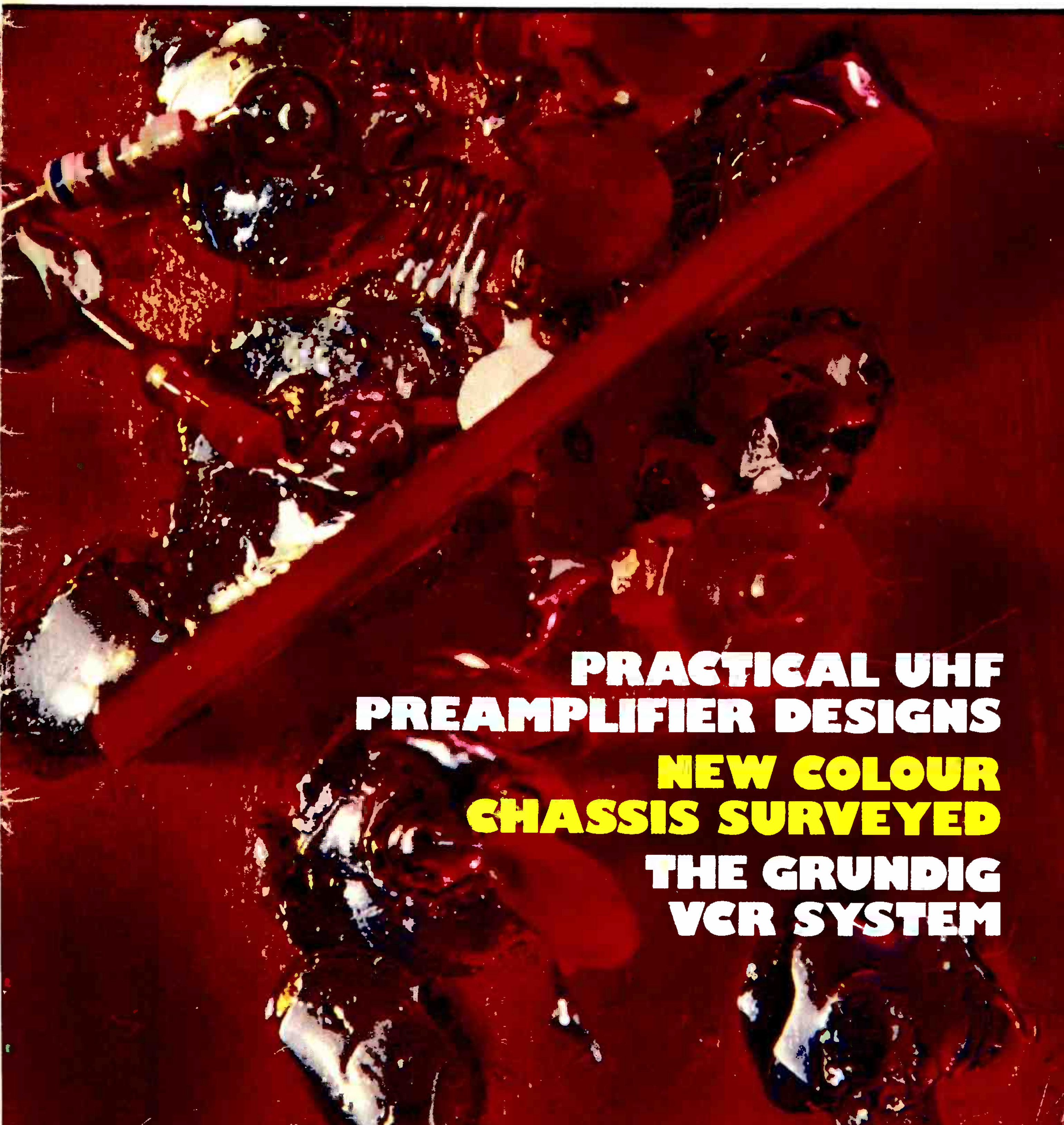
JULY 1979

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

55p

TELEVISION

SERVICING·VIDEO·CONSTRUCTION·DEVELOPMENTS



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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	0.16
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 3VO	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
BF459	1.00
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
TCA270SQ	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
TDA1190	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

DY/86/87	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
PCL82	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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4.443MHZ Crystals	2.00
Cut Out TCE 3500	2.00
Cut Out GEC	2.50
Cut Out TCE 8500	2.00
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TV20 Rectifier Stick	2.00
VA 1104 Thermister	0.60
Transductor TCE 3000	1.50
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PYE 691/697 Lopt	14.00
Bush A 774 Lopt	18.00
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Degaussing Panel Autovox 2282	2.00
Sound O/P Panel Autovox 2282	4.00
PS Panel Autovox 2282	6.00
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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
RRI 823 Tripler	7.00
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

MULTISECTION CAPACITORS

DECCA 400-400/350	3.72
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

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Sets of AVO Leads	10.00
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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
Antstatic	0.75
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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

July 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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QUERIES

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

this month

OUR NEXT ISSUE DATED AUGUST WILL BE PUBLISHED ON JULY 16

THE UNBEATABLE BRIARWOOD SERVICE

EX-EQUIPMENT SPARES

MISC. S/Output Trans. £1 + VAT + £1 P&P F/Output Trans. £1.25 + VAT + £1 P&P. Scancoils £1.50 + VAT + £1 P&P. Other spares available, please write or phone for details.

MONO TUBES
(tested)
19" Rimguard £3.00
23" Rimguard £4.00
20" Rimguard £5.00
24" Rimguard £6.00
+ £4.00 P.&P.

MONO TUNERS
6-button integrated all at £6.00
U.H.F. P/Button D/S £4.50. U.H.F. P/Button S/S £4.50. Rotary £3.00 + £1 P&P.

MONO LOPTS
All D/Standard Lopts at £4.00 + £1 P.&P.
All S/Standard at £4.00 + £1 P.&P.

MONO PANELS
i.e. Philips, Bush etc. £3.50 + £1 P.&P. Quotations for complete S/hand chassis if required. (Diff. prices)

PLEASE ADD 12½% V.A.T. TO ALL ITEMS AND OVERSEAS AT COST. CASH WITH ALL ORDERS.

VALVES (MONO & COLOUR)

PCL82	0.10	PCF802	0.10	PCC86	0.10	EY86/7	0.10	30PL1	0.25	PL509	1.00
PCL83	0.25	PCF805	0.25	PC97	0.20	EY8/7	0.10	30PL13/4	0.10	PY500	1.00
PCL84	0.10	PCF806	0.10	PC900	0.10	DY802	0.10	30P12	0.10	GY501	1.00
PCL85	0.10	PCF808	0.25	EF80	0.10	PY800/1	0.10	30FL1/2	0.25	PL508	0.50
PCL86	0.10	PCF80	0.10	EF85	0.10	PL36	0.25	ECC82	0.10	PCH200	0.50
PFL200	0.10	PCC189	0.10	EF183	0.10	PL504	0.25	ECC81	0.10	PCF200	0.50
PCF801	0.10	PCC86	0.10	EF184	0.10	PL81	0.10	ECH81	0.10	CEY51	0.15
30C1	0.10	30C15	0.10	6BW7	0.10	6/30L2	0.10	ECL80	0.10		
30C17	0.10	30C18	0.25	ECC85	0.10	U26	0.10	ECL82	0.10		
PL83	0.10	PL84	0.10	EH90	0.10						

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

WE DO NOT SELL RUBBISH AT BRIARWOOD TV

D/STANDARD COLOUR SPARE PANELS

	IF	LUM	CHROMA	EHT	REG	CON	S/OUTPUT	POWER	L/TB	F/TB
Bush/Murphy	6.50	6.50	6.50	—	—	6.50	1.50	6.50	—	—
GEC/Sobell	6.50	7.50	—	—	—	6.50	—	—	—	7.50
Philips	6.50	9.50	—	—	—	7.50	—	—	—	6.50
Decca	6.50	12.50	12.50	—	—	6.50	2.00 (19" only)	8.00	—	6.00
Thorn 2000	6.50	7.50	7.50	6.50	6.50	7.00	—	8.00	15.00	6.50
Pye	7.50	7.50	9.50	—	—	6.50	—	—	—	7.50
Baird	6.50	8.50	8.50	—	—	6.50	—	—	—	6.00

Postage & Packing £1.25

S/STANDARD COLOUR SPARE PANELS

	IF	LUM	CHROMA	VIDEO	CON	POWER	L/TB	F/TB
Bush 184	9.50	—	20.00	—	8.00	6.00	15.00	—
GEC Hybrid	9.50	9.50	15.00	—	6.00	—	—	12.00
Philips G6 S/S	9.50	—	10.00	—	9.00	—	—	10.00
Thorn 3000	10.00	9.00	18.00	10.00	6.00	20.00	20.00	10.00
Pye 691/693	8.00	7.50	12.00	—	8.00	—	15.00	7.50
Thorn 3500	10.00	9.00	12.00	10.00	7.50	20.00	20.50	7.50

Korting and other foreign panels available on request.

Postage & Packing £1.25

COLOUR TUBES

19"	£18.00
19" A49, 192	£20.00
20"	£20.00
22"	£22.00
25"	£18.00
26"	£28.00

Plus P&P £4.
NEW
Rebuilt tubes available on request.

COLOUR TUNERS

Bush	£6.50
GEC	£6.50
Philips G6 S/S	£6.50
Thorn 3000	£6.50
Pye 691/697	£7.50

Some new tuners in stock, can supply on request. Many Foreign Tuners also available on request. Plus P&P £1.

COLOUR LOPTS
Most Lopts available from £7.00. Both British & Foreign makes. Please ring or write.
P&P per Lopt £1.

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S/Output transformer from £1.50.
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COLOUR

Pye	19"	£60.00	22"	£65.00	26"	£75.00
GEC	19"	£60.00	22"	£65.00	26"	£75.00
Bush	19"	£80.00	22"	£80.00	26"	£90.00
Philips	G6	—	22"	£63.00	26"	£70.00

Many other makes & models available.
Please ring or write for information.

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MONO

20" & 24" S/S	£16.00		Pye, GEC, Bush etc.
20" & 24" D/S	£14.00		Pye, GEC, Bush etc.
19" & 23" D/S	P/button	£12.00	Pye, GEC, Bush etc.
19" & 23" D/S	Rotary	£8.00	Pye, GEC, Bush etc.

Please note there is 12½% V.A.T. on all the above prices. Plus £8 P&P. England, Wales & Scotland for colour T.V.'s. Inland N. & S. Ireland P&P £15. P&P £5 for mono T.V.'s to England, Wales & Scotland. Inland N. & S. Ireland £7 per set.

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NEW SPARES

TYPE	PRICE £
AC107	0.20
AC113	0.17
AC115	0.17
AC117	0.24
AC125	0.20
AC126	0.18
AC127	0.19
AC128	0.17
AC131	0.13
AC141	0.23
AC142	0.19
AC141K	0.29
AC142K	0.29
AC151	0.17
AC165	0.16
AC166	0.16
AC168	0.17
AC176	0.17
AC176K	0.28
AC178	0.16
AC186	0.26
AC187	0.21
AC188	0.20
AC187K	0.30
AC188K	0.30
AD130	0.50
AD140	0.65
AD142	0.73
AD143	0.70
AD145	0.70
AD149	0.64
AD161	0.40
AD162	0.40
AD161 } AD162 }	1.00
AF106	0.42
AF114	0.23
AF115	0.22
AF116	0.22
AF117	0.30
AF118	0.40
AF121	0.33
AF124	0.33
AF125	0.29
AF126	0.29
AF127	0.29
AF139	0.39
AF151	0.24

TYPE	PRICE £
AF170	0.25
AF172	0.20
AF178	0.49
AF180	0.60
AF181	0.30
AF186	0.29
AF239	0.43
AU113	1.29
BA130	0.08
BA145	0.14
BA148	0.17
BA155	0.08
BAX13	0.05
BAX16	0.08
BC107	0.10
BC108	0.10
BC109	0.10
BC113	0.09
BC114	0.12
BC115	0.10
BC116	0.10
BC117	0.11
BC119	0.22
BC125	0.12
BC126	0.09
BC136	0.12
BC137	0.12
BC138	0.21
BC139	0.21
BC140	0.24
BC141	0.22
BC142	0.19
BC143	0.19
BC147	0.07
BC148	0.07
BC149	0.07
BC153	0.12
BC154	0.12
BC157	0.10
BC158	0.11
BC159	0.11
BC160	0.22
BC161	0.22
BC167	0.09
BC168	0.09
BC169C	0.09
BC171	0.08

TYPE	PRICE £
BC172	0.08
BC173	0.12
BC177	0.12
BC178	0.12
BC179	0.12
BC182L	0.09
BC183L	0.09
BC184L	0.09
BC186	0.18
BC187	0.18
BC209	0.11
BC212	0.09
BC213L	0.09
BC214L	0.09
BC237	0.07
BC240	0.31
BC281	0.24
BC262	0.18
BC263B	0.20
BC267	0.19
BC301	0.22
BC302	0.30
BC307	0.10
BC337	0.11
BC338	0.09
BC307A	0.10
BC308A	0.12
BC309	0.14
BC547	0.09
BC548	0.11
BC549	0.11
BC557	0.11
BD112	0.39
BD113	0.65
BD115	0.30
BD116	0.47
BD124	1.30
BD131	0.32
BD132	0.34
BD133	0.37
BD135	0.26
BD136	0.26
BD137	0.26
BD138	0.26
BD139	0.40
BD140	0.28
BD144	1.39
BD145	0.50

TYPE	PRICE £
BD222/T1P31A	0.37
BD225/T1P31A	0.39
BD234	0.34
BD222	0.73
BDX22	0.73
BDX32	1.98
BDY18	0.75
BDY60	0.80
BF115	0.24
BF121	0.21
BF154	0.12
BF158	0.19
BF159	0.24
BF160	0.23
BF163	0.23
BF164	0.17
BF167	0.23
BF173	0.21
BF177	0.26
BF178	0.24
BF179	0.28
BF180	0.30
BF181	0.34
BF182	0.30
BF183	0.29
BF184	0.23
BF185	0.29
BF186	0.30
BF194	0.09
BF195	0.09
BF196	0.12
BF197	0.10
BF198	0.11
BF199	0.14
BF200	0.28
BF216	0.12
BF217	0.12
BF218	0.12
BF219	0.12
BF220	0.12
BF222	0.12
BF221	0.21
BF224	0.12
BF256	0.37
BF258	0.27
BF259	0.27

TYPE	PRICE £
BF260	0.24
BF262	0.28
BF263	0.25
BF271	0.20
BF273	0.12
BF336	0.2[illegible]
BF337	0.24
BF338	0.29
BFT42	0.26
BFT43	0.24
BFX84	0.27
BFX85	0.27
BFX88	0.24
BFY37	0.22
BFY50	0.15
BFY51	0.15
BFY52	0.15
BFY53	0.27
BFY55	0.27
BHA0002	1.90
BR100	0.20
BSX20	0.23
BSX76	0.23
BSY84	0.36
BT106	1.18
BT108	1.23
BT109	1.09
BT116	1.23
BT120	1.23
BU105/02	1.50
BU105/04	2.00
BU126	1.40
BU205	1.20
BU208	1.60
BY126	0.09
BY127	0.10
OC22	1.10
OC23	1.30
OC24	1.30
OC25	1.00
OC26	1.00
OC28	1.00
OC35	1.00
OC36	0.90
OC38	0.90
OC42	0.45
OC44	0.20

TYPE	PRICE £
OC45	0.20
OC46	0.35
OC70	0.22
OC71	0.28
OC72	0.35
OC74	0.35
OC75	0.35
OC76	0.35
OC77	0.50
OC78	0.13
OC81	0.20
OC810	0.14
OC82	0.20
OC820	0.13
OC83	0.22
OC84	0.28
OC85	0.13
OC123	0.20
OC169	0.20
OC170	0.22
OC171	0.27
OA91	0.05
BRC4443	0.65
R2008B	1.50
R2010B	1.50
R2305	0.38
R2305/BD222	0.37
SCR957	0.65
TIP31A	0.38
TIP32A	0.36
TIP3055	0.53
T1590	0.19
T1591	0.19
TV106	1.09

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SL901B	3.50
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DIODES

1N4001	0.04
1N4002	0.04
1N4003	0.06
1N4004	0.07
1N4005	0.07
1N4006	0.08
1N4007	0.08
1N4148	0.03
1N4751A	0.11
1N5401	0.12
1N5404	0.12
1N5406	0.13
1N5408	0.16

VALVES

DY87	0.52
DY802	0.64
ECC82	0.52
EF80	0.40
EF183	0.60
EF184	0.60
EH90	0.60
PC86	0.76
PC88	0.76
PCC89	0.65
PCC189	0.65
PCF80	0.70
PCF86	0.68
PCF801	0.70
PCF802	0.74
PCL82	0.67
PCL84	0.75
PCL86	0.78
PCL805	0.75
PLF200	1.00
PL36	0.90
PL84	0.74
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PL509	2.45
PY88	0.63
PY500A	1.60
PY81/800	0.57

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950 MK2 1400	2 00
1500 18" 19" stick	2.37
1500 24" 5 stick	2.48
Single stick Thorn TV 11.16K 70V	0.75
TV20 2 MT	0.75
TV20 16K 18V	0.75

IC's

SN76013N	1.20
SN76013ND	1.00
SN76023N	1.20
SN76023ND	1.00
SN76226DN	1.50
SN76227N	1.20
TBA341	0.97
TBA520Q	1.10
TBA530Q	1.10
TBA540Q	1.45
TBA550Q	1.40
TBA560CQ	1.50
TBA570Q	1.00
TBA800	1.00
TBA810	1.50
TBA920Q	1.50
TBA990Q	1.50
TCA270SQ	1.45
TCA270SA	1.45
TCA1327B	1.00

E.H.T. TRAYS COLOUR

Pye 731	5.20
Pye 691/693	4.50
Decca (large screen) CS2030/2232/2630/2632/2230/2233/2631	5.00
Philips G8 520/40	5.30
Philips 550	5.30
GEC C2110	5.50
GEC Hybrid CTV	5.10
Thorn 3000/3500	5.00
Thorn 8000	2.42
Thorn 8500	4.75
Thorn 9000	5.50
GEC TVM 25	2.50
ITT/KB CVC 5/7/8/9	5.10
RRI (RBM) A823	5.00
Bang & Olufsen 4/5000 Grundig 5010/5011/5012/6011/6012/7200/2052/2210/2252R Tandberg (radionette) Autovox	6.60
Grundig 3000/3010 Saba 2705/3715 Telefunken 709/710/717/2000	6.80
Korting	6.80

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Thorn 950 etc.	3.00
K.B.	3.00
Pye	3.00
Thorn 1400	4.50

D/S P/B 19" 23"

Thorn 1400	7.00
Bush 161 etc.	7.00
Baird 660 etc.	7.00
Philips 210 etc.	7.00
Pye Olympic etc.	7.00

D/S P/B 20" 24"

Bush	10.00
GEC	10.00
Philips	10.00
Pye	10.00
Thorn	10.00

S/S 20" 24"

Bush 313 etc.	£12.00
Pye 169 chassis	12.00
Thorn 1500	12.00
GEC series 1 & 2	12.00
Decca MS series	12.00

S/S COLOUR

	19" £	20" £	22" £	25" £	26" £
GEC	40	40	40	40	40
Philips	—	—	40	40	40
Thorn	55	—	60	45	65
Korting	—	—	55	—	60
Pye Mechanical	40	—	40	40	40
Pye Varicap	45	—	45	45	45

MAINS DROPPERS

Mono

Bush 161	60p
Philips 210 30+125+2K85	50p
Philips 210 118R+148R	48p
Thorn 1400	75p
GEC 2018	58p
Decca 2K5+90+100+167+5	72p
Thorn 1500	70p

Colour

Bush A823	72p
Pye 723 27Ω+56Ω	57p
GEC 2110 –41Ω	45p
GEC 2110 – 12R5+12R5	47p
GEC2110 –27R5	45p
Thorn 3500	58p
Thorn 8000	58p
Thorn 8500	54p
Philips G8 47R	30p
Philips G8 2.2+68	42p

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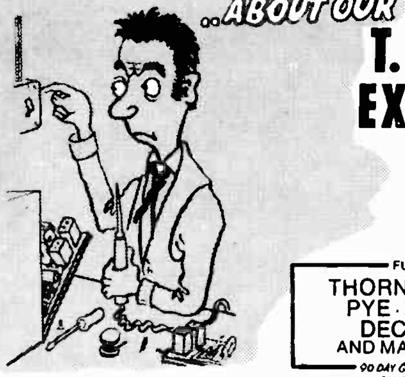

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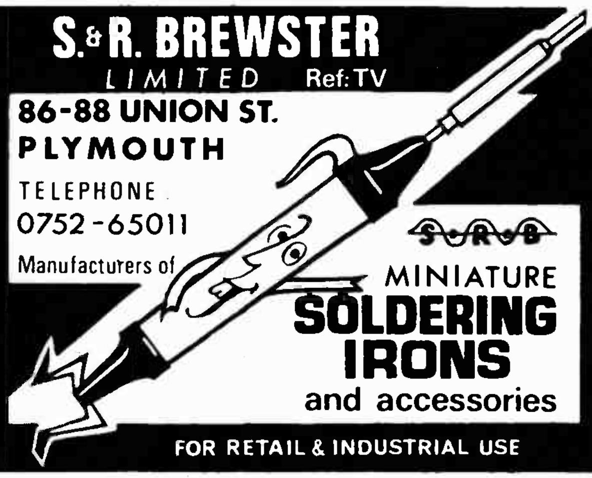

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Type	Price (£)
AC107	0.48
AC117	0.38
AC126	0.36
AC127	0.54
AC128	0.46
AC128K	0.55
AC141	0.65
AC141K	0.70
AC142	0.60
AC142K	0.65
AC151	0.31
AC152	0.36
AC153	0.42
AC153K	0.52
AC154	0.41
AC176	0.45
AC178	0.51
AC179	0.55
AC187	0.56
AC187K	0.65
AC188	0.52
AC188K	0.61
AC193K	0.70
AC194K	0.74
ACY17	1.20
ACY19	0.95
ACY28	0.98
ACY39	2.02
AD140	1.79
AD142	1.90
AD143	1.78
AD149	1.92
AD161	0.66
AD161/162	1.22
AD162	0.71
AF114	0.35
AF115	0.35
AF116	0.41
AF117	0.42
AF118	0.98
AF121	0.68
AF124	0.38
AF125	0.38
AF126	0.36
AF127	0.86
AF139	0.58
AF147	0.52
AF149	0.45
AF178	1.35
AF179	1.36
AF180	1.35
AF181	1.33
AF186	1.48
AF202	0.27
AF239	0.73
AF240	1.40
AF279S	0.91
AL100	1.30
AL103	1.58

Type	Price (£)
AU103	2.40
AU107	2.75
AU110	2.40
AU113	2.60
BC107*	0.16
BC108*	0.15
BC109*	0.16
BC113	†0.22
BC114	†0.22
BC115	†0.24
BC116*	†0.25
BC117	†0.30
BC118	†0.24
BC119	†0.34
BC125*	†0.30
BC126	†0.30
BC132	†0.20
BC134	†0.22
BC135	†0.21
BC136	†0.22
BC137	†0.30
BC138	†0.35
BC140	0.36
BC141	0.44
BC142	0.35
BC143	0.38
BC147*	†0.12
BC148*	†0.12
BC149*	†0.13
BC152	†0.42
BC153	†0.38
BC154	†0.41
BC157*	†0.13
BC158*	†0.12
BC159*	†0.14
BC160	0.52
BC161	†0.58
BC167B	†0.15
BC168B	†0.14
BC169C	†0.15
BC170*	†0.15
BC171*	†0.15
BC172*	†0.14
BC173*	†0.22
BC174A & B	†0.26
BC176	0.22
BC177*	0.20
BC178*	0.22
BC179*	0.28
BC182*	†0.15
BC182L*	†0.15
BC183*	†0.14
BC183L*	†0.14
BC184*	†0.15
BC184L*	†0.15
BC185	0.36
BC186	0.25
BC187	0.27

Type	Price (£)
BC192	0.56
BC204*	†0.39
BC205*	†0.39
BC206*	†0.37
BC207*	†0.39
BC208*	†0.37
BC209*	†0.39
BC211*	†0.36
BC212*	†0.17
BC212L*	†0.17
BC213*	†0.16
BC213L*	†0.16
BC214*	†0.18
BC214L*	†0.18
BC225	†0.42
BC237*	†0.16
BC238*	†0.15
BC239*	†0.22
BC251*	†0.25
BC252*	†0.26
BC253*	†0.38
BC261A*	†0.28
BC262A*	†0.28
BC263*	†0.26
BC267*	0.20
BC268*	0.28
BC286	0.40
BC287	0.49
BC291	0.27
BC294	†0.37
BC297	0.36
BC300	0.62
BC301	0.38
BC302	0.86
BC303	0.64
BC304	0.44
BC307*	†0.17
BC308*	†0.14
BC309*	†0.18
BC317*	†0.15
BC318*	†0.15
BC319*	†0.19
BC320	†0.17
BC321A&B	†0.18
BC322	†0.28
BC323	1.15
BC327	†0.16
BC328	†0.18
BC337	†0.17
BC338	†0.17
BC340	0.19
BC347*	†0.17
BC348A & B	†0.17
BC349B	†0.17
BC350*	†0.24
BC351*	†0.22
BC352A*	†0.24
BC360	0.59

Type	Price (£)
BC377	0.29
BC394	0.39
BC440	0.52
BC441	0.59
BC461	0.78
BC477	0.30
BC478	0.25
BC479	0.33
BC547*	†0.13
BC548*	†0.13
BC549*	†0.15
BC550	†0.24
BC556	†0.23
BC557*	†0.16
BC558*	†0.16
BC559*	0.17
BCY10	0.30
BCY30A	1.06
BCY32A	1.19
BCY34A	1.02
BCY72	0.27
BD115	1.35
BD123	1.50
BD124	1.85
BD130Y	1.56
BD131	0.58
BD132	0.68
BD133	0.70
BD135	†0.37
BD136	†0.38
BD137	0.40
BD138	0.42
BD139	0.46
BD140	0.50
BD144	2.24
BD145	0.76
BD150A*	†0.51
BD155	†0.90
BD157	0.51
BD158	0.75
BD159	0.68
BD160	2.69
BD163	0.67
BD165	0.66
BD166	0.88
BD175	0.90
BD177	0.58
BD178	0.92
BD181	1.94
BD182	2.10
BD183	1.34
BD184	2.30
BD187	1.20
BD188	1.25
BD189	0.71
BD222	0.91
BD225	0.91
BD232	0.91
BD233	0.62

Type	Price (£)
BD234	0.68
BD235	0.63
BD236	0.63
BD237	0.68
BD238	0.68
BD253	1.58
BD410	1.65
BD433	0.65
BD435	0.70
BD436	0.71
BD437	0.74
BD438	0.75
BD519	0.88
BD520	0.88
BD599	0.87
BD600	1.23
BD663BR	0.86
BDX18	1.55
BDX32	2.95
BDY16A	0.63
BDY18	1.56
BDY20	2.29
BDY38	1.38
BF115	0.48
BF117	0.45
BF120	0.55
BF121	0.85
BF123	0.48
BF125	0.68
BF127	0.51
BF137F	0.78
BF152	†0.19
BF158	†0.25
BF159	†0.27
BF160	†0.20
BF161	0.84
BF163	†0.65
BF164	†0.95
BF166	0.50
BF167	0.38
BF173	0.35
BF177	0.36
BF178	0.46
BF179	0.58
BF180	0.53
BF181	0.53
BF182	0.44
BF183	0.52
BF184	0.44
BF185	0.42
BF186	0.42
BF194*	†0.14
BF195*	†0.13
BF196	†0.14
BF197	†0.15
BF198	†0.29
BF199	†0.29
BF200	†0.25
BF218	†0.42

Type	Price (£)
BF222	†0.51
BF224 & J	†0.22
BF240	†0.32
BF241	†0.31
BF244*	†0.51
BF245*	†0.43
BF254	†0.48
BF255	†0.58
BF256L*	†0.49
BF257	†0.44
BF258	0.52
BF259	†0.54
BF262	0.73
BF263	0.88
BF270	0.47
BF271	0.42
BF272A	0.80
BF273	†0.33
BF274	†0.34
BF336	0.63
BF337	0.65
BF338	0.68
BF355	†0.72
BF362	†0.49
BF363	†0.49
BF367	†0.29
BF451	0.43
BF457	0.46
BF458	0.49
BF459	0.52
BF594	†0.16
BF596	†0.17
BF597	†0.27
BFR39	†0.30
BFR40	†0.29
BFR41	†0.30
BFR50	†0.29
BFR52	†0.33
BFR61	†0.29
BFR62	†0.28
BFR79	†0.30
BFR80	†0.29
BFR81	†0.30
BFR88	†0.42
BFT41	0.48
BFT43	0.55
BFW11	1.02
BFW30	2.58
BFW59	†0.19
BFW60	†0.20
BFW90	†0.65
BFX29	0.38
BFX84	0.42
BFY50	0.38
BFY51	0.37
BFY52	0.36
BFY53	0.36
BFY90	1.98
BPX25	1.62

