically operated 75-12.5mm lens. The camera's body is made of cast alloy and is covered with a mixture of metal and plastic panels with a matt black finish. The rear of the body has a built in shoulder mount, so that with the camera held in the right hand and resting on the shoulder the rubber eyecap of the 1in. c.r.t. viewfinder fits the user's eye comfortably.

The viewfinder can be moved from side to side and tilted



to accommodate different users. This also makes it easy to use the camera in any odd position, such as on a copy stand or for very low floor shots etc. The electronic viewfinder makes focusing and framing easier: it also doubles as a playback monitor for instant tape playback on location. The lens also has a macro facility, so that if sufficient illumination is available you can use an object-to-lens distance of only a few millimetres.

As is usual with this type of camera, a captive lead will connect it to either a suitable VCR such as the Sony C7 or the SL3000 portable, or to a mains power unit which is available as an optional extra. Adaptor leads enable the HVC2000P to be used with most VCRs, including various VHS format machines such as the Ferguson 3V23 etc. The camera operates with 12V d.c. and has the very low power consumption of 8.3W — which can be reduced to 6.5W by unplugging the viewfinder.

A small built in electret microphone enables you to record sound and vision simultaneously, but a higher quality unidirectional microphone can be plugged into a socket on the camera's body, automatically disconnecting the omnidirectional electret. When any sound is picked up a small yellow LED on the camera's back plate flashes to indicate that the microphone is working. A small jack socket enables a 3.5mm earpiece to be connected so that the sound being recorded or being played back from the VCR can be monitored.

## Special Features

The features mentioned so far are much the same as those found on cameras from other manufacturers. What does the HVC2000P have that makes it different? The answer is a number of small but neat features that considerably increase its versatility — also the Sony Trinicon tube, which we'll return to later.

As with other colour cameras, there's a colour temperature control to enable the camera to be used under different lighting conditions — ranging from Mediterranean sunlight through English overcast sunlight to artificial lighting. The control has the effect of altering the ratio of the red-blue signal levels while leaving the green signal level constant. A four-position switch has positions for tungsten lighting, fluorescent lighting, bright outdoor sunlight and cloudy, overcast sunlight, and in addition a fine balance control is provided so that you can trim the red-blue balance.

The technique used to optimise the adjustment is clever.



## next month in

# TELEVISION

### ● SERVICING THE RANK T20/T22 CHASSIS

These are the Rank colour chassis fitted with the 20AX c.r.t. and using a switch-mode power supply of the Siemens blocking oscillator type. Most of the circuitry is common to the two chassis, though the T22 has an up-dated signals panel. The switch-mode power supply might puzzle those not familiar with these sets, but is not difficult to deal with since it can be checked out independently on the bench. Derek Snelling and John Coombes will be reporting on their experiences with these chassis.

### ● COLOUR PORTABLE PROJECT

Part 2 deals with the signals panel. Excellent results are obtained from this compact unit, with its prealigned i.f. module, single-chip (TDA3560) decoder and class AB RGB output stages.

### ● AFC PROBLEMS

Practical TV Servicing looks at a.f.c. – the need for it, the ways in which it is applied, and the problems that arise when faults are present. A close look will be taken at the a.f.c. module used in the Philips G8 chassis.

### ● VHF LOG-PERIODIC AERIAL

To simplify his receiving installation, Gareth Foster designed and built a log-periodic aerial covering the entire v.h.f. spectrum (45-230MHz). Full constructional details will be given.

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When the indicator switch is moved to the "white balance" position, a vertical white line appears in the viewfinder. The camera is then either pointed at a white card, or the white translucent lens cap supplied with the camera fitted, the colour balance control being adjusted until the white line is as far to the left as possible.

When the indicator switch is moved to the "iris" position, a small vertical white line indicating the lens aperture appears in the viewfinder at the bottom. An electric auto iris system is incorporated. The aperture setting is also indicated by a needle visible through a small window in the lens body. The auto iris system works very well under most conditions, but there are occasions when it needs to be defeated, for example when shooting a subject with a bright light behind it. Provision is included to override the auto iris system and set the aperture manually.

A further degree of control over the camera's sensitivity is provided by the sensitivity control, which can be set to auto, high or low. In the auto position the auto iris system works normally: in the high position the exposure is about one stop greater, and vice versa in the low position.

By moving the indicator switch to a third position labelled "waveform", an approximation of a single line of video signal appears in the viewfinder – vertically. This is useful when adjusting the iris and sensitivity controls manually.

User controls for viewfinder brightness and h.f. peaking are also provided, enabling the user to obtain viewfinder conditions that suit his preference without affecting the recorded signal.

Two warning indicator LEDs are visible in the viewfinder – a yellow one which indicates insufficient light, and a red one for tape run. The latter also flashes on and off a few minutes before the recorder's battery goes flat.

A feature which so far as I know is unique to this camera is the fader. When switched on, this works in conjunction with the tape start/stop button on the handgrip, fading the recorded picture in and out as the tape starts and stops. This type of fade can be achieved on any camera by closing the iris, but having it done automatically makes it simpler to achieve good results.

A user control whose purpose I find it difficult to understand is the three-position sharpness control on the

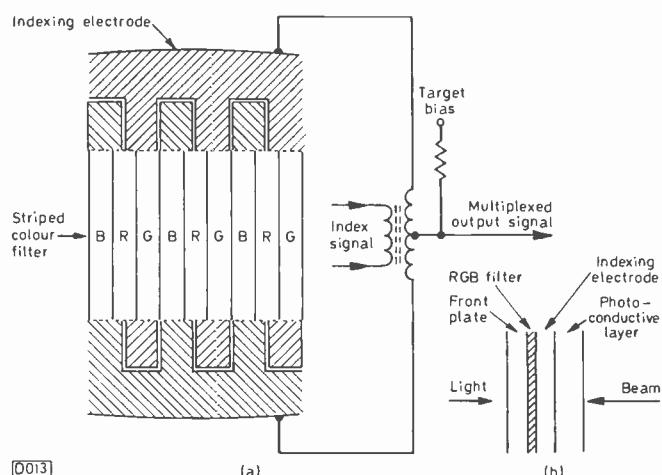


Fig. 1: The Sony Trinicon tube has an indexing electrode behind the colour filter section of the faceplate. The output obtained from the indexing electrode is a complex one consisting of the luminance and two quadrature-modulated colour-difference signals, multiplexed in the form of pulse amplitude modulation. (a) Alignment of the indexing electrode with the RGB striped filter; (b) the faceplate/target structure – the photoconductive layer is selenium based.

