JUNE 1979

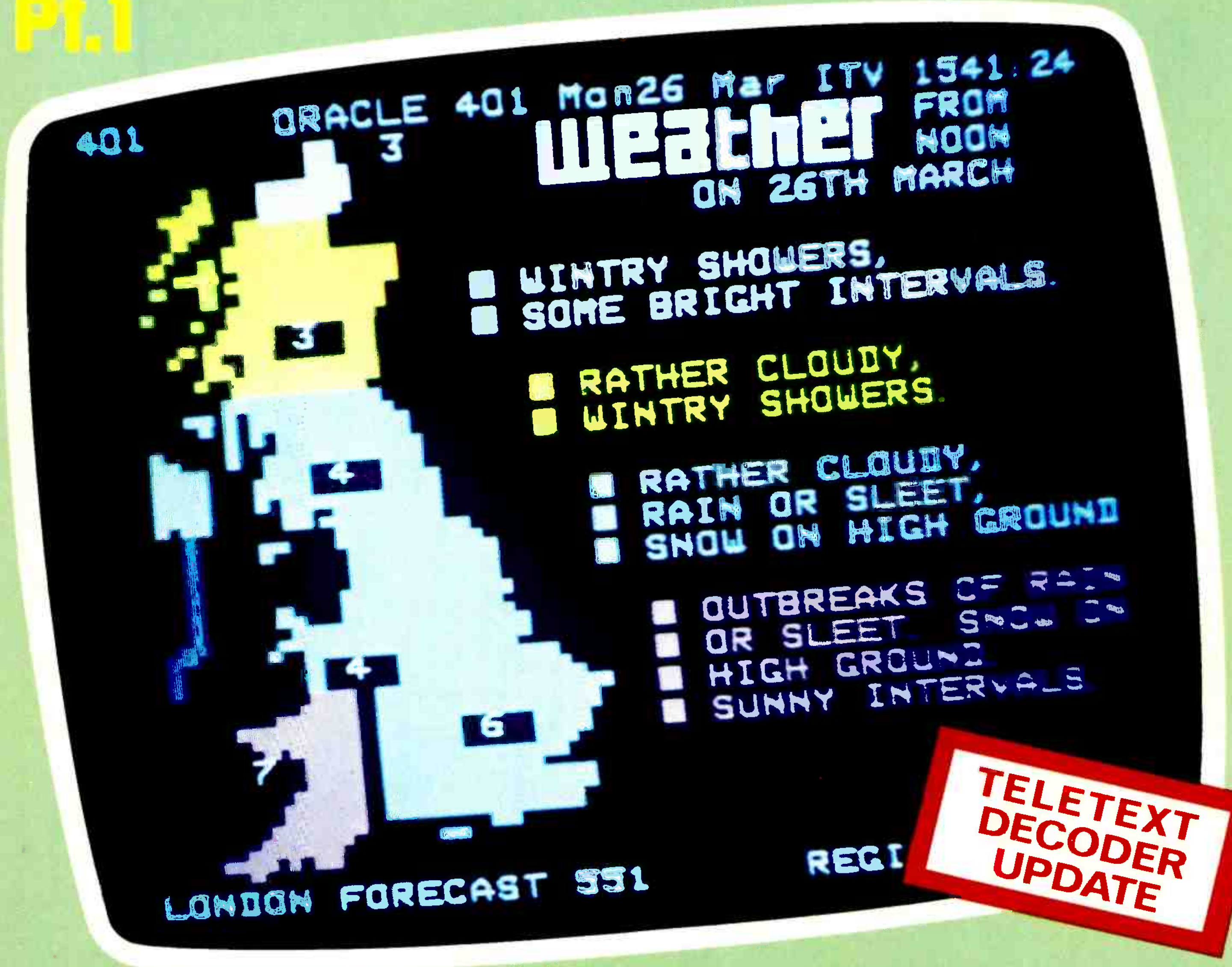
Australia 95c; Malaysia $2.75; New Zealand 95c

55p

TELEVISION

SERVICING·VIDEO·CONSTRUCTION·DEVELOPMENTS

TELETEXT in COLOUR Pt.1



TELETEXT DECODER UPDATE

RENOVATING KÖRTING HYBRID CTVs

UPDATING WITH SOLID-STATE UNITS

PHD COMPONENTS

RADIO & TV COMPONENT DISTRIBUTORS

UNIT 7 CENTENARY ESTATE
JEFFRIES RD ENFIELD MIDDX
MAIL ORDER ONLY TELEX 261295

ALL COMPONENTS OFFERED SUBJECT TO AVAILABILITY. WE RESERVE THE RIGHT TO SUBSTITUTE REPLACEMENTS SHOULD THE ORIGINAL PART BE OUT OF STOCK OR UNAVAILABLE!

PLEASE ADD 0.35p per parcel post and packing.

SEMICONDUCTORS

AA113	0.16
AA116	0.16
AA117	0.16
AA119	0.16
OA91	0.12
OA95	0.12
OA202	0.18
BA100	0.18
BA102	0.10
BA130	0.15
BA154	0.10
BA155	0.20
BA164	0.12
BAX13	0.16
BAX16	0.08
BAY38	0.16
BY206	0.20
IN4148	0.04
BY126	0.20
BY127	0.15
BY133	0.22
BY164	0.50
SKB2/08	1.00
BY238	0.15
BYX10	0.18
IN4001	0.10
IN4002	0.10
IN4003	0.12
IN4004	0.12
IN4005	0.12
IN4006	0.14
IN4007	o 16
IN5407	0.33
BR100	0.50
BR101	0.60
BRY39	0.60
TIC116ON	1.50
BT119	2.50
BT120	2.50
BYX.71/600	0.80
2N444	1.50
TV106/2	1.50
BYX88C2V7	0.10
BZY88 3V0	0.10
BZY88 3V3	0.10
BZY88 3V6	0.10
BZY88 3V9	0.10
BZY88 4V3	0.10
BZY88 4V7	0.10
BZY88 5V1	0.10
BZY88 5V6	0.10
BZY88 6V2	0.10
BZY88 6V8	0.10
BZY88 7V5	0.10
BZY88 8V2	0.10
BZY88 9V1	0.10
BZY88 10V	0.10
BZY88 11V	0.10
BZY88 12V	0.10
BZY88 13V	0.10
BZY88 15V	0.10
BZY88 18V	0.10
BZY88 20V	0.10
BZY88 22V	0.10
BZY88 27V	0.10
BZY88 33V	0.10
BZX61 7V5	0.25
BZX61 8V2	0.25
BZX61 9V1	0.25
BZX61 10V	0.25
BZX61 11V	0.25
BZX61 12V	0.25
BZX61 13V	0.25
BZX61 15V	0.25
BZX61 16V	0.25
BZX61 18V	0.25
BZX61 20V	0.25
BZX61 22V	0.25
BZX61 24V	0.25
BZX61 27V	0.25
BZX61 30V	0.25
BZX61 33V	0.25
BZX61 36V	0.25
BZX61 39V	0.25
BZX61 47V	0.25
BZX61 72V	0.25
AC107	0.35
AC127	0.50
AC127/01	0.60
AC128	0.60
AC128/01	0.60
AC141	0.50
AC141K	0.60
AC142	0.40
AC142K	0.60
AC176	0.60
AC176/01	0.60
AC186	0.40
AC187	0.40
AC187K	0.60
AC188	0.40
AC188K	0.60
AD140	1.50
AD142	1.50
AD143	1.50
AD145	1.50
AD149	1.00
AD161/2	1.50
AD162	0.70
AD262	1.50
AF114	0.60
AF115	0.60
AF116	0.60
AF117	0.80
AF118	0.60
AF121	0.60
AF124	0.60
AF125	0.60
AF126	0.60
AF127	0.60
AF139	0.60
AF239	1.00
AL102	3.00
AU107	3.00
AU110	3.00
AU113	3.00
AL103	3.00
AY102	3.00
BC107	0.20
BC108	0.20
BC109	0.20
BC113	0.15
BC114	0.15
BC115	0.20
BC116	0.20
BC117	0.20
BC118	0.20
BC119	0.50
BC125	0.20
BC126	0.20
BC136	0.20
BC137	0.20
BC138	0.40
BC139	0.40
BC140	0.40
BC142	0.40
BC143	0.40
BC147	0.15
BC148	0.10
BC149	0.15
BC153	0.15
BC154	0.15
BC157	0.15
BC158	0.15
BC159	0.15
BC160	0.40
BC161	0.40
BC170	0.15
BC171	0.15
BC172	0.20
BC177	0.20
BC178	0.20
BC179	0.20
BC182L	0.15
BC183L	0.15
BC184L	0.15
BC184LC	0.20
BC186	0.30
BC187	0.30
BC203	0.15
BC204	0.15
BC205	0.15
BC206	0.15
BC207	0.15
BC208	0.15
BC209	0.15
BC212L	0.15
BC213L	0.15
BC214L	0.15
BC225	0.40
BC237	0.15
BC238	0.15
BC251A	0.15
BC301	0.40
BC303	0.50
BC307	0.15
BC308	0.15
BC327	0.15
BC328	0.15
BC337	0.15
BC338	0.15
BC547	0.15
BC141 10	0.80
BD115	0.50
BD124	2.00
BD131	0.70
BD132	0.60
BD133	0.70
BD134	0.70
BD144	2.50
BD159	0.80
BD238	0.50
BD380	0.70
BD441	0.70
BD537	0.70
BD538	0.70
BD507	0.70
BD508	0.75
16181	1.20
16182	1.20
BD709	1.00
BD710	1.00
BD442	0.70
BD379	0.50
BF115	0.60
BF118	0.60
BF152	0.40
BF154	0.20
BF157	0.70
BF158	0.40
BF160	0.60
BF163	0.60
BF167	0.50
BF173	0.50
BF177	0.50
BF179	0.50
BF180	0.50
BF181	0.60
BF182	0.50
BF183	0.50
BF184	0.50
BF185	0.50
BF194	0.15
BF195	0.15
BF196	0.15
BF197	0.15
BF198	0.15
BF199	0.15
BF200	0.15
BF224	0.15
BF240	0.15
BF241	0.15
BF256LC	0.50
BF257	0.50
BF258	0.50
BF271	0.60
BF273	0.20
BF274	0.25
BF336	0.50
BF337	0.50
BF338	0.50
BF355	0.80
BF458	1.00
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BFT43	0.50
BFX29	0.50
BFX84	0.50
BFX88	0.50
BFX89	0.50
BFY50	0.50
BFY51	0.50
BFY52	0.50
BFY90	1.20
BF381	0.50
BFR39	0.30
BFR79	0.30
BFR81	0.30
BFR89	0.50
BF259	0.25
BDX32	2.50
BU206	1.60
BU208/02	3.00
BU326S	1.50
BU406	2.00
BU406D	2.50
BU407	2.00
BU407D	2.50
R2008B	2.50
R2010B	2.50
R2540	3.00
ME0402	0.20
ME0412	0.20
ME4003	0.15
ME6002	0.20
ME8001	0.20
MJE2955	1.50
MJE3005	1.30
MP8113	1.00
MPSU05	1.20
MPSU55	1.20
TIP2955	1.30
TIP3055	1.30
TIS90M	0.60
TIS91M	
2N2904	0.50
2N2905A	0.50
2N2905	0.50
2N3053	0.50
2N3703	0.20
2N3705	0.20
2N3710	0.20
2N3055H	0.75
TAA350	0.80
TAA550	0.60
TAA570	1.80
TAA611	1.75
TAA630S	2.50
TAA661B	2.00
SN76540N	1.50
TAD100	2.00
TBA120AS	0.75
TBA231	1.20
TBA480Q	2.20
TBA520Q	2.00
TBA530	2.00
TBA530Q	2.00
TBA540	2.20
TBA540Q	2.20
TBA550	3.00
TBA550Q	3.00
TBA560C	2.20
TBA560CQ	2.20
TBA570	2.50
TBA570Q	2.50
TBA641BX	3.00
TBA641B11	4.00
TBA651	3.00
TBA720A	1.50
TBA730	1.50
TBA750	2.00
TBA750Q	2.00
TBA800	1.00
TBA810S	1.50
TBA820	1.50
TBA920	2.00
TBA920Q	2.00
TBA990	2.00
TBA990Q	2.00
TCA270SA	3.00
TCA900	1.00
TCA940	2.00
TDA1170	2.00
TDA1200	3.00
TDA1270	4.00
TDA1412	1.00
TDA2020	4.00
SN76115N	2.00
SN76227N	1.20
SN76530P	1.00
SN76651N	1.50
SN76003N	3.00
SN76013N	2.00
SN76013NO	2.00
SN76013ND	2.00
SN76023N	2.00
SN76023ND	1.00
SN76033N	2.00
SN76110N	2.00
SN76226DN	2.00
SN76227N	1.20
SN76532N	2.00
SN76533N	2.00
SN76544N	2.00
SN766504	1.00
SN76665N	1.50
SN76666N	1.20
SL901B	6.00
SL917B	8.00
TBA396Q	2.00
TDA440	2.50
SN76001N	1.50
TBA520	2.00
TBA120S	1.00
UA7824	0.50
TBA396	2.00
TCA270SO	2.00
TDA2030	8.00
TDA2140	6.00
TDA2150	6.00
TDA2160	6.00
TDA1230	3.00
TDA3089	2.00
TDA1054M	2.00
MC1349P	1.50
SAA661	0.60
SAS560S	2.00
SAS570S	2.00
SN7400N	0.40
SN7413N	0.90
SN74122N	1.00
SN74141N	1.00
TBA395	1.80
TBA395Q	1.80
TBA950	4.00
TCA800	4.00
TCA800Q	4.00
TDA1180	3.00
TDA1190	3.30
TDA2002H	3.60
TDA2590Q	5.00
TDA2600	5.00
TDA2640	3.30
TDA3950	3.00
TAA621 AX1	3.30
TBA625X5	2.00
TCA830S	2.00
TDA2020/A2	5.00
TDA2020P	5.00
TDA2030V	3.60
TDA2010/BD2	4.50
TDA2002V	5.00
TCA940E	3.00

VALVES — ALL VALVES 'MAZDA' BRAND

DY86/87	1.20
DY802	1.20
ECC82	1.10
ECC84	1.35
ECH83	1.00
ECH84	2.00
ECL80	1.50
ECL82	1.30
ECL86	1.50
EF80	1.20
EF95	0.70
EF183	1.10
EF184	1.10
EL34	3.00
EL84	1.40
GY501	2.40
PC97	1.60
PC900	1.75
PCF80	1.50
PCF802	1.50
PCF806	2.50
PCL 82	1.50
PCL84	1.50
PCL85/805	1.50
PCL86	1.50
PD500/510	5.00
PFL200	3.00
PL36	2.00
PL81	1.00
PL504	1.60
PL508	2.40
PL509	3.50
PL519	5.00
PL802	3.20
PY88	1.80
PY500A	2.40
PY800/801	1.40
UCL82	1.50
30FL2 1	1.60
PCF805	1.00
PCF808	1.50

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173 Tuner (Repl Elc 1043/05)	8.00
4 443MHZ Crystals	2.00
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Cut Out GEC	2.50
Cut Out TCE 8500	2.00
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PYE 691/697 Lopt	14.00
Bush A 774 Lopt	18.00
Decoder Panel Autovox 2282	10.00
Degaussing Panel Autovox 2282	2.00
Sound O/P Panel Autovox 2282	4.00
PS Panel Autovox 2282	6.00
Comp Control Unit Autovox 2282	3.00
Field TB Panel Autovox 2282	5.00
IF Tuner Assembly Autovox 2282	7.50
TCE 850 Lopt	1.00
TCE 900 Half Wave	0.50
Delayline SDL 141	0.40
Pye 95 Tuner	1.50
GCE 2110 Degauss Panel	1.50

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TCE950/1400 Tripler	4.00
TCE1400 (Piped System Only)	4.00
TCE1500 Doubler	4.00
TCE1500 Tripler	4.50
TCE1600 1/2 Wave	3.00
DECCA CS 1730/1830 Doubler	4.00
DECCA CS 1910/2213 Tripler	6.50
DECCA 30 Series Tripler	6.50
DECCA 80 Series Tripler	6.50
DECCA 100 Series Tripler	6.50
GEC Hybrid 2028 Tripler	6.50
GEC 2110 Tripler PRE JAN77	7.00
GEC 2110 Tripler Post JAN77	6.50
ITT CVC 5/8/9 Tripler	6.50
ITT CVC 20/25/30	6.50
Phillips 520 Tripler	6.50
Phillips 550 Tripler	6.50
Phillips G9 Tripler	6.50
PYE 691/693/697 Tripler	5.50
PYE 731/725 Tripler	6.50
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RRI 2179/823	6.50
TCE 3000/3500 Tripler	7.00
TCE 4000 Tripler	8.00
TCE 8000 Doubler	3.00
TCE 8500 Tripler	6.00
TCE 9000 Tripler	7.00
TVK 76/13 Continental Sets	5.00
TVK 52 ITT Replacement	6.50
Korting 90% Tripler	6.50
Autovox Tripler	6.50
Rediffusion MK 1 Tripler	8.00
RRI TV 25 Quadrupler	8.00
Tripler Mounting Kit	1.50
RRI T20	6.50

PHD COMPONENTS

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DECCA 80/100 400/350 + 800/250	4.00
GEC 200-200-150-50/350	3.00
GEC 1000 2000/35	1.10
GEC/Phillips G8 600/250	2.10
GEC/Phillips G8 600/300	2.50
ITT KB 200 200-75-25/350	3.00
ITT CVC 20 200/400	2.20
Phillips G11 470/250	1.90
PYE 691 200-300/350	2.80
PYE 1000-1000/40	0.90
PYE 731 800/250	2.50
RRI 2500 2500/30	1.30
RRI 600/300	2.50
RRI 300 + 300/300	2.50
TCE 950 100 300-100-16	1.00
TCE 1400 150-100 100 100 150	3.70
TCE 1500 150 150 100	2.10
TCE 3000/3500 175/400 + 100 + 100 350	2.70
TCE 3000/3500 600/70	1.00
TCE 3000/3500 220/100	0.70
TCE 8000/8500 2500/2500 63	1.50
TCE 8000/8500 700/200	1.00
TCE 8000/8500 400/350	1.00
TCE 9000 400/400	3.00
TCE 9500 220/400	2.20

MAINS DROPPERS

TCE 140 128 + 16, IK7 + 116 + 462, 126	1.10
TCE 1500 350 + 20, 148, IK5, 317	0.90
TCE 1600 18 Thermal Link 320 + 70, 39	1.00
TCE 300/3500 6, 1 + 100	0.60
TCE 800 56 + 1K, 47, 12	0.90
Phillips G8 2.2 + 68	0.60
Phillips G8 47	0.50
Phillips 210 30 + 125, 2K85	0.90
Phillips 210 118 + 148 (Link)	0.60
RRI 141 154 + 50 + 16, 94	0.60
RRI A640 250 + 14 + 156	0.80
GEC 27840 10 + 15 + 19 + 10 + 63 + 188	1.00
GEC 2000	0.80
PYE 731, 735 56 + 27	1.00
PYE 11009 60 + 70 + 173 + 26 + 16 + 17 + 19	1.00

CONNECTORS

Sets of AVO Leads	10.00
Plug 13A (Box of 20)	6.50
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Plug Top 3A (Box of 20)	6.50
6DB Attenuator	0.90
12DB Attenuator	0.90
18DB Attenuator	0.90

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Super Servisol	0.75
Foam Cleanser	0.75
Silicone Grease	0.75
Plastic Seal	0.75
Aeroklene	0.75
Freezit	0.75
Antistatic	0.75
Solder 18 SWG 60 40 0.5KGM	5.50
ORYX 50 TC Soldering Iron	8.90
ORYX 50 TC Iron 24V	9.50
Power Supply Type PSU 24 VAC	17.50
Sponge for PSU 24 VAC	0.18
Replacement Element for ORYX5	3.60
Safety Stand	3.50
Sponges for Stand	0.15
ORYX Super 30 Soldering Iron	3.50
Replacement Element for ORYX 3	2.50
LLSF 16 Iron Coated Longlife Tip	0.90
LLSF 24 Iron Coated Longlife Tip	0.90
LLSF 32 Iron Coated Longlife Tip	0.90
LLSF 48 Iron Coated Longlife Tip	0.90
LLSF 64 Iron Coated Longlife Tip	0.90
LLDF 08 Iron Coated Longlife Tip	0.90
LLDF 16 Iron Coated Longlife Tip	0.90
LLDF 24 Iron Coated Longlife Tip	0.90
LLDF 32 Iron Coated Longlife Tip	0.90
LLDF 48 Iron Coated Longlife Tip	0.90
LLDF 64 Iron Coated Longlife Tip	0.90
LLDF 24 Iron Coated Longlife Tip	1.15
Isotip Quick Charge	18.50
Repl Battery for Isotip	5.50
PC Drill Replacement	10.60
Replacement Drill	0.85
Protective Carrier	1.10
12V Auto Charger	4.50
Replacment Bulb	0.35
Micro Tip Q Charge	2.30
Fine Tip Q Charge	2.30
HD Tip Q Charge	2.30
Regular Tip Q Charge	2.30
Tuner Ext Tip for QC	2.75
SR2 Desoldering Tool	8.50
SR3AS Mini Silver	5.50
SR3A Mini Orange	5.95
Replacement Nozzles	0.65
Replacement Washers	0.17
Bench Vice Model 1B	22.00
Bench Vice and PCB Holder	33.00
PCB Holder Only	11.00
Solda Mop Red Std	0.48
Solda Mop Brown Light	0.48
Ersa Sprint	9.50
Low Voltage Soldering Station	9.95
Side Cutters	2.50
Hex Trim Tool	0.10
TVT 78 Transistor Equivalents Book	5.00

TELEVISION

June 1979

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CORRESPONDENCE
All correspondence regarding advertisements should be addressed to the Advertisement Manager, "Television", King's Reach Tower, Stamford Street, London SE1 9LS. Editorial correspondence should be addressed to "Television", IPC Magazines Ltd., Lavington House, Lavington Street, London SE1 0PF.

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this month

OUR NEXT ISSUE DATED JULY WILL BE PUBLISHED ON JUNE 18

TRANSISTORS, ETC.

Type	Price (£)	Type	Price (£)	Type	Price (£)	Type	Price (£)	Type	Price (£)	Type	Price (£)	Type	Price (£)	Type	Price (£)	Type	Price (£)	Type	Price (£)
AC107	0.48	AU103	2.40	BC192	0.56	BC377	0.29	BD234	0.68	BF222	†0.51	BPX29	1.62	MPSU05	0.66	ZTX500	†0.18	2N3819	†0.47
AC117	0.38	AU107	2.75	BC204*	†0.39	BC394	0.39	BD235	0.63	BF224 & J	†0.22	BR101	0.53	MPSU06	0.76	ZTX502	†0.22	2N3820	0.72
AC126	0.36	AU110	2.40	BC205*	†0.39	BC440	0.52	BD236	0.63	BF240	†0.32	BR103	0.64	MPSU55	1.26	ZTX504	†0.28	2N3866	1.08
AC127	0.54	AU113	2.60	BC206*	†0.37	BC441	0.59	BD237	0.68	BF241	†0.31	BR303	1.06	MPSU56	1.32	2N404	1.30	2N3904	†0.20
AC128	0.46	BC107*	0.16	BC207*	†0.39	BC461	0.78	BD238	0.68	BF244*	†0.51	BRC4443	1.76	MPSU60	0.82	2N696	0.46	2N3905	†0.20
AC128K	0.55	BC108*	0.15	BC208*	†0.37	BC477	0.30	BD253	1.58	BF245*	†0.43	BRY39	0.60	MPU131	†0.59	2N697	0.46	2N3906	†0.20
AC141	0.65	BC109*	0.16	BC209*	†0.39	BC478	0.25	BD410	1.65	BF254	†0.48	BRY56	†0.44	OC26	1.90	2N706A	0.33	2N4036	0.94
AC141K	0.70	BC113	†0.22	BC211*	†0.36	BC479	0.33	BD433	0.65	BF255	†0.58	BSS27	0.92	OC28	1.49	2N708	0.29	2N4123	†0.17
AC142	0.60	BC114	†0.22	BC212*	†0.17	BC547*	†0.13	BD435	0.70	BF256L*	†0.49	BT106	1.50	OC29	1.60	2N914	0.32	2N4124	†0.17
AC142K	0.65	BC115	†0.24	BC212L*	†0.17	BC548*	†0.13	BD436	0.71	BF257	†0.44	BT109	1.99	OC35	1.25	2N916	0.46	2N4126	†0.17
AC151	0.31	BC116*	†0.25	BC213*	†0.16	BC549*	†0.15	BD437	0.74	BF258	0.52	BT116	1.45	OC36	1.25	2N918	0.54	2N4236	2.20
AC152	0.36	BC117	†0.30	BC213L*	†0.16	BC550	†0.24	BD438	0.75	BF259	†0.54	BT119	5.18	OC42	0.90	2N930	0.29	2N4289	†0.32
AC153	0.42	BC118	†0.24	BC214*	†0.18	BC556	†0.23	BD519	0.88	BF262	0.73	BU102	2.85	OC44	0.68	2N1164	8.29	2N4292	†0.32
AC153K	0.52	BC119	†0.34	BC214L*	†0.18	BC557*	†0.16	BD520	0.88	BF263	0.88	BU105	†1.80	OC45	0.63	2N1304	1.40	2N4416	0.85
AC154	0.41	BC125*	†0.30	BC225	†0.42	BC558*	†0.16	BD599	0.87	BF270	0.47	BU105/02	†1.95	OC70	0.65	2N1305	1.29	2N4444	1.90
AC176	0.45	BC126	†0.30	BC237*	†0.16	BC559*	0.17	BD600	1.23	BF271	0.42	BU108	†2.98	OC71	0.73	2N1306	1.49	2N4921	0.80
AC178	0.51	BC132	†0.20	BC238*	†0.15	BCY10	0.30	BD663BR	0.86	BF272A	0.80	BU126	†2.91	OC72	0.73	2N1307	1.32	2N5042	1.65
AC179	0.55	BC134	†0.22	BC239*	†0.22	BCY30A	1.06	BDX18	1.55	BF273	†0.33	BU204	†2.50	OC81	0.83	2N1308	1.53	2N5060	†0.28
AC187	0.56	BC135	†0.21	BC251*	†0.25	BCY32A	1.19	BDX32	2.95	BF274	†0.34	BU205	†2.78	OC81D	0.95	2N1711	0.47	2N5061	†0.30
AC187K	0.65	BC136	†0.22	BC252*	†0.26	BCY34A	1.02	BDY16A	0.63	BF336	0.63	BU206	†3.09	OC139	1.30	2N1893	0.52	2N5064	0.63
AC188	0.52	BC137	†0.30	BC253*	†0.38	BCY72	0.27	BDY18	1.55	BF337	0.65	BU208	†4.88	OC140	1.35	2N2102	0.71	2N5086	†0.49
AC188K	0.61	BC138	†0.35	BC261A*	†0.28	BD115	1.35	BDY20	2.29	BF338	0.68	BU407	†1.38	OC170	0.80	2N2217	0.55	2N5087	†0.50
AC193K	0.70	BC140	0.36	BC262A*	†0.28	BD123	1.50	BDY38	1.38	BF355	†0.72	BUY77	2.50	OC171	0.82	2N2218	0.38	2N5208	†0.59
AC194K	0.74	BC141	0.44	BC263*	†0.26	BD124	1.85	BF115	0.48	BF362	†0.49	C106D	0.80	OC200	3.90	2N2219	0.42	2N5294	0.66
ACY17	1.20	BC142	0.35	BC267*	0.20	BD130Y	1.56	BF117	0.45	BF363	†0.49	C106F	0.43	OC201	3.95	2N2221A	0.26	2N5296	0.68
ACY19	0.95	BC143	0.38	BC268*	0.28	BD131	0.58	BF120	0.55	BF367	†0.29	C111E	†0.46	OC202	2.40	2N2222A	0.41	2N5298	0.71
ACY28	0.98	BC147*	†0.12	BC286	0.40	BD132	0.68	BF121	0.85	BF451	0.43	D40N1	0.64	OC205	3.95	2N2369A	0.40	2N5322	1.16
ACY39	2.02	BC148*	†0.12	BC287	0.49	BD133	0.70	BF123	0.48	BF457	0.46	E1222	0.47	OCP71	1.98	2N2401	0.80	2N5449	†0.18
AD140	1.79	BC149*	†0.13	BC291	0.27	BD135	†0.37	BF125	0.68	BF458	0.49	E5024	†0.19	ON236A	0.94	2N2484	0.35	2N5457	†0.46
AD142	1.90	BC152	†0.42	BC294	†0.37	BD136	†0.38	BF127	0.51	BF459	0.52	GETB72	0.46	R2008B	†2.92	2N2570	0.74	2N5458	†0.40
AD143	1.78	BC153	†0.38	BC297	0.36	BD137	0.40	BF137F	0.78	BF594	†0.16	MC140	†0.36	R2010B	†2.79	2N2646	0.82	2N5459	†0.58
AD149	1.92	BC154	†0.41	BC300	0.62	BD138	0.42	BF152	†0.19	BF596	†0.17	ME0402	†0.18	R2322	†0.75	2N2784	1.15	2N5494	0.85
AD161	0.66	BC157*	†0.13	BC301	0.38	BD139	0.46	BF158	†0.25	BF597	†0.27	MF0404/02	†0.18	R2323	†0.85	2N2869	2.08	2N5496	1.05
AD161/162	1.22	BC158*	†0.12	BC302	0.86	BD140	0.50	BF159	†0.27	BFR39	†0.30	ME6001	†0.18	ST2110	0.49	2N2894	0.45	2N6027	0.55
AD162	0.71	BC159*	†0.14	BC303	0.64	BD144	2.24	BF160	†0.20	BFR40	†0.29	ME6002	†0.18	ST6120	0.48	2N2904*	0.40	2N6107	0.71
AF114	0.35	BC160	0.52	BC304	0.44	BD145	0.75	BF161	0.84	BFR41	†0.30	MJ2955	1.30	TIC44	†0.25	2N2905*	0.39	2N6122	0.60
AF115	0.35	BC161	†0.58	BC307*	†0.17	BD150A*	†0.51	BF163	†0.65	BFR50	†0.29	MJ3000	1.58	TIC46	†0.35	2N2906*	0.36	2N6178	1.07
AF116	0.41	BC167B	†0.15	BC308*	†0.14	BD155	†0.90	BF164	†0.95	BFR52	†0.33	MJE340	0.68	TIC47	†0.45	2N2926G	†0.15	2N6180	1.39
AF117	0.42	BC168B	†0.14	BC309*	†0.18	BD157	0.51	BF166	0.50	BFR61	†0.29	MJE341	0.72	TIP29A	0.47	2N2926O	†0.14	2N6211	2.74
AF118	0.98	BC169C	†0.15	BC317*	†0.15	BD158	0.75	BF167	0.38	BFR62	†0.28	MJE370	0.74	TIP30A	0.50	2N2926Y	†0.14	2SB337BP	4.28
AF121	0.68	BC170*	†0.15	BC318*	†0.15	BD159	0.68	BF173	0.35	BFR79	†0.30	MJE371	0.79	TIP31A	0.51	2N2955	1.12	2SC458C	0.78
AF124	0.38	BC171*	†0.15	BC319*	†0.19	BD160	2.69	BF177	0.36	BFR80	†0.29	MJE520	0.85	TIP31C	0.67	2N3053	0.48	2SC643A	2.25
AF125	0.38	BC172*	†0.14	BC320	†0.17	BD163	0.67	BF178	0.46	BFR81	†0.30	MJE521	0.95	TIP32A	0.56	2N3054	0.86	2SC930D	1.50
AF126	0.36	BC173*	†0.22	BC321A&B	†0.18	BD165	0.66	BF179	0.58	BFR88	†0.42	MJE2955	1.20	TIP32C	0.72	2N3055	0.72	2SC1061	1.45
AF127	0.86	BC174A & B		BC322	†0.28	BD166	0.88	BF180	0.53	BFT41	0.48	MJE3000	1.95	TIP33A	0.77	2N3250	0.52	2SC1172Y	3.55
AF139	0.58		†0.26	BC323	1.15	BD175	0.90	BF181	0.53	BFT43	0.55	MJE3055	1.22	TIP34A	0.84	2N3254	0.58	2SD234	1.48
AF147	0.52	BC176	0.22	BC327	†0.16	BD177	0.58	BF182	0.44	BFW11	1.02	MPF102	†0.40	TIP41A	0.72	2N3391A	0.38	3N128	1.60
AF149	0.45	BC177*	0.20	BC328	†0.18	BD178	0.92	BF183	0.52	BFW30	2.58	MPS3702	†0.33	TIP42A	0.80	2N3633	12.70	40250	0.98
AF178	1.35	BC178*	0.22	BC337	†0.17	BD181	1.94	BF184	0.44	BFW59	†0.19	MPS3705	†0.30	TIP2955	0.77	2N3703	†0.17	40251	1.14
AF179	1.36	BC179*	0.28	BC338	†0.17	BD182	2.10	BF185	0.42	BFW60	†0.20	MPS6521	†0.36	TIP3055	0.58	2N3704	†0.19	40327	0.87
AF180	1.35	BC182*	†0.15	BC340	0.19	BD183	1.34	BF186	0.42	BFW90	†0.65	MPS6523	†0.36	TIS43	†0.44	2N3705	†0.17	40361	0.48
AF181	1.33	BC182L*	†0.15	BC347*	†0.17	BD184	2.30	BF194*	†0.14	BFX29	0.38	MPS6566	†0.44	TIS73	†1.36	2N3706	†0.16	40362	0.50
AF186	1.48	BC183*	†0.14	BC348A & B		BD187	1.20	BF195*	†0.13	BFX84	0.42	MPSA05	†0.30	TIS90	†0.23	2N3707	†0.18	40410	0.94
AF202	0.27	BC183L*	†0.14		†0.17	BD188	1.25	BF196	†0.14	BFY50	0.38	MPSA06	†0.32	TIS91	†0.28	2N3708	†0.17	40429	0.88
AF239	0.73	BC184*	†0.15	BC349B	†0.17	BD189	0.71	BF197	†0.15	BFY51	0.37	MPSA55	†0.43	ZTX108	†0.14	2N3715	1.70	40530	0.79
AF240	1.40	BC184L*	†0.15	BC350*	†0.24	BD222	0.91	BF198	†0.29	BFY52	0.36	MPSA56	†0.45	ZTX109	†0.16	2N3771	2.39	40595	1.39
AF279S	0.91	BC185	0.36	BC351*	†0.22	BD225	0.91	BF199	†0.29	BFY53	0.36	MPSA93	†0.56	ZTX213	†0.23	2N3772	2.58	40603	1.13
AL100	1.30	BC186	0.25	BC352A*	†0.24	BD232	0.91	BF200	†0.25	BFY90	1.98	MPSL01	†0.33	ZTX300	†0.16	2N3773	3.90	40636	1.25
AL103	1.58	BC187	0.27	BC360	0.59	BD233	0.62	BF218	†0.42	BPX25	1.62	MPSU01	0.61	ZTX304	†0.26	2N3794	†0.40	40654	0.89

Alternative gain versions available on items marked*.

