MAY 1979

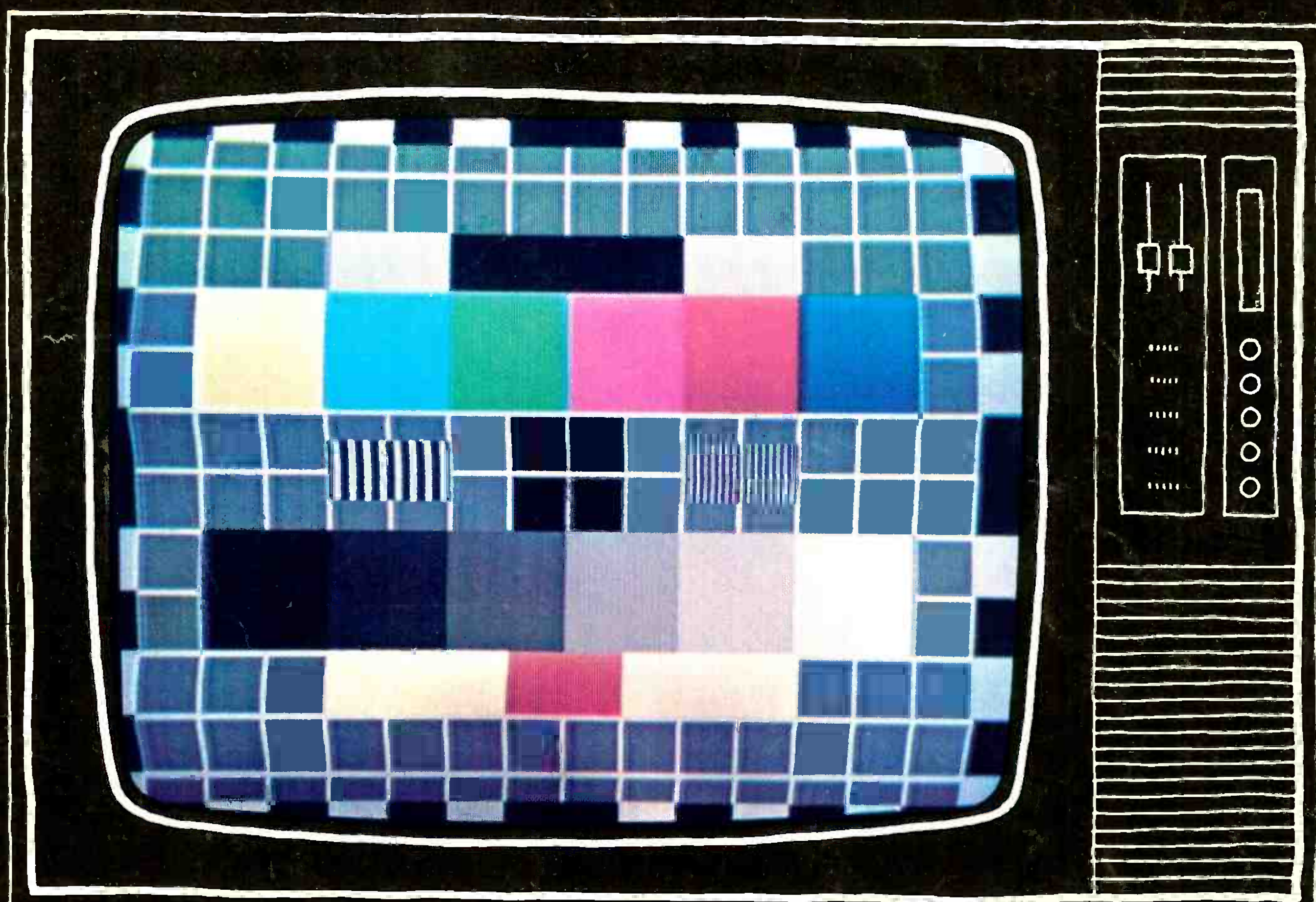
Australia 85c; Malaysia $ 2.50; New Zealand 85c

55p

TELEVISION

SERVICING·VIDEO·CONSTRUCTION·DEVELOPMENTS

COLOUR PATTERN GENERATOR Part 1



RANK TELETEXT RECEIVER

SERVICE NOTEBOOK

PHD COMPONENTS

RADIO & TV COMPONENT DISTRIBUTORS
UNIT 7 CENTENARY ESTATE
JEFFRIES RD ENFIELD MIDDX
CALLERS BY APPOINTMENT ONLY TELEX 261295

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

PLEASE ADD 0.35p per parcel post and packing.

CAPACITORS

Description	
DECCA 400-400/350V	3.25
GEC 2000 200-200-150-50/350V	1.90
GEC 1000-2000/35	1.85
GEC/G8 600/300V	1.83
GEC/G8 600/250V	1.55
RRI 600/300V	1.83
PYE 691 200-300/350	2.69
PYE 169 1000-1000/40	0.85
RRI 823 2500-2500/30	1.03
RRI 300-300/300	2.47
ITT/KB 200-200-75-25	2.86
TCE 950 100-300-100-16/275	1.83
TCE 400 150-100-100-100-15	3.51
TCE 1500 150 x 150 x 100	1.99
TCE 3000/3500 175-100-100	2.16
TCE 3000/3500 1000/70V	0.65
TCE 3000/3500 220/100	0.47
TCE 8000/8500 2500/2500/63	1.41
TCE 8000/8500 700/800	0.93
TCE 8000/8500 400/350	0.93
300-300/350	2.82
100-200/275	1.41
100-200-60/275	1.41
200-200-400/350	3.05
200-200-100-32/350	1.41
125-300-100/350	1.41
300-200-100/300	1.41
2000-2000/40	0.70
300-300-100-32	1.41
300-300-100-50	1.41
220-100-47-22/340	1.41
200-100-100-150/350	1.41

DROPPERS

Dropper TCE 1400	1.06
Dropper TCE 1500	0.85
Dropper TCE 1600	0.89
Dropper TCE 3000/3500	0.54
Dropper TCE 8000	0.80
Dropper TCE 8500	0.85
Dropper Philips G8	0.49
Dropper Philips G8	0.25
Dropper Philips 210	0.63
Philips 210 (Link)	0.54
Dropper RRI 141	0.42
Dropper RRI 161	0.58
Dropper 27840	0.83
Dropper GEC 2000	0.71
Dropper PYE 11062	0.85
Dropper PYE	0.85

DIODES & RECTIFIERS

AA116 Diode	0.11
AA117 Diode	0.11
AA119 Diode	0.11
OA47 Diode	0.08
OA79 Diode	0.08
OA81 Diode	0.08
OA85 Diode	0.08
OA90 Diode	0.08
OA91 Diode	0.08
OA95 Diode	0.08
OA202 Diode	0.12
BA100 Diode	0.12
BA102 Diode	0.07
BA130 Diode	0.10
BA145 Diode	0.20
BA148 Diode	0.20
BA154 Diode	0.06
BA155 Diode	0.09
BA164 Diode	0.09
BAX13 Diode	0.11
BAX16 Diode	0.07
BAY38 Diode	0.11
BY206 Diode	0.20
SK3F/04 Diode	0.20
IN4148 Diode	0.05
IS44 Diode	0.05
BY126 Rectifier	0.10
BY127 Rectifier	0.12
BY133 Rectifier	0.15
BY164 Rectifier	0.50
BY179 Bridge Rectifier	0.96
BY182 Bridge Rectifier	1.27
BY238 Rectifier	0.14
BYX10 Rectifier	0.16
BY187 High Voltage Rectifier	0.30
IN4001 Rectifier	0.08
IN4002 Rectifier	0.08
IN4003 Rectifier	0.09
IN4004 Rectifier	0.09
IN4005 Rectifier	0.10
IN4006 Rectifier	0.10
IN4007 Rectifier	0.11
BY142 Rectifier	0.10
BR100	0.30
BR101	0.35
BRY39	0.35
BT116	1.70
BT119	2.00
BT120	2.00
TV106	1.40
2N4443	1.00
BT100A/02	1.50
OT112	3.50
BYX55/350	0.60
BYX55/600	0.60
BYX71/600	0.60
2N4444 Thyristor	1.27
BT109 Thyristor	1.27

TRANSISTORS

AC107 Transistor	0.20
AC126 Transistor	0.20
AC127 Transistor	0.20
AC127/01 Transistor	0.30
AC128 Transistor	0.30
AC128/01 Transistor	0.30
AC141 Transistor	0.20
AC141K Transistor	0.30
AC142 Transistor	0.27
AC142K Transistor	0.45
AC153 Transistor	0.45
AC176 Transistor	0.30
AC176/01 Transistor	0.45
AC186 Transistor	0.30
AC187 Transistor	0.30
AC187K Transistor	0.45
AC188 Transistor	0.30
AC188K Transistor	0.45
AC193K Transistor	0.45
AC194K Transistor	0.45
AD140 Transistor	1.50
AD142 Transistor	1.50
AD143 Transistor	1.50
AD145 Transistor	1.50
AD149 Transistor	1.00
AD161 Transistor	0.50
AD162 Transistor	0.50
AD262 Transistor	1.20
AF114 Transistor	0.45
AF115 Transistor	0.45
AF116 Transistor	0.45
AF117 Transistor	0.45
AF118 Transistor	0.45
AF121 Transistor	0.45
AF124 Transistor	0.45
AF125 Transistor	0.45
AF126 Transistor	0.45
AF127 Transistor	0.45
AF139 Transistor	0.45
AF239 Transistor	0.60
AL102 Transistor	2.70
AU107 Transistor	2.70
AU110 Transistor	2.70
AU113 Transistor	2.70
BC107 Transistor	0.15
BC108 Transistor	0.15
BC109 Transistor	0.15
BC113 Transistor	0.12
BC114 Transistor	0.12
BC115 Transistor	0.15
BC116 Transistor	0.15
BC117 Transistor	0.15
BC118 Transistor	0.12
BC119 Transistor	0.33
BC125 Transistor	0.15
BC126 Transistor	0.14
BC136 Transistor	0.14
BC137 Transistor	0.14
BC138 Transistor	0.28
BC139 Transistor	0.28
BC140 Transistor	0.28
BC142 Transistor	0.28
BC143 Transistor	0.28
BC147 Transistor	0.10
BC148 Transistor	0.10
BC149 Transistor	0.10
BC153 Transistor	0.10
BC154 Transistor	0.10
BC157 Transistor	0.10
BC158 Transistor	0.10
BC159 Transistor	0.28
BC161 Transistor	0.28
BC170 Transistor	0.10
BC171 Transistor	0.10
BC172 Transistor	0.10
BC177 Transistor	0.17
BC178 Transistor	0.17
BC179 Transistor	0.17
BC182L Transistor	0.10
BC183 Transistor	0.10
BC183L Transistor	0.10
BC184L Transistor	0.10
BC184LC Transistor	0.12
BC186 Transistor	0.18
BC187 Transistor	0.18
BC203 Transistor	0.10
BC204 Transistor	0.10
BC205 Transistor	0.10
BC206 Transistor	0.10
BC207 Transistor	0.10
BC208 Transistor	0.10
BC209 Transistor	0.10
BC212L Transistor	0.10
BC213L Transistor	0.10
BC214L Transistor	0.10
BC225 Transistor	0.30
BC237 Transistor	0.10
BC238 Transistor	0.10
BC251A Transistor	0.10
BC301 Transistor	0.30
BC303 Transistor	0.30
BC307 Transistor	0.10
BC308 Transistor	0.10
BC327 Transistor	0.11
BC328 Transistor	0.11
BC337 Transistor	0.11
BC338 Transistor	0.11
BC547 Transistor	0.11
BD115 Transistor	0.35
BD116 Transistor	0.80
BD124P Transistor	1.80
BD131 Transistor	0.45
BD132 Transistor	0.45
BD133 Transistor	0.54
BD134 Transistor	0.54
BD135 Transistor	0.54
BD136 Transistor	0.54
BD137 Transistor	0.54
BD138 Transistor	0.54
BD139 Transistor	0.54
BD140 Transistor	0.54
BD144 Transistor	2.50
BD155 Transistor	0.60
BD157 Transistor	0.60
BD159 Transistor	0.60
BD163 Transistor	0.60
BD165 Transistor	0.60
BD175 Transistor	0.60
BD177 Transistor	0.60
BD183 Transistor	0.60
BD187 Transistor	0.60
BD210 Transistor	1.24
BD235 Transistor	0.54
BD236 Transistor	0.54
BD237 Transistor	0.54
BD238 Transistor	0.54
BD239 Transistor	0.54
BD380 Transistor	0.54
BD437 Transistor	0.54
BD439 Transistor	0.54
BD441 Transistor	0.54
BD535 Transistor	0.54
BD536 Transistor	0.54
BD537 Transistor	0.54
BD538 Transistor	0.54
BDX73 Transistor	0.60
BDY201 Transistor	2.10
BF115 Transistor	0.45
BF118 Transistor	0.45
BF121 Transistor	0.60
BF152 Transistor	0.30
BF154 Transistor	0.15
BF157 Transistor	0.50
BF158 Transistor	0.30
BF160 Transistor	2.16
BF163 Transistor	0.45
BF167 Transistor	0.45
BF173 Transistor	0.45
BF177 Transistor	0.45
BF178 Transistor	0.50
BF179 Transistor	0.50
BF180 Transistor	0.50
BF181 Transistor	0.50
BF182 Transistor	0.50
BF183 Transistor	0.50
BF184 Transistor	0.50
BF185 Transistor	0.50
BF194 Transistor	0.10
BF195 Transistor	0.10
BF196 Transistor	0.10
BF197 Transistor	0.10
BF198 Transistor	0.10
BF199 Transistor	0.10
BF200 Transistor	0.10
BF224 Transistor	0.10
BF240 Transistor	0.12
BF241 Transistor	0.12
BF256LC Transistor	0.36
BF257 Transistor	0.36
BF258 Transistor	0.37
BF271 Transistor	0.45
BF273 Transistor	0.15
BF274 Transistor	0.18
BF336 Transistor	0.37
BF337 Transistor	0.37
BF338 Transistor	0.39
BF355 Transistor	0.63
BF458 Transistor	0.75
BF459 Transistor	0.75
BFT43 Transistor	0.39
BFX29 Transistor	0.35
BFX84 Transistor	0.33
BFX85 Transistor	0.33
BFX88 Transistor	0.33
BFX89 Transistor	0.33
BFY50 Transistor	0.33
BFY51 Transistor	0.33
BFY52 Transistor	0.33
BFY90 Transistor	0.90
BDX32 Transistor	2.40
BU105 Transistor	1.50
BU105/01 Transistor	2.40
BU105/02 Transistor	2.40
BU105/04 Transistor	2.40
BU108 Transistor	2.40
BU204 Transistor	1.50
BU205 Transistor	1.50
BU206 Transistor	2.40
BU208 Transistor	2.40
BU208/02 Transistor	2.40
BU326S Transistor	1.98
BU406 Transistor	1.89
BU406D Transistor	2.66
BU407 Transistor	1.59
BU407D Transistor	2.10
2SC1172Y Transistor	2.40
R2008B Transistor	2.25
R2009 Transistor	2.25
R2010B Transistor	2.55
R2540 Transistor	3.00
ME0404 Transistor	0.15
ME0412 Transistor	0.15
ME4003 Transistor	0.10
ME6002 Transistor	0.15
ME8001 Transistor	0.12
MJE340 Transistor	0.75
MJE520 Transistor	0.60
MJE2955 Transistor	0.96
MJE3055 Transistor	0.87
MJ2955 Transistor	1.20
MJ3055 Transistor	1.20
MP8113 Transistor	0.75
MPSU05 Transistor	0.90
MPSU55 Transistor	0.90
TIP31A Transistor	0.48
TIP32A Transistor	0.48
TIP41A Transistor	0.75
TIP42A Transistor	0.75
TIP2995 Transistor	0.96
TIP3055 Transistor	0.96
TIS91M Transistor	0.21
2N2904 Transistor	0.33
2N2905A Transistor	0.36
2N2905 Transistor	0.36
2N3053 Transistor	0.36
2N3055 Transistor	0.88
2N3703 Transistor	0.12
2N3705 Transistor	0.12
2N3710 Transistor	0.12
2N5296 Transistor	0.57
2N5298 Transistor	0.57
2N5496 Transistor	0.63
2N6178 Transistor	0.90
2N6180 Transistor	0.90

INTEGRATED CIRCUITS

TAA550 Int Circuit	0.25
TAA570 Int Circuit	2.10
TAA611 B12 Int Circuit	2.00
TAA630S Int Circuit	2.50
TAA661B Int Circuit	1.60
TAA700 Int Circuit	3.50
TAD100 Int Circuit	1.75
TBA120AS Int Circuit	0.63
TBA231 Int Circuit	1.05
TBA325 Int Circuit	0.50
TBA480Q Int Circuit	1.94
TBA520Q Int Circuit	2.80
TBA530 Int Circuit	2.25
TBA530Q Int Circuit	2.40
TBA540 Int Circuit	2.60
TBA540Q Int Circuit	2.60
TBA550 Int Circuit	3.15
TBA550Q Int Circuit	3.15
TBA560C Int Circuit	3.15
TBA560CQ Int Circuit	3.48
TBA570 Int Circuit	1.62
TBA570Q Int Circuit	1.74
TBA641 BX1 Int Circuit	2.61
TBA641 B11 Int Circuit	3.18
TBA651 Int Circuit	1.75
TBA700Q Int Circuit	1.25
TBA720AQ Int Circuit	2.60
TBA730 Int Circuit	0.50
TBA750 Int Circuit	2.25
TBA750Q Int Circuit	2.40
TBA800 Int Circuit	1.30
TBA810S Int Circuit	1.50
TBA820 Int Circuit	1.05
TBA920 Int Circuit	3.66
TBA920Q Int Circuit	3.75
TBA990 Int Circuit	3.75
TBA990Q Int Circuit	3.66
TCA270Q Int Circuit	2.00
TCA900 Int Circuit	0.87
TCA940 Int Circuit	2.25
TDA1170 Int Circuit	2.60
TDA1200 Int Circuit	2.25
TDA1270 Int Circuit	2.60
TDA1412 Int Circuit	0.90
TDA2020 Int Circuit	3.80
MC1307P Int Circuit	1.60
MC1310P Int Circuit	1.80
MC1327P Int Circuit	2.10
MC1327PQ Int Circuit	2.10
MC1330P Int Circuit	1.35
MC1351P Int Circuit	1.74
MC1352P Int Circuit	1.30
MC1358PQ Int Circuit	1.40
SN76003N Int Circuit	3.10
SN76003ND Int Circuit	2.60
SN76013N Int Circuit	2.20
SN76013N07 Int Circuit	2.20
SN76013ND Int Circuit	2.00
SN76023N Int Circuit	2.20
SN76023ND Int Circuit	2.00
SN76033N Int Circuit	3.00
SN76110N Int Circuit	1.60
SN76131N Int Circuit	1.90
SN76226DN Int Circuit	1.30
SN76227N Int Circuit	1.00
SN76532N Int Circuit	1.50
SN76533N Int Circuit	1.50
SN76544N Int Circuit	1.70
SN76650N Int Circuit	1.50
SN76660N Int Circuit	0.80
SN76665N Int Circuit	1.25
SN76666N Int Circuit	0.60
SL901B Int Circuit	7.50
SL917B Int Circuit	9.90
TBA396Q Int Circuit	0.50
TDA440 Int Circuit	2.50
SN76001N Int Circuit	2.00