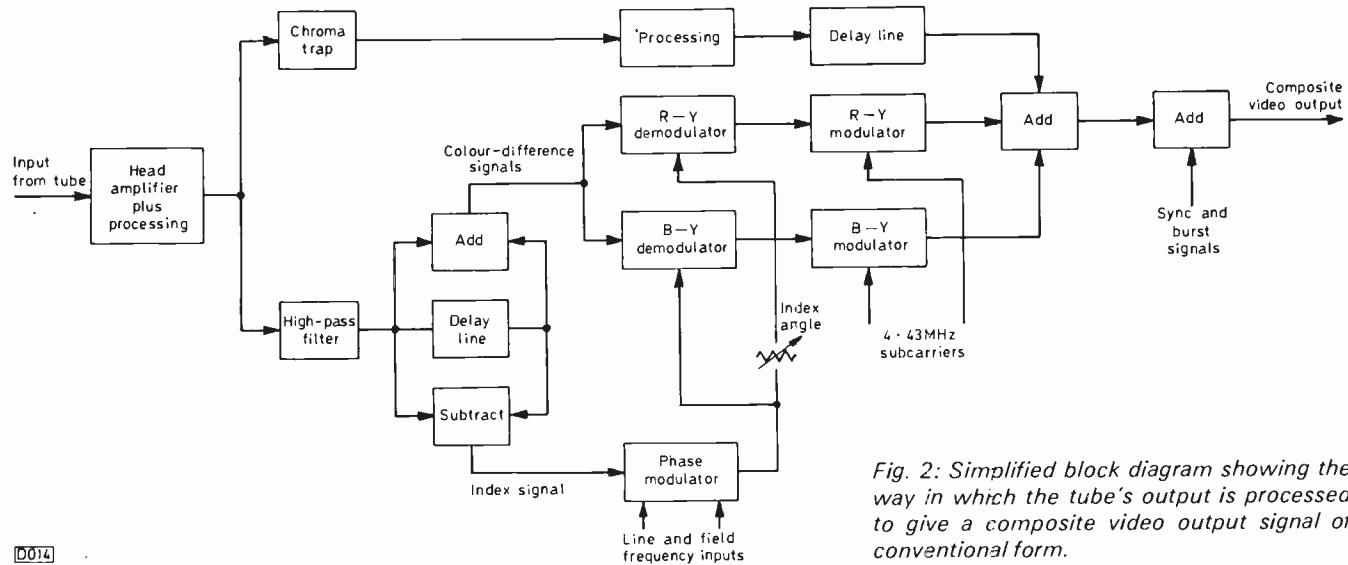


Fig. 2: Simplified block diagram showing the way in which the tube's output is processed to give a composite video output signal of conventional form.

D014

rear panel. This allows for a normal, sharp or soft picture. Do some people like soft, out-of-focus pictures?

Certainly unique is the optional remote control unit which plugs into the camera's body. When used with a few extension leads the viewfinder can be detached from the camera and sited along with the remote control, so that zooming and tape start/stop can be controlled at a distance. This is an advantage in hazardous industrial situations as well as when using the camera on a copy stand etc.

### A Trial Run

With all these controls you might think that a potential user would be subject to a dose of "techno-fear". Sony have made matters as simple as possible however. The normal positions of the various switches are marked with a green square, so with the excellent operating instructions and the brief ready-reference booklet the newcomer should soon adapt to the camera.

I had a preproduction sample of the camera for trial for a week or so. Unfortunately I didn't have an SL3000 portable Betamax VCR to go with it. Instead I used a portable U-matic machine and the mains power unit. With these, I found that the camera did all that the book said it would. The picture quality was perfectly adequate, not only for domestic but also for non-critical industrial and low-budget educational use.

The ability to work under comparatively low light levels (around 70 lux) makes the camera suitable for indoor use, but for optimum picture quality light levels of around 700 lux upwards are required. I found the colour balance system particularly easy to use, as the colour temperature can be set without taking one's eye from the viewfinder. Subjectively, the colour rendering appears to be very good, though trying to colour match two of these cameras would not be easy – this problem should not arise however, since the camera is intended for single camera applications (or for use with a monochrome camera and the HVS2000P effects unit reviewed in the February issue).

### The Electronics

The camera's circuitry is reasonably conventional, relying heavily on custom designed i.c.s – some 19 in all. The electronics are arranged on 16 separate PCBs which are held in place by the rigid diecast chassis. Although 16 PCBs may seem to be excessive, most of them house only a few components such as various switches, sockets, LED

indicators etc. Most of the main electronic circuitry is on two PCBs – as our photograph shows.

The tube used is the  $\frac{3}{4}$ in. Sony Trinicon which, unlike the tri-electrode tube used by Hitachi in their cameras, does not provide separate RGB output signals. Instead, it provides a multiplexed output signal that's separated into its component parts using an electronic indexing system. The way in which the output signal is obtained is shown in Fig. 1. The tube's faceplate has an integral set of vertical RGB filter stripes, and behind this (the tube is of the vidicon variety) there's a rather cunning indexing electrode from which the signal is taken. Because of the spacial relationship between the RGB stripes and the two sets of fingers forming the indexing electrode, a multiplexed output signal consisting of a luminance component and two quadrature modulated colour-difference signal components is obtained. An index signal is added.

The way in which this lot is sorted out is shown in Fig. 2. Following initial amplification, filters separate the luminance and the colour plus index signals. The colour-difference signals are modulated at the index signal frequency and, since they are in quadrature, they can be separated using standard decoding techniques. A delay line circuit is used to extract the index signal, which is then phase modulated and used as the reference signal input to a pair of synchronous detectors. This gives us separate R – Y and B – Y signals which can then be modulated at 4·43MHz and added to the luminance signal to obtain a normal PAL signal. After adding the burst and sync pulses, a standard 1V peak-to-peak  $75\Omega$  output is obtained.

The camera's sync pulse generator employs two crystals, for the colour subcarrier and syncs. As the camera is not designed for multiple camera use, no provision is made for feeding in external sync signals. The tube uses electrostatic line and field deflection.

### Conclusion

Apart from the electret microphone being mounted in a silly place where it gets knocked every time the viewfinder is moved, the camera seems to be very well designed and gives good colour pictures. Its extra features make it very easy to use and enable you to get more complex visual effects than would otherwise be possible. As to the sort of market there is in the UK for domestic colour cameras, frankly I'm not too sure. If you're a rich man interested in video however, the HVC2000P and the partnering SL3000 recorder will fit the bill.

# Service Bureau

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## BUSH BC6004A

The initial fault on this imported 14in. colour portable was no sound or raster. The fuses were o.k., but diode D687 on the line output stage module was found to be open-circuit. Replacing this restored the sound and picture, but now there's rolling. Adjusting the field hold control P742 has reduced this to a very slow movement, either up or down, but lock cannot be obtained.

Congratulations on tracking down the cause of the initial fault! This set uses an unusual combined switch-mode power supply/line output stage circuit, the various supplies in the set being obtained from the line output transformer. With D687 open-circuit, the drive from the line output/chopper transistor T686 (BU208) is not applied to the line output transformer. Your present symptom is lack of field sync, which could be due to a number of things. If you have a scope, check for 11V peak-to-peak field sync pulses at pin 3 of the sync/control module. If these are present, the TDA1170 field timebase chip could be faulty. If the pulses are absent, the main suspects are D907 and D909 (both 1N4148), T908 (BC308B) and the TDA2590 sync/line oscillator chip.

## THORN 9600 CHASSIS

The set can be tuned in quite normally with the a.f.c. switched off, but if the a.f.c. is switched back into circuit the set works for a while then suddenly goes off tune, the picture being lost altogether. Switching off the a.f.c. will then restore normal sound and vision. Since there's no tuning drift, the a.f.c. doesn't seem to be necessary. I've tried slight adjustment of the a.f.c. detector coil L111, also attenuating the signal from the aerial, but the problem persists.

It seems that the set is suffering from a form of a.f.c. lock-out. There's a modification for this problem: fit a 4.7µF 25V tantalum electrolytic capacitor with its positive lead to the cathode of zener diode W4 (TP4) and its negative lead to the junction of R22/R49/Z1 – these components are on the tuner/touch-tune control panel.

## MURPHY V1400

There's low and very distorted sound on this portable, though the voltages around the audio driver and output transistors all seem to be roughly correct.

We've known the coupling capacitor C312 (1µF, 10V) between the volume control and the audio driver transistor to be responsible for this fault on these sets. If C312 is o.k., the intercarrier sound i.c. (IC301) is suspect. Before condemning it however, check that the 10.5V supply is

present at pin 5, and that both the input pins 1 and 2 are at approximately 2V.

## SONY KV1330UB

This set has been in regular use for six years, giving a good, stable picture. Recently however I've had some problems. At switch on, the screen is completely blue. This clears to give reasonably normal colours after a couple of minutes, but the colouring fluctuates – monochrome is also affected. The colour once went completely, with the colour control having no effect, but a quick channel change restored the colour. Finally there's now some slight darkening at the extreme left-hand side of the screen.