Type	Price (£)
BPX29	1.62
BR101	0.53
BR103	0.64
BR303	1.06
BRC4443	1.76
BRY39	0.60
BRY56	†0.44
BSS27	0.92
BT106	1.50
BT109	1.99
BT116	1.45
BT119	5.18
BU102	2.85
BU105	†1.80
BU105/02	†1.95
BU108	†2.98
BU126	†2.91
BU204	†2.50
BU205	†2.78
BU206	†3.09
BU208	†4.88
BU407	†1.38
BUY77	2.50
C106D	0.80
C106F	0.43
C111E	†0.46
D40N1	0.64
E1222	0.47
E5024	†0.19
GETB72	0.46
MC140	†0.36
ME0402	†0.18
MF0404/02	†0.18
ME6001	†0.18
ME6002	†0.18
MJ2955	1.30
MJ3000	1.58
MJE340	0.68
MJE341	0.72
MJE370	0.74
MJE371	0.79
MJE520	0.85
MJE521	0.95
MJE2955	1.20
MJE3000	1.95
MJE3055	1.22
MPF102	†0.40
MPS3702	†0.33
MPS3705	†0.30
MPS6521	†0.36
MPS6523	†0.36
MPS6566	†0.44
MPSA05	†0.30
MPSA06	†0.32
MPSA55	†0.43
MPSA56	†0.45
MPSA93	†0.56
MPSL01	†0.33
MPSU01	0.61

Type	Price (£)
MPSU05	0.66
MPSU06	0.76
MPSU55	1.26
MPSU56	1.32
MPSU60	0.82
MPU131	†0.59
OC26	1.90
OC28	1.49
OC29	1.60
OC35	1.25
OC36	1.25
OC42	0.90
OC44	0.68
OC45	0.63
OC70	0.65
OC71	0.73
OC72	0.73
OC81	0.83
OC81D	0.95
OC139	1.30
OC140	1.35
OC170	0.80
OC171	0.82
OC200	3.90
OC201	3.95
OC202	2.40
OC205	3.95
OCP71	1.98
ON236A	0.94
R2008B	†2.92
R2010B	†2.79
R2322	†0.75
R2323	†0.85
ST2110	0.49
ST6120	0.48
TIC44	†0.25
TIC46	†0.35
TIC47	†0.45
TIP29A	0.47
TIP30A	0.50
TIP31A	0.51
TIP31C	0.67
TIP32A	0.56
TIP32C	0.72
TIP33A	0.77
TIP34A	0.84
TIP41A	0.72
TIP42A	0.80
TIP2955	0.77
TIP3055	0.58
TIS43	†0.44
TIS73	†1.36
TIS90	†0.23
TIS91	†0.28
ZTX108	†0.14
ZTX109	†0.16
ZTX213	†0.23
ZTX300	†0.16
ZTX304	†0.26

Type	Price (£)
ZTX500	†0.18
ZTX502	†0.22
ZTX504	†0.28
2N404	1.30
2N696	0.46
2N697	0.46
2N706A	0.33
2N708	0.29
2N914	0.32
2N916	0.46
2N918	0.54
2N930	0.29
2N1164	8.29
2N1304	1.40
2N1305	1.29
2N1306	1.49
2N1307	1.32
2N1308	1.53
2N1711	0.47
2N1893	0.52
2N2102	0.71
2N2217	0.55
2N2218	0.38
2N2219	0.42
2N2221A	0.26
2N2222A	0.41
2N2369A	0.40
2N2401	0.80
2N2484	0.35
2N2570	0.74
2N2646	0.82
2N2784	1.15
2N2869	2.08
2N2894	0.40
2N2904*	0.40
2N2905*	0.39
2N2906*	0.36
2N2926G	†0.15
2N2926D	†0.14
2N2926Y	†0.14
2N2955	1.12
2N3053	0.48
2N3054	0.86
2N3055	0.72
2N3250	0.52
2N3254	0.58
2N3391A	0.38
2N3633	12.70
2N3703	†0.17
2N3704	†0.19
2N3705	†0.17
2N3706	†0.16
2N3707	†0.18
2N3708	†0.17
2N3715	1.70
2N3771	2.39
2N3772	2.58
2N3773	3.90
2N3794	†0.40

Type	Price (£)
2N3819	†0.47
2N3820	0.72
2N3866	1.08
2N3904	†0.20
2N3905	†0.20
2N3906	†0.20
2N4036	0.94
2N4123	†0.17
2N4124	†0.17
2N4126	†0.17
2N4236	2.20
2N4289	†0.32
2N4292	†0.32
2N4416	0.85
2N4444	1.90
2N4921	0.80
2N5042	1.65
2N5060	†0.28
2N5061	†0.30
2N5064	0.63
2N5086	†0.49
2N5087	†0.50
2N5208	†0.59
2N5294	0.66
2N5296	0.68
2N5298	0.71
2N5322	1.16
2N5449	†0.18
2N5457	†0.46
2N5458	†0.40
2N5459	†0.58
2N5494	0.85
2N5496	1.05
2N6027	0.55
2N6107	0.71
2N6122	0.60
2N6178	1.07
2N6180	1.39
2N6211	2.74
2SB337BP	4.28
2SC458C	0.78
2SC643A	2.25
2SC930D	1.50
2SC1061	1.45
2SC1172Y	3.55
2SD234	1.48
3N128	1.60
40250	0.98
40251	1.14
40327	0.67
40361	0.48
40362	0.50
40410	0.94
40429	0.88
40530	0.79
40595	1.39
40603	1.13
40636	1.25
40654	0.89

Alternative gain versions available on items marked*.

For matched pairs add 20p per pair.

LINEAR IC's

Type	Price (£)
BRC1330	†0.93
CA810QM	2.44
CA3005	1.85
CA3012	1.45
CA3014	2.23
CA3018	0.71
CA3020	1.89
CA3028A	0.80
CA3028B	1.09
CA3045	3.75
CA3046	0.70
CA3065	1.74
CA3068	1.90
CA3130S	1.57
FCH161	†2.40
FCJ101	†3.32
LM309K	1.98
LM380N-14	1.65
LM1303N	3.08
MC1307P	†1.82
MC1310P*	†1.94
MC1312P	2.34
MC1327P*	†1.86
MC1330P	†0.93
MC1350P	†1.22
MC1351P	†1.42
MC1352P	†1.42
MC1357P	†2.92
MC1358P*	†2.30
MC1458G	1.43
MC1496L	1.15
MC3051P	0.58
MFC4008	0.85
MFC4060A	0.98
MFC6040	1.11
MIC1P	2.56
ML231	†3.57
ML232	†3.57
NE555	0.72
NE556	1.34
NE566	1.95
SAA1024	†5.70
SAA1025	†10.35
SAS560A	†2.[illegible]
SAS570	†2.01
SC9503P	†1.40
SC9504P	†1.38
SL414A	1.91
SL432A	2.52
SL450	5.10
SL901B	†4.20
SL917B	†5.60
SL918A	†5.95
SN72440N	†2.21
SN76001N	†1.67
SN76003N	2.22

Type	Price (£)
SN76008KE	1.56
SN76013N	1.56
SN76013ND	1.40
SN76018KE	1.56
SN76023N	1.56
SN76023ND	1.40
SN76033N	2.22
SN76110N	1.20
SN76115N	†1.62
SN76116N	1.78
SN76131N	†2.10
SN76226N	†2.60
SN76227N	†1.61
SN76228N	†1.80
SN76502N	†1.92
SN76530P	†0.97
SN76533N	†1.38
SN76544N	†1.85
SN76546N	†1.85
SN76570N	†1.81
SN76620AN	†0.99
SN76650N	†1.48
SN76660N	†0.64
SN76666N	†0.96
TA7073P	†3.51
TAA263	†2.20
TAA300	†3.85
TAA320	1.10
TAA350A	†2.48
TAA370A	3.18
TAA435	†1.70
TAA450	†3.39
TAA521	1.10
TAA522	2.09
TAA550	0.45
TAA560	1.93
TAA570	†2.30
TAA611A	1.67
TAA611B	1.89
TAA621AXI	2.33
TAA630Q	3.91
TAA630S	4.18
TAA661A	2.[illegible]
TAA661B	1.75
TAA700*	†2.80
TAA840	†3.38
TAA861A	0.95
TAA930A	1.43
TAA930B	1.43
TAA960	†2.25
TAA970	†2.48
TAD100	†2.66
(Filter)	0.98
TBA120A	†0.90
TBA120S*	†0.99
TBA120SA	†1.02
TBA231	1.1[illegible]

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

* Indicates Q version is also available.

DIODES

Type	Price (£)
AA113	0.17
AA119	0.21
AA129	0.28
AA143	0.18
AAY30	0.28
AAZ13	0.42
AAZ15	0.35
AAZ17	0.28
AY102	3.85
BA100	0.24
BA102	0.36
BA104	0.19
BA110	0.80
BA111	0.70
BA115	0.17
BA116	0.56
BA121	0.85
BA129	0.45
BA145	0.19
BA148	0.19
BA154	0.06
BA155	0.17
BA156	0.12
BA157	0.25
BA158	0.28
BA159	0.40
BA164	0.14
BA170	0.18
BA182	0.27
BA201	0.13
BA202	0.14
BA203	0.14
BA216	0.08
BA219	0.11
BA243	0.45
BA317	0.06
BA318	0.07
BAV10	0.10
BAV21	0.18
BAW62	0.06
BAX13	0.07
BAX16	0.10
BAX17	0.19
BAY72	0.16
BB104B	0.52
BB105B	0.33
BB105G	0.30
BR100	0.40
BY100	0.35
BY103	0.35

Type	Price (£)
BY114	0.60
BY118	1.10
BY126	0.20
BY127	0.21
BY133	0.35
BY140	1.40
BY164	0.75
BY176	2.80
BY179	0.83
BY182	1.14
BY184	0.44
BY189	5.30
BY190	4.90
BY206	0.26
BY238	0.25
BYX10	0.30
BYX38/600	0.70
BYX70/500	0.53
ITT44	0.08
ITT210	0.63
ITT827	0.80
MCR101	0.43
MR854	1.10
OA5	0.88
OA10	0.58
OA47	0.20
OA81	0.19
OA90	0.13
OA91	0.15
OA95	0.20
OA200	0.13
OA202	0.13
OA2[illegible]	0.89
TIL209	0.14
TIL211	0.18
TV20	2.25
IN914	0.06
IN916	0.06
IN4001	0.06
IN4002	0.07
IN4003	0.08
IN4004	0.08
IN4005	0.09
IN4006	0.10
IN4007	0.12
IN5400	0.15
IN5401	0.17
IN5402	0.20
IS920	0.09
IS921	0.11

ZENER DIODES

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

VDR's, etc. (†)

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

VALVES (†)

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

BRIDGES

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

10A and 25A ranges also stocked.

RESISTORS

Carbon Film (5%) (†)

	Ea	10 of one value	50pc	100pc	500pc
¼W 5.6Ω-330kΩ (E12)	3p	25p	95p	£1.49	£5.40
½W 10Ω-10MΩ (E24)	3p	25p	95p	£1.49	£5.40
1W 10Ω-10MΩ (E12)	5p	45p	£1.95	£3.40	£15.25
2W 10Ω-10MΩ (E6)	9p	80p	£3.60	£6.40	£28.90

Mixes of a minimum of 10pcs of any value: 50pc, 100pc, 500pc

Wirewound (5%)

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

Presets (†)

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

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

FUSES (all packs of 10)

20mm Time Delay (BEAB)

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

20mm quick-blow (BEAB)

100mA	68p
200, 250, 315, 500, 630, 800mA, 1, 1.25, 1.6, 2, 2.5, 3.15, 5A	all 56p
2A circuit breakers metal	£1.52
plastic	£1.48

LABGEAR (Details of full range on request)

COLOURTEXT ADAPTOR 7026

Full facility Colourtext decoder to place between aerial and receiver. All you would expect of a quality ready-made unit. Leaflet on request. **†£340.20**

COLOUR BAR GENERATOR

CM6052/DB. VHF/UHF gives standard 8 band colour bars • variable tuning • front panel on/off switch • sync trigger output • blank raster • red raster • crosshatch • greyscale stepwedge • colour bar • centre cross • dot pattern • centre dot. **£182.25**

TELEVISION COLOUR RECEIVER MK II

SEMI CONDUCTOR PACK No. 1 (Power Supply)

All Parts as Published £6.45 (inclusive of 51p VAT and p & p)

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A Set for the 80s

The UK's largest TV setmaker, Thorn, has a long history of engineering innovation. It's the only major setmaker never to have produced a hybrid colour chassis for a start. With the commencement of colour transmissions in the UK in 1967, Thorn introduced the 2000 chassis, the world's first all solid-state colour chassis. It used a pair of line output transistors that had been developed for radar purposes, another similar transistor for e.h.t. generation, and three jelly-pot transformers. There were separate regulators for the field and line timebase supplies, and an effective excess current trip. It must have been an expensive beast to produce, but was a major step forward when there weren't any large-screen monochrome solid-state sets either.

Single-standard operation came in 1969, when all three networks started transmissions at u.h.f., and from Thorn came the much simpler 3000 chassis. But again there was a major innovation, in the introduction for the first time of a switch-mode power supply in a TV receiver. Service engineers were worried about the strange idea of the chopper, with its variable mark-space ratio drive, chopping away at line frequency and feeding an inductive reservoir. But the system itself behaved very well.

It was not long before Thorn was back on the innovation trail again. June 1971 saw the introduction of the entirely new 17in. (to start with) 8000 series chassis, designed to break through the £200 price barrier for colour TV sets. Thorn had managed once again to reduce circuit complexity substantially. Three i.c.s appeared on the signals panel, a thyristor did the regulating, and out went the tripler, to be replaced by a carefully worked out transformer/half-wave rectifier combination.

In 1974 Thorn introduced the 4000 chassis, with a 110° delta-gun tube. This was intended mainly as an export model, with a decidedly up-market specification. The technical innovations included ultrasonic remote control, touch-tuning with a MOS i.c., and the use of a number of thick-film modules.

The next chassis for the popular market, the 9000, came in 1975. Once again important technical developments put in an appearance. There was the 90° PIL tube with its in-line guns, and the famed Syclops circuit in which a single transistor acts as switch-mode power supply chopper and line output transistor, driving two transformers. It's larger-screen brother, the first European set to use a 26in., 110° PIL tube, followed two years later.

Which brings us to 1979 – and the TX9 chassis just announced by Thorn. It's designed to drive 90° PIL tubes in all sizes from 14 to 20in., and the whole concept has been based on an assessment of what is likely to be a truly competitive chassis internationally in the early 1980s, bearing in mind the intensifying competition from an increasing number of countries. Innovations include the use of a single-chip decoder, a world first so far as PAL decoding is concerned, but the emphasis has been on getting the basic product right rather than on radically new technical departures.

What does this involve? First a neat and compact layout. The importance of this is not for cosmetic reasons, but because it simplifies manufacture, minimises the problems that can arise due to distribution hazards, and makes any servicing required during the life of the set easy to carry out. Thorn's achievement in this respect is quite remarkable, as the photograph on a later page shows – a whole colour chassis on a board measuring only about 10in. by 15in., with a small daughter board for the i.f. strip. This also minimises interconnections and the problems they give rise to. The second basic requirement is good shopping – getting good performance at the right price with assured reliability, on the basis of carefully drawn up specifications.

The TX9 certainly seems to match up to these requirements, and it's interesting to know the origin of "TX9" – 9 for 90°, X because current tubes have an X in their type numbers, and T because the remarkable success of the Model T Ford was kept firmly in mind! The reasoning was that if Ford could produce a reliable product that provided good performance and, at one time, accounted for about half the cars in the world, here was something worth emulating.

There's more to such a success story than getting the product right of course. It has to be sold, and when it comes to exporting today, well, there are few countries indeed with such open and well developed trading conditions as the UK. Getting the product right is nevertheless the essential first step and at a time when it's fashionable, with some justification, to discount much of the UK's manufacturing industry, it's heartening that Thorn have come up with something as fundamentally sound as the TX9. The UK's TV industry at any rate is alive and kicking in these difficult times.

Teletopics

1979 TRADE SHOWS

The main item of TV interest in this year's radio and television trade shows was the introduction of various new chassis, mainly small-screen ones. Some of these are discussed elsewhere in this issue. The new Mullard 20in. tube, the AX51, has put in an appearance in some new Thorn releases using a new version of the 9000 chassis (9900 chassis). Another new tube to appear is the Philips/Mullard 30AX, which Grundig are using in their new Super Colour 80 chassis. The tube has improved focus performance and simplified setting up compared to the 20AX, while the deflection system consumes less power. The small N. Ireland setmaker MAM is understood to be considering the introduction of a 30AX set shortly. One of the few large Japanese setmakers not previously represented in the UK, NEC (Nippon Electric), has appointed a distributor, Laltex and Co., 1 Canal Street, Manchester: the range includes 12, 14, 18 and 20in. colour sets, a 12in. monochrome portable, a 5in. portable with combined a.m./f.m. radio, and a 5½in. portable with a.m./f.m. radio plus cassette tape recorder. Remote control systems were present in abundance, the trend here being towards infra-red systems. A surprise was the re-emergence of projection TV systems for domestic use – at least three are available (Grundig, Mitsubishi, Panasonic) at prices from just under £2,000 to just under £4,000.

Grundig's new modular chassis is unusual in that almost all the components are housed in a group of modules. These have metal casings to provide screening and protection, and have a lead seal which will indicate whether they have received the attention of what Grundig refer to as "unauthorised amateur engineers". To make sure that the authorised, professional engineer does not have too difficult a time however each module incorporates a l.e.d. to indicate whether it is functioning . . . Another purpose of the metal casings is to provide additional large cooling surfaces, the air gaps in them being designed to give a chimney effect.

Another unusual set was shown by Toshiba – the smallest colour set at the shows, the 6in. portable Model C690B. This is 10in. wide, 6½in. high and 12¾in. deep, weighs 15lb, and has a suggested VAT inclusive price of £349·50.

The aim of Philips in introducing their 22in. Model 666 is to bring teletext within the reach of the 600,000 consumers expected to purchase replacement TV sets this year.

THE INTERNATIONAL SCENE

All these new small-screen chassis have not a little to do with the fact that the PAL licensing system expires this October. That will remove all restrictions on the production of PAL colour receivers. A consequence of this is that TV setmakers will be forced to think in terms of international markets. We all know about Japanese competition, but there's more to it than that. Japan is not a cheap country for production purposes, a fact that is reflected in the relatively high price of Japanese sets. In fact Japanese setmakers compete on reliability rather than price. The cheap sets come from elsewhere, from Taiwan, Singapore and South Korea for example.

There are some surprising facts when you come to look into this. For example South Korea, which is expected to produce some 1·3 million colour sets this year, has no colour service (it's expected to start in a couple of years' time). The sets have to go somewhere, which means abroad. This mainly means the USA, but the US government has imposed a quota of 300,000 sets a year. The result of this is excessive stocks – of both monochrome and colour sets – with prices at rock bottom. Yet more Korean firms are planning to enter the field. More countries too for that matter. A TV industry is being established in the Philippines, and plans are being laid to start production in the Argentine. One thing is certain: the TV industry is not going to be a very cosy place in the next decade.

It's one thing to be able to assemble TV chassis however, another to be able to make and check all that goes into them. Here the established manufacturing nations still have the advantage of know-how and technological back-up services. This is one reason why it's always been regarded as essential for the UK to retain its own tube manufacturing capacity.

THE 30AX TUBE

Now that the new Philips/Mullard 30AX tube has put in an appearance, some details can be filled in. The new tube has been developed from the 20AX, which has been in production since 1974, but brings with it several important advances. First, no dynamic convergence, static convergence, purity or raster correction adjustments are necessary. Secondly the new yoke design gives improved deflection sensitivity, a straight NS raster, and reduced EW raster distortion. Due to the close mechanical tolerances and the inclusion of positioning bosses on the tube bowl, the tube and yoke can be aligned simply by being pushed together – any 30AX yoke will automatically match any 30AX tube of the appropriate size. Thirdly the newly designed electron gun gives a sharper spot, with greater focus uniformity over the screen area. An internal magnetic ring is used to give correct purity and static beam convergence, in place of the multipole unit used in previous in-line gun tube designs. This results in a strikingly compact assembly. The automatic yoke/tube alignment does away with the need for preset mechanical tilt and shift adjustments which, Philips point out, correct one error by introducing another. The new tube is being produced in the 26, 22 and 20in. screen sizes. The power consumption of a set fitted with the 30AX is typicaly 100W compared to 120W with the 20AX system, at 1·2mA beam current and with an e.h.t. of 25kV. This compares with 88W for a set fitted with a 90° narrow-neck tube and hybrid yoke, under the same conditions.

3-D AND HI-FI VIDEO

Philips have been carrying out "considerable research and development" into three-dimensional colour TV at their Eindhoven research laboratories. The practical introduction of such a system is considered to be at least ten years away however. Research is also being carried out on high-definition TV using an increased number of lines. Neither development could be introduced without an agreed change in broadcasting standards, which seems a rather remote likelihood at present. The capability to produce high-definition equipment is with us now, but Philips point out that it's necessary to be "very careful not to overload the consumer with technology." TCE's director of engineering recently commented that he sees a 1,000-line TV service with stereo sound as a possible development.

NOTIFICATION OF TV SET DISPOSALS

The Television Licensing Organisation, Bristol BS98 1TL, has issued a new simplified version of form BRL1192 which is used by dealers to notify TV set disposals, whether by purchase or rental, to the organisation. The amending regulations authorising use of the new form come into operation on August 1st. The organisation stresses the importance of including the customer's post code on the form – this helps its computer.

STATION OPENINGS

The following relay transmitters are now in operation:
Chingford (East London) BBC-2 ch. 50, Thames/London Weekend Television ch. 52, BBC-1 ch. 56. Receiving aerial group C/D.
Craigellachie (Scotland) BBC-1 ch. 57, Grampian Television ch. 60, BBC-2 ch. 63. Receiving aerial group C/D.
Hasland (Derbyshire) BBC-1 ch. 57, Yorkshire Television ch, 60, BBC-2 ch. 63. Receiving aerial group C/D.
Hemel Hempstead (Herts) BBC-1 ch. 58, Thames/London Weekend Television ch. 61, BBC-2 ch. 64. Receiving aerial group C/D.
Llanwrtyd Wells (Powys) BBC Wales ch. 21, HTV Wales ch. 24, BBC-2 ch. 27. Receiving aerial group A.
Little Stretton (Salop) BBC-1 ch. 57, ATV ch. 60, BBC-2 ch. 63. Receiving aerial group C/D.

All the above transmissions are vertically polarised.

DOMESTIC COLOUR PROJECTION TV

The Panasonic Cinema-Vision colour projection TV system mentioned last month is a one-piece unit – the output from the projection unit, which is in the base of the equipment, is reflected back on to the screen – with a five-foot screen (diagonal measurement). The suggested price is £3,995 including VAT. Two rival systems have since been introduced. The Mitsubishi VS500 is similarly a single-piece unit, with a 50in. screen and a suggested price of around £3,500. The Grundig Cinema 9000 on the other hand has a separate projection unit, a 5ft. screen, and a suggested price of "a little under £2,000". All these sets feature remote control, and both the Grundig and Panasonic models can be used with VCRs and other video sources.

AEROSOL SPRAY REMOVES SCREEN REFLECTIONS

Teleflex have introduced an aerosol spray which can be applied to c.r.t. screens to avoid reflections. The treatment gives the screen a matt finish. There are two cans, one for applying the finish and the other for polishing the glass before and afterwards.

VIDEO EQUIPMENT

Two products of interest have emerged from the JVC factory recently. The HR3330 VHS-format VCR is an improved version of the HR3300. The two look very similar externally, but the new version features a remote pause unit, an eight-day timer and a u.h.f. signal generator to make the tuning of the TV set to the VCR's output easier. The timer can also be set to record say six thirty-minute editions of a daily serial on consecutive days, on a three-hour cassette.

The other item is a portable VCR system, incorporating the HR4100 VCR, AAP41 mains power unit/battery charger, TU41 timer/tuner unit and a choice of colour cameras, the GC4100 or GY71. The VCR itself is conventional, but has some neat protection arrangements, including excess moisture and low battery warning lights. With the TU41 added, the system can be used as a normal domestic VCR for recording off-air programmes. The GC4100 is a two-tube (one for colour, one for luminance) camera with a 6:1 zoom lens, auto iris control and electronic viewfinder. Colour temperature compensation is available to match the camera to a range of light sources, while additional controls provide for simple white and colour balancing. Extra amplification can be switched in to enable recording to be made at illumination levels as low as 100 lux. The GY71 is a single-tube colour camera which is somewhat cheaper but also incorporates the 6:1 zoom lens, auto iris control and electronic viewfinder. Another version, the G31, has a fixed focus lens and optical viewfinder and sells for around £600. The GS1000 monochrome camera can also be used with the system.

Thorn have now entered the video field, and are marketing the above VCRs under the Ferguson brand name. The basic VCR is known as the Videostar Model 3V00, and the portable version the 3V01. The monochrome camera is type 3V04 and the colour camera type 3V06.

Panasonic have also introduced colour cameras for use with their VHS type VCRs. There are two versions, the WV3310E which has an optical viewfinder, 25mm fixed focus lens and is expected to retail at about £575 excluding VAT, and the WV3300E which has an electronic viewfinder, a 6:1 zoom lens and a price tag of around £770. Both prices include the a.c. adaptor which connects the camera with the recorder.

A new version of the Philips VCR, Model N1702, has been introduced. The new machine is outwardly very similar to the N1700, but features a ten-day timer and a four-digit tape counter to give faster and more accurate access to the recorded material. The new machine will be marketed alongside the existing version. Philips point out that internal developments have resulted in improved picture quality.

Another Philips introduction is the G7000 Videopac Computer. This is a programmable video games unit which in addition has a full alphanumeric keyboard. Some 11 Videopacs are already available, and in addition to quite sophisticated games include a basic course in computing and other instructional material. The G7000 has a suggested price of around £150, with the Videopacs at about £11 each.

SOLUS EXTEND ACTIVITIES

Solus (Electronics) Ltd., well known for their TV picture tubes, have started to distribute discrete active and passive components as well. A well laid out, 48-page catalogue showing the complete range of components, valves and c.r.t.s has been published and is available free of charge to all service departments. There are some 1,500 items, covering the majority of servicing needs. Attractive quantity discounts are offered, the discounts being clearly shown against every part number. There's a nation-wide service, with no delivery or minimum order charges, and twelve representatives have been appointed to call on retail and rental outlets. For a free copy of the catalogue, contact Sheila Roberts at Cambridge (0223) 51502, or write to Solus (Electronics) Ltd., Kirkwood Road, Cambridge, CB4 2PF.

Letters

The subject of green tinting and an intermittently wholly green screen on the ITT hybrid colour chassis has come up in your columns from time to time. On a recent occasion I traced this to a break in the copper track pad at the junction of the green output transistor's collector load resistor R179 and the associated peaking coil L63, resulting in partial disconnection of the transistor. A spot of solder permanently reunited the components and cleared the fault.
G.R. Kay, Epsom, Surrey.

FAULT ROUND-UP

I've recently encountered several TV faults which might be worth setting down for the benefit of other readers of *Television*.

First, the Decca 80 series solid-state colour chassis. A couple of these came to us with the "dead set" symptom and the mains fuse blown. Tests proved that the fuse failure was due to excessive current demand from the power supply circuit, and in both cases this turned out to be the result of a burn up of the print between pins 3 and 4 of socket PLA on the line output panel.

Another Decca solid-state colour set, this time fitted with the 100 chassis, suffered from ringing of the verticals over the top third of the screen. The condition was intermittent and turned out to be due to C310 (4·7μF) in the TBA920 line oscillator circuit. Another line oscillator fault on this chassis is failure of the wire-wound resistor R317 in the start-up circuit. When this goes open-circuit, the set appears to be dead.

Sound problems on these sets are generally due to the plug and socket connections (PTU C, to the volume control) on the side of the main chassis. On several occasions I've encountered poor connections between the wires and the pins, causing either no sound, noisy sound or full volume, depending on which wire is affected.

Another chassis I have a fair amount to do with is the Pye solid-state 731 series chassis. One came in because of no results and on examination it was found that whilst a.c. was present at the input to the thyristor mains rectifier there was no d.c. output. An oscilloscope check showed that there were no drive pulses at its gate. This was eventually traced to D901, which had gone short-circuit. This diode is in the pulse timing circuit, and is included to ensure that the negative-going excursions of the mains waveform do not affect the operation of the circuit.

A peculiar effect occurs on these sets when the h.t. reservoir capacitor C880 goes open-circuit. The following smoothing resistor R973 (56Ω) gets very hot, presumably because of the increased a.c. ripple flowing through it. The fault caused confusion when we first encountered it, as an overload elsewhere in the set was suspected.

I had the same problem with a set fitted with the Rank Z179 chassis - in this case the set was dead, as the resistor (4R104, 27Ω) had disintegrated. The h.t. reservoir capacitor 4C72 was completely open-circuit. In neither the Pye nor the Rank chassis was there any sign of leakage from these capacitors incidently.

Returning to the Pye chassis, on another of these sets the thermal link on R555 would open for no apparent reason. This resistor forms part of the smoothing network for the 28V supply, which is obtained from the line output transformer. The cause of the trouble was broken print around the associated smoothing capacitor C554 (4,700μF). On yet another of these sets crackles and pops on the sound were due to both the BD131 audio output transistors.

A Thorn set fitted with the 8800 chassis suffered from intermittent field collapse. The condition was very erratic however and couldn't be brought on by either freezing or heating. It was eventually found that W421/2 were the culprits, though they read all right on a static test. They form part of the discharge path for the field charging capacitor C446 (earlier versions of the chassis use a single diode in this position).

The problem with an ASA Model CT6000A 110° colour set was lack of height with slight field foldover. Any attempt to increase the height would result in severe bottom fold up. This was eventually traced to the 7W feed resistor Rg45 which supplies the field output stage: it had increased in value from 2·7Ω to 3Ω. The supply (28·6V) is obtained from the input/commutating transformer in the thyristor line output stage.

Distorted sound was the problem with a Telefunken colour set fitted with the 710 hybrid chassis. It was found that the supply to the audio output transistors was very low, due to the feed resistor R244 reading open-circuit instead of 4·7Ω. There was no sign of physical damage to this resistor, but replacing it completely cured the trouble.