VALVES

DY86/87 Valve	1.00
DY802 Valve	1.20
EABC80 Valve	1.50
EB91 Valve	1.10
EBC81 Valve	0.60
EBF80 Valve	0.65
EC86 Valve	1.10
EC88 Valve	1.10
ECC40 Valve	1.20
ECC81 Valve	1.20
ECC82 Valve	1.02
ECC83 Valve	1.02
ECC84 Valve	1.35
ECC85 Valve	1.75
ECC88 Valve	0.75
ECC189 Valve	1.20
ECF80	1.50
ECF82 Valve	0.65
ECF86 Valve	1.10
ECH81 Valve	1.80
ECH83 Valve	0.75
ECH84 Valve	2.10
ECL80 Valve	1.50
ECL82 Valve	1.32
ECL83 Valve	1.10
ECL84 Valve	0.90
ECL86 Valve	1.60
EF80 Valve	1.20
EF83 Valve	1.70
EF83 Valve	1.70
EF85 Valve	1.20
EF86 Valve	2.20
EF89 Valve	2.45
EF91 Valve	0.60
EF95 Valve	0.65
EF183 Valve	1.10
EF184 Valve	1.10
EH90 Valve	1.90
EL34 Valve	3.25
EL36 Valve	0.90
EL41 Valve	1.20
EL81 Valve	0.90
EL84 Valve	1.35
EL86 Valve	0.75
EL95 Valve	1.50
EM84 Valve	1.20
EM87 Valve	1.50
EY51 Valve	0.65
EY86/87 Valve	1.20
EY88 Valve	0.75
EZ80 Valve	1.00
EZ81 Valve	1.00
GY501 Valve	2.40
GZ34 Valve	2.25
PC86 Valve	2.00
PC88 Valve	2.00
PC97 Valve	1.60
PCC84 Valve	1.25
PCC85 Valve	1.50
PCC89 Valve	2.00
PCC189 Valve	2.00
PCC806 Valve	2.50
PC900 Valve	1.70
PCC88 Valve	1.70
PCF80 Valve	1.50
PCF82 Valve	1.90
PCF86 Valve	2.00
PCF200 Valve	1.20
PCF201 Valve	1.25
PCF801 Valve	2.10
PCF802 Valve	1.30
PCF806 Valve	2.10
PCH200 Valve	2.10
PCL82 Valve	1.50
PCL83 Valve	1.80
PCL84 Valve	1.50
PCL85/805 Valve	1.50
PCL86 Valve	1.50
PD500/510 Valve	4.80
PFL200 Valve	2.50
PL36 Valve	1.70
PL81 Valve	1.70
PL81A Valve	1.70
PL82 Valve	0.75
PL83 Valve	1.50
PL84 Valve	1.50
PL95 Valve	1.05
PL504 Valve	1.80
PL508 Valve	2.40
PL509 Valve	4.10
PL519 Valve	5.40
PL802 Valve	4.95
PY33 Valve	1.00
PY82 Valve	0.60
PY83 Valve	0.75
PY88 Valve	1.75
PY500A Valve	2.40
R19 Valve	0.75
U25 Valve	0.75
U26/KY80 Valve	2.20
U49 Valve	0.75
U191 Valve	0.75
UBF89 Valve	0.75
UCC85 Valve	0.76
UCH81 Valve	0.75
UCL82 Valve	1.50
UCL83 Valve	0.75
UF41 Valve	0.75
UL84 Valve	1.80
UY85 Valve	1.50
6BW7 Valve	2.10
6F23 Valve	2.40
6/30L2 Valve	2.40
30C15 Valve	2.40
30C17 Valve	2.40
30F5/6F23 Valve	2.40
30FL2/1 Valve	1.70
30FL12/PCE82 Valve	2.50
30L15/PCC805 Valve	2.50
30L17 Valve	2.50
30P12/PL801 Valve	2.50
30P19/PL36 Valve	1.70
30PL13 Valve	2.50
30PL15 Valve	2.50

EHT TRIPLERS

TCE950 Doubler	2.25
TCE950/1400 Tripler	3.50
TCE1400 (Pied system only)	4.00
TCE1500 Doubler	3.00
TCE500 Tripler	3.50
TCE1600 1/2 Wave	3.50
Decca CS1730/1830 Doubler	3.60
Decca CS1910/2213 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
GEC2110 Tripler Pre Jan 77	7.00
GEC2110 Tripler Post Jan 77	6.50
ITT CVC5/8/9 Tripler	6.50
ITT VCV20/25/30 Tripler	6.50
Philips 520 Tripler	6.50
Philips 550 Tripler	6.50
Philips G9 Tripler	6.50
PYE 691/693/697 Tripler	6.00
PYE 731/725 Tripler	6.50
Philips 570 Doubler	6.50
PYE 713/CT2001 only/Doubler	6.50
RR1823 Tripler	7.00
RR1Z179/823 Tripler	6.00
TCE3000/3500 Tripler	6.50
TCE4000 Tripler	8.00
TCE8000 Tripler	3.00
TCE8500 Tripler	6.00
TCE9000 Tripler	6.50
TVK52 Continental Sets	6.00
Korting 90% Tripler	6.50
Autovox Tripler	6.50

MISCELLANEOUS PRODUCTS

Sets of Avo Leads	9.50
ELC1043/05 Tuners	6.50
4.443 MHz Crystals	1.30
Cut Out TCE3500	1.20
Cut Out Grundig	1.50
Cut Out GEC	1.50
Cut Out TCE 8500	2.50
TV18 Rectifier Stick	0.50
TV20 Rectifier Stick	1.30
VA1104 Thermistor	0.35
Aerial Isolator	0.65
Solder 18SWG 60/400.5KGM	5.00
Plug 13A	0.36
Super Servisol	0.75
Foam Cleanser	0.75
Silicone Grease	0.75
Plastic Seal	0.75
Aeroklene	0.75
Freezit	0.75
Antistatic	0.75

TELEVISION

May
1979

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Issue 343

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 OPF.

SUBSCRIPTIONS
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QUERIES
We regret that we cannot answer technical queries over the telephone nor supply service sheets. We will endeavour to assist readers who have queries relating to articles published in *Television*, but we cannot offer advice on modifications to our published designs nor comment on alternative ways of using them. All correspondents expecting a reply should enclose a stamped addressed envelope.
Requests for advice in dealing with servicing problems should be directed to our Queries Service. For details see our regular feature "Your Problems Solved". Send to the address given above (see "correspondence").

this month

OUR NEXT ISSUE DATED JUNE WILL BE PUBLISHED ON MAY 21

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.

MISC.
S/Output transformer from £1.50.
F/Output from £1.25.
Scancoils from £5.00.
P&P £1.
Other spares available on request.

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SPECIAL OFFER
CHROMA £12.00

THORN 1500 TUNERS
NEW SPECIAL OFFER
AT £8.00
Postage & Packing £1.00

MAIL ORDER T.Vs. IN GOOD WORKING ORDER

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.

PERSONAL CALLERS WELCOME.

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.

Briarwood T.V. Limited
Britain's Mail Order T.V. Specialists
BRIARWOOD

THE PROFESSIONAL CHOICE. NATIONWIDE

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	0.28
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
SL917B	5.00

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
PL504	1.10
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

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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

All transistors, IC's, offered are new and branded. Manufactured by Mullard, I.T.T., Texas, Motorola etc. Please add 12½% VAT to all items and overseas at cost P & P U.K. 25p per order, overseas allow for package and postage. Cash with all orders. All prices subject to alteration without notice.

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Please note all mono sets sold as 100% comp.
No broken masks, no broken panels etc.
Colour sets sold with good c.r.t.s and 100% comp.

Working Mono £3.00 extra.
Working Colour £15.00 extra.
Supplied in 1's or 100's.

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GEC	£3.00
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	45	50	50	45	60
Philips	—	—	45	45	60
Thorn	65	—	65	60	85
Bush	55	—	60	60	60
Kort	—	—	65	—	75
Pye Mechanical	45	—	50	—	50
Pye Varicap	55	—	55	—	55

MAINS DROPPERS

Mono

Bush 161	60p
Philips 210 30+125+2K85	45p
Philips 210 118R+148R	40p
Thorn 1400	75p
GEC 2018	55p
Decca 2K5+90+100 +167+5	72p
Thorn 1500	60p

Colour

Bush A823	72p
Pye 723 27Ω+56Ω	47p
GEC 2110 –41Ω	45p
GEC 2110 –12R5+12R5	47p
GEC2110 –27R5	45p
Thorn 3500	54p
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Thorn 8500	54p
Philips G8 47R	25p
Philips G8 2.2+68	36p

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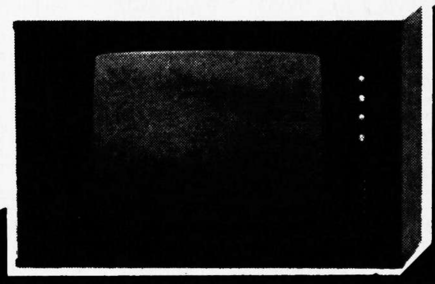

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600mfd 300v.	G8	£1·70
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600mfd 300v.	GEC	£1·65
600mfd 250v.	G8	£1·40
700mfd 250v.	8000	£1·80
1000 mfd 63v.	3500	60p
1250mfd 50v.	169	55p
4700mfd 25v.	1590	70p
2200mfd 63v.	G9	85p
200 + 300mfd 350v.	691	£2·00
400 + 400mfd 350v.	Decca etc.	£2·50
400/350 + 800/250v.	Decca 80 & 100	£2·80
150 + 150 + 100mfd 300v.	1500	£1·55
175/400 + 100 + 100/350v.	3500	£1·95
200 + 400 + 50mfd 325v.	A816	£2·30
200 + 200 + 150 + 50mfd 325v.	GEC	£1·90
300 + 300 + 150 + 50 + 100mfd 325v.	GEC	£2·75
1000 + 1000mfd 40v.	169	75p
1000 + 2000mfd 35v.	GEC	95p
2500 + 2500mfd 30v.	A823	95p

The above prices are for single items.

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2·2/350, 100/63, 220/40.	Five for 85p
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220/63, 1000/16.	Five for £1·00
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0·1mfd 250v. AC (class X) mains filter capacitor.	40p each
5200pF 2kV pulse Flyback type.	40p each
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TRANSISTORS, ETC.

Type	Price (£)	Type	Price (£)	Type	Price (£)	Type	Price (£)	Type	Price (£)	Type	Price (£)	Type	Price (£)	Type	Price (£)	Type	Price (£)	Type	Price (£)
AC107	0.48	AU103	2.40	BC192	0.56	BC377	0.29	BD234	0.66	BF222	†0.51	BPX29	1.62	MPSU05	0.66	ZTX500	†0.18	2N3819	†0.47
AC117	0.38	AU107	2.75	BC204*	†0.39	BC394	0.39	BD235	0.63	BF224 & J	†0.32	BR101	0.53	MPSU06	0.76	ZTX502	†0.22	2N3820	0.72
AC126	0.36	AU110	2.40	BC205*	†0.39	BC440	0.52	BD236	0.63	BF240	†0.32	BR103	0.64	MPSU55	1.26	ZTX504	†0.28	2N3866	1.08
AC127	0.54	AU113	2.60	BC206*	†0.37	BC441	0.59	BD237	0.68	BF241	†0.31	BR303	1.06	MPSU56	1.32	2N404	1.30	2N3904	†0.20
AC128	0.46	BC107*	0.16	BC207*	†0.39	BC461	0.78	BD238	0.68	BF244*	†0.51	BRC4443	1.76	MPSU60	0.82	2N696	0.46	2N3905	†0.20
AC128K	0.55	BC108*	0.15	BC208*	†0.37	BC477	0.30	BD253	1.58	BF245*	†0.43	BRY39	0.60	MPU131	†0.59	2N697	0.48	2N3906	†0.20
AC141	0.65	BC109*	0.16	BC209*	†0.39	BC478	0.25	BD410	1.65	BF254	†0.43	BRY56	†0.44	OC26	1.90	2N706A	0.33	2N4036	0.94
AC141K	0.70	BC113	†0.22	BC211*	†0.36	BC479	0.33	BD433	0.65	BF255	†0.56	BSS27	0.92	OC28	1.49	2N708	0.29	2N4123	†0.17
AC142	0.60	BC114	†0.22	BC212*	†0.17	BC547*	†0.13	BD435	0.70	BF256L*	†0.49	BT106	1.50	OC29	1.60	2N914	0.32	2N4124	†0.17
AC142K	0.65	BC115	†0.24	BC212L*	†0.17	BC548*	†0.13	BD436	0.71	BF257	†0.41	BT109	1.99	OC35	1.25	2N916	0.46	2N4126	†0.17
AC151	0.31	BC116*	†0.25	BC213*	†0.16	BC549*	†0.15	BD437	0.74	BF258	0.52	BT116	1.45	OC36	1.25	2N918	0.54	2N4236	2.20
AC152	0.36	BC117	†0.30	BC213L*	†0.16	BC550	†0.24	BD438	0.75	BF259	†0.54	BT119	5.18	OC42	0.90	2N930	0.29	2N4289	†0.32
AC153	0.42	BC118	†0.24	BC214*	†0.18	BC556	†0.23	BD519	0.88	BF262	0.73	BU102	2.85	OC44	0.68	2N1164	8.29	2N4292	†0.32
AC153K	0.52	BC119	†0.34	BC214L*	†0.18	BC557*	†0.16	BD520	0.88	BF263	0.68	BU105	†1.80	OC45	0.63	2N1304	1.40	2N4416	0.85
AC154	0.41	BC125*	†0.30	BC225	†0.42	BC558*	†0.16	BD599	0.87	BF270	0.47	BU105/02	†1.95	OC70	0.65	2N1305	1.29	2N4444	1.90
AC176	0.46	BC126	†0.30	BC237*	†0.16	BC559*	0.17	BD600	1.23	BF271	0.42	BU108	†2.98	OC71	0.73	2N1306	1.49	2N4921	0.80
AC178	0.51	BC132	†0.20	BC238*	†0.15	BCY10	0.30	BD663BR	0.68	BF272A	0.80	BU126	†2.91	OC72	0.73	2N1307	1.32	2N5042	1.65
AC179	0.55	BC134	†0.22	BC239*	†0.22	BCY30A	1.06	BDX18	1.55	BF273	†0.13	BU204	†2.50	OC81	0.83	2N1308	1.53	2N5060	†0.26
AC187	0.56	BC135	†0.21	BC251*	†0.25	BCY32A	1.19	BDX32	2.95	BF274	†0.34	BU205	†2.78	OC81D	0.95	2N1711	0.47	2N5061	†0.30
AC187K	0.65	BC136	†0.22	BC252*	†0.26	BCY34A	1.02	BDY16A	0.63	BF336	0.63	BU206	†3.09	OC139	1.30	2N1893	0.52	2N5064	0.63
AC188	0.52	BC137	†0.30	BC253*	†0.38	BCY72	0.27	BDY18	1.55	BF337	0.65	BU208	†4.68	OC140	1.35	2N2102	0.71	2N5086	†0.49
AC188K	0.61	BC138	†0.35	BC261A*	†0.28	BD115	1.35	BDY20	2.29	BF338	0.68	BU407	†1.38	OC170	0.80	2N2217	0.55	2N5087	†0.50
AC193K	0.70	BC140	0.36	BC262A*	†0.28	BD123	1.50	BDY38	1.38	BF355	†0.72	BUY77	2.50	OC171	0.82	2N2218	0.38	2N5208	†0.59
AC194K	0.74	BC141	0.44	BC263*	†0.26	BD124	1.85	BF115	0.45	BF362	†0.49	C106D	0.60	OC200	3.90	2N2219	0.42	2N5294	0.66
ACY17	1.20	BC142	0.35	BC267*	0.20	BD130Y	1.56	BF117	0.45	BF363	†0.49	C106F	0.43	OC201	3.95	2N2221A	0.28	2N5296	0.68
ACY19	0.95	BC143	0.38	BC268*	0.28	BD131	0.56	BF120	0.55	BF367	†0.29	C111E	†0.46	OC202	2.40	2N2222A	0.41	2N5298	0.71
ACY28	0.98	BC147*	†0.12	BC286	0.40	BD132	0.68	BF121	0.55	BF451	0.43	D40N1	0.64	OC205	3.95	2N2369A	0.40	2N5322	1.16
ACY39	2.02	BC148*	†0.12	BC287	0.49	BD133	0.70	BF123	0.48	BF457	0.48	E1222	0.47	OCP71	1.98	2N2401	0.80	2N5449	†0.18
AD140	1.79	BC149*	†0.13	BC291	0.27	BD135	†0.37	BF125	0.68	BF458	0.49	E5024	†0.19	ON236A	0.94	2N2484	0.36	2N5457	†0.46
AD142	1.90	BC152	†0.42	BC294	†0.37	BD136	†0.38	BF127	0.51	BF459	0.52	GET872	0.46	R2008B	†2.92	2N2570	0.74	2N5458	†0.40
AD143	1.78	BC153	†0.38	BC297	0.36	BD137	0.40	BF137F	0.78	BF594	†0.16	MC140	†0.36	R2010B	†2.79	2N2646	0.82	2N5459	†0.58
AD149	1.92	BC154	†0.41	BC300	0.62	BD138	0.42	BF152	†0.19	BF596	†0.17	ME0402	†0.18	R2322	†0.75	2N2784	1.15	2N5494	0.85
AD161	0.66	BC157*	†0.13	BC301	0.38	BD139	0.46	BF158	†0.25	BF597	†0.27	MF0404/02	†0.16	R2323	†0.85	2N2869	2.08	2N5496	1.06
AD161/162	1.22	BC158*	†0.12	BC302	0.66	BD140	0.50	BF159	†0.27	BFR39	†0.30	ME6001	†0.18	ST2110	0.49	2N2894	0.48	2N6027	0.55
AD162	0.71	BC159*	†0.14	BC303	0.64	BD144	2.24	BF160	†0.20	BFR40	†0.29	ME6002	†0.18	ST6120	0.48	2N2904*	0.40	2N6107	0.71
AF114	0.35	BC160	0.52	BC304	0.44	BD145	0.75	BF161	0.84	BFR41	†0.30	MJ2955	1.30	TIC44	†0.25	2N2905*	0.39	2N6122	0.80
AF115	0.35	BC161	†0.56	BC307*	†0.17	BD150A*	†0.51	BF163	†0.65	BFR50	†0.29	MJ3000	1.58	TIC46	†0.35	2N2906*	0.38	2N6178	1.07
AF116	0.41	BC167B	†0.15	BC308*	†0.14	BD155	†0.90	BF164	†0.95	BFR52	†0.33	MJE340	0.66	TIC47	†0.45	2N2926G	†0.15	2N6180	1.39
AF117	0.42	BC168B	†0.14	BC309*	†0.18	BD157	0.51	BF166	0.50	BFR61	†0.29	MJE341	0.72	TIP29A	0.47	2N2926D	†0.14	2N6211	2.74
AF118	0.96	BC169C	†0.15	BC317*	†0.15	BD158	0.75	BF167	0.38	BFR62	†0.28	MJE370	0.74	TIP30A	0.50	2N2926Y	†0.14	2SB337BP	4.28
AF121	0.88	BC170*	†0.15	BC318*	†0.15	BD159	0.68	BF173	0.35	BFR79	†0.30	MJE371	0.79	TIP31A	0.51	2N2955	1.12	2SC458C	0.78
AF124	0.38	BC171*	†0.15	BC319*	†0.19	BD160	2.69	BF177	0.38	BFR80	†0.29	MJE520	0.85	TIP31C	0.67	2N3053	0.48	2SC643A	2.25
AF125	0.38	BC172*	†0.14	BC320	†0.17	BD163	0.67	BF178	0.46	BFR81	†0.30	MJE521	0.95	TIP32A	0.56	2N3054	0.86	2SC930D	1.50
AF126	0.36	BC173*	†0.22	BC321A&B	†0.18	BD165	0.66	BF179	0.58	BFR86	†0.42	MJE2955	1.20	TIP32C	0.72	2N3055	0.72	2SC1061	1.45
AF127	0.86	BC174A & B		BC322	†0.28	BD166	0.58	BF180	0.53	BFT41	0.48	MJE3000	1.95	TIP33A	0.77	2N3250	0.52	2SC1172Y	3.55
AF139	0.58		†0.26	BC323	1.15	BD175	0.90	BF181	0.53	BFT43	0.55	MJE3055	1.22	TIP34A	0.84	2N3254	0.56	2SD234	1.48
AF147	0.52	BC176	0.22	BC327	†0.16	BD177	0.58	BF182	0.44	BFW11	1.02	MPF102	†0.40	TIP41A	0.72	2N3391A	0.38	3N128	1.60
AF149	0.45	BC177*	0.20	BC328	†0.18	BD178	0.92	BF183	0.52	BFW30	2.58	MPS3702	†0.33	TIP42A	0.80	2N3633	12.70	40250	0.98
AF178	1.35	BC178*	0.22	BC337	†0.17	BD181	1.94	BF184	0.44	BFW59	†0.19	MPS3705	†0.30	TIP2955	0.77	2N3703	†0.17	40251	1.14
AF179	1.36	BC179*	0.28	BC338	†0.17	BD182	2.10	BF185	0.42	BFW60	†0.20	MPS6521	†0.36	TIP3055	0.58	2N3704	†0.19	40327	0.67
AF180	1.35	BC182*	†0.15	BC340	0.19	BD183	1.34	BF186	0.42	BFW90	†0.65	MPS6523	†0.38	TIS43	†0.44	2N3705	†0.17	40361	0.48
AF181	1.33	BC182L*	†0.15	BC347*	†0.17	BD184	2.30	BF194*	†0.14	BFX29	0.38	MPS6566	†0.44	TIS73	†1.36	2N3706	†0.16	40362	0.50
AF186	1.46	BC183*	†0.14	BC348A & B		BD187	1.00	BF195*	†0.13	BFX84	0.42	MPSA05	†0.30	TIS90	†0.23	2N3707	†0.16	40410	0.94
AF202	0.27	BC183L*	†0.14		†0.17	BD188	1.25	BF196	†0.14	BFY50	0.38	MPSA06	†0.32	TIS91	†0.28	2N3708	†0.17	40429	0.88
AF239	0.73	BC184*	†0.15	BC349B	†0.17	BD189	0.71	BF197	†0.15	BFY51	0.37	MPSA55	†0.43	ZTX108	†0.14	2N3715	1.70	40530	0.79
AF240	1.40	BC184L*	†0.15	BC350*	†0.24	BD222	0.91	BF198	†0.18	BFY52	0.38	MPSA56	†0.45	ZTX109	†0.16	2N3771	2.39	40595	1.39
AF279S	0.91	BC185	0.36	BC351*	†0.22	BD225	0.91	BF199	†0.29	BFY53	0.36	MPSA93	†0.56	ZTX213	†0.23	2N3772	2.58	40603	1.13
AL100	1.30	BC186	0.25	BC352A*	†0.24	BD232	0.91	BF200	†0.25	BFY90	1.98	MPSL01	†0.33	ZTX300	†0.16	2N3773	3.90	40636	1.25
AL103	1.58	BC187	0.27	BC360	0.59	BD233	0.62	BF218	†0.42	BPX25	1.62	MPSU01	0.61	ZTX304	†0.26	2N3794	†0.40	40654	0.89

Alternative gain versions available on items marked*. For matched pairs add 20p per pair.