After six years or so the Trinitron tubes used in these sets tend to become "lazy", with one or more guns slow to warm up. This could well be the cause of your problem of a blue display at switch on. Some decoder panels of this vintage are suspect regarding print/solder adhesion – the intermittencies you describe could well respond to flexing and tapping the panel. For the shading we suggest you check the capacitors associated with the c.r.t.'s first anode supply – the reservoir capacitor C517 (680pF) and the decoupling electrolytic C701 (0.47µF) – also the electrolytics C158/9 (both 0.47µF) which decouple the emitter and collector of the beam limiter transistor Q152.

## ITT CVC32 CHASSIS

There was no sound or raster, the switch-mode power supply tripping. Replacing the e.h.t. tripler and the line output transformer restored the picture and sound, but there were still problems – barrel distortion, no response from the width control, and picture size variation with changes in the setting of the brightness control. Yet again the transformer developed shorting turns, but on replacing this once more there's still barrel distortion.

The line output transformer failure has obviously taken with it something in the EW correction circuit. Short-circuit the base-emitter junction of the BD238 diode modulator driver transistor T13. If this affects the width, check T13 and the components on the modulator board CMH31. If there is no effect on the width, the modulator diodes D24 (BY223) and D25 (BYX55-600) are probably faulty.

## GRUNDIG 1230GB ELITE

The trouble with this portable is that the a.g.c. isn't working – there's a heavy snow effect. The voltage at the collector of the a.g.c. amplifier transistor Tr368 and at the base of the tuner a.g.c. amplifier transistor Tr372 is zero, but both these transistors are o.k. The a.g.c. delay diode Di329 also seems to be in order, so I now suspect the TBA400 i.f. amplifier i.c. or the tuner. Any comments?

You don't say whether you've checked the a.g.c. gating diode Di365 and the pulse coupling capacitor C384. These would be worth checking as a start, then if replacing the i.c. doesn't improve matters the finger of suspicion will point to the tuner – these Grundig units were not too reliable.

## INDESIT T24EGB

The raster failed due to a faulty line output transformer. A replacement restored the picture, but the line sync is now very weak and can be lost with changes in picture content and advancement of the brilliance and contrast controls. Also the picture is too wide, and pulls to the right when the brightness is advanced. The voltages and waveforms in the line timebase seem to be all right, though the voltages in the sync separator circuit seem wrong. The line sync cannot be

**adjusted with TP15 shorted to chassis as specified, though a picture of sorts can be obtained by carefully adjusting the oscillator coil L421 alone.**

There seem to be two faults here. First the line sync problem. Try a new PCF802 valve, and make sure that the flywheel sync feedback/integrating resistor R432 is properly connected to pin 4 of the line output transformer and hasn't changed value (39 k $\Omega$ ). Check the value of the discriminator load resistors R414/5 (2.7 M $\Omega$ ), and note that the sync pulse inverter/amplifier transistor TR403 is concerned with the line sync only, so could be faulty. If the problem persists, it would be worth checking the value of the sync separator transistor's base bias resistor R404 (1 M $\Omega$ ). For the excessive width, the resistors to check are R427 and R428 (both 4.7 M $\Omega$ ) in the width circuit and the line output valve's screen grid feed resistor R433 (3 k $\Omega$ ) – all these resistors tend to decrease in value in this chassis.

#### **PYE 169 CHASSIS**

**This set has line hold trouble. I've tried a new PCF802 line oscillator valve, and replaced the pulse feedback resistor R69 and the electrolytic decoupler C66, but the fault persists. The voltages around the line oscillator valve all seem near enough.**

The most likely cause of the trouble is one or other of the polystyrene capacitors C65 (0.0033  $\mu$ F) or C67 (820 pF) in the line oscillator circuit. They are of transparent plastic construction and change value with age. Also check the line oscillator coil L14 by squeezing it – shorted turns will cause it to change frequency.

#### **ZANUSSI BR1026**

**There are two faults on this set. First a bright, unmodulated raster with very faint sound. This fault seems to be on the signals board and I assume is an a.g.c. fault. The user brightness and contrast controls function, and the preset contrast control has been replaced. Secondly the power supply went into the trip mode. Shorting the gate of the flyback thyristor in the line output stage stopped the tripping, so a new thyristor was fitted and the 30V supply obtained from the combi coil was checked to make sure there were no shorts. This has stopped the tripping, but there's a loud whine and if a raster is allowed to appear there's lack of width and interleaved lines at the centre of the screen – it looks like a Telefunken 711 chassis with a shorting focus transformer. I've not left the set running in this condition as the line timebase is under some strain – and thyristors are expensive! There are no obvious dry-joints, no signs of a burnt inductor, and the shift diodes are o.k.**

There doesn't seem to be any connection between the faults unless the first one is due to the absence of a.g.c. gating pulses as a result of the second fault. We'll take the timebase fault first. If the raster has a bow-tie shape, the 1.5V zener diode D35 in the field timebase is probably open-circuit – it sets the d.c. conditions in the field output stage. Check by shorting it out – two 1N4148 diodes in series can be used as a replacement. Alternatively one of the amplifier/driver transistors T47/8/9 may be faulty. If on the other hand the fault is a narrow raster with severe foldover, check for dry-joints on the combi coil and the width transducer, then if necessary change diode D41 which is in series with the transducer's load winding. Any fast, soft-recovery diode rated at about 5A will do.

If the first fault persists, check that the voltage at TP4 decreases when the aerial is removed. If so, the a.g.c. is

working. If not and the voltage is below 1V or above 5V, check the a.g.c. transistor T11 and the associated components – the gating diode D4, pulse coupling capacitor C54, etc. If the voltage at TP4 is about 1.2V the fault is in the a.g.c. loop, i.e. no signal is reaching T11. Check the voltages around the i.f. amplifier transistors T9 and T10 and the video emitter-follower T12 – any of the 0.0047  $\mu$ F decouplers C32, C33, C37 or C41 could be short-circuited.

#### **THORN 3500 CHASSIS**

**R528 on the line timebase panel was found to be disconnected and badly burnt. A new resistor was fitted, but on switching on smoke came from the e.h.t. transformer. A new transformer was fitted, but the screen is still blank though all the fuses are o.k. and sound is present.**

R528 is in the h.t. feed to the line driver and output stages. If it overheats it usually means that one of the associated components L502 or C514 is faulty. Check R907 on the beam limiter panel, preferably by substitution, and if necessary try a new e.h.t. tripler.

#### **ZANUSSI BR1026**

**When I use this set with my VCR in the playback mode, there's line flickering at the top of the picture. Is there any sync modification that will cure this?**

The only modification necessary is to connect pin 10 of the TBA920 sync/line oscillator i.c. to chassis. If the signal strength is such that this affects the line sync when running the set off-air, fit a switch.

#### **PHILIPS 300 CHASSIS**

**The trouble is a loud hum from the speaker – the set is otherwise o.k. A new PCL82 audio valve has been tried, and the h.t. electrolytics have been bridged, but these measures have had no effect.**

Check the earthing of the h.t. smoothing electrolytics and the condition of the output pentode's cathode bias components R2100 (470  $\Omega$ ) and C2023 (80  $\mu$ F). The value of the valve's screen grid feed resistor R1547 (1 k $\Omega$ ) can fall, increasing the current through the valve and thereby introducing hum problems and shortening its life. The value of this resistor can usefully be increased to 2.2 k $\Omega$ . Shorting out suspect capacitors is not a complete guide to their condition – replacement is the only sure check. The triode cathode's decoupling electrolytic C2020 (25  $\mu$ F) is also worth checking. If necessary, turn attention to the volume control, checking in particular the earthing of the screen connections. The control is returned to chassis via the electrolytic C1503 (2.5  $\mu$ F) which might also need to be checked. A dry-joint or a corroded joint on an earth connection is a common cause of hum – check around under a good light.