A favourite fault on the subsequent solid-state 711 chassis is severe blue misconvergence. This often occurs after the set has been moved. The cause is the core dropping out of the sawtooth transformer Tr564.

The later 712 20AX chassis seems to be very reliable. The only problem I've come across is failure of the BU208 line output transistor. A complete new line output panel was fitted, but a few days later the customer complained of a loud bang after which the set went dead. The loud bang was found to be due to C567 (10μF) on the line output stage panel exploding. It's connected between the h.t. (163V) input and chassis. A thyristor is used to provide the stabilised 163V rail, and on monitoring this supply we found a steady increase as the set warmed up. A replacement thyristor cured the trouble.

A Telefunken set fitted with the Decca 30 chassis suffered from top compression with a white line across the picture, about a third of the way down the screen. The cause was the PL508 field output valve's cathode bias resistor R413 (560Ω) going completely open-circuit (there's a d.c. path to chassis via the field convergence circuit).
Mick Dutton, Heath Hayes, Nr. Cannock, Staffs.

DARK SCREEN

We encountered a mysterious fault recently on a NordMende 110° colour receiver (F VI chassis). A normal picture was obtained when the set was switched on, but after about five minutes the screen became dark. The first step of course was to check the c.r.t.'s cathode voltages, which were found to increase from 155V to 198V when the fault condition occured. The tube base socket was removed and the measurement confirmed, indicating that the fault was in the drive circuitry rather than the tube.

Checking back under the fault condition revealed complete absence of voltage at the bases of the RGB output transistors (the lower ones in these class AB circuits). The drive comes from a TBA530 matrixing i.c., which next came under suspicion. A check at the luminance input pin revealed 2V instead of 1·3V however. Operating the service switch produced a horizontal white line of normal brighness, while the voltage at the TBA530's luminance in-

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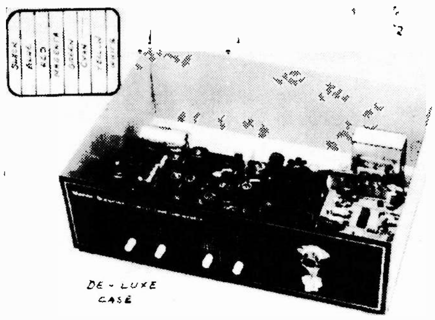

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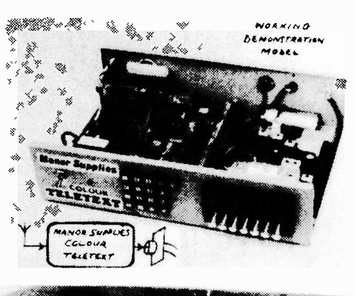

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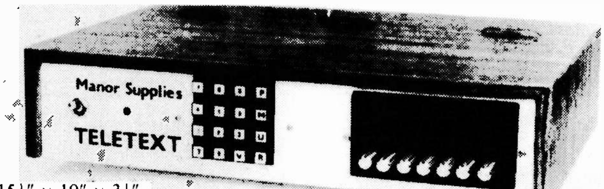

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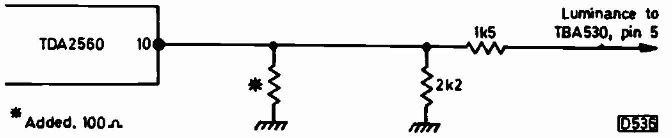


Fig. 1: Dr. Karailiev's method of stabilising the luminance output from the TDA2560 i.c.

put pin fell to 1·4V. So it was back to the TDA2560 luminance/chrominance signal processing i.c. The luminance input to this i.c. comes from an emitter-follower and was found to be correct, so the remaining thing to do was to try a replacement TDA2560. This is not available here at present however, so instead we decided to try connecting a 100Ω resistor from its luminance output pin (10) to chassis (see Fig. 1). This resulted in a first class picture.
Dr. A.M. Karailiev, Senior Lecturer, College of Science and Technology, Port Harcourt, Nigeria.

Editorial note: The NordMende F VI chassis is also used in the Ferguson 3787 14in. portable. The output from pin 10 of the TDA2560 comes from an integrated emitter-follower. The added 100Ω resistor will increase the emitter-follower's collector current, a dodge that can work when the trouble is due to a leaky transistor.

FUSIBLES AND SUCHLIKE

How is Les getting on with Mr. and Mrs. Black (April issue)? You see, the sequence of events leading to all three RGB output stage collector load resistors springing open is (1) the h.t. rises (check 8R6, the diac 8D3 and thyristor 8THY1), (2) the e.h.t. rises and the line timebase is shut down by the overvoltage trip, removing the clamp pulse so that the RGB output transistors are bottomed, when (3) the load resistors go ping, ping, ping.

Another odd 'un on this chassis is when the 600mA h.t. fuse 8F3 is found open-circuit but only normal current is drawn when the fuse is bridged by the Avo meter on its 1A range. The giveaway here is to look for flyback lines, which indicate faults in 4VT1/2 on the c.r.t. base panel. The cause is no beam limiter action, with 8F3 opening on a peak white raster.

Finally a fuse fault on the newer Rank T20/22 chassis. This time when the mains fuse 7FS2 is found blackened and the set dead. Again the meter shows that all is well, but in fact the posistor 7TH1 in the degaussing circuit goes short-circuit intermittently. Replacement is the only cure.

I could think of many more oddities on Rank chassis, like low height (1½in.) on the Z718 chassis, all diodes in the field timebase measure o.k. when checked cold, but one is faulty. Or the flyback blanking diode (on the signal panel) which produces a picture edge like the Himalayas though the raster is o.k.
Tony Thompson, Coventry.

MAINS FILTER CAPACITORS

As a self-confessed chopper-out of mains filter capacitors I would like to comment on the letter in the March issue. My reason for not fitting replacements is quite simply that I've never been able to find capacitors that are sufficiently reliable when used in this position - 1kV d.c. working seems to be the highest voltage rating available. In my experience these are quite inadequate, surviving at best only a month or two. If one's conscience shrinks from actually omitting the filter capacitor, I've found that using a lower-value replacement is often successful.

Regarding 13A plugs and 3kW heaters (*Teletopics*, March), I've never been able to find 13A plugs and sockets which are able to supply 3kW for any length of time without overheating - many indeed are hard pressed at 2kW. A light smear of silicone grease on the plug pins is helpful however.
W.G. Williamson, Yell, Shetland.

Editorial comment: Polypropylene capacitors of suitable value rated at 1·25kV d.c., 400V a.c., are available, for example in the RS Components range, and are recommended as replacement mains filter capacitors.

PURITY PROBLEM

We had purity trouble on a Hitachi Model CAP160 and eventually discovered that this was due to lack of degaussing as a result of the somewhat unusual mains switching system employed. When the power on/off switch is switched on, the c.r.t. is preheated to give an instant picture once the pull on/push off switch associated with the volume control is operated. It's worth noting that the degaussing circuit operates when the receiver is switched off, but that this action does not occur if the mains supply is completely removed by the power on/off (or wall) switch. A dramatically improved picture has been obtained since we realised that for the degaussing action to occur the mains must be left connected after the push-pull switch has been operated.
H. Gregory, Blackpool, Lancashire.

COLOUR RECEIVER RENOVATIONS

In reply to the letters in the April issue commenting on my article on renovating colour receivers, Mr. Charles is quite correct in pointing out that there is another path for the PL802's control grid current on the Pye hybrid colour chassis other than via the 4·7MΩ resistor R352. This was an oversight on my part. The case for reducing the value of the PCL84 colour-difference output valves' grid leak resistors still applies however - it's been proved to increase the reliability of the CDA stages in both the Pye and GEC hybrids we've modified in this way.

Regarding Mr. Coles' remarks on the G6 colour-killer, there are actually two a.c.c. systems on this chassis. One works in the conventional way, using a single diode to rectify the burst, producing a negative voltage which is applied to the control grid of the EF183 first chroma amplifier valve. The other system employs a phase detector circuit which is similar to the burst phase detector except that it produces a positive output when the reference oscillator is phase locked to the burst. This positive voltage is amplified by one section of the PCC85 double-triode valve, the resulting negative-going output being again applied to the control grid of the EF183.

I've always found it easier to pull out the PCC85, and indeed to anyone unfamiliar with the chassis this is easier than locating other components on the layout diagram. Only the phase-dependent a.c.c. is disabled by this action - the burst amplitude is at maximum, and cannot be increased by turning down the colour control. If there are no faults present, this should give a slightly over-saturated display. I've never found this a disadvantage when setting up the a.p.c. loop, particularly as the a.c.c. system that's been disabled comes into action only when the reference oscillator has been finally locked.

Also, when the delay line output is shorted out (simple PAL) the saturation is reduced by half. The G6's valve chroma amplifiers are very linear, so that if the blinds on a very saturated display are cancelled out the adjustment still holds good at normal saturation levels. Most G6 decoders are in such a state of misalignment that they can only be improved.
Mike Phelan, Holmfirth, Yorkshire.

Practical UHF Preamplifiers

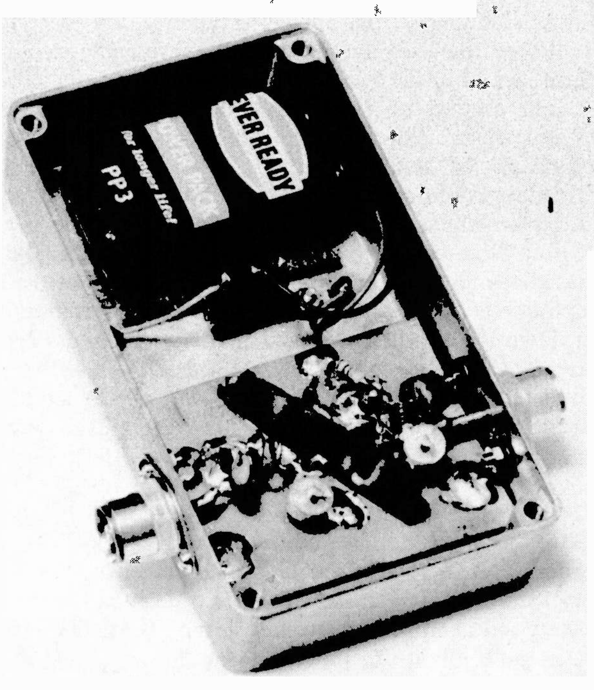
Roger Bunney

THE UK's u.h.f. transmitter network has grown dramatically in recent years. Phase I, in which all communities of more than 1,000 people are within the service area of a main or a relay transmitter, is now nearing completion, and Phase II, in which communities of 500-1,000 will be similarly served, has now been started. There are nevertheless still vast numbers of sites in fringe areas or where reception is inferior due to screening by local obstructions (hills, valley locations, etc.) even though they are within an accepted service area. There is a continuing need therefore for medium-gain, low-noise signal preamplifiers to improve the reception quality under such conditions, and in fact a steady stream of enquiries for details of such amplifiers is received by the magazine.

The needs of such viewers were the first consideration behind the present article, leading to a wideband amplifier design. For many readers however the main requirement is an alternative programme source on a specific channel, usually from a neighbouring ITV area. For this application a narrow-band amplifier is required, and the basic design was modified accordingly.

Selected Transistor

The transistor selected was the SGS/ATES BF679S, a silicon planar pnp device which is supplied in a T-plastic package. It's a low-current device featuring a low-noise performance with a relatively high stage gain. The SGS/ATES data sheet quotes a typical power gain of 15dB at 800MHz, and a typical noise figure at the same frequency of 3·5dB. Optimum gain is obtained when the collector current is in the range 2·5-4mA.



Internal view of the narrow band version of the preamplifier.

Wideband Circuit

The wideband circuit adopted is shown in Fig. 1. The transistor is operated in the common-base mode, the base being biased by the potential divider R3/R2, decoupled at r.f. by C5, while the emitter is biased by R1, decoupled by C4, L1 being a stand-off choke. The signal is coupled to the emitter of Tr1 by C1, with C2 providing a degree of noise matching. L2 forms the collector load, with the supply end decoupled by C6. The signal is tapped off to the 75Ω output by C3, which is soldered close to the earthy end of L2.

With the 9V supply, the current consumption of both verions of the amplifier is 3mA.

The wideband circuit was built up and once the adjustment of the output coil L2 was completed a good gain/bandwidth performance was obtained. For group A operation, 2¼ turns were sufficient for L2, which was tapped at half a turn from the dead end. The coil was made using the single inner conductor from low-loss coaxial cable. To adjust for optimum frequency coverage, spread or compress the turns. This adjustment must be done with care in order to avoid damaging the transistor's lead-out connection. For group B/C, 1¼ turns should be sufficient, adjusted as before.

The value of the input noise matching capacitor C2 should be below 5pF, typically 3pF. The optimum value can be found by experiment. A low-loss miniature preset could be used, provided the lead inductance can be severely minimised.

Single-channel Version

For the narrow-band (single-channel) version the basic circuit was modified to that shown in Fig. 2. The transistor's biasing conditions remain the same, but bandpass tuning is used at the input and output. The input tuned circuit consists of L3 and the trimmer C7 – with L3 actually the inner conductor of the input coaxial socket. Noise matching is again provided by C2, which in the ch. 23 prototype was found to have an optimum value of 3·9pF. The transistor's collector circuit is tuned to resonance by the trimmer C8, and the channel peaking adjustment of this is extremely sharp.

Both C7 and C8 have to be adjusted to set up the amplifier. The tuning of C7 is rather flat, whereas C8 is by comparison critically sharp. Alignment is best carried out using a field strength meter. Alternatively a TV set can be used, but the a.g.c. action must be minimised in order to reduce the masking effect of the a.g.c. on the signal displayed on the screen. If a strong local signal is present on an adjacent channel, correct alignment on the weak wanted signal should discriminate against breakthrough by the local one. With incorrect peaking under these conditions, you are

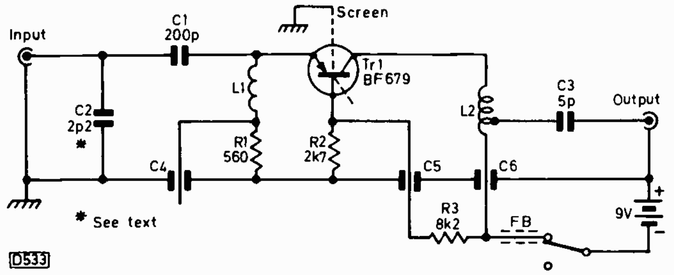


Fig. 1: Circuit diagram of the wideband version of the u.h.f. preamplifier. The number of turns on L2 varies according to channel grouping.

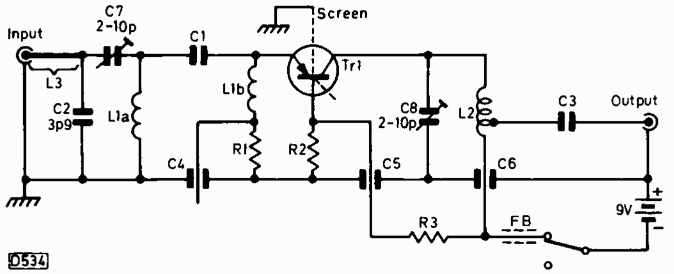


Fig. 2: Circuit diagram of the narrow-band version of the u.h.f. preamplifier. L1a and L1b both consist of five turns as in the wideband version.

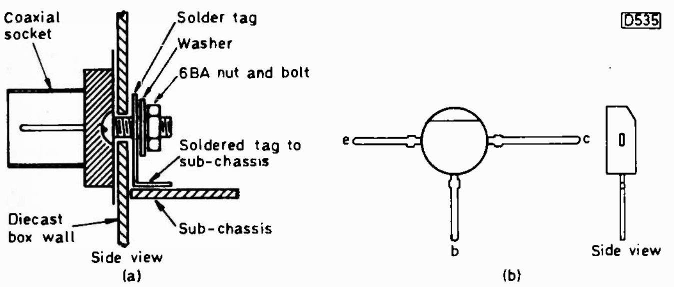


Fig. 3: (a) Method of securing the subchassis to the metal case by means of solder tags. (b) Transistor connections.

★ Components required

Wideband version

C1	200pF silver mica 5%
C2	2·2pF silver mica 5% (see text)
C3	5pF silver mica 5%
C4-6	1,000pF feedthrough
R1	560Ω ¼W metal oxide 5%
R2	2·7kΩ ¼W metal oxide 5%
R3	8·2kΩ ¼W metal oxide 5%
L1	5 turns 3/16 in. diameter close spaced, 26 s.w.g.
L2	2¼ turns 5/16 in. diameter (see text)
Tr1	BF679S (available from Consort Electronics, Rosebank Parade, Reading Rd., Yatelee, Camberley)

Eddystone 7969P or equivalent (RS) diecast box
Two Belling-Lee surface mounting coaxial sockets
One ferrite bead
PP3 battery with connector
6BA nuts and bolts
On/off switch (miniature toggle)

Narrow-band version

As above except:

C7, 8	2-10pF miniature film dielectric trimmer (yellow). From Maplin Electronics
C2	3·9pF silver mica 5% (see text)
L3	Consists of full uncut length of coaxial socket inner conductor

Eddystone 7134P or equivalent (RS) diecast box

likely to get cross-modulation/overload interference on the weaker, wanted station.

Performance

The measured voltage gain for the wideband group A version was 13·53dB (4·5 times) at 500MHz, rising through the band to 15·4dB (5·8 times) at 600MHz. The narrow-band version provided a measured gain of 24·8dB (17·5 times) on ch. 23. Gain on the adjacent local channel ch. 24 was down 8·4dB at 16·4dB (6·6 times). The amplifier was tuned to ch. 23 to obtain Crystal Palace, the local ch. 24 being Rowridge.

A signal generator feeding a TES field strength meter at 75Ω was used to make the wideband gain measurements. For the ch. 23 narrow-band measurements a steady off-air test signal was used during non-fading conditions.

Unfortunately, noise measuring equipment is not available. Subjective assessment of the noise compared to known commercial designs does however show that a very low-noise performance was reached with the prototypes, within the specification in the SGS/ATES data sheet.

Construction

Construction is relatively simple, but it's essential to observe the requirements of u.h.f. operation. Thus *all* leads must be short (unless specified otherwise), and the components used should be similarly small with low-loss/low-noise characteristics. Use of the diecast aluminium boxes specified is considered mandatory, in order to keep out unwanted signals. The larger box is necessary for the narrow-band version in order to accommodate the additional components required. Use the smaller box specified for the wide-band version.

The amplifier itself is built on a small subchassis which fits across the box. It's held by solder tags which are retained by the 6BA coaxial socket mounting bolts – see Fig. 3. A screening shield has to be fitted across the transistor in order to maintain stability. This screen and the subchassis can be made of copper, tin or brass as convenient – for the prototypes copper-clad laminate was used.

Conclusion

The high performance and simple design make this a worthwhile and rewarding constructional project at reasonable cost. The cost of some ready-made commercial designs may well be similar to the self-constructed one, but the quality and performance of the finished home-built amplifier should, provided care is taken, be both mechanically and electronically better than most commercial single-stage amplifiers. No commercial manufacturer at present produces a single-channel amplifier within the domestic price range, so for those requiring an additional channel at minimal cost this design should provide the answer.

Problems can arise where the distant channel is adjacent to a much stronger local one. Notch filtering will remove the unwanted adjacent channel signal, but rather than incorporate the filter within the amplifier it's easier to use the imported W. German "in-line" u.h.f. filter mentioned in the March 1979 *Long-Distance Television* column. This filter is available from Astra Aerials at low cost and can be fitted prior to the amplifier's input socket.

Finally my thanks to SGS/ATES (UK) Ltd., Aylesbury, for their help with this project.■

Only in Dreams . . .

Les Lawry-Johns

WEARILY I clambered up the graceful curve of the Spit's port mainplane, once again to wedge myself in the tiny cockpit, to clunk-click the straps, and to prepare for the ordeal to come. I looked down on the strained and anxious faces of my faithful fitter and rigger, Fred and Reg, who had kept the Spit serviceable through the long months to enable this one plane, with its one pilot, to hold off the entire enemy air force by night and by day. I was feeling a bit groggy, after six months without sleep . . . Alone to keep the skies clear until replacements could be built and pilots trained to take my place.

"Be careful sir" shouted Fred. "They'll be coming at you out of the moon." My haggard face managed a ghost of a smile as I pulled up the side of the cockpit cover and pressed the starter. The sharp bark of the Koffman cartridge preceded the clatter of the Merlin as it burst into life in the early morning air, and the March Hares sat up in silence around the airfield perimeter, sole witnesses to what could well be the last act of the drama, their ears providing V signs of encourangement.

"Chocks away chaps."

"Chocks away sir, and good hunting. Oh God. He can't, he just can't. But of course..... he must".

My headphones crackled into life. Dorniers over Dover, Junkers over Jarrow, Messerschmitts over Manchester. I pushed the throttle forward and the tiny aircraft raced across the grass. Make sure the guns are working. I gave the eight Brownings a quick burst, and the Vs disappeared from the March Hares' heads. No more for them the battle's noise. The engine screamed and the tail lifted..... Screamed.

"Wake up, wake up. You're tearing the bed to bits. What dream is it this time?"

This was to be my reward then. To be rudely awakened by an unsympathetic spouse who knew and cared nothing about my valiant efforts to save our blessed island home.

I lay there reflecting for a while, the battle of the skies receding as I remembered what I'd done the previous day to my precious test cassettes, all carefully recorded. Correction. They had been carefully recorded until I'd left that open-wound transformer next to them while testing some audio stuff. For the life of me I couldn't find the reason for the loss of playback on the next cassette to be tested. I really must learn to be careful and logical like all those other chaps are.....

Came the Day

Some outside calls to make. Mrs. Acorn was first.

"I'm on the third floor, this end. The lift's at the far end."

Might just as well nip up the stairs at this end rather than drag all the way along to the lift carrying this lot and then drag all the way back again once I get up there and repeat the process on the way back.

So we danced up the first flight and then up the next to the first floor. Nip smartly up the next flight and round up the next to the second floor. Funny, it says first floor on the board. The first two flights had been up to the ground floor... Plod up the next two flights to the second floor. The boxes now weighed a ton and my legs felt a bit rubbery. Stagger up the next flight and then the final seven steps which seemed like seventy. It was worse than this when we climbed Everest the first time though. But not a lot worse. At least we (the boxes and I) arrived at No. 49.

Mrs. Acorn was the chatty, worrying type, always thinking up reasons for doom and disaster and discussing them at great length to no real purpose.

"The set's in here. Do you think it's finished? I've had it only a couple of years. It should last longer than that, shouldn't it? Doesn't seem fair. The vacuum cleaner was the same. It all happens at once, and I do miss the telly. Half way through Cross Roads. I'm frightened to touch it myself. Always have been afraid of electricity, but I don't suppose you are. Neither was my husband, and he's dead."

By this time I'd reached the set. A 20in. monochrome one with a solid wood case. Unfamiliar. Unitra. Oh dear.

Back off, juice on and present at h.t. points. No heaters alight. Where's the dropper? Swing down chassis. Thermistor and large wirewound behind the e.h.t. compartment, upper right side.

Wirewound intact. Chase along to PY800. Open-circuit. Should have been a PY88 (PY800 19V heater, PY88 30V heater). Fit new PY88.

Heaters now alight, hissy sound. Aerial out of wall socket. Insert plug. No better. Redress plugs at both ends. Sound clear, but no raster yet.

Narrow picture slowly expanding after extended wait. Lazy PL504. Fit new one. Full picture now, but expanding when brilliance advanced. DY802 e.h.t. rectifier glowing o.k., but suspect low emission. DY802 not a DY802 but an EY86, with four turns on the heater winding. Look in vain for an EY86. Refit old one and promise to return later with replacement.

"Can I use it? It won't blow up, will it? Perhaps I'd better not have it on, but it's all I have and I do want to see the World at One."

"It's all right Mrs. Acorn. It's just that the picture gets bigger when it's bright, and I'll be back later anyway to stop that caper."

"All right, I'll get my little radio out, and you can do that for me as well when you come back, and perhaps you could have a quick look at the cleaner as well."

I fled.

Ekco, Ekco

They never come in singles, and it's a constant source of surprise that if you get a fault on one type of set the next one will be identical. After this you may go months before encountering the same fault again, even though the same type of set is met regularly but with different defects.

Next we had a 26in. Ekco colour set (Pye group hybrid chassis) which was a little too big for the customer to bring in. Symptom: sound, no picture. No valves heating. Whip out the PY500: open-circuit heater. Whip out the PL509: open-circuit heater. Check for shorts, none until PY500 refitted – it had a heater-cathode short of course, and since the PY500 is the second valve in the heater chain the first heater (PL509) is also dealt a mortal blow. Extract new valves from spares box, fit, and ensure that all is well before departing. The following call required exactly the same performance, with the result that we are now out of PL504s and PY500s.

And of Course

The last call was a little way out in the sticks. Ringing the door bell produced a loud barking by way of response. The door was opened by a friendly lady and the largest Old English Sheepdog I have ever seen. As far as his face was concerned, all that could be seen other than fur was a black nose. His feet were the size of dinner plates. More like a Yeti than a dog. He was friendly though. Even though he had no tail to wag, his rear end sort of undulated to show his pleasure.

"Get out of the way Saxon, you big slob" said Mrs. Norman.

We made our way to where the sick set stood. A large Philips G6. I was suddenly aware of what was not in the spares box.

I put the tool box down and grappled with the G6 to move it out. At the same time Saxon decided to sit on the tool box and I think he looked at me although I couldn't be sure. I then had to grapple with him to get him off the box, and he thought this was great fun and was in no hurry to give up his seat. Eventually I grabbed the box and got out the 4BA nut spinner to remove the rear cover of the set. Saxon was a great help, and did his best to distribute all the tools on the floor just in case I needed them.

With the set on, all the valves glowed and there was h.t. to the top caps of the PL509 and PY500 but no pulse voltage, the PL509 remaining cool. Check its screen feed resistor. Easier said than done on these sets. It proved to be open-circuit. The spares were out in the van.

"I'm going out to get a couple of bits and pieces. Are you coming?" I asked Saxon. He didn't need second asking and was ahead of me to the front door. Out we went to get the wirewound and the iron. Saxon jumped into the van and settled down comfortably.

"Come out you daft bugger, we haven't repaired the set yet." He didn't argue, and amiably followed me back into the house.

Now putting a new wirewound under the PL509 and PY500 valve bases is no joke, and as I wasn't inclined to put the set on its side I had to adopt a rather uncomfortable posture in order to solder the thing in. The trouble was that Saxon wanted to see what was going on as well, which made our heads too close for comfort, particularly since his was twice the size of mine and took up far too much space. Mrs. Norman came to my aid and dragged away my helper.

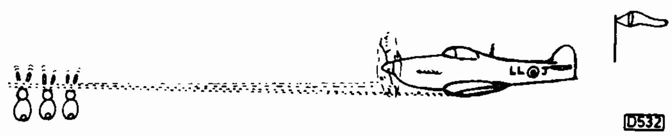
Eventually the resistor was in, and as there were no shorts present we tried the set, desperately hoping the PL509 was not going to play tricks. The resultant picture was quite pleasant, but rather soft and tinted due to the age of the tube precluding an accurate grey scale. I prepared to depart and the final pleasantries were being exchanged.

"The picture's gone off" said Mrs. Norman. Back to square one, with the wirewound overheating sufficient to melt the solder. The PL509 was faulty after all.

"Sorry Mrs. Norman, I'll have to pop back later. It needs someting I had when I started out but haven't got now. See you later Saxon."

Visit from a Reader

Back at the ranch we had a few bits and pieces to clear up before we could return to the scene of the uncompleted jobs. I'd just accidentally managed to short the base and collector



A quick burst from the Brownings . . .

of a regulator transistor in a reel-to-reel tape recorder, thereby returning us to exactly the same condition as when we had started (worse, as we now had no MJE3055: the last one had been the last one), when a couple of very nice people came into the shop to make themselves known as regular readers (she as well as he). As I say they were very nice people, but there was one odd thing: he was wearing a fur collar, not her.

"We thought we'd pop in to say hullo and just to make sure that you really do have a dog and a cat that do funny things."

"Oh yes. They're here all right. There's Spock, and the nose round the corner is Ben."

At that moment I took another look at the fur collar and it yawned at me. It was a dog. "She was getting tired you see." The dog was elegantly draped around his neck and for all the world looked like a fur collar. What a lovely lot of daft readers we do have.

Came the Night

We had discharged our responsibilities to the letter, and had recharged our batteries at Harold's hostelry before retiring for the night, the better to slumber rather than lie fretting into the early hours . . .

It was a freezing cold morning as day dawned. The lone Swordfish stood, ungainly as ever, freshly loaded with its single torpedo, and only one occupant instead of three.

Lt.-Commander Prangham-Wright nodded to me briefly as I clambered up the lower port mainplane, the starting handle in my icy hand.

"The entire enemy fleet is proceeding up through the straits – two carriers, two battleships, four cruisers and ten destroyers. They must not be allowed to get through, or all is lost. Not one. I must press home my attack with the utmost despatch."

"But this is our last aircraft sir, and that's the last torpedo" I stammered, at a loss to see how he could sink the lot in one go.

"No one knows that better than I" said the intrepid naval officer. "I've had the armourers up all night specially hardening the warhead so that it'll penetrate anything up to nineteen ships and explode on impact with the last – just in case they have a supply ship tucked away. All I've got to do is to get 'em in line and dive the old stringbag at 100 knots at the first one and the lot will go down *wham*!" What a wonderful man. What ingenuity. What courage. No wonder he had the D.S.O. and scar.

"Right Les, wind her up and we'll get going."

Standing on the leading edge of the mainplane, I inserted the handle into the socket behind the engine and commenced the winding up process. Slowly my frozen hands rotated the handle to get the flywheel moving, then faster and ever faster until the flywheel was up to speed. "Switches on." "Switches on." I removed the handle and pulled the ring which would bring the spinning flywheel into marriage with the engine. Clatter, clatter, clatter. The big three-bladed airscrew turned and stopped as the engine coughed and died.