LINEAR IC's

Type	Price (£)	Type	Price (£)	Type	Price (£)
BRC1330	†0.93	SN76008KE	1.56	TBA240A	†3.98
CA810QM	2.44	SN76013N	1.56	TBA281	†2.07
CA3005	1.85	SN76013ND	1.40	TBA395*	†2.58
CA3012	1.45	SN76018KE	1.56	TBA396	†2.40
CA3014	2.23	SN76023N	1.56	TBA400	†2.20
CA3018	0.71	SN76023ND	1.40	TBA480Q	†1.84
CA3020	1.89	SN76033N	2.22	TBA500*	†2.21
CA3028A	0.80	SN76110N	1.20	TBA510*	†2.21
CA3028B	1.09	SN76115N	†1.62	TBA520P*	†3.40
CA3045	3.75	SN76116N	1.78	TBA530P	†2.24
CA3046	0.70	SN76131N	†2.10	TBA540*	†2.88
CA3065	1.74	SN76226N	†2.80	TBA550*	†3.13
CA3068	1.90	SN76227N	†1.61	TBA560C*	†3.18
CA3130S	1.57	SN76228N	†1.80	TBA570*	†1.29
FCH161	†2.40	SN76502N	†1.92	TBA611B	2.68
FCJ101	†3.32	SN76530P	†0.97	TBA641	2.55
LM309K	1.98	SN76533N	†1.38	TBA641A12	2.35
LM380N-14	1.66	SN76544N	†1.85	TBA641B11	2.61
LM1303N	3.08	SN76546N	†1.85	TBA651	†2.12
MC1307P	†1.82	SN76570N	†1.81	TBA673	†2.19
MC1310P*	†1.94	SN76620AN		TBA700*	†2.50
MC1312P	2.34		†0.99	TBA720AQ	†2.38
MC1327P*	†1.86	SN76650N	†1.48	TBA720Q	†2.38
MC1330P	†0.93	SN76660N	†0.64	TBA750*	†2.18
MC1350P	†1.22	SN76666N	†0.96	TBA800	1.65
MC1351P	†1.42	TA7073P	†3.51	TBA810AS	1.69
MC1352P	†1.42	TAA263	†2.20	TBA920*	†3.80
MC1357P	†2.92	TAA300	†3.85	TBA940	†3.62
MC1358P*	†2.30	TAA320	1.10	TBA950	†2.78
MC1458G	1.43	TAA350A	†2.48	TBA990*	†2.90
MC1496L	1.15	TAA370A	3.18	TCA270A*	†3.55
MC3051P	0.58	TAA435	†1.70	TCA280A	1.43
MFC4008	0.85	TAA450	†3.39	TCA290A	3.46
MFC4060A	0.98	TAA521	1.10	TCA420A	1.98
MFC6040	1.11	TAA522	2.09	TCA440	1.67
MIC1P	2.56	TAA550	0.45	TCA640	2.76
ML231	†3.57	TAA560	1.93	TCA650	2.76
ML232	†3.57	TAA570	†2.30	TCA660	2.76
NE555	0.72	TAA611A	1.67	TCA730	3.54
NE556	1.34	TAA611B	1.89	TCA740	3.04
NE566	1.95	TAA621AXI	2.33	TCA750	2.63
SAA1024	†5.70	TAA630Q	3.91	TCA760	1.52
SAA1025	†10.35	TAA630S	4.18	TCA820	3.29
SAS560A	†2.01	TAA661A	2.38	TDA440	†4.16
SAS570	†2.01	TAA661B	1.75	TDA1003	1.52
SC9503P	†1.40	TAA700*	†2.80	TDA1004	2.73
SC9504P	†1.38	TAA840	†3.38	TDA1005	3.04
SL414A	1.91	TAA861A	0.95	TDA1022	6.89
SL432A	2.52	TAA930A	1.43	TDA1024	0.97
SL450	5.10	TAA930B	1.43	TDA1034	1.98
SL901B	†4.20	TAA960	†2.25	TDA2610	2.86
SL917B	†5.60	TAA970	†2.48	TDA2640	2.86
SL918A	†5.95	TAD100	†2.66	ZN414	1.45
SN72440N	†2.21	(Filter)	0.98		
SN76001N	†1.67	TBA120A	†0.90		
SN76003N	2.22	TBA120S*	†0.99		
		TBA120SA	†1.02		
		TBA231	1.12		

* Indicates Q version is also available.

DIODES

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

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	0.48
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	0.80
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	0.67
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	0.86
	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

Mixes of a minimum of 10pcs of any value:

Carbon Film (5%) (†)	Ea	10 of one value	50pc	100pc	500pc
¼W 5.6Ω-330kΩ (E12)	3p	25p	95p	£1.40	£6.40
½W 10Ω-10MΩ (E24)	3p	25p	95p	£1.40	£6.40
1W 10Ω-10MΩ (E12)	5p	45p	£1.95	£3.40	£15.25
2W 10Ω-10MΩ (E6)	9p	80p	£3.60	£6.40	£28.90

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 £3.58
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
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What we already knew

The National Economic Development Council's electronic consumer goods Sector Working Party (SWP) has issued a report on the state of the industry. It doesn't contain anything very surprising – industry watchers will be well aware of the industry's problems in recent years. It's useful however to have everything spelt out in one convenient summary.

The report emphasizes the industry's lack of international competitiveness, and the increasing percentage of the home market taken by imports. The industry's output in 1977 was valued at £523 million, 22 per cent of which was exported. The balance of trade deficit for the year was £214 million. Imports have increased from 19 per cent in 1970 to 49 per cent in 1977, while employment in the industry fell from a peak of around 70,000 in 1973 to about 52,000 in 1977.

Mention of 1973 brings us once again to the great Barber boom. Just to refresh your minds, during that boom year sales of colour sets in the UK rose to 2·775 million, of which over 2 million were home produced, an increase of 43 per cent on 1972. That incredibly rapid expansion in so short a time brought with it many bad habits and conditions from which we are only now escaping – the use of almost any components that could be obtained in a situation of severe component shortages, lack of attention to testing, and crude assembly techniques adopted so as to get the sets produced regardless. The economic situation then led to the government having to slam on the brakes. Colour receiver deliveries fell by 20 per cent in 1974, by a further 28 per cent in 1975, and then bottomed out in 1976, when the fall was only 5 per cent, at 1·506 million. But what a massive overall drop – and with imports continuing to do well as the reputation of UK produced sets came into growing question.

Colour receiver production is only part – though much the largest – of the UK's consumer electronics industry. Returning to the SWP report, the industry's problems in competing with products from lower cost countries is emphasized – mainly Japan, Taiwan, Singapore and South Korea. The report comments that the industry's response has been largely defensive, withdrawing from the production of cheaper lines such as transistor radios to concentrate instead on more sophisticated products – colour receivers in particular. In fact the report points out that concentration on colour receiver production has masked the overall decline of the UK's consumer electronics industry. It also points out that the prolonged spell of depressed demand from 1974 onwards led to reduced profitability and in turn decreased industrial investment. What this amounts to is that the industry has been burdened with excess and increasingly antiquated and uneconomic production capacity, and has not been able to generate the funds required to buy and instal the latest production equipment – automatic component insertion machinery, computerised component testing equipment, and so on. Graphic examples of the consequences can be quoted: the closure of Thorn's Bradford plants for example, and the need for Rank and GEC to link up with Toshiba and Hitachi in order to obtain modern assembly plant.

The SWP has put forward various proposals, though their likely effectiveness is open to question. One is the need to limit imports to protect UK employment in the short run and to provide a respite during which the industry can be reorganised. Voluntary restriction agreements have in fact already been negotiated by the industry. They could well help the TV industry: one can't see anything short of a siege economy leading to the return of large-scale radio receiver production however, and that's clearly not on whatever government we have in the immediate future.

During 1978 the SWP commissioned the Boston Consultancy Group to carry out a study of comparative production costs. Again, this doesn't tell us anything not already pretty widely known. It confirmed the lack of cost competitiveness of UK produced goods relative to those of Far Eastern origin – though UK costs are roughly comparable to those in W. Germany – and pointed out that Japan's substantial cost advantage has been achieved through its high level of investment, automated production and insistence on high-quality components.

A strategy to halt the UK industry's decline and provide a basis for increased exports is suggested. This calls for expenditure of £300 million over the next five years, which it feels would be sufficient to eliminate the trade deficit and provide a foundation for sustained future growth. There seems a certain vagueness about where this money is to come from however. Other proposals are mainly obvious ones, such as industry rationalisation, the use of more sophisticated production techniques and so on.

Against a background of continuing world recession however one fails to be convinced by these fine words. One thing is certain: increased employment is not going to be achieved. Increased investment in modern production equipment means that the industry will end up more capital intensive and less labour intensive. One also has a feeling that the increasing links between the Japanese and the UK consumer electronics industries could end up with the UK industry simply providing off-shore assembly lines for the Japanese. As for talk of increased UK production of radio receivers, tape recorders, public address equipment and so on, someone seems to be whistling in the dark.

PRICE INCREASE

We regret that it has been necessary to increase the cover price of *Television* with this issue. The increase (5p) has been kept to the minimum practical amount, and has been agreed to by the Price Commission. We have held the price steady since November 1977, but the effects on our costs of continuing inflation during this period have now made an increase unavoidable.

Teletopics

JAP FIRMS INCREASE UK TV INTERESTS

Following the joint operations being set up by Rank-Toshiba and GEC-Hitachi, the latest development is the complete take over of a UK TV setmaking plant by one of the large Japanese TV manufacturers. The opportunity, seized by Mitsubishi, came following the financial difficulties in which Tandberg's Norwegian parent company found itself late last year (see *Teletopics*, February). Tandberg has now been reorganised, and its profitable data products, educational and high-quality audio equipment divisions are continuing as newly established concerns. The production of colour receivers in Norway, the cause of the loss-making situation, has ceased. This left Tandberg's UK colour setmaking plant at Haddington, outside Edinburgh, out on a limb, since colour receivers no longer form a part of Tandberg's overall sales strategy. Mitsubishi has now taken over the Haddington plant, which has been producing some 25,000 sets a year, and plans to increase production there and also to diversify into other areas such as audio equipment manufacture. It's understood that the present CTV3 chassis is still in production, but that there will be a rapid change over to Mitsubishi designs. Tandberg (UK) comment that existing service and repair guarantees will be honoured, and that parts and expertise will be available for at least seven years.

Meanwhile, Sony (UK) is undertaking a 140,000 sq. ft extension to its Bridgend, South Wales TV plant. This is expected to be completed late next year and will increase the production capacity to 150,000 colour sets a year, about half of which will be exported to markets in Europe, the Middle East and other overseas areas. Matsushita (National Panasonic), which ceased exporting colour TV sets from Japan to the USA last year, has announced that during 1979 it will be increasing its overseas production of colour sets by about 20 per cent – Matsushita also has a colour TV plant in S. Wales.

WHAT'S IN A NAME?

Fidelity Radio has signed an agreement with EMI giving it exclusive rights to use on a new range of audio and radio products one of the world's most famous trademarks, the "His Master's Voice" dog and gramophone symbol. The aim is to introduce a new up-market range of equipment which will be sold by independent dealers and marketed through a newly formed subsidiary, Intersound Electronics. EMI will continue to use the trademark on its discs and tapes.

EMI ceased to manufacture its own radio and television receivers in the mid-fifties, and for many years after that the trademark and name were used by Thorn for its up-market models. Thorn dropped the brand name a couple of years ago whilst rationalising its operations, and the only firm that's understood to have been using it recently is RCA in the US.

National Panasonic has decided to drop the "National" bit from its brand name and will in future be using the contracted title Panasonic. The parent company Matsushita will be following this policy world wide.

TRADE SCENE '78

BREMA has released details of colour/monochrome TV/radio/audio equipment deliveries to the trade during 1978. As mentioned in our leader this month, colour receiver deliveries fell to their lowest point in recent years in 1976. There was a slight increase (8·9 per cent) in deliveries in 1977 (to 1·64 million), and a further slight increase (6 per cent) in 1978 (to 1·74 million). Though deliveries of UK produced colour sets rose slightly in 1978, they accounted for a slightly lower proportion of total deliveries at just under 80 per cent. Monochrome set deliveries did well in 1978, rising by 20 per cent to 1·27 million, with the UK share of the total rising to 54 per cent.

AUSTRALIA TO HAVE TV SATELLITE

Australia is the latest to join the growing number of countries which either have or are planning a satellite TV system to cover their remoter areas. The Australian government plans to spend some $A9 millions on a three-year plan to bring TV to 76 towns in remote areas. During the first two years of the programme 41 receiving stations for local distribution will be built.

WHAT WILL 30AX BRING?

Now we all know that the 30AX colour tube/yoke system is on its way – though it's understood that the design details have not yet been finalised – the next question is what will it involve in terms of chassis design? First however the advantages of the system: no convergence correction circuitry is required; improved focus is obtained by using a higher-voltage focus system; and use of a more sensitive deflection yoke gives, in combination with the elimination of convergence correction circuitry, a reduction of 10W dissipation in both the field and line deflection circuits. The saving in the field scan circuit is particularly noteworthy, halving the dissipation in comparison to the 20AX system. As a result, Mullard are recommending the use of a class B field timebase i.c., type TDA 2652. A proposal put forward by Mullard is to obtain the drive for the line output stage from the switch-mode power supply. Since with this system the line output transistor and the efficiency diode could both be non-conductive in the event of a large change in the mains voltage, leading to a discontinuity of the line scan, a three-diode EW modulator circuit is recommended – one diode will remain conductive to provide a clamp action, removing the possibility of scan discontinuity. Various switch-mode power supply options are suggested, but it seems that much of the circuitry used for the 20AX system can be retained.

SONY DEVELOPING VIDEODISCS

At the US IEEE Conference on Consumer Electronics last year Sony showed a prototype videodisc player using, like the Philips system, a helium-neon laser to scan the disc. Sony comments that the same basic player can be used with an adaptor to reproduce digitally recorded (p.c.m.) audio discs, and feels that a compatible video/audio disc system will be more convenient and acceptable to customers. In commenting on possible domestic VCR developments, Sony points out that on the basis of recent trends we could, in the early 1980s, expect track widths of ten microns or so and minimum recorded wavelengths of 0·8-0·9 microns. This would give a recording density three or more times higher than current VCR standards, leading to a three-hour or more cassette as small as the present compact audio cassettes.

ENGINEERING GO AHEAD FOR TV4

Parliament has given the second reading to a bill authorising the IBA to incur expenditure to equip itself for the transmission of the fourth UK TV network. The IBA will be able to use for the purpose operating surpluses up to a total of £10 million, and to borrow from the government if necessary up to a further £18 million. The Home Secretary pointed out that whatever authority eventually provides and supervises the fourth network, preliminary engineering work needs to be started quickly. It's hoped that the engineering work will be complete by 1982.

PYE TO MARKET VCR

The Philips N1700 VCR is also to be marketed in the Pye range of domestic TV equipment.

SALORA ENTERS UK MARKET DIRECTLY

Scandinavia's largest exporter of colour TV sets, the Finnish firm Salora OY, is to establish a wholly-owned subsidiary to market its sets in the UK. The intention is to start a limited dealership distribution system. Salora's sets are not unknown in the UK: for many years they have been supplied to Granada TV Rentals under the Finlandia brand name.

DOUBLE-HEIGHT TELETEXT DISPLAY

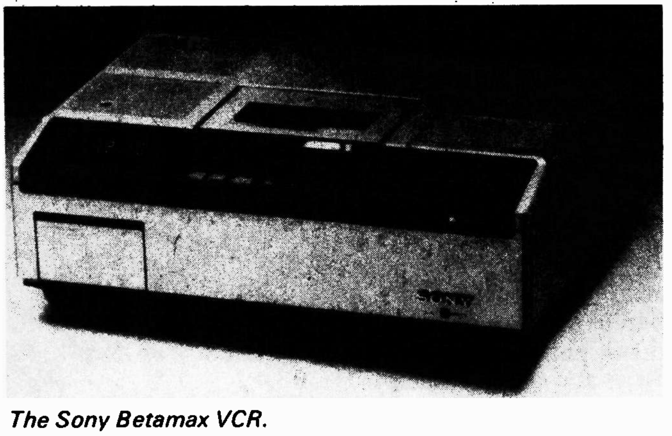
The latest teletext receiver from Philips, the up-dated 26in. Model 674/02, features a double-height graphics facility – either the top or the bottom half of the teletext page can be enlarged to twice the normal size and displayed, giving easier reading. Two extra buttons on the remote control handset control this extra facility. There are plans for including the facility in a smaller-screen model shortly.

UP-DATED CRT TESTER

Video Circuits (1a, Wentworth Court, Alston Road, Barnet, Herts) have introduced a new, up-dated version of their c.r.t. tester, Model V35. There are plug-in bases so that the latest types of c.r.t. can be tested – both monochrome and colour. Beam current is measured at the c.r.t.'s first anode, making it unnecessary to disconnect the e.h.t. cap. Comparisons between the performance of the three guns in a colour tube can be made, there is a tube reactivation facility, and the tester can also be used as a 50MΩ ohmmeter.

PORTABLE WITH A FLAT-FACED CRT

Due for release later this year at a suggested retail price of about £110 is a new 5in. radio/TV portable, Model 5TH-65R, from Crown. An unusual and exclusive feature is a completely flat-faced c.r.t., which Crown say will give a larger viewing area. A colour version is predicted for next year. The medium/long/v.h.f. radio section has magic-eye tuning, an external aerial can be connected for use in weak signal areas, and the set can be operated from internal batteries, the mains, a rechargeable power pack or a car battery.



The Sony Betamax VCR.

VCR CONVERSIONS

When we first published, in February 1978, some suggestions for converting the earlier Philips N1500 etc. machines to the current N1700 standard, we received several rather rude letters from readers who maintained that such unofficial changes to a very sophisticated piece of equipment were just not on. Well, the proof is in the eating as they say, and it seems that several firms are now willing to undertake this exercise. Reports of successfully converting the N1500 and the N1502 have appeared in our Letters pages (August 1978 and April 1979 respectively), and "Square Wave", a regular contributor to the *Electrical and Electronic Trader*, wrote on the subject recently in that magazine. He says his firm finds the results very satisfactory and cost-effective in terms of cash saved on tapes, and that the work can be carried out for about £120 plus VAT – provided the machine is in good condition of course. The N1700 head unit is mechanically identical to the earlier ones, so can be fitted without trouble. To reduce the tape speed to the required figure, the size of one of the drive pulleys is reduced and a jig specially made for the purpose is used to grind an exact amount off the capstan spindle. Some other mechanical work is necessary, also some work on the electronics to alter the servo circuits. A final point made is that it's considered inadvisable to use a tape with a running time of more than two and a half hours.

LOW-COST VIDEO/TV SET LINK

Datanomics (Westminster Road, Wareham, Dorset BH20 4SP) have introduced a low-cost u.h.f. modulator unit that enables video and audio signals to be fed into and reproduced through an ordinary TV set. The Datacom, as the unit is known, enables any composite video signal from a TV camera, videotape recorder, TV games chip, microprocessor or character generator for example to be linked to a domestic TV set – with the added advantage of sound. Audio compressors are incorporated to ensure that both soft and loud sounds are clearly audible. Amongst the many possible suggested uses are caller identification, security surveillance, farm animal monitoring, and document/information transmission.

STATION OPENINGS

The following relay transmitters are now in operation:
Ashburton (Devon) BBC-1 ch. 21, Westward Television ch. 24, BBC-2 ch. 27. Receiving aerial group A.
Dog Hill (Greater Manchester) BBC-1 ch. 40, Granada Television ch. 43, BBC-2 ch. 46. Receiving aerial group B.
Skinningrove (Cleveland) BBC-1 ch. 40, Tyne Tees Television ch. 43, BBC-2 ch. 46. Receiving aerial group B.
All the above transmissions are vertically polarised.

SERVICE BRIEFS

A couple of points that may be worth noting from Rank. First the old problem of field bounce due to the time-constants of the a.g.c. circuit, this time on the latest T22A chassis. The cure is to change 2C16 on the signals panel from 1μF to 2·2μF. Secondly, there have been cases of no results on the T20/T22A chassis due to the line oscillator failing to start because of failure of 4D11. Rank suggest using a more robust replacement – type 1N4001.

Letters

VIDEO FAULTS

I was surprised at AD's description of the fault on the Hitachi HV40 camera fitted with a silicon-diode tube, and even more so that the auto-target control worked. While altering the target voltage of a vidicon tube will alter its sensitivity, this is not so with a silicon-diode tube – hence the need for an auto-iris lens which samples the video output. The target voltage should be fixed at 8V and not altered, the auto-target circuit being superfluous. I suggest carrying out further modifications in this respect.

The spreading of light from a bright source is a characteristic of silicon-diode tubes – due to space-charge spread on the diodes. The effect is usually eliminated with the H version of the tube (i.e. 4833H), while Chalnicon and Newvicon tubes do not suffer in this respect.