For matched pairs add 20p per pair.

LINEAR IC's

Type	Price (£)	Type	Price (£)	Type	Price (£)
BRC1330	†0.93	SN76008KE	1.56	TBA240A	†3.98
CAB10QM	2.44	SN76013N	1.56	TBA281	†2.07
CA3005	1.85	SN76013ND	1.40	TBA395*	†2.58
CA3012	1.45	SN76018KE	1.56	TBA396	†2.40
CA3014	2.23	SN76023N	1.56	TBA400	†2.20
CA3018	0.71	SN76023ND	1.40	TBA480Q	†1.84
CA3020	1.89	SN76033N	2.22	TBA500*	†2.21
CA3028A	0.80	SN76110N	1.20	TBA510*	†2.21
CA3028B	1.09	SN76115N	†1.62	TBA520P*	†3.40
CA3045	3.75	SN76116N	1.78	TBA530P	†2.24
CA3046	0.70	SN76131N	†2.10	TBA540*	†2.88
CA3065	1.74	SN76226N	†2.60	TBA550*	†3.13
CA3068	1.90	SN70227N	†1.61	TBA560C*	†3.18
CA3130S	1.57	SN76228N	†1.80	TBA570*	†1.29
FCH161	†2.40	SN76502N	†1.92	TBA611B	2.68
FCJ101	†3.32	SN76530P	†0.97	TBA641	2.55
LM309K	1.98	SN76533N	†1.38	TBA641A12	2.35
LM380N-14	1.65	SN76544N	†1.85	TBA641B11	2.61
LM1303N	3.08	SN76546N	†1.85	TBA651	†2.12
MC1307P	†1.82	SN76570N	†1.81	TBA673	†2.19
MC1310P*	†1.94	SN76620AN		TBA700*	†2.50
MC1312P	2.34		†0.99	TBA720AQ	†2.38
MC1327P*	†1.86	SN76650N	†1.48	TBA720Q	†2.38
MC1330P	†0.93	SN76660N	†0.64	TBA750*	†2.18
MC1350P	†1.22	SN76666N	†0.96	TBA800	1.65
MC1351P	†1.42	TA7073P	†3.51	TBA810AS	1.69
MC1352P	†1.42	TAA263	†2.20	TBA920*	†3.80
MC1357P	†2.92	TAA300	†3.85	TBA940	†3.52
MC1358P*	†2.30	TAA320	1.10	TBA950	†2.78
MC1458G	1.43	TAA350A	†2.48	TBA990*	†2.90
MC1496L	1.15	TAA370A	3.18	TCA270A*	†3.55
MC3051P	0.58	TAA435	†1.70	TCA280A	1.43
MFC400B	0.85	TAA450	†3.39	TCA290A	3.46
MFC4060A	0.98	TAA521	1.10	TCA420A	1.98
MFC6040	1.11	TAA522	2.09	TCA440	1.67
MIC1P	2.58	TAA550	0.45	TCA640	2.76
ML231	†3.57	TAA560	1.93	TCA650	2.76
ML232	†3.57	TAA570	†2.30	TCA660	2.76
NE555	0.72	TAA611A	1.67	TCA730	3.54
NE556	1.34	TAA611B	1.89	TCA740	3.04
NE566	1.95	TAA621AX1	2.33	TCA750	2.53
SAA1024	†5.70	TAA630Q	3.91	TCA760	1.52
SAA1025	†10.35	TAA630S	4.18	TCA820	3.29
SAS560A	†2.[illegible]	TAA661A	2.[illegible]	TDA440	†4.16
SAS570	†2.01	TAA661B	1.75	TDA1003	1.52
SC9503P	†1.40	TAA700*	†2.80	TDA1004	2.73
SC9504P	†1.38	TAA840	†3.38	TDA1005	3.04
SL414A	1.91	TAA861A	0.95	TDA1022	6.89
SL432A	2.52	TAA930A	1.43	TDA1024	0.97
SL450	5.10	TAA930B	1.43	TDA1034	1.98
SL901B	†4.20	TAA960	†2.25	TDA2610	2.86
SL917B	†5.60	TAA970	†2.48	TDA2640	2.86
SL918A	†5.95	TAD100	†2.66	ZN414	1.45
SN72440N	†2.21	(Filter)	0.98		
SN76001N	†1.67	TBA120A	†0.90		
SN76003N	2.22	TBA120S*	†0.99		
		TBA120SA	†1.02		
		TBA231	1.1[illegible]		

* Indicates Q version is also available.

DIODES

Type	Price (£)	Type	Price (£)
AA113	0.17	BY114	0.60
AA119	0.21	BY118	1.10
AA129	0.28	BY126	0.20
AA143	0.18	BY127	0.21
AAY30	0.28	BY133	0.35
AAZ13	0.42	BY140	1.40
AAZ15	0.35	BY164	0.75
AAZ17	0.28	BY176	2.80
AY102	3.85	BY179	0.83
BA100	0.24	BY182	1.14
BA102	0.36	BY184	0.44
BA104	0.19	BY189	5.30
BA110	0.80	BY190	4.90
BA111	0.70	BY206	0.26
BA115	0.17	BY238	0.25
BA116	0.56	BYX10	0.30
BA121	0.85	BYX38/600	0.70
BA129	0.45	BYX70/500	0.53
BA145	0.19	ITT44	0.08
BA148	0.19	ITT210	0.63
BA154	0.06	ITT827	0.80
BA155	0.17	MCR101	0.43
BA156	0.12	MR854	1.10
BA157	0.25	OA5	0.88
BA158	0.28	OA10	0.58
BA159	0.40	OA47	0.20
BA164	0.14	OA81	0.19
BA170	0.18	OA90	0.13
BA182	0.27	OA91	0.15
BA201	0.13	OA95	0.20
BA202	0.14	OA200	0.13
BA203	0.14	OA202	0.13
BA216	0.08	OA210	0.89
BA219	0.11	TIL209	0.14
BA243	0.45	TIL211	0.18
BA317	0.06	TV20	2.25
BA318	0.07	IN914	0.06
BAV10	0.10	IN916	0.06
BAV21	0.18	IN4001	0.06
BAW62	0.06	IN4002	0.07
BAX13	0.07	IN4003	0.08
BAX16	0.10	IN4004	0.08
BAX17	0.19	IN4005	0.09
BAY72	0.16	IN4006	0.10
BB104B	0.52	IN4007	0.12
BB105B	0.33	IN5400	0.15
BB105G	0.30	IN5401	0.17
BR100	0.40	IN5402	0.20
BY100	0.35	IS920	0.09
BY103	0.35	IS921	0.11

ZENER DIODES

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

VDR's, etc. (†)

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

VALVES (†)

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

BRIDGES

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

10A and 25A ranges also stocked.

RESISTORS

Carbon Film (5%) (†)

		10 of one value	Mixes of a minimum of 10pcs of any value: 50pc	100pc	500pc
	Ea				
¼W 5.6Ω-330kΩ (E12)	3p	25p	95p	£1.49	£5.40
½W 10Ω-10MΩ (E24)	3p	25p	95p	£1.49	£5.40
1W 10Ω-10MΩ (E12)	5p	45p	£1.95	£3.40	£15.25
2W 10Ω-10MΩ (E6)	9p	80p	£3.80	£6.40	£26.90

Wirewound (5%)

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

Presets (†)

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

0·2W (Vertical and Horizontal)
Values as 0·1W **all 14p each**

FUSES (all packs of 10)

20mm Time Delay (BEAB)

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

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Writer's Cramp

A couple of months ago we published a letter from a trade press colleague commenting on the problems that can arise when technical material is translated from one language to another. More recently, at the annual RETRA conference, *Electrical and Radio Trader's* deputy editor, whilst outlining the present VCR situation, spoke in scathing terms on the quality of the user manuals supplied with these machines. Technical writers, he commented, should never be let loose on writing consumer manuals. Now this brought us up with something of a start. Our immediate reaction was why ever not? Are technical writers some strange species that cannot be trusted to write simple English when required? Is there in fact such a thing as a technical writer as opposed to any other sort of writer?

A technical writer is surely simply someone who is used to writing about technical matters. To us this implies one thing and one thing only: that in addition to a basic understanding of how sentences should be constructed, he has enough technical knowledge to be able to deal with his subject without getting it wrong. The former skill is something that schools are supposed to teach. You add the technical bit later. But doing so shouldn't have the slightest effect on the ability to understand and use words. If a technical writer can't be trusted to write simple instructions for non-technical users, the implication is that he's not competent in the use of language and shouldn't be writing about anything at all that others will have to be able to follow.

To be fair, this probably wasn't quite what Arthur Ord-Hume was getting at. We labour the point because it's something of a pet subject of ours. We do feel that there is little of a technical or scientific nature that can't be expressed reasonably simply and clearly, the only hurdle for the layman being that he may not understand some of the terms used. Why this hobby-horse? Well, we're not all that bright you see, and what we've managed to pick up has been something of a struggle – one that wasn't made easier by the confused way in which so much information and so many ideas are expressed. We became rather angry when we first appreciated this, but then realised that we might have come across some sort of vocation – wielding the traditional editorial blue pencil. It's also one of the reasons why we dislike unnecessary jargon – especially the type of slang jargon that's intended simply to confuse the outsider.

All this is not to deny that quite serious problems can and do arise in writing about technical matters. Those of us who've been involved in technical journalism through the era of rapid development in semiconductor technology and the development of colour TV techniques will be all too well aware of this. Back in 1967, when many firms and organisations were making initial attempts to familiarize their staff with the basic elements of colour TV, it became apparent that several different technical languages were being used for the purpose! We made a deliberate effort on this magazine to adopt what seemed to us a reasonably straightforward and self-explanatory vocabulary for the purpose, and have tried to stick to it ever since. With semiconductor technology the problems can be much worse. There is a tendency for firms – especially their sales promotion personnel – to use technical terms to suggest that products which are basically the same as everyone else's are of a different order of sophistication altogether, while much of the engineering information that's issued tends to gloss over the interesting technical bits, probably for quite understandable commercial reasons.

It's the job of the technical writer however to handle all this intelligently. And if he can manage semiconductor technology say, he should certainly be able to write simple instructions for operating a VCR. The only problem here is that an effort is required to appreciate his readers' exact requirements. It reminds us of a question we're sometimes asked: "at what 'level' should an article be written?" We tend to reply "make whatever points need to be made, and do so clearly." That to us is the most important consideration, though what the questioner is really asking of course is "what should I assume the reader knows and doesn't know?" To some contributors this seems to be a very real stumbling block, but it's no different a problem in kind from being able to appreciate the requirements of say the VCR user. A sensible approach seems to us to be to make things clear to the proverbial man on the Clapham omnibus, assuming that he has access to a suitable dictionary for the technical bits.

If it's that simple then, why is there so much badly written and presented information around? Probably because of a combination of human and other failings, such as carelessness, the blind leading the blind, shortage of time and the fact that as in most walks of life excellence is rarely achieved.

Homework for readers/contributors: prepare a pamphlet on operating a programmable TV games unit for the man on the Caracas omnibus.

LATE PUBLICATION

We regret that due to production difficulties recent issues of *Television* have appeared at newsagents and bookstalls on dates later than those planned. The April issue was published on April 4th instead of March 19th, and the May issue on May 9th instead of April 17th. It seems likely that the present issue will also be delayed. We apologise to readers and advertisers for the inconvenience caused. Readers are advised to keep on trying if an issue fails to appear on the date announced. Every effort is being made to return to normal scheduled publication dates.

Teletopics

PRESTEL SERVICE LAUNCHED

The PO has now officially inaugurated its viewdata service: on March 27th, the UK became the first country in the world to have such a service available to the public. It employs a combination of telephone and television techniques to give the user access to information stored in a central computer, the TV set being used to display the information called up via the telephone link to the computer. Potentially, the information that could be made available is virtually limitless. Initially, about 150,000 pages of information covering a wide range of subjects is available, though this can be rapidly increased. Over a hundred organisations, including British Airways, British Rail, the Consumers Association, the English Tourist Board, the Financial Times, Good Food Guide, Guinness Book of Records, National Trust, Norwich Union, W. H. Smith, Sports Council, The Stock Exchange and many others are already supplying information.

Two factors are severely limiting the service to start with however. First the service is limited to the London area, with only the Gresham Street computer in use so far – other centres at Fleet, Clerkenwell and Wood Green should be linked to the network by the autumn, when the service will be made available to business users as well. The service will then be extended to Birmingham, Manchester and Edinburgh, and eventually to the rest of the country. The second factor is that sets for use with the service are still in only very small scale production – a statement issued by the setmakers through BREMA points out that only a couple of hundred applicants for sets could be supplied at present. Quantity production of sets, which has been delayed by disagreements between the PO and the setmakers over specifications, is due to start in the second half of the year, with an expected build up in 1980.

Eastern Counties Newspapers Ltd, one of the main Prestel information providers, is publishing a quarterly *Prestel Users Guide and Directory,* which incorporates the current issue of the *Teletext and Viewdata Magazine*. The directory contains a complete guide to the information providers and services available through Prestel, and the combined directory/magazine is being distributed to all Prestel users – it's also on general sale at a price of £1.50.

The PO has announced the sale of Prestel software for pilot trial use to Switzerland, the fourth overseas country to place an order for Prestel equipment with the PO.

NEW COLOUR TUBE

According to a report in the US magazine *Radio-Electronics,* Matsushita (Panasonic) is planning to introduce later this year a small-screen, battery-powered colour set fitted with a new type of colour c.r.t. – a single-gun type using the beam-indexing principle. The idea is that the RGB signals are applied sequentially to the c.r.t. beam as it traverses the phosphor stripes on the screen, black control stripes between the phosphor stripes emitting ultra-violet rays which provide a control signal to ensure that the colour signals and the colour phosphor stripes are synchronised. The principle of this type of tube was first demonstrated in the fifties, but it has never before been put into production. Matsushita say that the power consumption of sets using this tube is so low that they can be operated for three hours from nine flashlight batteries.

STATION OPENINGS

The following relay stations are now in operation:
Gosforth (Cumbria) BBC-1 ch. 58, Border Television ch. 61, BBC-2 ch. 64. Receiving aerial group C/D.
Hope (Derbyshire) BBC-1 ch. 22, Yorkshire Television ch. 25, BBC-2 ch. 28. Receiving aerial group A.
Llangollen (Clwyd) BBC-Wales ch. 57, HTV Wales ch. 60, BBC-2 ch. 63. Receiving aerial group C/D.
Parbold (Lancashire) Granada Television ch. 41, BBC-2 ch. 44, BBC-1 ch. 51. Receiving aerial group B.
Tighnabruaich (Strathclyde) BBC-1 ch. 39, BBC-2 ch. 45, Scottish Television ch. 49. Receiving aerial group B.

All the above transmissions are vertically polarised.

WORKSHOP SAFETY

The Radio, Electrical and Television Retailers' Association has published a manual giving guidance on electrical safety when testing and servicing radio, television and audio equipment. Called *Safety in Electrical Testing,* the manual has been prepared in consultation with the Electrical Branch of HM Factory Inspectorate. Supply and protection systems are recommended, along with layout and safe working procedures for premises where servicing is carried out. Attention is also given to safety when making service calls and to work carried out at a customer's home. The manual is available at 75p from RETRA Ltd., 57-61 Newington Causeway, London, SE1 6BZ. A number of illustrations make the recommendations especially clear.

MOTOROLA'S CHROMA III SYSTEM

Motorola's third generation PAL decoder system (Chroma III) employs a single 40-pin i.c., type TDA3300. Amongst the features of this i.c. are low dissipation, typically 600mW, with a single 12V supply; a patented 90° phase-shift system requiring no adjustment; and direct inputs for on-screen (data, TV games, etc.) displays, with a complementary fast blanking input. Of particular interest is the beam limiting and automatic black-level adjustment system, the latter making it unnecessary to incorporate preset controls to set up the black level. These arrangements rely on three high-voltage transistors to monitor the beam currents, providing feedback signals for the i.c. As shown in Fig. 1, c.r.t. cathode current flows via R1, R2 and Tr1. The voltage developed across R1 is fed back and compared to a reference voltage within the i.c. If the reference voltage is exceeded, the beam current limiting action comes into operation, reducing the contrast. The system has been designed to enhance the set's video and digital signal handling capability. During the flyback time the feedback input impedance rises, activating a further internal comparator.

This compares the tube's cut-off current (a hot cathode doesn't cut off completely) with another internal reference voltage. The resultant signal is integrated and added to the output (at the output clamp) to provide the automatic black-level correction. Readers may recall that a similar idea, using discrete circuitry, is employed in certain B and O colour chassis. The advantage is that the black level is held constant throughout the tube's life, with no grey-scale drift.

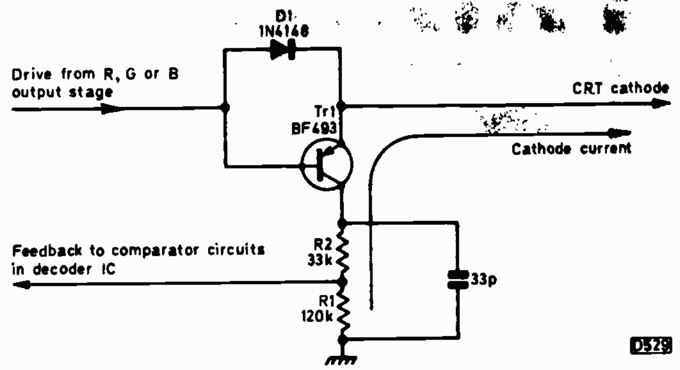

Fig. 1: Method of monitoring c.r.t. beam current used with the Motorola Chroma III single-chip PAL decoder system. The voltage developed across R1 is fed back to the TDA3300 i.c. where it activates the beam current limiter in the event of excessive beam current and, during the flyback blanking periods, initiates black-level correction. D1 protects the base-emitter junction of Tr1.

HIGH-PERFORMANCE TV RECEIVER

In his column in the RSGB journal *Radio Communication* Pat Hawker recently drew attention to an interesting high-performance TV receiver design developed by Texas Instruments in the USA and delivered to the Federal Communications Commission for evaluation. The aim of the exercise was to show that more efficient use could be made of the frequency bands available for TV transmissions in the USA by employing new semiconductor devices and other state-of-the-art techniques to improve receiver performance. The objectives set were as follows: to eliminate image frequency problems; to move the i.f. beat and half-i.f. signals far from the desired signal; to improve the adjacent channel performance substantially; to obtain greatly improved cross-modulation and intermodulation performance; and to improve the u.h.f. noise figure. The first two objectives led to the use of a much higher than usual i.f. – 346MHz – the others being realised through increased i.f. selectivity (the use of two SAW filters) and improved tuner circuitry. To meet N. American requirements, the Texas Instruments' design was a v.h.f./u.h.f. one: to illustrate the design approach simply however, we've extracted the u.h.f. bits in the block diagram shown in Fig. 2.

The initial sections are fairly conventional. A pin-diode attenuator is used for r.f. a.g.c. purposes, followed by a varicap tuned bandpass filter (–3dB bandwidth approximately 24MHz at 470MHz and 40MHz at 885MHz) which drives a low-noise, high dynamic range bipolar transistor r.f. amplifier. The voltage-controlled local oscillator feeds the mixer via a two-stage buffer amplifier. This isolates the oscillator's varicap tuned circuit from impedance variations in the mixer caused by large interfering signal levels – such variations can result in frequency modulation of the oscillator by an interfering signal. The first mixer is particularly interesting, consisting of a high dynamic range double-balanced circuit using four silicon mesfets (metal-semiconductor field effect transistors) to provide an i.f. output at 346MHz while contributing a gain of 2dB. The square-law characteristic of the mesfets results in very low cross- and intermodulation distortion levels. SAW filters are used at the input and output of the 346MHz i.f. amplifier block. The second mixer consists of another mesfet transistor which provides an i.f. output at 42·15MHz with a gain of 8dB, the associated oscillator consisting of a SAW resonator – a very stable yet economical form of oscillator. The 42·15MHz i.f. signal is fed to a conventional i.c. i.f. amplifier, but additional circuitry is used to provide a gated a.g.c. action and to interface with the double-i.f. system – the a.g.c. is applied first to the 42·15MHz amplifier, then to the 346MHz amplifier and finally to the tuner unit.

All very interesting, but hardly relevant to domestic use in the UK where TV broadcasting is based on a carefully planned four-channel system. DXers might find some ideas here however, though we understand that the mesfets were experimental devices. It seems that cost-conscious US setmakers have not shown any great interest.

BU208A SPECIFICATION CHANGED

Mullard are now producing an improved version of the BU208A line output transistor which is used in many current large-screen colour sets. Improvements enable a smaller heatsink to be used, but for optimum results modifications to the drive conditions are required. In the Philips/Pye G11 chassis the following changes have been made in connection with the use of the new version of the BU208A: the line driver transformer has been changed; the resistor (R3106) feeding the primary winding of the line

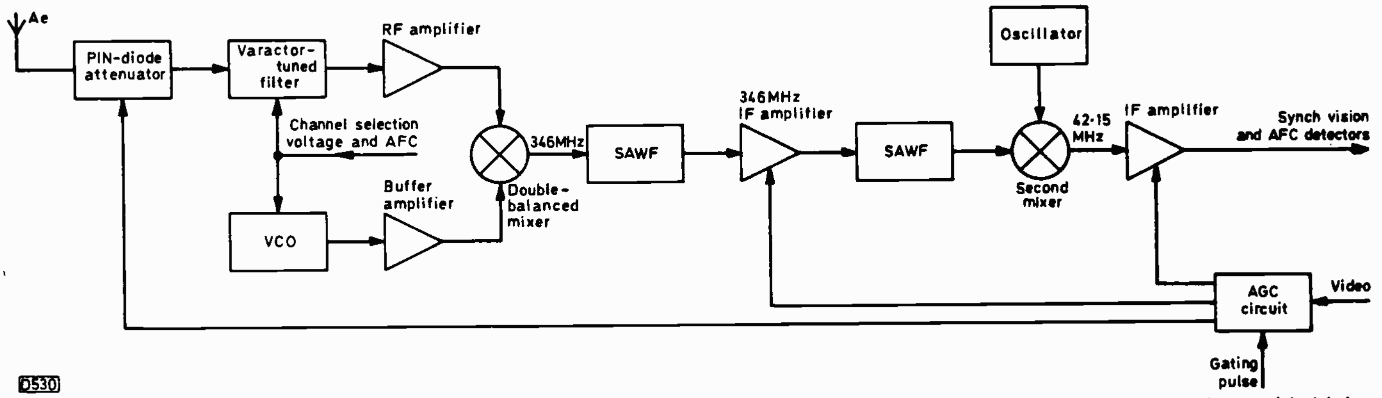

Fig. 2: Block diagram showing the basic arrangements used in the Texas Instruments design for a TV receiver with high-performance signal handling capability. Only the u.h.f. part of the original v.h.f./u.h.f. design is shown. The aim of the exercise was to demonstrate to the FCC that improved receiver performance could provide more economical use of the frequency spectrum available for TV broadcasting.

next month in

TELEVISION

● **UHF PREAMPLIFIERS**

One of the most common requests we receive from readers is for details of a practical u.h.f. preamplifier design. With developments in transistor technology, it seemed an appropriate time to look into this subject again. The device chosen was the BF679, an SGS/ATES pnp silicon planar transistor featuring a low noise figure. There are two basic reasons for requiring a preamplifier: to improve reception in areas where the available signal is poor, and when attempting to obtain reception of an extra channel from a non-local station. To cater for these different requirements, wide- and narrow-band versions of the circuit will be included.

● **THE NEW TV CHASSIS**

To meet the growing challenge from Japanese and other Far Eastern TV manufacturers, UK setmakers have been developing a new generation of colour TV chassis. The aims have been to produce simple, reliable sets that nevertheless give a high level of performance. Totally new chassis include the Thorn TX9, Philips KT3 and Decca 70. Next month we shall be taking a look at the technical features of these new designs.

● **THE GRUNDIG VCR SYSTEM**

Though using the same basic tape cassette format as the current Philips N1700 VCR, Grundig's Super Video VCR incorporates a number of extra features. David Mattewson reviews the machine.

● **SERVICING FEATURES**

Les has an avionic turn. S. Simon on the use of the meter in TV servicing. More on Körting hybrids. Some hints from readers. And so on . . .

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driver transformer has been changed from 820Ω to 390Ω; the resistor (R3108) in series with the base of the BU208A has been changed from 0·39Ω to 0·62Ω.

MITSUBISHI'S UK PRODUCTION

Mitsubishi has announced that production of 22 and 26 in. colour sets using its own chassis design will start at Haddington, near Edinburgh, this autumn. As mentioned last month, Mitsubishi recently acquired the Haddington plant from Tandberg.

EUROPEAN COLOUR SETMAKERS FACE DIFFICULTIES

UK colour setmakers aren't the only ones to have experienced problems following the declining demand for colour receivers in recent years. Tandberg have pulled out of the field entirely, and Körting survived only as a result of a rather remarkable arrangement involving the Yugoslavian white goods manufacturer Gorenje. Körting's problems came to a head when a German chain-store group with which it had an exclusive agreement was taken over and another firm to which it sold audio equipment ran into financial difficulties. Körting's Grassau plant was closed for two months last year while new arrangements were being brought into operation in conjunction with Gorenje and the Bavarian government. Production during the last quarter of 1978 was back to normal however, and Körting claim to account for over three per cent of German colour set production. Another setmaker that ran into problems was Skantic's parent company Luxor AB of Motala, Sweden. The firm, which also has plants in Singapore and Finland, has now been taken over by the Swedish government through the Swedish Investment Bank.

PROJECTION TV FROM PANASONIC

Panasonic has introduced its Cinema-Vision colour projection-TV system on the UK market, at a suggested retail price of £3,995. The combination of a highly-reflective five-foot screen and a three-tube projection system is said to give bright, sharp pictures that can be viewed under normal lighting conditions. The system is compact, being designed to save space and time in setting up.

NEW AUDIO SYSTEM DEMONSTRATED

Not a TV item this one, but a development worth recording nevertheless. Philips recently demonstrated a new audio disc system, called the Compact Disc (its diameter is only 4½ in.), which could well come to be a standard item in a few years' time. The discs are made of PVC with a protective/reflective coating, and provide an hour's playing time in stereo. The system employs many of the features which Philips developed for use with their video disc system – a miniature laser instead of a conventional pickup is used to scan the disc, while the track consists of a series of pits recorded using digital techniques. The similarly compact player unit, which provides an audio signal to drive a hi-fi system, is the size of an audio cassette player. Philips claim that the costs will be roughly the same as those of current, conventional discs and players.

It seems to us that new, improved audio systems are bound to appear as a spin off from the work being done by many firms on video disc systems, and that before long we could well have on our hands an audio revolution comparable to the advent of the LP record.

Letters

MAINS FILTER CAPACITORS

I've noticed frequent reference to the failure of mains filter capacitors in your magazine. The recent regulations relating to r.f. suppression make interesting reading in this context, and two of the four directives concern a large number of domestic appliances, office machines, small motors generally and other apparatus using controls such as contacts, thyristors and triacs. Fluorescent lights are also included. The regulations came into effect on April 1st, except in the case of lighting dimmers where the date is November 1st. Discussions relating to TV and radio receivers are still in progress however, and I'm told that no new regulations will come into force for at least two years, even though the rectifier circuit may contain triacs and thyristors. The new regulations apply to both manufacturers and users, and failure to replace a filter capacitor may infringe the existing requirements if an interference complaint is lodged and the PO interference service is called in. I wonder whether this has ever happened in the case of a TV receiver?

New test specifications for suppression capacitors call for a life test at 375V a.c. (for 250V a.c. operation) for 1,000 hours at 85°C. The capacitors use new materials and/or construction (for example series winding) so that ionisation within the capacitor does not occur at the operating voltage – it's ionisation that causes deterioration of the dielectric, leading to breakdown and failure.

The short-circuit mains filter capacitors so often mentioned have failed after some years' use, during which time the approval and component selection methods may have changed. Today's improved component may well cost much more than the type originally specified. We should perhaps also bear in mind that a setmaker's original choice may have been dictated by the availability of a suitably priced component.

While on the subject of capacitors, may I mention a potential problem with the current colour receiver project? C16 is a common replacement type and is not, as you point out, a PCB mounting type. Because of this there's no need for the solder tags to be precisely located or jig tested for accurate positioning. Two examples before me show considerable differences, so that constructors may experience difficulties in lining up the tags with the PCB holes. There are several service types for PCB mounting that could have been used.

P. E. White, Camberley, Surrey.

13A PLUGS/SOCKETS

I've had years of trouble with 13A plugs and sockets, chiefly due to heating, and expect to go on having trouble. From my own experience and that of colleagues, I believe there's virtually no plug-and-socket pair in the country that could honestly be said to be up to its job at 13A or even half that current, and I believe this state of affairs is a disgrace. For many years the grip of the socket on the plug pins has often been seriously inadequate, especially the grip at the earth pin. When using a vacuum cleaner or moving a piece of furniture, slight movement of the flex can cause table lamps to flicker and electric clocks to stop, while the plugs do not hold flat against the socket but hang away at an angle. There must in the manufacturing firms be engineers who know perfectly well that brass is not a satisfactory spring material, yet firms continue to act as though it is. In recent years however most of the trouble seems to be due to the failure of the terminals in the plug to maintain a tight hold on the copper conductors of the lead.

Copper is a good conductor but poor mechanically (solder is worse). Under pressure, copper will flow so as to relieve the pressure – this effect is particularly marked where there is high pressure over a small area. It's better to use a moderate pressure over a larger area – and of course the copper flows more quickly when it gets hot. It has been suggested that brass ferrules, something like bootlace ends, be supplied to slip or crimp over the flex ends when hole-and-screw terminals are used, but I've not seen this idea tried. It takes a bit of getting used to the idea that the terminals in a plug are likely to work loose at any time, especially when one has taken every care when making the connections, but it is so. The first thing to do when heating is experienced is to check the terminals.

A high-resistance contact can develop elsewhere of course – at a loose rivet or screw, or because of poor grip on the fuse. Again the trouble spot can often be observed because of the discoloration of the metal – hot metal surfaces usually oxidise fairly rapidly. The plastic body of the plug may be discoloured, since heat decomposes and eventually destroys most plastics. I'm also told that some imported fuses run hot at full current, and that this can cause trouble. I could also say uncomplimentary things about the design of earth sockets, but I suppose that's another story.