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**TELEVISION MAY 1981**

## DECCA 80 CHASSIS

There's an intermittent fault on one of these sets – the sound and vision signals go, leaving a blank raster with hash on sound. The fault occurs at quite long intervals – sometimes not for several days. It sometimes clears after a short period, or alternatively can be cleared by switching the set off for a couple of minutes. A new tuner unit has been tried without success.

On the occasions we've had this fault it's usually been due to one or other of the two i.c.s in the i.f. strip – IC101 (MC1349) or IC102 (TCA270). Try these, also if necessary the 16V zener diode D101 which stabilizes the supply to the MC1349 i.c.

## TELETON TVC20

About half an hour after switching on there's loss of height – about half an inch at the top and bottom. I've replaced the 21LU8 field timebase valve but the problem persists.

The voltage at the anode of the triode section of the valve (pin 2) should be about 58V. If you find this voltage low, check the value of R616 ( $1.2M\Omega$ ) which is connected between the height control R617 and the field charging capacitor C612. If R616 is in order, go back to the boost circuit and check the value of R725 ( $1.8M\Omega$ ). R617 could also be faulty. This seems to be something of a stock fault on these sets – in March we incorrectly described C619 as the field charging capacitor: in fact it decouples R725.

# TEST CASE

## 221

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.

Few manufacturers have used such a wide range of circuitry in domestic electronic equipment as Sony. This, together with the now legendary Japanese reliability, means that on those rare occasions when we're called out to service a Sony TV set we all too often find ourselves confronted with something that's quite new to us. A recent example concerned a Sony Model KV1822UB whose fault was reported as "no signals". We ascertained over the phone that the set was displaying a blank but very snowy raster, and that there was a good, strong rushing sound. So we sallied forth in the confident expectation that the aerial or the connections between it and the set had failed.

Our self-assurance soon evaporated when we arrived on site however. Another set we had with us proved that the local Band V signals were arriving at good strength, but not

a whit of a signal would the Sony set produce at any setting of the tuning potentiometers. This is a touch-tune model, and in the absence of any spares we rounded up the set and drove it back to the ranch.

In the workshop we dismantled the set and consulted the circuit diagram. It was quickly established that the 18V supply was reaching the tuner unit, so attention was turned to the a.g.c. line. No problems here either. Could the tuner be faulty? We don't keep BT871 tuners in stock, so we connected a variable power supply to the tuner's tuning pin – and were rewarded with a selection of TV programmes as we varied the voltage. So the problem was in the set's tuning voltage supply rather than the tuner. With its own tuning supply reconnected, we found that the maximum voltage that could be obtained on the tuning line, with a tuning potentiometer wound up fully to channel 68, was 2.5V. As you can see from the circuit (Fig. 1), the arrangement is quite conventional.

Meter checks proved that the tops of the tuning potentiometers were being correctly supplied with 33V, and that the lower end of a selected potentiometer would be properly earthed via IC151 or IC152. The sliders of the potentiometers were also tapping off a voltage proportional to their settings. The emitter-follower Q155 was faulty we decided. Out it came, in went an equivalent – and the results were exactly the same as before! We found the answer eventually – can you? See next month.

## ANSWER TO TEST CASE 220 – page 325 last month –

The symptoms last month were no raster on the screen of a hybrid B and O colour set, though the tube was being correctly biased and provided with e.h.t., focus and first anode supplies. If the set had been examined by a first year student with only the most basic knowledge of thermionic emission he would probably have spotted the cause of the trouble right away – to have emission you've got to have thermos, and in our B and O set the tube's heaters were out! In these sets there's a 6A fuse in the heater supply, and this was open-circuit. In our brightly lit workshop we hadn't noticed this small point... We would have been better off on this occasion crouched in a dark corner of the owner's living room! The fuse had failed for its own reasons – probably metal fatigue.

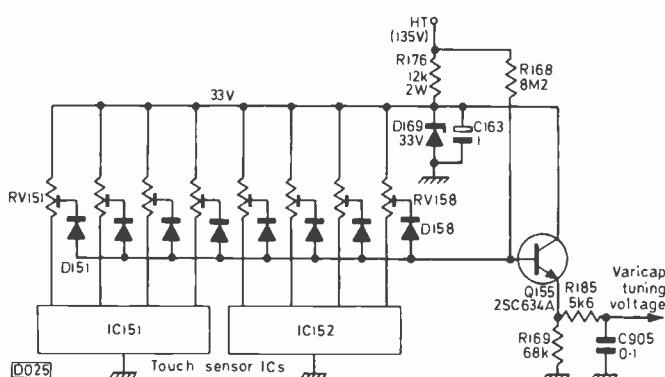


Fig. 1: Touch-tuning circuit used in the Sony Model KV1822UB.

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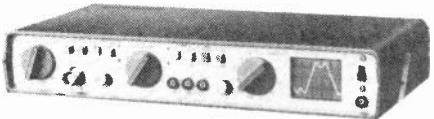
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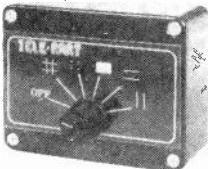
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- \* Horizontals
- \* Verticles

A lightweight, extremely portable and versatile pattern generator for black/white and colour T.V. alignment and service at the customers home. At the turn of a switch, the generator can provide five essential test patterns for correct installation, fast checks and repairs. Pattern stability is first class and compares favourably with other more costly bulky generators only suitable for bench work. The generator is pocket size measuring 10x7.5x4 cm and weighs only 190 grams.

**PRICE £14.95 (Subject to V.A.T.)**



### Telepart Colour Bar Generator

- \* Exceptionally light & durable
- \* Compact 13x17.5x5.5 cms
- \* Battery powered for mobility
- \* Cross hatch grid
- \* White raster
- \* Grey scale
- \* Colour bars
- \* Sound

A Versatile Generator for Servicing or aligning mono or colour TV receivers. Lightweight and very compact for outside service. Features sound facility often not found on more costly generators.

**PRICE £49.95 (Subject to V.A.T.)**

### Power Supply

A Power Supply can be supplied for the Telepart COLOUR BAR GENERATOR. This compact unit mounts by 2 screws into the Battery compartment and converts the unit to a bench instrument.

**PRICE £5.50 (Subject to V.A.T.)**

## CARDIFF CENTREVISION

### EX RENTAL T/V's

\* In stock now. Philips G8 Thorn 3500

Philips K9 26" 110° VCR Position from **45.00**

Also Mono from **£2.00**

Large range of spares. Call and see our 4000 sq. ft. warehouse, you won't be disappointed.

Unit 2 corner of Penarth Road and Hatfield Road.  
Tel. Cardiff 0222 44754

# CELTEL

26" G8...£25 22" 3500...£45

DECCAS all sizes...£25

26" 3500...£12 PYE 205...£18

WHITE MURPHY...£15

Also available: TELEFUNKEN, SABA, JVC, etc.

ALL PLUS VAT @ 15%

WARNERS MILL, SOUTH ST., BRAINTREE, ESSEX (0376) 43685

UNIT 5A, KEMPS SHIPYARD, QUAYSIDE ROAD,

BITTERNE, SOUTHAMPTON 0703 331899

# WMTV LTD. – THE TV PROFESSIONALS



## THE BEST DEAL IN TV's

- ★ Britains most reliable source of Quality T.V.'s.
- ★ Hundreds of working polished T.V.'s.
- ★ Full customer testing facilities.
- ★ Thousands of untested S/S Colour T.V.'s from £10.
- ★ Quantity deliveries arranged anywhere in Britain or the World.