The auto-iris lens system does not refer to any preset level as such. The video output signal is integrated to an average d.c. level which is then referred to a fixed reference, the iris motor then operating to adjust for any imbalance due to video level changes. The preset is a video level control. A distinct disadvantage of the system is that the auto-iris lens will shut down on a single source. For example, if a camera giving a reasonable picture in a room is panned and a window appears in the scene, the auto iris will shut down making it difficult to see anything but the window, due to the video "average" being considerably increased by the single, small high brightness source. A Chalnicon or Newvicon will produce less output from such a source as the tube limits. So much more of the room in the example given would emerge from the black level depths.

In connection with the article on VCR renovations, I'd like to add the following tips:

(1) Good forward wind, good take-up tension, poor rewind. Don't touch the clutches. Replace the small idler wheel between the capstan and turntables (part no. 528-70242).

(2) Start key-knob locking down. Adjust the latching plate underneath by bending its little leg.

(3) The worst fault of all, a tracking error at the bottom of the screen on its own recording/replays. Steps to take are: (a) A good clean of the guide surfaces. (b) Check threading cord and springs, and that the head assembly rotates fully on threading up. Lightly oil around the head assembly. (c) Check threading motor for full travel, and adjust nylon screw (180A on exploded view diagram). (d) Panic . . .

Avoid going in for cosmetic replacements: a lid for the N1500 is more than £50 plus VAT, and for the N1501 more than £70 plus VAT.

It will cost nearly £100 in parts to renovate the average machine with a lot of wear. So tread carefully.

Steve Beeching, T.Eng. (CEI), Newark.

DARK HORIZONTAL BANDS

A maniacal cackle of laughter echoed through the workshop when I read in *Your Problems Solved* the plea for help from the bloke with dark bands across the screen of his Pye hybrid colour set. The symptoms, you'll recall (March, page 271), were dark bands across the picture whenever a bright white was displayed (typically caption letters).

I renovate a lot of these sets, and a month or two ago was beating my head against the brickwork when confronted with this problem on *four* sets in which I'd fitted regunned tubes! Took tubes back to regunner, but they checked out perfectly. Rang Philips Service who gave the same advice you did. Changed every panel in the set one by one, but after all this found the fault still present. In desperation gave the set a resounding thump – and the fault disappeared! Aaaargh!

There's an earth strap that goes from the c.r.t. base to the line timebase panel, via the tube shield. I'd been forgetting to put it back on the line timebase earth tag: it had been resting on the metal body of the tower but not contacting – till my thump disturbed it!

Why didn't I take up an easy profession, like alligator wrestling?

Roderick M. Buck, Lincoln.

13A PLUGS/SOCKETS

The electrical query raised in the March *Teletopics* is virtually a stock fault with all (regardless of make) 13A plug and socket combinations when operating at their peak of around 12A say – they start cooking. The square plug pin carries this o.k., but the socket makes insufficient contact area with the pin – hence the heat generated.

Being in an experimental mood the other day, I measured the voltage drop across the 13A fuse with a 3kW load. Surprisingly, this was 0·1V a.c. So with 12·5A flowing this means that the fuse wire is knocking out 1·25W – not bad for a wee piece of wire! The fuse wire is well heatsinked however, so we have to say that the heat producer is the live pin-socket contact – or rather the lack of it.

Conclusion: definitely a case for British Standards tightening up their specification here.

John Riddell, Glasgow.

PHASE CONFUSION

I read with interest the article on phase confusion in the February issue. I'd like to point out an error in Fig. 2(c) however. In paragraph four S. W. Amos states that "to produce the result shown in Fig. 2(c), in which the wave is delayed by half the fundamental period without a change in the waveshape, a network that introduces a 180° phase shift at the fundamental frequency, ... is needed." This is true of a waveform which, although not symmetrical in the positive and negative going aspect, does at least change from positive to negative (or vice versa) at the 180° time point – in other words when the time period of each excursion is the same. But this is not the case in Fig. 2, and although the inversion of waveform (a) is as illustrated in waveform (b), it's not correct to say that waveform (c) represents a 180° phase change. The correct waveform is shown in Fig. 1 herewith. It will be noticed that the negative

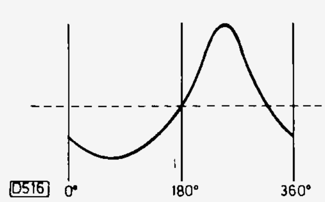


Fig. 1: Asymmetrical waveform shifted by 180° – compare with Fig. 2, page 202, February 1979.

part of this waveform extends over about 215°. This means that a phase change of only 180° gives a waveform which starts at a negative value on the Y axis.

J. Sinclair, C.Eng., M.I.E.R.E., Epsom.

Come back, come back . . .

Les Lawry-Johns

WE'VE just had the roughest patch for a very long time. I now realise that as a service engineer I'm a pretty good cowboy. Even so, most of it wasn't my fault . . . but some was.

An Ageing Ultra

When Mr. Middlestump (initials L.B.W.) brought in his somewhat ageing Ultra 3000 because it didn't go, we thought it was going to be another quick job. It wasn't too easy, but then again it wasn't too bad – at the start that is. The tube heater was glowing, or rather the tube heaters were glowing, and there was plenty of h.t. on the body of the chopper transistor (VT604). Other than this, there were no signs of life.

Checking the 30V line proved that F602 was intact, the 30V was present and was being passed on to the line oscillator. R607 in the feed to the chopper driver transistor VT605 seemed to be warmer than usual however, so the voltage at its "low" end was checked and found to be 5V instead of 12V. Funny, we thought. Until this was cleared up there was no chance of the chopper being driven. So out came the power pack, after the usual struggle with the front hooks.

An ohmmeter check on the 12V line showed a low reading one way but a higher one the other. This didn't seem strange, but in view of the low voltage we thought it worth investigating. Moving the test prod from chassis to the emitter of VT605 showed a dead short whichever way the leads were connected, and in no time at all VT605 was out and another E1222 was fitted.

With the power unit back in the set the chopper started chopping or whatever choppers do, and all services were restored. A fair picture was displayed, and Mr. Middlestump was happy when he took his set away. He wasn't happy for long. He was back the next day. Sound, no picture: screen lighting up, purple. Examining the latter first, with the set on its side, we found the green output transistor's collector voltage high and this transistor proved to be open-circuit. In went another and the grey scale was restored, but of course still no picture.

So back along the line we went and finally ended up on the i.f. strip, set now the right way up. The final i.f. amplifier transistor VT104 turned out to be open-circuit. Replacement restored the picture and made the sound a lot stronger (it would have been much simpler had the sound signals gone right off, as they should have done, but they didn't). So there we were, all systems go. For a while that is.

We showed the picture to Mr. Middlestump and were just saying "nice, isn't it?" when the picture went completely blurred. Surely not the tripler? Removing the rear cover showed the focus lead from the tube away from its pin on the top right side. I was about to plonk it on when there was a sharp crack in the tube (I think) and the set went dead. The cutout had cut out. Putting the focus lead on firmly, I pressed in the cutout button. There was a hum and it popped out again. Frantic investigation showed that both R2009 line output transistors had gone short-circuit.

"Surely nothing else could have gone wrong?" said Mr. Middlestump a trifle irritably.

"It could, it has and I don't like it any more than you do" I said.

We wearily fitted another pair of line output transistors and carefully checked around to make sure that everything was in order. Back came the picture but the height was anything but right – and fluctuating in time with a queer hum which came and went. Voltages were varying on the field panel, and much time was wasted in this area. We then found that the 30V line was fluctuating between 40V and 45V.

Panic stricken, we turned to the 30V stabiliser transistor VT601 and accused it of having emitter-to-collector leakage. So we changed it: the variation continued apace. Unhooking its emitter lead should have killed the lot. It didn't. In fact the voltage went up. There was obviously a leak from the h.t. line, but where? Unhook this, unhook that. Red herrings came and went. Many were the bitter tears that fell.

Bleary eyes scanned the circuit diagram and focused on the power unit. I had looked at the links from the h.t. rail to the feedback amplifier VT608 several times, but had stupidly not seen the relationship between W619 and W620 (see Fig. 1). If W619 goes short-circuit the 30V rail will be connected to h.t. via W620. Fool. A quick check on W619 proved that it was indeed short-circuit. Out it came and in went a replacement. 30V line steady. Height stabilised. Picture quite good.

"It's O.K. now Mr. Middlestump. I think."

"I wouldn't like your job" he said. "Fancy all that just because you left a lead off."

"I, I, er, oh well never mind." I gave up.

I thought (hoped) that that was the end of that one. It wasn't. However . . .

No Colour

His name isn't Mr. Hoo actually, but he came from Hoo which is a fair distance from us and is on the Medway. His name was so unusual however that I just can't spell it.

Anyway, it was an ITT CVC5 or something like that and it had no colour. Ah ha, thought I, not going to get caught this time. So off came the back and up the top we went to ensure that the flip-flop was flip flopping (T36, T37). Sure enought, it wasn't. So back to the ident transistor T35 to see how this was faring. "Nice colour" said Mr. Hoo as I touched the test prod on the base of T35. So I took it off. The colour stayed. "Very good" he said. "How did you do it?"

"Blowed if I know" I confessed, thinking to myself that I must have prodded T35 into life thus starting up the 7·8kHz generator. This suggested that T35 was sluggish, so I changed it. Result: no colour.

All associated components were painstakingly checked, and Mr. Hoo departed because he had a lot to do.

We then found that an electrolytic bridged across C205 ($4\cdot7\mu F$) in the burst amplifier's collector circuit restored colour signals. That's it! It wasn't.

The temptation to rush round the decoder in a blind panic was resisted since the trouble was right there up on the top right side and was probably a dry-joint of some kind. But where? The burst amplifier transistor T34 next received attention. The voltages were slightly wrong, so the associated components were checked and the transistor changed. Full colour! Nothing would shift it. I thought (hoped) that that was that. It wasn't.

When Mr. Hoo came back we proudly showed him his glorious colour and off he went with many a yelp of pleasure. One hour later he phoned to say that he had no colour. He yelped with displeasure and said he would return the following day. I cried.

Enter a Jolly River Pilot

"Mr. Lolly-Jones is it?" rubbing me up the wrong way to start with. "Harold said I'd find you here. Frankly I didn't know you existed till he told me over a pint. Anyway, I've a Bush colour set and it keeps going down to a thin white line or two across the screen every week or so and the buggers can't find out why. Harold said to take it to you and you'd sort it out in no time. Speedy Gonzales he called you. Ha Ha!" Bully for Harold. With friends like him you don't need enemies. So in came the Bush CTV1226 (A823B chassis).

Prodding around the field timebase caused the fault to come and go, but it wasn't till we opened up the panel and played with the pincushion phase coil 6L20 that the cause was evident. Resoldering the coil pegs cleared the trouble permanently.

"Well I never. Perhaps it'll be all right for a week or so, eh?"

"Bet you a pint to a brandy it'll stay longer than that."

It was not quite the end of the saga though.

"Oh, by the way, last night we kept getting a sort of morse code coming through on the sound. Perhaps you could have a quick look at the sound side while it's here?"

Until now I'd kept the sound down. Turning it up produced quite reasonable quality but with an edgy edge to it. After a short time the quality became worse and the thing started to motor boat. I touched the audio transistors and burnt my fingers. Spraying the BC126 driver transistor 2VT11 with freezer stopped the motor boating, but for a short time only. So I stuck in an equivalent and this got hot too. The voltages were haywire, and how it produced reasonable sound beats me. Checking the output pair cold showed that they gave perfectly good readings, provided they were both npn types that is. *BOTH* npn?

Grabbing the circuit confirmed that the lower one should be a BC139 pnp transistor. The one fitted was an npn field output type 16039. My mind went numb. How long had this been in? Perhaps this is what is meant by bipolar . . . Now I knew.

Anyway, we stuck in a BD204 and everything ran nice and cool and there was no more morse code.

Looking back at the screen and changing channels, the faces went green.

"Oh that happens quite often. We just press the buttons in a couple of times and it goes right again."

Getting the faces to go green again, we reset the ident preset 3RV4 and tried it a few times. Now O.K.

Wrap it up and chat. "Thanks very much. Nice to have met you. See you soon. Goodbye." Very nice chap. His wife was very nice too. Funny about that sound output though.

Back they Come

The phone rang. Mr. Middlestump, and I felt my nerves cracking.

"We're having to watch this rotten set in black and white. After it's been on about an hour the colour starts flickering in and out and we're fed up with it."

"So am I. Why don't you find a good engineer?"

"I'll bring it in tomorrow. Perhaps it's only a little thing caused by that wire coming off. Cheers."

So we had a lovely day to look forward to. The ITT with intermittent colour and the 3000. Quite apart from the usual run of the mill heartache. Was tomorrow going to be the day when they would finally cart me off to the funny farm?

When it was time to get up in the morning I didn't want to. I wanted to stay there nice and warm and go back to sleep and not face these colourless colour sets.

The cat insisted that I got up however, so down we went to feed her, take the dog for his sniff around and generally do all the things everyone does at the start of the day.

Easy Ones

The first set to be tackled was of all things an ITT. No signals. No transistor supply voltage. O.K. at the l.t. bridge. Not passing through the AD161 regulator transistor as its base voltage very low. This comes from T45 (BC170) which was also not being turned on. Check the reference voltage. Very low. Suspect the zener i.c. D11. Change to TAA550. All voltages now back to normal. Picture rolling, so change PCL805. Width in each side, so check drive to PL509. O.K. Change PL509. Done.

Bring on the next one. Thorn 8500, picture very blurred, suspect focus unit. Focus unit O.K. Low voltage at focus pin on tube, so check $100k\Omega$ series resistor which turns out to be virtually open-circuit. Fit new resistor. O.K.

The Intermittents

Enter Mr. Middlestump. Spirits fall.

On the bench there was very little colour signal and what there was was varying. We started on the decoder panel, which really was not a good place to start.

There was quite a bit of variation going on. We finally ended up at R306 (see Fig. 2), where there was quite a bit of variation. Now this is the a.c.c. line, so it seemed logical to check the associated preset R308 which could have been playing about. It wasn't, and the voltage at its slider was steady.

So back to the i.f. panel where the first chroma amplifier transistor VT110 lives. This proved to have base-to-emitter leakage, and once a new BF224 was fitted the colour signal was steady and the picture could not be faulted. Our spirits rose. To be quite honest we had spent some time chasing red herrings on the decoder panel, but we are learning, bit by bit, not to leap before you jump or something.

It appeared that Mr. Middlestump had finally been sorted out so it was one down, one to go – with Mr. Hoo.

The latter gentleman finally arrived, and we set to to sort out his intermittent trouble.

It needed only a finger on the base of the ident transistor T35 to cause some sort of colour bars to appear on the screen, so we had to conclude that the trouble was still in the circuit preceding this – the burst detector circuit. The coil, diodes etc. are in the top left can, and although we had

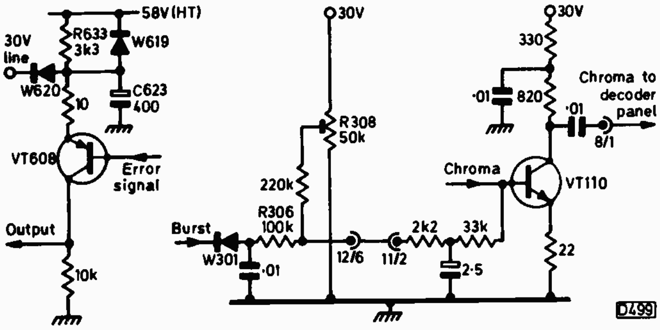


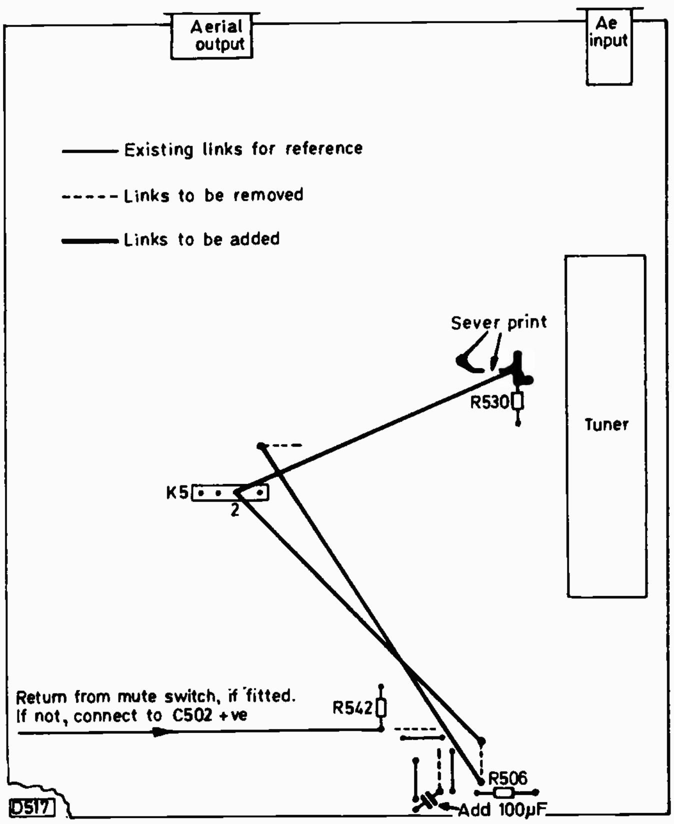
Fig. 1 (left): Power supply error amplifier circuit, Thorn 3000 chassis. W620 clamps the emitter of VT608 to the 30V rail. The time-constant of R633-C623 ensures that VT608 is cut off when the set is switched on, giving a slow-start action. W619 is included to discharge C623 rapidly when the set is switched off.

Fig. 2 (right): A.C.C. detector and first chroma amplifier circuits, Thorn 3000 chassis.

already had this off once – to check the diodes – we hadn't really attacked it head on. Now seemed the time to do so. Every connection on this small subpanel was checked and resoldered.

Upon reassembly we had the bistable happily sharing the voltages and the colour on the screen warmed our hearts. It didn't go off any more, so we had to conclude that no component had actually been at fault and that all along it had been a dry-joint in the phase detector even though all the connections had looked good. It was a good job the cat had got me up, or I'd have still been worrying about them. Now we have only the changing colour on that Decca to worry about . . .

N1700 VCR MODIFICATIONS



The above layout should help those carrying out the off-tape monitoring modification suggested last month.

The Rank Teletext Receiver

Bob Fisher

RANK RADIO INTERNATIONAL was the first setmaker to produce a teletext television receiver for the ordinary domestic market. Models AC6333 and BC6333 were initially distributed in the London area only, at a price that seemed to settle at around £1,200. Subsequently, with increased production, the sets came to be nationally distributed and seem to be available at around £700-£750.

Basic Chassis

The conventional parts of the receiver are based on the now familiar Z718 chassis, with its Toshiba RIS c.r.t. The purpose of the present article is to examine the sophisticated logic interface required between the conventional receiver circuitry and the teletext decoder section. Many people will breathe a sigh of relief when they discover that the decoder itself is the Texas Instruments Tifax XM11 module, which uses a selection of specially developed l.s.i. chips and is supplied by Texas ready built, tested and aligned.

Many parts of the receiver remain unchanged from the basic chassis – the audio amplifier, timebases, convergence circuitry, basic power supply, width modulator and tube control circuits. Changes have been made in the i.f. panel however, which uses a surface acoustic-wave filter (SAWF) to provide the i.f. bandpass shaping. This is followed by a four-stage wideband amplifier and then a TCA270SQ i.c. which provides further amplification, synchronous demodulation and an a.f.c. output. A TBA120S is used in the intercarrier sound channel.

The colour decoder still uses the Mullard three-chip arrangement (TBA560C/TBA540/TCA800), but differs in the following respects. The RGB output stages are now driven from either the TCA800 or the teletext decoder; picture/text blanking is added to the contrast input of the TBA560C (pin 2); and small component changes have been made to facilitate the introduction of remote brightness and colour control.

Changes have also been made to the control panel to enable the touch tuning circuitry to be interfaced with the commands from the remote control transmitter.

Remote Control

An ultrasonic remote control system is employed, using the ITT SAA1024 transmitter/encoder i.c. and SAA1025 receiver/decoder i.c. The hand-held remote control unit has 25 separate push buttons to control most functions of the receiver. The remote control system is conventional and various versions of it have been described in some detail in previous issues – see January/February 1978 for example. We shall pass straight on to the teletext interfacing therefore. Fig. 1 shows the receiver in simplified block diagram form, to serve as an introduction to the basic concepts involved.

Seventeen control functions are applied to the Tifax decoder. They are made by momentarily connecting two wires of a four wire by four wire matrix which is connected to the XM11 module. This gives sixteen commands: the seventeenth (reveal) is made by earthing one of outputs. The connections could be made by a nine-way cable to a seventeen push-button unit, but it's much more elegant as here to operate the controls via the remote control system. Hence the need for interfacing.