E. F. Good, Malvern, Worcs.

Perhaps I could reply to the query raised in *Teletopics* (March) on the overheating of plug tops used with 3kW fan heaters. A report published by the National Bureau of Standards in the USA entitled "Exploratory Study of Glowing Electrical Connections" suggests that due to a loose or non-locked connection, e.g. the connection of the spring fingers to the fuse end connections, a glow emitting light and substantial heat may occur. The small pressure exerted by spring fingers is with some types of plug top exacerbated by disturbance due to the plug top being frequently removed from the socket. The report suggests that copper to brass connections do not exhibit the glow condition however, and that in the main glow is noticed most frequently in connections involving steel. No mention is made of silver, which I understand is used to plate the end connections of plug top fuses. Should a glow occur, there would be sufficient heat generated to raise the temperature of the fuse link to melting point, with subsequent rupture.

I've soldered the fuse link in circuit (in the plug top) and this appears to reduce the temperature of operation. Whether this is due removal of the glow or simply reduction of the ohmic resistance of the connection (more likely the latter) I don't know. This begs the question of safety in other types of connections, especially the spade or lucar types which are frequently steel to brass or copper and not mechanically sound.

G. N. M. Tolley, Chief Technician, Medical Engineering, East Birmingham Hospital.

Teletext Decoder Update

Adding colour and other options to the Television teletext decoder

Part 1 **Steve A. Money, T.Eng. (C.E.I.)**

WHEN the *Television* teletext decoder was originally designed some four years ago, the object was to provide a basic teletext decoder which could be used with any unmodified 625-line television receiver. In order to simplify the design, a number of the options included in the full teletext specification, such as colour, were omitted, a simple black and white display of text and graphics being provided instead.

Although this basic decoder enables users to receive and view the teletext services, it was always anticipated that at some future date constructors of the original unit might wish to build in some of the other options available in the teletext system. With this possibility in mind, the power supply of the basic unit was designed to have a reasonable amount of reserve capacity so that it could cope with the addition of extra display control circuits at a later date. No problems were envisaged in fitting extra circuit cards into the unit, since there is plenty of unused space available within the cabinet.

Since the original series of articles on the decoder came to an end, the design and development of several extra features have progressed and we are now able to offer a selection of new display options which can be added to the basic decoder system. One extra circuit board carries the additional electronics for these new options. In order to simplify conversion of the unit, a new mother board has been designed. This replaces the existing mother board and provides the socket for the new card and the necessary interconnections.

There are many features that could be added to the basic decoder. One problem has been to select those that give the most effective improvement and are relatively easy to implement, since it was considered unlikely that all the teletext options available could be provided on a single extra circuit board. One aspect that influenced the choice of new options was the desire to keep modifications to the existing circuits to a minimum.

Colour Display

The first and most important new feature that could be added to the basic decoder was the provision of a full colour display for text and graphics. The original decoder is quite effective in displaying the text, but colour is now regularly used to highlight some sections of the text on a page, and this is completely lost with only the basic black and white display.

On graphics pages, colour can be essential for proper results on the screen. If we consider a weather map page for example, the different areas on the map are normally presented in different colours, but all will appear in white with the basic decoder. Thus the boundaries between areas on the map are lost with a black and white display, whereas in colour they stand out clearly. Adding colour to the display tends to make the pages come alive and brings a whole new dimension to teletext.

Because the *Television* teletext decoder uses direct aerial input to the receiver at u.h.f., the addition of colour involves the use of a colour modulator to generate a PAL compatible signal. It was at first thought that due to the bandwidth limitations of the chrominance channel of the average colour receiver, problems would be experienced with degradation of the text display and poor colour saturation. In fact these fears appear to have been groundless, and the colour option provides remarkably good results with colour saturation comparable to that produced by direct RGB drive to the picture tube.

Apart from text colour, the teletext specification allows the possibility of switching the background colour as well. It was thought that this feature would be virtually impossible to achieve with an r.f. input system. Good results were obtained however and this display option has therefore been built into the new circuit card. In some ways this is an added bonus, because many commercial receivers cannot provide the background colour option.

Other Options

On some pages of teletext, flashing symbols are used to emphasise parts of the text. Provision has been made for this type of display in the new decoder circuits.

When a quiz type page is presented on teletext, it's usual

Table 1: Teletext control codes.

D531				B7	0	0
				B6	0	0
B4	B3	B2	B1	B5	0	1
0	0	0	0		NUL	DLE
0	0	0	1		ALPHA RED	GRAPHICS RED
0	0	1	0		ALPHA GREEN	GRAPHICS GREEN
0	0	1	1		ALPHA YELLOW	GRAPHICS YELLOW
0	1	0	0		ALPHA BLUE	GRAPHICS BLUE
0	1	0	1		ALPHA MAGENTA	GRAPHICS MAGENTA
0	1	1	0		ALPHA CYAN	GRAPHICS CYAN
0	1	1	1		ALPHA WHITE	GRAPHICS WHITE
1	0	0	0		FLASH	CONCEAL
1	0	0	1		STEADY	CONTIGUOUS GRAPHICS
1	0	1	0		END BOX	SEPARATED GRAPHICS
1	0	1	1		START BOX	ESC
1	1	0	0		NORMAL HEIGHT	BLACK BACKGROUND
1	1	0	1		DOUBLE HEIGHT	NEW BACKGROUND
1	1	1	0		SO	HOLD GRAPHICS
1	1	1	1		SI	RELEASE GRAPHICS

to have both the questions and answers on the same page. By using the conceal command however the answers can be blanked out on the screen until the viewer presses the reveal button on his decoder unit. Our basic decoder tends to make these pages rather pointless, since it shows both the questions and answers all the time. Some extra logic has been provided therefore to implement the reveal/conceal facility.

For newsflash and subtitle pages, the "boxed" mode of display can be used. With this a section of the normal television picture is blanked out and the text is displayed inside the black box area thus produced. Decoding of the control signals for the box mode has been provided on the new logic board, but lack of board space meant that the actual switching circuits for the video and text signals had to be omitted. Some suggested circuits will be given for those constructors wishing to add the box feature.

Other display options, such as graphics hold, double-height text and separated graphics symbols, would have involved major changes to the existing logic boards and some complex additional logic. These have been left out therefore. Partial decoding of the commands for these display options has been included on the board however, and these signals have been brought out to the edge connector.

A number of features of the teletext system, such as update and time-coded pages, make use of control bits in the page header row. The design of the input logic card in the basic decoder does not lend itself readily to decoding these control bits without major alterations to the board's logic circuits. No attempt has been made to implement these options therefore. This is not a serious problem at present, since time-coded pages for example are not at present being used while the update facility is generally used with this type of page.

Colour Decoding

The first stage in producing a colour teletext display is to decode the colour control commands. The teletext system enables the text or graphics symbols to be displayed in seven different colours. These colours are red, green, yellow, blue, magenta, cyan and white, which will be recognised no doubt as the ones used for a colour-bar test signal. In fact they are all built up from various combinations of the three primary colours red, green and blue.

In the teletext system the first two columns of codes in the signal code table are reserved for control commands, the remaining six columns of the table representing the text and graphics symbols. Table 1 shows the teletext control codes and their functions.

Display colour is controlled by the eight codes in the upper half of each column of the control code table. To simplify colour coding, each of the primary colours red, green and blue is allocated one data bit of the code – these are bits 1, 2 and 3 respectively. Thus if bit 1 of a colour control code is at the 1 level, the red gun of the display tube will be turned on, whilst if bit 1 is at 0 the red gun will be turned off. Bits 2 and 3 control the green and blue guns in a similar fashion. When bits 1 and 2 are at the 1 level, the result on the screen will be yellow (red + green) symbols, whilst combinations of bits 1 and 3 or 2 and 3 will produce magenta or cyan symbols respectively. If all three colour control bits are set at the 1 level, white text or graphics will be produced.

If all three colour bits are at 0, the command has no meaning in the teletext system (codes labelled NUL and DLE). The simplified decoding scheme used in our decoder will cause black symbols to be produced if either of these two codes is detected. In practice this condition is likely to occur only when there are errors in the received signal, so the simplified decoding scheme is perfectly satisfactory.

It will be noticed that pairs of codes in the table produce the same display colour, the only difference in the display being that either the text or graphics mode will be selected by a particular code of the pair. As far as colour is concerned therefore, we can ignore the state of bit 5 of the data signal – the display colour is the same whether bit 5 is at 1 or 0.

All the control codes have data bits 6 and 7 in the 0 state, and we can use this fact to detect control codes in the incoming data stream. Inputs B6 and B7 from the memory board are fed to a two-input NOR gate (pins 2 and 3 of IC2, see Fig. 1) whose output will go to 1 whenever both B6 and B7 are at 0. Thus a 1 output from this gate signifies that the data code is a display control command and not a normal symbol code.

For the colour control codes bit 4 of the signal is always at 0, so if the B4 input is inverted and gated with the output of the B6, B7 NOR gate a signal will be generated whenever a colour command is received. To produce a more suitable control pulse, the display clock signal DCK is also gated with bits 4, 6 and 7, using a 7410 gate (IC4). The output of this gate is a short, negative-going pulse whenever a colour command is detected.

Three 7474 D-type flip-flops (IC10/11/12) are used to generate the red, green and blue control signals for the display colour. The D inputs of these three flip-flops are driven from inputs B1, B2 and B3 respectively, and the

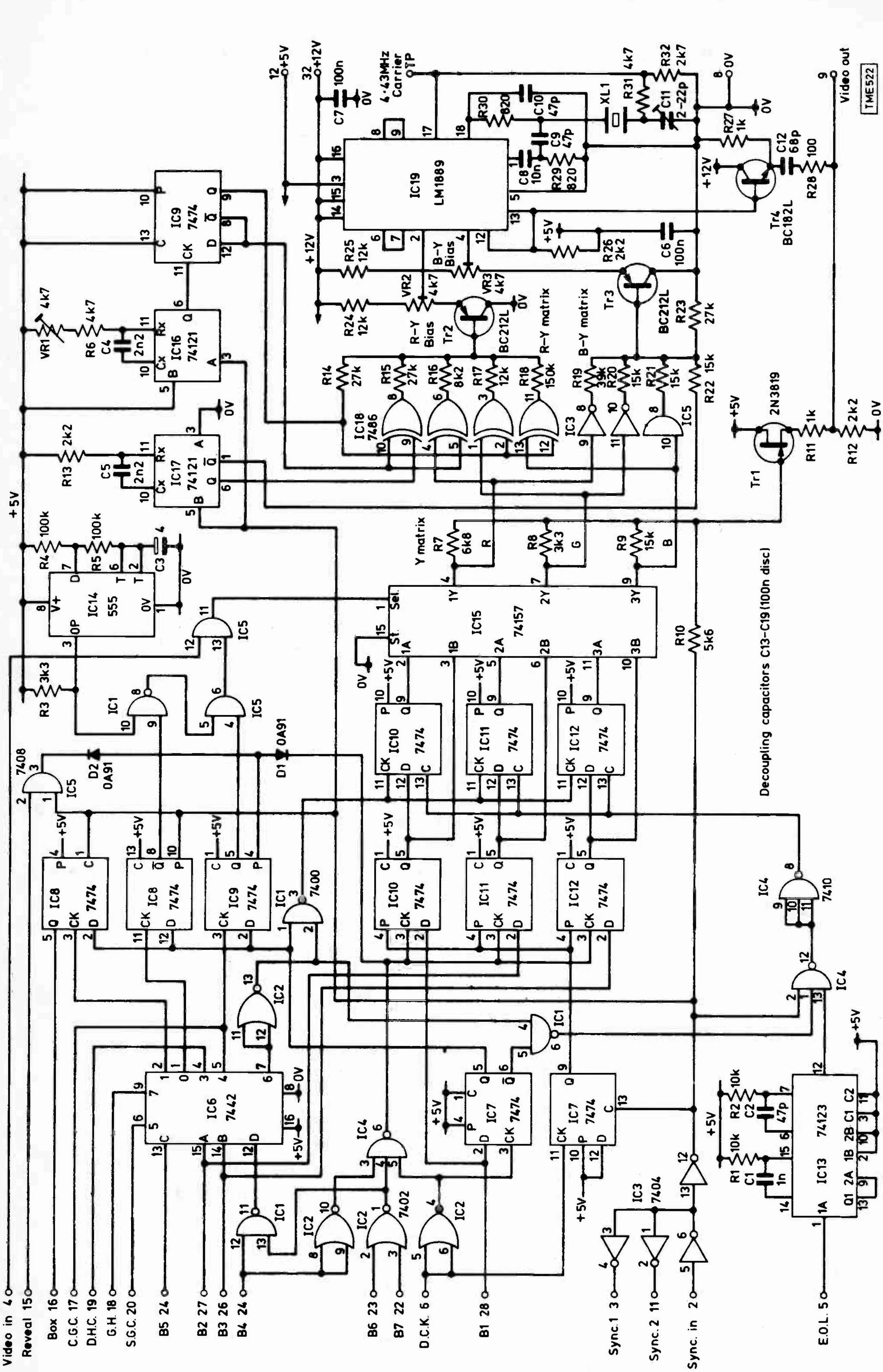


Fig. 1: Circuit diagram of the Television teletext decoder options board.

clock inputs are driven in parallel by the pulse from the 7410 gate IC4 so that when a colour control command is detected the three flip-flops will take up the states of bits B1, B2 and B3 of the control code. The outputs from these three flip-flops can now be used as R, G and B control signals to select the colour of the displayed symbols.

To avoid the need to send a colour control code at the start of every row of text, it is assumed that every row in the teletext system starts with the white alphanumeric condition selected. To ensure that this state of affairs is achieved, the three colour control flip-flops are preset to the 1 state at the start of each line scan. This could be done by using the line sync pulse, but because of timing problems it's necessary to hold the three flip-flops in the preset state until about half way through the first DCK clock period. This has been achieved by using a further 7474 flip-flop (IC7) which is reset by the line sync pulse and then clocked into the set state by the DCK pulse. The output pulse from this flip-flop then controls the preset inputs of the three colour-control flip-flops.

Background Colour

Apart from the display of text and graphics symbols in colour, teletext also permits control of the background colour. Unfortunately there are not enough control codes available to permit direct encoding of the background colour in the same way as for symbol colour, so an alternative coding scheme is used.

Two control commands are used to select the desired background colour. The first command, called new background, causes the background colour to be set to the same colour as the symbols. The second code, called black background, allows the background colour to be switched back to black. This is needed because theoretically there is no black symbol colour condition in teletext, so the new background code could not be used to select a black background. After a background colour has been set up, the background remains in that colour until another background colour command is received, and remains independent of any changes of symbol colour that may occur.

To detect the background colour commands, a 7442 one-of-ten decoder device is used (IC6). Inputs A, B and C of this device are fed by inputs B2, B3 and B5 of the data signals. Bits B4, B6 and B7 are then gated together to provide the D input signal to the 7442. These inputs have been chosen so that the 7442 effectively detects pairs of control codes in the lower half of the table, producing a separate output signal when each of these pairs of codes is detected. Output 6 of the 7442 will go to 0 whenever either of the background control codes is detected.

As with the symbol colour control, three 7474 D-type flip-flops (the other sections of IC10/11/12) are used to control the background colour. The D inputs of these three flip-flops are driven from the Q outputs of the three symbol colour flip-flops, whilst the clock signal is produced by gating output 6 of the 7442 with the B1 input of the data signals. When bit 1 is at 1 during a background control code, the code must be a new background command and the three background flip-flops will be clocked so that they take up the same state as the three symbol colour flip-flops. When the bit 1 input is at 0 during a background command, this implies a black background code and a pulse is generated which is fed to the three clear inputs of the background flip-flops causing all three to be reset to the 0 state to give a black background.

The signal for bit 1 is delayed slightly to avoid a timing problem. This is carried out by using a 7474 flip-flop (IC7) to generate the bit 1 signal for use by the background control circuits.

At the start of each row of text, it's assumed that the black background condition is selected. For most pages the background will in fact be black, so this avoids the need to send a background command on every text row. To ensure this condition, the three background flip-flops are reset at the start of each line scan by applying the line sync pulse to their clear inputs.

If the background colour was set to something other than black during a row, this background colour would continue to the end of the line scan. To ensure the proper display of background, we need to arrange that any background colour is reset to black after the last symbol space has been scanned on a text row. This can be achieved by using the end of line (EOL) signal from the memory circuits. The EOL signal occurs at the start of the last symbol space in the text row however, so a delay of about 1μsec is needed after EOL before the background flip-flops are reset.

A 74123 dual-monostable (IC13) provides this background reset pulse. One half of the 74123 is triggered by the EOL pulse and produces the delay of one symbol period, whilst the other half of the 74123 produces the reset pulse for the three background flip-flops.

The reset pulses for start and end of line and the black background command are combined in two sections of a 7410 gate (IC4) to produce the required reset pulse for the three background flip-flops.

Colour Control Signal

We now have R, G and B control signals for symbol and background colour, and these must be combined to produce a final colour control signal. This is achieved by using a 74157 (IC15) which acts as a three-pole changeover type switch.

Control of the switch is effected by using the dot video signal from the display board. When this video signal is at 1, it represents part of a symbol and the changeover switch is set to pass the three symbol colour control signals to the output. When the dot video is at 0, representing the background, the changeover switch is set to pass the background control signals to the output.

At the output of the 74157 we have R, G, B control signals which could be used to drive the three guns of a colour tube to produce the required display. For r.f. input to a receiver however we must build up a correct PAL signal consisting of a luminance signal (Y) and two chrominance signals (R−Y and B−Y).

The luminance signal can be derived from the R, G and B signals by using the following equation,

$$Y = 0{\cdot}299R + 0{\cdot}587G + 0{\cdot}114B.$$

The luminance component is generated simply by combining the appropriate proportions of the R, G and B outputs of the 74157 in a resistor network (R7/8/9). Standard value resistors which give approximately correct levels of R, G and B for the combined Y signal have been used, since the precise colour produced is not so important in a text display as it would be in a normal picture signal.

At this point the combined sync signal is added to the luminance signal to produce a combined video signal which is then buffered by a source-follower stage (Tr1), providing a video output signal to drive the u.h.f. modulator.

CONTINUED NEXT MONTH

The Best Laid Schemes

Les Lawry-Johns

I WAS trying to find an irritating fault on a cassette deck and was engrossed in watching the busy little VU meter needles flickering up and down in time with the music coming through the headphones, which were keeping my ears warm, when this fellow came in.

Communications Problems

I didn't like him very much. Intelligence wise, he was a cross between a cretin and a moron. His distinguishing characteristic was that he didn't bother to open his mouth when he spoke, which on the one hand showed decided lack of consideration for those expected to listen to him but on the other was of little consequence because what he did say didn't amount to much anyway. Added to this I did have the headphones on.

Ignoring the fact that I was totally engrossed with the job I was doing, he launched into a tirade of his troubles, at the same time keeping time with the index finger of his right hand. I didn't hear a thing, so just to be awkward I pointed to the headphones and then removed the jack plug from the deck. I showed him the plug, whereupon he took it and bawled into it as though it were a microphone.

Now that the music was off, I could vaguely hear bits and pieces of the gabble since now he thought he was talking into a microphone he was speaking far more (for him) carefully. Apparently he had brought this here stereo thing into us for repair some time ago, and now when he plays his record it sounds funny half way through. It's outside and he'll bring it in. He brought it in complete with his record, by which time I'd removed the headphones.

"Can you hear me without your hearing aid?" he shouted.

"Yes thank you, I need it only now and again."

"I'll leave it with you and call back at the end of the week then."

That isn't exactly what he said, but that's what it amounted to. After he had gone, I rigged it up with a couple of speakers and put the record on – at the far end of the bench so that I could get on with the cassette deck at the same time.

Cat's Paw

It played away quite nicely, and I could hear no distortion at all – until it reached track three when the sound was decidedly distorted. Apparently the cat thought so as well. In one movement she leaped up on the bench and swiped the pick up arm with her paw. Zip.

"Spock, you horrible cat, clear off" I bawled.

Spock fled, leaving me to examine the record which was well and truly scratched from track three to the centre. My fault of course, but it was the first time the cat had taken a hand in the bench work for a long time. Enter the wife.

"What are you shouting at the cat for? Honestly, you make her life a misery. What's she done now? Damaged a record? Is that all? Well I'm going to the record shop so I'll pick up one of these as well. A lot of fuss over nothing. You ought to be ashamed of yourself."

"Either that cat goes or I do."

"Wait until I get back from the town and then I'll help you to pack. Don't you dare kick her while I'm gone. I know you, you're evil." There's no justice in this world.

Actually she did get a new record, and track three sounded just as good as the others. Did he have only one record? She's a good cat really.

The Fool on the Hill

I had a couple of outside jobs to do, so I packed my bags with care, slightly hampered by knowing only the make but not the model of the sets to be dealt with. One was a Murphy, the other a Pye, so there are no prizes for guessing the main content of my bags. Both calls were in the vicinity of Telegraph Hill, one actually on it.

The Murphy was the first one. It turned out to be the 110° remote control Z179 chassis, not one of my favourites so far. The complaint had been reported as "no sound or picture." Quite so, but the glass of the tube face was very much alive, and the tube heaters were glowing, plus the fact that there were very faint traces of shortwave stations issuing from the speaker. There was not the hiss that there would have been if the i.f. stages were working however. The left-hand signal panel can be released on the bottom catch and slid out to allow better access to the plug-in i.f. strip.

Playing with this revealed plenty of life at the output of the video processing i.c. (SC9503P or TDA1330) but no response from the input. Our spares box contained just about every i.c. except this one, so we promised to "pop back later with the bit you want."

Up the hill to the Pye. This turned out to be one of the 725 series, solid-state with vertical panels.

The bottom centre 800mA h.t. fuse had failed. This is in the feed to the line output stage. With the stupidity that seems to characterise my every move lately (senile decay), I thought I'd take a short cut and unhook the tripler. Sure enough the current dropped to about 500mA and a new fuse held. Our box contained almost every tripler except one for the 731-725 series. So we made the same promise and departed. Oh well, it was worth it just for the view from the hill over the estuary.

A quick nip back to base to pick up the (a) necessary and (b) unnecessary parts, delayed by people wanting to know this, that and the other. Eventually we were on our way back.

Whip out the Murphy's i.f. panel, suck up the solder on the chip, and stick in the replacement 1330. Lots of lovely sound and vision signals.

Up the hill to the Pye. Remove suspect tripler, fit new one. Switch on. No e.h.t. Fuse slowly gets red hot, curls up and dies. Realisation hit me. Idiot. Too stupid to take my own advice (these pages some months ago, suspect C563 0·1 μF 1·2kV under the focus unit, c.r.t. first anode supply reservoir, off the tripler). This capacitor was short-circuit of course, and had been isolated by disconnecting the tripler (it's at the earthy end of the line output transformer overwinding). Better by far to have removed the two-pin plug rather than the input to the tripler. Next time, next time.

Having restored what appeared to be normal reception by replacing the capacitor and refitting the original tripler, we stood back to admire the picture.

Tap and Tap Again

"Oh, there's one thing you might see to while you're here. The picture goes off every now and again and we have to tap the top to get it back again." So we tapped the top of the cabinet and off went the picture (leaving the sound). Another tap brought it back. Here we go again.

Having slid out the left-side signal panel, every touch anywhere caused the picture signals to come and go. It appeared to be plug and socket connections, so each relevant one (and others) were checked with fairy fingers.

In view of the symptoms – sound unaffected but complete loss of luminance – we were inclined to dally around the delay line area. But as we prodded and probed, the fault became less and less easy to provoke. In short we were improving the contact without locating it, and time was a hurrying by.

A purpose had been served however, since only one item would now respond to light treatment. This proved to be the i.c. near the delay line (IC348, TBA560CQ) – it clips into a socket rather than being soldered to the print.

Out came the wee beastie (thus slightly altering the leg formation) and back in again he went. Inspecting the print side showed no sign of dry-joints or what have you, and no amount of vibration now seemed to disturb the picture.

Out again to admire the view, and then back to the traffic and the noise and the shop and the jobs.

Tube Trouble

"Mr. Creaky has left his set here. He says that since you put the new tube in the picture is worse than ever. He'll be back at five o'clock to collect it." It was four thirty.

"You wouldn't like me to paint the Forth Bridge before five o'clock as well would you?" I complained.

"Well he did bring it in as soon as you went out, and you have been gone a long time. Mr. Creaky is very nice looking too."

I gave up and hoisted the G8 on to the bench.

The picture looked fine to me, for a while anyway, and then something funny happened. The whites started to have long pennants of orange streaking out to the right, which is typical of a failing tube. Off came the rear cover, back in went the aerial, and in the mirror the picture looked perfect. Whites were white with no streaks. Bitterly I wished I knew my job better than I did. Why can't I be quick witted and clever like most chaps I know? All I can ever do is plod on following dull routines that may or may not result in eventual success.

Self-hypnosis. That's the thing. I'll tell myself I'm clever.

It didn't work however, and I had only a few minutes left.

As I watched the crisp picture it started to play about again. This time it faded, becoming bluish in the process, and I heard a very faint clicking noise. The tube heaters were out.

Quickly (for me) I switched the meter to a.c. and applied the prods to the heater posts. Full 6·3V. The tube heaters were glowing. Ah! A dry-joint on the tube base.

There weren't any. The clicks started again (from the speaker). Again the heaters dulled, and now the 6·3V reading was swinging. I fairly leapt over to the power panel to the tube heater supply plug. Moving it produced the clicks and the variation. Tightening up the socket stopped the hanky panky completely.

I now felt full of guilt. Had I put in a new tube unnecessarily? The old one was still in the basement. Checking it with the tube tester showed very low emission on all three guns. The poor heater supply contact must have occurred after the new tube was fitted. I was not guilty but I could have been, easily.

By the time Mr. Creaky came to collect I had also painted the Forth Bridge. I cannot understand these dull people who have no confidence in themselves.

The phone rang. It was Mr. Hoo.

"A couple of weeks ago you had a lot of trouble with my ITT because the colour kept going off. Well, it's gone off again."

Help!

Anyway we had the set in again, and this time had a look at the reference oscillator control loop's filter circuit. There's a 6·8μF electrolytic here (C208), and replacing this seems to have done the trick at last. I'm still nervous when the phone goes though.

Ghost Train

Nothing to do with defective TVs, but it's worth telling. Now it's part of a river pilot's job to get up at unearthly hours in order to be at a certain place at a certain time – to pick up his ship. So our friend Clifford left home at 03.30, down to the pier where the cutter took him across to Tilbury where he intended to catch the 4.30 first train. At the station there was only a sleepy ticket collector.

"Purfleet train, platform 4" he yawned. Clifford looked over to platform 4. There was no train at platform 4 or for that matter at any other platform. In other words, the whole place was bare of trains.

"I thought it started from here" said Clifford.

"It does. It comes in last thing at night and it's the first one out in the morning."

"I can't see it".

The collector turned his head toward platform 4. He woke up with a jerk.

"Where's it gone?" he demanded.

"I haven't taken it" Clifford assured him.

The collector hot footed it over to a phone. Whoever was on the other end of the phone seemed as disturbed as the collector, and apparently accused him of losing the train. He banged the phone down muttering "It ain't my fault."

Just then two lonely figures came on the scene. It was the driver and guard, who were to take the train out.

"Where is it?" asked one.

"Don't you start. How do I know where it is?" said the unhappy collector. "It must have come in last night."

"It's bloody Fred, that's who it is. He just won't walk home last thing." Whereupon the driver and guard walked down the platform and into the darkness.

"Where've they gone?" asked Clifford, by now prepared to believe anything.

"Over to the sidings I suppose. Fred lives over there somewhere."

Sure enough, ten minutes later there was a rumbling on the tracks and the 4.30 slid into platform 4.

Clifford swears it's true, but you never know with him.

Colour Pattern Generator

Part 2

Malcolm Burrell

IN Part 1 last month most of the circuitry used in the colour pattern generator was shown and described. This month we're covering the rest of the circuitry and starting on the construction. The circuitry is on two printed panels, one incorporating all the logic circuitry and the other the analogue and power supply circuits. These panels have been designed by the magazine and at the time of writing are being built up and tested – the original prototypes were built on pinboard with hand wiring and, as mentioned last month, resembled a telephone exchange. Since the panels are still being evaluated, final constructional and setting up details will have to wait till next month.

Pattern Displacement

There's a point at the centre of the active line period when all the bistables are in the process of switching from one state to another. If preventive measures were not taken, this would result in a thin but very noticeable vertical line down the centre of the screen. Another problem is that the various patterns inserted into the background grill tend to start and finish in such a way that whilst the grill lines would be prominent on one side of the raster they'd be absent from the other side. The cure adopted has been to add various capacitors, such as C8, C9 and C10, which might seem to be in odd positions. With larger values they could have constituted a hazard, probably necessitating some protection: as used here however they perform their functions without giving rise to any problems.

Chroma Logic

Colour bars from pins 6, 8 and 10 of IC10 pass to IC40 where they are gated so that they slot into the top part of the pattern allocated to them. As mentioned last month, the red and green components of the colour fit pattern are ORd with them. In the case of red, we also add the burst gate pulse in IC43c. This pulse is derived from the monostables IC45/6 which are triggered by the line drive, giving a pulse of about 2·5μsec in length roughly 5·6μsec after the leading edge of the line sync pulse. In our simple coder it's sufficient to allow the burst to be in the R – Y phase, there being little effect on the picture in mixing it with the blue to place it in the normal – B – Y phase.

Since because of its simplicity the coder doesn't completely eliminate all trace of the subcarrier (and it's by no means unique in this respect) some logic circuitry was devised to ensure that the chroma amplifier transistor Tr1 is gated on only when chroma is present in the picture. At all other times, except when the burst is present (remember it's already mixed with the red signal), this transistor is off. This could have been done by using the gating signals already present in the generator, but this would have severely limited any further developments to the design it may be desired to make – such as adding switching to provide full-screen colour bars, or even a pure red raster.

IC36/40/44 detect the colour information. Part of IC36 conducts when all three colour signals are present (i.e. white information), passing this signal to pin 8 of the inverter IC44. The signal then goes to IC40, part of a 7408 used in this case as an OR gate. Inverted colour signals are fed into the other section of IC36, and also pass via an inverter to IC40. This circuit conducts when all colour signals are absent (black).

Subcarrier Signals

For simplicity, a TBA540 is used to obtain the 4·43MHz subcarrier. R1/2/3 keep the phase detector section of this i.c. quiet, the remaining components, including the crystal and the only adjustment (C9), setting the correct frequency. L1 (the reference coil assembly from the GEC C2110 colour series, part number L420016) forms part of the phase-shift network providing signals with a 90° phase difference to pins 2 and 8 of the TBA520 i.c. The latter acts as the chroma modulator. 7·8kHz pulses from IC39 drive the internal PAL switch in this i.c.

Colour Coding

The colour signals are summed in the network R23/4/5 to give a Y signal which is inverted in the unlikely looking stages Tr2 and Tr3 which mix in the blue and red signals to give B – Y at pin 9 of IC2 and R – Y at pin 13. R9 helps to correct the colour reproduction. The modulated chroma signal appears at pin 5 of the TBA520 and is fed to the chroma amplifier transistor Tr1. The chroma signal appearing at its collector is resistively mixed with the luminance and sync signals, giving a low-impedance composite video signal which is fed into pin 8 of the modulator. The output from this lies between channels 35-45, depending on manufacturing tolerances.

The main disadvantage of the chroma blanking system used is that all the chroma signals sit on a slight pedestal. This has not so far caused any problems however.

Construction

Before starting construction, note that there are some alterations (see later) to the circuit diagram shown last month (the PCB is correct).

Almost all the circuitry required to produce the test card in monochrome is contained on the logic board. It has been extremely well designed, but there are some tedious points that will hamper construction.

First, wire up the supply rails as shown. Why not use printed tracks? Well, thin tracks could have carried the full 700mA or so needed by the TTL i.c.s. At best this would have caused instability, at worst the print could have melted. So it was felt best to revert to wiring for this part of the project, and an hour or so spent on this will not detract from the attractive appearance of the board.