### Special Deals

- ★ Mixed 25" 4 for £30
- ★ GEC 19" 10 for £100
- ★ BRC 26" 10 for £250
- ★ Pye 691 22" 10 for £120
- ★ PYE 205 22" 10 for £199
- ★ Personal collection only

*All above prices are plus 15% V.A.T.*

RING 021-444 6464 FOR DETAILS OF QUANTITY DISCOUNTS

### MAIL ORDER TV's – Working Colour TVs supplied by Mail Order and fully tested before despatch.

- ★ BRC 22"/26" £70
- ★ BUSH 184 22" £40
- ★ BRC 8000 17" £65
- ★ BUSH A823 22"/26" £60

*Above MAIL ORDER prices include V.A.T.  
but please add £12 p & p/T.V. Set.*

- ★ New T.V. Stands.
- ★ Fully adjustable.
- ★ £6.25 plus £1.75 p & p.
- ★ Quantity discounts.
- ★ Price inc. V.A.T.



### EXPRESS MAIL ORDER SPARES

#### ★ Ex-equipment Panels

	Con	Power	Line	Decoder	Video	IF	Frame	Tripler	LOPTX
<b>RBM 823</b>	7.00	6.00	14.00	14.00	—	6.00	9.00	3.00	3.00
<b>BRC 3000</b>	6.00	12.00	12.00	6.00	6.00	6.00	6.00	4.00	6.00
<b>BRC 3500</b>	9.00	12.00	12.00	6.00	6.00	6.00	6.00	4.00	6.00
<b>GEC 2100</b>	6.00	—	—	8.00	6.00	6.00	10.00	5.00	5.00
<b>PYE 205</b>	6.00	—	12.00	8.00	7.00	6.00	5.00	5.00	7.00

Postage & packing £1.25 Panels 50p Triplers

#### Ex-Equipment Valves

##### Untested

ECC82	10
PCF80	10
PCF802	9
PCL82	10
PCL84	10
PCL85/805	9
PCL86	10
PFL200	10
PL36	10
PL504	10
PL508	18
PL509	30
PL519	40
PL802	—
PY500	20
PY800/81	10
PY801/88	10
30FL1/2	20

- ★ p & p paid but minimum order of £3.00 please.
- ★ Deduct 10% discount on orders over £20.00.

#### Ex-Equipment Colour Tubes

All fully tested

17" (A44-271X)	£18.00
18" (A47-342X)	£18.00
18" (A47-343X)	£18.00
19" (A49-191X)	£18.00
20" (A51-120X)	£25.00
22" (A56-120X)	£17.00
25" (A63-200X)	£10.00
26" (A66-120X)	£20.00
26" (A67-120X)	£17.00

Please add £5.00 p & p per C.R.T.

#### Equipment Spares

- \* Always available
- ★ Colour and Mono Scan Coils £1.50 + £1.00 p & p.
- ★ Tuners for all makes of Colour and Mono £4.00 + £1.00 p & p.
- ★ Reconditioned 50p meters £92.00/Box of 10 incl. p & p.
- ★ PLESSEY SL918 colour ICs with circuit for substitution of SL917 £2.00 + 25p p & p.
- ★ NEW VHF/UHF Varicap Tuners with circuit and full data £1.25 + 75p p & p.

WE ARE OPEN MON-SAT 9.30-5.45

PLEASE NOTE – ALL THE ABOVE MAIL ORDER PRICES INCLUDE 15% V.A.T.

**WMTV LTD.** 92 HIGH ST (A435) KINGS HEATH B'HAM B14 7JZ TEL. 021-444 6464  
021-444 2575

## COLOUR BAR GENERATOR UHF AERIAL INPUT PATTERN GENERATOR

★ GREY SCALE



VERTICALS ★

★ WHITE

DOT MATRIX ★

★ HORIZONTALS

CROSS MATCH ★

★ ADD ON PAL COLOUR BARS ★

Send SAE for full specifications.  
Batteries not included.

PG6RF Kit £28.75	Built £37.95	ACCESS
C6 Kit £20.75	Built £29.90	ORDERS
CPG6RF Kit £48.30	Built £72.45	ACCEPTED



Price includes P&P and 15% VAT.  
VHF versions available.

Full 12 month guarantee on built units.

MAIL ORDER ONLY FROM

**TECHNALOGICS LTD. (Dept TV),  
UNIT 2, TAYLOR STREET,  
INDUSTRIAL ESTATE,  
LIVERPOOL, 5.**

## MAIL ORDER PROTECTION SCHEME

### INTRODUCTION

The Office of Fair Trading have agreed that the notice of the Mail Order Protection Scheme to appear in periodicals carrying mail order advertising should appear as follows:—

### "MAIL ORDER ADVERTISING"

#### British Code of Advertising Practice

Advertisements in this publication are required to conform to the British Code of Advertising Practice. In respect of mail order advertisements where money is paid in advance, the code requires advertisers to fulfill orders within 28 days, unless a longer delivery period is stated. Where goods are returned undamaged within seven days, the purchaser's money must be refunded. Please retain proof of postage/despatch, as this may be needed.

#### Mail Order Protection Scheme

If you order goods from Mail Order advertisements in this magazine and pay by post in advance of delivery, Television will consider you for compensation if the Advertiser should become insolvent or bankrupt, provided:

- (1) You have not received the goods or had your money returned; and
- (2) You write to the Publisher of Television summarising the situation not earlier than 28 days from the day you sent your order and not later than two months from that day.

Please do not wait until the last moment to inform us. When you write, we will tell you how to make your claim and what evidence of payment is required.

We guarantee to meet claims from readers made in accordance with the above procedure as soon as possible after the Advertiser has been declared bankrupt or insolvent.

This guarantee covers only advance payment sent in direct response to an advertisement in this magazine not, for example, payment made in response to catalogues etc., received as a result of answering such advertisements. Classified advertisements are excluded."

## THE TELEVISION COLOUR RECEIVER PROJECT

We will be offering all components as specified by the magazine for this latest project starting this month with the Switch-mode Power Supply.

All items, down to the last nut and bolt, are available separately or in kit form, with the exception of the P.C.B.

### SMPS

RESISTOR PACK	ref no 15811	£3.35
CAPACITOR PACK	ref no 15812	£8.40
SEMICONDUCTOR PACK	ref no 15813	£3.60
MISCELLANEOUS PACK	ref no 15814	£18.00

### SAVE BY ORDERING ALL FOUR PACKS TOGETHER

complete smps pack ref no 15815 £28.75

*All prices include postage, packing and VAT.*

For individual component list, please enclose  
S.A.E. quoting ref no 15815L.

**JLC electronics**

110 FIRST AVENUE, BUSH HILL PARK, ENFIELD EN1 1EP

### RADIO/TAPES BARGAINS

LW/MW Mains/Battery Radios £9.00 each (P&P £1.00).

LW/MW Car Radios with Speaker £9.00 each (P&P £1.00).

Small VHF/MW Battery Radios £7.00 each (P&P 50p).

8-C60 High Gain Cassettes £2.00 (P&P 50p).

5-C90 High Gain Cassettes £2.00 (P&P 50p).

Stereo Headphones with Lead & Jack Plug £4.50 (P&P 50p).

**AERIAL AMPLIFIERS**

Aerial amplifiers can produce remarkable improvement on the picture and sound in fringe or difficult areas.

**B45** — for mono or colour this is tunable over complete UHF television band.

**B11** — for stereo or standard VHF/FM radio.

**B12** — for VHF television band 1 & 3. All amplifiers are complete and ready to use.

Battery type PP3 or 8v to 18v dc, next to the set type fitting. Prices £6.70 each.

**SIGNAL INJECTORS** with (pre-set) variable AF, which emits RF harmonics into the UHF band. Protected up to 300 volts dc. Complete with leads £5.70 each.

*All prices include VAT at 15%. P&P per order 30p. S.A.E. for leaflets. Access cards.*

**ELECTRONIC MAILORDER LTD,**  
62 Bridge Street, Ramsbottom,  
Via Bury, Lancs. BL0 9AGT. Tel. Ramsbottom (070 682) 3036.