Remote Control Interfacing

The circuit of the remote control interface section of the receiver is shown in Figs. 2-4. It takes the binary-coded decimal (BCD) outputs from the SAA1025 remote control decoder i.c. in the remote control receiver unit and processes them in such a way that they connect the required two wires of the four by four wire matrix just mentioned. The BCD information consists of negative-going pulses approximately 23msec wide, repeated at approximately 185msec intervals whenever a signal is being received from the remote control transmitter. The outputs appear on pins 8, 9, 7, 11 and 12 of the SAA1025 i.c., and are applied to pins 5, 7, 8, 6 and 4 of the interface input connector Z2. All five BCD inputs are reduced in level from 17V peak-to-peak to 5V peak-to-peak by zener diodes ZD1-5. This makes them suitable for use with the 74 series logic i.c.s which are employed in the following circuitry. The first i.c. 14IC12 is used simply to buffer the input signals from the zener diodes before they are applied to the following logic circuits.

The five BCD outputs from the SAA1025 i.c. are given the now conventional code letters A, B, C, D and E. A comes in at Z2-4, E at Z2-6, B at Z2-8, C at Z2-7 and D at Z2-5. During each teletext instruction, the D bit applied to pin 14 of 14IC12 will always be at the logic one level. 14IC12 identifies a teletext command therefore. The resultant signal at pin 15 is used to trigger the monostable 14IC6, which produces at pin 8 an output pulse approximately 200msec long. The timing is determined by C26, C27 and R40 and is chosen to be significantly longer than the 23msec pulses from the BCD decoder but short enough to not fill the spaces between successive teletext commands from the remote transmitter unit. When the receiver is first switched on, 14IC6 could trigger at random: to prevent this, pin 5 is temporarily held at the low state until C25 charges to 5V via R42. The logic outputs at pins 6 and 8 of 14IC6 are used to identify a teletext command.

The 23msec pulse outputs from 14IC12 (pins 2, 12, 4 and 10) next have to be converted to true logic signals which can be used to control the Tifax module. This is done by the quad flip-flop 14IC9. When 14IC6 identifies the presence of a teletext command, its output is used to clear 14IC9 by applying a pulse to pin 1. After a short delay, determined by R43/C29, 14IC9 is clocked, causing the output of each of its flip-flops to assume the same logic state as the input. The output conditions of this i.c. will stay in the same state as the inputs until pin 8 of 14IC6 falls to zero when the D bit input disappears. 14IC9 is not clocked when the remote receiver is receiving analogue control commands (increase/decrease brightness/colour/volume) because the D input then remains at zero.

The outputs from 14IC9 are A, E, B and C plus $\bar{B}$ and $\bar{C}$.

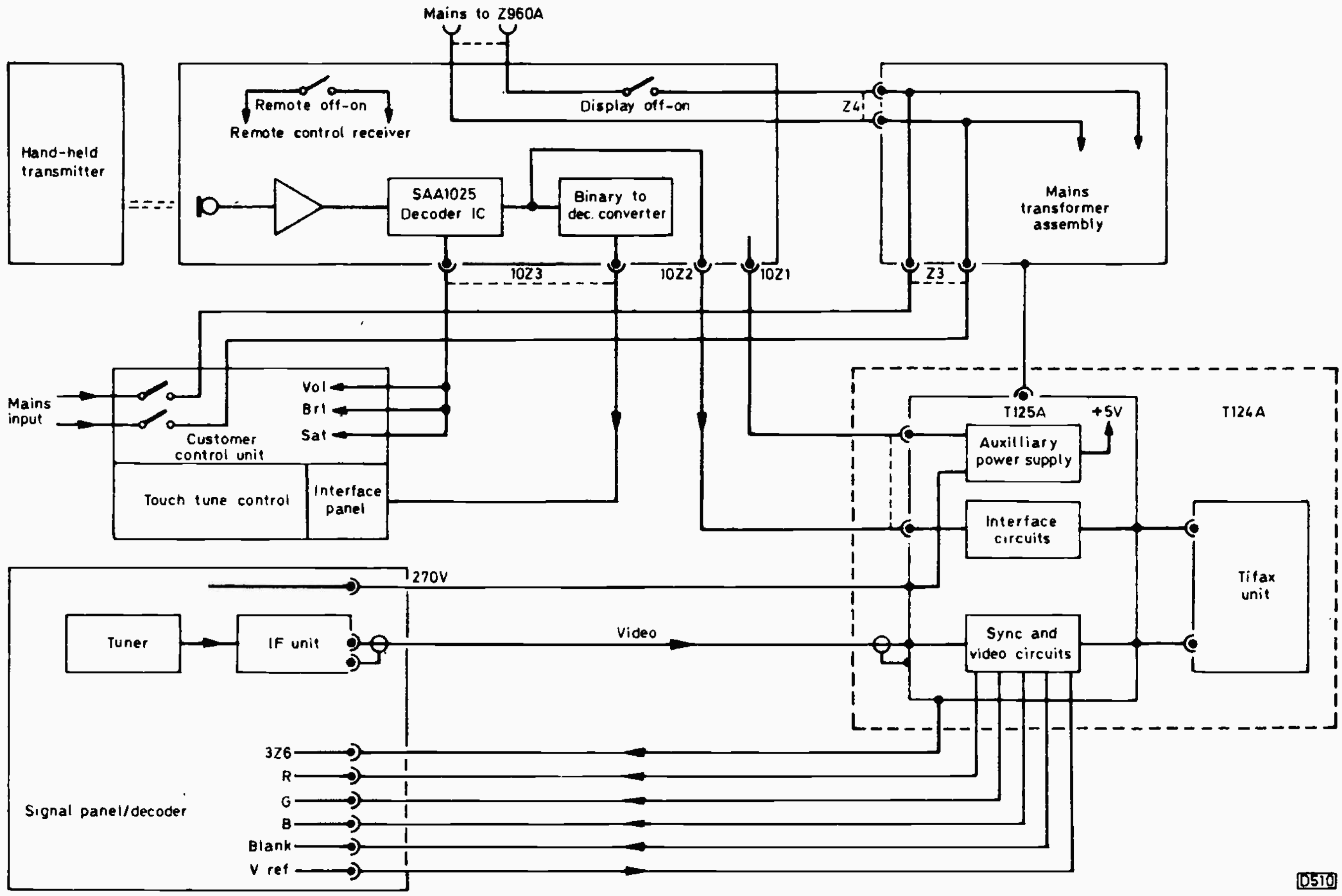


Fig. 1: Block diagram of the remote control and teletext reception/display arrangements.

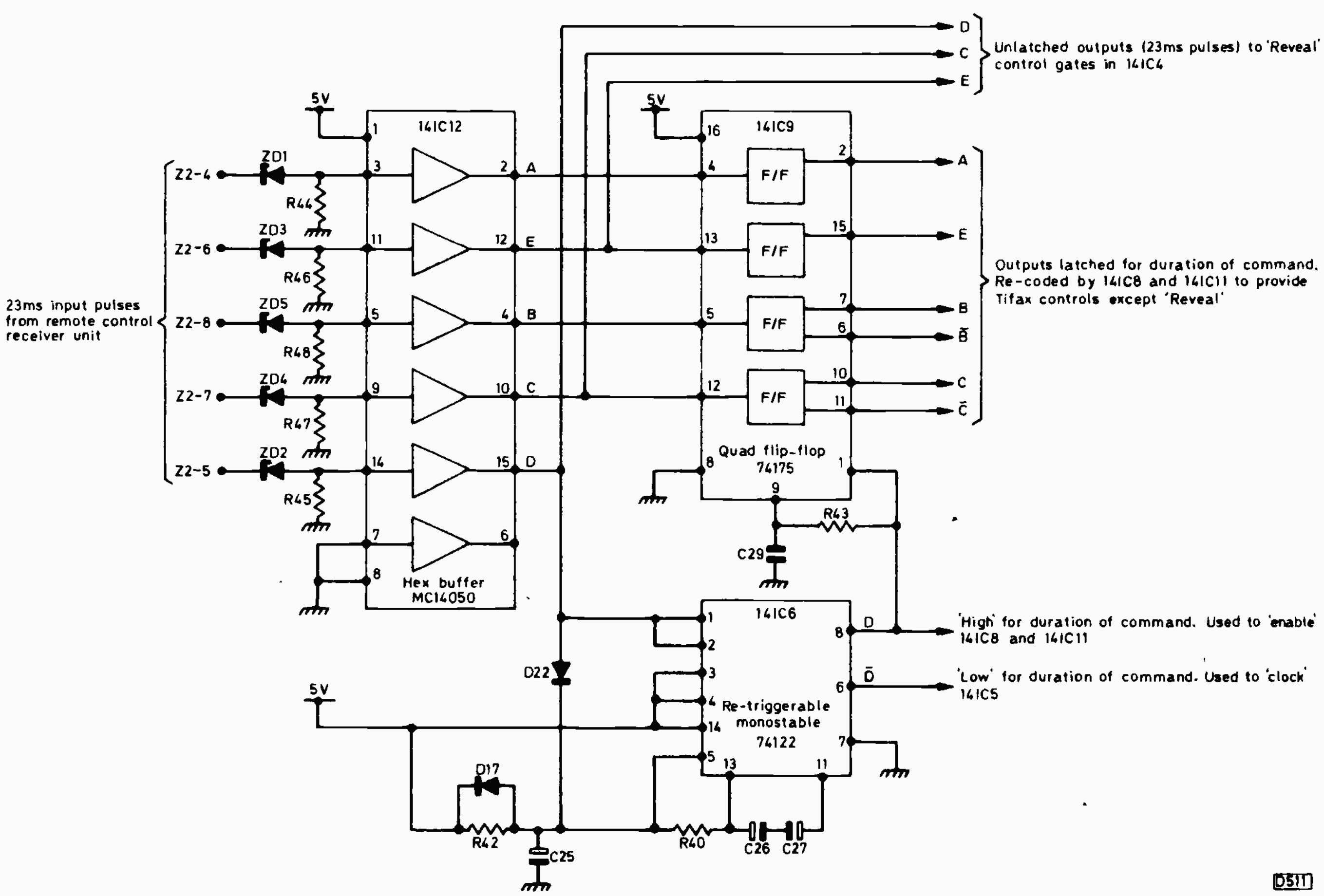


Fig. 2: The interface buffer and latch circuits, which receive the decoded signals from the remote control receiver.

The B, C, $\bar{B}$ and $\bar{C}$ signals, together with the D output from pin 8 of 14IC6, are recoded by 14IC8 and 14IC11 (see Fig. 3). The four outputs produced, together with the A and E outputs from 14IC9, provide separate inputs to the "one-to-four line" decoders 14IC7 and 14IC10. These are arranged in two pairs and decode the information from 14IC11 and 14IC8 to produce the cross contacts on the four by four matrix to and from the Tifax module.

12μsec pulses (determined by the internal timing of the Tifax module) appear at PL1-5 to PL1-8, and depending on the command transmitted one of these lines is connected to one of the input lines on PL1-1 to PL1-4, giving individual page selection etc.

The reveal instruction requires PL1-5 to be earthed. This is achieved by taking the C and E outputs of the buffer 14IC12 and inverting them in 14IC4. Hence pins 1 and 2 of 14IC8 are fed with $\bar{E}$ and $\bar{C}$ respectively, and a third input on pin 13 is the unlatched D output of 14IC12. Thus when D is zero (high) and C and E are at one (low) all the inputs to this three input NAND gate are at logic one, and its output at pin 12 becomes low. This causes the cathode of 14D15 to return to zero volts, thus earthing PL1-5 as required.

It should be noted that the E, C and D inputs used for this function are unlatched, and therefore consist of a series of 23mS pulses. In this mode of operation the pulsing is unimportant as the first pulse grounding the cathode of 14D15 will latch the required circuits in the Tifax module. The A and B outputs of 14IC12 are also at low for reveal, but no use is made of these outputs because the D, C and E outputs give an unambiguous identification of the instruction received.

Channel Change Inhibit

The channel change circuits must be inhibited for either three or four figure commands after a text function has been transmitted. To achieve this inhibit, the page or preselect command must first be identified, and the following numbers of commands (three after a page, four after a preselect command) counted.

The circuitry responsible for carrying out these operations is shown in Fig. 4. The counting element is the five-stage shift-register 14IC5, together with the NAND gates 14IC4 and 14IC3. Under normal conditions, the clear input at pin 16 of 14IC5 is held at 5V via 14R39. The preset enable input is normally low because the two inputs at pins 4 and 5 of the NAND gate 14IC4 are held high (5V) via 14R36 and 14R37. The preset inputs to each of the five flip-flops in the register are also held at 5V, and the serial shift input (pin 9) is grounded.

Selection of the page button on the ultrasonic transmitter causes pin 5 of 14IC10 (Fig. 3) to be pulsed low, and this causes pin 4 of 14IC4 also to go low. Hence the output of this NAND gate (pin 6) drives the preset enable input to 14IC5 high, enabling the shift register to be clocked.

Clocking the register is achieved by taking the $\bar{D}$ output of the monostable 14IC6 (this identifies the transmission of a text command), delaying this pulse by the network 14R41 and 14C28, and applying it to pin 1 of the shift register. When the $\bar{D}$ output of 14IC6 returns to 5V, the rising edge clocks the 0V on pin 9 of 14IC5 into the first flip-flop. Exactly the same sequence of events takes place when the preselect command is transmitted, causing pin 5 of 14IC4 to be pulsed low. Again the output on pin 6 goes high, enabling the shift register.

The number commands also cause the D bit from the BCD decoder i.c. to be in the one state, i.e. 23msec negative pulses. This causes the $\bar{D}$ output from 14IC6 to change state every time a number command is transmitted. As a result, 14IC5 is clocked on the positive rising edge of the $\bar{D}$ signal, advancing the zero volts condition applied to the first flip-flop to the second flip-flop. This sequence of events continues until three figure commands have been transmitted, when pin 11 of 14IC5 falls low, and after four commands when pin 10 of 14IC5 falls low. Each of these outputs feeds a separate NAND gate latch, and under normal conditions these are set so that the outputs of both latches are at one, and therefore the two inputs to the NAND gate 14IC3 will be at one. The output of this gate will be at zero, causing 14TR7 to cut off.

Let's assume that a time-preselect command is transmitted. Pin 2 of 14IC4 is pulsed low during the preselect command. This causes the output at pin 3 to go high, producing two logic one inputs to pins 12 and 13 of the second NAND gate 14IC3. The output of this gate (pin 11) now goes to a logic zero, causing the output of the final NAND gate 14IC3 to go to a logic one. This drives 14TR7 into saturation, thus inhibiting the channel change circuitry. This situation will continue until four number commands are transmitted and clocked through the series of flip-flops in 14IC5 as previously described.

On the fourth number command, pin 10 of 14IC5 falls to zero. 14D14 conducts, causing pin 13 of 14IC3 to go to logic zero. This NAND gate now has two logic zero inputs, hence its output will rise to logic one and be latched in that condition by 14IC4. The final NAND gate 14IC3 now returns to its two logic one input state, driving 14TR7 into cut off.

During a page command, an identical series of events takes place using the NAND gates C and D and the output from pin 11 of 14IC5. The difference in this situation is that the output latch is held for only three number commands instead of four.

It's necessary to be able to reset this circuit, so that the channel change inhibit is disabled if half way through a text page or preselect command the viewer wishes to display a television picture. Whenever a picture instruction is transmitted, the output at pin 11 of 14IC10 goes low during the 12μsec Tifax strobe pulses. This causes 14D19 to conduct, so that the anode of the diode and hence pin 16 (the clear input) of 14IC5 falls to logic zero. This action clears all the flip-flops in 14IC5, and thus resets the two output latches 14IC3/4.

The start-up circuit previously described in conjunction with 14IC6 (the D-bit flip-flop) is also used to clear 14IC5 initially. At switch on, C25 charges slowly through R42 to 5V. At the beginning of this charge-up time D16 will be forward biased, returning pin 16 of 14IC5 to logic zero. Diode D17 is used to discharge C25 via the low impedance of the power supply smoothing circuits when the receiver is switched off.

To prevent the receiver displaying either text or mixed picture when it's switched on it's necessary to hold the D bit low, which the Tifax module interprets as a clear instruction. To produce this effect D22 is connected between the D bit line and the positive end of C25. When the receiver is switched on C25 is in a discharged state. D22 conducts, returning the D bit line to logic zero on switch on.

Tifax/Video Interfacing

The analogue interface circuits (see Fig. 5) handle the pulse, video and RGB signals to and from the Tifax unit. They are considerably simpler than the logic circuits just described, and use circuit techniques with which the reader

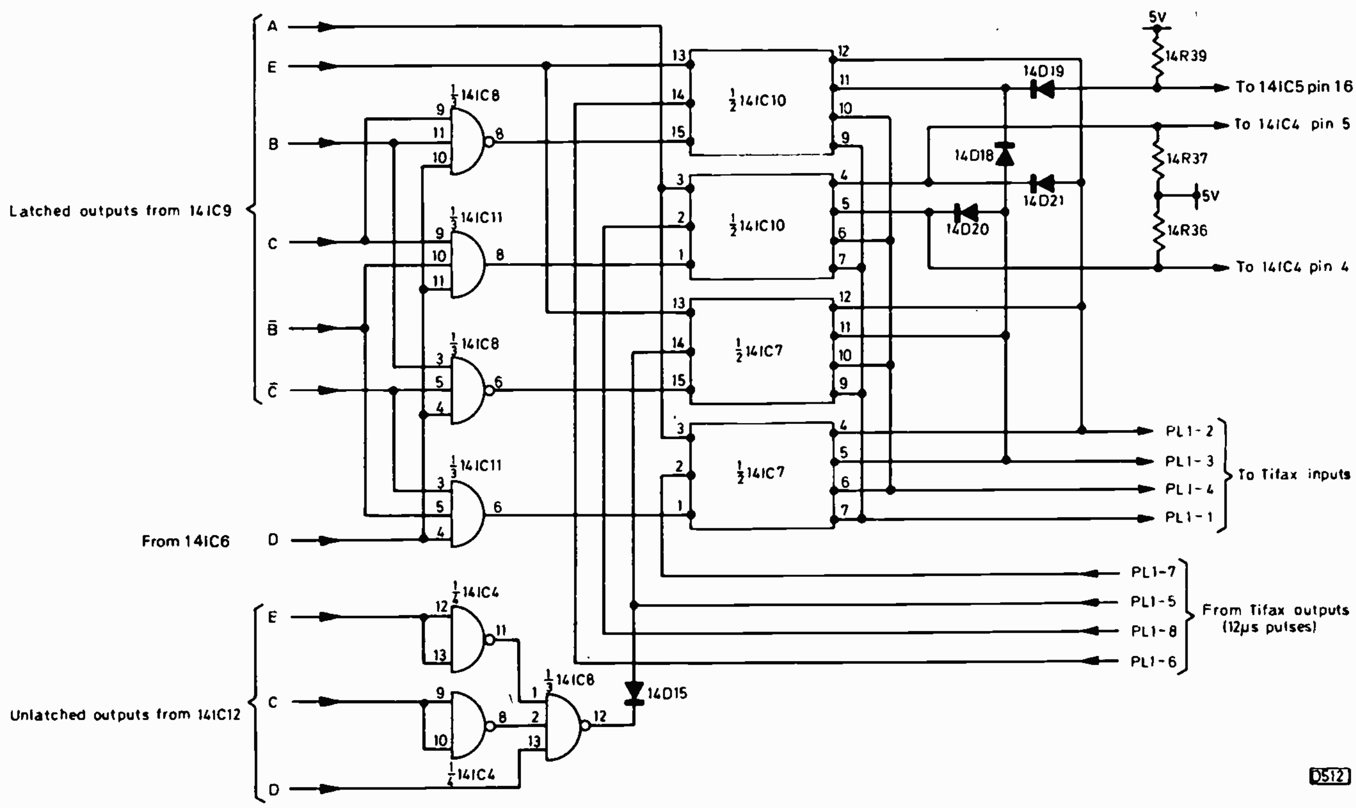


Fig. 3: The interfacing circuitry which controls the Tifax teletext module.