Next, trace the through points connecting the print on

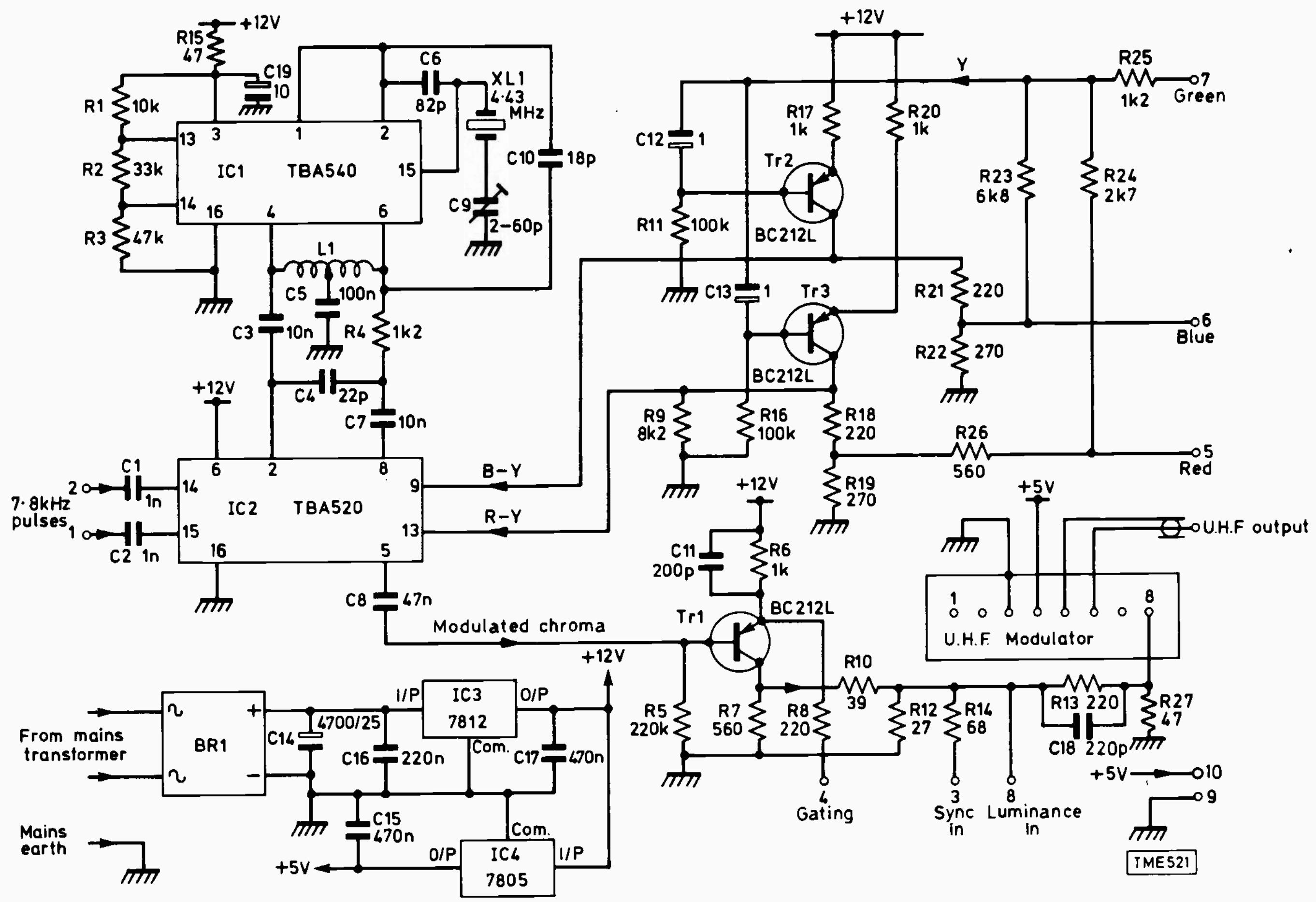


Fig. 5: Power supply and analogue sections of the colour pattern generator circuit. The mains transformer is an RS type 207-267. Mount the two regulators on a common RS 401-497 heatskink.

one side of the board to the other. Pass a thin piece of tinned copper wire through each, solder then snip off.

Last month we suggested using i.c. sockets. These would be difficult to fit however, since it's necessary to solder connections to the top print as well. A cheaper and more satisfactory method is to use Soldercon strips. These are quite easy to fit and tidy. Simply cut off the number of pins required for each side of the i.c. – seven in each case except for IC1 – then insert them without removing the ribbing. Solder the bottom printed connections first, then carefully solder the top where the pin passes through a track. It's best to do it this way round – heating the board from the bottom can cause the joint on the top of the board to melt with the result that solder runs into the pin, clogging it so that the i.c can't be inserted. Once the Soldercons are in place, insert the i.c.s and rock the ribbing gently until it snaps off.

Finally insert the remaining components.

It's important to use a fine soldering bit for this work, since it's very easy to bridge tracks or pins and possible to create dry-joints. If you don't have a small iron, a piece of tinned copper wire clipped to a standard bit works but takes a while to warm up. A suitable circlip can often be found on old TV set knobs with narrow shafts – as used for example in the Philips 70 series chassis.

No matter how careful you are, the circuit is unlikely to work first time. Provided you've used good quality components, the trouble is more likely to be due to a forgotten link, an almost invisible bridge across adjacent tracks, or a dry-joint. There are many combinations of faults that could cause incorrect operation or even no results, so it's not possible to give a fault guide. When we come to final construction and setting up next month however some quick checks to enable you to see what's happening in parts of the logic circuit will be given.

Modifications

IC12 will not function with pin 8 earthed. The circuit should be amended as follows: pin 6 goes to pin 12, not pin 7; pins 7 and 8 remain linked; none of these pins is earthed.

Pins 2 and 5 of IC11 (also pin 2 of IC23 therefore) should be linked to pin 11 of IC9.

Remove the link between pins 4 and 12 of IC22. Pin 12 goes to pin 9 of IC14; pin 4 goes to IC14 pins 5/11 as shown.

IC43 pin 9 should go to pin 6, not pin 1, of IC46.

Pin 8 of IC11 should go to pin 13 of IC25.

To give improved temperature stability, add a G23 thermistor in parallel with R6. This is a glass bead device, available from Maplin (part no. WH24B).

Add a 3,300pF ceramic disc capacitor between the supply line and pin 8 of IC26.

As the circuit stands, the frequency gratings are displayed on the opposite sides of the screen to the prototypes. This doesn't matter, but if you want them as illustrated, transpose pin connections 1 and 5 of IC42.

Finally, no more rude comments please! The poor picture geometry on the cover of the May issue was due to the set, not the pattern generator. In their usual state of confusion, the editorial staff were caught without a working set when the photographer called. A hasty search in the remoter corners of Kings Reach Tower produced a set which gave that odd display. But it does show how effective the pattern is, doesn't it?!

Long-distance Television

Roger Bunney

THE exceptional F2 conditions during February were not repeated in March. There has been some F2 reception however, mainly from the south rather than the east, bringing in Rhodesia and suspected Ghana/Nigeria on ch. E2. There are signs of increasing Sporadic E, though with only short openings, while the adverse weather in Western Europe during March didn't encourage any increase in tropospheric reception.

March 1st produced reports of a weak ch. R1 signal (49·75MHz video), but from the south. This was followed by the commonly received ch. E2 (48·25MHz) vertical frequency grating pattern thought to originate in W. Africa. The 2nd and 3rd also produced southerly F2 signals, with Gwelo, Rhodesia and the pattern just mentioned during the late afternoon. Similar ch. E2 signals were logged on the 6th, 12th, 14th, 15th and 21st.

Perhaps the most dramatic day for F2 reception was the 10th, with strong E. Russian signals on ch. R1, resembling the jammed conditions of the previous month. Strong signals were received from 0800, with fair quality vision but distortion due to co-channel a.m. transmissions, the signals fading from about 0930. Later the same day relatively strong signals on ch. E2 were noted here, from the south west, giving thoughts of Ghana/Nigeria. If any readers who live in that area can give details of the types of test patterns transmitted by the local stations it would help us in identifying signals.

Good news from Anthony Mann in W. Australia. Hugh Cocks sent him notes to enable him to convert an Australian TV set for reception of System A transmissions (405 lines with positive vision modulation). Following this, Anthony successfully resolved both the vision and sound BBC-1 ch. B1 signals on February 12th, the most distant reception of BBC TV in the present cycle. Our congratulations! Vision was resolved between 1234-1302 GMT, with easy locking though the picture quality was somewhat fuzzy.

The good opening on March 10th was also noted in Australia, where the MUF rose to 53·3MHz during the early afternoon period. Again two BBC TV signals were received (in sound) and three sound signals. The offset frequencies were measured at 18, zero and −34kHz.

Ryn Muntjewerff (Holland) reports reception on March 18th of 625-line, negative-going video from RTL (Luxembourg) on ch. E27, from the newly listed 1,000kW e.r.p. transmitter which provides a service for Belgian French-language viewers. The usual test card with "Ecoutez RTL" was seen, though weakly. This transmitter is listed in the 1979 WRTV Handbook, but had not been seen previously.

EBU Listings and News Items

Spain: Montanchez ch. E23, 158kW e.r.p., horizontal. RTVE-2.

France: Nantes ch. E23, 1,000kW e.r.p.; Alencon ch. E48, 100kW e.r.p.; Laval ch. E63, 120kW e.r.p. All transmitting TDF-1 with horizontal polarisation.

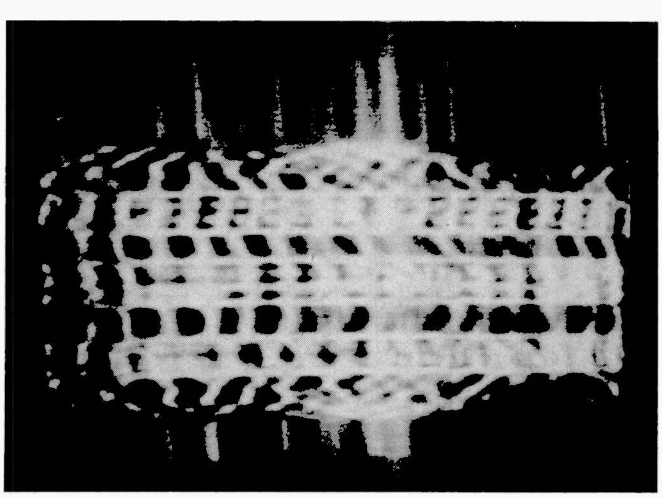
Israel: A report suggests that Israel may begin colour transmissions in three-four years' time. Israel is at present the only Middle Eastern country not transmitting in colour – an "electronic scrambler" converts incoming colour information to monochrome at the transmitter. Apparently the signals can be "descrambled" at the receiver to give colour reception, using an Israeli made unit. The reasons for delaying colour seem to be economic – the Israeli transmitters are colour capable, and fifty per cent of programmes are made and recorded in colour.

Somalia: Iraq is to assist in setting up a monochrome service which should commence operations later this year.

Australia: Bad news for F2 TV-DXers. There are at present three transmitters operating on ch. 0, but due apparently to complaints from radio amateurs who suffer from heavy interference ATV-0 and TVQ-0 (Melbourne and Brisbane respectively) are to change channel, leaving only ABMN-0 in operation. The change is scheduled for November this year.

Czechoslovakia: Our friend Vladimir (Prague) writes as follows: An accident at the Krasov (West Bohemia) TV centre mast affects chs. R10/34. The new mast will take almost two years to get into operation. The Plzen (Pilson

Dushanbe (SSE of Tashkent) regional identification slide, received by Geoff Perrin at Abu Dhabi.



Can anyone help identify this ch. E2 signal received by Ryn Muntjewerff (Holland) at 1525GMT on 2/3/79 via F2?

City) transmitter is now operating on chs. R10/34, and there's a new u.h.f. outlet at Trebic, on ch. R28, at 300kW e.r.p. The aerial of the Polish Snieze Kotly transmitter on the Czechoslovakian border has been modified to give reduced TVP-2 output into Bohemia (ch. R35). This corrects some information previously given.

India: The INSAT-1 satellite providing direct TV broadcasting (hopefully at 860MHz) to the entire subcontinent is due to be launched in 1981. There will be two high-powered transmitters aboard, giving adequate signal for single receiver units in villages.

From our Correspondents . . .

Dennis Boniface (Ripon) is currently using a Bush Model TV161 fed from an external tuner of the type used in the Pye 40F chassis. His aerial arrays consist of a wideband Band I aerial at 10ft, a wideband Jaybeam ABM11 Band III aerial at 12ft and a wideband Antiference XG21W u.h.f. array at 16ft. Dennis saw strong Russian F2 programmes on February 15th and 26th, but unfortunately his local Holm Moss ch. B2 signal tends to jam the lower end of Band I most of the time. He's very active with auroral work: warning signs are a fade out of the h.f. band, increasing solar noise and the appearance of Radio Gdansk at 70·31MHz along with the 144·96MHz Lerwick beacon.

Chris Wilson (Potters Bar) is another DXer who received many F2 signals during February. An interesting reception occurred on the 11th when in addition to F2 some longer than normal duration MS signals were received from the south, on ch. E3. The pictures showed the characteristic multiple images of F2 propagation – the first F2 reception via MS? Early morning (0830-0845) F2 video was also received on ch. E2 on several occasions when there were strong Russian signals present on ch. R1. Malaysia maybe? Chris is currently working on a new i.c. noise blanker (audio type): a tape of the results during heavy impulsive industrial interference shows a quite dramatic improvement. We hope to give further details in due course. Dare I hope for an anti-VDU i.c.?

Cliff Dykes also received F2 video on ch. R1 during February: measurement on his Eddystone 770R receiver confirmed the presence of both the main 49·75MHz carrier and other heterodyne co-channel signals.

A New Aerial

Antiference have sent me for evaluation a sample of a new aerial, type MH473. It doesn't resemble any of the familiar UK systems, having seemingly countless Band I sized elements along the boom. The leaflet describes it as a "new colinear array for long-distance colour TV reception", and it appears to be aimed at the Middle East market. The boom is 10ft, 1in. long, and carries eleven elements cut to Band I sizes (two are folded and connected by open phasing bars) and three Band III sized half-wave elements which are in close proximity to the two Band I folded dipoles. The colinear elements behave as normal half-wave elements in Band I and as one-and-a-half-wave elements (i.e. series connected) in Band III. The resultant Band III gain is increased by 3·2dB compared to a tuned half-wave dipole.

A careful design exercise has provided a forward gain of 3dB at 48MHz rising to 6·5dB at 66MHz, with a Band III gain of 6·75dB at 172 MHz rising to a peak of 11dB over 195-225MHz before falling to 10dB at 230MHz. At 55MHz the half-power points give a beamwidth of 62°: in Band III the beamwidth is 40° at 205MHz and approximately 28° at 225MHz. It seems that the correct use

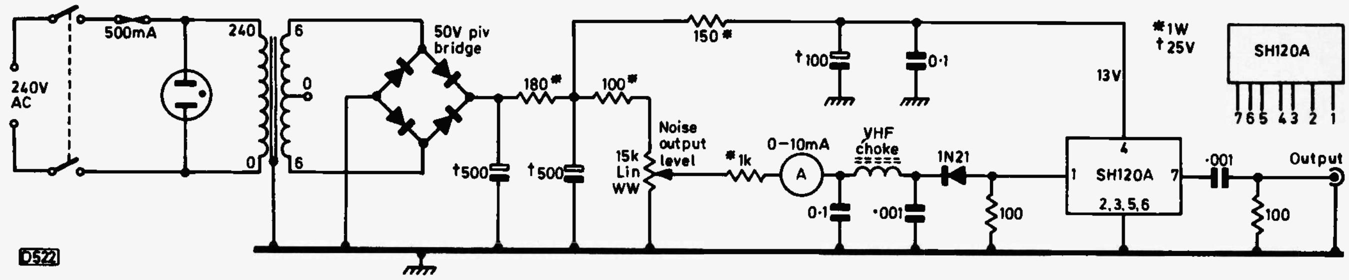


Fig. 1: Simple v.h.f./u.h.f. noise generator. An Eagle mains transformer is used. The v.h.f. choke is from the RS Components range. The SH120A i.c. was obtained from Maplin Electronics and the 1N21 diode from Z and I Aero Services.

of colinear elements can dramatically improve the polar response in both Band I and III, giving improvements of 16° and 40° compared to earlier and more traditional three plus eleven element arrangements.

News of this new aerial will I'm sure be welcome, offering the DXer a high-gain Band I/III system as a single though large structure, with Band splitting indoors by means of a conventional diplexer.

Apart from the gain, there's the advantage of reduced headload at the mast, also the use of a single feeder for v.h.f. and a Band III system with a larger capture area. As for the practical matters of price and availability, these have yet to be made known!

Noise Generator

Aligning an aerial preamplifier for use with the normal three local channels is relatively easy, since the improvement obtained can be seen immediately on the screen. Aligning a v.h.f. preamplifier for DX use is not so simple, since there will not be signals present throughout the spectrum – say 48-70MHz. A signal generator could of course be used, with an input attenuator and signal strength meter, but such equipment is expensive and unless it's going to be used regularly the expenditure is not worth while.

The television set itself is an ideal instrument for making basic observations: if run with the a.g.c. inoperative, relatively accurate subjective assessments of gain and level response over the bandwidth can be made. Faced with the problem of aligning a multiple stage wideband Band I preamplifier some years ago, I constructed a noise generator using the 1N21 germanium microwave diode – the design came from the RSGB's *Radio Communication Handbook*. More recently I modified it to operate from the mains, and added current metering to enable a more accurate reading to be obtained. Provided care is taken in constructing the generator, a degree of u.h.f. noise should be obtained – care in this context meaning the use of minimum lead lengths etc. With the advent of wideband hybrid i.c. amplifiers, I decided to further update the generator, using an SGS type SH120A which has a gain averaging 18dB over the 30-900MHz bandwidth. The circuit is shown in Fig. 1, the noise output being somewhat dramatic and adequate for both v.h.f. and u.h.f. use.

In use, the noise generator is connected to the receiver via the amplifier to be aligned, the noise output level control being set to give a noticeable level of noise on the screen. As alignment over the bandwidth progresses, the observed noise level should rise. During alignment, tune over the bandwidth to ensure that a level response is maintained. When no further noise increase can be obtained, reduce the noise level control until the original level of noise on the screen is seen, indicating that the required gain has been obtained over the bandwidth.

Construction is quite simple. An Eddystone type diecast box should be used – for screening, strength and general appearance. Adastra meters are suggested for their particularly attractive appearance, and a professional finish can be achieved by using Letraset or similar lettering. Paint over the letters with clear varnish – either nail varnish or a pressure spray from an art dealer. Complete the lettering before fitting the meter.

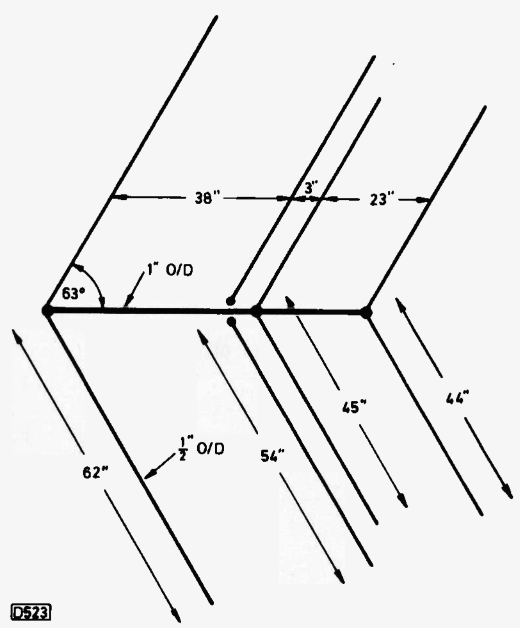


Fig. 2: Modified aerial for chs. E2-4.

Wideband Band I Array

Chris Wilson (Potters Bar) has sent in details of a modified wideband Band I array (see Fig. 2) which gives a somewhat reduced turning circle area – apparently Chris is allowed the use of the roof at his place of work provided the aerial elements don't overhang the edge of the building. The standard Trumatch (Antiference patent) design was modified to give the arrangement shown. This alters the forward acceptance lobe slightly, making the pickup sharper. It resembles a North American aerial known as the Vee array, variations on which have additional elements associated with the dipole in a fan formation to widen the bandwidth without the use of a director system.

For Disposal

I have for disposal a v.h.f./u.h.f. 20in. monochrome Blaupunkt 625-line receiver equipped to receive System B, G and I signals – ideal for DX-TV use. It's varicap tuned, with a 300Ω balanced input. Anyone interested in making an offer should contact me through the magazine. It would have to be collected – from Romsey, Hants.

Bionic Pyes

E. Trundle

THE PYE hybrid colour chassis has been with us since the start of colour transmissions in the UK in 1967. Initially appearing in dual-standard form, the same basic design remained in production for many years and was sold under the Pye, Ekco, Invicta and Dynatron banners. Single-standard versions of the chassis were designated the 691, 693 and 697 series, the last named boasting a redesigned line output and power supply section – on a PCB – in which access to many components is much more difficult than in the module it replaced. This assembly also suffered from board warping and print track troubles.

While these things can be overcome, there are three less soluble problems. First the price of spares for these receivers is very high. Secondly the colour-difference amplifier clamps are ineffective with an ageing c.r.t. which is on the soft side. And finally the CDA (colour-difference amplifier) panel, due to inexcusably bad design, can virtually disintegrate around the valveholders after some years' use.

CDA Panel Problems

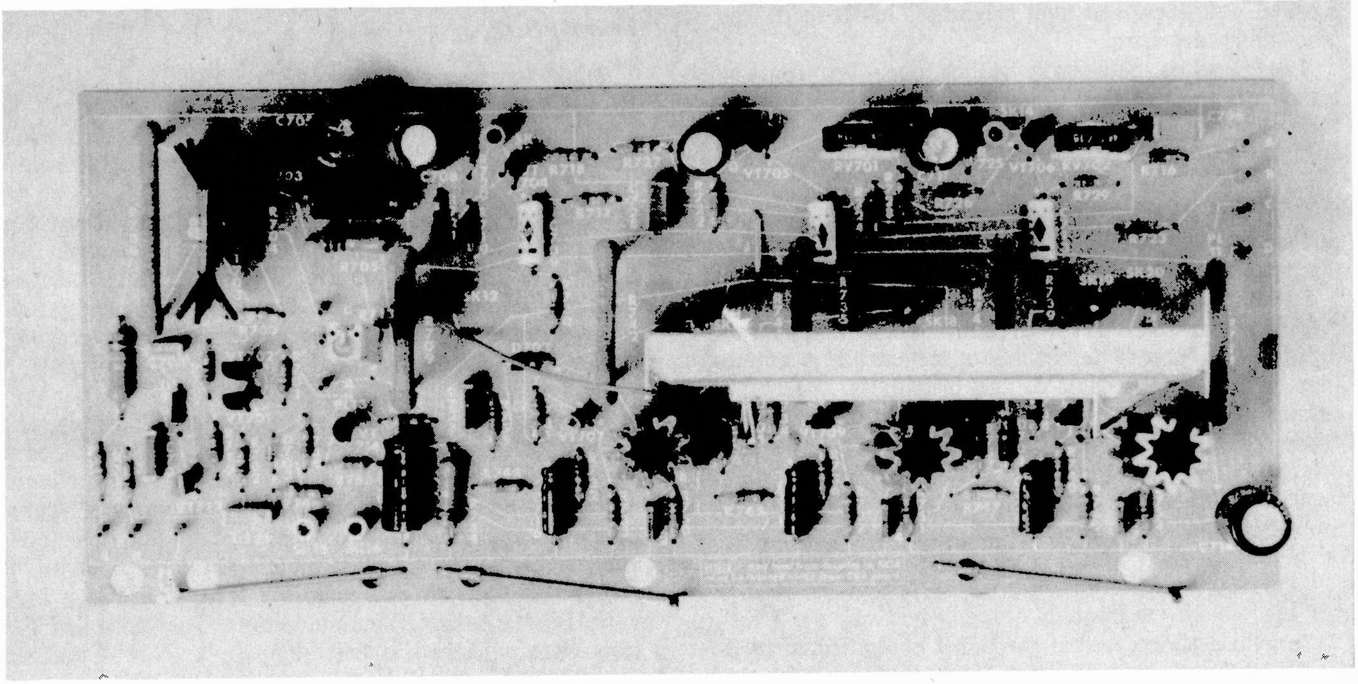
The method of mounting the CDA panel, and the heat generated by its hefty complement of valves and wire-wound resistors, result in cracks developing on the panel. These can be repaired, but conditions deteriorate to the point where the panel itself becomes charred and carbonised. At a rather late stage, when it had become obvious that this affect was widespread, the setmaker made available a valveholder with long legs and suggested fitting a set of these wherever the trouble is encountered. This was a case of locking the stable door after the horse had gone however: the action of fitting the new valveholders was sometimes the last straw for a board in an advanced state of decay.

Ironically, the manufacturers indignantly refuse to operate their service exchange scheme on panels which have "gone too far". This means that the old panel must be scrapped and a new one purchased at full price. To add insult to injury, the PL802 luminance output valve used in these receivers became very expensive and often scarce, while the LP1162 sound module which forms the audio amplifier for the set virtually went out of production, becoming hard to find.

An incidental perk of the workshop engineer is the benefit of television programmes during the day. Idly watching a soak-testing receiver the other day, and vaguely hoping that I would be regaled by the Pink Panther (far and away my favourite) I saw the beginning of an episode of Six Million Dollar Man. Here indeed was a parallel to the ailing Pye! We can rebuild him! We have the technology! In the case of the Pye, restoration rather than enhancement is the object, and the finished product comes rather cheaper than Steve Austin.

Panacea

A solid-state replacement CDA panel has been developed by a Croydon firm, LEDCo, to replace the offending valved type. In layout, it's remarkably similar to the original panel, and is a plug-in replacement with colour-coded sockets to match the flying plugs.



The LEDCo solid-state CDA replacement panel for use in Pye hybrid colour receivers.

The circuit is shown in Fig. 1, from which it will be seen that the design is conventional and very much dictated by the need for compatibility with the existing circuitry. The luminance channel is d.c.-coupled throughout, and uses a Darlington pair (VT701/2) to drive the BF459 luminance output transistor (VT703). The latter's emitter is taken to ground via the blanking transistor VT713, both transistors being cut off during the line and field flyback blanking.

The colour-difference channels employ a preamplifier plus G matrix circuit (VT704/5/6) similar to that of the original panel. The three colour-difference signals are a.c.-coupled to two-stage video amplifiers, each consisting of an emitter-follower driver and a BF259 output transistor. The frequency response is tailored by the 0·0015μF emitter decoupling capacitors which set the gain at 1MHz. Feedback clamps are employed to maintain the correct black-level at the c.r.t. grids – a more effective system than the driven triode clamps used in the original Mullard design. The 47V line pulse which drives the valve clamps is not used in the Ledco panel. Instead the –47V flyback blanking pulse is utilised, after inversion by VT714.

The panel is surmounted and dominated by a 200Ω resistor on a large aluminium heatsink. This is a necessary evil, dissipating the energy previously used by the four valve heaters. The panel comes complete with a circuit diagram, transistor alternative chart, voltage table and setting-up instructions.

On Test

The Ledco panel was fitted to a suitable receiver for evaluation. Mainly due to the method of mounting, the surface of the panel undulates rather, and I fear for the continuity of the print tracks after a few thousand thermal cycles. The brightness level was set up in accordance with the instructions supplied, and the colour-difference settings checked – they were virtually spot on. Ironically, the review sample had two dry-joints at the CDA power transistors – undoubtedly the result of a lot of handling here and at the Editorial office. After putting these right I was confronted with a very good picture indeed, quite indistinguishable from a well set up valved panel. The beam-limiter function performed as it should, and the flyback blanking circuit worked well – even at high brightness levels there was no trace of flyback lines.

The panel is necessarily a hot one. The four video transistors are mounted in very substantial heatsinks, as is the heater-dropper resistor, the latter being very close to the BF259s. The heatsinks of these transistors ran so hot that, suspicious as ever, I was prompted to calculate their dissipation. It came out at well below (of course) the published rating for the device, in spite of the case temperature.

I next sought a set with a tired tube. It was not long in coming – an Ekco set with lurid bands of colouration, mostly green, across the display of test card F at any more than a moderate setting of the brightness, contrast and colour controls. This effect is due to grid currents from a gassy tube loading the high-impedance clamps in the original CDA panel design. The Ledco panel, with its feedback clamps, does not suffer in this way. The picture is much better, which is a real bonus.

Verdict

Despite assurances that the panel is unaffected by heat (and has, I'm told, undergone long term tests with rental companies) I would be interested to see the effects of four or more years heavy use on it. The price is below the Philips Service price (nett to the trade) for a new CDA panel, with the added bonus of freedom from performance deterioration due to valve ageing, and the necessary expense of their replacement. I would say that provided the line output transformer and tube are in good condition any Pye group hybrid colour receiver is worth having this panel fitted to it, especially in view of the acknowledged reliability of the rest of the signal stages of the receiver.

Sound Module

The Ledco company also manufactures and markets a sound module for the same chassis. It replaces the ill-fated Mullard LP1162, and also finds applications in audio equipment where this module is specified. Again the physical and electrical characteristics match the module it replaces, but without the vulnerability of the germanium semiconductors that were a feature of the Mullard module. The pin connections are marked with their functions.

A type SN76013ND i.c. is the heart of the module – and this chip was in fact used in some of the final production of the Pye group hybrid chassis, in a very similar circuit to the Ledco one. This chip has not in my experience distinguished itself in the reliability stakes in audio equipment, though in TV applications its track record is much better: this is undoubtedly because the device is much harder pressed in audio applications.

My sample worked well in the test receiver – again with results indistinguishable from the original. The i.c. was not affected by a prolonged period of use at a high volume level, but I was – a 12Ω resistor was soon substituted for the speaker. Never mind the niceties of inductive loads and $X_L = 2\pi fL$, a resistor is *quiet*.

As with the CDA panel, the price of the audio module is below that of the original one from the setmaker, and I see no reason why the Ledco module should not be fitted in preference to an LP1162. I've got a definite mean streak however, and where the germanium driver and output transistors in an LP1162 have failed I'm not above drilling them out of their heatsinks and fitting replacements, time permitting.

The BF802

I had two samples of solid-state PL802s to try out, a PL802S from LEDCo and a PL802/T from DR Developments. They've inevitably been christened BF802 here – what else? The internal circuits are almost identical – that of the PL802/T is shown in Fig. 2.

Probably the first question one would ask about these devices concerns their vulnerability to damage from flashovers. The answer to this lies on the c.r.t. base rather than in the module however. Provided the spark gap and series protection resistor are present and correct, these devices are no more at risk than any other video transistor feeding a c.r.t. electrode in any type of set.

Again a built-in oven is unfortunately necessary, to double for the valve heater, but the heatsink provided for the BF459 video output transistor used in these modules is more than adequate. Regarding the performance, I cannot fault this, though I must confess that I have only looked subjectively at the excellent picture these modules provide rather than carried out elaborate tests – as did a major valve (and transistor!) manufacturer. The results of these tests were published in that company's "News" and were distributed to the trade for its edification. They were to the effect that the contrast performance of most PL802-type

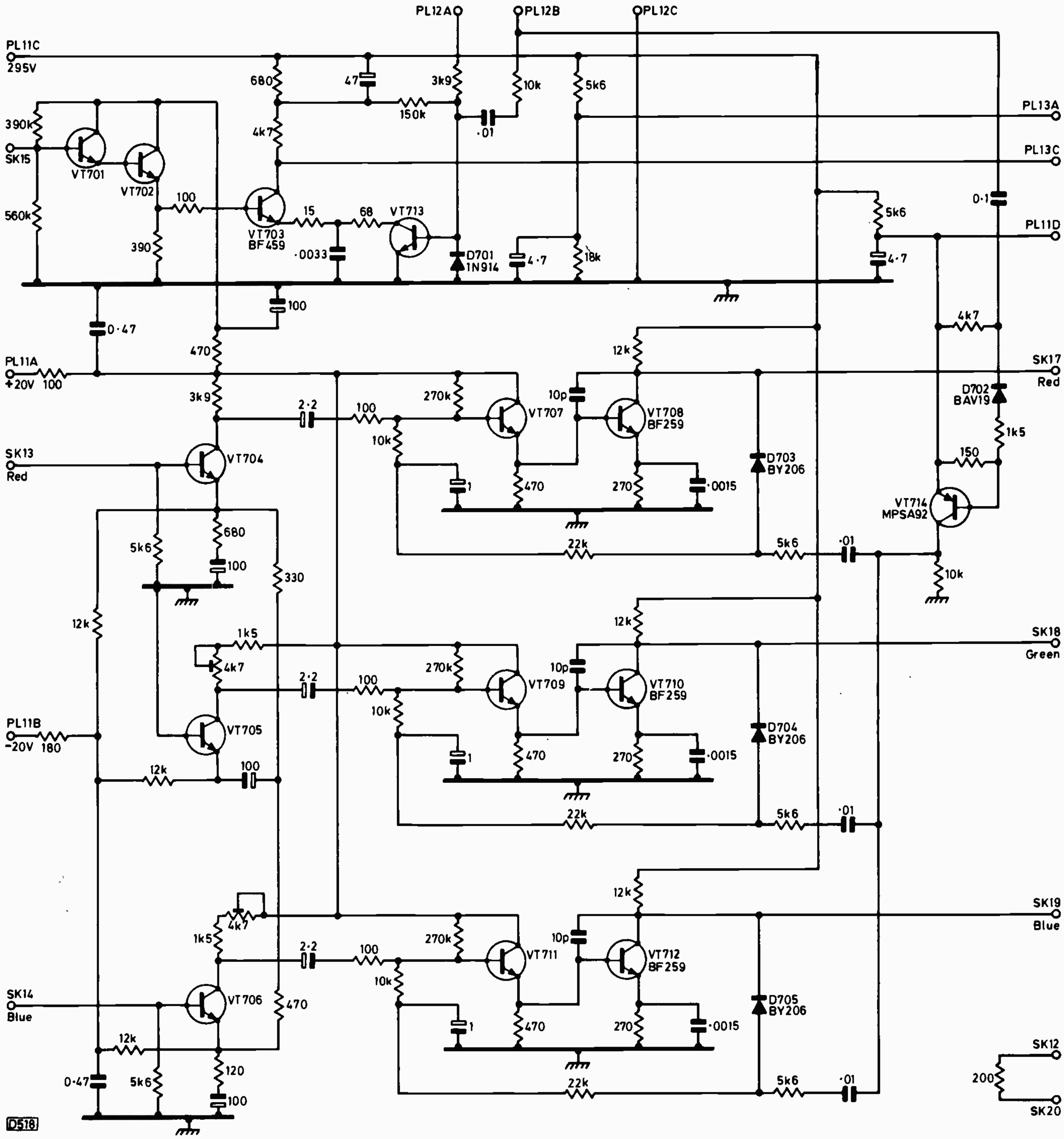


Fig. 1: Circuit diagram of the LEDCo solid-state CDA panel.

modules fell short of that of the genuine thermionic article. Well, the proof of the pudding is in the eating. Most sets which call for a PL802, especially Pye and GEC group chassis, have no shortage of contrast: seldom does the contrast control need to be fully up, whether the PL802 is a valve or a solid-state module.