"You bloody fool, you didn't get her up to speed. Do it again" bawled Prangham-Wright. "And this time put some backbone into it."

Wearily I reinserted the handle, and with aching muscles started to wind her up again. Faster and faster, faster and faster. The flywheel was screaming, screaming . . .

The New Colour Chassis

IT has not for many years been such an interesting time in the TV receiver industry. All of a sudden, every setmaker has introduced a new colour receiver chassis. There are two basic reasons for this. First, an expected substantial increase in the sales of smaller-screen colour receivers, and secondly a more settled situation in the tube field. The latter is of interest, since it seems not so long since that a growing number of incompatible tube systems were being offered to setmakers. The present situation is that the 110° PIL and 20AX tubes have come to be accepted for use in larger-screen (22 and 26in.) models, while for use in smaller-screen (14-20in.) sets the 90° PIL type of tube has been generally adopted. So we find that every setmaker now feels it necessary to have a smaller-screen chassis designed to drive a tube of the 90° PIL variety. Amongst the new chassis are the ITT CVC40 and CVC45/1, the Decca 70 series chassis, the Pye/Philips KT3 chassis and the Thorn TX9 chassis. The purpose of this article is to survey the technical features of these new chassis.

You might think that given a common requirement, to drive a 90° thin-neck tube using a saddle-toroidal (line/field) deflection yoke, setmakers would come up with much the same solutions. After all, car manufacturers seem to come up with remarkably similar products for various sections of the market. The TV industry never seems to have worked in this way however, and the new chassis present some interesting contrasts in design approach. In fact there are only three circuit features common to all these chassis, the use of a bridge rectifier in the mains input circuit, the use of the Mullard U321 tuner unit, and the use of a TDA2540 in the i.f. strip. The latter device incorporates a three-stage i.f. amplifier with a.g.c. applied to each stage, synchronous vision and a.f.c. demodulators, a gated a.g.c. system, a white-spot inverter and video preamplifier. Areas of contrast include whether or not to use a switch-mode power supply linked to the line timebase, the extent to which i.c.s have been adopted, and whether to use single chassis or modular construction.

ITT CVC40 and CVC45/1 Chassis

The first of these chassis to come along, the ITT CVC40, was introduced late last year. The original version was fitted with a 16in. tube and the power consumption under normal operating conditions was down to 65W. The subsequent CVC45/1 is fitted with a 20in. tube and has the same average consumption though a slightly higher consumption (90W) at maximum brightness. The figure of 90W compares very favourably with the 150W consumption of the previous CVC20 chassis at maximum beam current.

The CVC40 was evolved from the CVC20, using the same modular chassis approach and the same Mullard three-chip decoder (TBA560C/TBA540/TCA800) with class A RGB output stages. There are substantial differences elsewhere however.

First, the switch-mode power supply also drives the BU208 line output transistor. The idea is shown in Fig. 1. A series chopper transistor is used, and the line output transistor obtains its base drive from a secondary winding on the chopper's inductive reservoir. The line oscillator is contained within the well-established TBA920 sync/line generator i.c., the line drive from this being fed to a relatively simple discrete component switch-mode power supply control circuit. A feature of the line output stage is the use of a diode-split line output transformer to provide the e.h.t. while the EW modulator drives a transductor which is connected in series with the line scan coils. The field timebase uses discrete circuitry throughout, with a class B output stage.

On the signals side, the TDA2540 i.f. i.c. is preceded by a surface acoustic wave filter (SAWF) which forms the i.f. bandpass response. This is in turn preceded by a two-stage wideband transistor amplifier to make up for the SWAF's insertion loss. There are separate intercarrier sound (TBA120U) and audio (TDA2611A) i.c.s.

The main difference between the CVC40 and the CVC45/1 is that the latter employs a conventional line output transformer with a separate tripler to provide the e.h.t.

Pye/Philips KT3 Chassis

The Pye/Philips KT3 chassis has some things in common with the ITT chassis, in particular the use of modular construction. Perhaps we should put this down to the continental approach to TV receiver design. There's also a series chopper which again also provides the drive to the line output transistor. At this point however a couple of rather interesting i.c.s come into the picture, the TDA2581 and TDA2571, which are designed as a matched pair for switch-mode driven line deflection circuits. Each i.c. contains an oscillator, the TDA2571's oscillator operating at twice line frequency (31·250kHz) while the TDA2581's oscillator operates at 15·625kHz. The idea is that the TDA2571 provides timebase synchronisation while the TDA2581 controls the switch-mode power supply. The block diagrams (Fig. 2 and 3) indicate the functions of each. The TDA2571 is particularly interesting in containing a 625:1 divider to obtain a field sync pulse from the line sync pulses. It incorporates a field sync pulse separator as well,

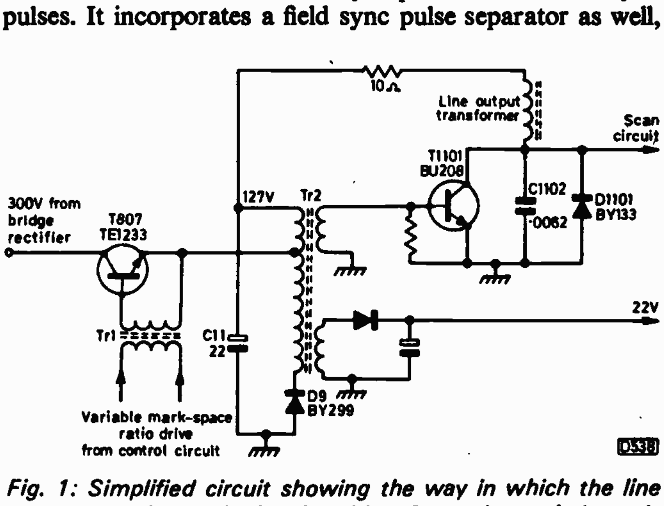


Fig. 1: Simplified circuit showing the way in which the line output transistor obtains its drive from the switch-mode power supply in the ITT CVC40 chassis.

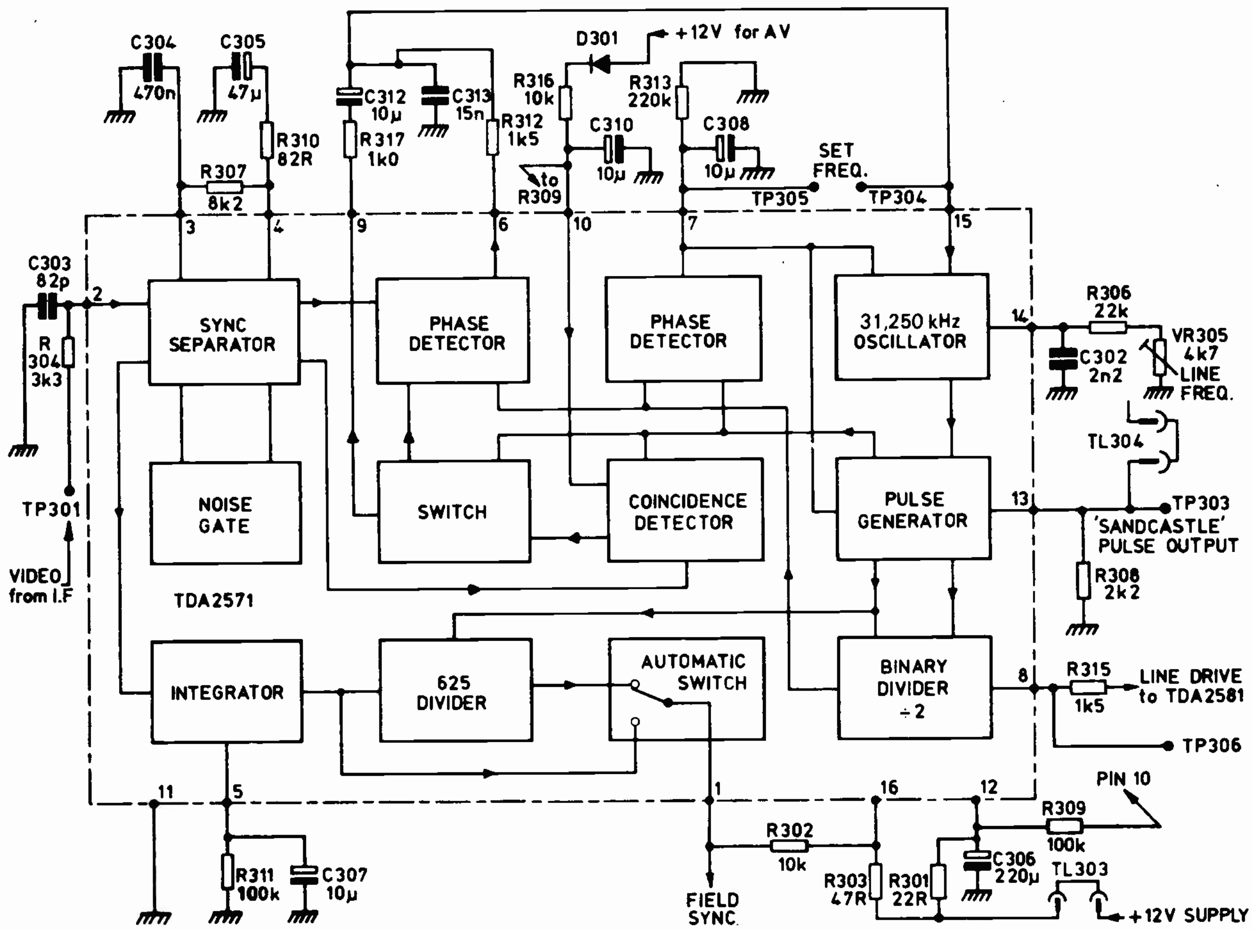


Fig. 2: Block diagram of the TDA2571 i.c., which combines the sync and line oscillator functions. The oscillator operates at twice line frequency, and with a standard signal input the field sync pulses are obtained from line frequency pulses by means of a 625:1 divider. There are three control loops within the i.c., each with its own phase detector. Peripheral components as used in the Decca 70 series chassis.

with automatic switching between direct field sync and sync pulses obtained by counting down. This provides for VCR use.

The KT3's timebase circuitry is otherwise conventional, with a diode modulator for EW correction, a tripler to provide the e.h.t., and a discrete component field timebase with class B output stage.

On the signals side, conventional *LC* filter networks form the i.f. response prior to the TDA2540 i.f. strip. The sound section is similar to the CVC40, with a TBA120AS intercarrier i.c. and TDA2611AQ audio i.c. There are two chips in the decoder, a TDA2560 luminance and chrominance signal control i.c. and a TDA2522 reference oscillator/chrominance demodulator/PAL switch i.c. A discrete resistor network is used for matrixing to obtain the RGB signals, which are fed, via emitter-followers, to class AB output stages.

14, 16 and 20in. models using the KT3 chassis have been announced, and the average power consumption is quoted as 65-70W depending on screen size.

Decca 70 Series Chassis

14 and 16in. models have so far been announced using the Decca 70 series chassis, which is quoted as having an average power consumption of 60W. Most of the circuitry is contained on a single panel, with two daughter boards, one for the i.f. strip and the other a decoder sub-panel. The switch-mode power supply/line output stage arrangements look similar to those of the KT3 chassis, but there are some important differences. While the TDA2581/TDA2571 combination again puts in an appearance, a parallel chopper circuit using a BUW81A Darlington device is used. By this means the switch-mode power supply can be used to provide mains isolation. There's also a rather neat touch in the start-up arrangements. To get the set going, the TDA2581 requires a start-up supply. This can be obtained from a zener diode fed via a suitable resistor from the rectified mains supply, but the zener's feed resistor will continuously dissipate several watts. The arrangement used in the 70 series chassis is shown in Fig. 4. At switch on, Tr601 is forward biased and the TDA2581 receives its supply via R627, Tr601 and D603. Once the switch-mode power supply comes into operation, D604 and Tr602 switch on and Tr601 switches off. There is thus no further dissipation in R627.

The line output stage uses a BU500 transistor with a tripler to provide the e.h.t. There's an unusual looking diode connected between the base of the BU500 and the pulse winding on the line output transformer. The purpose of this is to apply a negative-going 10V pulse to the base of the transistor to ensure that it remains switched off during the flyback period. EW correction is by means of a driven transductor in series with the line scan coils, as in the CVC40 chassis.

The field timebase consists of a TDA1170 i.c. as in the Decca 80 and 88 series chassis. This includes a class B output stage. A TDA1190Z i.c is used as the intercarrier sound strip and audio amplifier. There's a TDA2560 and TDA2522 in the decoder, as in the KT3 chassis, but matrixing is carried out in a TDA2530. Class AB RGB output stages are used.

A SAWF with differential input forms the i.f. bandpass response ahead of the TDA2540 i.f i.c. A Plessey SL1430 i.c. provides i.f. preamplification to make good the insertion loss introduced by the SAWF.

Thorn TX9 Chassis

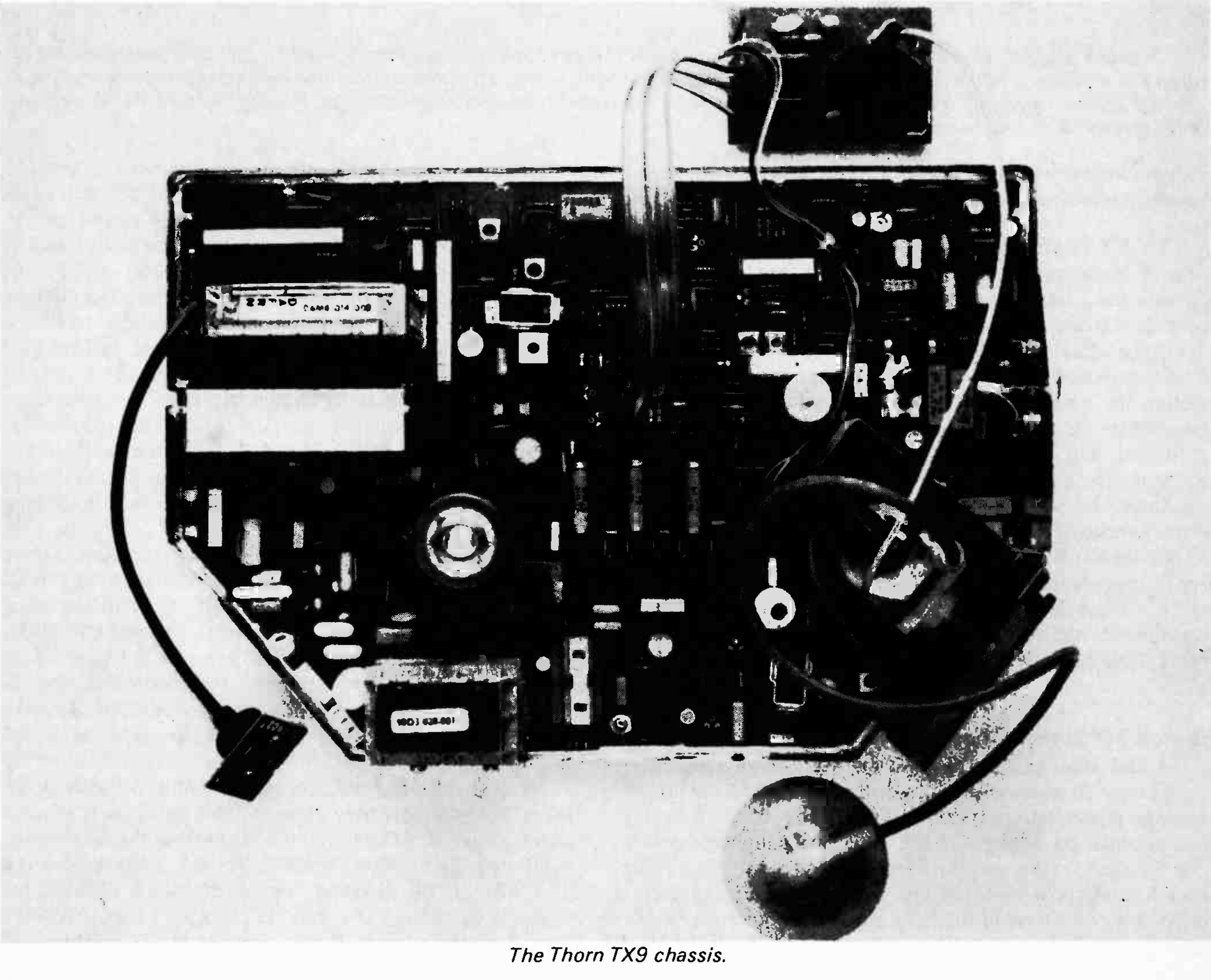
Moving finally to the Thorn TX9 chassis, we find a simple main panel with an ultra-low component count, achieved by the extensive use of i.c.s, and a single daughter board for the i.f. strip. Keeping the i.f. strip on a separate board simplifies production in enabling boards for different TV systems to be easily substituted. The main board is also drilled ready for accepting the addition of a v.h.f. tuner. One of the most intriguing technical features however is that Thorn, who pioneered the use of switch-mode power supplies in TV sets, have this time decided to use a thyristor instead for voltage regulation and to keep the power supply and line timebase separate. The chassis is designed to drive all tube sizes in the range 14-20in., and the consumption under normal viewing conditions is only 55W – 40W at back level.

The i.f. strip follows the same pattern as the Decca 70 series chassis – an SL1430 providing differential drive to a SAWF followed by a TDA2540, and again a single chip (TDA1035S) takes care of all the sound circuitry. Another similarity is in the field timebase, though this time the slightly different TDA1170S is employed while the use of close-tolerance, high-stability components in conjunction with the stable oscillator in the i.c. has enabled the field hold control to be dispensed with.

A particularly interesting technical feature is that the decoder consists of a single i.c. driving class A RGB output stages. The chip is the NEC type UPC1365C, and the story behind this is a tale in itself. Thorn had heard of the extraordinary reputation for reliability of NEC's NTSC single-chip decoder, and entered into a joint operation to develop a version for PAL decoding. The result is a complete decoder in a 28-pin chip, a low-consumption device and a considerable contribution to achieving a single board layout.

Thyristor regulated power supplies have been widely used but have been disliked technically because the current drawn from the mains supply has consisted of narrow, large-amplitude pulses – typically 6-20A when operating at 50Hz. This current pulse produces considerable r.f. interference and, due to its high r.m.s. value, causes dissipation problems in the thyristor and the series limiting components. Using a bridge rectifier to give operation at 100Hz helps and is not new, but the significant feature of the TX9's thyristor power supply is the use of a large value choke (typically 0·3H) to spread the thyristor's conduction time to about 5msec. This, in conjunction with the low receiver power consumption, limits the current pulse to approximately 0·6A, greatly reducing r.f. interference and enhancing the reliability of the circuit.

The thyristor's control circuit includes a time delay which results in a wait period of about 1sec at initial switch on. This ensures that the degaussing operation is completed before the field scan starts. The power supply then goes through a soft-start cycle, with the h.t. rail rising relatively



The Thorn TX9 chassis.

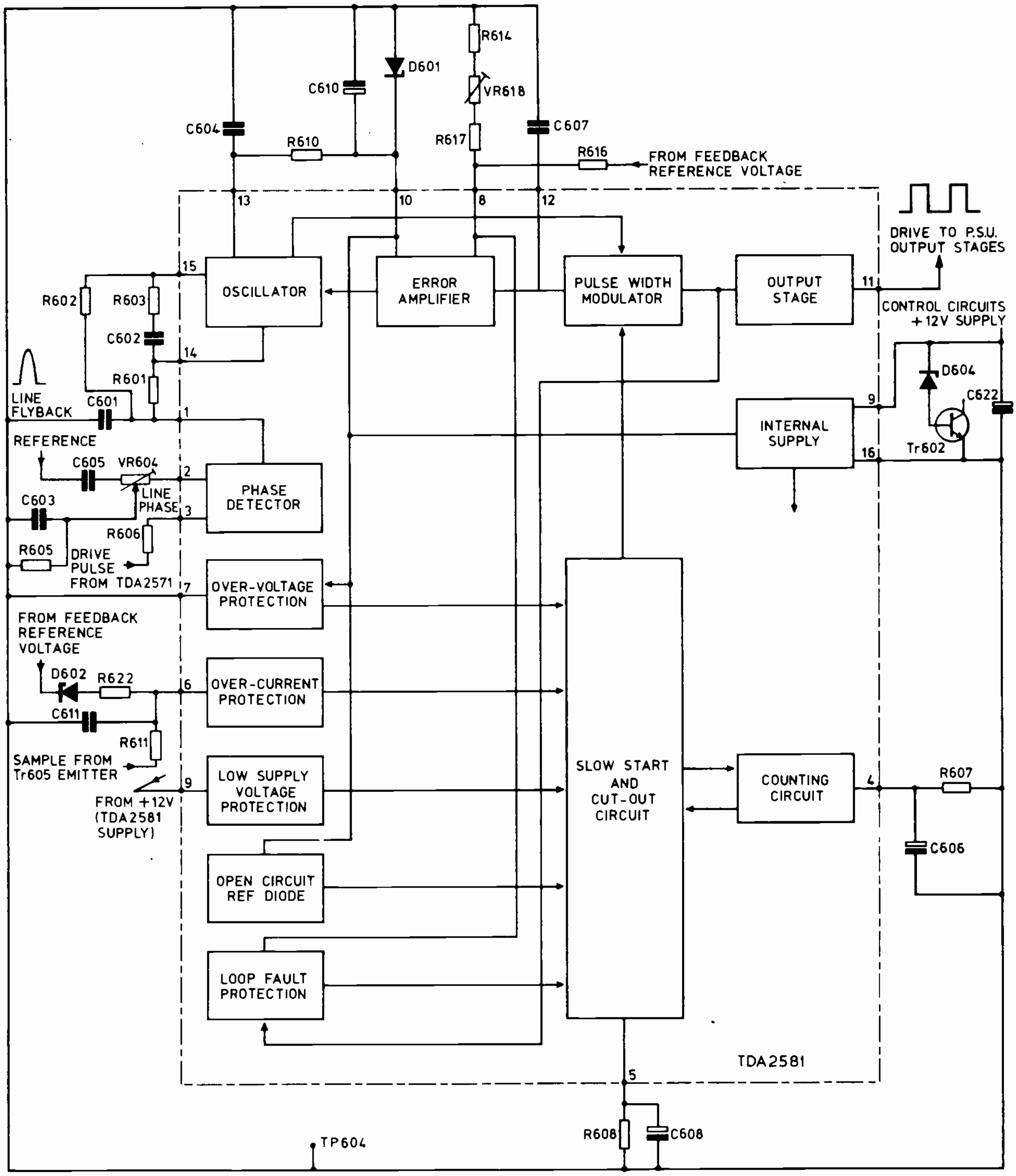


Fig. 3: Block diagram of the TDA2581 switch-mode power supply control i.c., which is designed to operate in conjunction with the TDA2571. Component numbering as used in the Decca 70 series chassis.

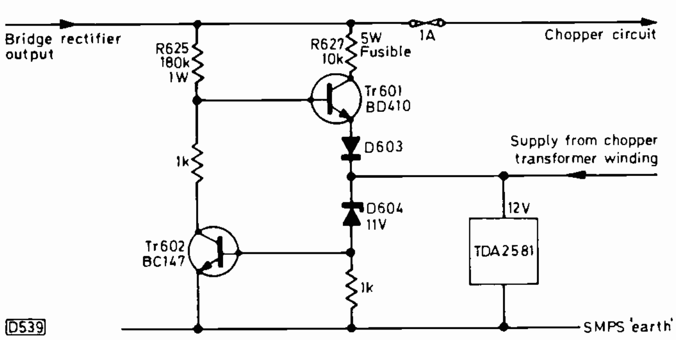


Fig. 4: The TDA2581 start-up circuit used in the Decca 70 series chassis.

slowly to eliminate supply rail overshoot and minimise mains input current surges.

The e.h.t. is obtained from a diode-split line output transformer with integral focus unit. The transformer's output impedance is improved by the use of an external, damped tuned circuit. This interacts with the transformer's inherent harmonic tuning, giving an output impedance of about 1·6MΩ. The tuned circuit requires no adjustment for different transformers of the same type, and no adjustment is necessary when replacing a transformer. The significance of this low output impedance is in improved e.h.t. regulation of course.

The line oscillator and sync circuits are contained in a TDA9053 i.c., while a diode modulator is used to provide

EW correction.

Some final points worth noting about the TX9. In comparison with the 9000 chassis, which it replaces, the component count is 410 against 618. This also reduces the number of soldered joints, the number of interconnecting plugs and sockets, and the amount of wire – there are around 400 fewer soldered joints than in the 9000 chassis, and there's 15m less wire! There's a 35% reduction in the number of setting up adjustments in comparison with the 9000 chassis – the use of the single-chip decoder has reduced the number of adjustments in this area from 12 to 8. The power consumption is halved compared to the 9000 chassis.

All this doesn't come cheaply: Thorn have made a massive investment in new capital plant – roughly £10 million is being spent on new machinery for the production of the TX9 chassis, much of it under sophisticated computer control.

The first set to be fitted with the TX9 chassis is the 14in. Model 3755. An optional inverter unit to enable the set to be operated from a 12V or 24V battery is available for use with this model. It fits inside the cabinet, on the left-hand side. Current consumption with a normal picture is approximately 5A from a 12V battery.

To sum up, these new chassis offer good performance and efficient operation, exploiting the latest technology. Black matrix tubes offering high brightness with good focus performance are used. The aim is products that compare favourably with those from any other source.■

Test Report: New Dimension TV TR500 CRT Tester/Rejuvenator

J. H. Starling

BEING a full-time field service technician, most of my time is spent looking after various rental and maintenance contract TV sets. The majority of these date from the TV boom years of 1972-4, so their tubes are by now getting rather tired. This means that some means of checking and reactivating them is an almost essential item of servicing gear. There's quite an elaborate tube tester in the workshop, but it's too expensive to spend most of its time under the seat in the service van. Most build-it-yourself reactivators on the other hand don't include a meter amongst the transformers, pygmy bulbs and whatnots. The presence of a meter is most important so far as I am concerned: it can be used for before-and-after checks on the effectiveness of tube reactivation, can forestall attempts to jack-up a perfectly good tube when the fault lies elsewhere in the set, and also allows you to let the anxious customer see for himself the condition of his tube.

CRT reactivation can be likened to Russian Roulette – perhaps sudden death may ensue, or maybe a reprieve for months or years. Life is full of surprises! The game is usually played in a dark corner of the customer's lounge, where the victim sits surmounted by assorted pot plants, souvenirs of last year's package holiday on the Costa del Whatsit and a photo of Aunt Flo, skirt at half-mast, taking her annual paddle at Blackpool. Squatting behind all this paraphernalia, cup of tea in one hand and the reactivator in the other, I usually suggest to the customer that he leaves the room. Often, with a sense of impending doom, he'll hover outside the door . . .

So to the subject of this test report, the New Dimension Television TR500 "universal tube tester". It's a pocket-sized instrument in a plastic case measuring 11 × 7 × 4·5cm. CRT emission is indicated on a small panel meter whose scale is divided into "low" and "good" segments. The heater of the tube being tested is supplied with 8V from the mains transformer within the TR500, and during reactivation a positive voltage is applied between the selected grid and cathode, the resulting current flow being sufficient to remove the resistive layer of oxides from the cathode. The degree of removal is determined by the instrument's current limiting properties. A neon indicator shows the level of reactivation current, and is fully lit when the reactivation process is complete.

The TR500 comes with no tube base fitted, just a 6-core colour-coded cable. I found it most convenient to wire this into B8H and B14G sockets mounted on the faces of a small box – plastic for preference, since the wires to the c.r.t. base can become live if the tester is incorrectly wired to the mains. The latter condition, also the absence of an earth connection, prevents the neon indicator in the TR500 working, thus drawing attention to the error.

I quickly got to know what meter readings to expect during emission tests of tubes of varying degrees of decrepitude. Although the meter scale is small, the readings are clear and reliable. A first-class tube drives the meter just to f.s.d., with tubes of lesser virtue giving proportionally lower readings.

Regarding the efficacy of the reactivation process, I found that the TR500 is well capable of "jacking" most c.r.t.s encountered. A colour tube with all guns low emission and maybe six or more year's use behind it is not a good prospect however, and of course the same applies to tubes which have been "squirted" before. As with any tube tester, sometimes a tube appears to have been successfully reactivated but then goes downhill during the next day or two. I find the best proposition for reactivation is a colour tube with one gun low in emission, or one in which all three guns have deteriorated over four years or less.

Conclusion

Since I've had the TR500, it's probably paid for itself several times over by saving recalls with the workshop machine. A session with the TR500 quickly establishes whether a set needs carrying off to the workshop, and I've seldom found the more elaborate workshop machine able to reactivate a tube on which the TR500 had failed.

It cannot be denied that the "live chassis" technique used on the instrument, and the necessity for an earth connection, is sometimes inconvenient in the field. But nobody is more used to working with a live chassis than the field service technician!

I've no doubt that this small and compact instrument is reasonable value for its price tag of £25 or so, and very useful to a busy field technician. It's available from New Dimension Television, 12 Buxton Row, Heaviley, Stockport, Cheshire. ■

Renovating Körting Colour Receivers

Part 2

Mike Phelan

LAST month we covered the power supplies and timebases, also the tuner unit. In this concluding instalment we will be covering the remaining signal stages and also providing setting up notes.

The i.f. module, designated Z, is very reliable. It follows the now almost universal practice of having the bandpass filtering at the front, followed by a broad-band amplifier. In this chassis there's also extensive filtering after the final i.f. amplifier stage, before the final vision and sound detector diodes (D102 and D101 respectively). By this means the 33·5MHz sound carrier is almost entirely eliminated from the input to the vision detector, so that there is no trace of sound/chroma beat.