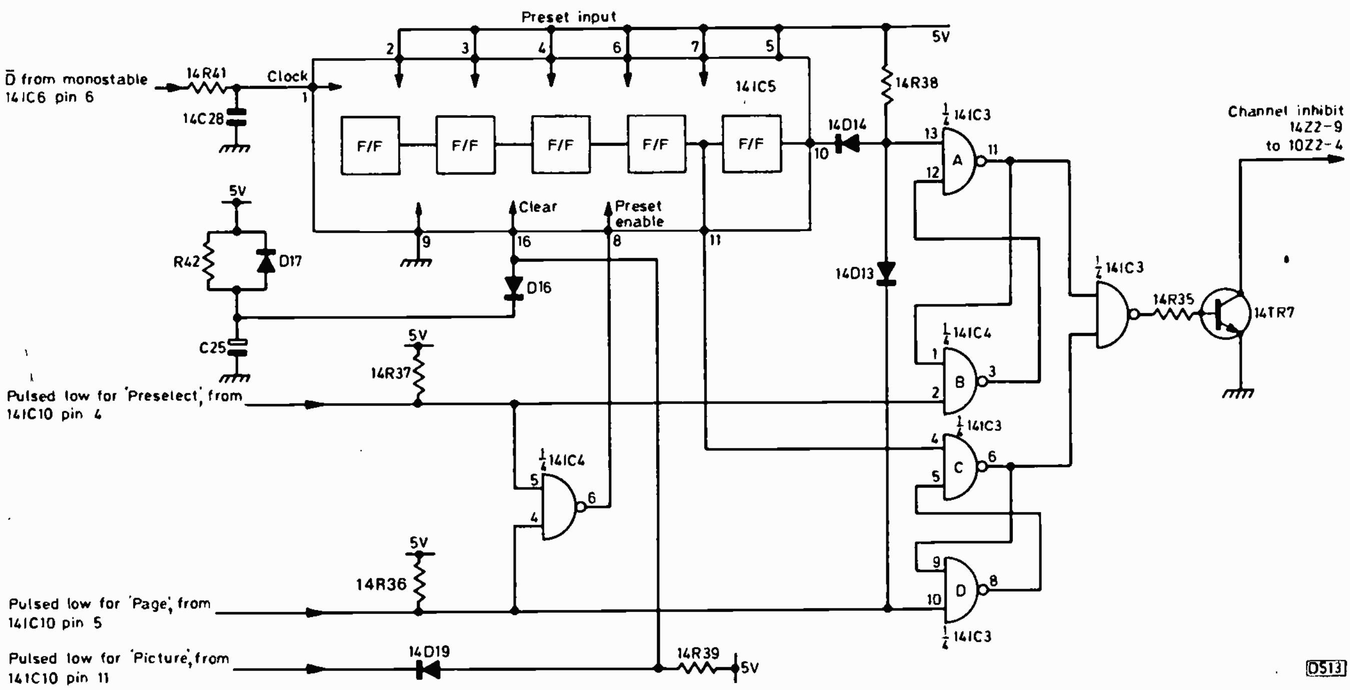


Fig. 4: The circuitry used to inhibit the channel change circuits during a teletext command.

will be familiar. A detailed explanation is not necessary.

A composite video signal from the i.f. amplifier is applied to the base of TR2, which is in turn d.c. coupled to the phase splitter TR3. A non-inverted output from the collector of TR3, whose gain is controlled by RV3, is used to supply the Tifax module with its video input, via PL2-16. An inverted video output from the emitter of TR3 is coupled via C11 to the TBA950, IC1. This section of the circuit is the same as that used in the receiver's line timebase. Text line hold is adjusted by RV2, and text centring (horizontal phase control) is achieved by RV1. A line sync output from pin 2 of IC1 is d.c. restored by D1 and C9 and then applied to the base of the sync pulse amplifier transistor TR1. An inverted and amplified output from this transistor is coupled via C10 to PL2-15 to supply the Tifax module with the required sync information.

Inverted RGB outputs from the Tifax unit appear at PL2-19, 18 and 17 respectively, resistors R27/28/29 forming collector loads for transistors mounted on the Tifax unit. Each of these signals is inverted in IC2, producing non-composite positive-going RGB text signals at pins 12, 8 and 10 respectively. The amplitude of the blue text level is fixed, adjustment via RV4 and RV6 enabling the green and red text levels to be matched to produce the correct levels to

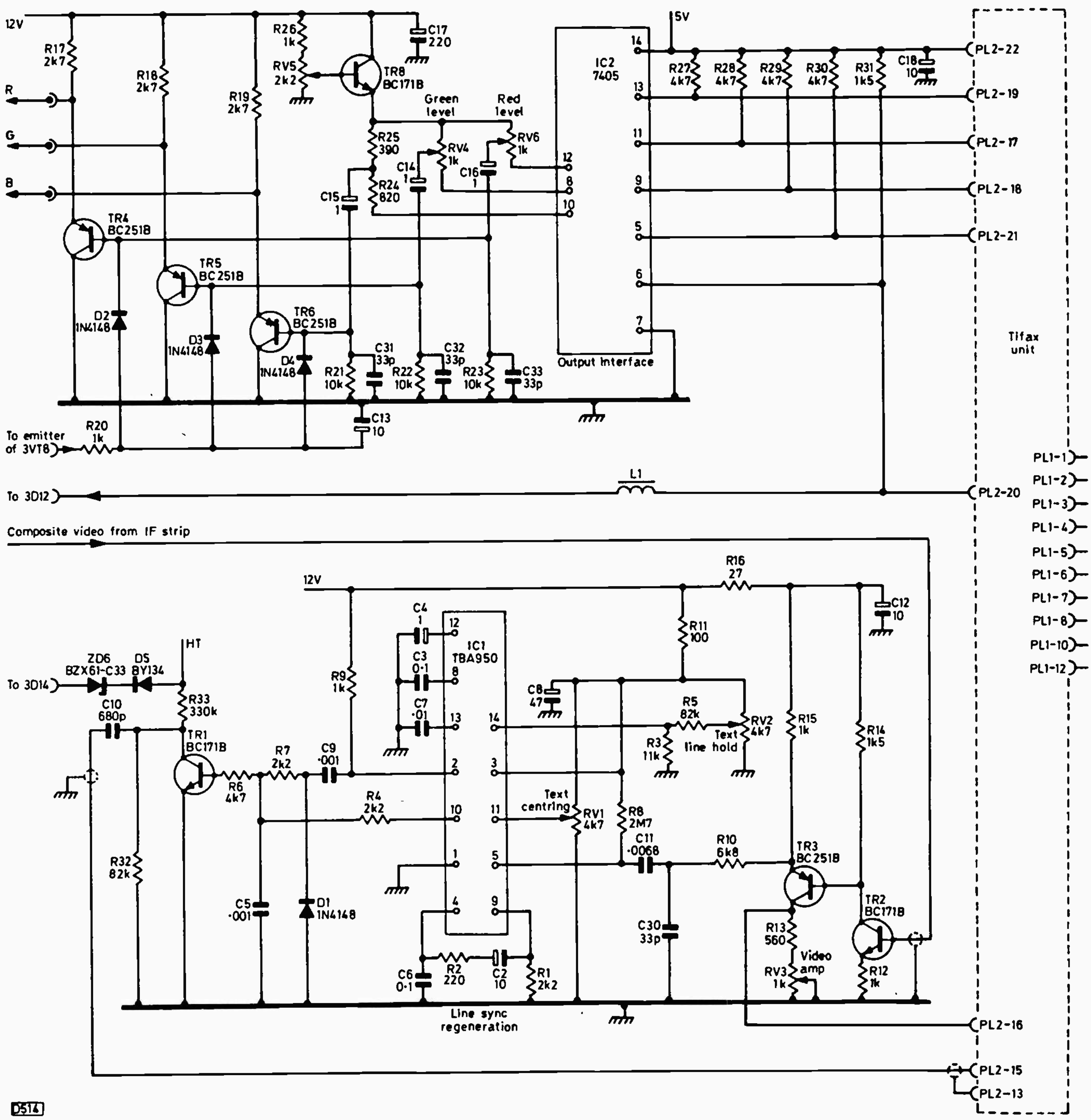


Fig. 5: The circuitry which interfaces the Tifax module with the set's video circuits. The lower part of the circuit feeds sync pulses to the Tifax module.

give a black and white display. Overall gain in the text mode, achieved by adjusting RV5, is effected by controlling the current flowing through TR8. This in turn controls the current flowing through RV4, RV6 and R24/25, the output load resistors of IC2.

From here the three signals are a.c. coupled (C14/15/16) to the output emitter-followers TR4/5/6. The base of each emitter-follower is d.c. restored to a reference voltage derived from the RGB output stages of the receiver. This ensures that the black level of the text information closely matches that of the picture, so that large changes in brightness do not occur when switching from picture to text or vice versa.

To provide a box display between picture and text, a blanking signal is made available at PL2-21. It takes the form of a switching waveform that changes level when a change over from picture to text or vice versa is required. This output is inverted by IC2 and then fed via L1 to the luminance circuitry, where it turns off the video signal during the boxed section of the picture. The inserted text information is fed to the RGB output stages of the receiver via the interface circuits just described.

In the mixed text mode a monochrome output from the Tifax unit at PL2-20 is added to the blanking signal. This produces a monochrome text display that's superimposed on top of the colour off-air picture.

This is the first teletext receiver to have been examined in any detail in *Television*. Most of the major setmakers are now producing receivers which follow very similar lines to those just described, and as the number of teletext receivers on the market increases so the service engineer will begin to encounter this sort of circuitry more frequently. It would seem that the logic probe and the 16-pin logic checker will soon be taking their place alongside the well established multimeter! ■

Colour Receiver Project

Part 8

Luke Theodossiou

WE are now nearing the end of the basic receiver, and the only remaining details to be covered are the board interconnections, construction of a suitable cabinet (both covered this month), the setting up procedure, and a fault-finding guide with oscillograms.

It's important at this stage to consider the receiver as a whole, as this will affect the cabinet design and the purchase of the various miscellaneous cabinet components (e.g. the station selector/potentiometer assembly). Three options will be featured in forthcoming issues, and constructors are advised to make their choice before tackling the cabinet. If you are unable to decide until you have seen the components list (for economic reasons) then we strongly advise that the cabinet is left in abeyance until you have been able to come to a decision.

Options

The options are as follows:

(1) Remote control: This system allows the volume, brightness and colour saturation levels to be remotely controlled, along with remote selection of up to eight preset channels. In addition, there's a normalise function, sound mute and mains off. The selected channel number is displayed on a seven-segment l.e.d. display.

When this option is adopted, the only component mounted on the cabinet as a user control is the mains on/off switch to allow switch on and manual switch off (the former operation cannot be performed by remote control).

(2) Teletext: This employs the Texas Instruments XM11 Tifax module with a keyboard which is linked to the set via a multiway cable. In this case the only difference from the cabinet point of view between the basic receiver and one equipped for teletext reception is the need for an additional hole for the multiway connecting cable. All other control operations are performed by the cabinet-mounted controls.

(3) Remote control plus teletext: This is similar to (1) but involves the use of a different transmitter unit to cater for the additional commands and an interface board within the receiver to enable the transmitted commands to control the Tifax module.

So the cabinet design will be affected whichever of these options may be selected. Further details will be provided when we come to cover each of the options in turn. Note that a station selector/potentiometer assembly is not required when remote control is incorporated.

At this stage it's advisable to wire up the basic receiver using manual controls which are not mounted on the cabinet to enable setting-up adjustments to be carried out. The receiver can then be set up and tested without getting involved with the added complications the options introduce.

Cabinet Design

The basic cabinet details are shown in Fig. 2. We used Contiboard for the first prototype, with a plywood front panel. The method of construction is quite straightforward, with only glueing being required to produce a rigid structure. The back can be made of pegboard, with a rectangular protruding section added to accommodate the end of the tube and the tube's base board.

Either rotary or slider controls can be used in the basic receiver. The cutouts in the front panel will have to be made to suit. Either a 7 × 4in. 15Ω or an 8 × 5in. 15Ω speaker can be used – we don't recommend the use of a hi-fi type of speaker since its high flux density will adversely affect the purity of the display (we speak from experience!). For similar reasons the mains transformer should not be permanently fixed in position until the receiver has been set up and tested. The transformer can then be oriented so as to eliminate any interference between it and the c.r.t.

Alternatives to the suggested cabinet design can of course be used. One possible approach, which has been successfully adopted with another prototype, is to make use of a cabinet rescued from an older, scrapped set. Another approach is purchase a cabinet as a replacement part from a setmaker. The operation of the set is quite cool, so that the exact board layout and mounting arrangements are relatively unimportant. One should adopt a logical arrangement however so as to keep the wiring as simple as possible. The compactness of the basic receiver design allows quite a

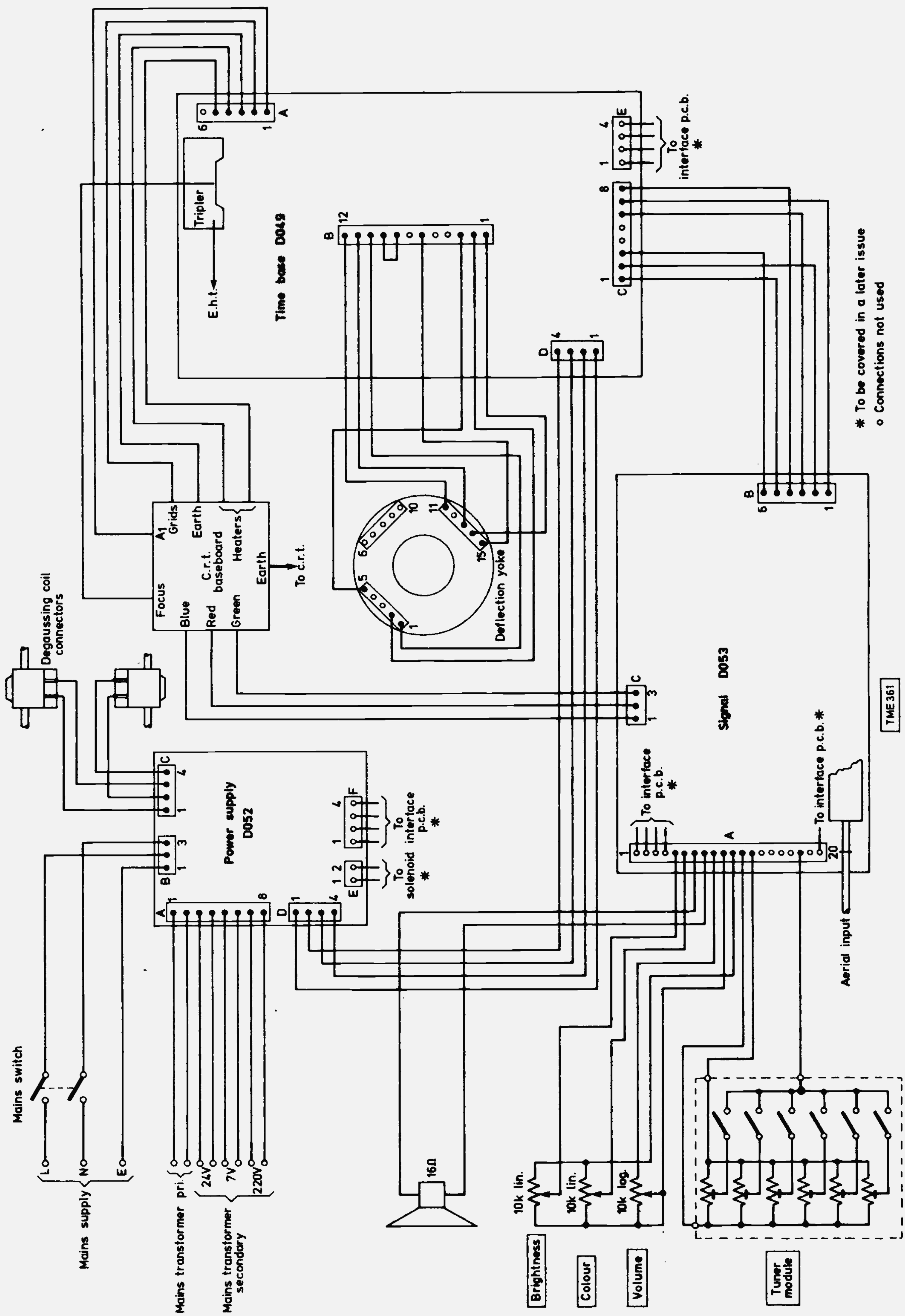


Fig. 1: Inter-module wiring details.

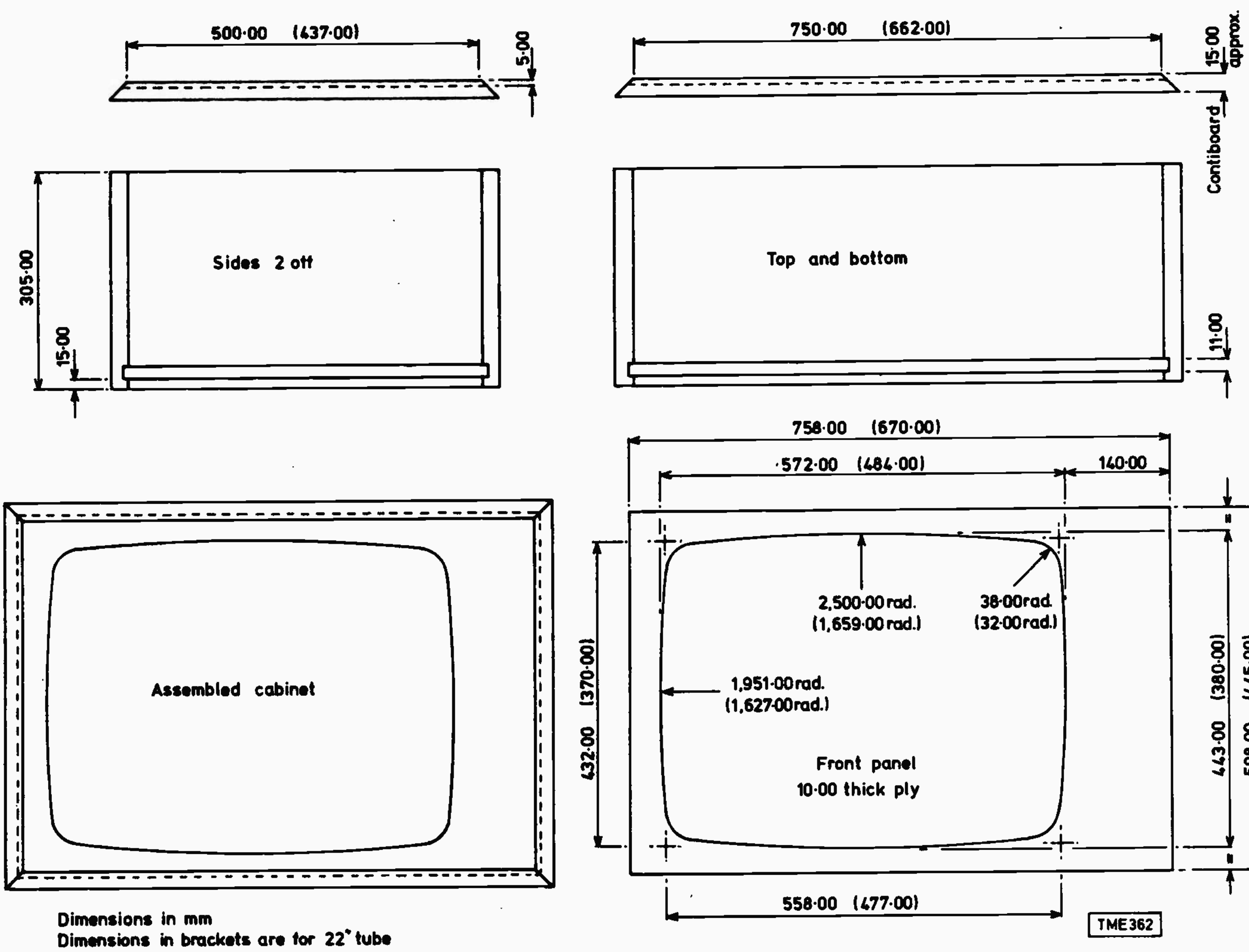


Fig. 2: Details of the cabinet used in the first prototype. The design was shown on the front cover of our October 1978 issue. Stain and polish the outside to obtain the desired finish.

degree of flexibility in the choice of layout adopted, and no problems should be experienced when a ready-made cabinet is used.

Wiring Details

The wiring diagram for the basic receiver is shown in Fig. 1. When making connections, either individual ones or via wire looms, it's worth checking back to the circuit diagrams of the boards that are being interconnected so as to get an overall view of the wiring. Many of the connection points are also used as test points – so it's useful to familiarise yourself with as many of them as possible while wiring up.

Mating connectors are used for all board connections, and ribbon cable can be used in all cases except for the mains connections, the connections to the c.r.t. base board, and those to the mains transformer, the degaussing coils and the deflection yoke.

Keep wiring as short as possible and straightforward. Avoid passing any wires near the line output transformer and e.h.t. tripler. When complete, secure the wiring looms to the cabinet. The controls are all d.c. operated, so there's no need to use screened cable. If neither of the two remote control options is to be used, a mains switch and a station selector assembly are required. The mains switch can be of any type, rated at 240V a.c. 2A or greater. In the case of a remotely controlled receiver, the mains switch required is a special type incorporating a solenoid – details will be given in the article describing the remote control. For test purposes, use any type of switch as specified above.

The station selector we used in the first prototype is a Telefunken unit which we understand is available from Manor Supplies. Virtually any type can be used – 4, 6 or 8 position. Since the a.f.c. is permanently connected, ignore any a.f.c. switch which may be present. Again, if you choose one of the remote control options this unit is not required – for test purposes even a standard 10kΩ linear potentiometer can be used, though the tuning will be very critical.

There now follows a very strong warning: **do not switch on** as soon as you have finished wiring up. We apologise for getting so far in our description and then leaving the switch-on precautions and the setting up procedure until next month, but these are rather involved. Resist the temptation to switch on, since it's very likely that damage to expensive components on the timebase board and stress to others will be the result if various preliminary precautions are not taken.

Finally, it should not be necessary to emphasize that *all* wiring should be double checked. Reversed connections can be dangerous and can result in serious damage.

Correction

An error occurred on the timebase board component layout – Fig. 2, page 254 of the March issue – where two capacitors were identified as C14. The capacitor in series with R8 should have been shown as C7.