In view of this and the long-term reliability and low initial cost of the solid-state alternative, I'd not hesitate to come down very strongly in favour of the solid-state module. Ahem, what's the word on a PL519/T lads – any chance?

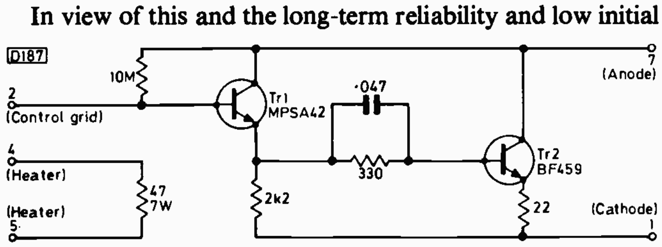


Fig. 2: Circuit of the PL802/T.

Prices

The CDA module Model 705, audio module Model 702 and PL802S are available from LEDCo, 189a Livingstone Road, Thornton Heath, Surrey, CR4 8JZ. At the time of writing prices are £21, £6·75 and £2·40 respectively including VAT and post/packing. Discounts are available for orders of five or more. The PL802/T is available from Lloyd Electronics, 63 North Parade, Grantham, Lincs at £2·50 including VAT. Quantity discounts are available; add 20p for post/packing on orders under £10.■

Renovating Körting Hybrid Colour Receivers

Part 1

Mike Phelan

MANY of these excellent Austrian built sets are appearing at trade disposal outlets. They are well made, reliable, and give very good picture quality. The sets use valves in the timebases and semiconductor devices elsewhere. There are either two or three integrated circuits, depending on the type of audio output stage fitted. A combined v.h.f./u.h.f. tuner is used, but the rest of the receiver is single standard.

The Körting is of not unpleasing appearance, and the same control layout is used in the 22in. and 26in. versions. All the controls are on a panel below the speaker grille, and consist of the seven-button tuner (the seventh button is for tuning), a perspex tuning scale, four sliders for brightness, contrast, saturation and tint, rotary volume and tone controls and push on-off switch. Earlier models had a switch to turn the colour off.

Layout

On removing the back cover, one is impressed by the solid mechanical construction and good accessibility. The chassis consists of four non-removable printed boards (see Fig. 1) mounted in a swing-down metal frame, à la ITT CVC5. The right-hand board contains the line timebase, enclosed in a screening box. The board above the c.r.t. has on it the heater thermistor, h.t. rectifier, and various large wirewound resistors. The lower board contains the smoothing electrolytics, the flyback blanking and raster correction circuitry, and above these the field output transformer. On the c.r.t. base, as well as the usual things, are the luminance output transistors. The largest board, on the left, contains the field timebase, the l.t. supply, and six plug-in modules for the signal handling stages. The print side of the main boards is covered not only with component references but also voltages, waveforms and even ripple values for the various supply lines.

Accessibility

After turning the two slotted pegs anticlockwise, the chassis can be lowered to the 45° position; a slight lift and it can be lowered further until horizontal. The chassis, tuner and control panel can be removed from the cabinet in about ten minutes without the use of any tools.

To remove the chassis, unplug the following connectors first: blue/white lead from c.r.t. base; base itself; final anode cap; two earth leads from c.r.t. shield, one from tuner; two flat plugs below line can; scan coil plug on side of same; ten-pin plug near PAL delay line; three-pin plug near PCL805; two-pin plug from contrast control to Y board (the module at the top left of the chassis); brown speaker plug above mains transformer; seven-pin plug on tuner; and finally the two-pin mains plug near it. If the chassis is now raised until vertical, it can be lifted clear. To remove the tuner, undo the plastic nut above it, press the retaining spring to one side, and slide the tuner unit out. Three more plastic nuts hold the control panel in; the knobs can be left on if they are the small type.

All the modules can be plugged in on the reverse side of the main board to facilitate servicing. The i.f. module has an earth connection which has to be unsoldered before removal: it's midway between the two halves of the edge connector. The audio, luminance and chroma amplifier boards are held in by latches which must be turned through 90°. The decoder comes out when the top of the screen has been taken off and the CDA panel is retained by a latch on the chassis edge. All presets are accessible with the modules in position.

The Tube

It's quite likely that the set you obtain will need the c.r.t. replacing, either because it has lost emission or has a heater-cathode short. The latter is a very prevalent fault on this chassis, due to the fact that the heater supply is earthed. A last-ditch repair can sometimes be effected by raising the heater supply to cathode potential as follows. The two tags nearest to the chassis on the mains transformer are earthed. Disconnect the earth from the one next to the edge. Remove completely the brown lead from the c.r.t. base heater pin. Route a new lead from this pin to the now vacant tag on the transformer. Fit a resistor of about 1MΩ from one of the heater pins to the cathode of the faulty gun. It's worth while carrying out this modification whether or not the tube is faulty. Also take particular note of the setting up procedures given later, as incorrect adjustment can seriously shorten tube life.

Power Supply Circuits

Unlike some very sophisticated (and unreliable) power supplies, that of the Körting is fairly simple (see Fig. 2). A half-wave rectifier (GL601) feeds three h.t. lines. The l.t. supply comes from a bridge rectifier (GL651) and is stabilised by a series regulator circuit. The heater chain is supplied from a tap on the mains transformer, through the usual thermistor: this explains the very long warm-up time on these sets, but pays dividends in valve life.

There are quite a few fuses on this chassis. Si1 and Si7, both 3·15A anti-surge types, mounted behind the mains filter assembly, are in the live and neutral sides of the mains supply respectively. If both fuses have blown, the filter capacitor C689 (0·22μF) will be found short-circuit. This component is mounted just in front of the fuses. If only one fuse has blown, you will probably find that the h.t. rectifier, on board "N" above the c.r.t., has gone short-circuit. After replacing it with a BY127 and switching on, probably no raster will appear. Before panic sets in, check R605 (180Ω) which may be open-circuit.

Si4 (500mA A/S) and Si5 (1A A/S) are the heater and 285V h.t. line fuses respectively. Failure of Si4 is usually due to a defective PY500 or spark gap (this is on the print side of the PY500 base). If the h.t. fuse fails, the reason is probably nothing more complicated than a faulty PL509,

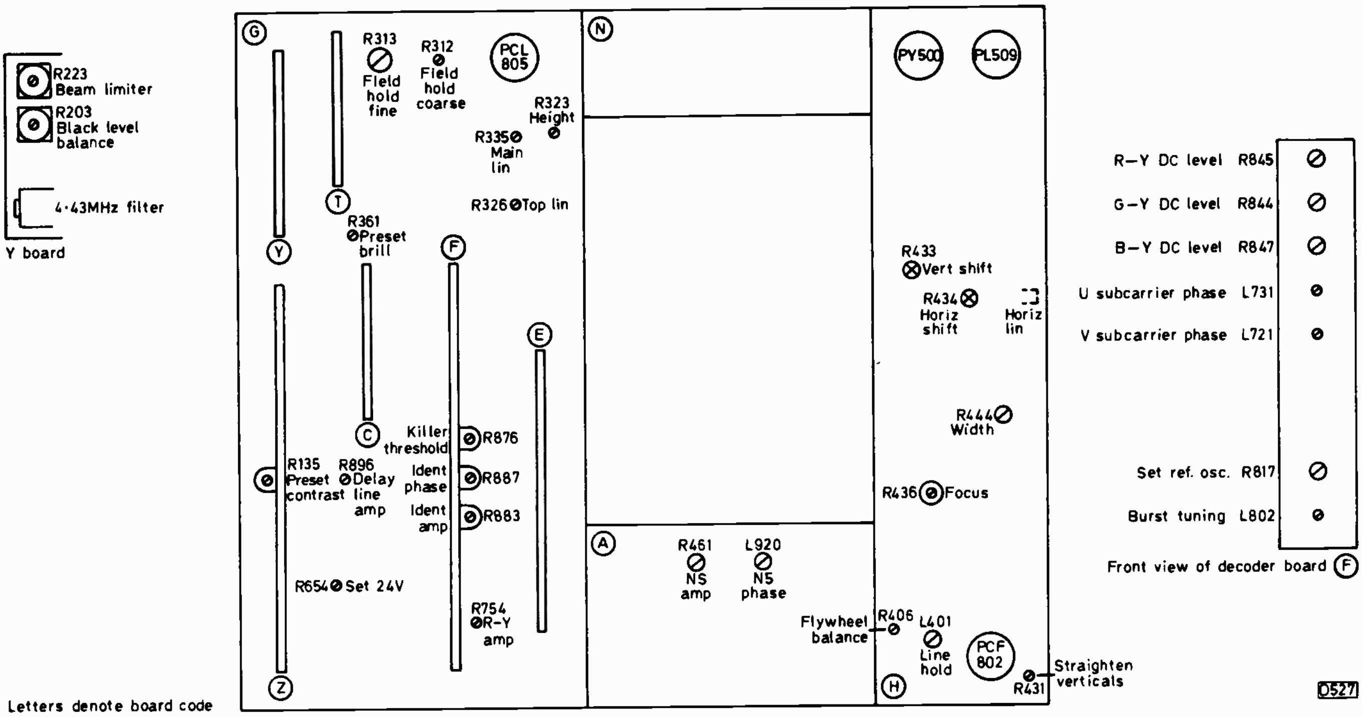


Fig. 1: Positions of the preset adjustments etc., viewed from the rear.

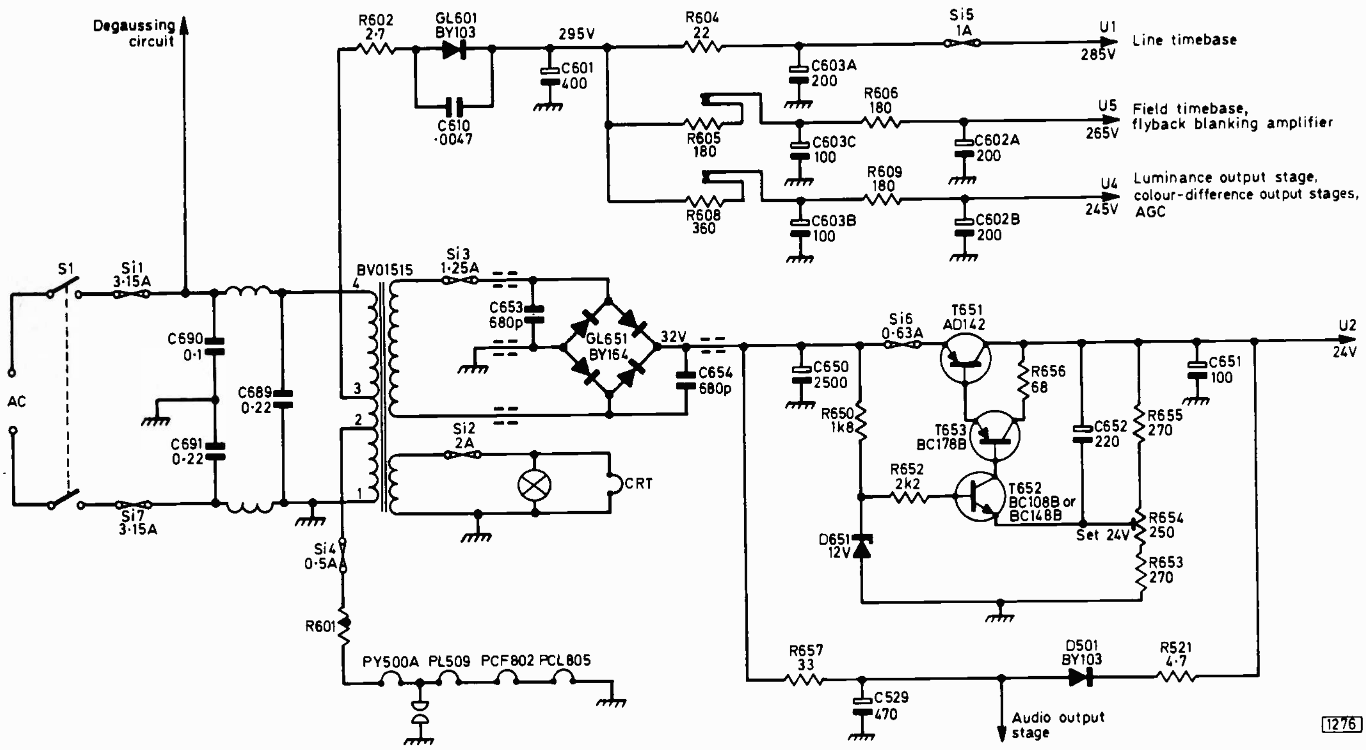


Fig. 2: Power supply circuitry used in Körting hybrid colour receivers. D501/R521 protect the audio output transistors against positive-going spikes produced in the stage.

PY500, or tripler. This fuse feeds the line timebase only. The other two h.t. lines, U4 and U5, are protected by the fusible resistors R608 and R605.

There are three other fuses in the set. Si2, on board A, is in the c.r.t. heater supply and rarely fails. The two fuses on the bottom chassis rail are in the l.t. supply. Of these, Si3 (1·25A A/S) will blow if the l.t. bridge GL651 goes short-circuit; this is approximately halfway up board G. When replacing it, check that the large resistor on the CDA board is not touching it, otherwise this will lead to its premature failure. Si6 (630mA) comes after the rectifier, and will blow if there is a short on the 24V rail. Before getting involved in extensive fault tracing, remove the i.f. panel: the short will probably disappear. If it does, check C149 (2·2μF tantalum) on the i.f. panel.

A high 24V rail with a hum bar is usually caused by a leaky regulator transistor T651 (AD142), although either of the other two transistors in the circuit, or the 12V zener diode D651, could be responsible. If the 24V rail is low, again any of the semiconductor devices in the circuit could be at fault. A look at Fig. 2 will show that there's a network R657-D501-R521 connected across the 24V regulator circuit. The purpose of this is to clip any spikes produced in the audio output stage. If there's no output from T651, e.g. if it or Si6 has gone oven-circuit, the network will try to supply the 24V rail, albeit not very successfully. R657 will

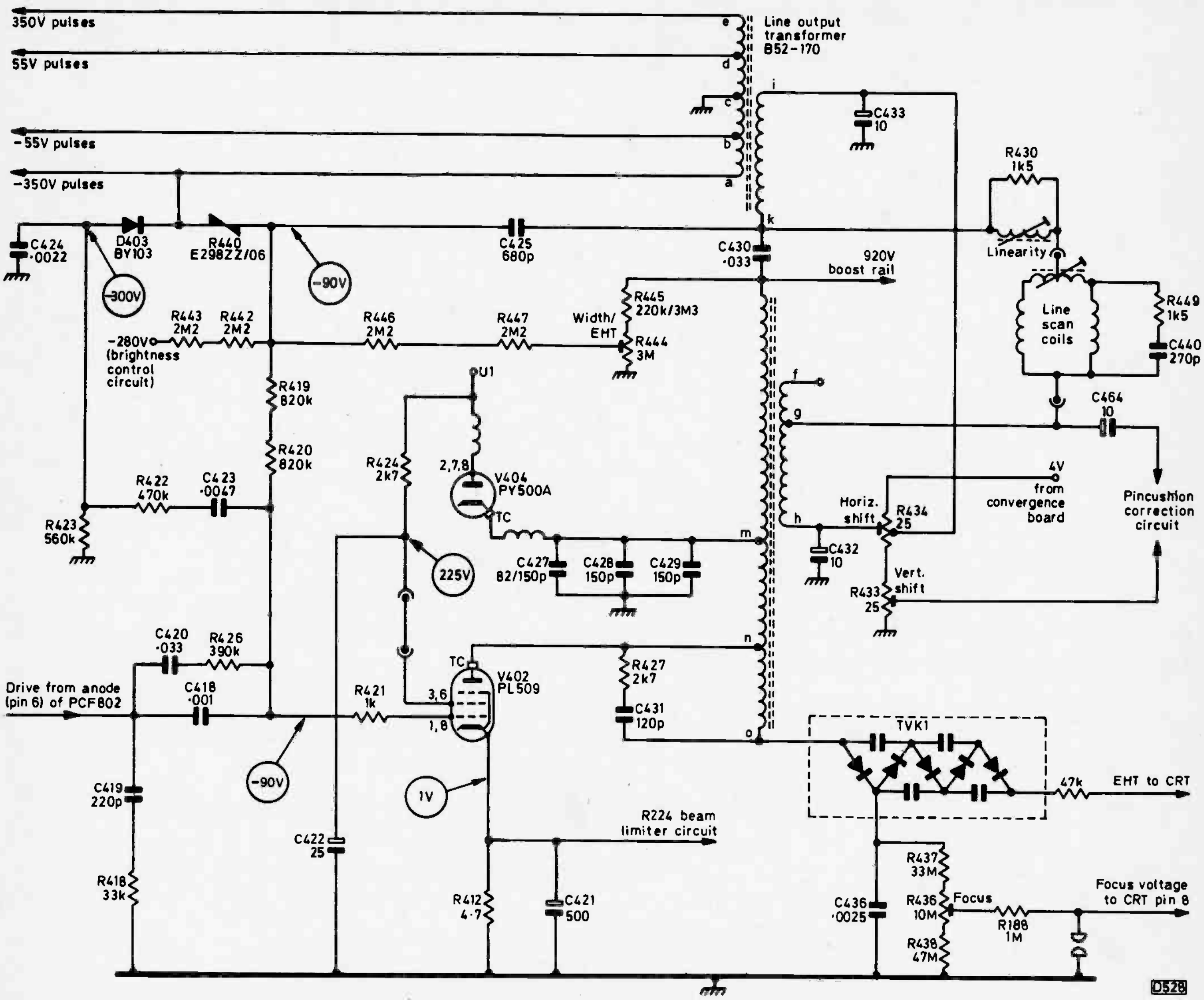


Fig. 3: The line output stage is conventional apart from the extra circuitry in the width/e.h.t. control loop to provide a fast-acting auxiliary control system.

overheat, and the colour will vary with the sound. It must be noted that on some chassis R657 is connected after the fuse, not as shown. In this case R657 will not overheat when Si6 blows.

The smoothing electrolytics can be forgotten as they rarely fail, probably because there are so many of them! A word of warning though. The A board forms an excellent trap for dropped screws etc., and these can cause some elusive h.t. shorts.

Line Timebase

The line timebase is entirely on board H, and is conventional except for a few unusual features. The feedback to the flywheel sync circuit is taken from the screen grid of the oscillator rather than from the output stage. The line sync is thus independent of changes in beam current, giving a very steady picture. There's also an auxiliary e.h.t. stabilizing circuit that responds to rapid changes in beam current, e.g. captions. These two extra details give a noticeable improvement in picture quality.

The VDR in the width control circuit (R440, see Fig. 3) is fed with positive line pulses via C425, and rectifies them to give a negative bias voltage for the grid of the PL509. Instead of the other end of the VDR being earthed however, it's fed with negative pulses from the line output transformer. This gives a much better control action.

The fast-acting auxiliary circuit works as follows. The negative pulses applied to the VDR vary in amplitude with the loading on the output stage: they are rectified by D403 to give a negative charge on C424 which is proportional to beam current. This is fed directly to the grid of the PL509 through C423, acting almost instantly. The main control cannot act quickly because it's connected to the long time-constant of the grid leak.

A glance at the circuit diagram will show that most of the high-value resistors in both timebases are series pairs for greater reliability.

Faults in the line timebase are usually nothing more than valve or tripler failure. The tripler develops a pinhole near one of the fixing bolts, and can sometimes be repaired by drilling out the hole to about ⅛in. depth, filling with epoxy resin and covering with a plastic patch. If the tripler has gone short-circuit then the 47kΩ resistor inside the final anode cap will smoke. After replacing, test with only one gun switched on, in case excessive brightness was the original cause of the failure. If so, common reasons are the luminance output transistor T151 or R163 (47Ω), both on the c.r.t. base (see Fig. 4). If the set was turned off soon enough, the tripler may have been saved, but renew the

47kΩ resistor in the connector. C436 (2·5nF) in the focus circuit can also destroy triplers, but is usually visibly burnt.

Poor focus can be due to the control itself, the two high-value resistors R437 (33MΩ) and R438 (47MΩ), the spark gap on the c.r.t. base or the c.r.t. itself. When replacing the focus control, make sure that the nut and washer make good contact.

Lack of width and e.h.t. can be due to R445, R446, or R447 being high, whereas excessive e.h.t. can be due to R419, R420 or the control itself (R444).

The boost capacitor C430 sometimes fails quite spectacularly, and the replacement must be of the correct type. Failure of the line output transformer is not very common; on some replacement types it will be necessary to connect the leads from point G to point F, as there is no G pin. A dry-joint in the h.t. feed from the power supply panel N to the line output stage is another possible cause of no e.h.t. A defective C419 can shorten the life of the PL509.

Failure of the line oscillator can be due to either R413 or R416 being open-circuit, but this stage is quite reliable. A hum bar on the line only will be seen if C417 (25μF) is open-circuit.

Access to the line oscillator and focus circuits is by swinging the tripler out of the way after depressing the spring. The shift controls occasionally lose their wipers, and can be repaired with a modicum of care. When refitting, be sure to replace the asbestos pad between the control and the printed board.

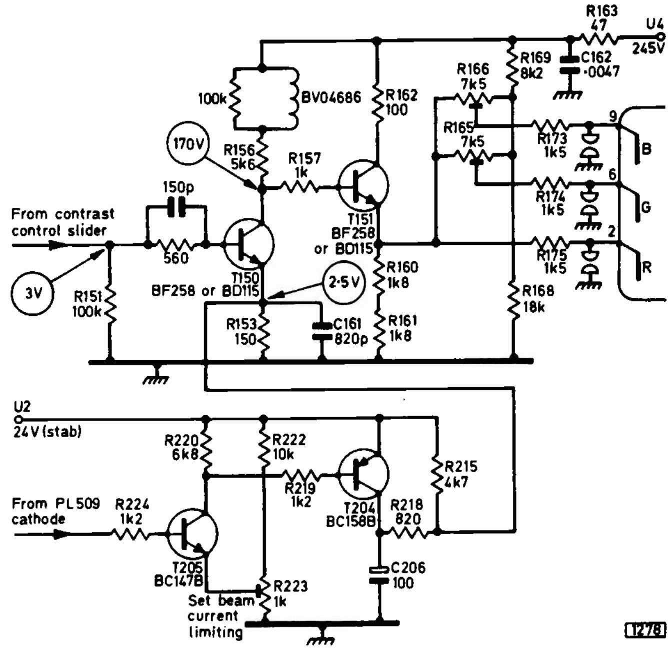


Fig. 4: The two-stage luminance output circuit, which is mounted on the c.r.t. base panel, and the beam limiter circuit. In some sets the drive control network R165/6/8/9 is omitted. An AA117 protection diode is connected between the base and emitter of T150 on some sets (cathode to base). The following alterations may be found in the beam limiter circuit: C206 220μF and R217 (100Ω) added between the collector of T204 and the junction of R218/C206.

Field Timebase

The field timebase could not be simpler! The PCL805 triode functions as a blocking oscillator and drives the pentode output stage (see Fig. 5). There is a trap for the unwary, though. C.R.T. protection is provided by supplying the brightness control from the field output stage, so that field failure will result in no raster. Changing the valve will usually put matters to right.

The bias components rarely give trouble, and failure of the height and linearity presets is almost unknown, these being high-quality components with carbon wipers. Something which does give trouble however is the group of four 47kΩ resistors just above the presets (R333, R334, R327 and R328). For some obscure reason, R333 is a ¼W component, and causes field jitter – as can any of the other three. R333 and R334 can go open-circuit giving severe non-linearity. R314 and R315, both 330kΩ, can go high in value, giving lack of height.

The pulses at the anode of the output pentode are partially rectified by VDR R345 to provide a positive

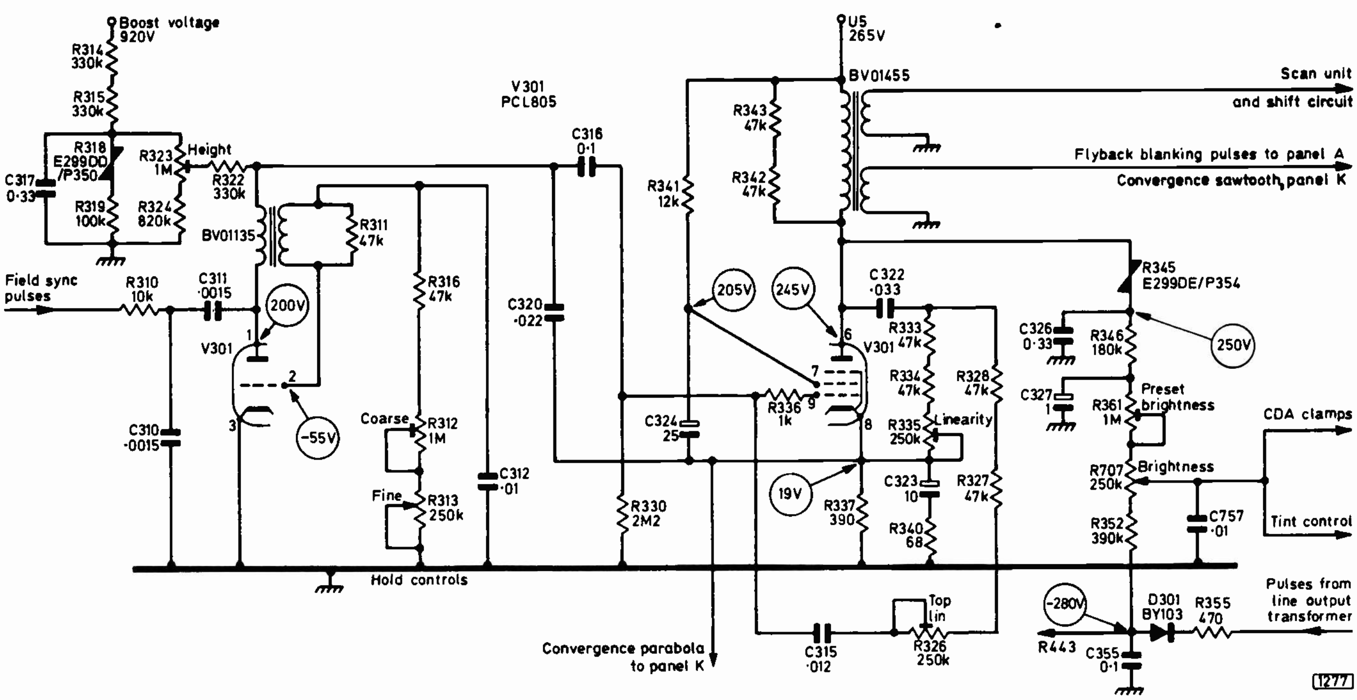


Fig. 5: The field timebase and brightness control circuits – field timebase failure results in a blank raster due to the way in which the brightness control circuit operates. In some sets R324 is omitted and the oscillator timing capacitor C312 is 0·015μF.

supply for the brightness control. The VDR also damps the spikes across the field output transformer's primary winding, as is usual in many chassis. Because the brightness control varies the clamping level on the CDA board, a negative supply is necessary at the other end. This is obtained by using D301 to rectify line pulses. The component that fails regularly in this part of the set is the preset brightness control R361 (1MΩ). Don't be tempted to turn it to one end if it has gone open-circuit, as this can lead to tripler failure and a short-lived c.r.t. The correct setting for this control is given later. R355 (470Ω) in the negative pulse feed sometimes goes open-circuit, giving excessive brightness of course.

Tuner Unit

The tuner is similar to that fitted to early Decca colour sets. It can be switched to Band I or Band III operation by rotating the push button in question while in the "out" position. A key is printed at the bottom of the tuning scale. Don't try to turn the buttons when they are in. The bottom button operates the fine tuning mechanism, and can be pulled out to turn if so desired.

The tuner contains three transistors – only the tuned circuits are band switched. T5 (AF106) forms an i.f. preamplifier: this, together with the high-gain i.f. strip, means that an attenuator is often required with these sets.

The most frequent tuner fault is failure of the r.f. amplifier transistor T3 (AF239). When replacing it, extra care is required to avoid either breaking the 160pF disc ceramic on its base lead or unsoldering the stator of the tuning gang by applying too much heat to the collector lead. You *are* in trouble then! Low gain and a low supply rail can be due to the 820pF capacitor at the base of T5 being leaky, or to one of the feedthrough ceramics having a splash of solder across its dielectric – remove with a small file.

Tuning Mechanism

Poor resetting accuracy occurs if the levers on the ends of the gang shaft are loose, or if the shaft has any endshake. Tighten the bearing screw only as much as is necessary, as excessive tightening will put the tuner out of alignment. Seal the screw with paint.

The push-button mechanism is very robust and trouble free, and the buttons themselves do not seem to break very often. If one needs renewing however, the method of removal is given as it is not very obvious. Behind the button there's a circlip: when this is removed, the rear part of the button can be pressed back on the shaft, exposing the front part. Ease the claws of the front piece out of the groove in the shaft, remove it, and the rest of the button will slide off. The fine tuner knob is held on by a wire spring. It will also be noticed that the bracket that holds the tuner has numerous adjustments for position, to enable the push buttons to be centred in their holes.

Colour Receiver Project

Part 9

Luke Theodossiou

This month we are dealing with switching the receiver on and carrying out all the adjustments. We strongly advise that you adhere to all the precautions described – failure at this stage will be very disappointing, and possibly expensive! We will assume you have thoroughly checked the board assemblies and all wiring. If there is any doubt whatever, check again.

Switching on

Before switching the set on, the following safety procedure is necessary. Power supply unit: remove all plugged connectors except A (from the mains transformer). Switch on and check voltages on the following connector pins:

F3	+5V	These voltages
F2	+18V	were taken on
D3	+24V	a prototype set
D2	+220V	using an Avo 8

Check the total (series) resistance of the degaussing coils; this should be about 25Ω. If everything is correct, replace the connector plugs.

Timebase board

First of all, using the resistance range of your multimeter, check for any obvious shorts at connector terminals D4, D3, across SCR3 and SCR4, across C42 (give it a little time to charge up), and D3. Then if all is well, using wire links short the anode-cathode pins of SCR2 and the anode-cathode of SCR4. The function of the first step is to completely bypass the regulator circuit, therefore clamping the horizontal deflection circuitry to the h.t. rail. This results in reduced current demand and avoids the risk of failure due to faults in the regulator circuit.

The second step prevents operation of the line scan circuitry but allows the flyback thyristor SCR3 to function. This enables us to set up the correct gate conditions for SCR4. If SCR4 was allowed to operate normally on first switch on, in all probability the circuit would miscommutate due to a wrong waveform at the gate of SCR4, since L1 was probably correctly adjusted. You would then get a very loud whistle for a few seconds followed by silence as SCR4 shorted due to overloading. This would also strain several other components, including the line output transformer, and these might fail.