The i.f. module also contains the video/chroma distribution amplifier (T105), the gated a.g.c. stage (T106), and the a.g.c. phase-splitter (T107 – the tuner requires a.g.c. of the opposite polarity to that of the controlled i.f. stage).

The i.f. strip does not cause many problems. Most of those that do occur are in the a.g.c. circuit. If the a.g.c. locks out when the line timebase starts operating, C142 (33μF) will be found open-circuit. C144 (0·47μF) can cause low gain if open-circuit and lockout if short-circuit.

The preset contrast control R135 can become intermittent, and should be adjusted with a non-metallic tool to avoid shorting the wiper to ground. This also applies to the presets on the decoder.

Overloading when the brightness is turned up is caused not by an i.f. fault but by the print to the earth connection on the line output transformer being open-circuit. This also causes certain of the convergence controls to vary the i.f. gain (yes!).

Finally, the usual warning about not twiddling cores. The Körting i.f. strip is more difficult to align than most, so beware! Test points (the base connections of each stage) are available through holes in the screen. The habit of C149 shorting to blow the 24V supply fuse Si6 was mentioned last month.

After leaving the i.f. strip, the luminance signal passes through the luminance delay line and then goes to the Y board. This contains the luminance preamplifier T201, a switchable notch filter (L201), the beam current limiter (T204-5), and the sync separator (T206). The preamplifier is an emitter-follower, with the contrast control connected between its emitter and a potential divider. The transistor and its load resistor thus form one arm of a bridge, which is balanced by setting the transistor's collector current (R203), so that the contrast control does not alter the black level. The notch filter is tuned to 6MHz, but on receipt of a chroma signal a voltage from the colour-killer circuit forward biases the switching diode D201, putting an extra capacitor across the tuned circuit and reducing its resonant frequency to 4·43MHz.

The beam current limiter (see Fig. 4) monitors the PL509 line output valve's cathode voltage, as is usual in hybrid colour sets. It's a two-stage amplifier, thus giving a very sharp cut-off. This allows the c.r.t. to run right up to its maximum beam current (1·5mA). This is necessary, otherwise the beam limiter would be working in opposition to the fast-acting e.h.t. stabiliser. The sync separator is entirely conventional.

T201 sometimes goes open-circuit, giving no luminance, but this symptom is often due to a dry-joint on the filter coil L201. Use a small, very hot iron for removal. The signal can be traced with a meter from the vision detector to the c.r.t., as the entire luminance channel is d.c. coupled. The sync separator transistor and its load resistor R233 (680kΩ) occasionally fail, giving weak sync or no sync at all. Either of the beam limiter transistors can give rise to no raster, which will be restored by pulling off the red and white lead next to the contrast control plug.

There are three versions of the audio panel. The earliest one used a discrete transistor output stage which gave good results from the twin-cone speaker. It used a TAA640 as the intercarrier sound channel. This panel gives little trouble. Later ones use a TBA800 audio i.c., with either a TBA480 or TBA120S intercarrier sound i.c. The audio from these is good, though not quite up to that of the original panel. The TBA800 fails fairly often, giving intermittent or no sound. There are facilities for fitting an extension speaker, in the form of extra pins on the panel above the mains transformer.

As mentioned before, the c.r.t. base panel houses the luminance output transistors T150/T151 (see Fig. 4). The input from the contrast control is at a very low impedance, and the final stage T151 is an emitter-follower. The tube's input capacitance and that of the wiring make little difference to the h.f. response therefore. This, coupled with the fact that the stages in question are mounted on the c.r.t. base, means that the definition is better than average. The transistors get very hot however, and frequently become dry-jointed. Replace with BF337s and use heatsink grease. Later models use BF459s which do not seem to suffer from this problem.

If T151 goes open-circuit emitter-to-base, the 47kΩ resistor in the c.r.t.'s final anode cap will emit much smoke, hopefully before the demise of the tripler! R160/161 going open-circuit will cause severe ringing, as will a faulty delay line. Burning of any of the c.r.t.'s 1·5kΩ cathode resistors means a heater-cathode short in that gun: see notes about this earlier.

Blanking board A gives little trouble. H.T. smoothing blocks, forget them! Transductor, ditto. R464 (12Ω) occasionally goes open-circuit to give slight pincushion distortion, and the blanking transistor T302 and diode D302 sometimes fail. The three 1MΩ resistors R465-7 feeding the c.r.t.'s first anodes sometimes increase in value.

The controls on the convergence panel are fairly high in value (mostly 250Ω) and don't give as much trouble as those of lower value used on other chassis. Severe trapezium distortion means that the wire link behind the line symmetry coil L940 has become disconnected (it's located on top of the scan coils). The three controls for radial static convergence should be set to mid-position first, and coarse adjustment carried out with the magnets.

Setting Up

Before attempting any adjustments on the set, ensure that the 24V rail is correct; adjust if necessary. The c.r.t. first anodes should be set at 500-550V. Set the preset contrast control for a signal of 130V peak-to-peak at the tube cathodes, with the front contrast control at maximum. Adjust R203 so that the black level remains constant at all contrast settings. Inability to do so means an emitter-base

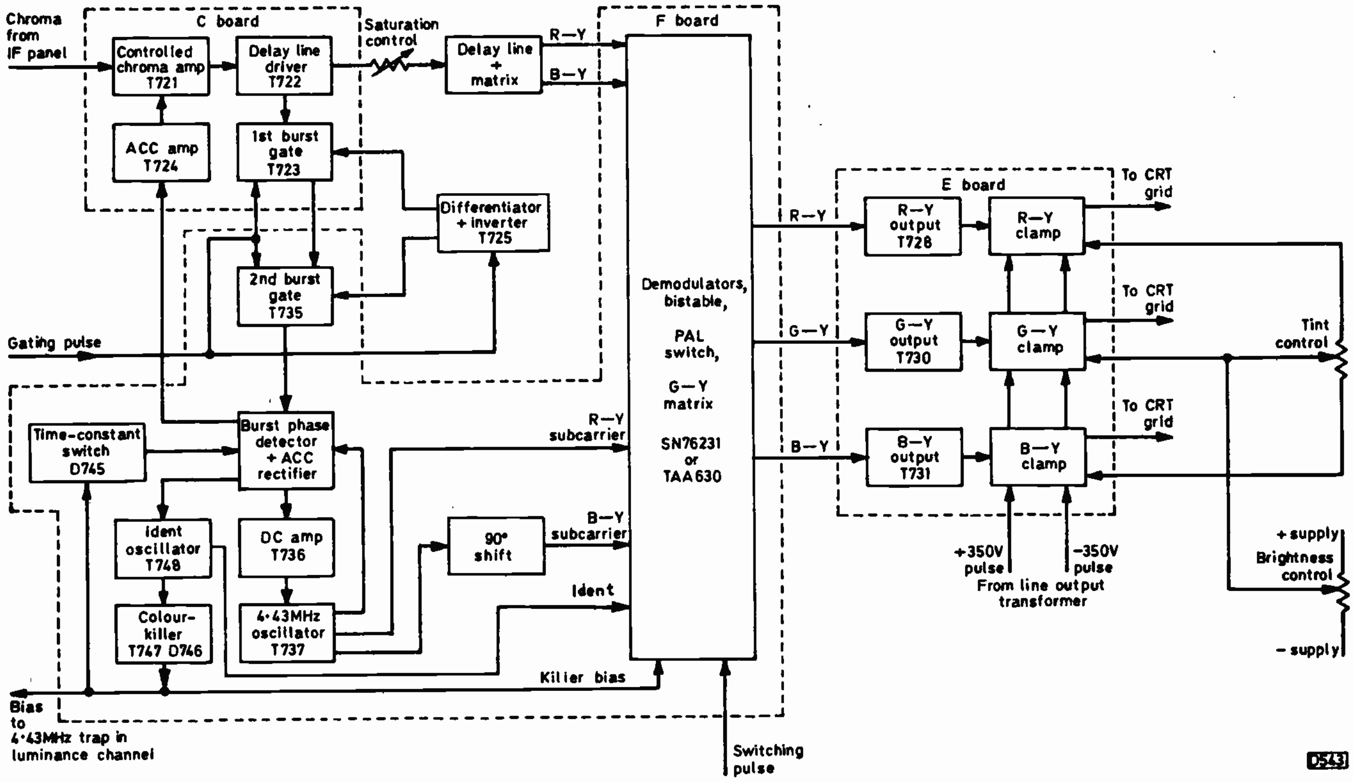


Fig. 6: Block diagram of the decoder.

short in T201, or that R206 (220Ω) or R207 (390Ω) have altered value. Turn the brightness control to maximum, and the beam limiter potentiometer R223 likewise, then set the preset brightness control R361 so that the black bar of a grey-scale wedge is just illuminated. Finally turn the beam limiter control R223 slowly until the black bar just starts to darken.

The Decoder

The decoder is arranged on three printed boards, with a number of components on the main board. The block diagram (see Fig. 6) shows what is where. As this part of the set has a few unconventional features, a brief description will not be amiss. The unusual stages are the burst gate and the ident oscillator.

Composite chroma is fed to T723 (see Fig. 7) and then to T735, both of which are without a fixed forward bias. A large-amplitude positive-going line flyback pulse is clipped to 24V by D731, giving a wide, square pulse extending from the flyback until after the burst. This drives the two gates T723 and T735 into conduction. The pulse also goes to the base of T725, through the differentiating network C747/R759 which form a positive spike followed by a negative one. As T725 is normally saturated, the positive spike cuts if off, producing a negative pulse at its collector. This is integrated by R761/C749 and fed to the bases of the two burst gates, thus cancelling out the first part of the gating pulse. This really is a most ingenious way of doing it! C733 sets the burst amplitude, and via the a.c.c. the chroma level.

The ident stage (Fig. 8) is an *RC* sinewave oscillator (T748) which is synchronised by the 7·8kHz ripple from the burst phase detector. The output is rectified by D746 to give a killer turn-on bias. When no burst is present, pin 10 of the TAA630 demodulator/matrix i.c. is taken down to 0·1V, causing the outputs to go high, so that the colour-difference output stages are saturated. The time-constant of the d.c. amplifier circuit in the reference oscillator control loop is also altered to give a greater pull-in range for a short period on switching from monochrome to colour.

Many chroma problems are due to incorrect adjustment of the ident/killer circuit. A scope, or at least a diode probe, is essential. The complete decoder setting up procedure is given later.

There seem to be few recurring decoder faults. Transistors fail occasionally, particularly T725, which will cause weak chroma. To over-ride the killer, simply turn R876 fully clockwise. C747 (27pF – see Fig. 7) on the main board goes open-circuit sometimes, removing the burst. Reluctance of the oscillator to lock may be due to a faulty crystal or to the a.c.c. diode (D732 OA90) being leaky. Weak locking accompanied by excessive chroma, usually intermittent, can be because C749 (100pF) is going open-circuit. No chroma when the killer is disabled may be a stopped oscillator (check capacitors and T737), one of the capacitors in the input filter (near the two coils on the main board), or the TAA630 i.c.

Faults on the CDA board are usually defective transistors, which will give loss of one colour-difference signal, or leaky clamp diodes, giving lack of or excess of one primary colour. These must be replaced in pairs of the same type, e.g. BA148, BA158, BY206 or any other suitable fast soft-recovery type.

To set up the decoder, turn the colour-killer threshold control R876 clockwise and use a bar or test card signal. First set the d.c. levels of the colour-difference signal output stages by adjusting R847, R844 and R845 for 140V, 70V, and 120V at the collectors of the B—Y, G—Y and R—Y output transistors. Always set the blue first. Short the base of T735 to earth to remove the burst, and set the reference oscillator to zero beat with R817. Remove the short.

A peculiarity of this chassis is that if the ident phase control R887 is in need of adjustment the result on the screen looks similar to the reference oscillator being off frequency. Adjust L802 for minimum chroma, either visually or with a

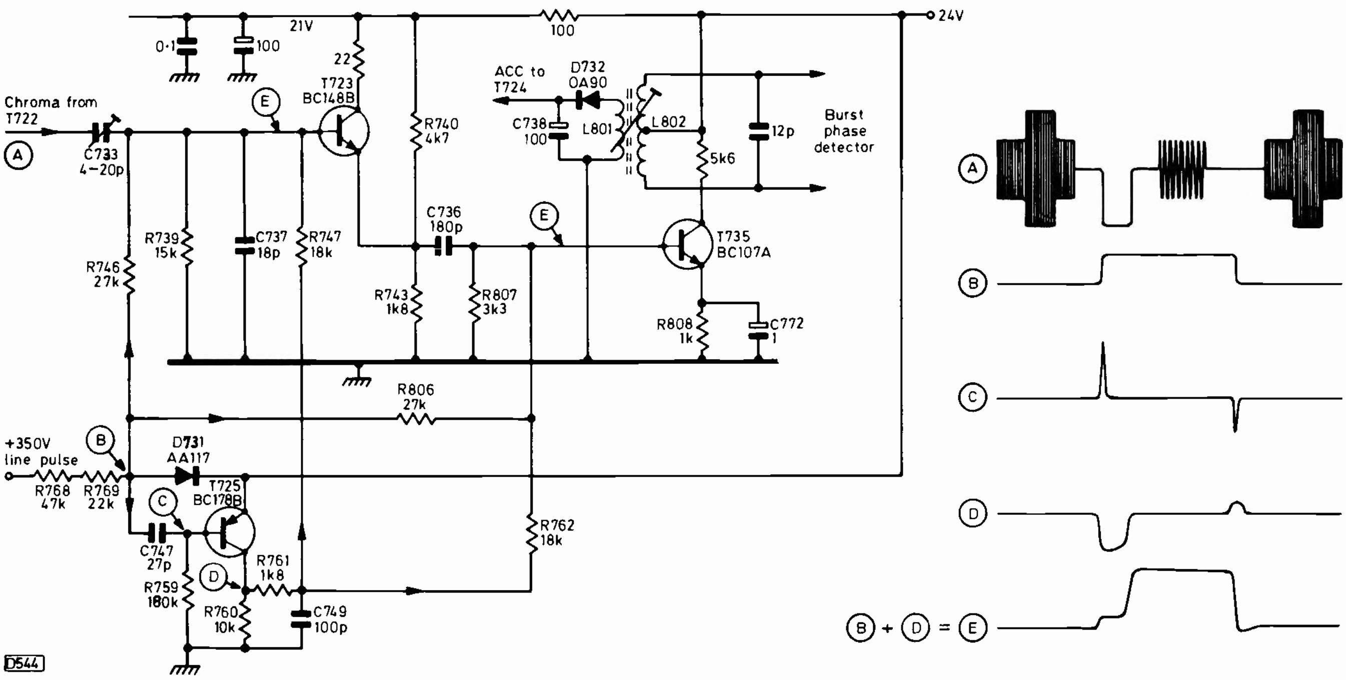


Fig. 7: Both transistors (T723 and T735) in the burst channel are gated. T725 provides pulse inversion.

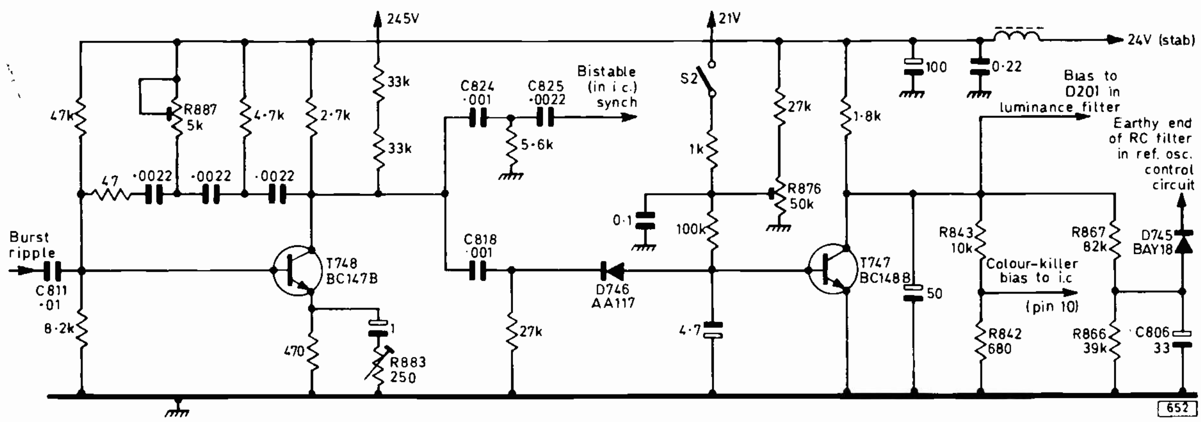


Fig. 8: The ident oscillator and colour-killer circuits.

scope on point M34 (the pin at the top of board C). Note that the tuning of this coil is very flat. With the scope on pin 8 of the decoder edge connector, set R887 for maximum sinewave, then set R883 (ident amplitude) for 18V peak-to-peak. Repeat both adjustments several times. If a dual-trace scope is available, a better way of setting R887 is to display one line of video, from the luminance delay line for example, and with the other trace display two consecutive lines of ident sinewave, so that they overlap: two lines of ident is, of course, one complete cycle. R887 can then be set so that the crossing over of the ident coincides with the line sync pulse on the video waveform. Now to set the killer threshold control R876, reduce the ident to 6V peak-to-peak with R883, then turn R876 slowly anti-clockwise until the colour goes off. Reset the ident to 18V. For those without access to a scope, reasonable results can be had with a diode probe and meter, but haphazard twiddling will not work with this circuit.

The subcarrier phase coils L721 and L731 can be easily set by converting to simple PAL. This is done by placing a shorting clip across pins 14 and 15 of the edge connector. Any blinds present are due to phase errors, and can be removed by adjusting the two coils. Remove the short, then remove remaining blinds with the delay line amplitude control R896.

On early models there was also a delay line phase control (L705). In this case a better method of alignment is to set only *one* of the subcarrier phases, then deliberately misalign the other one so that severe blinds appear on that signal, say R–Y. Then adjust the delay line potentiometer for minimum blinds (easier with a scope) on R—Y *only*. Set the R—Y phase coil by the simple PAL method, and finally adjust the delay phase coil.

There's an R—Y amplitude control (R754) which can be used to obtain correct flesh tones on the test card. C733, as mentioned before, acts as a preset colour control.

Front Controls

The rotary front controls don't seem to give any problems, but the slider controls become noisy. They are repairable if dismantled carefully. The trouble is mainly the metal strip that forms the common connection becoming tarnished. A rub with metal polish and all is well. Don't use switch cleaner. Reassemble carefully, with special attention to the plastic strip as this keeps the dust out.

In conclusion, though many faults have been mentioned, few will be experienced on any one set. An ex-rental set in good condition should give long and trouble free service. Spares are readily available.

Long-Distance Television

Roger Bunney

APRIL, often a quiet time before the opening of the Sporadic E season in May, ran pretty well to form this year, with little reception via any mode of long-distance signal propagation. Even the usual MS (meteor shower) signals were lacking here at Romsey during the early part of the month, though there was an improvement towards the end. I've seen little of importance unfortunately, though there are rumours that RTVE (Spain) may be using a new test pattern. Details are awaited.

On both the 11th and 16th I logged F2/TE signals from a southerly direction during the early evening period. On the 11th there was a vertical pattern at 1825, followed by a caption at 1844, the station announcer at 1845 and then news, the signal fading completely at 1846 (all times BST). True to form the signal was very fuzzy during the caption and announcer time, making positive identification impossible. The weak signal information on the 16th came from the same direction at a similar time but didn't give a recognisable image.

Kevin Jackson (Leeds) reports an aurora just after midnight on the 4th, producing we think for the second time transatlantic, auroral TV signals on ch. A2 – non-locking, with rolling and the sound carrier some 4MHz higher than the vision one (the system M sound/vision spacing is 4·2MHz). The signal went off the air at 0101 GMT, which Kevin suggests is perhaps too early for a North American station, though certainly no European transmitters are on-air at that hour. There have been suggestions that the signal could well be from an AFRTS ch. A2 outlet in perhaps the Faroes, Iceland or even Greenland, though there are no listings anywhere of any such outlets. It suggests to me that the transmitter could perhaps be located in a more rural part of the Canadian N.E. seaboard. Any comments on this unusual sighting would be welcome. Meanwhile, congratulations to Kevin on this reception. A daytime check with a TVP (Poland) MS signal enabled Kevin to confirm the ch. A2 position in relation to the Polish ch. R2 frequency.

Though F2 reception above 40MHz has been generally absent in the UK and W. Europe, reports from Australia indicate that there's been F2 activity there. Bob Copeman (Sydney) reports reception of two floating chessboard patterns on March 31st, probably originating from Nanking and Lanchow (ch. R1). Deutche Welle harmonics were present on 38·4/46·8MHz, several Russian communications channels at up to 43MHz, and another Asian TV channel on the ch. E2 video frequency. Bob confirms incidentally that ATV0 will move to ch. 10 this year, though the TVQ0 move may be delayed. A thousand miles to the west, Anthony Mann reports a massive TE opening from 1850 till 0015 on March 20th, with Chinese, Malaysian and suspected Indonesian test cards, East Malaysia in at "tremendous strength" on ch. E2 with programme material, Korean ch. A2 signals, and Russian and Chinese ch. R2 signals adding to the general confusion.

Ian Roberts reports from Pretoria, South Africa, that a new amateur radio record was established recently with a series of three contacts, two using c.w. (i.e. morse) and the other s.s.b. (single sideband), between a Greek (Athens) radio amateur and the South African amateur ZS6DN in Pretoria, using the 2 metre (144MHz) band. The signal was weak but resolvable, strange characteristics being a 15μsec delay over the signal path – theoretically the delay should have been only 5μsec – and that the reception in Greece was at an optimum with an aerial elevation angle of 20° from horizontal. Ian confirmed reception during March of BBC stations up to the ch. B4 sound frequency (at 10·37p.m. on the 12th), also RTE (Eire) ch. B and on the 12th signals up to the ch. E4 vision frequency till approaching midnight locally. All very exciting, but for us UK enthusiasts I fear that the F2/TE signals are falling in the south of France!

Further news on the reception last July 30th by myself and three other DXers of unknown system M ch. A2 signals via Sp.E. The ch. A2 transmitter we all received (two of us also received ch. A3 vision) has still not been positively identified, but my cassette recording of the ch. A2 sound was sent to WTFDA member John Combs in Orlando, Florida who is familiar with the various American accents. He's been able to resolve part of the identification that had been incorrectly deciphered by myself. TFL has not been explained, but at the end of the identification the signal continues "... at 10·30, Ottowa Rough Riders meet the Edmonton Eskimos." This is apparently a plug for a Canadian football league game that was replayed during the evening on July 30th, and Canadian members of the WTFDA active in the broadcasting field are checking old schedules to find out who carried the game at 10·30 and the possible ch. A2 transmitters. It's hoped to be able to single out a specific one through the promotional music and content. More news is hoped for soon.

The New Antiference Aerial

During the Easter break I laboured to instal the Antiference wideband aerial described last month. As anticipated, it was not an easy system to rig. Problems arose

The Antiference MH473 wideband (Band I/III) aerial, with its colinear elements.

due to a slight wind at 30ft. above ground level, as a result of which the elements were blown against the mast, meshing with the latticework... The 10ft boom and weight in excess of 8kg means that installation should be carefully planned – preferrably on a mast without guywires!

Once installed, Lopik ch. E3 was immediately resolved. Band III has been more difficult to assess, due to the extremely poor tropospheric conditions recently, but Belgium chs. E8/10 are present (just) at times. I was surprised at the directional performance of the system in Band III, and the pickup from beneath the main forward lobe is a noticeable improvement on earlier systems (i.e. less pickup of unwanted signals/interference). Not surprisingly, the system is expensive, and anyone interested should contact accredited suppliers for delivery dates. Since this is an export array in batch rather than continuous production, delays may be experienced. I hope to report further on the system following a longer period of evaluation.

The recommended retail price of the MH473 array is £47. Other aerials in the Antiference range include the H1010 at £14, the MH308 at £22 and the MH311 at £25. The prices do not include VAT (12½%).

News Items

Saudi Arabia: Aramco TV (HZ22), previously on system M (525 lines), has confirmed the change to system B with PAL colour. The e.r.p. has not been increased.

Qatar: There's been a report that an English language TV service is to start in the near future, at u.h.f.

Belgium: The RTB service's PM5544 pattern generator was destroyed during a fire. The pattern subsequently radiated consisted of colour bars with the identification "RTBF" or "RTBFbis".

USA: Amongst the proposals the FCC will be making at the World Administrative Radio Conference are the extension of the MW broadcast band to 1860kHz, the extension being on a shared basis but with 1800-1860 exclusive to broadcasting, the use of the 470-890MHz band exclusively for TV broadcasting rather than on a shared basis as at present, and also the allocation of the 12/14GHz bands similarly for broadcasting from satellites.

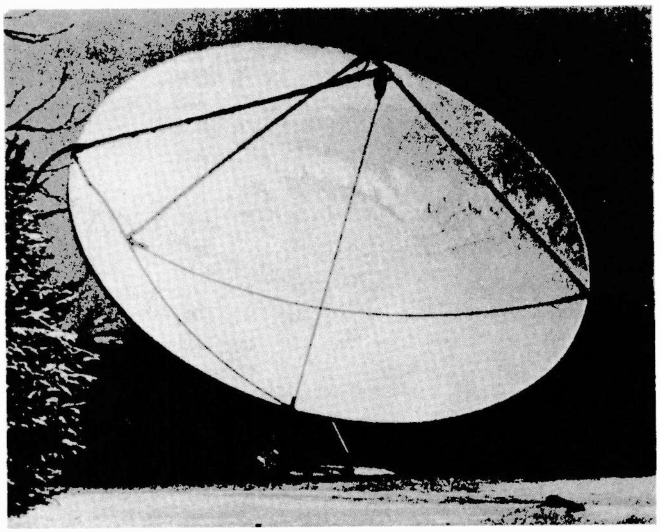
Spain: The projected Catalonian TV service has been rejected.

France: New EBU listing – Brest TF1 1,000kW e.r.p., horizontal.

From our Correspondents...

Andrew Tett is using a Murphy V849 receiver fed from a horizontal Band I dipole "with Band III attachments" in the loft, pointing to Europe. Despite this difficult arrangement, Andrew resolved Holland ch. E4 and Belgium chs. E3, E8 and E10 last November via tropospherics. He's anxious to hear from any other local DXers who can assist him in improving the gain of his receiver – the address is 109 Ronelean Rd., Tolworth, Surrey.

Gareth Price (Lowestoft) has had the benefit of assistance from Clive Athowe and has successfully resolved a vast number of v.h.f. and u.h.f. signals, using a Premier wideband Band I aerial and Fuba XC391 u.h.f. array. The receivers in use are a Philips with the 210 chassis and an added G8 selectivity panel, and a 5½in. JVC v.h.f./u.h.f. set. The latter is apparently a high performance receiver and, being a mains/battery portable, can be carried around the house for monitoring anywhere. Amongst the signals received on this set are Gwelo, Rhodesia ch. E2 and many MS signals. It seems that prior to Lopik ch.E4 coming on



A 6-metre USTC (United States Tower and Fabrication Company) dish aerial for satellite reception.

air certain oil rig communications have been heard. I'm wondering whether this is due to cross-modulation, since this is an allocated broadcast band.

Hugh Cocks has been carrying out tests with a Wolsey Colour King and a Jaybeam JBX21 array at his East Sussex location. He's noticed that the signals from the two aerials at their different heights can vary considerably. The Colour King is at 38ft. and the JBX somewhat lower, but at times fading will give a stronger signal from the lower aerial and vice versa.

N. American Satellite TV

It's unfortunate that with the OTS-2 satellite in use at present to conduct tests into 12GHz propagation and receiver techniques no commercial receiving equipment is available. There's the further point that with an established terrestial network, the advent of satellite TV broadcasting to the UK is likely to be some way into the future. Things seem to be more lively in the USA however.

In recent months Bob Cooper, from the CATA organisation at Oklahoma City, has been sending me copies of their journal CATJ, which is devoted to describing progress and developments in the cable TV field. It's all too obvious from this that enthusiasm for advances in communications and entertainment is rather more dramatic there than we experience in the UK and W. Europe. Satellite engineering and the associated receiving apparatus seem to have become something of a growth industry in the US, with emphasis in particular on improved, low-cost amplifiers and other spin-offs which will be to the advantage of consumers.

Satellite TV is already a benefit to both cable TV operators and TV station operators in the states, enabling the former to offer their subscribers a much wider choice of material obtained from the latter. For example, WTCG Atlanta ch. 17's programmes are now (as at October 1978) linked via the Satcom-2 satellite to some 250 cable systems serving 1·3 million households. WTCG pioneered satellite TV programme distribution of this type. Its success has been followed by other stations across the USA, and by what are called programme facility houses, all leasing relay transmitters (transponders) on a variety of satellites (or "birds" as they are coming to be known as in CATV circles).

From 99°W to 135°W a series of synchronous satellites operating in the 3·7-4·2GHz band is providing coverage over the greater part of N. America (with spot beams to the USA's 50th state, Hawaii). The numerous programme sources are transmitted to the satellites from ground stations operating in the 6GHz band. Three of the satellites (Anik 1, 2 and 3) are used primarily by the Canadian government and the CBC to provide links with conventional transmitters which reradiate the programmes. Included in the transmissions are 12GHz signals for the CTS experiment. The five satellites operating in the USA are Westar 1 and 2 (Western Union), Comstar, and two RCA owned satellites.

Western Union's satellites have 12 channels each, within a 500MHz bandwidth, each channel being 40MHz wide with a 40MHz separation between channels. The RCA satellites similarly have 40MHz channels, but the 20MHz separation provides 24 channels within the total bandwidth. This is made possible by using cross-polarisation – vertical polarisation is used for twelve of the channels and horizontal polarisation for the other twelve.