## SOLE SCOTTISH AGENTS 'Liver' Quality Colour Tubes

### 2 YEAR GUARANTEE! 4 YEAR OPTION

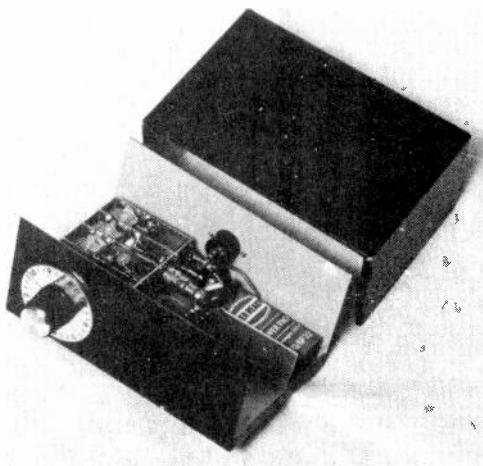
A56/120X 22" only.....	£28.00
A66/120X 26" only.....	£31.00
A67/120X 26" only.....	£31.00
A51/110 20" only.....	£28.00

ALL PRICES PLUS VAT. OLD GLASS RETURNABLE. PERSONAL CALLERS WELCOME

**RITEL**

THE MILL,  
PEACOCK CROSS  
INDUSTRIAL ESTATE,  
32 BURNBANK ROAD,  
HAMILTON.  
TEL: (0698) 282141.

## IDEAL FOR FEEDING INTO YOUR HI FI TELEVISION SOUND



**TV Sound Tuner Kit**  
£9.50 plus VAT plus 50 pence P.&P.

## SENDZ COMPONENTS

63 Bishopsteignton,  
Shoeburyness, Essex SS3 8AF.

## N.G.T. COLOUR TUBES

First Independent Rebuilder with

### B.S.I. CERTIFICATION

(Certificate No. 004)

2 year guarantee: 4 year option

All Colour Tubes are debanded, high temperature pumped and rebanded using new adhesives and new tension band.

19" £30, 20" £32, 22" £33, and 26" £38.

Exchange prices: add VAT at 15%

**N.G.T. ELECTRONICS LTD.,**  
120, SELHURST ROAD, LONDON S.E.25

Phone: 01-771 3535.

20 years experience in television tube rebuilding.

EMO - EUROSONIC - GRUNDIG - TELETON + ALL BRITISH MAKES  
ETC., ETC. • ALL SPARES READILY AVAILABLE •

## IMMEDIATE CREDIT AVAILABLE—TRADE ONLY

Almost any TV Component supplied by return "off the shelf" e.g. LOPTX -  
EHT trays - droppers - OSC coils - switches - cans - smoothers - I.C.'s, etc., etc.

**YOU CAN BE 95% SURE WE CAN SUPPLY ANY  
TV COMPONENT BY RETURN  
IF YOU NEED SPARES FAST - RING NOW!**

ACCESS AND BARCLAYCARD ACCEPTED.

S.A.E. FOR FREE WALL CHART

**TELEPART (WTON)** THE TELECENTRE, WORCESTER ST.,  
WOLVERHAMPTON (0902) 773122

## TELEVISION TUBE SHOP

### NEW TUBES AT CUT PRICES

#### EUROPEAN TYPE Nos.

Price £ VAT £

	15%
A28-14W .....	21.95
A31-19W/20W .....	19.95
A31-120W/300W .....	17.95
A31-410W/510W .....	17.95
A34-100W/510W .....	18.50
A38-160W/170W .....	17.50
A44-120W .....	27.00
A50-120W .....	17.95
A59-23W .....	21.50
A61-120W .....	19.95

#### U.S.A./JAP. TYPE Nos.

9AGP4 .....	21.82	3.27
190AB4/C4 .....	23.00	3.45
230ADB4 .....	28.50	4.28
230DB4/CT468 .....	26.60	3.99
240AB4A .....	17.95	2.69
CT507 equiv .....	21.95	3.29
CT512 .....	27.50	4.12
310DGB4/DMB4 .....	23.00	3.45
310EUB4 .....	19.95	2.99
310EYB4 .....	18.75	2.81
310FDB4 .....	27.50	4.13
310FXB4 .....	17.50	2.62
310GNB4A .....	27.50	4.13
310HCB4 .....	27.50	4.13
340AB4 .....	22.50	3.38
340AYB4 .....	30.00	4.50
340RB4/CB4 .....	26.00	3.90
340AHB4 .....	26.00	3.90

Some Rebuilt Japanese & European Types Available from £14.00 + VAT £2.10

#### COLOUR TUBES

New and Mullard Colourex\*

12VARP22 .....	62.50	9.37
330AB22 .....	73.50	11.03
A44-271X .....	60.00	9.00
A47-342X .....	63.00	9.45
A47-343X .....	63.00	9.45
A49-191X .....	53.00	7.95
A51-161X .....	67.00	10.05
A51-220X .....	64.00	9.60
A56-120X .....	54.00	8.10
A63-120X .....	69.50	10.42
A66-120X .....	65.00	9.75
A66-140X/410X .....	70.50	10.57
A67-120X .....	65.00	9.75
A67-140X/200X .....	69.50	10.42
A67-150X .....	75.00	11.25

\*Old Bulb Required for Colourex\*

ALL TUBES TESTED BEFORE DESPATCH & GUARANTEED FOR 12 MONTHS. 4 YEAR GUARANTEES AVAILABLE ON MOST TYPES

#### CARRIAGE

Mono £3.00 Colour £10.00  
Mainland only. Overseas Rates on Application.

## TELEVISION TUBE SHOP LTD.

52 BATTERSEA BRIDGE RD.,  
LONDON, SW11.

Tel. 228 6859/223 5088

# SMALL ADS

The prepaid rate for classified advertisements is 25p per word (minimum 12 words), box number 60p extra. Semi-display setting £4.80 per single column centimetre (minimum 2.5 cms). All cheques, postal orders etc., to be made payable to Television, and crossed "Lloyds Bank Ltd". Treasury notes should always be sent registered post. Advertisements, together with remittance, should be sent to the Classified Advertisement Manager, Television, Room 2337, IPC Magazines Limited, King's Reach Tower, Stamford St., London, SE1 9LS. (Telephone 01-261 5846).

## NOTICE TO READERS

Whilst prices of goods shown in classified advertisements are correct at the time of closing for press, readers are advised to check with the advertiser to check both prices and availability of goods before ordering from non-current issues of the magazine.

### SETS & COMPONENTS

#### COLOUR TUBES

P.I.L. 20 AX C.R.T.S.  
BRAND NEW MULLARD

26" £85.00  
22" £75.00

Deflection Yokes £5.00  
Lopt. £5.00

Inc. VAT P.P. £5 per tube  
Cash with order.

TRADE ENQUIRIES WELCOME

**ARGUS APPLICATIONS LTD**  
65 MARINE PARADE, BRIGHTON  
Tel. 0273 682086 or 681608 (24 hours)

#### TV DX.

High Quality, proven equipment supplied by an expert in the TV DX field.

**UHF Mosfet preamplifier.** This is a tunable amplifier (set side) which has very low cross modulation/noise figures. Mains powered.

£25.95

**Upconverter.** This is an ideal way to view the upcoming sporadic E signals on a UHF only TV. A tuned RF stage ensures low conversion noise and cross modulation. £10.30

**Band I/II tunable Mosfet preamplifier.** 25dB gain. Very low noise/cross modulation figure. £25.95.

**Philips G8 selectivity modules.** One or two of these placed between the tuner and IF strip of your TV gives reduced bandwidth essential for serious DX work. £1.50.

**FM DX!** 88-108MHz tunable Mosfet preamplifier. Reduces local signal overload. Mains powered. £25.95.

**TV DX receivers** available. Please send s.a.e. for my product list to:

**H. COCKS,**

Cripps Corner,  
Robertsbridge, Sussex TN32 5RY.  
Phone 0580 83317.