Service Notebook

George Wilding

Plugs 'n Sockets

It should never have happened of course, but it was all so easy and can cause needless, time-consuming checking. The power supply/line timebase panel of a Pye hybrid colour receiver (697 chassis) had been brought in for replacement of the tripler, the h.t. reservoir/smoothing electrolytic can and, while we were at it, all those resistors which so commonly change value on this board to produce various symptoms. Regular readers will know them – R203 (47kΩ), R227 (100kΩ) and R210 (100kΩ) in the line timebase, plus the thermistor R305 and its series surge limiting resistor R306 in the power supply section. When renovating the panel the flywheel line sync discriminator diodes D40/41 should be checked for good forward/reverse resistance ratio, C215 (16μF) which decouples the supply to the PCF802 should be changed if at all suspect, and the various small can electrolytics used to smooth and decouple the various l.t. supplies should be similarly checked – look for domed end caps and slight white deposits around the soldering tags, sure signs of deterioration and impending failure. Change the c.r.t. first anode supply decoupling capacitor C224 (0·1μF) if at all discoloured, and it won't do any harm to change the boost capacitor C218 (0·47μF) if it appears to be the original one.

Following this overhaul, we took the panel back to the customer's set and plugged up. Result, sound and valves alight but an otherwise dead set due to no h.t. The immediate suspicion was that a break could have developed in one of the five edge connectors. On second thoughts however this didn't seem likely, since most feeds to and from the edge connectors were in order. But there we were: ample h.t. on the smoothing electrolytic, none in the line output stage. The penny dropped on glancing over the panel: two of the five edge connectors, one red and one white, are interchangeable and had been transposed. Changing them to their correct positions restored normal operation, and it appeared that the connectors were so wired that transposing them would cut off the h.t. supply to avoid possible damage. Wouldn't it have been simpler to have had non-interchangeable connectors though, or at least to have had the three at the side of the panel in one colour, different to that of the connectors on the top edge? As it is, the sole red plug is between the two white plugs at the side, complementing the top edge which has a red plastic fuse cover between two white connectors.

Usually, miniature plugs on flying leads fit into panel sockets of similar colour. In the solid-state Pye 731 chassis to which we were called the other day however we found that while the several plugs to the chrominance panel, which had to be changed, were on separately coloured leads, there was no matching identification on the sockets. Before removing them therefore it was necessary to mark the coloured lead positions on the diagram in the manual. Imagine the work that could have been caused if this had not been done and there was no other set to refer to.

Lack of Width

The trouble with a hybrid ITT colour set (CVC5 chassis) was lack of width. Fitting new line output stage valves produced no improvement, so as this fault is very often in all sets with valve line output circuits due to increase in the value of one or more of the resistors in the width circuit these were next checked. All turned out to be within specification, the trouble eventually turning out to be due to one of the 0·0022μF decoupling capacitors associated with this network – C300.

No Raster

The owner of a Pye hybrid colour receiver (697 chassis) reported that the picture had suddenly gone, leaving the sound only. Naturally we first suspected the line timebase, so the back was removed and a spark test made at the anode of the PL509 line output valve. The arc obtained was only about half the normal size, so valve replacements (PL509 and the associated PY500 boost diode) were then tried – without success. The PL509's wirewound screen grid feed resistor couldn't be open-circuit or there would have been no sort of arc at all. The next possibility that occurred to us was that maybe the PL509's cathode resistor R226 had gone open-circuit, with the result that the shunt electrolytic had broken down to become a much higher value resistor, in this way biasing the valve excessively. R226 read correctly at 10Ω however. A check on the h.t. voltage then revealed that it was only 160V instead of around 285V. The most likely, though unusual, cause would be sudden loss of capacitance in the h.t. reservoir electrolytic. Inspection of the main electrolytic canister showed considerable curvature of the end cap – always a bad sign – and on removing it from the set the reservoir section was found to be virtually without capacitance, though the smoothing section appeared to be normal. Absence of hum on sound was due to the audio circuits being fed from a separate l.t. supply.

Trouble with Rectifier Diodes

We've come across three Waltham monochrome portables recently, all with the same fault – a blown mains input fuse due to a short-circuit diode or diodes in the bridge rectifier circuit. The shorted diode(s) can be detected even without a meter – by their discoloured or burnt appearance. They are particularly small, and we find it best to replace all four with BY127s or equivalents.

No Results

A Pye hybrid colour set with the fault condition "no results" proved to have a blown mains fuse, the very blackened nature of it showing that the rupture had been violent. First suspect was the mains filter capacitor, but this was o.k. Then, on looking down the component side of the vertical panel, we saw that the insulation of the mains lead at one point was badly damaged and burnt, completely exposing one of the conductors for a fraction of an inch. One fitting a new lead and trying again the fuse held but there was quite severe sparking around the surge-limiting thermistor R305, which is in series with the h.t. rectifier D49 and a 3·3Ω resistor (R306). The thermistor was very brittle, breaking off when touched and more or less unsoldered from the print. There was no short-circuit across the h.t. line, but the h.t. rectifier itself was short-circuit, thus applying the full a.c. mains input to the reservoir/smoothing electrolytics via R305/6. Surprisingly, first class results were obtained after replacing the diode, thermistor and resistor, the high-value electrolytics apparently being none the worse for the overload they'd received.

Solid-state Pye Chassis

Over the past few months we've come across several Pye solid-state colour sets fitted with the 731/725 series chassis, all with the same fault – a broken down tripler. In each case the cause of the trouble was the same, a short-circuit in the capacitor C563 across which the tube's first anode supplies are developed – the capacitor is connected to the earthy end of the e.h.t. overwinding on the line output transformer. You'll find the h.t. supply fuse F971 (1A) blown, but no apparent h.t. short. It's always worth checking this capacitor first when these conditions are encountered – it's mounted horizontally just under the top side of the e.h.t. can on the line timebase panel. Note that it's a 1·25kV working type – the common 1kV type boost capacitor is quite unsuitable here.

Signals Missing

One rule I always follow is never to unsolder any components, especially semiconductor devices of any type, unless such action proves to be unavoidable – rather like the advice given by a famous royal physician about taking medicine! After first isolating suspect components as far as possible by removing plug-in connectors etc., double check junction resistances using a low-reading ohmmeter.

The value of this rule was well illustrated by an example that came our way recently – an ITT hybrid colour set fitted with the CVC9 chassis and a Feathertouch touch-tuner assembly. The fault was no picture, only weak sound from a foreign radio station – with the channel selector completely inoperative and not even any bulb illumination. The symptoms suggested absence of one or more l.t. rails feeding the varicap tuner, control panel and other associated circuitry. A quick check showed that all the fuses were intact, but the main l.t. rail was at only a few volts instead of 20V. The line is stabilised by a series regulator circuit, with a zener diode being used to provide both the reference voltage here and also the regulated supply for the preset tuning potentiometers (see Fig. 1). The diode (D11) is shown as a zener on the circuit, but is actually a dual-lead miniature i.c. (type ZTK33B). The same low voltage was found across it, instead of the 32-38V shown on the circuit diagram, suggesting at first that either this component or the 0·0047μF shunt decoupling capacitor C41 was faulty. We switched off

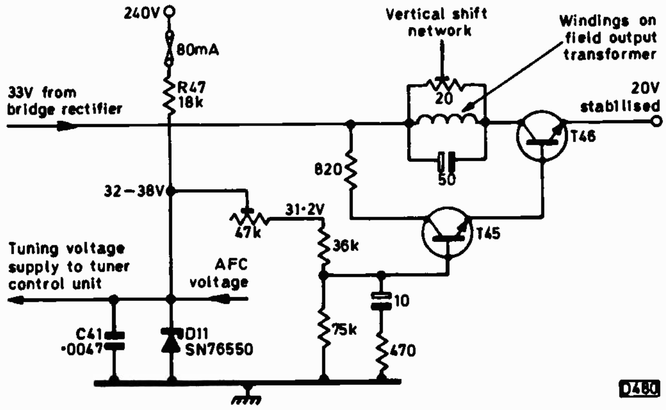


Fig. 1: 20V stabiliser and tuning voltage regulator circuitry, ITT CVC9 chassis. The supply to the tuning potentiometers is taken via i.c.s which provide channel switching. A defective zener i.c. D11 can affect the 20V supply as well as the tuning. The TAA550 and ZTK33B are alternative devices in this position.

and found a low-resistance reading across these components in both directions, seeming to confirm our suspicion.

Nearby however there are two multicontact plugs and sockets, one supplying the tuner and the other the Feathertouch control panel. Remove the latter, and the short-circuit across D11 vanished. So the trouble was on the control panel. Removing and dismantling the latter turned out to be a simple matter, and we then discovered that removing the SAS560S plug-in i.c. removed the short. Fitting a replacement restored the short however! So we followed the same course with the other, SAS570S, plug-in i.c., whereupon normal operation was restored. Both being digital i.c.s, they are d.c. connected.

Incidentally, if you ever want to fit a zener diode or voltage stablising i.c. to a set that's just been switched off, especially if the original was open-circuit, always first connect the connection points. These devices are very susceptible to surges, and can easily be made useless.

Dark Picture

The owner of a Thorn monochrome set fitted with the 1500 chassis said that the picture had suddenly gone very dark while viewing. Inspection showed that the symptoms were very similar to those of a very low emission tube, though without the silvery effect and tendency to defocus at the edges. In addition, flyback lines were quite noticeable, even with the brightness control setting at minimum. We often come across these symptoms, indicating a defective tube, and in most cases find that lightly tapping the tube's neck confirms the diagnosis by producing bright horizontal streaks. In a high proportion of such cases, further judicious tapping restores a normal picture for a while – sometimes for a considerable time. Before writing off tubes that exhibit these symptoms therefore it's worth checking whether tapping the neck provides a cure. On this particular occasion the restored picture lasted a couple of days, but following a repeat of the process it's lasted a couple of months without further trouble.

Christmas Day Saga

A blown mains fuse in sets fitted with the various Pye hybrid colour chassis seems to be a very common fault. Last Christmas day we received an urgent call to one of these sets and encountered the fault yet again. The mains filter capacitor was in order and the power supply seemed o.k., so attention was turned to the line output stage, the first check being to connect the ohmmeter from the anode of the PL509 line output valve to chassis. Only a low ohms reading was obtained, indicating that the 0·47μF boost capacitor C218 was almost certainly short-circuit. This particular set was one of the earlier ones, with a wired chassis type of line timebase/power supply unit, with C218 mounted just under the line output transformer. It was found to have broken down as expected, but on replacing it and switching on we found we had another fault – field collapse.

Since the set had been working normally prior to the fuse blowing, our immediate reaction was that somehow we'd disconnected a lead – there are five multicontact edge connectors to the line timebase/power supply unit. Nothing amiss could be seen visually – we should be so lucky! – but we were rather pleased to find that the cases of the BD124 field output transistors were cold. At least we knew the cause of the trouble, a non-operative, probably non-powered field output stage.

As you're probably aware, the two field output transistors

– continued on page 368

Colour Pattern Generator

Part 1

Malcolm Burrell

SEVERAL pattern generator designs have been published in recent years, including the odd colour one. Most have tended to be variations on the crosshatch theme however, and thus of limited practical use. When carrying out service work, most technicians prefer to have a fairly detailed test pattern available, but all too often one's not there when most needed. The obvious answer is to create one's own!

Several factors influenced this design. Foremost was cost. Although the unit uses the rather expensive ZNA134 integrated circuit as the source of sync pulses, this was favoured due to its quality and simplicity. Plans are afoot however to develop a very basic random-interlace unit which could be used in conjunction with this pattern generator by those willing to forgo a little stability on grounds of cost.

The printed boards are also expensive items, but are preferable to hand-wiring as used in the two prototypes which tended to resemble a telephone exchange! It's well worthwhile investing in a set of i.c. sockets, since the odd faulty i.c. – or one inserted the wrong way around – which has to be removed could spoil the board.

Where possible, TTL i.c.s were used because of their low cost. There are rather a lot, but they are readily available and the logic used is very basic in spite of one or two deviations from convention. The disadvantage of these components is their high power consumption, amounting to about 700mA on the 5V rail. Apart however from the design problem created by carrying such currents on narrow printed tracks, the fact that we are transforming our current from the mains and not indulging in the purchase of hefty batteries means that the actual energy consumed is very small.

Since a high proportion of workshop and field service work relies upon the observation and diagnosis of screen symptoms, it was felt best to simplify the circuitry so as to provide only a single satisfactory display. There's scope for the ambitious user with elaborate test equipment to modify the design, but this is outside the confines of the present article.

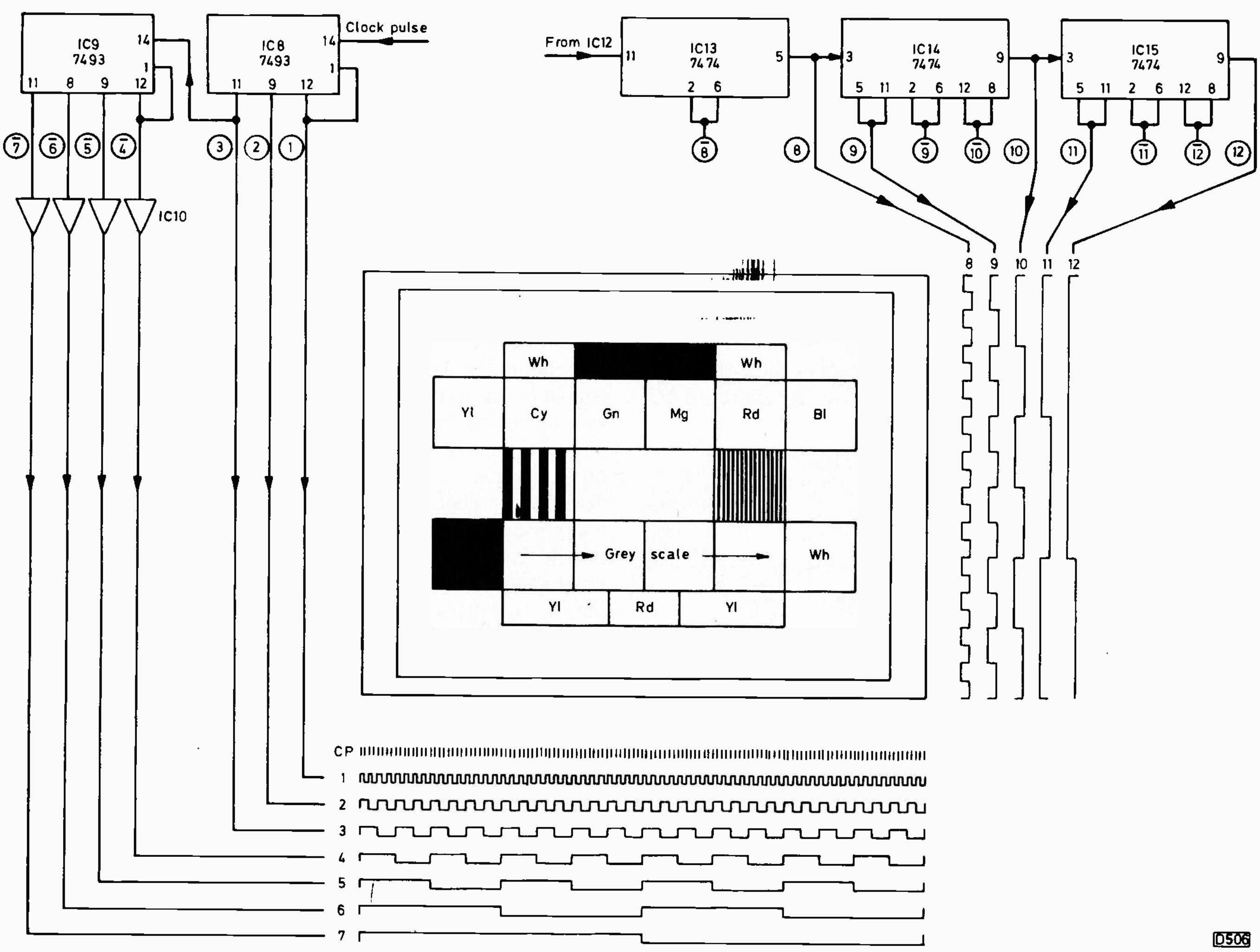


Fig. 1: Simplified diagram relating the digital waveforms to the test pattern.

In any case, many home constructors would probably not possess any more test equipment than a multimeter, which brings us to the next criterion: that there should be a minimum of preset adjustments, and that by judicious use of the built-in r.f. modulator many constructional errors can be traced by observing the display produced on a conventional receiver.

Patterns Provided

As many features as possible have been incorporated in the composite pattern so that the operation of a receiver can be assessed at a glance. Also, in the event of it being distributed to service bays in a workshop, the single pattern should suffice most purposes with no need of any selection system and the no argument as to who is going to use which pattern!

Since it might be used for demonstration purposes, the pattern should also be aesthetically acceptable – both in monochrome and colour. This necessitated much initial doodling, and the eventual production of scale line drawings with corresponding waveforms sketched in at the sides. A simplified version of the final drawing appears in Fig. 1. The two accompanying tables show the combinations of these waveforms: those shown and the inverted (bar-numbered) ones not shown on the drawing give the desired patterns when applied to the appropriate gates. There is ample scope for those who so desire to extend the unit so that it gives out a complete range of different test patterns, such as crosshatch and chequerboard, but since this is a matter for the individual the generator will be treated for the present as a single output unit.

A symmetrical castellated border is incorporated for picture centring and geometry checks. The width of the left- and right-hand borders is a little over one sixteenth of the active line period (or about 3·2μsec) to give a rather thick border so that at least some of it should be visible on any TV receiver screen irrespective of the aspect ratio – unless there is grossly excessive overscanning of the line.

The grill consists of almost exact squares for linearity and convergence checking. Where the grill lines are partly obscured in the vicinity of other patterns there may be some cross-colour due to the rapid picture transitions that occur and the fact that the vertical grill lines are less than the intended 0·1-0·2μsec in width. On modern sets this cross-colour will be slight, but on certain older receivers or those below par it will be prominent. This is a very real check on the quality of i.f. strips and decoders.

Near the top there's a "letterbox" pattern. This gives a check on the l.f. response of a receiver: minor defects may introduce slight streaking on either the black or the white boxes, but this should not be excessive.

Normal full-screen width colour bars are used in the next segment, but with the white and black sections removed. They are very approximately 100% saturation, and are the usual colours in order of decreasing luminance – yellow, cyan, green, magenta, red and blue.

The intersection of the grill lines at the centre of the test card is backed by a black square to emphasise poor static convergence. It also marks the centre of the card, and provides an area of high contrast to improve the appearance on monochrome receivers.

Although a full multiburst had initially been envisaged, it would have added too much to the complexity of the unit. It was felt that some fine detail was needed however, especially with the increasing popularity of videocassette machines which need regular maintenance and a reliable test signal for assessment purposes. Both the frequency gratings used in the test card, corresponding to about 1·125MHz and 2·25MHz, should be clearly resolved under all conditions. They should create virtually no cross-colour.

The step wedge together with the neutral grey background enables a check on grey-scale tracking to be made. The steps are intended to be about equal as seen on the average colour TV receiver screen.

There's virtually no bandwidth limiting of the chroma signals in the unit. This helps to keep the coder simple and also makes it ideal for observing the quality obtainable with most decoders, given this slightly sharper colour image, and by using the "colour fit" pattern at the bottom one can observe any luminance/chrominance delays which seem to cause complaints that "footballers' shirts don't fit when shown in long shot." In fact the red box between the yellow "cheese" should sit quite happily over the two centre grill line squares. It's very unlikely that any real faults will show up, since they rarely occur in this area. The pattern was included to give an extra tool to the engineer as a customer relations exercise. It also adds to the aesthetic appeal of the pattern.

Power Supply

The power supply (to be shown next month) is very simple. Most of the pattern generator needs a 5V regulated supply whilst the transistors, subcarrier oscillator and chrominance modulator i.c.s need 12V. Mains transformer T1 feeds a full-wave rectifier and main 4,700μF reservoir capacitor which in turn supply the regulators for each rail. The 10μF capacitors together with the 0·1μF ones assist in smoothing and the removal of transients.

Sync Pulse Generation

Since it's probably the simplest way to generate a fully-interlaced sync waveform, the ZNA134 i.c. was selected. It's rather expensive, especially when one realises that with

Table 1: Important line waveforms.

Background	
Left-hand border	4 5 6 7
Letterbox	7 $\overline{6}$ +* $\overline{7}$ 6
Colour bars	(7 6 5 +* $\overline{7}$ $\overline{6}$ $\overline{5}$) inverted
Frequency gratings	7 $\overline{6}$ 5 +* $\overline{7}$ 6 $\overline{5}$
Step wedge	As colour bars
Colour fit	As letterbox
Right-hand border	$\overline{7}$ $\overline{6}$ $\overline{5}$ $\overline{4}$
Component parts	
Letterbox (white parts)	7 $\overline{6}$ 5 +* $\overline{7}$ 6 $\overline{5}$
Left-hand frequency grating	7 $\overline{6}$ 5 2
Right-hand frequency grating	$\overline{7}$ 6 $\overline{5}$ 1
Colour fit, red	7 $\overline{6}$ $\overline{5}$ $\overline{4}$ +* $\overline{7}$ 6 5 4
Colour fit, yellow	Use letterbox with red colour fit substracted

*Added by OR gates.

Table 2: Important field waveforms.