Certain guidelines on the performance of the receiving terminals are laid down by the FCC, and potential users have to present their proposed specifications for approval. Since the field strengths produced by the various satellites vary over the landmass, it follows that the design of receiving terminals varies.

Once the terminal has received FCC approval, the operator can turn to a large number of suppliers of the specialised equipment required. Negotiations with programme originators continue during the installation of the terminal. Many TV stations now feed their output to satellites, from San Francisco in the West to Las Vegas, Chicago, Atlanta and Virginia Beach in the east: the programme facility houses often provide exclusive reshowings of movies on current release, and shows. Once contracts are concluded, the cable operator hooks up his system to the satellite and the extra programmes are added to those (often in double figures) already available to his subscribers.

The parabolic reflector aerials used vary in diameter from 11 metres down to 4·5 metres. The feeder system may be of the prime focus type (r.f. extracted at the focal point of the dish) or the Cassegrain type (r.f. extracted at the dish centre, after reflection from the focal point). The heart of the system, determining the performance of the terminal, is the low-noise amplifier. It's perhaps in this area that most original research has been done, in an effort to achieve very low noise figures without recourse to the use of the rather larger parametric

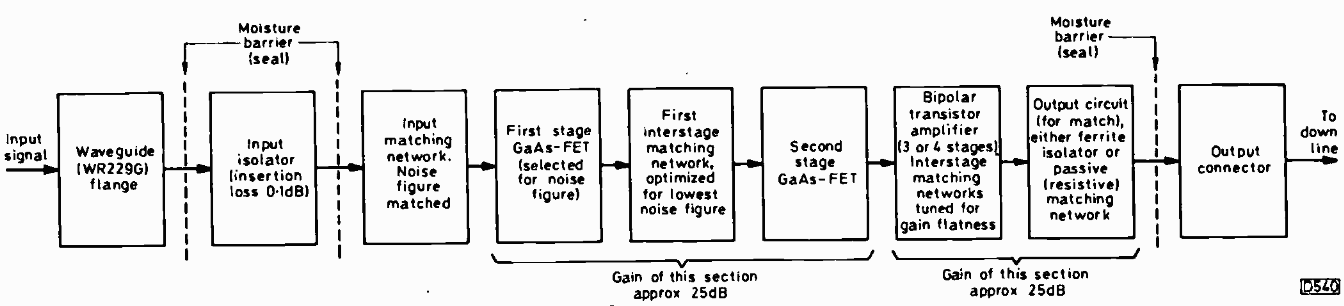


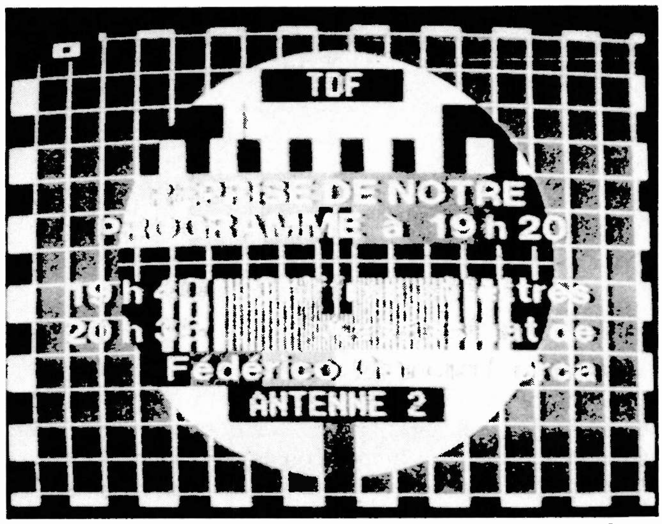
Fig 1: Block diagram of a high-gain low-noise amplifier for satellite reception in the 4GHz band.

amplifier. The gallium-arsenide f.e.t. seems to have revolutionised LNA manufacture, making it possible to achieve a noise figure of under 2dB at 4GHz with a gain of 25dB. The Hewlett Packard HFET-2201 has noise figures of 1·2dB, 2·4dB and 3·1dB at 4, 10 and 14GHz respectively. These devices are expensive, currently around $300 for one off. Higher noise devices such as the HFET-1102 (1·7dB at 4GHz) sell for correspondingly less – $150. Delivery is slow, due in part to the small quantity production, with each device being individually selected and processed. The LNA is mounted at the r.f. extraction head, with the signals fed to the main receiver via low-loss coaxial cable which can be up to an inch thick. The receiver itself may be a single-channel type, a 12- or 24-channel type, or tunable over the 500MHz bandwidth. The prices are high – up to $4,000 for a single-channel unit, up to $7,500 for a multi-channel type. The output from this is remodulated and fed to the cable distribution system.

There is increasing interest in the US amongst private operators thinking of setting up their own backyard terminals and hooking up to the programmes now available via satellite. If this develops, we may see manufacturers producing smaller dishes – 10ft. and below, possibly using fibreglass in view of the increasing cost of aluminium.

In practice terminals are constructed for use with alternative satellites, calling for a high degree of mechanical engineering precision to obtain both accuracy of aerial aim and rigidity during service. Some operators prefer to employ separate aerials for different satellites.

That very simply is a summary of the present state of satellite TV in the USA. No direct transmissions to domestic installations are planned at present, though one manufacturer has been awarded a contract to undertake research into and develop a low-cost 12GHz "domestic quality" terminal using a small, say 3ft., dish.



An impressive shot of the TDF A2 test card received by Steve Birkhill at 12GHz from the OTS-2 satellite.

The N. American satellites unfortunately can't be received in W. Europe – even if any reasonably priced 4GHz equipment was available (if anyone knows of a source, let me know!). There are other satellites operating in this band however, such as the Intelsat series. If you're thinking of trying to construct a terminal, you'd be well advised to check with the Home Office at Waterloo Bridge House, London – such activities are likely to be restricted to an experimental basis only.

My thanks to Bob Cooper for his help with information and illustrations.

Service Notebook

George Wilding

Poor Picture

A GEC hybrid colour set was brought to us with the complaint "poor picture with white lines". The white lines were field flyback lines, which were being emphasised because the brightness control couldn't reduce the d.c. level of the picture sufficiently. We also noticed that the focus was well away from optimum, while the line scan was short by about three-quarters of an inch at the right-hand side of the screen. The owner commented that the picture took a long time to reach this size.

Since the width deficiency was at the right-hand side, the first main suspect was naturally the PL509 line output valve. A replacement brought no improvement however, but on changing the PY500 efficiency diode the warm-up time returned to normal, the raster gap disappeared, and the tube had a much healthier appearance – doubtless due to the increased e.h.t. Readjusting the first anode presets enabled the brightness control to be adjusted to give the correct black level, removing the flyback lines, while adjusting the focus control removed the final defect and gave a very good picture.

More on EW Tinting

In the March issue I mentioned EW tinting on a Pye hybrid colour receiver, with the trouble vanishing when the first anode switches were turned off and on again one at a time. This brought a very interesting letter from Bill Thorpe of Southampton, who has come across the trouble on several occasions. The first time, Bill found that on the following day the trouble had returned. After making some inconclusive tests, he decided to try some resistance measurements. On making comparative tests from the anodes of the colour-difference output pentodes to chassis, he found that although readings were obtained from the R – Y and G – Y valves there was no reading from the B – Y valve, due it turned out to its 12kΩ anode load resistor being open-circuit – though surprisingly he was able to obtain a voltage reading at pin 6 (anode) of the valve. Possibly current was getting across the break in the resistor. Anyway, replacing the resistor completely cured the trouble – on this and later occasions. Bill comments that it's been the B – Y stage every time.

Lack of Width with Field Bounce

The width on a Bush colour set fitted with the A823 chassis was in slightly at the right-hand side of the screen, while a few minutes after switching on the raster would bounce up and down erratically by about a quarter of an inch. Now field judder due to a defect in the power supply (the thyristor or, less often, the trigger diac) is quite common on these sets, but this intermittent and pronounced bounce was quite different. Correct h.t. voltage is vital to the operation of a transistor line output stage of course, so our first move was to measure this. There was only about 187V at the h.t. fuse 8F3, so we advanced the set e.h.t. control 8RV1 to obtain just under 200V. This might seem a little on the low side to some, but we find that the h.t. voltage often tends to creep up as the set gets really warm: adjusting it slightly on the low side to start off with reduces the risk of trouble in the line output stage. Anyway, this gave us correct width and also completely cured the field bounce. After readjusting the focus control and the static convergence magnets, a really good picture was obtained – it never fails to amaze the professional service engineer how viewers accept the performance of a set that's gradually drifted away from its original standard.

Intermittent Purple Picture

A hybrid ITT colour receiver fitted with the CVC8 chassis gave a good picture which went purple intermittently for brief periods, i.e. there was intermittent loss of green. On arriving at the owner's house, we found that a monochrome set was being temporarily used as a replacement. Even without an aerial, the colour set gave a surprisingly good picture, but on plugging the aerial in the picture, raster and sound completely vanished. Oh dear! On top of the green trouble, we'd apparently given ourselves another fault simply by plugging in the aerial.

Off came the back, and all fuses were found to be intact. Bearing in mind the importance of the stabilising zener D11, which stabilises the tuning voltage supply as well as providing the reference voltage for the l.t. supply series regulator circuit, we first checked the voltage across it. This turned out to be only 11V, while the diode's metal casing was quite hot. It was clearly defective, and a good picture with normal sound was obtained on fitting a replacement. The raster had gone due to the lack of drive to the RGB output circuit incidentally, leaving the c.r.t.'s cathodes at h.t. The fault occurred during the freak cold weather this winter, and we assume that the failure of the diode so soon after switching the set on, coincidentally with plugging the aerial in, must have been as much due to a sudden thermal change as to an electrical breakdown.

Within minutes, the intermittent total loss of green developed, and we found that the fault could usually be cured or instigated by panel tapping. All the soldering in the green channel appeared to be perfect, so as the RGB output transistors are BD115s, which have given us trouble in the past, we tended to suspect the green one (T26). A simpler course to start with however was to try a new TDA1327A colour demodulator i.c., since on this particular chassis it's a plug-in arrangement – changing a video output transistor on its heatsink can be time consuming. Unfortunately however the fault persisted.

The RGB channels are extremely simple, consisting of a pnp emitter-follower driving the output transistor, with d.c. coupling throughout. We decided to see whether we could pin-point the fault by finding out which voltages altered when the green was not present. It didn't take long to establish that the output transistor's base voltage disappeared, though the correct voltage was still present at the emitter of the driver transistor, clearly pointing to intermittency in the 180Ω series resistor R177. The resistor is secured to a pair of short mounting pillars and, due to their close positioning, the leadout wires have to be bent at right angles almost at the ends of the casing. This had evidently put some internal mechanical strain where one of the leadout wires joined the resistive composition, with the result that light tapping caused this apparently – perfect resistor to go open-circuit intermittently. Anyway, a new resistor cured the trouble, and after readjusting the focus control and the first anode presets a perfect picture was obtained.

Teletext Decoder Update

Adding colour and other options to the Television teletext decoder

Part 2

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

LAST month we saw how the colour control commands are decoded, and how the corresponding luminance signal is generated. In order to produce colour on the screen however we also have to create a pair of colour subcarrier signals which, when added to the luminance component, will produce a PAL compatible video signal.

The chrominance subcarriers are derived from a pair of chrominance signals representing R–Y and B–Y respectively. We shall start by examining the B–Y signal, since it's much easier to generate than R–Y.

The B–Y Signal

Some simple arithmetic with the equation for Y shows that the B–Y signal is made up from the following mixture of R, G and B components:

$$B-Y = 0.886B - 0.299R - 0.587G.$$

This can readily be generated, in much the same way as the luminance, by adding together appropriate proportions of the R, G and B logic signals in a resistor network (R19-21, see Fig. 1 last month). To cope with the minus signs, the logic signals for R and G are inverted. Thus if all three logic signals are at 1, corresponding to white, the R and G components together will cancel out the B component, giving a B–Y signal of zero.

At the start of every line of the signal a reference colour burst must be inserted. This burst, which occurs just after the trailing edge of the line sync pulse and lasts for about 2.25μsec, is used to synchronise the colour demodulator circuits in the receiver.

The burst pulse is produced by a monostable (IC17) which is triggered from the trailing edge of the line sync pulses. The B–Y burst pulse amplitude is adjusted to –0.5B by using the negative-going pulse from the monostable, feeding it to the matrix via R22. Adding the burst signal causes a bias at the B–Y output, so a further resistor (R23) to chassis is included in the matrix to compensate for this bias component.

At the output of the matrix, the B–Y signal swings positively and negatively about a mean level of some +2.5V. The positive swings produce a blue display whilst the negative swings produce the complementary yellow colour. Note that if B is off whilst R and G are both on, the result will be yellow. B combined with either R or G gives a lower level blue output, as required for magenta or cyan displays.

PAL Switching

An extra complication arises when we start to consider the R–Y signal. In the PAL system, the phase of the R–Y component of the colour subcarrier signal is reversed on alternate lines in order to reduce colour errors due to phase shifts during transmission.

To achieve this phase reversal requirement, we need a control signal which switches state on alternate lines. This is obtained by using a 7474 D-type flip-flop (IC9) as a divide-by-two counter, driven from the line sync pulses.

Originally this divide-by-two counter was driven from the combined sync signal that comes into the options board. It was found however that although the divide-by-two circuit appeared to be running correctly the resultant signal would not unlock the colour-killer circuit in many receivers. As a result, there was erratic colour or no colour at all. The effect was apparently due to the divide-by-two circuit responding to the half-line period pulses in the field sync interval, and was solved by using a monostable to effectively filter out these half-line period pulses. The monostable IC16 has a time period of roughly 0.75 of a line scan period, and once triggered it will not respond to any pulses occurring during this time. The output from this monostable provides the clock drive for the divide-by-two circuit, which then produces the PAL phase switching control signal.

The R–Y Signal

Like the B–Y signal, the R–Y signal can be built up from R, G and B components which in this case come out as:

$$R-Y = 0.701R - 0.587G - 0.114B.$$

Once again a resistor network (R16-18) is used to produce the required proportions of the three input logic signals, but here the phase of the three signals must be reversed on alternate lines.

This phase switching is carried out by means of exclusive-or type gates (IC18). In a two-input gate of this type, when one input is held at 0 the signals at the other input simply pass through to the output. If one input is at 1 however the signals from the other input still pass to the output but this time they are inverted. By applying the PAL switching signal to one of the inputs of each exclusive-or gate and the colour drive signal to its other input, the required phase switched output signals can be produced for application to the resistor matrix.

The R signal gate is controlled by the $\bar{Q}$ output of the divide-by-two stage, whilst the B and G gates are fed from its Q output. They always have the opposite phase to the R component therefore, as required by the R–Y equation.

A phase-switched burst pulse in the same phase as R is produced in a further exclusive-or gate and added to the matrix. To compensate for the bias effect produced by the burst pulse, a component from the Q output of the divide-by-two counter must also be applied to the R–Y matrix. This is fed in via R14.

The R–Y matrix produces a signal at a mean level of about +2.5V. In this case positive-going signals produce red on the screen whilst the negative swings produce green. The proportions of R, G and B have in fact been modified from the correct values to give a higher R drive and smaller B drive. This gives improved saturation of the red parts of the display.

When combined with the B–Y burst, the R–Y burst signal produces a resultant burst signal which swings ±45° about the −B phase on alternate lines.

Subcarrier Generation

Having generated the B−Y and R−Y signals, we must use these to modulate a 4.43MHz colour subcarrier. What we require is a double-sideband suppressed-carrier chrominance signal. This involves the use of a 4.43MHz oscillator and a pair of double balanced modulator circuits.

We've used the National Semiconductors LM1889 i.c. (IC19) to perform this operation. This integrated circuit was originally made for use with TV games providing colour displays, and is designed to produce colour signals to the American NTSC standard. It contains a subcarrier oscillator intended to operate at the 3.83MHz NTSC subcarrier frequency, but it was found to work quite happily at the PAL 4.43MHz subcarrier frequency. There are two double balanced modulators for the R−Y and B−Y signals, and these are also suitable for use with PAL signals. In addition the device has a pair of v.h.f. oscillators and modulators for generating Band I signals, but these are not required for our application.

The oscillator is designed to generate two subcarrier signals which are phased 90° relative to one another. This is achieved by using two external *RC* phase-shift circuits, one producing a 45° lead and the other a 45° lag. The oscillator frequency is primarily controlled by the 4.43MHz external crystal XL1, whilst a trimmer capacitor (C11) is used for fine tuning and to adjust the phase of the feedback network to ensure proper oscillation.

The inputs to the two balanced modulators are fed in at pins 2 and 4, whilst a common reference bias voltage is fed to both modulators via pin 3. The subcarrier inputs to the two modulators are connected internally.

With a supply of +12V the modulator reference input should ideally be set at +6V, but for convenience we have used the +5V logic supply rail as a reference supply.

The R−Y and B−Y drive signals must now be arranged so that they swing positively and negatively about a nominal +5V level. Since the matrix outputs are at around +2.5V, a d.c. voltage shift is required. This is provided by feeding each signal through an emitter-follower (Tr2 and Tr3) and then tapping the drives for the LM1889 down the emitter load resistors. To allow the bias levels of the R−Y and B−Y signals to be adjusted for proper colour output, a preset potentiometer has been fitted in each emitter load (VR2, VR3).

A subcarrier output signal is produced at pin 12 of the LM1889. This pin is also one of the inputs to the v.h.f. modulator, whose other input goes to pin 13. To balance the internal circuits of the LM1889, pins 12 and 13 have been connected together. The chrominance signal from pin 12 is fed through an emitter-follower buffer stage (Tr4) and is then coupled via a small capacitor (C12) to the luminance signal output line where it's combined with the luminance and sync signals to form the composite video output signal.

Flashing Symbols

Symbols can be made to flash an and off if a flash control command is received. This effect is sometimes used to highlight a particular item on the page. A typical use can be seen on the Ceefax page 190, where an index of news pages is shown. Here the page number of the latest item to have been added to the magazine is flashed on and off. To restore the display to a steady state, a steady command may be sent. The following symbols in the row will then be displayed normally again.

The flash and steady codes each produce a pulse at the 0 output of the 7442 decoder chip IC6. This signal is used as a clock pulse for a D-type flip-flop (lower IC8) which controls the flash operation. The D input of this flip-flop is fed from the delayed bit 1 signal to avoid timing problems at the start of the row of text.

When a flash command is received, the flash control flip-flop will be reset, since bit 1 is at 0, and its $\overline{Q}$ output will go to the 1 state. This output is used to open a 7400 gate (IC1, pin 9). The flashing rate of the symbols is set by a free-running oscillator, using the 555 timer device IC14. The rate is set at about one cycle per second. The signal from this oscillator is also fed to the 7400 gate (pin 10). Thus when flash is selected the output from the gate will switch at about one hertz. The output from this gate passes through a 7408 AND gate where it's combined with the reveal control signal, and then goes on to another 7408 gate where it switches the dot video input signal to the colour gate.

Thus when flash is selected the dot video signals will switch on and off at about one hertz, producing flashing symbols on the screen. The background colour is not affected by the flash pulses, and when a symbol is blanked by the flash signal its space will be displayed in the background colour.

When a steady command is received, the flash control flip-flop will preset. Its output will go to 0, closing the 7400 gate and forcing its output to a steady 1 state. This in turn allows the dot video signal to pass through unaffected and give normal display symbols. Only those synbols which are supposed to flash during a text row will be blanked by the one hertz flash clock signal.

At the start of each row of text it's automatically assumed that the display will be in the normal steady state. To ensure this condition, the line sync pulse presets the flash control flip-flop to its steady state at the start of each scan line.

Reveal-Conceal

When a conceal command is detected it will cause the 4 output line of the 7442 (pin 5) to produce a pulse. This in turn clocks the conceal control flip-flop IC9. The D input of this flip-flop is driven by a delayed bit 1 signal, and as a result the flip-flop goes to its reset, or conceal state, when bit 1 is at 0.

The output signal from the conceal flip-flop passes first through a 7408 gate, where it's combined with the flash blanking signal, and then on to a second 7408 gate where it controls the dot video signal which produces the displayed symbols. Those symbols following the conceal code will now be blanked out on the display.

Although part of the display on the screen may be concealed, the data for the blanked out symbols will still be retained in the page memory. In order to display concealed parts of the display therefore all we have to do is to override the conceal control flip-flop by forcing it into its normal reveal state. This can be done by means of a viewer operated switch on the front panel of the decoder. This switch is used to hold the reveal input line to the options card at 0V, which in turn forces the preset input of the conceal flip-flop low, causing the flip-flop to return to its reveal state. The dot video gate will now be released, allowing the symbols that were blanked out to appear on the screen.

It will be seen from the code table (Table 1 last month) that a contiguous graphics command will also produce a pulse at the 4 output of the 7442, and will therefore also clock the conceal flip-flop. In fact it will produce the same effect as a reveal command. In practice it's unlikely that this command code will occur within a concealed portion of the display, since in most cases the concealed symbols are text, while the contiguous graphics code is rarely used anyway. This condition could have been avoided by using a more complex decoding scheme for conceal commands. It was felt however that the simplified decoding scheme used would be acceptable, though on a few rare occasions incorrect operation of conceal may occur.

It will be seen that there is in fact no separate code for reveal, though clearly it's desirable that only a part of a display row may be concealed. Careful study of the teletext specification shows that an alternative scheme has been provided for restoring the revealed display after a conceal command has been received in a text row. This is achieved by using any of the colour change commands to reset the conceal state. In our decoder this is implemented simply by routing the colour change clock pulse to the preset input of the conceal control flip-flop. Thus any colour code for alpha or graphics will restore the dispaly to the normal revealed state.

At the start of each text row the display is assumed to be in the revealed state. To ensure this, the line sync is coupled to the preset input of the conceal control flip-flop, forcing it to the reveal state at the start of each line.

The reveal switch on the front panel of the unit can be either a toggle type or a simple push-button according to the preference of the individual constructor. A push-button switch has some attraction here since it ensures that the concealed parts of the page will normally be blanked out until the viewer presses the reveal button to take a look at the answers to the quiz or whatever else may have been concealed on the page.

Correction

R21 in the B–Y matrix circuit should have been shown as 12kΩ instead of 15kΩ in the circuit diagram (Fig. 1) shown in Part 1 last month.

The Grundig SVR VCR System

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

THE Grundig Super Video SVR4004GB is the latest in a long line of Philips' format based VCRs designed for sale to domestic users. Although the mechanics are designed around the Philips cassette with its concentric reels, this VCR will operate only with the special Grundig standard SVC (Super Video Cassette). The crafty inclusion in the VCR of an extra microswitch which engages in a lug in the plastic cassette housing ensures this. Grundig say that this is done because only specially well machined and assembled cassettes will give the consistently high standard of reproduction claimed for the machine. Rumours have it however that any recently produced Philips type cassette will work in the machine if the microswitch is, um, fixed. Note however that the specification of the oxide coat on the tape in the SVC cassette is considerably higher than that of the standard Philips type.

The SVR uses the two-head, slant azimuth, helical-scan recording/playback system which has become standard for domestic VCRs. In this system there's no guard band between adjacent tracks. Instead, the slant azimuth mounting of the heads is relied upon, the resultant recorded signals on adjacent tracks being out-of-phase with one another. This gives an acceptable level of cross-talk between tracks.

The tape speed is 3·95cm/sec, giving a recording time of four hours. This compares with a speed of 14·29cm/sec for the original Philips' one-hour format. Grundig had hoped to introduce a five-hour tape during 1979, but plans for this seem to have been delayed. The present SVR gives the longest playing time of any domestic VCR, but this is likely to be overtaken by the four hours per side Philips V2000 machine before too long. It's certainly a fast moving field! Trying to find an SVR4004 – or an ITT 240 (same machine, different sticky label) – to review turned out to be rather tricky – Grundig said there were only about 70 of them in the UK at the time.

When one eventually arrived in our workshop it turned out to be quite an attractive machine. Though it has few features which can be said to be truly unique, it gives a general impression of being well built, somewhat up-market from the Philips N1700. For a start, all the tape transport controls are solenoid operated, from a series of touch-buttons on the front panel or an optional remote control unit

The TV tuning section is very neat, incorporating a self-seeking unit and covering the v.h.f. Bands I and III as well as the u.h.f. Bands IV and V. The circuitry used is similar to that employed in some of the more expensive Barco colour television receivers, and an eight-channel preselector and l.e.d. display of the selected channel are incorporated.

As is standard practice on domestic VCRs, the machine incorporates a digital clock to enable unattended recordings to be made. The main advantage of the Grundig system over its rivals is that a delay of up to ten days can be selected between setting the machine and the recording taking place.

A picture crispener circuit is incorporated. This effectively enhances the horizontal definition on playback. An unusual feature is the large customer control, on the top, to adjust the degree of crispening (do some people really prefer a softer picture?).

A few neat features include the use of the front panel meter to display the approximate frequency of the selected TV channel, and also to give an indication of the tracking error in the playback mode. Tracking is a measure of how closely the alignment of the video heads with the video tracks corresponds to that during the recording process: the better the match, the better the picture. As previously mentioned, the SVC cassette incorporates an extra lug to activate a microswitch – a small l.e.d. on the front panel indicates whether you are trying to put a non-SVC cassette into the VCR! Another l.e.d. flashes on and off if the cassette breaks or becomes jammed.

The most common version of the VCR is the SVR4004GB. For about £30 more however you can buy the SVR4004GB-AV, which incorporates colour video in and out facilities as well as audio in and out. The basic machine has a microphone input socket only. Both versions have u.h.f. in and out sockets. The specifications of the three VCR formats based on the Philips cassette are compared in Table 1.

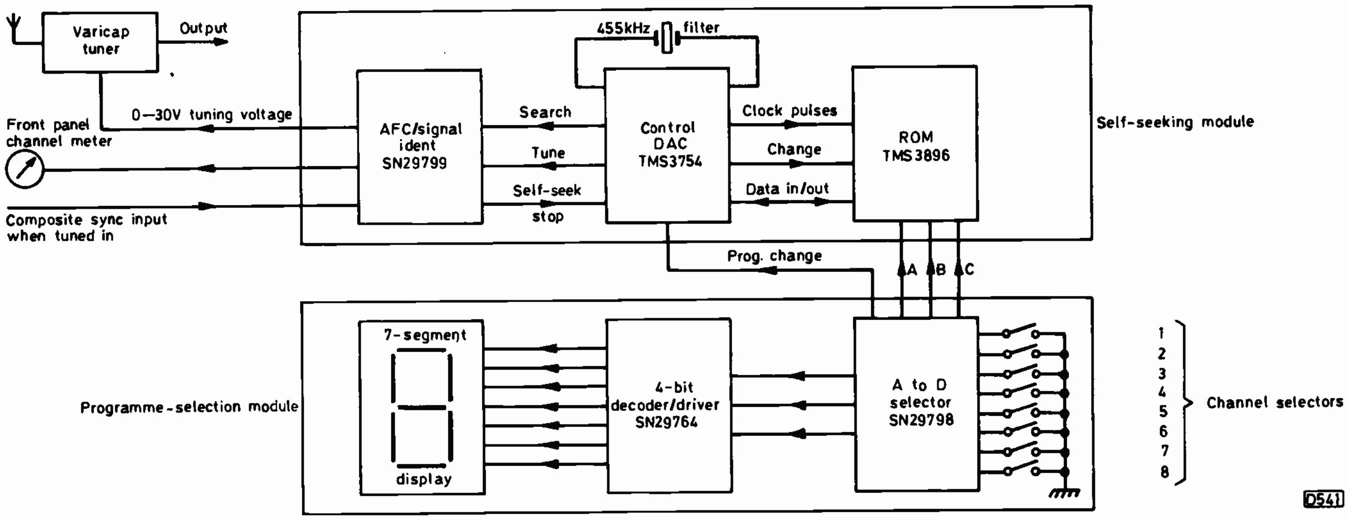


Fig. 1: Block diagram of the tuning arrangements used in the Grundig SVR4004 videocassette recorder. There are three basic modules, the tuner itself, the programme-selection module and the self-seeking tuning section.

Grundig have gone to considerable lengths to ensure that the Philips' format cassette is treated as gently as possible. In addition to the solenoid-operated controls and logic circuitry interlocks, there are various tape speed and tension sensors to protect the tape and the machine. Five separate motors drive the rewind, fast forward, play, cassette lace-up and head-disc functions.

Following this general outline of the VCR, we'll take a more detailed look at some of the specifications and the circuitry used.

The video heads are made of a glass impregnated ferrite material, which should be very resistant to wear but unfortunately has the property of being rather brittle. Video heads have never been the most robust of items however!

The use of side-by-side, out-of-phase video tracks improves the information packing density and thus tape costs, but the penalty is some increase in the luminance and chrominance signal cross talk. By tilting one video head 15° with respect to the other the luminance cross talk is reduced to an acceptable level, but this procedure is not sufficient to produce acceptable chrominance signals. To overcome this problem, alternate pairs of lines of chroma information from alternate fields are inverted and, on playback, compared in a comb filter. This results in cancellation of errors due to cross talk, giving an acceptable picture. As usual, the chroma information is recorded on the tape using a "colour under" system – the chroma carrier frequency is 562·5kHz.

Upon taking the lid off the machine, one is greeted by a very tidy layout. Most of the active components are mounted on plug-in boards which are attached to a mother board. Unlike the Philips N1700 however, which uses the modular and mother board system, the Grundig units are not enclosed in small metal boxes and are not intended as non-repairable items. Indeed Grundig produce three adaptor cards which plug into the mother board and into which the module under test can be plugged. Not only do these adaptors allow the module to be removed from the depths of the VCR to be worked on, they also allow currents to be measured without the need to desolder components etc. Incidentally the set of adaptors fits not only the SVR4004 but also the older BK3000, VCR3500, and VCR4000.