The next thing to check is whether we have line drive pulses out of IC1 pin 2. Disconnect the lead to terminal 4 on connector D to interrupt the h.t. supply. Set all controls to their midpoint except the volume control, which should be set to its minimum position. Switch on, and check for +12V across D3. Transfer meter probe to the hot end of R13 (that is, pin 2 of IC1) for a reading of about +4V. Reconnect the h.t. supply. A Variac may be used in the mains supply when switching on – we've found this isn't absolutely necessary, but if you have one handy, use it. Now, keeping fingers crossed, switch on!

A faint whistling noise emanating from T1 means you are in business. The voltage on the gate of SCR4 is negative, so arrange the meter probes accordingly. Adjust the core of L1 until the most negative voltage is reached (i.e. the maximum reading on the meter). This is quite a critical adjustment if miscommutation on full switch on is to be avoided. Switch off, remove shorting link on SCR4, connect scope probe to the anode of SCR4 and switch on again. A positive going flyback pulse of around 600V peak to peak should be obtained. If all is well, switch off, remove shorting link on SCR2, and turn your attention to the signal board.

Signals board

Switch on: advance the brightness control until some kind of display is achieved. If you can't get a display, advance the black level controls VR8, VR9 and VR10 until you can. Now tune in to a station. Adjust the a.g.c. control VR1 until the picture is noisy but not lost, then adjust the core of the i.f. coil on the top of the tuner for best picture – the usual position for this core is right into the coil. Now adjust the a.g.c. control until the noise just disappears from the picture, then advance one quarter of a turn more.

The sound tank coil is adjusted for best sound (don't forget to advance the volume control first). This is a somewhat critical adjustment for optimum performance.

Black level and grey scale

Set the brightness and background (VR9 on the timebase board) controls to their midpoint positions. Turn the black level controls to maximum, which corresponds to maximum voltage on the tube cathodes, then the contrast control to minimum. Turn the gain pots VR5, VR6 and VR7 on the signal board to maximum, and the colour control to minimum.

Set the black level controls to midpoint and advance the background control until one gun just lights the screen. Now adjust the other two guns until they too just light the screen. This is a delicate operation, so take your time – it has to be right! When you are satisfied, inject a grey scale signal to the set and turn up the contrast control until you get a good picture.

Adjust field and line hold controls for a steady picture. If one colour dominates in the highlights of the pattern turn down the corresponding gain control. If another colour then dominates, turn down its corresponding gain control. At least one gain control must be at its maximum.

You should now have a good mono picture. You can make slight final adjustments to the black level controls to compensate for any lowlight colouring, but take care not to overdo it or you'll have to repeat the whole procedure from scratch!

Colour decoder

Display colour bars from a generator or use a broadcast testcard. Turn colour control to practically maximum. Then solder the two shorting links on the signal board: the one shorting pin 19 of IC3 to ground overrides the colour killer, while the other connecting pin 23 to pin 6 disables the phase locked loop.

Adjust C37 slowly until correct colours are seen "passing through". Switch off and remove both shorting links. Switch on again, and you should now have a colour picture, probably suffering from Hanover bars. Display a colour bar signal, and adjust VR4 for minimum Hanover bars. If necessary adjust at this point either or both of the coils incorporated in the chroma delay line, but in most cases you won't need to.

Raster correction

Display testcard F, and centre the display in both vertical and horizontal directions using VR7 and VR2 respectively. Now adjust width to give nominal overscan, using VR6, followed by height (VR4) and vertical linearity (VR5). Use magnet on L4 nearest to the p.c.b. to adjust for optimum horizontal linearity.

N-S correction is obtained by alternately adjusting VR8 and L3 (for optimum amplitude and phase), which are somewhat interactive.

A satisfactory way of setting the horizontal hold control is to find the position giving the most instantaneous lock when changing channels. Adjust the vertical hold control for a locked picture with minimum jitter.

Waveforms and faultfinding

The waveforms shown here were taken from a prototype receiver and should prove useful when fault-finding. With the precautions outlined earlier, failures and faults should not lead to catastrophe. When we made several prototype boards, numerous mistakes slipped through our checking net but none led to real "nasties". We had various component failures; these were due to our mistakes in the experimental stages rather than to defects in the overall design. There was one exception however: the tantalum bead capacitors. We've had several go either short circuit or very leaky and they've all been cases of decoupling capacitors on the signal board, so please note the following trouble spots: C4, C5, C6 and C12.

Most parts of the circuit are self-current-limiting, and in cases where the circuit "Block" simply does not function, a check on its supply rail will usually be rewarding.

Note that a Manor Supplies colour-bar generator, switched to give a colour-bar output, was used when the following waveforms were being taken. All receiver controls were set for normal operation.

Matters Arising

For correct contrast control range, make R10 390Ω and R51 680Ω.

Manor Supplies have a 1·8kΩ fusible resistor which is suitable for use in position R19.

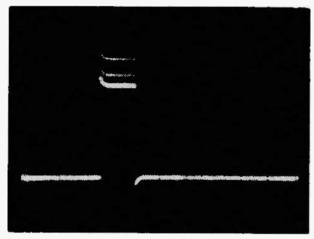
The alternative Thorn c.r.t. base type 90M4 458 001N can be used.

C25 is a polyester (not electrolytic) capacitor.

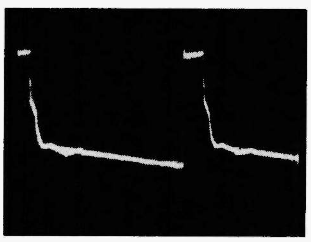
For optimum performance, the use of a separate earth wire from the power supply board earth to the centre of the edge earth plane of the signals board, adjacent to connector C, is recommended.

Junction of R10 and D1 – Timebase board 10μS 200mV/division

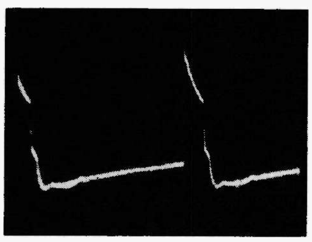
Junction of R3 and C11 – Timebase board 10mS 20mV/division



Junction of R15 and R18 – Timebase board 1mS 100mV/division

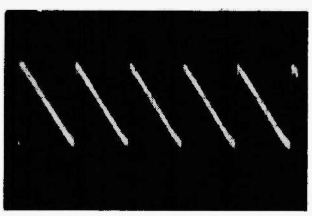


Junction of R13 and C15 – Timebase board 10μS 200mV/division

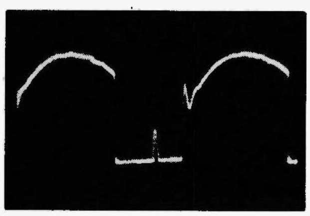


Gate of SCR3 – Timebase board 10μS 200mV/division

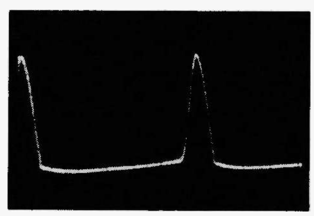
Junction of C24 and C25 – Timebase board 5mS 500mV/division



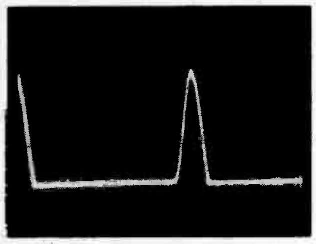
Junction of R43 and C25 – Timebase board 10mS 50mV/division



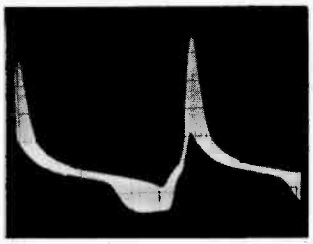
Anode of SCR3 – Timebase board 10μS 20V/division



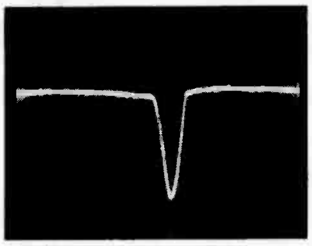
Anode of SCR4 – Timebase board 10μS 20V/division



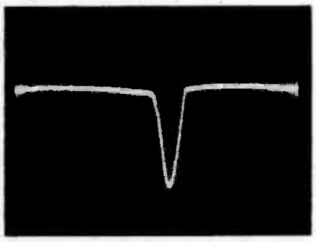
Terminal 2 of T3 – Timebase board 10µS 10V/division



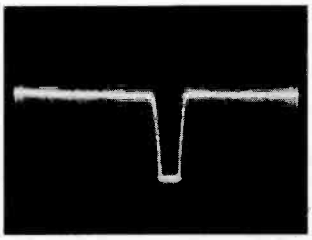
Terminal 1 of T2 – Timebase board 10µS 2V/division



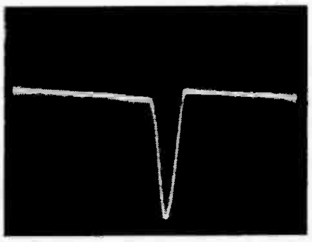
Terminal 12 of T3 – Timebase board 10µS 2V/division



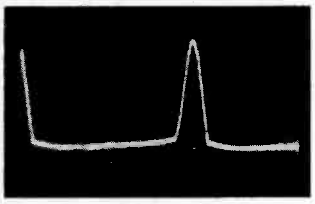
Terminal 10 of T3 – Timebase board 10µS 10V/division



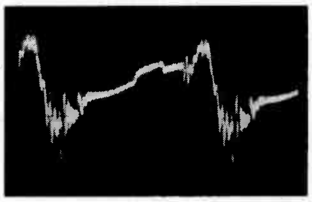
Junction of D10 and R51 – Timebase board 10µS 1V/division



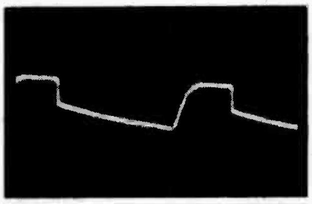
Terminal 3 on connector E – Timebase board 10µS 1V/division



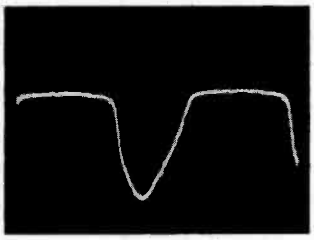
Terminal 13 of T3 – Timebase board 10µS 2V/division



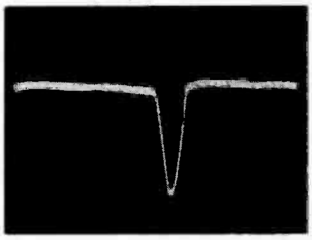
Junction of D5 and R40 – Timebase board 10µS 50mV/division



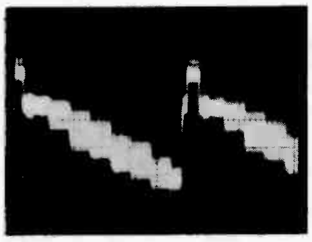
Junction of D4 and C18 – Timebase board 10µS 1V/division



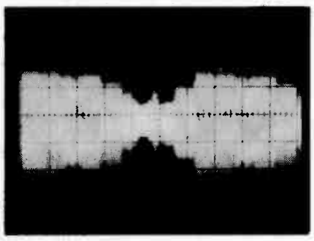
Gate of SCR4 – Timebase board 10µS 1V/division



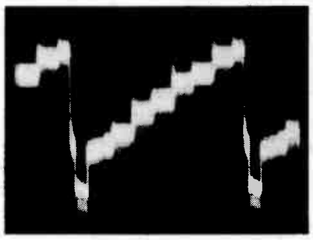
Terminal 4 on connector B – Signals board 10µS 200mV/division



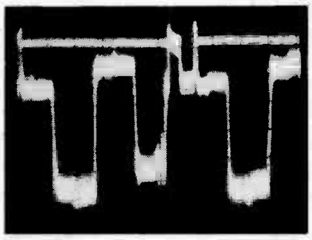
Terminal 3 on connector B – Signals board 10µS 50mV/division



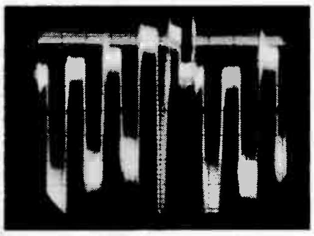
Pin 17 of vision detector module – Signals board 10µS 20mV/division



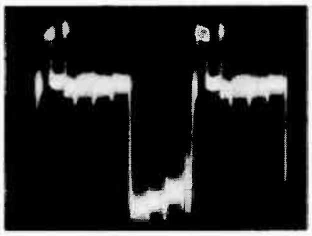
Pin 15 of vision detector module – Signals board 10µS 20mV/division



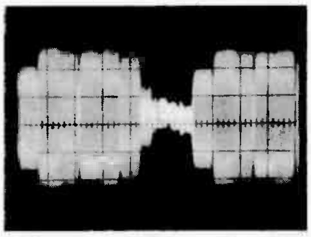
Terminal 2 on connector C – Signals board 10µS 20V/division



Terminal 1 on connector C – Signals board 10µS 20V/division



Terminal 3 on connector C – Signals board 10µS 20V/division



Wiper of VR4 – Signals board 10µS 5mV/division

TV Servicing: Beginners Start Here . . .

Part 21

S. Simon

Can the operation of the line output stage be described in simple terms so that the basic idea can be easily grasped without getting too involved in the intricacies?

We can have a go, but you'll have to come to grips with the awkward bits sooner or later! Let's start by considering a simple electrical switch – since the active device, be it a valve, a transistor or a thyristor, that controls the line output stage acts simply as a switch. What does a switch do? When it is made, i.e. the contacts are joined, the circuit it controls is completed and current will flow – provided there is a voltage difference across the load to induce the flow of current – see Fig. 1(a). In this simple example the nature of the load does not matter: it could be an element which requires heating by the passage of a lot of current, or at the other extreme a neon indicator which requires very little current to operate it.

If the voltage is the same in both cases, what determines the current – large in one case, very small in the other?

The current flowing depends on the resistance (or impedance, when we are talking about an a.c. circuit) of the load – low in the case of the element, high in the case of a neon.

Whatever current is flowing, it must pass through the switch and of course the power source (e.g. the mains supply or a battery) as well as the load. Both the switch and the power supply source have some resistance (or impedance), which can be largely ignored in the case of a switch provided that it is in good condition and designed to carry the current required.

We have said that a neon has a high resistance, but this is not strictly true. When its striking voltage is applied to it and it comes into operation, it has a low resistance – a property which is employed in some circuits to bring them into operation when a critical voltage is reached. We were referring to a neon indicator however, which always has a high-value resistor included in series with it. In this example the resistance of the switch contacts is of little importance, since the current flowing is small and thus the voltage developed across the switch contacts will be negligible.

When a larger current is flowing in the circuit, the resistance of the switch becomes very important, since the voltage developed across the switch is greater when the load resistance (impedance) is low.

Why are we so concerned about a switch controlling an electrical circuit? Because, as we've already mentioned, the line output valve/transistor/thyristor performs exactly this function. We could represent the line output stage in its most basic form as shown in Fig. 1(b), where the switch (valve/etc.) simply connects and disconnects the line scan coils and the power supply.

If the load was purely resistive, x amount of current would flow immediately the switch is closed. Since the load consists of a winding however, the current flowing will be opposed by the magnetic field which builds up around the coils – particularly when they are wound on a material which concentrates the field, dramatically increasing its effect.

In this case then although the whole voltage is available across the coil as soon as the switch is closed the resultant current flowing is impeded by the increasing magnetic field Thus when the switch is made, or turned on, the current flowing through the inductive load (the coils) builds up in a fairly linear manner. If we make the connections to our deflection coils correctly, the effect is to deflect the previously undeflected spot at the centre of the screen across to the right hand side (if we make the connections incorrectly, i.e. the wrong way round, the spot will be deflected to the left instead).

We've got to do rather more than this of course. The arrangement shown in Fig. 1(c) comes closer to the basic ingredients required to form a line output stage. A capacitor C is added to tune the load, and a diode is added (note its polarity) in parallel with the switch. All right then, we close the switch and a magnetic field is produced in the neck of the tube as the current flowing through the coils builds up. This deflects the spot to the right-hand side of the screen. Note that the diode is reverse biased so far, and has thus taken no part in the action. Note also that closing the switch has deflected the spot from the *centre* to the right-hand edge of the screen: this implies that the line output device (valve/etc.) is switched on towards the middle of the deflection of the spot from the left-hand side to the right-hand side of the screen. What next? Well, we've obviously got to get the spot from the right-hand side of the screen to the left-hand side – and quickly, since the picture information can be presented on the screen correctly only when the spot is travelling from the left-hand side of the screen to the right-hand side.

The only course open to us at this point, i.e. having closed the switch and deflected the spot to the right-hand side of the screen, is to open the switch again. This is precisely what we do. Now in the same way that there's a delay in the build up of current when we close the switch, so also there's a delay in the cessation of current flow when we open the switch. By adding the capacitor C we can make use of this fact. On opening the switch the voltage at point A swings positively, giving us the famed flyback pulse, and the value of the tuning capacitor C is carefully selected so that at the end of the flyback pulse the spot has been shifted rapidly back to the centre of the screen and then on to the left-hand side (in valve timebases there is no separate capacitor, the capacitance within the line output transformer being used instead, but the principle remains the same).

At this point diode D, which has done nothing so far, comes into operation. Left to itself, the resonant circuit formed by the capacitance and inductance (windings) present would next produce a negative-going pulse at point

A. As soon as the voltage at point A tries to swing negatively however diode D conducts, connecting point A to chassis. The result of this action is a controlled decrease in the current flowing through the coils, so that the spot moves slowly (relatively) back towards the centre of the screen. When the current falls to zero, we close the switch once more and the whole cycle of events is repeated.

For reasons that should be obvious, diode D is called an efficiency diode. In large-screen transistor receivers the line output transistor generally conducts in the reverse direction during the initial part of the scan so that it provides the efficiency diode action itself (i.e. its collector-base junction acts as the efficiency diode). Valve circuits are arranged somewhat differently, as we'll see when we come to them.

The arrangement shown in Fig. 1(c) is purely theoretical of course. That shown in Fig. 1(d) brings us to the basics of a practical transistor design. The first thing to note is the addition of a transformer – the line output transformer. Strictly speaking, this isn't necessary. But as we've seen in previous parts, the line output stage provides a number of additional services, in particular the generation of the e.h.t. voltage required by the final anode of the c.r.t., and for these purposes a transformer is essential. An overwinding on it feeds the e.h.t. rectifier, while other windings provide auxilliary services (pulses for this that and the other). C1 is the tuning capacitor, while C2 couples the line scan coils to the output stage, providing a d.c. block (if it goes short-circuit, the fuse blows). Since the transistor is switched on for the latter part of the scan, and also provides the efficiency diode action during the first part of the scan, C2 is essential to couple energy into the scan coils which would otherwise be shorted throughout the scan. By selecting its value carefully, it also serves another purpose: tuning the coils to provide scan correction (necessary to compensate for the fact that the tube face is relatively flat instead of being spherical with respect to the point of beam deflection). The tuning capacitor C1 tunes the total inductance present, i.e. the transformer plus the scan coils and any other windings present (in practice there may be a linearity coil etc.): its tuning action operates during the flyback period only of course, when the transistor is cut off.

Valve line timebases do have a separate tuning capacitor, but not to tune the flyback. Instead, it tunes a harmonic of the flyback in order to get the required flyback pulse shape. We mention this becase, as we shall see, it can be responsible for failure of the line output stage.

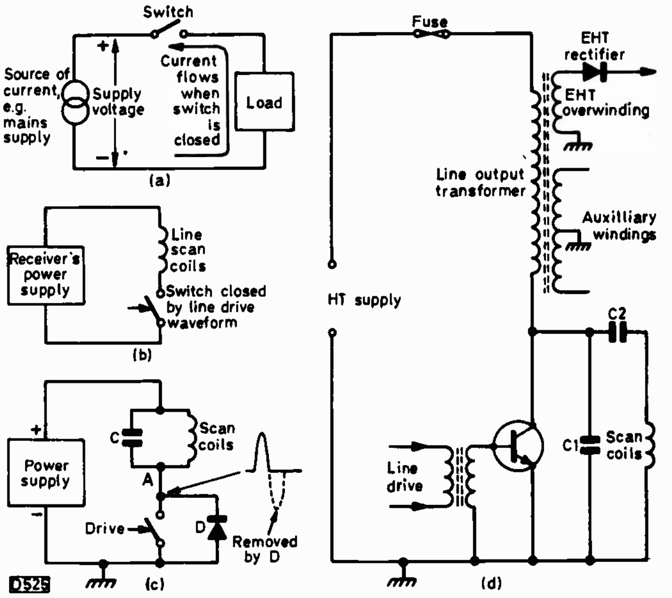


Fig. 1: Analogy between a simple switch circuit and a line output stage. (a) Switch controlling the flow of current through an electrical load as a result of the application of the supply voltage when the switch is closed. (b) The line scan coils are energised by the receiver's power supply when the switch in series with them is closed. (c) Addition of a capacitor to tune the scan coils and a diode to remove the negative-going overswing at point A. (d) Basic elements of a practical transistor line output stage. The line output transformer enables the stage to provide additional services. C1 tunes the flyback, with C2 providing a.c. coupling to the scan coils. Note that a transistor line output stage must be fed from a regulated supply.

The main differences found in valve line output stages concern the way in which the line output transformer's windings are arranged and the position of the boost capacitor in the circuit. These are both important from the servicing point of view, since they affect the fault conditions that will be found. In many circuits for example one side of the boost capacitor is returned to chassis instead of to the h.t. line. If the capacitor goes short-circuit, the boost diode will be connected between the h.t. line and chassis and may be damaged, as we shall see.

It's worth noting that many transistor portables have both a series and a shunt efficiency diode. The series, or boost, diode provides a boost voltage of typically 24V.

Valve Line Output Stages

What differences are to be found in valve line output stages?

There's a lot of variation in the design of valve line output stages, some examples of which have been shown in previous instalments. The simplified circuit shown in Fig. 2 will serve to bring out the important features however. Note first that the efficiency diode V1 is connected in series with the line output valve V2 between the h.t. line and chassis. This means that it's conductive throughout the forward (left-to-right) scan period, being cut off only during the flyback period – when the positive-going flyback pulse is present at its cathode. During the initial part of the scan, when V1 is conducting and V2 is cut off, the current drawn by V1 charges the boost capacitor C1 so that its lower plate (in our drawing) will be at something like 900-1,000V above chassis potential. This is called the boost voltage and is used for various purposes, e.g. to supply the c.r.t.'s first anode and the field charging circuit. C3 provides the harmonic tuning previously mentioned. Connected in this way, V1 is generally referred to as the boost diode.

What about width/e.h.t. stabilisation?

We can use feedback to stabilise the operation of a valve line output stage. This is simply done by rectifying the flyback pulse in such a way that a negative voltage proportional to the e.h.t. is produced. This negative voltage is used to bias the control grid of the line output valve. In Fig. 2 the flyback pulse is fed back to the VDR, which provides the rectifying action, via C4: the negative bias is developed on the left-hand plate of C4. To set the circuit up, a width/set e.h.t./set boost or whatever it may be called control is added. This is usually connected in a high-resistance network between the boost line and chassis, a positive potential being taken from its slider to the line output valve's control grid circuit. The control may however be found connected between the VDR and chassis, with its slider taken to one end of the track. This can affect width faults, so is worth noting.

This stabilisation technique cannot be used with transistors, which are far more efficient when considered as switches. Instead, transistor line output stages are fed from a stabilised power supply.

Basic Fault Conditions

Right, now we've got the basic ideas straight, what goes wrong and how do we find the item responsible?

It will be appreciated that much energy is generated and used in the line output stage, so it's not surprising that a goodly proportion of TV receiver faults occur in this part of the receiver. We have here in fact a happy hunting ground for casualties to be sought and found . . .

What to look for depends on the symptoms present. Say for example that the h.t. supply fuse has blown, or that a fusible resistor in the h.t. supply to the line output stage has melted its solder and sprung open. This means that the line output stage was drawing too much current, due either to a short-circuit somewhere or because the line output stage is operating under stress.

Let's assume that the receiver concerned has a valve line output stage. Maybe a monochrome set like the 1500 chassis we've referred to so often in these articles, or perhaps a hybrid colour set such as one of the Decca, GEC, ITT or Pye ones.

Before any move is made to connect the mains supply or replace the fuse or resolder the fusible resistor, some "cold tests" should be made. Valved sets are very convenient in this respect. Remember that the supply to the line output valve comes via the boost diode, which like the line output valve has a top cap. In the case of a monochrome set the boost diode will probably be a PY800, PY801 or PY88: in the case of a colour set it will be a PY500. In all cases the top cap is the cathode connection. This goes directly to the transformer (maybe via a small coil), and the valve should be the only d.c. path from this point to the h.t. line (when it's heated and working that is). In addition, the only d.c. path from this point to chassis should be via the high-value resistors in the width circuit etc. So we have here a very convenient test point to check for shorts.

Switch the multimeter to Ohms, and connect one lead to chassis and the other to the efficiency diode's top cap (or the line output valve's top cap since its anode is only a few turns away through the line output transformer's primary winding). A reading of not less than something like 200kΩ should be read, often much higher than this (it all depends on how many resistive paths there are to chassis). If a low reading is recorded, there's a fault present.

Remove the efficiency diode's top cap connector and see whether the short or partial short is still present at the cap or the clip. If the short is present at the top cap but not the clip, the valve itself must be faulty – with a heater-cathode short. This is not all that common, and usually the short will be present at the clip instead. In this case we've proved that the valve is in order and must look further.

Take a closer look at the meter reading to see what the leakage really is. If it's a dead short, the chances are that a capacitor is responsible, and this may or may not be easy to find. There are two main suspects. The boost capacitor (value normally between $0{\cdot}1\mu$F and $0{\cdot}47\mu$F, with a voltage rating of 1kV), or a pulse capacitor used to provide harmonic tuning (value between 140pF-220pF, rated at 8kV).

Here it's useful to know whether the boost capacitor is connected to the h.t. line or to chassis. If it's shorted and is returned to the h.t. line, the meter reading will be the same as when the meter is connected to that line, i.e. there'll be a low reading initially, recovering as the main smoothing capacitors charge and ending up with a fairly high reading of well over 1kΩ. In many colour sets, and some monochrome ones, the boost capacitor is returned to chassis. On Pye group hybrid colour sets for example the capacitor is mounted on the transformer. It's large and fat and can hardly be missed. On the ITT CVC5 and subsequent chassis a similar $0{\cdot}47\mu$F capacitor resides virtually under the line output transformer, whilst on the GEC and Decca models of the same vintage the capacitor is some distance from it. The point however is that when investigating an open fuse/fusible resistor in the h.t. feed the boost capacitor is suspect only when it's returned to chassis. If it's shorted but is returned to the h.t. line, the operation of the line output stage will be seriously impaired but the fuse won't blow. In any event it's no difficult task to unhook one end of the capacitor and apply the meter to it to check whether it's short-circuit or not.

The pulse capacitor is the second main suspect. This too may be mounted on or very near the transformer, and may present a decidedly charred appearance to leave little doubt as to its guilt. This is quite common on the 1500 chassis for example, where it's on the transformer, one side to the PY800 tap and the other to the chassis tag. The ceramic tubular type is far more likely to go short-circuit, and should be replaced by the round disc type which is better able to stand up to pulse conditions.

Are these pulse capacitors always found on the line output transformer?

Generally yes, but not always. The ITT VC200 monochrome chassis for example has three tubular ceramic ones mounted on the panel between the valves and the transformer. Two (in parallel) are for tuning, the other one being the width stabilisation feedback capacitor. All are 270pF, 8kV. It's extremely common to find one of these capacitors cooked up, thereby taking the cathode of the PY88 valve to chassis and explaining the demise of the 1A mains supply fuse or possibly the failure of one or more of the wirewound feed resistors, which may have found the going too hot before the fuse could fail.

So the supply resistors could fail before the fuse?

That's right. It's not uncommon to find the fuse intact and the valve heaters glowing but no h.t. supply to pin 9 of the PY88 if R106 has failed, or no h.t. anywhere in the set if the surge limiter R108 has given up.

In any case, two checks should always be made with the receiver switched off before any wirewound resistors which have failed are replaced – with the ohmmeter connected from the h.t. line to chassis (positive prod to chassis so as not to read through the h.t. rectifier diode), and from the top cap of the PY88 to chassis. This applies to all sets of course.

Is this a conclusive test?

No. A pulse capacitor can have a high-resistance leak when the set is off, but can break down completely when the high pulse voltage is applied to it. Generally however such a capacitor will show signs of this type of hanky panky by being blackened. When the h.t. has been restored and the line output section warms up, there will be distress signals from the capacitor to establish the cause of the trouble beyond doubt. In most cases however the capacitor will read a short on a cold test.

Until the reason for a low reading from the top cap of the efficiency diode to chassis has been established, it's unwise to proceed further.

Apart from failure of the fuse or possibly one of the wirewound resistors, what other casualties can result from such a short?

The efficiency diode itself, having had to pass such an excessive current, could well have suffered damage which may be immediately evident or may show up later.

What sort of damage, and what is the effect?

Parts of the cathode's emitting surface may have been lost. This could result in a very slow warm up time and/or lack of width. More seriously, the insulation between the cathode and the heater may have been impaired. The usual effect of this is the destruction of the valve's heater.

If the efficiency diode is the first valve in the series heater chain, one simply has to confirm the open-circuit and replace the valve. Unfortunately however the efficiency diode may be the *second* valve in the heater chain, the line output valve's heater being first. In this case the probable result will be the loss of two valves instead of one.

There's more to this than meets the eye, so pay attention. If the line output valve is the first valve in the series chain and is found to have an open-circuit heater, *don't immediately fit a new one.* First check the condition of the second valve in the chain, which will be the efficiency diode. Failure to observe this precaution could result in the loss of a new line output valve as well, and these items are not cheap.

Homework to consist of looking up the price of PL509/PL519 and PY500A valves, and calculating the cost of the repair when the initial fault was a shorted 180pF 8kV pulse capacitor costing a few pence, the PY500 suffered a heater-cathode short as a result and, being the second valve in the heater chain, blew the PL509 as well, leaving this open-circuit heater as the first and most obvious cause of the set not working – apart perhaps from a blown fuse. We know you're not that stupid, and that you would not just fit a new PL509 and leave it at that. You would of course check the PY500. And you would not replace these two valves before checking for a possible initial cause. Would you? You may say that you are not tackling colour sets yet. For PL509 read PL504 and for PY500 read PY88 or PY801 (say), and the lesson is the same for monochrome.

O.K., we'll be careful. But we did start off by considering the switching action of the line output device, be it a valve or a transistor. From a practical servicing point of view, what is the difference and what is the result of that difference?

The most important difference from our point of view is that a line output transistor passes no current until it is switched on by the drive circuit which precedes it. If the line oscillator is not working, the line driver cannot turn on the output transistor, whose base and emitter will be at the same potential – refer back to Fig. 1(d). With no current passing, the line output transistor will be inactive and cold.

This is precisely the reverse of what happens in a valve circuit. A line output valve is biased only when being driven by the preceding stage. So if the line oscillator is not working, the line output valve will pass excessive current and will become obviously overheated. This current must also flow through the efficiency diode (except that which flows in the screen grid circuit), so the efficiency diode will also overheat. This state of affairs can be damaging, and provision is usually made to call a halt to it.

We've just said that the valve's screen grid also collects a share of the excess current. There's always a screen grid feed resistor (value roughly between 1·7kΩ and 2·5kΩ, typically a 2·2kΩ, 5W wirewound type). If this resistor is provided with a soldered spring clip, the overheating of the resistor will melt the solder and result in the "switch" flying open. This leaves the screen grid without voltage, turning off the valve. The current can be restored only by resoldering the clip.