The above prices include post/packing. Overseas enquiries welcome (2.I.R.C.s). Callers welcome. Please telephone first.

## STS

FOR  
QUALITY  
USED T.V.s

200 EX RENTAL  
COLOUR AND MONO TVs  
ARRIVING WEEKLY  
GOOD CLEAN CABINETS

Bush ★ Decca ★ GEC

Pye ★ Philips ★ Thorn

Grundig ★ Sanyo ★ ITT Etc

TROLLEY STANDS AND  
ALL SIZE REGUN TUBES.

#### DELIVERY IF REQUIRED

Call or phone now to:

**SOUTHERN TRADE SERVICES**  
21 COLINDALE AVE.,  
LONDON NW9  
TEL 01-200-7337.

## QUALITY REBUILT TUBES

#### HIGH TEMPERATURE PUMPING

COLOUR (2 year Guarantee)

90° up to 19"	£32
90° 20" - 22"	£34
90° 25" - 26"	£36
110° and PIL	£38

MONO (including thin necks) from £12.

All prices + VAT

Delivery UK Mainland £6.

4 year Optional Guarantee

Send or phone for full list and terms.

**WELTECH PICTURE TUBES**  
Unit 3-10 Wembley Commercial Centre,  
East Lane, Wembley, Middx.  
01-908-1816

## WERNETH

ELECTRONICS

LIMITED

FREEPOST.

P.O. BOX 9, MARPLE, STOCKPORT, CHESHIRE. SK6 6YE.

WERNETH ELECTRONIC PRODUCTS · WINNINGTON RD · MARPLE · STOCKPORT · CHESHIRE.

#### TUBE TEST INSTRUMENTS

TX80 PROFESSIONAL £48.85

TX50 LOW COST SERVICE TESTER £29.50

TX50 COMPLETE KIT OF PARTS £21.00

#### IN-CIRCUIT TRANSISTOR TESTER £15.60

C.W.O. / S.A.E. for product details.



**PHILIPS**  
VIDEO  
CONVERSIONS  
HOUR DUAL SPEED  
RECORDING  
FROM N1700 - 02 VIDEOS

EXCELLENT PICTURE QUALITY  
USES EXISTING TAPES SEE DEMONSTRATION  
VIDEO/AUDIO INPUT FACILITIES £65 inc  
N1500-01-02 LP CONVERSIONS FROM £105  
LVC150's £15 EACH - TAPES REPAIRED

EVANS VIDEO SERVICES

061  
439 8696

## LOOK!

#### THORN 3000/3500 & 9000 TRIPLEXES

High Quality Silicon Replacement Units

T3500 only £4.95 inc. P.P. Add 74p V.A.T.

T9000 only £5.45 inc. P.P. Add 82p V.A.T.

Quotes for 50+.

1 Year Guarantee

**WING ELECTRONICS**

15, Waylands, off Tudor Road, Hayes End,  
Middlesex.

TV-DX Aerials for Bands 1,2,3, UHF, amplifiers and filters (all bands), wideband up-converters (VHF/UHF, no tuning needed), hardware, etc., South West Aerial Systems. The experienced specialists. Catalogue 45p from 10 Old Boundary Road, Shaftesbury, Dorset, SP7 8ND. Tel. (0747)-4370.

# SUFFOLK TUBES LIMITED

214 Purley Way, Croydon, Surrey.  
Tel: 01-686 7951/2/3/4

SUPPLIERS OF MONO AND COLOUR TUBES TO MAJOR RENTAL COMPANIES.

ALL COLOUR TUBES HOT PUMPED AT 385°C AND REBANDED TO BRITISH STANDARD. 415 1972 CLAUSE 18-2.

19" and 22" TUBES APPROVED. OTHER TYPES PENDING.

BRITAIN'S LARGEST INDEPENDENT REBUILDER FOR 21 YEARS.

#### CAMPBELL ELECTRONICS LTD.

Distributors of specialist spares to radio and television service depts.

We stock semiconductors, I/Cs, special T.V. and audio spares, service aids, rebuilt CRTs etc.

Fast off the shelf delivery of stock items.  
Send S.A.E. or telephone for full catalogue and price list.

#### CAMPBELL ELECTRONICS LTD.

Unit 5, Heath Hill Estate,  
Dawley, Telford, Shropshire.  
Telephone Telford (0952) 502422.

# TELEVISION

**R**WE HAVE TELLIES (HEAP BIG PILE). YOU HAVE CASH, WE WANT CASH, YOU GIVE US CASH, WE GIVE YOU TELLIES (HEAP CHEAP). CALL & SEE **BIG CHIEFS** IN THEIR WIGWAM AT UNION ST., THEY DO YOU GOOD DEAL ON SPOT.

(PS. DON'T FORGET THE CASH)

## GENERAL FACTORS

OPEN MON to SAT

GOOD MOTORWAY ACCESS  
EXPORT ENQUIRIES

UNION ST, DONCASTER DN1 3AE  
TELEPHONE (0302) 49583-68416

## COLOUR T.V.s

### PHILIPS G8 COMPLETE

22" £55 26" £65

DISCOUNT FOR  
BULK BUYERS

TEL: 965 1230 & 961 3997

SMITH

ELECTRONICS

43-43A, PARK PARADE,  
HARLESDEN,  
LONDON N.W.10.

EXCELLENT QUALITY  
USED COLOUR TV's  
CHOOSE UNTESTED  
OR FIRST CLASS  
WORKERS ENGINEERED  
IN OUR WORKSHOP.

**TELFURB T.V. LTD.**  
WHEATLEY  
08677 3849

TURN YOUR SURPLUS capacitors, transistors, etc.  
into cash. Contact Coles-Harding & Co., 103 South  
Brink, Wisbech, Cambs. 0945 4188. Immediate  
settlement.

## ★ TELEBEST ★

Good quality sets always available,  
working - non working.

98 \* 3500 \* 8500 \* Grundig etc.

Discount on quantity.

841 Romford Road,  
Manor Park,  
London E.12  
Tel: 01-514 7333.

## COLOUR SETS WANTED

SONY - HITACHI - TOSHIBA - MITSUBISHI

All sets must be under four years old

### TOP PRICES PAID

THESE SETS ARE FOR EXPORT

**REPLY TO:  
BOX NO. 160**

## T.V.s FOR EXPORT

We have a selection of Bush and Ferguson colour T.V.s in good working order.

VHF/UHF suitable for countries using PAL system. We also supply The Home Market.

Write:  
Tele Spares Ltd.,  
7 Walkinstown Road,  
Dublin 12, Ireland.  
Tel: Dublin 520485.

When replying to Television Classified Advertisements please ensure:

- (A) That you have clearly stated your requirements.
- (B) That you have enclosed the right remittance.
- (C) That your name and address is written in block capitals, and
- (D) That your letter is correctly addressed to the advertiser.

This will assist advertisers in processing and despatching orders with the minimum of delay.

**CAMPBELL ELECTRONICS LTD.**  
COLOUR T.V. PANEL EXCHANGE/  
REPAIR SERVICE

THORN, RANK, PHILIPS, GEC,  
DECCA, TELPRO, GRUNDIG etc.  
90 Day Guarantee on all repairs - same  
day postal service.

Telephone Telford (0952) 502422  
for catalogue and price list.

**CAMPBELL ELECTRONICS LTD.**,  
Unit 5, Heath Hill Estate,  
Dawley, Telford, Shropshire.

COLOUR TELEVISION PANELS. Ex-equipment complete. RBM, Thorn 2000, 3000, 3500, 8000. Pye, Gec, Philips, Decca hybrid. Colour tubes tested £8 to £15. SAE List. Camber T.V. Centre, Lydd Road, Camber, Sussex.