Table 1 : VCR system specifications

System	VCR	LVC	SVR
Tape speed (cm/sec)	14·29	6·56	3·95
Writing speed (m/sec)*	8·1	8·1	8·2
Video track width (μm)	130	85	51
Guard track width (μm)	57	none	none
Video head inclination	0°	±15°	±15°
Maximum playing time (minutes) with VC60	60	130	220
Maximum playing time (minutes)	80 (VC80)	180 (LVC180)	300 (SVR5)

*The writing speed takes into account both the linear tape speed and the rotation of the video heads.

Function Control Module

Although it might seem logical to start an examination of the circuitry at the tuner unit, I will instead look first at the function control module. This is the heart of the VCR, and is analogous to the Syscon module found in the Sony U-matic and Betamax VCRs. It accepts signals from the tape transport selectors (fast forward, rewind, etc.) as well as from the tape sensors, time clock, threading motor and microswitches which check the cassette compartment and cassette identification. The motor speeds are also checked by the Syscon module. A single 28-pin i.c. correlates this information, and will allow only permissible options to be performed. Checks are made to ensure that nothing goes wrong during operation – i.e. if the tape breaks during rewind, the signals from the rewind motor will alter and the function control module will stop the tape transport system and unthread the cassette. The beginning and end of the cassette are marked by conductive metal foil strips.

A neat touch is that when an unattended recording comes to the end the tape rewinds to the beginning and then stops, leaving the programme ready to watch.

Tuning System

When we turn to the tuner, the care which Grundig have lavished on this VCR again becomes rapidly apparent. The tuning arrangement consists of three modules: the varicap tuner itself, the programme-selection module, and the self-seeking unit. The assembly covers all the u.h.f. and v.h.f. bands used in Europe, on 625 lines only. The varicap tuner is quite conventional and needs no further explanation. The programme-selection and self-seeking modules are of more interest, as they rely extensively on digital integrated circuits. These i.c.s have been custom made for Grundig by

Texas Instruments, and two of them are closely related to microprocessor i.c.s. Fig. 1 shows in block diagram form the functional relationships of the component parts of the tuning assembly.

The programme-selector unit houses eight channel-selector buttons, an encoding i.c., and the seven-segment display and decoder/driver i.c. to indicate the selected channel. The output of the SN29798 encoding i.c. is fed to the TMS3896 programme memory i.c. in the self-seeking module. This is a microprocessor family i.c., and is of the ROM type (Read Only Memory). This i.c. stores in its memory the coded information corresponding to the eight selected channels and enables this to be recalled at any time when the appropriate channel selection button is operated. The main i.c. on this panel is the TMS3754, which controls both the programme memory and the automatic frequency control i.c. The TMS3754 operates as a type of digital-to-analogue convertor, taking from the ROM i.c. the coded pulses corresponding to say BBC-1 and converting them into a control voltage for the varicap tuner unit. Thus the ROM can be envisaged as a store of digital codes which correspond to certain tuning voltages. There are also facilities for manually adjusting the fine tuning of the picture.

The self-seeking unit scans the wavebands by producing a slowly increasing voltage which is fed to the varicap tuner. When an active TV channel is located, the sync pulses are detected and used to stop the scanning system. If the user wishes to retain this channel, he simply presses the store button and the digital code for that channel will be stored. The self-seeking board also provides an output to drive the front panel frequency meter, which gives an approximate indication of the channel selected.

All in all a very sophisticated tuning system – and one that calls for a good read of the instruction book before you try to use it! Incidentally, the channel frequency information stays stored in the memory i.c. even when the power is switched off.

Other Modules

The i.f. module has a single transistor plus two i.c.s. It's interesting to see that the various i.f. coils are etched on to the board, again showing the manufacturer's thoughts concerning ease of maintenance and factory setting up. I.C.s are also used in the sound module, which resembles that found in audio tape recorders and is quite conventional.

The other circuits, including the servo, u.h.f. modulator and audio/visual in/out board (found only in the AV version) are all straightforward and neatly designed.

Performance

Some of the test results obtained from the machine are interesting, especially when you consider the very slow tape speed. The audio response was measured as 85Hz-8kHz ± 1dB, and to 10kHz ± 4dB. (The audio response of the Philips N1700 is 100Hz-10kHz ± 8dB.) The resolution was quite acceptable – the 2·5MHz bars on the test card were clearly resolved. With a pulse and bar test, the uppermost limit was found to be around 3·5MHz.

To sum up, a very well designed machine making the best of the concentric reel design of the Philips cassette. Grundig have obviously put a lot of thought and money into its design and production, but with new VCR formats springing up almost every month one can only wonder whether the SVR has any chance of lasting success. ■

TV Servicing: Beginners Start Here . . .

Part 22

S. Simon

WE'VE spent some time discussing the various sections of a TV receiver and what goes wrong with them, mentioning expected meter readings and even the effect of the meter upon some circuits. It's been pointed out to us however that many readers are in some doubt as to the basic use of a voltmeter, ammeter or ohmmeter. Now long drawn out explanations can be pretty dreary reading, so we'll liven things up a bit by taking some actual practical examples of the use of a multimeter (one which performs most of the required functions), with the "hows" and "whys" included so as not to leave anyone out.

Let's assume first that you don't have a meter and are about to purchase one. What do you want?

Voltage and Current Ranges

The first basic requirement is that you need to be able to measure voltages from zero up to say 1,000V with a fair degree of accuracy. Bearing in mind the low voltages involved in transistor and integrated circuit operation, it's essential to be able to read these low voltages accurately and without too much eye strain. This is where the digital meter scores, as the read out shows the actual figures and only these, the size of the read out not being too important. Most will choose the traditional needle and scale type however, as these have certain advantages which may not be immediately obvious. Here the size of the scale and the ease with which it can be read are most important – it's of little advantage to have good accuracy if the measurement cannot be read accurately. Thus on the lowest scale the needle should deflect from zero to say 2·5V or 3V, showing each division between clearly, so that the difference between say 0·5V and 0·7V can be read without difficulty.

This requirement rules out the choice of a pocket meter of the lowest price. In addition, such a meter would have a pretty low sensitivity, which means that a lot of current is required to move the pointer. Since this current is drawn from the circuit to be tested, this disadvantage is too obvious to require comment – the current taken distorts the circuit's operation.

So the main voltage requirements are accuracy, nicely spread (easily read) scales, and low loading on the circuits to be tested. This latter requirement dictates a "goodness or sensitivity" factor of not less than 20kΩ/V, and the specification of the meter will state whether this requirement is met.

As well as the low voltage range already mentioned, full scale readings of say 10V, 25V, 100V, 250V and 1,000V are necessary, at least on the d.c. ranges. The a.c. ranges are less essential, but we will again need to be able to read up to 250V.

It's also essential to know how much current is passing through a particular circuit. For example, we've already seen that simply removing a fuse and connecting a meter in its place will record the current being drawn by the circuit protected by that fuse. Thus when the meter is switched to the current ranges (amps, milliamps, microamps) it should be capable of recording the amount of current expected. If a meter is designed to pass only 500 mA say, it can't be used to measure for example the total current (l.t.) taken by a mains-battery portable TV set – the l.t. current (not the mains) could in this case well be some 1·5A. So one has also to look at this aspect or limitation of the proposed "best friend" of the service engineer.

Resistance Measurements

The other prime requirement is a good ohms range, since we may need to know the resistance of various items varying from say 0·5Ω to several million ohms. We need at least three ohms ranges therefore to stand a dog's chance of getting an accurate reading, not forgetting that the high resistance ranges can also be used for a rough check on capacitors, recording their ability to charge up from the ohmmeter's internal battery. The low resistance range will also enable one to check loudspeakers. When the meter is applied to the loudspeaker's tags, a click should be heard if the coil is intact, the meter then indicating for all practical purposes the impedance of the coil – say 3Ω, 8Ω or 15Ω – thus confirming or not its suitability for use in the circuit if the speaker is unmarked.

Earlier in the series we outlined the checks that could be made on transistors and diodes with the ohmmeter. Couple this with continuity checks on printed panels, leads and fuses etc. and one sees the importance of the ohmmeter, matched only by the voltmeter. The ability to measure current is secondary, since current consumption can be gauged by the voltmeter when it's applied across a resistor of known value (voltage divided by the resistance gives the current flowing, as you already know of course from Ohm's Law).

Meter Protection

There are several other factors to bear in mind. Among the most important is provision against overloads, which can occur due to incorrect connection of the meter or wrong range selection. Such things happen far more often than they should, to even the most careful. Whilst a fuse may be fitted there's an inevitable delay before this fails, and during this time the meter movement may be damaged. A fast-acting cutout is a most desirable feature therefore.

Add all these features together, and the choice of the cheapest meter must be the wrong one.

Getting Used to the Meter

Having obtained a meter and fitted the batteries necessary to operate the ohms ranges, check these ranges to ensure that the pointer deflects fully when the test prods are touched together. Do this on each ohms range, so that the control provided (perhaps one for each range) can be set to indicate zero. Failure to obtain a full deflection (zero ohms) probably means that the batteries supplied are less than fresh.

Having happily zeroed the ohms ranges, one can sort out a few resistors of various values (known) in order to get used to the scale readings, and then go on to check transistors and diodes to see the different readings obtained by reversing the leads – remembering the fact that most meters have the positive side of the batteries brought out to the "negative" (black) terminal. This means that the "negative" prod will have to be applied to the anode (unmarked) of a diode in order to cause it to conduct, with the "positive" (red) prod applied to the cathode (marked).

Similarly, if one wishes to check an electrolytic capacitor it's the black probe that should be applied to the capacitor's positive terminal in order to polarise it correctly. When this is done and the highest resistance range is selected, the pointer will move over as the capacitor charges, and then settle back to a high reading. The deflection will depend upon the value of the capacitor. The capacitor will remain charged for a short time, and this charge can be read if the meter leads are removed, the meter switched to a low voltage range, and the leads are again applied but reversed (positive to positive this time).

Try these things to find out, but do start by making sure that the test capacitor is not still holding a charge from its last employment (if any). Do this by shorting the capacitor's positive and negative terminals together with a lead or a screwdriver blade – or, if the capacitor is known to have been recently connected in a fairly high-voltage circuit, use a low-value resistor to short the terminals (in order to limit the current flow – otherwise you could take up welding as a hobby).

You can of course check your own resistance with the meter switched to the high ohms range, holding one prod in each hand. You will probably record some 50kΩ if your skin isn't too thick, which explains why you can often check a transistor with the meter applied to its collector and emitter and your finger applied between the collector and base – provided you get the polarity right for the type of transistor, as outlined in more detail in a previous article.

Trying the Voltage Ranges

To get used to the voltage ranges, check any spare batteries which may be around. A one-cell type such as an SP2 (HP11 or HP7 for example) should record 1·5V according to its condition, and for this we would switch to the d.c. voltage 2·5V or 3V range in order to get something like a mid-scale reading. A battery such as a PP9 should record 9V approximately on the 10V or higher range, and the rule is to select the highest voltage range before applying the test prods if there is any doubt at all about the voltage likely to be present. If no satisfactory reading can be obtained from a known good source, the meter is probably switched to a.c. instead of d.c.

Checking the Mains Input Circuit

Having got used to the behaviour of the meter, we can now employ it to trace faults on a TV receiver.

The normal household has a single-phase supply consisting of a live and a neutral cable with a difference of 240V between them (r.m.s. value, since it's constantly rising and falling at 50Hz). There's also a connection to true earth made on the premises, and all appliances with an exposed metal surface must be bonded to this. The average TV receiver is adequately covered by plastic or wood, and does not have an earth connection.

When part of the cover is removed to expose the receiver's working parts, it must first be established that the main frame metalwork is not live. This may sound "old hat" to most of you, but we have to put safety first and cater for all. If the supply cable is connected to the supply source via a three-pin plug which is fused, the brown lead (old red) must be connected to the fused pin, which should be the live connection if the household wiring has been properly carried out. There's no guarantee that it has. In addition, all too often the supply plug is of the two-contact type, which is reversible.

There's always the possibility therefore that the metal parts of the chassis may be connected to the live side of the mains supply, or that the receiver is designed so that the "chassis" is always live with respect to true earth. It must be treated accordingly, and nothing which has an earth connection (this includes the aerial plug) must be allowed to make direct contact with it.

Your best friend is a neon screwdriver which is known to be working. It should glow clearly when applied to the live mains. If it also glows when applied to the receiver's chassis, either the mains connection is wrong (join in the lead?), the on/off switch is defective, or there is some other reason why the neutral return is not being made (break in the lead?) – or perhaps the receiver is of recent design, with a floating chassis due to the use of a bridge rectifier connected direct to the mains.

If a receiver shows no signs of life when plugged into the mains, it must not be assumed that the set is not live at some point or points. Indeed it must be assumed that the set *is* live until proved otherwise. Having proved that the *chassis* is not live, one then goes on to prove certain other points – the set's input fuse, the on/off switch or, if there's a dropper resistor in a convenient position, the tags of this. If there are still no signs of life, remove the supply plug from the mains and check the continuity of the supply lead with the ohmmeter.

Now let's go over that again, this time using the voltmeter. If the chassis is not live (neon check), clip the common (black) lead of the meter to the chassis (assuming that the set is an average table model, and not a mains/battery portable with an isolating transformer, in which case the only connection to the mains would be through the primary winding of this) and, with the meter set to 250V a.c. or higher, apply the red lead's probe to the set's fuse, the on/off switch's live contacts, or to any other point which should be at full mains potential. If no reading can be obtained, locate the ends (brown and blue usually) of the mains lead and apply the meter to these lead ends. If there's still no reading, remove the mains plug from the supply source and prove the continuity of the leads with the ohmmeter switched to the low ohms range. If the plug fuse is intact, the break is likely to be where the lead is captured under the point of entry to the plug. The fractured lead would have to be the live one (or both), since the neon check would have shown the presence of mains at the receiver if the neutral lead only had been open-circuit.

Defective Switch

The receiver's on/off switch is a suspect item, and can be checked with the ohmmeter if the supply is not connected or with the voltmeter if it is. The on/off switch has four contacts, one pair to break the live mains connection, the other to break the neutral one. It's common to find one pair defective.

Blown Fuse

If the voltmeter or neon shows that the mains input fuse has blown, its condition will often give a clue as to the cause. If the fuse is severely blackened, it's likely that either the mains filter capacitor has shorted, thus making a direct connection between live and neutral, or that the h.t. rectifier diode has suffered a similar fate, the almost direct path from live to neutral in this case being through the surge limiting resistor, the diode and then its reservoir electrolytic capacitor which presents a dead short-circuit to a.c.

If the overload that blew the fuse is "farther in" the set, it would not normally have such a severe effect due to resistive paths. Thus the fuse, although open, would not present such a blackened appearance.

So if the fuse is blackened one would first locate the h.t. rectifier diode and check this with the ohmmeter on the low range. A reading of some 30Ω should be recorded with the prods applied one way, and a much higher reading when they are reversed. A low reading both ways indicates that the diode is shorted, or possibly that the small protection capacitor wired across it is defective – this is far less likely however. If the diode reads all right, find the mains filter capacitor – probably near the fuse or the on/off switch – and suspect this even if the meter shows no direct short when applied across it. If in doubt, unhook it and see if a replacement fuse holds. Do not leave the set working without a filter capacitor, as it has the job of absorbing high peak "spikes" on the mains waveform.

Heaters not Alight

If the mains voltage is known to be present at the fuse etc. but the valves are not heating there are several ways of tackling the problem. We have seen previously that the valve heaters are connected in series in the average type of set likely to be encountered – much like a string of fairy lights. The start of the chain is the mains supply live side, and of course there must be a return to neutral. Adding up the various valve heater voltage ratings will not produce a figure anything like 240V, so the difference must be dropped by something or some things. The something could be a single large wirewound resistor, the value of which can be calculated by dividing the voltage that has to be dropped by the heater current, which is normally 0·3A (300mA).

If for example we need to drop 80V, assuming that the valve heater chain total requirement is say 160V, as it may be if lots of valves are used, the resistor would need to be about 266Ω and its wattage rating would be 0·3A times 80V which is 24W – 30W would be an adequate rating.

This assumes that the heater current is raw a.c. It doesn't have to be. If there are fewer valves, as in most sets (perhaps only four or five), instead of using a very large resistor dissipating a lot of heat we can insert a diode in the chain. This will lop off half the a.c. waveform, providing a rippled d.c. supply. As a result, the voltage to be dropped will be somewhat smaller (not half as may be thought, more like 30%). In such a design there will be a dropper resistor of about 160Ω (in the Thorn 1500 chassis for example it's 148Ω), and a diode of the BY126 variety.

In addition to the dropper resistor there may well be a thermistor to limit the current at switch on, when the valve heaters are cold.

There follows the heater chain itself. The first heater is usually the efficiency diode, say pin 4, with pin 5 leading off to the line output valve and so on through to the tube. The final heater connection may go either direct to chassis or through a network to provide a transistor supply line.

If the heaters do not light up but the supply is present at the supply fuse, the first suspect must be the dropper resistor – if for no better reason than that it's the most convenient point to check on most sets. It's essential of course to establish which section of the mains dropper resistor is used in the heater line – there are likely to be several sections, each performing different functions, and it's easy to be misled.

If there's doubt, start at the valve base of the efficiency diode and establish whether or not there is a high voltage at pin 4 or 5. If not, follow the relevant track or lead back to one of the dropper sections and see what's present at the other end of this section. Full voltage will probably be found here, proving that there's a fracture in this section.

If full voltage is present at both ends, carefully follow the circuit to the first valve heater as it's possible that there is a break in this feed line.

If the full voltage is present at the first heater pin, check at the next pin (4 or 5) to see whether this valve's heater is open-circuit. Then if necessary check through the chain until the point of no reading is obtained. This can be done with a d.c. voltmeter (250V range minimum) if there's a diode in the circuit, or switched to a.c. if there's no diode (GEC 2038 and back for example), or simply with a neon screwdriver.

No HT Supply

Another common symptom is that the set is quite lifeless except for the fact that the heaters are glowing. Here one would switch to 250V d.c. or more, again with the negative probe to chassis, and apply the positive probe to any convenient point which is known to be at h.t. potential when the set is working properly. Examples are the tags of the main electrolytic smoothing block, pin 9 of the PY801 (PY88 etc.), or the cathode of the h.t. rectifier diode.

One has to use a little caution here. It's possible for the diode to be working (a.c. applied to its anode and its cathode at full h.t.), thus charging the reservoir capacitor section of the main electrolytic block, but if the h.t. smoothing resistor (perhaps part of the dropper) is open-circuit there will be lack of h.t. elsewhere. The point about this is that even after the set has been switched off the reservoir capacitor will still be fully charged and will still indicate full h.t. when the meter is applied to it. This means that it has to be discharged before being handled. Since the fault is an open-circuit resistor, one can either bridge the suspect with a wirewound resistor of the correct resistance value and wattage rating, or discharge the capacitor to chassis using any convenient fairly low-value resistor. This is before getting down to fitting the correct replacement (don't leave a defective wirewound bridged as it may remake contact when hot, thus upsetting the operation of the circuit).

On the other hand it's quite likely that no h.t voltage will be found at all. This suggests that the anode of the h.t. rectifier diode is not receiving its a.c. supply, due to the surge limiting resistor becoming open-circuit. This is a very common fault indeed, as the surge limiter leads a very hard life. A typical value for this item is 10Ω – higher in some cases, lower in others. If it's open-circuit, a.c. voltage will be recorded at one end only. Once again this resistor may form part of the mains dropper. If you use a neon tester for this check, you might expect it to glow fully when applied to one end and not glow at all at the other because there's no through circuit. This is not always so however, and in fact the neon may glow at the "dead" end, albeit a subdued glow. This can be misleading to the uninitiated, and serves to demonstrate the more precise results obtained by using a multimeter.

Some other Checks

Whilst most checks are carried out with the negative probe connected to chassis, thus reading positive voltages at various points with respect to chassis and comparing them with those shown on the service sheet, it must be remembered that many receivers have lines which are negative with respect to chassis. In addition, readings obtained in this way may be meaningless or may actually interfere with the correct operation of the circuit. In such cases the voltage drop across a particular resistor may be more relevant, and many circuit diagrams show this sort of reading.

The meter itself can alter the working conditions of a circuit, since it requires current to operate it – more if it is of low sensitivity. This factor can often be used to our advantage. If the voltmeter is connected across a resistor, it forms a parallel resistive path or shunt of value depending on the meter's sensitivity and the range to which it's switched (so many ohms per volt, as specified). As a result, if a resistor is suspected of being "high", application of the test prods across it will often produce a visual effect on the screen of a working set. We get this clue in addition to the voltage reading obtained on the meter. Obviously we're not talking about resistors with a value of a few thousand ohms or less. We're talking in terms of say 1MΩ or more. Such resistors are often used in a.g.c., height and width circuits for example.

In the latter case there may be several resistors with values of well over 1MΩ, and there may be some doubt as to which is the cause of say severe loss of width. Whilst they can be checked "cold" separately, using the ohmmeter switched to the highest resistance range, it's often more convenient to leave the set on and apply the meter (switched to a high voltage range) across each suspect resistor in turn, noting the effect. There will be an effect if the suspect is good, due to the shunting effect of the meter. We would not be looking for small variations however.

Caution is needed here as there will probably be high boost line voltages (say 1kV) present across certain resistors, plus pulse voltages. It's imperative therefore to have the meter on the highest range. In addition the meter should not be left connected in the circuit for long – its presence may result in the line output stage being over driven (excessive width), with consequent risk of breakdown in the line output transformer.

The secrets of nearly all electrical circuits can be unravelled by judicious use of a voltmeter when the equipment is powered and an ohmmeter when it is not.

Colour Pattern Generator

Part 3

Malcolm Burrell

LAST month we described the analogue board and dealt with construction of the logic board. This time a brief note on constructing the analogue board, followed by suggestions for testing and setting up.

Constructing the Analogue Board

The analogue board is also used for the power supply components, except for the mains transformer. First, drill two holes in the heatsink. These serve the dual purpose of clamping the regulator i.c.s down and holding the assembly on the board. Use 6BA or similar nuts and bolts. It's prudent to smear a little heatsink compound on the components before finally tightening them down. If you are working to a tight budget, the heatsink can be omitted and the regulators fixed directly to the case metalwork: it will be necessary to lengthen their leads however, and will make fault-finding more difficult.

Having mounted the power supply components, make temporary connections to the mains transformer and measure the two supply rails to ensure that both 12V and 5V are present and correct – a simple precaution, which could prevent most of the i.c.s being damaged if the 5V rail is too high due to a fault.

Next fit the single wire link to the board, following this with the small components and a couple of sixteen-pin i.c. holders (or Soldercons). Finally fit coil L1 and the modulator. Check that all joints are secure, that there are no shorts, and that the right parts are in the correct places.

Testing and Setting Up

The analogue board is designed to sit on top of the logic board when everything is complete. While testing and setting up however it's probably better to lay them side by side. Tune in a monitor TV set (between channels 35-40) to lock in the pattern.

Although a scope has its uses, a monitor TV set is better for adjusting VR1 and VR2. A very good one would be something like an old Thorn 900 or 950 series dual-standard monochrome chassis (non-flywheel sync version) as this permits the line hold to be slipped, producing a side lock. The edges of the pattern can then be seen at the centre of the screen, on either side of the line blanking pulses. Failing this, try to reduce the scan amplitude so that the extreme edges of the pattern can be examined.

Adjust VR1 so that an equal amount of castellation is visible at each side of the pattern. There is not much doubt about this. Incorrect setting gives either a large, stretched pattern with one side missing or two patterns side by side.

Next slip the field hold to obtain a false lock, or reduce the height. Adjust VR2 for equal amounts of castellation at the top and bottom, without any white parts intruding between the pattern and the blanking pulse. Adjustment of this control moves the entire pattern up or down. Adjustment of neither of these controls is tricky however, and there's just sufficient range to allow for component tolerances.

Having obtained a satisfactory monochrome display, plug the unit into a colour set – with the a.f.c. disabled if fitted. With an insulated trimming tool, rotate C9 until the colour locks in. It's just like adjusting the reference oscillator in a colour set. Attenuate the signal input with say an 18dB attenuator, and trim if necessary for a more critical lock.

The whole unit can then be assembled, and any minor ajustments made after it's warm. There's a hole in the analogue board to gain access to VR1.

The coder is not perfect. If it overloads some sets, especially older ones, a green cast may be seen. It may be necessary to reduce the value of R8 (220Ω). A 5,000pF ceramic capacitor to decouple pin 4 of the modulator may also be helpful if it's fitted as close to it as possible, with short leads. If there's insufficient colour, add capacitance (C18) across R13 in steps of 100pF until the correct level is found.

Since the modulators may vary, the value of R13 may need altering slightly to compensate. Should the frequency coincide with a local channel, the loop of wire over the BF197 in the modulator can be bent *slightly*, although some trial and error will be needed since it's necessary to remove the can for this, and subsequent refitting will of course shift the frequency again.

Fault Finding

After many hours of painstaking construction, the dreaded moment arrives and with bated breath the constructor switches on. The fact that perhaps nothing happens or the result is a jumble will probably be a disappointed relief. Dry-joints and other mistakes are quite easy to see on the analogue board. The logic board is where the fun begins! You could sit and look at it for hours – you *might* see something but, if you'll forgive the pun, you must adopt a logical approach.

If a locked raster is obtained on the monitor, the sync generator and modulator can be assumed to be in order. Glance at the board for missing through links and dry-joints, particularly with the top soldering.

Check that the 5V supply is present on all the i.c.s by measuring between their supply pins (pins 7 and 14 in most cases).

If a scope is handy you can proceed with that. You might however find it easier to locate faults by using the monitor itself, since by this means you can observe the relative

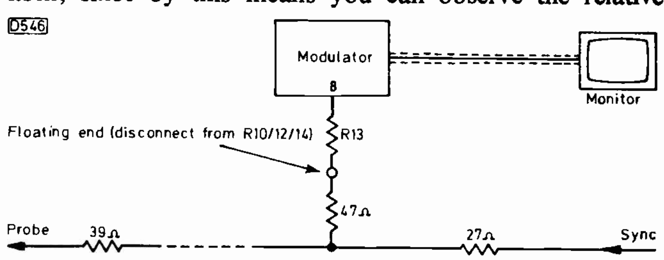


Fig. 6: Probe to enable a monitor to be used for fault-finding in the logic circuitry.

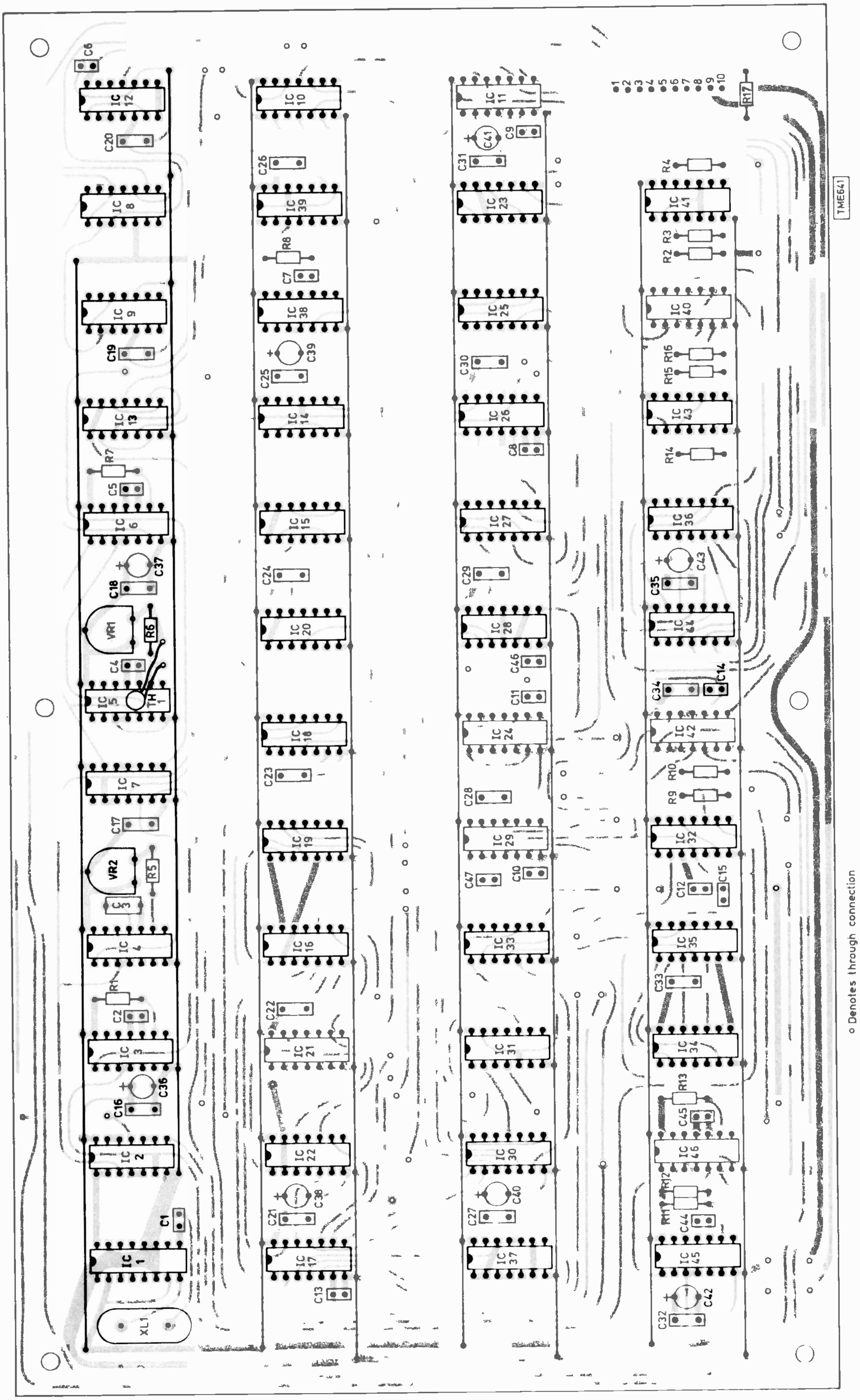


Fig. 7: Layout of the logic printed board. Note that there are print patterns on both sides of the board. Actual size is 7 × 11¾in.