Having said that this condition can be caused by lack of drive from the line oscillator, we must hastily add that in a goodly number of cases the line output valve itself is the

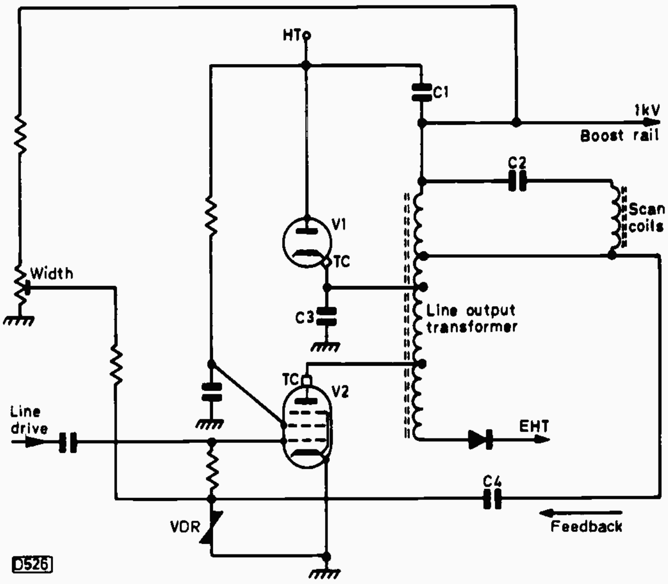


Fig. 2: Basic elements of a valve line output stage. In this case the efficiency diode is connected in series with the switching device (the line output valve V2). It produces a boosted h.t. supply across the boost capacitor C1, which in some designs is connected to chassis instead of to the main h.t. line. Considerable variations are found in practical line output transformer designs. The width and e.h.t. are stabilised by the feedback network, the VDR rectifying the pulses fed back via C4 to produce on the left-hand plate of C4 a negative bias voltage proportional to the pulse amplitude and thus the e.h.t.

cause of the trouble (particularly the PL504) and must be the first suspect.

While the line oscillator provides the drive to the line output valve, the line output valve's bias is self-generated. This occurs because current flows in the control grid circuit when the valve is switched on hard, charging the coupling capacitor negatively (quite apart from the separate biasing via the feedback circuit). Thus with a working line oscillator there should be a negative voltage of say 40V or more at the control grid of the line output valve. This negative voltage is often loosely referred to as the line drive.

Let's take a common example of the protective arrangements found. There's a soldered screen grid feed resistor next to the PL504 line output valve in the Rank (Bush/Murphy) A774 chassis. On inspection this is often found to be open. In the majority of cases replacing the PL504 will restore normal operation. If the overheating persists however it will be necessary to check back to the oscillator circuit and, possibly, the flywheel sync circuit. The EF184 valve and the capacitors are suspect in the oscillator circuit, the discriminator diodes in the flywheel sync circuit.

In the Thorn 1500 chassis the protection takes the form of a fusible resistor in the feed to the line output stage. It's roughly above the PCL805 field timebase valve, not near the line output stage.

There's more to line output stage circuitry and faults than this, isn't there?

Yes, but in this and previous instalments we've covered the basic fault conditions. The object of the present instalment was to bring out the point that the line output device is essentially a timed switch which is used to get the inductive sections of the circuit, the transformer and scan coils, ringing (or swinging if you like).

Improved Flywheel Sync

Garry Smith and Keith Hamer

THE Bush TV125/Murphy V849 series of dual-standard monochrome receivers has been available through trade disposal outlets at very reasonable prices in recent years. Many of them after a thorough overhaul and several minor modifications have become the heart of DX-TV installations, since they are particularly suited to this use. Advice on modifications to make these sets suitable for DX-TV reception was given in Roger Bunny's article "Receiver System for Long-Distance Reception" in the December 1973 issue of this magazine. Other articles on servicing and restoration have appeared from time to time.

General Overhaul

The authors obtained several of these sets from an ex-rental source some years ago. They were thoroughly overhauled and in due course six were modified for DX-TV use. It's essential that the sets are restored to efficient operation before any modifications are undertaken. It's a good idea to replace the PCF80 video amplifier valve and the three i.f. amplifier valves for a start, bearing in mind that increased gain will be achieved by using a frame-grid valve (EF184) in place of the third i.f. valve (EF80). Modifications to the i.f. strip were given on page 74 of the December 1973 issue.

It may also be worthwhile replacing the valves in the v.h.f. tuner – the PCC89 r.f. amplifier valve and the PCF86 frequency changer. In an alternative tuner less often encountered the valves are a PC900 triode and PCF806 respectively. Replace the timebase valves as necessary, and the c.r.t. if it's low-emission and funds permit.

If several of these receivers are put into use then theoretically they should, after being overhauled, be capable of giving identical performance. In practice however there are usually differences in the characteristics and performance of individual receivers. The more of these sets you have, the more you'll become aware of the differences, however slight.

The Line Sync Problem

One problem that seemed to be common to all the sets we acquired however was the seemingly unreliable action of the flywheel line sync circuit during fast-fading DX signals, necessitating frequent adjustment of the line hold control. Other DX-TV enthusiasts using these sets have also experienced this problem.

When we encountered the same trouble with all the six sets we modified, we first wondered whether they were all suffering from a common fault or whether we were perhaps expecting too much of them. After all, the symptom did not seem to be present under normal reception conditions, whilst the circuit, of the balanced variety (see Fig. 1), had obviously been designed with care.

After wading through the recommended line sync setting up procedure several times on each receiver with little success, we decided to try replacing the line sync discriminator diode block, using two separate OA202 diodes with 39kΩ series resistors instead. This produced some slight improvement in the performance, but the overall results still left something to be desired.

Thoughts then turned to alternative approaches – mounting the line hold control at the front of the set, or attempting to redesign the flywheel sync and oscillator circuits completely. A third solution was found however. The later Bush TV141/Murphy V153 series use an almost identical line oscillator circuit but a totally different flywheel line sync circuit (see Fig. 2). It was decided to try this out in the TV125/V849 therefore.

This turned out to be a more straightforward exercise than was at first anticipated. The original flywheel sync circuit was temporarily disconnected from the rest of the circuit – a simple matter, since there are only four connections to remove, as follows: First the sync pulse input from the anode of the sync separator to the differentiating network 3C9/3R2 – 3C9 was disconnected. Secondly the output to the triode section of the multivibrator line oscillator circuit – 3R5 in the filter circuit was disconnected from pin 9 of the PCF80 valve. And finally the two pulse inputs from the line output transformer. This was done by disconnecting the integrating resistors 3R1 and 3R7 and the phasing capacitor 3C4.

The adopted TV141 circuit was then wired into the TV125 in rat's-nest fashion – a sort of electronic transplant. Since the later circuit is of the unbalanced type, only a single pulse feed from the line output transformer is required. R6 in the adopted circuit was connected via a lead to tag 3 of the line output transformer. A selenium diode block was used in the TV141, but instead we decided to try a pair of OA202 diodes which proved to be satisfactory.

The results were very encouraging, and after initial adjustment of the line hold control no further trouble has been experienced. The "postage-stamp" trimmer 3TC1 was replaced with a 560pF fixed-value capacitor for good measure. 3C12 was replaced at the same time.

The new flywheel line sync circuit was built up using a length of tagstrip, as shown in Fig. 3. The defunct components in the original circuit were removed from the chassis above the line oscillator valve – the component mounting pins and their associated plastic studs being removed with the aid of pliers. This provided enough space for the tagstrip. One earth tag of the strip was secured by means of a self-tapping screw, the other being soldered – a very hot soldering iron is required for this purpose. In due course the remaining five receivers were modified.

★ components required

C1	27pF	R1	120kΩ	
C2	3300pF	R2	820kΩ	
C3	1000pF	R3	1MΩ	
C4	0·22μF	R4	390Ω	
C5	4700pF	R5	100kΩ	
MR1	OA200	R6	47kΩ	2W
MR2	OA200	R7	62kΩ	
or similar		R8	56kΩ	

All ¼W except R6.
R7 can be 47kΩ+15kΩ in series.

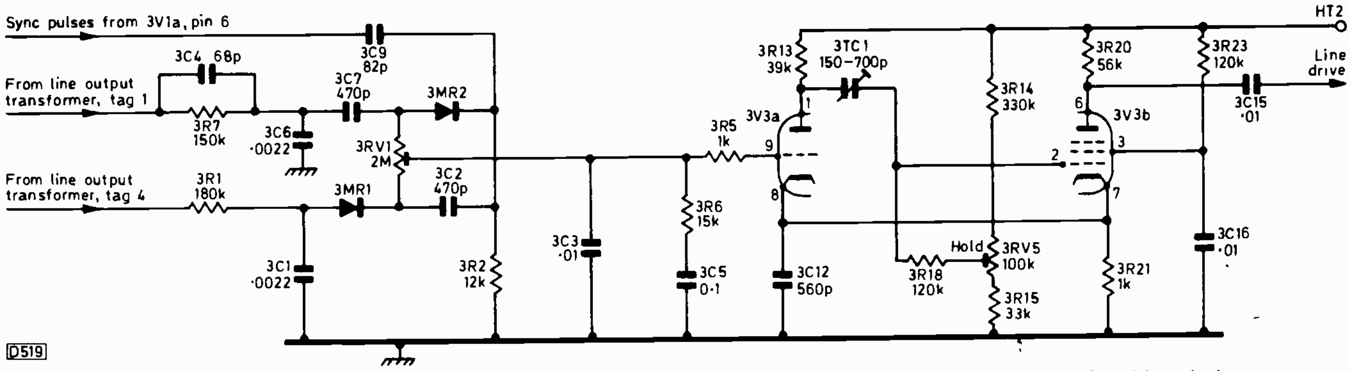


Fig. 1: Flywheel line sync and line oscillator circuits used in the Bush TV125 series. 625-line preset omitted for clarity.

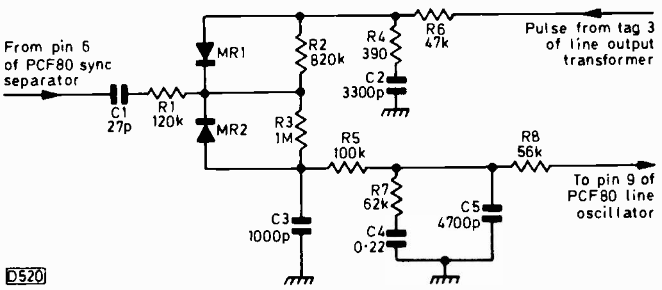


Fig. 2: Flywheel line sync circuit used in the Bush Model TV141, adapted for use in the TV125.

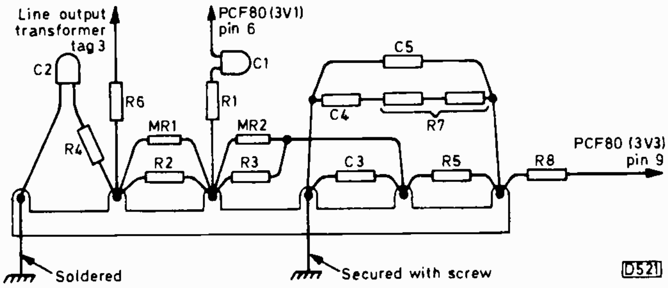


Fig. 3: Suggested tagboard layout for the circuit shown in Fig. 1 (R7 consists of two resistors in series).

The modifications were carried out some six years ago, since when all the sets have been in daily use. The change has proved well worthwhile, and most of the sets still have their original PCF80 line oscillator valves.

It's hoped that the information in this article will be of help to other DX-TV enthusiasts who use this type of set and are not satisfied with the line sync performance when operating under difficult reception conditions. In fact anyone using one of these receivers for normal domestic viewing would probably find the modification worthwhile should they ever have problems with this section of the receiver. ■

New Look at an Old Circuit

George Wilding

FEW basic circuit building blocks could be simpler than the half-wave rectifier, though many conflicting considerations have to be taken into account when it's used as a vision detector. For power rectification however the values of reservoir capacitor, smoothing capacitor, surge limiter and series filter resistor or choke present no great problems.

If we want to obtain a positive output from the secondary winding of a mains transformer, we simply connect one end of the winding to chassis and the other, probably via a surge limiting resistor, to the anode of a diode which charges a reservoir capacitor. For a negative output, we simply reverse the polarities of the diode and its electrolytic reservoir capacitor.

Another factor has to be taken into account when it comes to rectifying the signal developed across a secondary winding on a line output transformer, namely, do we want to rectify the scan or the flyback portion of the waveform? The two are in opposite polarity of course. By connecting two diodes in opposite polarity we can obtain simultaneously scan- and flyback-derived outputs. But suppose you wanted to do the same thing with two diodes connected the same way round. Could you, and if so how? I'm tempted to make this into a sort of test case item, with the answer next month, but let's press on.

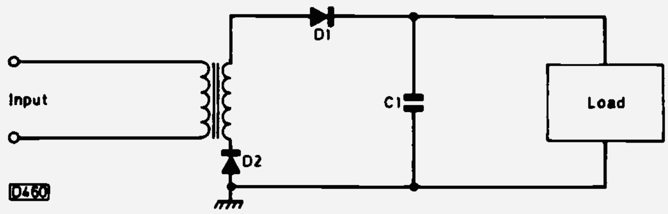


Fig. 1: Alternative ways of connecting a half-wave rectifier diode to obtain a positive supply.

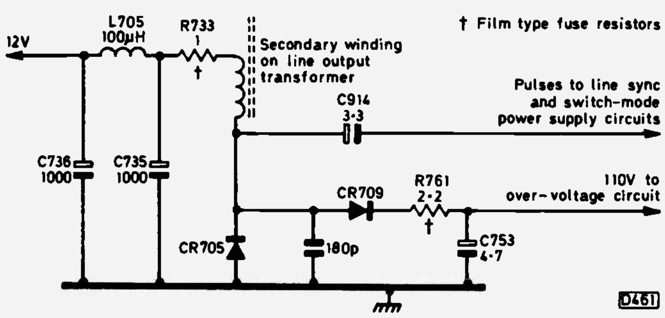


Fig. 2: Diodes used to obtain 12V and 110 V supplies from the line output transformer in the Hitachi NP6C chassis.

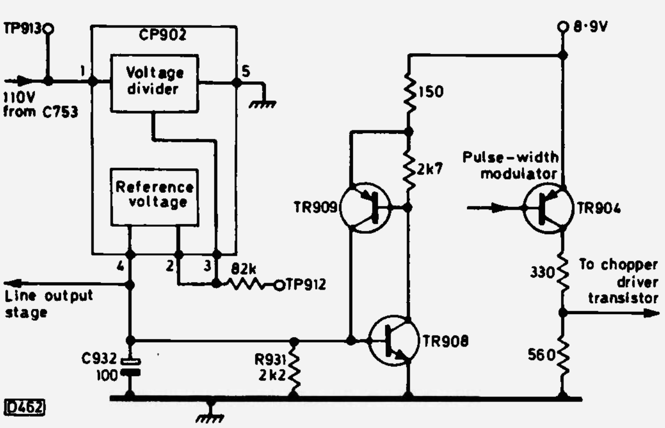


Fig. 3: The over-voltage protection circuit used in the Hitachi NP6C chassis.

Fig. 1 shows the basic half-wave rectifier circuit, with an extra diode D2 connected between the transformer's secondary winding and chassis. This arrangement will give the normal positive output across the reservoir capacitor C1, but note that if we shorted out the conventionally placed diode D1, the other diode D2 will continue to produce a positive output across C1. This occurs since either way C1 can charge during only the positive-going excursions of the waveform developed across the transformer's secondary winding.

Placing the diode rectifier in the chassis return lead is not the usual practice since it introduces several disadvantages. First, the winding has to carry both the rectified voltage and the waveform, increasing the insulation stress. Secondly the winding is no longer earthed at one end. And finally if the bottom of the secondary winding shorts to the transformer's core the rectifier is shorted out and in consequence the load is subjected to the full a.c. waveform – not good for electrolytics or semiconductor devices!

Practical Circuit

Could we adopt this technique to rectify the scan section of the line waveform and add to it the output obtained by rectifying the positive-going line flyback pulses? Well, just about every conceivable circuit technique seems to find its way into television receiver practice at some point or another, and what do we find in the latest Hitachi colour chassis, the NP6C? We find, as shown in Fig. 2, the technique we've been talking about.

The two rectifier diodes involved are CR705 and CR709, the waveform applied to them consisting of a negative-going scan potential followed by a much higher positive-going line flyback pulse. CR709 conducts during the flyback pulse period, developing 110V across C753. CR705 on the other hand conducts during the negative-going scan, charging C735 to provide at the junction of the smoothing components L705/C736 the main 12V line for the receiver. Although the flyback period is only brief, a reasonably constant high-voltage supply will be obtained from it provided the current drain is small.

Over-voltage Protection

The 110V supply provided by CR709/C753 is used by the over-voltage protection circuit (see Fig. 3). If the h.t. voltage (coincidentally, also 110V) rises, the amplitude of the line flyback pulses and the e.h.t. will rise. Since the voltage across C753 depends on the flyback pulse amplitude, this will also rise, activating the over-voltage protection circuit.

The thick-film unit CP902 contains a voltage divider section and a reference voltage section. Provided the flyback-derived voltage from CR709 remains at approximately 110V, the voltage at pin 4 is 0·2V, which is insufficient to switch on TR908. If the voltage from CR709 rises however, the voltage from pin 4 increases until the point is reached where TR908 conducts. Now TR908 and TR909 are coupled together to form the transistor equivalent of a thyristor. Thus when TR908 conducts, both transistors switch to fully on and the voltage at TR909's emitter falls to little above chassis potential – about 1V in fact. This voltage is in turn linked to the emitter of the pnp pulse-width modulator transistor TR904 in the switch-mode power supply. As a result, the drive to the chopper transistor is removed and the h.t. line falls to zero.

Reference pulses are also taken from the circuit shown in Fig. 2, via C914. These are applied to the flywheel line sync circuit and, after integration and shaping, drive the pulse-width modulator in the switch-mode power supply circuit. ■

Over the Counter

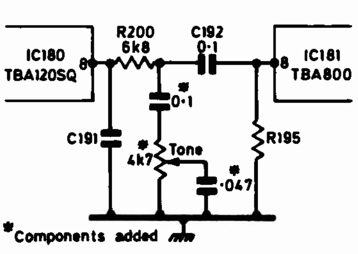
Robin D. Smith

GEC C2110 Series

I've commented on various faults on the GEC C2110 series of solid-state colour sets in previous issues. One of the most common faults is failure of the line output transistor TR51, and in this event it's advisable to change the complete panel. Before switching on again it's worth checking or changing the 40V rectifier D601, type BY210-800 or two BY210-600s in series – the line output transistor's emitter is taken to the 40V line. On several occasions I've found D601 short-circuit or smoking. As a precaution, R607/8 (both 1MΩ) in the e.h.t. earth return circuit should be checked, and the set h.t. control P701 should be adjusted for 38-40V at the positive terminal of the 40V supply reservoir capacitor C601.

A common complaint on versions of these sets using the six-position touch tuning head is flashing neons or difficulty in changing channels. There are several cures. For flashing neons, change the lot: I've found that it's no use changing only the faulty ones. The RS type 586-015 will do. Difficulty in changing channels can be due to the neons or dirt on the head – the best cure for the latter is to strip down the head completely and thoroughly clean with methylated spirits. Alternatively, R675 may need to be changed from 12MΩ to 4·7MΩ. The ETTR6016Q i.c. can also be responsible for this fault, as well as for the set being stuck on one channel permanently. Customers with nylon carpets sometimes have a problem with changing channels: the simplest thing to do in this case is to jump in the air when making the channel change! I've experienced no trouble with the later versions which use four i.c.s and light-action channel switching.

I've sold several C2015H and C2220H models to old people, and they've all come back with the complaint that the speech is not clear. It's clear enough to me, but of course hearing deteriorates with age. The sound panel is the same as is used in all models in this series, but the trouble could be due to cabinet acoustics – the C2015H and C2220H are housed in large cabinets. There are several ways of dealing with the problem. One is to change the value of the de-emphasis capacitor C191 from 0·47μF to 0·01μF. Another is to change the value of the audio output coupling capacitor C198 from 220μF to 100μF. Finally a tone control network can be fitted as shown in Fig. 1. The method adopted depends on the degree of hearing loss: I usually find that changing the value of C191 is sufficient.



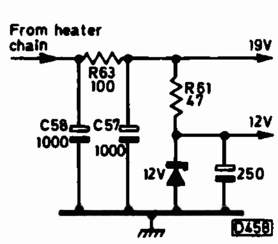


Fig. 1 (left): Fitting a tone control to the GEC Models C2015H and C2220H.
Fig. 2 (right): Method of obtaining the l.t. supplies used in the Pye 169 chassis.

Problem with a Hum Bar

The trouble with a Pye single-standard hybrid monochrome set was a severe hum bar, and it took us some time to track the cause down. A scope check on the h.t. lines showed no excessive ripple here, so attention was turned to the two l.t. lines which are derived from the earthy end of the heater chain (see Fig. 2). Checking each end of R61 with a scope didn't show any adverse conditions however, so I assumed that the l.t. supplies were in order. As I was busy in the shop, the problem was handed over to my colleague. He took a fresh look and found that with the scope connected directly across C58 a ripple voltage of 20V could be observed, though there was no observable ripple at the other side of R63. C58 was obviously open-circuit, and on replacing it the ripple was reduced to 2V peak-to-peak.

Field Collapse – Rank Z718 Chassis

The fault on a Bush set (Model BC6100) fitted with the Z718 chassis was field collapse. Checks on the voltages in the field output stage revealed that they were all incorrect, though the transistors themselves checked out o.k. Attention was turned to the associated components therefore, and I eventually found that 4R30 (13Ω) which is in series with the field output transistors had gone high in value. On replacing this, using a ¼W type in place of the 1/8W original, the set worked correctly – a check on later manuals revealed that 4R30 had subsequently been uprated by Rank to ¼W. I then phoned the Rank TLO to find out whether anything else might need replacing. He suggested changing 4D4 and 4D5, which are in series across 4R30 and form part of the bias network that determines the field output stage crossover point, as a precaution. They didn't read faulty, but apparently their parameters are important and if these change 4R30 goes up in smoke.

On another of these sets the same fault was eventually traced to a dry-joint on pin 12 of plug 4Z2, which feeds the scan coils. Again the voltages in the d.c.-coupled field output stage were incorrect, and some time had been spent checking the transistors individually. On another occasion the trouble was due to the field driver transistor 4VT6 (BD150) being open-circuit.

Overhauling a G8

A customer bought a colour set at an auction and when she took it home found it to be a non-worker. It was an early Philips G8 set, and although this is a chassis I'm not familiar with I decided to take on the repair as a challenge. The first thing I noticed was that the 2·2Ω wirewound surge limiter section R1367 had disintegrated, while the convergence etc. wiring loom had burnt badly where it had been touching the "dropper" section. The complete dropper was replaced and the loom repaired, and on switching on I next found that the thyristor mains rectifier was open-circuit. Its heatsink was made out of an old tobacco tin and was most inadequate! After dealing with this we switched on again but there were still no results. So I consulted Mike Phelan's excellent series on this chassis, and as recommended disconnected D1398 to isolate the overvoltage circuit. The set now worked, and D1398 was found to be short-circuit and the associated transistor T1399 defective. On dealing with these problems a very poor picture was obtained, with the colour and brightness levels drifting all over the place. The set had the discrete component RGB sub-panel, and on inspecting it I decided the best course was to return it to Philips for repair. On return and refitting it we had correct colour and brightness levels, but there were other points needing attention: the beam limiter circuit needed adjustment, the green output transistor had a dry-joint, and two convergence controls needed replacement.

By now the set was looking good, so we tidied up the printed panel generally (it had been butchered). The set was then run for several hours, various small adjustments made, and by that time I was very pleased with the results, especially as the tube was in very good condition. The work took several hours and the charge had to be high, but even so for £100 (auction bid price plus cost of repairs) the customer had an excellent colour set.

Rank A823 Chassis

No l.t. voltages on the Rank A823 series chassis is usually simply an open-circuit l.t. bridge rectifier (8BR1). The bridge can go short-circuit intermittently however, giving intermittent loss of l.t. This can be confusing, so it's always advisable first to check at the source of the l.t. supplies.

Flyback lines and slight deterioration of the picture is a fault we sometimes encounter with these sets, the fault giving the appearance of a soft tube. Before condemning the tube however, it's well worth checking the voltage at 4TP1 (see Fig. 3) in the beam limiting/flyback blanking circuit associated with the c.r.t. grids. The voltage at this point should be around −85V. In a recent case it was found to be down to −20V. The two transistors 4VT1 and 4VT2 and the 15V zener diode were all right, so we decided to check the source of the −85V. This is provided by the line flyback pulse overswing clipper diode 6D1, acting as a rectifier to charge 6C9. Now if 6D1, 6C9 or 6C15 goes short-circuit, there's a lot of smoke and eventually the 600mA h.t. fuse 8F3 blows – sometimes taking the tripler with it. There were no such problems this time, so 6R8 was next checked – and found to be open-circuit. On replacing it (a very difficult job) the voltage at 4TP1 was correct, with no evidence of flyback lines. It's interesting that there's any voltage at all with 6R8 completely open-circuit, though the line flyback pulses will still be coupled to 6D1 and the e.h.t. rectifier by 6C8.

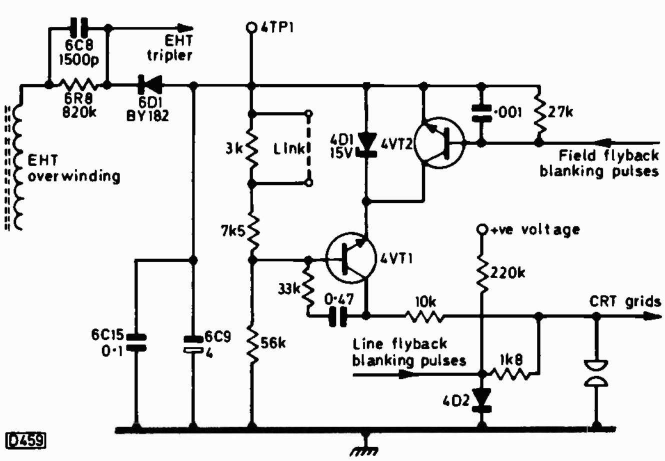


Fig. 3: The beam limiting and flyback blanking arrangements used in the Rank A823 chassis.

How to Make a Faulty Diagnosis!

There was no raster on a Decca hybrid colour set, while the line output valve's screen grid feed resistor R465 was smoking. Changing the PL509 made no difference, so we wondered whether the line output stage was drawing excessive current or maybe the line drive was incorrect. That was our first mistake. Removing the top caps of the PL509 and PY500 made no difference, so we decided that the line output stage was in order and proceeded to check the line drive. Mistake number two: the line drive waveform was correct. Back to the screen grid circuit: perhaps the decoupling capacitor was short-circuit? Mistake number three. What we should have done to start with was to try a new PY500. If the PY500 is not passing any current, the entire PL509 cathode current must flow via it's screen grid. We'll learn yet.

Poor Picture

Back in 1977 I had given my parents a 15 in. GEC portable (Model 1501H) as a second set, but had never been completely happy with the BBC-2 picture, due to ringing and ghosting. I knew the aerial was in order, and as I had a bit of time recently (one's own family always has to wait till last!) I decided to look into the matter.

I noticed that whichever button was pressed in, the preset tuner slider on position one affected all stations other than number one. Clearly something was wrong with the push buttons, and on closer inspection I noticed that a tiny piece of solder had bridged across the print on position one, making a parallel contact with all the other buttons when they were pressed in. Removing the solder cured the tuning problem, the ghosting and ringing also disappearing.

The World at Large

Finally a human interest story – and a complaint. An old spinster asked us why LW disappeared first when the battery in her radio started to fail. I asked whether she really did want a technical explanation – and she did. So we explained that the mixer stage would stop oscillating at the lower frequencies first – and were then asked whether in that case we might perhaps sell old batteries at half price for MW use only . . . Now to the complaint. Why do some engineers find it necessary to carry on about trannys, cappys and so forth? Isn't straightforward English far preferable to this pointless jargon?

Your PROBLEMS solved

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PYE 741 CHASSIS

The screen occasionally goes very bright, though it's still controllable – if the brightness control is turned right back with the fault present, there's a good monochrome picture but no colour. The trouble is intermittent, but when it appears it lasts for an hour or so. The fault is definitely on the decoder board, since a replacement panel clears it. All the i.c.s have been replaced without improving matters.

It's possible that the burst gate control RV325 is incorrectly set: as a guide, its wiper point usually faces the nearest end of R328. Alternatively, lack of line pulses via the adjacent two-pin plug will cause the same effect.

ITT CVC5 CHASSIS

A streaky magenta cast is present on transitions from dark to light areas, while on light to dark transitions there's a streaky green cast. The fault is not very consistent however, sometimes changing every few seconds, remaining sometimes for an hour or so, while on other occasions it may occur only once or twice during an evening. The transistors in the green channel have been replaced. Is there anything else to check before trying a new tube? Incidentally, the only other faults we've had over the past six years have been a defective PCL805 field timebase valve and output stage cathode decoupling electrolytic C427 (went short-circuit), R429 in the focus network going open-circuit, and a dry-joint in the i.f. preamplifier circuit (caused a noisy signal).

The fault is often due to C143 (0·0015μF) which adjusts the frequency response of the G output stage. Check this capacitor, and its 27Ω series resistor R176, by substitution. If the fault persists, the tube could well be at fault. Interchange the blue and green drives to the c.r.t., set up the grey scale, and watch in monochrome: if the fault still shows up in the same way, a new c.r.t. will be necessary.

THORN 1400 CHASSIS

Faint flyback lines are visible on dark parts of the picture, while with no modulation, i.e. a blank screen, the right-hand side is much darker than the left – this is not obvious when a picture is present. The field flyback blanking pulse coupling components R129 and C102 have been replaced without making any improvement. The shading effect is not gradual – one half of the picture is bright and the other dark.

The trouble could be due to the c.r.t.'s first anode decoupling capacitor C100 being open-circuit, but we're more inclined to suspect that the blanking pulses applied to pins 2 and 6 are incorrect. They are developed across R122, being fed via C102 (field) and C103 (line). Note the effect of shorting pin 2 of the tube base to pin 1 – this removes the blanking pulses entirely, and may also remove the shading effect, confirming that the fault is in this circuitry. If so, check the components mentioned and winding E-D on the line output transformer, noting that tag D should go to chassis.

THORN 1500 CHASSIS

There's severe lack of width – only about 6in. – though the picture seems to be normal otherwise.

First check the harmonic tuning capacitor C95 (C113 in larger screen versions of the chassis) since it's likely that this is about to go short-circuit. Otherwise, check the scan-correction capacitor C90, then check the h.t. at pin 9 of the PY801 boost diode (should be 240V or so) and the drive to the PL504 line output valve (should be approximately –70V at pins 1 and 2). If the latter is low, check back to the line oscillator circuit. If everything is in order so far, the line output transformer is suspect. The surest way of checking the capacitors mentioned is by substitution.

DECCA CTV25

When I bought this set the tube had a broken neck. A new tube was fitted – an A63-200X in place of the original A63-11X – and I am now trying to restore the set to working order. The problem is sound but no raster, with the valves in the line output stage running rather hot. All the valves in the line timebase have been replaced, and I now suspect the line output transformer. Any suggestions before I take this expensive step? And is the replacement c.r.t. correct?

The replacement c.r.t. is suitable. The first step to take is to see whether there's a negative voltage of –30V or more at the control grid (pin 1) of the line output valve. If not, you will have to find out why the line oscillator is not working – check around the PCF802, also the flywheel sync circuit if necessary. If the negative voltage is present, check the boost capacitor C413, the line output valve coupling components C415 and L408, the focus rectifier D401 and its reservoir capacitor C416, and the third harmonic tuning capacitor C414. If all these are in order, the line output transformer is suspect – it's not over reliable in this chassis. D401 and C416 can be checked simply by disconnecting D401: if the valves then run cool, you've found the fault.

TELETON TVC14

The trouble with this set was intermittent loss of sound, which could last for a few minutes or several hours after the set had been switched on. It could be brought back by advancing the volume control and then restoring it to the original setting. Sometimes there was no sound at switch on, though a drop of Electrolube injected into the volume control would usually restore it. Changing the volume control cleared the fault for some months, but now it's back again.

We suggest you change the 10μF capacitor C301 which couples the signal from the slider of the volume control to the base of the audio amplifier transistor TR18. This is the most likely suspect, but it might also be necessary to check C46 (also 10μF) which couples the output from the TA7073AP intercarrier sound i.c. to the volume control (via plug/socket J201).

THORN 3000 CHASSIS

The picture on this set will suddenly change from perfect to one which lacks contrast and has faded colours. This condition will persist for a number of days, then a perfect picture will suddenly reappear. All the adjustments seem to work normally.

Since the fault affects both the contrast and the colour, it would seem to be in the i.f. strip. Check the a.g.c. and the i.f. circuits carefully for dry-joints or similar troubles. Then suspect the a.g.c. smoothing capacitors C179 (10μF) and C134 (25μF, early production only), and the first i.f. amplifier transistor's collector decoupling electrolytic C177 (30μF), also the vision i.f. transistors, especially the final one VT104.

PYE HYBRID COLOUR CHASSIS

On monochrome, the picture is much lighter over the last third of the screen, with a magenta tinge. The first two-thirds of the picture have a brownish tinge. The colours appear to be normal on colour reception, though the right-hand side of the screen is noticeably lighter.