## VALVE BARGAINS

BOXED & TESTED 30p EACH

ECC82, EF85, EF183, EF184, PFL200, PCF80,  
PCF802, PCC84, PCC89, PC97, PC86, PC88,  
PCL84, PCL805, PCL86, PY800, PY88, PL36,  
PL504, 6F28, 30PL13, 30PL14.

COLOUR VALVES 65p EACH

PY500/A, PL508, PL509/519, PL802.

Postage & Packing 30p, no VAT

## VELCO ELECTRONICS

9 Mandeville Terrace, Hawkshaw, Via Bury, Lancs.

TRIANGLE TELEVISIONS COLERAINE. N.I.  
quality working sets. Clean. Cabinets Decca, Bush,  
Kirting Phone Coleraine 3600.

### PL 802 REPLACEMENTS

PL 802T solid state valve	£2.30
PL 802 The original valve	£2.50
<b>MAINS DROPPER RESISTORS</b>	
Philips G8: 2R2 + 68R	45p
Philips 210: 118 + 148 + link	57p
Thorn 1500: 350 + 20 + 148 + 1500 + 317	86p
Thorn 3000/3500: 6 + 1 + 100	68p
Thorn 8000: 56 + 1K + 47 + 12	85p
Thorn 8500: 50 + 40 + 1K5	90p
GEC 2018: 10 + 15 + 19 + 70 + 188	85p
RRI A640/TV161: 250 + 14 + 156	67p
VAT inclusive. Add 25p P&P for orders below £5.00	
ACORD ELECTRONICS LTD., 45 Stoke Road, Guildford, GU1 4HT.	

### 20 AX & P.I.L. TUBE

Colour Tubes.....	from £25
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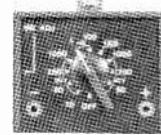
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TBA120SA	40p	BA182	7p	BSS68	20p	1 amp/400V
TBA120SB	40p	BA248	7p	BSX20	5p	1 amp/1600V
TBA120U	40p	BAV10	7p	BSY79	7p	3 amp/100V
TBA1441	£1.00	BAV103VHF	7p	BT100	30p	3 amp/300V
TBA396	£1.00	BB105UHF	7p	BT106	£1.00	3 amp/1200V
TBA480Q	£1.00	BC107	7p	BT106 special	50p	W04 bridge
TBA510	£1.00	BC108	7p	BT109	£1.00	W005 bridge
TBA520Q	£1.00	BC109	7p	BTF34	£1.00	ITT bridge 1½A C73
TBA530	£1.00	BC116	7p	BT116	£1.00	3 amp bridge
TBA540	£1.00	BC139	7p	BT119	£1.00	B30C 600A6
TBA550Q	£1.00	BC142	15p	BT138/10A	70p	B30C 500
TBA560CQ	£1.00	BC147C	7p	BT151/800R	70p	1 amp/100V
TBA560Q	£1.00	BC148B	7p	BTT822	£1.00	NKT279, AC128
TBA570	£1.00	BC149C	7p	BTT8224	£1.00	MC7724CP
TBA625	£1.00	BC154	7p	BTY80	20p	Condensers
TBA641	£1.50	BC157	7p	BT146	25p	4000 Thorn Set Thick Films in Stock.
TBA651	80p	BC158	7p	BU105/04	£1.00	4700/25
TBA673	£1.00	BC171	7p	BU108	£1.00	10p
TBA720A	£1.00	BC171B	7p	BU124	50p	5p
TBA750Q	£1.00	BC173	7p	BU126	£1.00	220/40
TBA800	40p	BC173C	7p	BU137	60p	1500/40
TBA810S	£1.00	BC174	7p	BU204	40p	1250/50
TBA820	£1 each	BC182L	7p	BU205	£1.00	220/63
TBA890	£1.00	BC183	7p	BU208	60p	10p
TBA920	£1.00	BC183LB	7p	BU208A	£1.00	1000/63
TBA920Q	£1.00	BC207	7p	BU208/02	a1.00	35p
TBA950	£1.00	BC212LT	7p	BU326	60p	800/250
TBA950Q	£1.00	BC213LA	7p	BU407	50p	30p
TBA990Q	£1.00	BC237B	7p	BU500	£1.00	4/350
TCA270	£1.00	BC238	7p	CA270	50p	8p
TCA270Q	£1.00	BC238A	7p	CA270EW	50p	U322 V/Cap T/Unit U.H.F. £6.00
TCA270SQ	£1.00	BC238C	7p	E1222	20p	47M/250V 10p
TCA4500A	£1.00	BC245	7p	R2008B	£1.00	680M/40V 10p
TCA640	£1.00	BC250	7p	R2010B	£1.00	8M/300V 5p
TCA650	£1.00	BC251A	7p	R2603	50p	9000 Thorn Line O/P Transistors with Heatsink T903 8V £1.00
TCA660	£1.00	BC252C	7p	RCA16573	30p	SW150 Surface Acoustic Wave Colour T.V. Filters £1.00 each
TCA740	£1.00	BC257	30p	OA90	7p	8 mixed gun switches £1.00
TCA800	£1.00	BC300	30p	OT112	£1.00	Reg. Office Only. Callers by appointment only.
TCA830S	£1.00	BC303	30p	MJE517 NPN 300V 4A	25p	Add 15% VAT and 50p P. & P. All items subject to availability.
TCE82	30p	BC307	7p	MJE2955/15A	50p	Add postage for all overseas parcels.
TCE120CQ	£1.00	BC308B	7p	MJE2955/15A	25p	
TCE157	20p	BC327	7p	MJE1661	25p	
TCE527	20p	BC336	20p	MJE2801	30p	
TCEP100	£1.20	BC337	7p	BY127	10p	
TDA1170	£1.20	BC350	20p	BY133	10p	
TDA1190Z	£1.20	BC365	10p	BY176 type	25p	
TDA1327	£1.00	BC413C	7p	BY176	50p	
TDA1412	50p	BC454	7p	BY179	35p	
TDA2540	£1.00	BC455	7p	BY184	25p	
TDA2002	£1.00	BC460	20p	BY187/01	10p	
TDA2640	£1.00	BC462	7p	BY190	40p	
TDA2680	£1.00	BC463	7p	BY204/4	7p	
TDA2690	£1.00	BC546	7p	BY206	10p	
TDA3960		BC559	7p	BY210/400	7p	
SN1682AN	£1.00	BD124	£1.50	BY210/800	10p	
SN16964AN	50p	BD131	30p	BY233 5A/1500V	25p	
SN29764	£1.00	BD132	30p	BY226	10p	
SN29848	50p	BD136	10p	BY296	10p	
SN75108AN	£1.00	BD207	30p	BY298	12p	
SN76001	£1.00	BD221	20p	BY299	10p	
SN76003	£1.00	BD228	25p	BYF3123 wire end	50p	
SN76003*	£1.50	BD238	20p	BYF3126 wire end	50p	
SN76008KE	£1.00	BD239	12p	BYF3214 20Kv	50p	
SN76013*	£1.50	BD331	25p	BYX36/600	10p	
SN76018KE	£1.00	BD332	25p	BYX38/600	50p	
SN76023*	£1.50	BD253B	35p	BYX55/350	10p	
SN76033	£1.00	BD416	25p	BY225 4.8 amps	10p	
SN76115*	£1.50	BD561/2 pair	30p	BYX38/300	25p	
SN76131	50p	BD595	35p	BXY71/350	25p	
SN76226	£1.00	BD596	35p	2N390	7p	
SN76227	50p	BD681	25p	2N2222	7p	
Tuner Units Varicap and Mechanical repaired. Please ask for estimate.		BD807 10/a/70V	20p	2N3055	35p	
		BD534	25p	2N3566	7p	
		NPN 9 watt	25p	2N4355	7p	

**SENDZ  
COMPONENTS**  
63 BISHOPSTEIGNTON,  
SHOEBOURNESS,  
ESSEX, SS3 8AF