★ Components List

Analogue Board

Resistors:

R1	10k
R2	33k
R3	47k
R4	1k2
R5	220k
R6	1k
R7	560
R8	220
R9	8k2
R10	39
R11	100k
R12	27
R13	220
R14	68
R15	47
R16	100k
R17	1k
R18	220
R19	270
R20	1k
R21	220
R22	270
R23	6k8
R24	2k7
R25	1k2
R26	560
R27	47

All 0·25W, 5% carbon film

Capacitors:

C1	1n ceramic
C2	1n ceramic
C3	10n ceramic
C4	22p ceramic
C5	100n polyester
C6	82p ceramic
C7	10n ceramic
C8	47n polyester
C9	2-60p trimmer
C10	18p ceramic
C11	220p ceramic
C12	1/35 tantalum bead
C13	1/35 tantalum bead
C14	4700/25 electrolytic
C15	470n polyester
C16	220n polyester
C17	470n polyester
C18	220p ceramic
C19	10/16 tantalum bead
C20	22p ceramic

Semiconductors:

IC1	TBA540
IC2	TBA520
IC3	7812
IC4	7805
Tr1	BC212L
Tr2	BC212L
Tr3	BC212L
BR1	KBL02 (or RS Components type 262-113)

Miscellaneous:

L1: GEC C2110 series reference oscillator coil, part no. L420016
Heatsink for IC3 and IC4: RS Components type 401-497
UHF modulator: From Manor Supplies
Coaxial cable
XL1: 4·43MHz crystal
Mains transformer: Secondary 15V, 3A. RS Components type 207-267 with the secondaries in parallel
PCB D063

Logic Board

Resistors:

R1	5k6
R2	560
R3	220
R4	47
R5	560
R6	1k
R7	1k
R8	10k
R9	100
R10	100
R11	10k
R12	47k
R13	1k2
R14	100
R15	270
R16	560
R17	27

All 0·25W, 5% carbon film

VR1	4k7
VR2	4k7

Subminiature Horizontal mounting

Capacitors:

C1	22p ceramic
C2	2n2 ceramic
C3	470n polyester
C4	22p ceramic
C5	22p ceramic
C6	330p ceramic
C7	22p ceramic
C8	1n ceramic
C9	1n ceramic
C10	470p ceramic
C11	2n2 ceramic
C12	3n3 ceramic
C13	1n ceramic
C14	1n ceramic
C15	1n ceramic
C16-C35	100n ceramic for decoupling
C36-C43	10/35V tantalum bead, for decoupling
C44	1n ceramic
C45	1n ceramic
C46	1n ceramic
C47	3n3 ceramic

Semiconductors:

IC1	ZNA134
IC2	7408
IC3	74121
IC4	74121
IC5	74121
IC6	74121
IC7	7401
IC8	7493
IC9	7493
IC10	7404
IC11	7408
IC12	7490
IC13	7474
IC14	7474
IC15	7474
IC16	7421
IC17	7408
IC18	7432
IC19	7421
IC20	7421
IC21	7421
IC22	7421
IC23	7400
IC24	7432
IC25	7408
IC26	7432
IC27	7408
IC28	7411
IC29	7411
IC30	7432
IC31	7408
IC32	7408
IC33	7404
IC34	7404
IC35	7430
IC36	7411
IC37	7400
IC38	74121
IC39	7474
IC40	7408
IC41	7408
IC42	7410
IC43	7432
IC44	7404
IC45	74121
IC46	74121

Miscellaneous:

TH1 G23 or GL23
XL1 2·5625MHz crystal from Senator Crystals, 36 Valleyfield Road, London SW16 2HR.
PCB D062

Corrections: C20 was omitted from the analogue board circuit (Fig. 5). It's connected from pin 15 of IC1 to chassis. C11 was shown as 200pF in error. On the digital board circuit (Fig. 2) IC27 should be shown as type 7408 and C7 as 22pF. C47 (not shown) is between pin 8 of IC26 and the supply line.

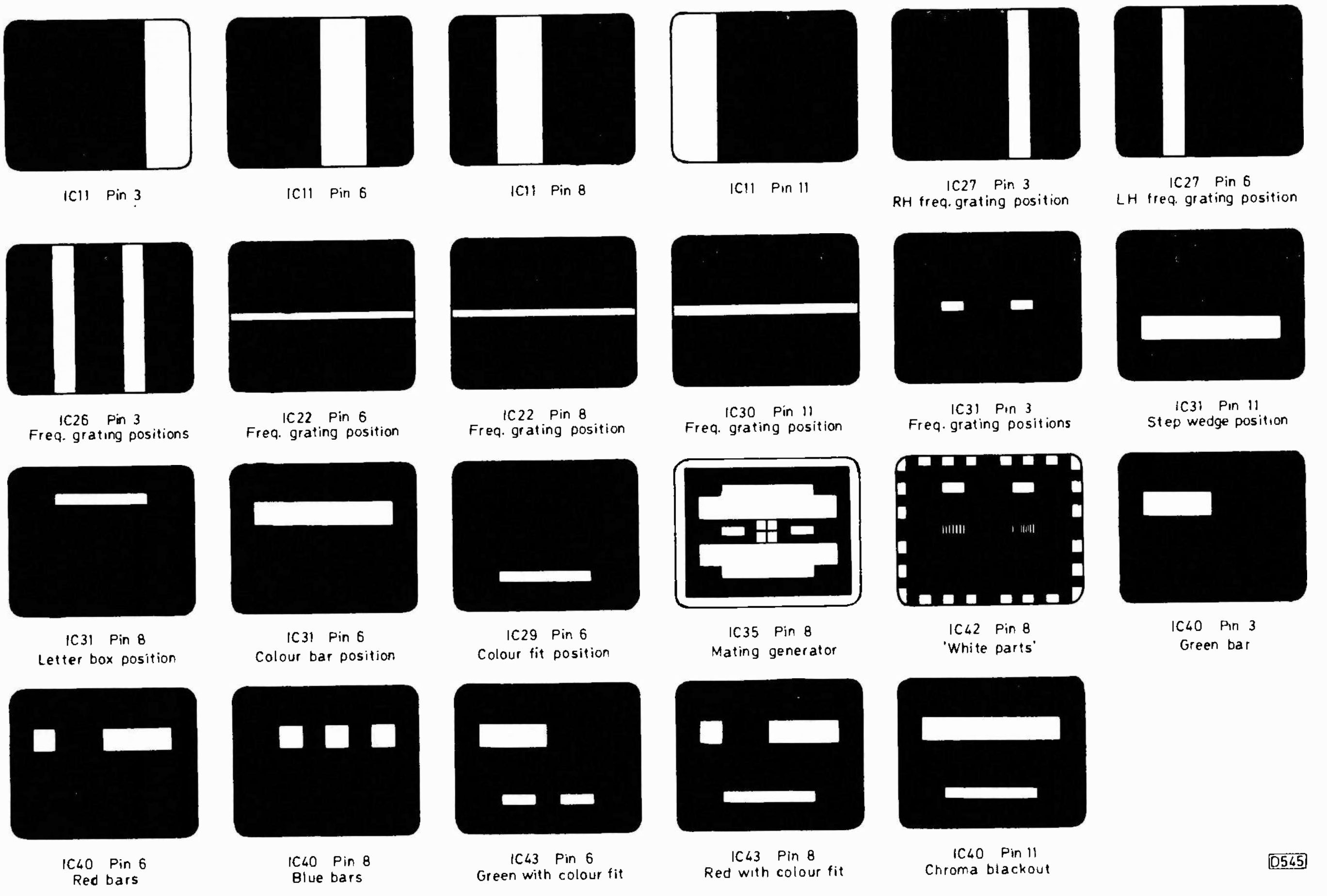


Fig. 8: Patterns which should be obtained at various points, using a probe and monitor.

positions of each shape in both the horizontal and vertical directions.

To do this, unhook R13 (see Fig. 6) from its junction with R10, R12, R14 (see Fig. 5). Unhook R14 from its printed link to the plug/socket at the end of the analogue board. Connect a 27Ω resistor to this connection and fit a 47Ω resistor in series with it. Connect the other end of this 47Ω resistor to the floating end of R13. We now have a sync feed to the modulator, but no video. Take a short piece of wire to use as a probe, and fit a 39Ω resistor to its end. Connect the wire to the junction of the added 27Ω and 47Ω resistors.

With careful tuning, it should be possible to monitor the outputs of most of the gates. Since there's no blanking signal however, there may be some pulling of the picture at times. An attenuator in the aerial output lead may help. Beware of stray pickup with this approach, since this will cause vertical lines on the picture and can be misleading.

TTL chips are very robust, and it's very unlikely that this method of fault-finding will cause any damage. Try to stay clear of the ZNA134 however – it's too expensive to take risks with.

Systematic Checks

Using the diagrams and tables in Part 1, together with the circuit description, first check the presence of waveforms 1 to 7. On a TV screen, they will show as vertical stripes. If these are OK, check the outputs from IC11. These should be as shown in Fig. 8: bear in mind that VR1 will affect their formation. Some examples of the waveforms and shapes to be expected from the frequency grating generator have been shown in detail. Other diagrams show the various complete shapes for the patterns. If they are not present, it will be necessary to trace back along the chain of gates until an abnormality is found. Waveforms 8 to 12 may be tricky to hold on the screen, since they may disturb vertical locking, but subsequent shapes at the gate outputs should not present too many problems.

These are digital i.c.s and the outputs are always either on or off. White areas are therefore logic 1, black areas logic 0. This is an unusual approach to checking but it certainly works, especially if you can't afford an oscilloscope.

If the output from a gate is missing or incorrect when the correct inputs are apparently present, either there's a short circuit to the 0V rail or between the pins of the next chip it feeds. Faults in gates themselves are not as common as badly soldered joints. Chips incorporating bistables, such as the 7474 and 7490, are a little more prone to failure, but even here the above comments still apply.

Conclusion

Provided you are familiar with TV engineering and fault-finding, this circuit should not prove too difficult to construct, even if you've never handled digital i.c.s before. We have attempted to produce a cheap solution to the engineer's problem of lack of a test pattern at crucial times. Since individual requirements vary, it's possible that some readers will modify the circuit. We will be pleased to hear of any suggestions and modifications which may be made, and hope shortly to publish a short article on extending the range of the unit to utilise some of the waveforms to generate other patterns. For those who find the price of the ZNA134 i.c. daunting, we've produced a simple alternative in the form of a cheap, random-interlace s.p.g. Details will follow next month.

Analogue board details overpage ➔

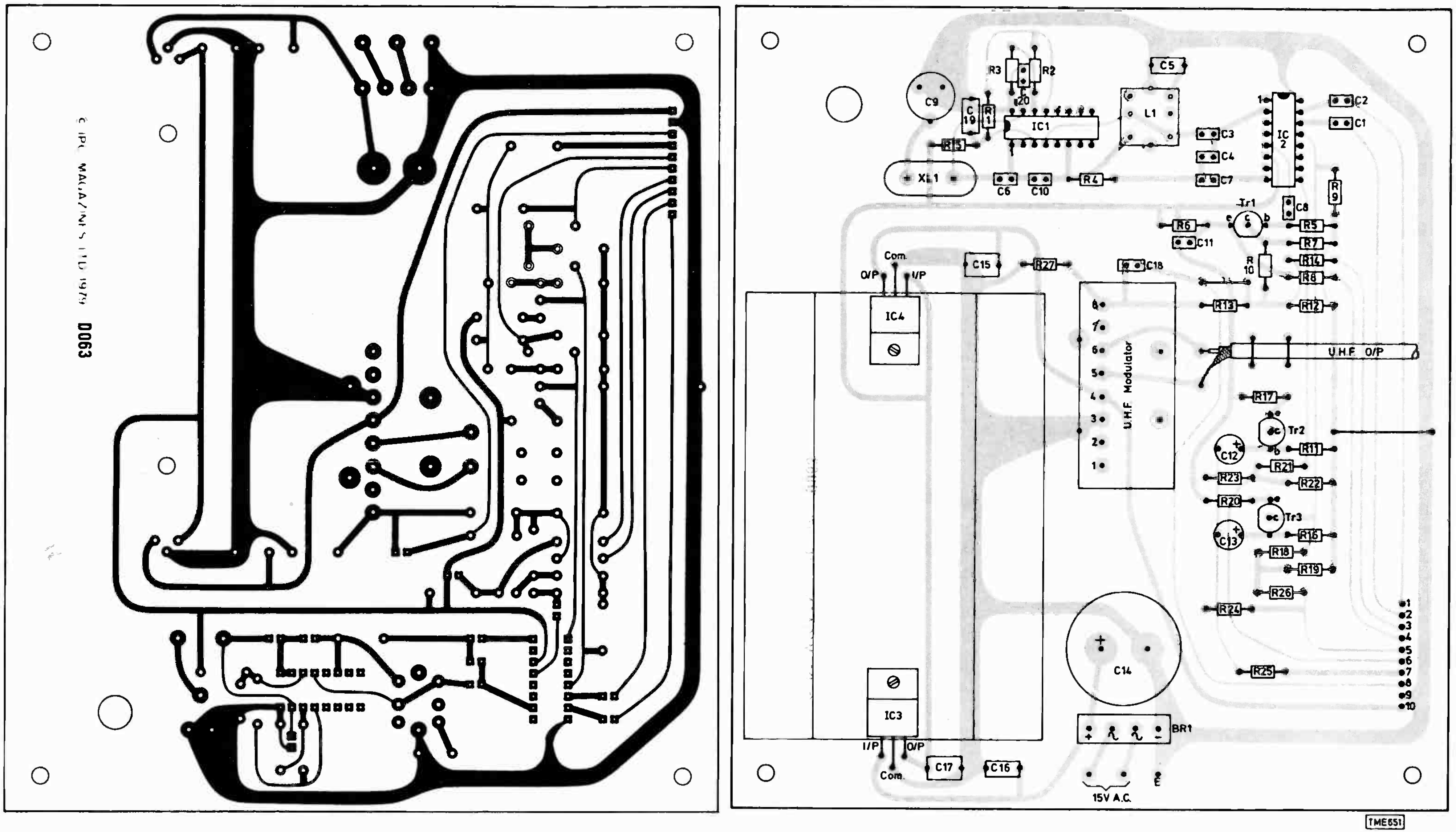


Fig. 9: Layout of the analogue board (right) and print pattern (left). The actual board dimensions are 7 × 6¼in.

Your PROBLEMS solved

Requests for advice in dealing with servicing problems must be accompanied by a 50p postal order (made out to IPC Magazines Ltd.), the query coupon from page 495 and a stamped addressed envelope. We can deal with only one query at a time. We regret that we cannot supply service sheets nor answer queries over the telephone.

PYE 693 CHASSIS

The screen lights up two-three minutes after the set is switched on, but for the next nine-ten minutes the picture is very blurred. It then becomes sharp. Also, there's a loud crack and a flash from the line timebase area during warm up, when changing channels, or when the brightness is lowered.

The trouble is undoubtedly in the VDR from which the focus voltage is obtained. If one end connection has become loose, you may be able to repair it by bonding with wire. Be careful though, there's 25kV on one end!

DECCA 100 CHASSIS

There are two intermittent faults on this set. First, red patches appear at the centre edges of the screen. They are most noticeable in white areas of a monochrome picture, though they can be seen on some colour pictures. They don't vary when the colour control is adjusted. The purity has been adjusted, improving matters, but the fault is still visible. The tube has also been degaussed. Secondly, patches of green and black vertical lines appear even more erratically. They are visible on black backgrounds only, and only one patch at a time appears.

The patch problems are certainly due to impurity, and are a function of the shadowmask temperature. This accounts for their intermittency. The two remedies which we find seldom fail are to readjust the purity when the set has been running for some time, and to run the set at lower brightness and contrast levels. This will keep the mask cooler and also provide a much better picture.

RANK A774 CHASSIS

The line and field sync are very weak, the picture pulling over to the left and rolling every minute or so. The fault disappears when the printed board is flexed, but no breaks can be found in the tracks. The symptoms also disappear after the set has been on for about an hour.

The trouble is due to poor contact between the tags of the vertical struts on the main frame, at either side of the tube neck. These tags protrude through the panel in about four places, from top to bottom. First remove the solder from those earthing points to expose the tags. Clean the tags thoroughly (you'll probably notice that the solder never "bit" into them all in the first place) and tin them. Then resolder, and run a lead from the top to the bottom to ensure that the earthing is good even without the efficient contact of one or more of the tags. Solder each lead in four places in order to back up the vertical metal strips.

BRUNSWICK CSB2206

I've been unable to identify this 22in. hybrid colour set. The fault is no raster, though the e.h.t. is present and correct.

The set is probably basically the same as the Decca 20 series chassis. As there is no screen illumination though the e.h.t. is normal, check the c.r.t.'s first anode voltages (should be over 400V) and its cathode voltages (should be under 200V). High cathode voltages would suggest a low-emission PL802 luminance output valve or incorrect operation of this stage.

RANK A816 CHASSIS

The sound is o.k. on this set, but the tube heaters don't light up and there's no spark from the final anode of the c.r.t. I've checked the c.r.t. heaters, which are in order.

Since the sound is normal and the l.t. supplies are obtained from the line output transformer, it would appear that the line output stage is working. The TV20 e.h.t. rectifier stick could be open-circuit, removing the e.h.t., while 3R114, which is in series with the c.r.t. heaters, could be open-circuit to remove the heater supply.

SANYO CTP 5101

The trouble is arcing from the flyback transformer T904, where the lead goes to the e.h.t. rectifier. Does this mean that the e.h.t. is too high for some reason, and how do I go about testing when the arcing starts immediately the set is switched on?

This is a fairly common fault on these sets, and is due to the insulation breaking down around the high-voltage connector. The only cure for the problem is to fit a new transformer.

BUSH TV125

There's a fuzzy dark patch, about 4in. in diameter, in the centre of the screen. Also the picture is split, e.g. with a newsreader the right-hand half is on the left and vice versa. With more than one object on the screen, nothing can be seen properly.

First get the line hold right. If the line hold control 3RV5 can be adjusted so that one complete picture hovers on the screen (without actually locking), replace the flywheel sync discriminator diodes (top right side). If you cannot manage to resolve one picture, check the PCF80 line oscillator valve 3V3 by substitution and the setting of the preset line hold control 3RV3. Once a steady picture has been obtained, check the DY86 e.h.t. rectifier valve or, if the picture is of insufficient width, the PL36 line output valve.

TELETON C18BS

There's no sound or raster, though the five fuses are intact and voltages are present at the mains transformer secondaries. The tube heaters, also the channel lights, glow. The touch-type channel selectors work, but channel one does not appear automatically when the on/off switch is operated.

The touch-tune system depends on a voltage feed from the line timebase, which is clearly not working, cutting off the rest of the set. Check whether the 120V line is present at the output of the series regulator transistor TR708, and that it's reaching the collector of the line output transistor TR304. If not, check TR708, R414 (10Ω), L403 etc. If power is reaching TR304, suspect loss of line drive – there should be 89V at the collector of the line driver transistor TR303.

INTEL BPT12 PORTABLE

This portable, made by Amerex, has a damaged tuner unit. I've been unable to find any source of spares however. Any suggestions for alternatives?

The JVC 3020 uses a similar tuner to that in the Amerex set. The mechanical fitting differs however, and you may have to redrill the fixing holes. Most other Japanese tuners incorporate a built-in i.f. preamplifier, which would complicate adaption.

THORN 3500 CHASSIS

The line output transistor was replaced (had been found short-circuit) and the set e.h.t. control was then adjusted for minimum e.h.t. consistent with sufficient width (h.t. at 60V, I can't measure the e.h.t. itself). The set was o.k. for a time, then on switching on the final anode kept arcing loudly to the metal shield. I cleaned around the anode connector and the insulated metalwork, and reduced the h.t. slightly (width still adequate) but there's bad frying to the outer tube coating, so the e.h.t. is obviously too high – increasing the h.t. above 58V makes it worse. The tripler has been replaced and the preset controls set up. The voltage across R907 in the beam limiter circuit is slightly high at 1·7V.

We feel that it's essential to be able to check the actual e.h.t. voltage. If this is not in excess of 25·5kV, cleaning and polishing the appropriate areas of the c.r.t. bowl should be sufficient. If the e.h.t. is excessive, suspect the flyback tuning capacitor C518 (0·028μF). Note that there are alternative line output stage transformer connections and that these affect the width – details are given on card 9 in the service manual.

PYE 693 CHASSIS

The set gives excellent results but there appears to be an intermittent power supply fault. The mains lead, plug etc. are free of physical defects, but when the set is switched on from cold the raster and sound collapse then return within a split second – as though there was a momentary power supply interruption. This happens up to a dozen times, after which the set operates normally.

The trouble sounds like a thermistor with a dry-jointed end. The one to suspect is the surge limiter R305 (VA1104) in the h.t. supply, on the panel behind the e.h.t. box. A disturbance test should show a spark at the offending end.

TELETON TH14

There's a very strong "shadow", or second image, to the right of the pictures on the screen. Sometimes however the display changes, the entire picture becoming negative.

The double-image effect could be due to the set being operated from its own loop aerial or a badly sighted outdoor aerial. The entire picture becoming negative suggests a worn tube however, the weakness possibly being accentuated by over-advanced contrast and/or brightness control settings. Reduced tube emission would also make it difficult to see the picture in bright daylight, with silvery highlights and a tendency to defocus at the edges. If the tube is at fault, the picture should return from negative to normal when the contrast/brightness levels are reduced. It would also be worth ensuring that the 1X28 e.h.t. rectifier is in good condition.

If the negative picture can't be restored to normal when the contrast/brightness levels are reduced, the fault could be a video one, probably the SE7010 (or 2SC686) video output transistor TR205 itself. In this case, compare the working voltages in the video output stage under normal conditions and when the picture is negative.

The fact that the picture goes negative only on occasions could be due to different signal strengths on the channels available. Variations in a.g.c. level could also produce a negative picture if the tube is weak, but this should be accompanied by sound level variations and possibly a tendency to cross-modulation (vision on sound or vice versa).

Note the effect (if any) the contrast control has when the negative picture develops – there could be an intermittent short in the 100μF electrolytic (C235) connected from its slider to chassis. If the tube gives a bright picture, free from the silvery effect, change this anyway to be on the safe side. Also check that the peaking coil in the video output transistor's collector circuit is not intermittently open-circuit.

ITT CVC8

The trouble with this set is pincushion distortion, which is most pronounced at the top. Adjusting the associated controls R362 and L125 has no effect on the picture geometry at all.

First check for dry-joints (under the transductor, and on the print connection to pin 1 of the line output transformer). R362 or R364, which are in series across the transductor, could be open-circuit, or the transductor itself defective. Once the cause of the trouble has been put right, adjust R362 and L125 for optimum picture geometry.

ITT CVC9

The tube is blanked out at the centre, and to avoid damage the tripler must be disconnected. The RGB output transistors are all switched hard on – only 15V at their collectors. There's 15V at the RGB output pins of the TDA1327A colour demodulator/matrixing i.c. instead of 6V. Removing the i.c. results in the voltages at the collectors of the RGB output transistors rising, but fitting a replacement does not cure the fault.

The d.c. levels at the RGB output pins of the TDA1327A i.c. are under the control of the voltage at pin 3 (luminance input). You'll probably find this wildly incorrect. If so, check the beam limiter transistor T24, the voltage at the cathode (pin 9, sensed to give the beam limiting action) of the PL509 line output valve, and the presence of 15·8V at the top of the preset brightness control R90. If these points are in order, check the black-level clamp diodes D21 and D22.

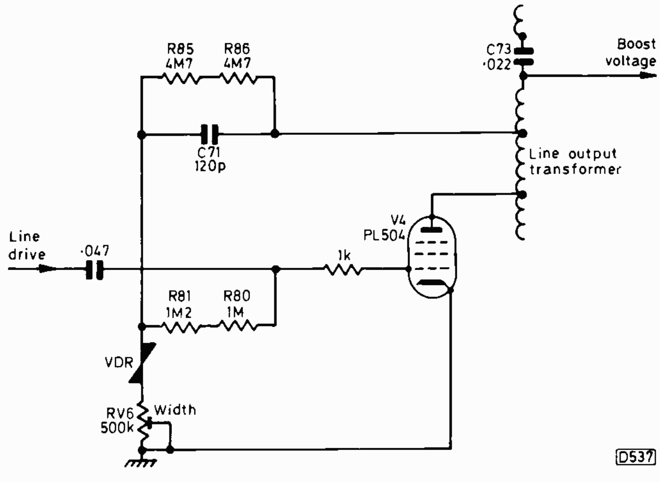


Fig. 1: Width control circuit, Pye 169 chassis.

PHILIPS G6 CHASSIS

Two coloured bands, blue and green, move slowly up and down the screen. They are also present on a monochrome display.

The problem is hum on the signal. First check the PCF200 colour-difference output/clamp valves for heater-cathode leakage – preferably by substitution. If the trouble persists, the most likely cause is hum on the l.t. lines, probably due to C1019/20/21. Make sure they are properly earthed before replacing them.

TEST CASE

199

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 Pye colour set fitted with the 691 hybrid chassis suffered from a change of colour from one side of the screen to the other. This became increasingly apparent the longer the set remained in operation. The symptom was present even with the colour control turned right down, so it was concluded that the fault had something to do with the tube's d.c. conditions.

It was decided to look first at the control grid circuitry, since this chassis uses colour-difference drive, i.e. the three control grids are driven by the three separate colour-difference signals while the luminance signal is applied to the cathodes. There are three PCL84 valves on the colour-difference amplifier panel, one each to drive the red, green and blue grids of the tube. In each case the pentode is the output section of the valve, a.c. coupled to the tube, the triode section acting as a driven clamp, i.e. it's switched on once each line by a drive pulse applied to its grid. The purpose of the clamp is to hold the d.c. conditions steady during the line scan. The symptom gave the impression that the d.c. conditions were changing during each line scan, so the first line of attack was to check the clamp valves and associated components.

To isolate the stage responsible for the colour drift, the three c.r.t. guns were switched on individually. The blue raster (red and green guns off) showed up the symptom far more dramatically, so the blue PCL84 was replaced. This failed to provide any improvement, so as a further check on the valves all three were interchanged. Once again the fault remained the same.

The technician then consulted the circuit diagram and noted the high-value (8·2MΩ) anode load resistors in each clamp stage. Such resistors tend to change value, but on checking their values all three were found to be within the tolerance range. The one in the blue circuit was nevertheless changed, to be on the safe side, but again the fault came up as before. It was next decided to make sure that the clamps were actually operating, by checking that the drive pulses were present. Connecting the oscilloscope up proved that everything was in order in this part of the circuit.

After making further checks in the blue colour-difference amplifier circuit, the technician resolved the problem by replacing one small component. What is the most likely suspect? See next month for the solution and a further item in the series.

SOLUTION TO TEST CASE 198
–Page 439 last month–

There are two basic width control arrangements used in conjunction with valve line output stage width/e.h.t. stabilisation circuits. Usually the width control is connected in a resistive chain between the boost rail and chassis, its slider being connected via a high-value resistor to the line output valve's grid bias network. The alternative arrangement, used in the chassis in question and a number of others, is to connect the control between the VDR and chassis – see Fig. 1. In this particular circuit C71 couples flyback pulses to the VDR, which rectifies them to produce on the capacitor a d.c. bias voltage proportional to the flyback pulse amplitude and hence the e.h.t. To enable the width control to be used to set up the circuit, a d.c. path is also necessary. This is provided by the two high-value resistors R85 and R86, which are effectively connected from the boost rail to chassis via the VDR and the width control.

There's a high d.c. voltage across R85 and R86 therefore, and in addition they are subjected to the high-amplitude flyback pulses. Now resistors are not too happy when subjected to high-voltage stress, and tend to change value – usually going high and tending towards open-circuit. With a pair of resistors in series, as here, the stress will be divided between them. This helps, but the trouble is still one to bear in mind. The technician concerned was aware of this, and the reliable and swift method of checking he adopted to prove the goodness or otherwise of the suspect resistors was to use the meter itself as a shunt resistor.

The meter reading obtained is of little significance, but when making shunt checks while watching the display any change brought about by the checks is immediately apparent.

A 20kΩ/V meter switched to the 240V f.s.d. range has a terminal resistance of 4·8MΩ – just right for shunting 4·7MΩ resistors! The test proved of course that the first resistor tested, R85, was abnormally high in value. The slight overscan produced was due to the fact that the resistor was not completely open-circuit – the net resistance present was less than 4·7MΩ therefore. Replacing the resistor resolved the fault without further ado.

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TELEVISION JULY 1979

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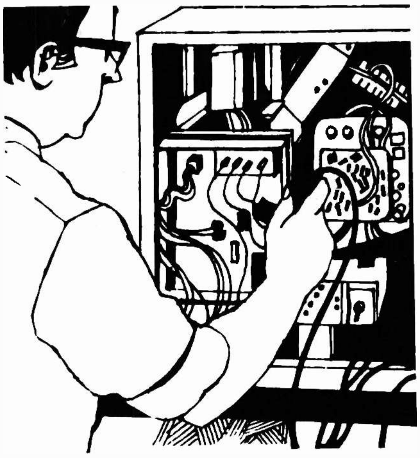

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ECL82	60p	PC86	75p	PCL82	73p	PY800/1	69p
ECL86	75p	PC88	75p	PCL84	80p	UCH81	65p
ECF86	80p	PC92	85p	PCL805/85	85p	UCL82	75p
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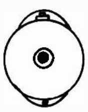
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