Remove the CDA panel and clean the print at the sides and the chassis runners which earth the panel. If this fails to clear the problem, check the blanking components (VT28 and D53) in the cathode circuit of the PL802 luminance output pentode, and if necessary the electrolytic decouplers C367 and C371 (both 4μF) in the colour-difference output stages.

THORN 950 CHASSIS

I replaced the Mazda AW47-91 c.r.t. with a spare Mullard tube of the same type, the only apparent difference being that it is not fitted with a linearity sleeve. On switching on however the fusible resistor in the h.t. supply opened. I assumed that this was due to excessive width, but there's insufficient room between the neck of the Mullard tube and the deflection coils for a sleeve to be fitted. Any ideas?

You can safely leave the linearity sleeve out – the line linearity should be acceptable without it. The width can be reduced by means of R132. The fusible resistor probably failed for some other reason. Check the valves in the line output stage (PL504/PY81) and the harmonic tuning capacitor C131. The tripler could be faulty, also the scan coils – see whether the line output stage valves run cool when they are disconnected. Also check for line drive to the PL504 if necessary.

PYE 713 CHASSIS

The trouble with this set is noise, i.e. a grainy picture. The picture itself is good, and all the controls work correctly. The aerial has been checked and seems to be in order. Any ideas as to the cause of the trouble?

The fault on this and similar chassis, e.g. the 731, seems to be fairly common. The usual cause is a dry-joint somewhere in the selectivity/gain module – the largest can on the i.f. panel. The trouble can be due to the griplets used to connect the sides of the copper together, or to the group of small ceramic capacitors in the middle of the unit. Raise and resolder the capacitors, so that the coating is clear of the joints.

TELETON TVC20W

There are two faults on this set. First, atrocious field linearity. The extreme bottom of the picture appears at the top, followed by a very compressed section and then a considerably stretched section from the centre to the bottom of the raster. Secondly, the colour is normal but on monochrome there are horizontal yellow bands across the screen.

For the first fault the items to suspect are the 21LU8 field oscillator/output valve, the 2·2kΩ and 2·7kΩ (both 1W) resistors R625 and R624 in the cathode circuit of the output section (connected to pin 9), and the 1MΩ resistor R618 which is connected between the field linearity and height controls. For the yellow bands we suggest checking the 10GK6 luminance output valve and the two 8FQ7 colour-difference output valves for heater-cathode leakage, and for dry-joints etc. in these areas.

THORN 1690 CHASSIS

The symptoms are no raster and no sound except for a hissing sound from the loudspeaker. As there was no line whistle, we checked for e.h.t. and as expected found this absent. Both fuses are intact. A new line output transformer/e.h.t. rectifier combination was tried, but this made no difference. The 11·3V rail is correct, but the 100V rail is not there because of the lack of line output. The line driver transistor's collector feed resistor R90 (12Ω, 0·2W) was found to be very high in value, starving the transistor of collector voltage. As a direct replacement wasn't available, a 10Ω ¼w resistor was tried but got hot within seconds, as did the driver transformer T3. Continuity tests on the driver transistor have been carried out, but it seems to be satisfactory.

The line driver transistor VT16 is obviously hard on. This could be due to leakage in VT16 itself, or in the preceding oscillator transistor VT15. It's best to check these by substitution. First however ensure that the tuning capacitor C84 (0·0068μF) is not leaky, as this would upset the bias conditions.

SONY KV1810UB

The trouble with this set is no sound or vision. On checking it was discovered that the chopper device Q603 is short-circuit, whilst the resistors in series with it (R607/R610) both overheat – R607 subsequently went open-circuit. Is the SG6533 a suitable replacement for the chopper?

The SG6533 can be used to replace the SG608 (early production) or SG613 (later production) chopper – it's a gate-controlled switch incidentally. The reason for Q603 going short-circuit is almost certainly that the line output device Q510 – another SGS, of the same type – or the flyback tuning capacitor C542 (0·018μF, 1·5kV) has gone short-circuit. Replace as necessary, along with the damaged components on the power supply panel.

THORN 8000 CHASSIS

The set lost its colour. An exchange i.f./chroma/video panel was fitted and the set worked well for about three weeks. Then the colour started to come and go – sometimes disappearing for a few minutes, at other times for an hour or so.

First check the 33kΩ resistor R404 on the timebase panel – it supplies the burst gating pulses, and has a habit of going high-resistance. If this is o.k., turn to the decoder section. Try slight adjustment of the burst gate timing control R151, in an anti-clockwise direction. If this fails and you are sure there are no dry-joints or board faults present, replace the d.c. amplifier transistor VT110 and then set up the a.p.c. loop as described in the manual.

PHILIPS G8 CHASSIS

There's an intermittent convergence fault on this set. The right-hand side of the screen, particularly the lower part, goes out of red/green convergence. The fault can be present at switch on, and remain for the whole period of viewing and for several days afterwards. At other times the picture will be perfect for several days.

This is a fairly common problem on receivers with the chassis-mounted convergence unit. The fault is usually due to the R/G parabola control R1934 becoming intermittent or dry-jointed, or a similar defect in the 2·7Ω resistor R1919. Gentle probing should reveal the fault, and replacement is simple. Repeated failure of these components can occur if the h.t. is excessive, so this should be checked and if necessary reset.

NATIONAL PANASONIC TC42G

The basic problem with this set is lack of signals – just a bluish-red raster with faint lines (pinkish) running across.

We've found a defective final i.f. transistor TR103 (2SA563A) and a faulty detector/a.g.c. i.c. (IC301, AN231) to be responsible for loss of signals on this chassis. Loss of luminance has been traced to the emitter-follower TR301 (2SC538A).

TEST CASE

198

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

A set fitted with the Pye 169 monochrome chassis arrived in the workshop with the written complaint of "black vertical bands at the sides of the picture". This was soon found to mean low width. The line scan in fact was around half an inch short at each side, but the linearity was normal while the picture and sound quality were very acceptable. Adjustments failed to make any meaningful impressions on the symptom, while a test on the main h.t. supply line in the set showed that this was pretty well normal – if anything, a trifle high.

A fairly common cause of this symptom is a low-emission PL504 line output valve. This could also account for the slightly high h.t. voltage. A substitution test (always the best in such cases) gave no change to the symptom however. The same was true with changes of the line oscillator and boost diode valves.

Voltage tests were then made around the PL504's input circuit, with a meter switched to 240V f.s.d. and the receiver active. When the meter was connected to the valve's control grid there was a further reduction in line amplitude. It was next found that when the meter's test probes were connected across one of the two 4·7MΩ resistors in this circuit there was an immediate restoration of width, with a slight overscan. When the meter was removed and connected across the other 4·7MΩ resistor, which is connected in series with the first, the increase in line amplitude was far less dramatic and full width could not be achieved. The resistors are identified as R85 and R86, and operate in conjunction with a VDR etc. in the e.h.t./width stabilising circuit.

Did the technician shunt the resistors accidentally with his meter while testing generally, or was the shunt test deliberate? If the latter, what could be learnt from the results? See next month for the solution and for a further item in the series.

SOLUTION TO TEST CASE 197
–Page 383 last month–

The convergence circuitry used in the RRI Z179 chassis is rather more complex than usual, since this chassis uses a 110° delta-gun tube. For horizontal red/green convergence, a line pulse modulated at field frequency is used. This is subjected to a double integration process, first by the R/G amplitude coil 5T1 and then by the convergence coils themselves – 7L9 green and 7L10 red. Since there's a common coupling to the red and green convergence coils, via 5C4, 5T1 and 5L3, and movement of the red crosshatch lines could be achieved by adjusting the control, the technician concluded that the modulated line pulses must be entering the circuit. This was proved by connecting up an oscilloscope.

The next step was to check the current flowing through the red and green horizontal convergence coils. This was done by connecting a low-value resistor in turn in series with the earthy end of each coil, using an oscilloscope to monitor the voltage across the resistor in each case. Provided the value of the resistor used is small compared to the impedance of the coil, the display obtained on the oscilloscope will be that of the current flowing in the coil, and the peak-to-peak current will equal the peak-to-peak voltage divided by the value of the resistor.

The check revealed that there was normal current flowing through the red coil but virtually none flowing through the green coil. The resistance of the green coil was then measured and was found to be infinite.

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A67-120X	82.00	10.25
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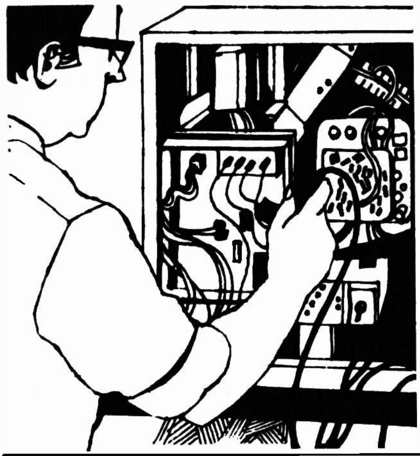
A67-150X	75.00	9.37

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

CARRIAGE
Mono £3.00 Colour £4.00
Mainland only. Overseas Rates on Application.

TELEVISION TUBE SHOP LTD.
52 BATTERSEA BRIDGE RD., LONDON, SW11.
Tel. 228 6859/223 5088



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When replying to 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.

SETS & COMPONENTS

MAINS DROPPERS AND CAN CONDENSERS

Philips G8 47Ω	40p
Philips G8 2·2-68Ω	60p
Philips 210 118-148-LoopΩ	60p
Philips 210 30-125-2K85Ω	70p
Philips GT23 6-124-84Ω	70p
Thorn 3500	70p
Thorn 1500 350-20-148-1500-317Ω	85p
Thorn 1400	75p
Thorn 8000 56-1K-47-12Ω	85p
Pye 725 27-56Ω	60p
R.B.M. TV161 250-14-156Ω	65p
GEC 2010 8-15-17-70-63-188Ω	85p

2010 Covers 2013 2014 2017 & Sobell 1010 10A 13 & 1014
Bush TV165-166-171-175-176-178 65p
Murphy V1910-1913-1914-2014-2310-2311-2312 2314 65p
Bush A823 68-56Ω 85p

TV Condensers:	– 200 + 200 ± 100 mfd 300V			42p each
	150–100–100–100–150M 325V			£1.90
	150–150–100M 300V			£1.50
	175M 400V 100–100M 350V			£1.95
	400–400M 350V			£2.50
All	2500–2500m 30V 75p		2500–2500m 63V	£1.35
Can	4700m 25V 80p		1500m 70V	75p
Cond	2200m 40V 60p		1000m 63V	60p
	BDX32 £1.98		PL802T Special	£3.50
	100–300–100–16m 300V			£1.60

Post Free, Cash with order, VAT paid.

Durham Supplies
367 Kensington Street, Bradford 8, West Yorkshire

20 AX & P.I.L. TUBE

Colour Tubes .... from **£25**
20 AX all sizes .... from **£25**
Toshiba P.I.L. All Sizes .... from **£25**
S/S COLOUR SETS .... from **£60**
S/S & D/S MONO .... from **£5**

RING: JEFFRIES 01-845 2036

COLOUR TUBES

Rebuilt with new electron gun, to British Standard. High temperature pumping.

Here is what you pay.

17-18-19 inch £29.00
20 inch £30.00
22 inch £32.00
25 inch £34.00
26 inch £38.00

Guarantee 2 years.
Exchange basis.
Prices negotiable for contracts.
Old Colour tubes purchased.
Carriage £5·00.

TELESTAR TUBES
575c Moseley Road, Birmingham B12 9BS.
Tel: 021-440 5712.

SMALL ADS

The prepaid rate for classified advertisements is 18p per word (minimum 12 words), box number 60p extra. Semi-display setting £3.50 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).

CONDITIONS OF ACCEPTANCE OF CLASSIFIED ADVERTISEMENTS

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3. Although every care is taken, the Publishers shall not be liable for clerical or printers' errors or their consequences.

IRELANDS LARGEST DISTRIBUTORS OF COLOUR AND MONO TELEVISIONS

THOUSANDS TO CHOOSE FROM. MAKES INCLUDE BUSH, FERGUSON, PYE, PHILIPS, GEC, DECCA, GRUNDIG, NORMANDIE, etc.

Mono from **£2**, Colour from **£10**, *Delivery can be arranged.*

Distributors for Tele-part, Labgear, Jaybeam Aerials, Weller and Eagle products etc.

SOLE DISTRIBUTORS IN IRELAND FOR TYNE INTERNATIONAL COLOUR TELEVISION.

TELETRONICS, SESKINORE, OMAGH, CO. TYRONE. TEL: FINTONA 389
(STD 066 284)

DXTV Televisions, Amplifiers, filters supplied to individual requirements. Hugh Cocks, Bre Cottage, Staple Cross, Robertsbridge, Sussex. S.A.E. with enquiry please. Telephone 058083-317.

LEDCo

THE PANEL PEOPLE

Specialists in the design, manufacture and servicing of TV panels

Typical repair prices:

PYE 697 Decoder	£8.40
THORN 3000 Power Supply	£9.50
PHILIPS G8 Line Scan	£10.20
RANK A823 Timebase	£9.50
GEC 2040 Decoder	£8.40

VAT & P/P included

Send for full details and price list. Special rates for contract and bulk work.

We also make and supply the celebrated LEDCo *Solid State* CDA panel for the Pye hybrid receiver (£21.00), Solid State PL802 (£2.40) and Audio IC module to replace Mullard LP1162 (£6.75). Prices include VAT & p.p. Discounts for 5 or more.

LEDCo. 189a Livingstone Road, Thornton Heath, Surrey CR4 8JZ
Tel. 01-653 7575

BRC/TCE 2000, 3000, 8000, 9000.
Philips G8 550
Pye 691, 697, 713
Bush Murphy 802, 823.

Panel Repair/Exchange Singles or Bulk

MODULAR ELECTRONICS
160 Brabazon Road, Hounslow, TW5 9LP.
Telephone 01-897 0976.

EX RENTAL TV

19" UHF 625 £4.50
23" UHF 625 £6.00
Colour from £40.00

EDWARDS & SONS
103 Goldhawk Road, London W12
Tel: 01-743 6996

VALVE BARGAINS

ANY 1–20p, 5–80p, 10–£1.25, 50–£5.50

ECC82, ECH84, EH90, PFL200, EF80, EF183, EF184, PCF80, PCF802, PCL82, PCL84, PCL85/805, PY81, PY800, PY88, PL36, PL504, 6F28, 30PL14.

COLOUR VALVES 50p EACH
PY500/A, PL508, PL509, PL519.
Postage & Packing 30p, no VAT

VELCO ELECTRONICS
9 Mandeville Terrace, Hawkshaw, Via Bury, Lancs.

COLOUR PANEL EXCHANGE SERVICE

BRC 3000 – 3500 8000 – 8500
Philips G8 and GEC 2110 series.

Free delivery in London area on Exchange Panels. Large stock of BRC 3500 series spares. New and S/H BRC Panels for sale. Immediate exchange on repairable panels.

Catalogue available on request.

KAY JAY TV SERVICE
34, Clauson Avenue, Northolt. Phone 864 0350.

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

URGENT TRADE NOTICE

Large quantities of good quality mono and colour TV receivers for sale, at competitive prices.

WHY not come to us where your custom will be welcomed and appreciated.

WE supply receivers to all parts of the UK, and to EIRE. All export enquiries welcomed.

TV WHOLESALE SUPPLIES
35 Shipston Road, Stratford-on-Avon.
TEL: 0789 4424

S.W.T.V. WHOLESALE

(TRADE ONLY)

WHOLESALERS OF EX-RENTAL TVs

MONO: 20″ & 24″ S/S from **£8·00**

COLOUR: NORDMENDIE, PHILIPS, PYE, GEC, DECCA etc. ALL S/S

FRESH DELIVERIES WEEKLY

WORKING SETS AVAILABLE—WITH TESTING FACILITIES

OPEN MONDAYS & WEDNESDAYS 11 am-6 pm

128 LANDOR ROAD, LONDON S.W.9

Tel: 01-733 6232

PL802/T TOP QUALITY

SOLID STATE REPLACEMENT VALVE
£240 each C.W.O.

LLOYD ELECTRONICS
63 North Parade, Grantham, Lincs.

BY127	5 for 60p	BU208	£1·60
BT106	95p	BDX32	£1·60
TV106	£1·30	BF459	45p
2N4443	70p	MPSA42 300v NPN	30p
2N4444	85p	2SC 1520 250v Power	30p
R2010B	£1·20		
R2008B	£1·40	BF394 (BF194)	5 for 60p
BU105	£1·50	BC184	5 for 60p

TV CONDENSERS

PYE 200+300μf 350v	£2·00
THORN 3K 175μf 400v+100+100·350v	£2·00
THORN 3K 1,000μf 70v	75p
12VA CHOKES SUITABLE FOR THYRISTOR OR LOW VOLTAGE SMOOTHING	65p
PHILIPS/BUSH/GEC 600μf 300v	£1·80

ADD 20p P/P ORDERS UNDER £10

P. V. TUBES

All types including 20AX-P.I.L. **12 months guarantee**

Colour tubes supplied on a 'glass for glass' basis
Callers ring to arrange to bring your glass for on the spot exchange from our stocks
Lancashire/W. Yorks. deliveries by arrangement
Carriage costs per tube: Portables £1·00; Mono £3·50; Colour £4·50; incl. VAT

REBUILT MONO

A28-14W	11″ (Pencil)	£14
A31-410W	12″	£14
A31-120W	12″ (Pencil)	£14
A31-18W	12″	£14
A34-100W	14″ (Pencil)	£14
A38-160W	15″ (Pencil)	£14
A44-120WR	17″	£14
A59-23W	23″	£14
A50-120WR	20″	£11
A61-120WR	24″	£11

Glass is required for portable rebuilt mono please.

REBUILT COLOUR

17″ 18″ 19″ 20″	£28
22″	£30
25″ 26″	£34
26″ 110°	£36

NEW MONO

A31/510 12″ Replaces A31/120, A31/410 (Mullard 2 year warranty)	£17
A34/510 14″ Replaces A34/100 (Mullard 2 year warranty)	£18·50
A50/120WR 20″	£12
A61/120WR 24″	£13·50

All tube prices subject to 12½% VAT.

No minimum order limit – you may order as you please
Cash with order please – any excess refunded
Cash with order please
SAE all enquiries please
Immediate despatch
Many more "U" series valves in stock

NEW VALVES

Valve prices include 12½% VAT

Type	Price	Type	Price	Type	Price	Type	Price
30FL1/2	£1 25						
DY802	67p	EF184	64p	PCC85	60p	PL36	90p
DY86/7	58p	EH90	75p	PCC89	65p	PL81	50p
ECC81	52p	EL34	£1·80	PCC189	65p	PL84	65p
ECC82/3	62p	EL84	50p	PCF80	80p	PL504	£1 33
ECC85	50p	EL509	£2·50	PCF86	65p	PL508	£2 00
ECC88	72p	EY86/87	50p	PCF200	£1·60	PL509	£2·52
ECF80	65p	EY500A	£1·50	PCF801	60p	PL519	£3·00
ECF82	65p	EZ80	50p	PCF802	80p	PL802	£2·22
ECH81	55p	EZ81	50p	PCF805	£1·65	PY81	69p
ECH84	£1·00	GY501	£1·40	PCF806	70p	PY88	80p
ECL80	60p	GZ34	£1·75	PCF808	£1·70	PY500A	£1 60
ECL82	60p	KT66	£3 50	PCH200	£1·20	PY800/1	69p
ECL86	75p	PC86	75p	PCL82	73p	UCH81	65p
ECF86	80p	PC88	75p	PCL84	80p	UCL82	75p
EF80	40p	PC92	85p	PCL805/85	85p	UCL83	£1·00
EF85	40p	PC97	75p	PCL86	85p	UL84	£1 00
EF86	60p	PC900	75p	PD500	£3·30	U26	50p
EF183	64p	PCC84	30p	PFL200	£1·25	U191	50p

ALL VALVES ARE UNUSED - BOXED - AND GUARANTEED

Post & Packing charges 14p for 1 valve - 7p for each
Additional valve - 2p extra for large valves - max. 80p.
Post free orders over £20 - any parcel insured extra 10p.

P. V. TUBES *Regd. Office* Tel. (0254) 36521 and answering service.
9 Havelock Street, Oswaldtwistle, Accrington, Lancashire BB5 3JY
V.A.T. No. 291-1937-45.

RE-BUILT COLOUR TUBES

19″ £29.50	MONO	20″ £30.50
22″ £32.50	20″ 24″	25″ £34.50
26″ £38.50	£16	

One Year Guarantee.

MATRIX TV LTD.,
112 Essex Road, London N1. Tel: 226 1111

REBUILT COLOUR AND MONO TUBES IN

South Wales

All tubes are guaranteed for 12 months. Colour tube guarantee extendable to 4 years.

Colour	Price examples
18″, 19″	**£31.00**
20″, 22″	**£33.00**
25″	**£35.00**
26″	**£36.00**
Mono	
20″	**£11.00**
24″	**£12.00**

Add V.A.T. @ 12½% to all the above prices.

Prices are based on a sound tube for tube exchange.

For further details, contact:

C.R.T. Services

BISHTON, NEAR NEWPORT, GWENT

Telephone: Newport (0633) 412112
Llanwern 2112

COLOUR TV's

Many working for disposal, trade only.
All sizes and makes available.
Mono sets also available.

Ingertone (London)
24 Dames Road, Forest Gate,
London E7. Tel: 01-555 5569

Ingertone (Bristol)
28 St. Thomas St., Bristol 1.
Tel: 0272 211179

TELEVISIONS to the Trade. Large quantities of Mono from £2.00; Square Screen from £6.00. Colour T.V.s Working from £65. R.B.M. GEC, Pye, Thorn etc. Phone Scarborough 0723-68087-65451. Scarborough T.V. Trading, Ridings House, Depot Lane, Seamer Road, (A64) Scarborough.

BRITISH AERIALS

The full range of quality BASC/AMA* aerials, amplifiers, lashing kits, cables, masts, rotators and accessories can be supplied at extremely competitive prices, normally from stock. Representative examples are shown. For quotations on specific items, or general and technical application queries, please write (SAE). Lists supplied on request

Labgear CM6030/6040 wide band amplifiers	£22·48
Jaybeam 'Super Fringe' FM9S F.M. Aerial	£28·87
Antiference XG21	£38·15
Wolsey "Colour King"	£13·25

All prices include VAT and post and packing.

A Customer Advisory Service is available specialising in both problem and fringe area reception for F.M. radio, VHF and UHF T.V., and for receiving a 2nd ITV channel. An aerial installation service is anticipated to commence in the late summer for South West England, providing well engineered installations tailored for individual locations and requirements.

BASC: Aerialite, Antiference, Jaybeam, Maxview, Wolsey. Premier Industries.

SOUTH WEST AERIAL SYSTEMS
10 Old Boundary Road, Shaftesbury, Dorset. Tel. 0747 4370

T.V. SPARES, PANELS AND MANUALS

PHILIPS · GRUNDIG

TELEVIEW 01-994 5537
194, Acton Lane, London W.4.

VALVE LIST

ALL VALVES FULLY TESTED

Five valves or over postage paid
Under five valves postage 6p each

DY86/87	15p	PC900	8p	PCL85/805	20p
EB91	12p	PCC84	8p	PL36	20p
ECC82	10p	PCC85	20p	PL504	25p
ECL80	8p	PCC89	8p	PY32/33	15p
EF80	8p	PCC189	8p	PY81/800	15p
EF85	8p	PCC805	15p	PY801	20p
EF183	10p	PCF80	8p	U191	15p
EF184	10p	PCF86	15p	6F23	15p
EH90	13p	PCF805	20p	6/30L2	15p
EY86/87	13p	PCL82	15p	30F5	10p
PC86	15p	PCL83	15p	30FLI	20p
PC88	15p	PCL84	15p	30PL14	15p

AND MANY MORE AVAILABLE

S. W. ELECTRONICS
114 Burnley Road, Rawtenstall, Rossendale, Lancs.

FRENCH. T.V. Black and White and Secam Colour Sets available at reasonable prices. Hugh Cocks, Bre Cottage, Staplecross, Robertsbridge, Sussex. Telephone 058083-317.

QUALITY REBUILT TUBES
HIGH TEMPERATURE PUMPING
Colour (2 year guarantee) from **£30**
Mono (including thin necks) from **£10**
Send or phone for full list and terms
OPEN SATURDAYS
WELTECH PICTURE TUBES
5 Masons Avenue, Wealdstone, Harrow, Middx.
01-427 5063.

WANTED

NEW VALVES and CRT's required, PCL805, PL504, PL509, PY500A etc. Cash waiting. Bearman, 6/8 Potters Road, New Barnet, Herts. Tel: 01-449 1934/5.

WANTED to buy or borrow UHF signal strength meter. Fraser 4 Oykel Bridge, Lairg, Sutherland, Scotland.

REPAIRS

REPAIRS – have you more work than you can handle, send your repairs of Televisions, Tape-Recorders, music centres, radio-grams etc. to D. Savage, 13 Salisbury Road, Wood Green, London N22. Tel: 888-8787.

LADDERS

ALUMINIUM Roof Crawlers. Sizes 12ft.-24ft. Also aluminium ext. up to 62½ft. Leaflet. Ladder Centre (TEL2), Halesfield (1), Telford. Tel: 586644. Callers welcome.

AD 161-162 PAIR 60p

40 M/A
160 M/A
250 M/A
800 M/A
1 Amp
1·15 Amp
1·6 Amp
2 Amp
2·5 Amp
3 Amp
4 Amp

20MM Fuses Mixed Values Anti Surge and Quick Blow 30 for £1.00

3500 Thorn Triplers £3.50
F7068PC 5 Watt O/P I.C. £1.00
TK 25KC 15BL Ex Panel Pye £1.50
ITT 11TDL CVC 20/25/30 £4.00
TS2511TDT Thorn £4.00
TS2511TBQ Pye £1.50
TS2511TCE £3.00
1730 Decca £1.00
Mains Droppers 69R + 161R Pye 40p
Rank/Bush Mains Dropper 302R/70R/6R2 40p
147R + 260R Pye 40p
Thorn Mains Dropper 80R/6R/054R/720R/317R 40p
Thorn Mains Droppers 6R + 1R + 100R 35p
Thorn Mains On/Off Switches, Push Button or Rotary 15p
100 Mixed Diodes £1.00
1N5349 Diode, 12V Z/Diodes 10p EACH
400 MFD/350V 50p
GEC Tripler C2100 £2.00
300 Mixed Condensers £1.50
300 Mixed Resistors £1.50
30 Pre-sets 50p
100 W/W Resistors £1.50
40 Mixed Pots £1.50
20 Slider Pots £1.50
470M/100v 25p
Focus Unit 3500 Thorn £1.00
Thorn 8500 Focus Unit £1.00
4 Push Button UHF Unit 1400 – 1500 Series and 8500 £3.50
D.P. Audio Switch 7½p

BF127 BC350 BF194
BF264 BF178 BF184
BF180 BF257 BC460
BF181 BF137 BF395
BF182 BC161 BC263B
BC300 BF185 BF273
AC128 15p EACH

3300/40v 680/40v
680/50v 220/63v
2200/10v 12½p EACH

2N930 BC183
2N2222
2N3566 7½p EACH

BF336 30p
TIP41A – 42A PAIR 40p
G11 Philips Thyristors GEC112M 60p
Pye Thyristors 2N4444-OT112 BT116 85p
BU126 £1.00
6200PF/2000V 8p
·3/600V 8p
Mixed Components 1lb for £1.50
Mains On/Off Switch GEC Push Button or Rotary ·30p

15,000 PF 10kV 10p
22,000 PF 10kV 10p
25,000 PF 10kV 10p
F7068 PC 5 Watt O/P.I.C. £1.00
100 Mixed Electrolytics 1000 MFD to 4 MFD £2.50
SN76530P 35p
BYX 38/600R 50p
·1 MFD 400 5p
·1 MFD 2000v 15p
·1 MFD 800v
·01 MFD 1000v
·047 MFD 1000v
·47 MFD 630v
·0047 MFD 1500v
·0022 MFD 1500v
8p EACH
·47 1000v 35p.

200+200+100M 325v 40p
470+470 250v 40p
100+200M 325v 30p
200+200+100+32M 350v 70p
150+200+200M 300v 50p
800M 250v 20p
600M 300v £1.00
400M 400v £1.00
800+800M 250v 60p
300+300+100+32+32 300v £1
100M 450v 25p
33/450v 25p
47M 450v 25p
680M 100v 25p
6800M 40v 35p
100M 350v 20p
22M 350v 20p
33000 10v 30p
15000 40v 50p

2·2/63v
220M 10v
2·2M 100v
22M 100v
4·7M 63v
5p EACH

470/63
470/100
220/63
1000/40
2200/63
15p EACH

MJE2021 90v 80v, SJE5451 5A 15p EACH
90V 661 NPN, 80W 5A 660 PNP 28p PAIR
EHT lead & anode cap 25p
Thorn 1500 EHT Rec Sticks 10p EACH
BRC2108 10p
100 Mixed Transistors £1.50
3 amp Diodes 10p
BU500 £2.00
BC107 7p
BF200 10p
BSY79 19p
BXY50 15p
700M/250V 35p

LONG WIRES
300 Mixed Carbon Film
5 of each type ¼ Watt
1R to 2 meg. £1.50. ITT

SP8385 Thorn 25p
GEC Push Button Mains Switches 30p
GEC Rotary Mains Switches 15p
UHF Varicap Units
ELC 1043 EQUV Thorn Unit £4.00
6 Push Button Unit for Varicap Thorn 4000 £2.00
6 Push Button Unit with Cable Form for 1590 series for Varicap Tuner £1.00
VHF Varicap Units New £2.50
VHF Varicap Units New, 49·00-219·00 MHZ £1.50
10M/500v 12½p
·56/400 8p
180PF 8Kv 10p
220/63 12½p
700M/250 50p
2200/25 15p

SN76533N £1.00
TBA990 £1.00
SN76660N 50p
SN76650N £1.00
TBA560Q £2.00
TBA540Q £1.00
TBA54Q £1.00
TIS91 25p
TAD100 £1.00
SAB550 £1.50
TBA530 £1.00
RCA40506 Thyristors 50p
BC108 7p
BD610, BD619 50p PAIR
MJE2955 50p
TIP2955 50p
AC188 10p
BC149C 7p
Aerial Amp Power Supplies 15 volts £1.00
BC158 8p
BC213LA 6p
BF594 6p
BC147C 7p
BC212LT 7p
BC182L 7p
BC148B 7p
BD131 25p
Thorn 1590 Mains Lead & On/Off Switch & Control Panel with 3 Slider Pots £1.00
Reject VHF Varicap Units UHF 50p
AE Isolating Socket & UHF Lead 30p
6 Position 12·5k V/Resistors Units for Varicap 50p
EHT Rectifier Sticks Used in Triplers x80/150, CSD118xMH 10p EACH
CSD118xPA 12p
3 Off G770/HU37 EHT Rec. Silicone, used in Tripler 15p
Bridge Rectifiers 3 Amp 40p
1A 100v 20p
2A 100v 25p
W005M 20p
BY127 10p
1N4005 20 for £1.00
1N4006 20 for £1.00
1N4007 20 for £1.00
BYX94 1200v 1 Amp. 15 for £1.00
BY 210/800 10 for £1.00
BB105 UHF
BA 182 Varicap Diodes
BB103 VHF 12 for 60p
BY176 50p
BA248 7p
BY133 10p
BYX55/350 10p
BY210/400 5p
BY206 15p
BT106 95p
BT116 85p
UHF Mullard Tuner Units £2.00
BY212 15p
12 Kv Diodes 2 M/A 30p
18 Kv BYF3123 Silicone 30p

160PF 8Kv
270PF 8Kv
1000PF 10Kv
1200PF 10Kv
1000PF 12Kv
160M 25v
220M 25v
1000M 16v
220M 35v
220M 40v
220M 50v
470M 25v
22M 315v
100M 50v
330M 10v
330M 25v
330M 35v
330M 50v
330M 63v
470M 25v
470M 35v
470M 40v
47/63
300PF 6Kv
8M/350v
10p EACH

BC365 10p
BD561-2 PAIR 30p
BD183 50p
TDA2680 £1.00
TDA2690 £1.00
SN16862 £1.00
MC1352PQ £1.00
SN76131N £1.00
TBA651 £1.00
TBA750Q £1.50
TBA920Q £2.00
SN76003N £1.50
SN7660N £1.00
SAS570S £1.50
1N4148 3p
BF198 7p
BF274 5p
BA159 10p
BY184 25p
BY187 50p
TAA550 20p
TBA396 £1.00
TBA510Q £1.00
TBA480Q £1.00
TBA550Q £1.50
TBA720A £1.50
TBA 790B131 £1.00
TBA800 95p
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