Top border	12 11 10 9 8
Letterbox	12 11 $\overline{10}$ 9
Colour bars	12 11 $\overline{10}$ $\overline{9}$ +* 12 $\overline{11}$ 10 9
Frequency gratings	10 $\overline{11}$ $\overline{9}$ $\overline{8}$ +* $\overline{10}$ $\overline{11}$ 9 8
Step wedge	12 $\overline{11}$ $\overline{10}$ $\overline{9}$ +* $\overline{12}$ 11 10 9
Colour fit	$\overline{12}$ 11 10 $\overline{9}$
Bottom border	$\overline{12}$ 11 $\overline{10}$ $\overline{9}$ $\overline{8}$

*Added by OR gates.

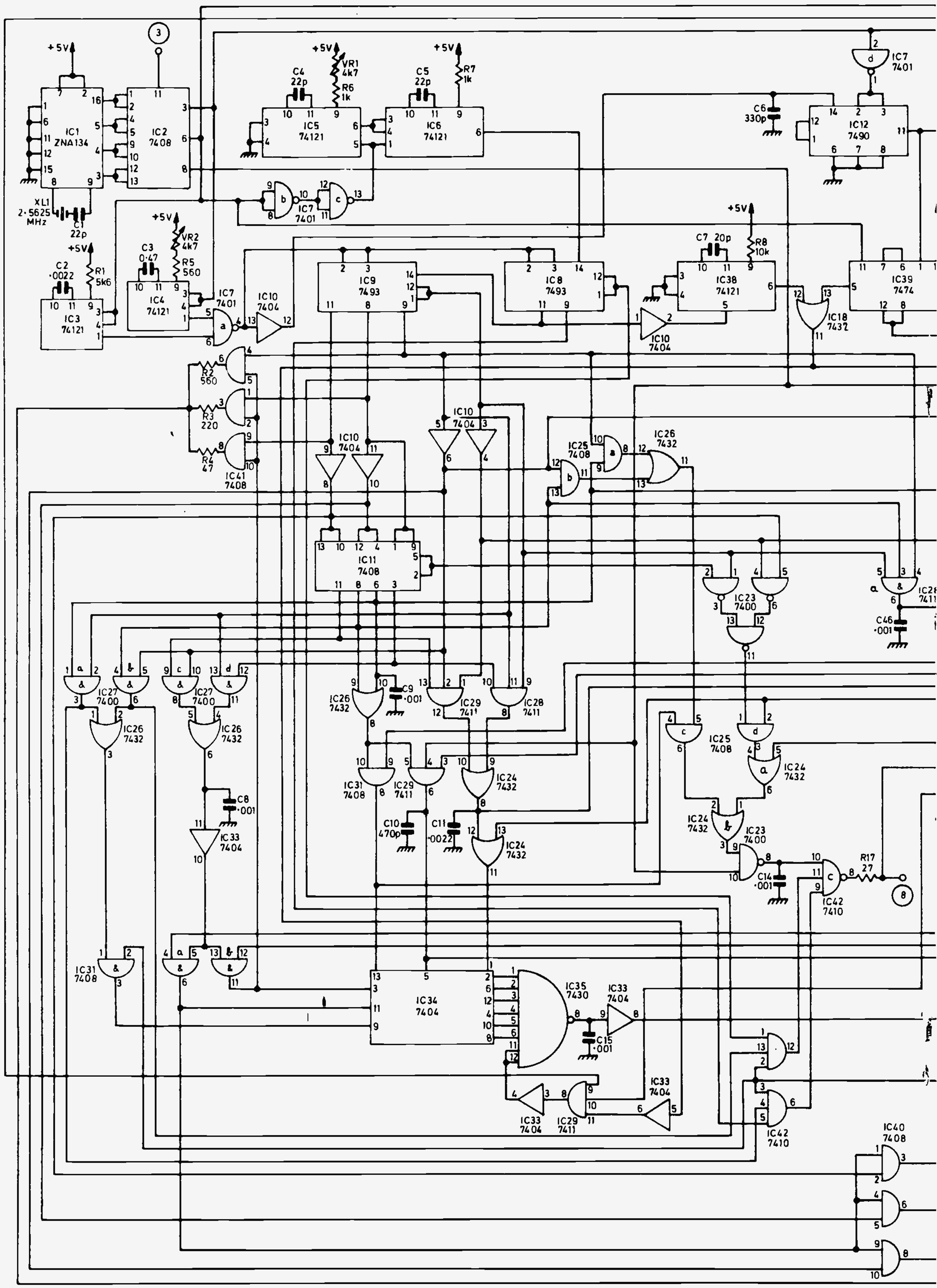
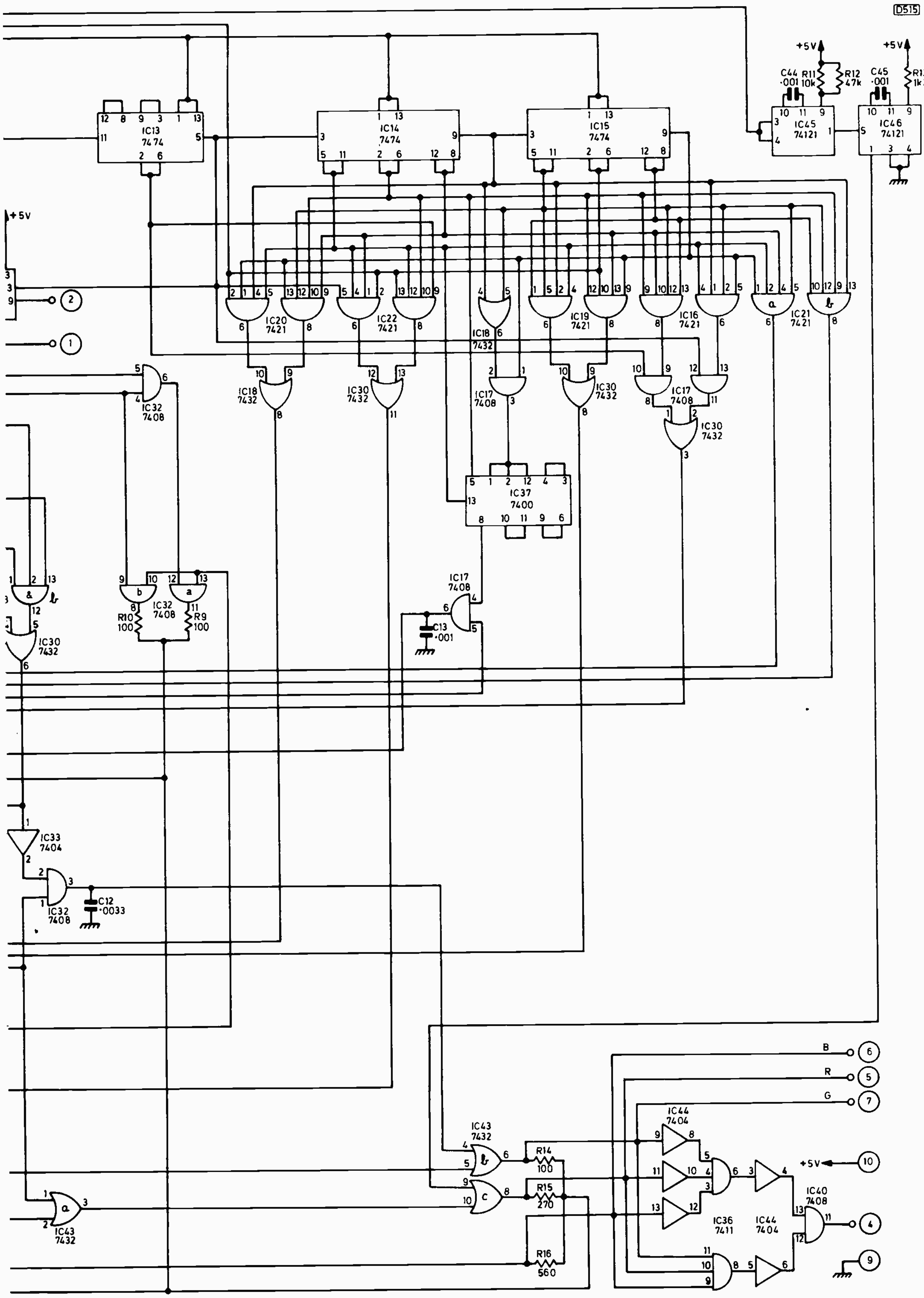


Fig. 2: Circuit diagram of the digital se



ctions of the colour pattern generator.

its 2·5625MHz crystal the cost will be in the region of £30. Those willing to forgo transportability may find it possible to drive the unit from an external sync generator which gives line drive, field drive, mixed syncs and blanking. Those who find the cost exhorbitant and are willing to accept slightly inferior performance may find the random interlace pulse generator to be described later of interest.

The number of gates driven by the various sync waveforms are few, but in the interest of protecting IC1 from overload, IC2 is included simply to act as a buffer. This is a 7408 which houses four AND gates.

The pulse outputs from IC1 are at logic 0 during the relevant pulse periods and revert to logic 1 between the pulses. It is these gaps at logic 1 that trigger the inputs to each AND gate, thus enabling it to function as a buffer.

Offset Sync

The various patterns are derived by counting down from a regular series of pulses. Our main concern is for the appearance of the pattern on the screen during the active picture period. The line and field drives are outside this and are normally masked by the blanking pulses which effectively put a frame around the raster. We cannot perform all the triggering operations from the line and field drives however, because the picture would be displaced to the left and would also be too high up. The latter effect is caused by dividing the 312½ lines in the vertical direction by an even number.

The simplest solution is to utilise the drive signals to produce false sync pulses slightly shorter than the blanking pulses. IC3 is a 74121 monostable whose timing is set by C2/R1 for the line, whilst IC4 similarly functions as a field pulse generator. C3 together with R5 and VR2 affect the duration, with VR2 acting as a fine vertical centring control. Part of the NAND gate IC7 is used to OR the outputs, which are inverted again in IC10 to give a mixed sync waveform.

Line Waveform Generation

The finest detail required in the horizontal direction is that for the fine frequency gratings. Rather than generate them separately, it was decided to use a high clock pulse frequency of about 4·5MHz and divide by two to give the 2·25MHz grating then again by two to give the coarse grating of 1·125MHz.

The clock pulse generator is formed from two 74121 monostables, IC5 and IC6, with fine frequency adjustment for setting up by VR1. This mode of generation was chosen partly for simplicity and partly because the 74121 is a very good, temperature-compensated device which, as used here, provides a stable combination locked rigidly to the line drive with negligible drift. The two NAND gates are strapped as inverters for convenience, and provide isolation between the main line drive feed and the multivibrator, thus preventing feedback of spurious waveforms.

Incidentally, a gated Schmitt oscillator had been employed in this position in a prototype, but suffered from excessive drift with temperature change. This resulted in the picture moving off centre, and defeated the object of trying to produce a stable picture source which could be used in many environments. This final arrangement is more satisfactory.

Fig. 1 shows the line and field waveforms related to the basic pattern. These are numbered 1 to 12. We also need inverted versions, which are indicated with a bar sign – for example the opposite of waveform 1 is $\overline{1}$. Some outputs of the four-bit counters IC8 and IC9 are in the "bar" mode,

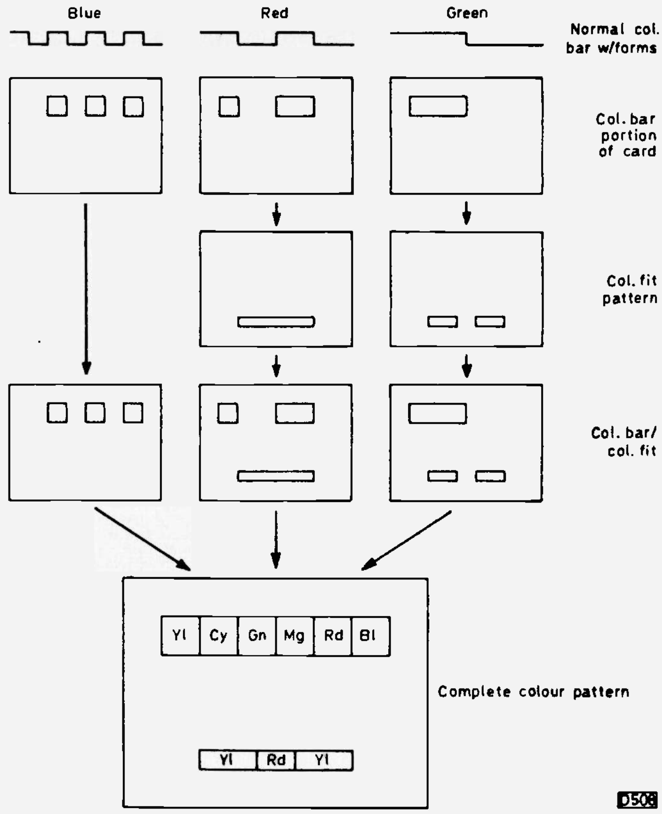


Fig. 3: Assembling the colour sections of the pattern.

and where necessary are inverted in IC10 to give the other outputs. Each counter houses four bistables, which are all cascaded but have a common reset to the offset sync pulses from IC7a. In all eight bistables are used, but the output from pin 8 of IC8 is not used. The numbering of the line waveforms is from 1 to 7.

Waveform 4 corresponds to the smallest chunk of pattern needed in the horizontal direction, but 3 is needed to trigger monostable IC38 which provides the vertical grill lines. These take on a similar spacing to the number 4 waveform.

Line Patterns

Table 1 shows the various waveform combinations used to produce most of the essential features of the pattern. The components of the colour bars and the step wedge are obtained directly from waveforms 5, 6 and 7 which correspond to blue, red and green respectively (see Fig. 3). In some cases, such as the colour fit pattern which traverses the vertical centre line, the patterns are made in two halves. This would seem to encourage the possibility of a fine vertical bar down the middle, but this is easily removed as explained later.

All the above need one of four combinations of waveforms 6 and 7. It's possible to save gates by producing these combinations in IC11 (7408). Pin 11 provides the combination of 7 and 6; pin 8 gives 7 and $\overline{6}$; pin 6 gives $\overline{7}$ and 6; and pin 3 gives $\overline{6}$ and $\overline{7}$. Each of these can define in which of four areas a pattern is placed horizontally.

Background

Before describing the basic patterns, we will describe the formation of the background pattern. This consists of a white grid on a grey background, which is mated to the other signals. The gating waveforms for each pattern are inverted and fed to the NAND gate IC35 which effectively ORs them together, the result being inverted again and fed to IC32a and b. IC38 is a 74121 monostable with a short time-constant. It's triggered by waveform 3 to give fine vertical grill lines. IC39 is a 7474 dual D-type bistable. Half of it is used to provide the 7·8kHz half line switching for the coder. The other half is triggered by field waveform 8 and is reset by the output of IC12 (7490), which gives horizontal lines each of about two lines duration per field. This provides the horizontal part of the grill – slightly thicker than conventional crosshatch waveforms to make visibility on the grey background easier.

The outputs of the two i.c.s are combined in the OR gate IC18 and are fed to IC32a, the output of which consists of the grill with black cutouts corresponding to the wanted waveforms. The grill is logic 1, background logic 0.

Blanking is fed to IC32b. Since the mating signal is also fed to this i.c., the output is logic 1 except during the mating waveform blackout and, of course, the actual blanking period.

By passing the outputs of each i.c. through identical value resistors (R9 and R10), each signal assumes half its original amplitude. If one assumed that each was 1V p-p, each will now be ½V p-p. The actual values are relatively unimportant. Since the grill signal is sitting on the ½V output from IC32b, it assumes 1V amplitude. The output of IC32b is ½V of course, but during the mating period it's 0V in common with that of IC32a. Thus we now have three signal levels, peak white, mid-grey, and black.

Letterbox

The mating line waveforms are similar for both the letterbox and the colour fit pattern. For clarity they are shown in the table. OR gate IC26 combines the two sets of line waveforms which pass to the AND gate IC31. Here the appropriate field waveforms cause the i.c. to conduct during only the relevant period to form the rectangle at the top of the raster for mating. The output is fed to inverter IC34, thence to IC35 as described above, and also to IC25c where it gates the signals from IC26 to give the characteristic white box on each side of a black one. IC26 is an OR gate combining the signals from IC25a and b.

The letterbox then passes to the OR gate IC24, where it's combined with the castellated border, to be described later, and finally via IC23 where blanking takes place to the 7410 IC42 which is again used to OR together the various component parts of the pattern, in this case those which are purely black and white.

Colour Fit

The line waveform for the letterbox from IC26 is fed to IC29 together with the field waveform from IC21b. Blanking is also added, since this will prevent any part of this pattern recurring during the field blanking period as it would like to. This would cause a section of the colour fit to appear at the top of the picture, perhaps giving coloured flyback lines on receivers with slow field flyback.

The resultant mating signal from IC29 goes to inverter IC34 and also to IC32 and IC43. This is where things become more interesting, because we are trying to create a colour signal.

The colour fit pattern consists of a large yellow bar the same width as the letterbox. Into it is fitted a small red bar two grill squares in width. Yellow is made by mixing red and green (additive colour mixing) in equal proportions. It's necessary therefore to provide two patterns, one red and one green. Fig. 3 illustrates this. IC43a is an OR gate through which pass the red colour bars. The signal from IC29 is equivalent to the red signal, so it's combined with the red bars here. But the green part should consist of two bars with a gap corresponding to where the red signal only occurs. Thus, as will be seen from the table, we need to generate a signal to produce the small middle gap. This is done in two halves, IC28a and b, which are ORd by IC30 and inverted by IC33 to give a negative signal to interrupt that applied to the AND gate IC32. The resultant green part of the colour fit is combined with the green colour bars in IC43b.

Frequency Gratings

Line frequency grating signals from IC27a and b are combined in the OR gate IC26 to give a composite signal for mating purposes. The field waveform from IC30 is added to it in IC31. As with the other signals, this is fed to the 7404 inverter and subsequently to the 7430 (IC35).

Separate signals from IC27a and b are fed to the IC42 NAND gates which are also turned on by the field waveform and the relevant 1·125MHz or 2·25MHz waveform. The result is two blocks of frequency gratings on a logic 1 background. These directly connect with IC42c, providing the combined letterbox, border and gratings output.

Step Wedge

Six grey-scale steps are incorporated in the step-wedge design in order of increasing luminance. They complement the colour bars for reasons of symmetry, and are of roughly equal steps when viewed on a c.r.t. screen.

Line waveforms from IC27c and d are combined in the OR gate IC26 to give the horizontal part of the gating/mating signal. Since it's easier to gate in portions of the screen corresponding to the gaps at each side, this signal is inverted to give the solid centre block needed. IC19 provides the positional field waveforms in two halves, which are combined in the OR gate IC30 and fed to IC31b together with the line waveform. As well as feeding the mating circuit, IC31 feeds three AND gates in IC41. Each AND gate is fed respectively with waveforms $\overline{5}$, $\overline{6}$, and $\overline{7}$ – equivalent to inverted colour bars. The output of each gate is mixed in a resistor network to give a grey-scale output near the bottom of the raster.

Colour Bars

The same line waveforms from IC27 are used for the colour bars but are fed to IC31a where the vertical position is dictated by the waveforms from IC20, via the OR gate IC18.

Centre Cross

The centre cross was something of a latecomer to the pattern. Although considered in the planning, it was not until it was realised that a spare gate existed in IC29 that it was thought worth incorporating this feature, to make static convergence checking easier as well as improving the appearance of the pattern.

Its generation involves creating a black square in the centre of the test card behind the grill. This is achieved by feeding the inverted grill to pin 11 of IC29, the centre part of the colour fit from IC30 pin 6, and field waveform $\overline{11}$ from pin 2 of IC22. The second waveform defines the width of the square, whilst waveform $\overline{11}$ defines the height. In spite

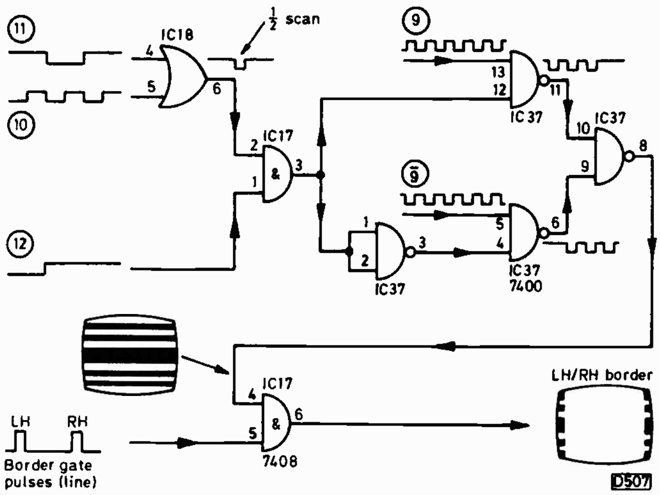


Fig. 4: Example showing the production of the right- and left-hand borders from field waveforms 9-12.

of being larger than needed, the latter ensures sufficient vertical coverage which is then corrected by the other mating waveforms. The result is a large oblong with grill information which is injected into the mating i.c. (IC35) only. This reduces the centre area to logic 0, with the centre grill at logic 1 coinciding with the grill output from IC32a also at logic 1 during the grill period. The combined result consists of the blacked-out background as before, grey with peak white grill, but with the addition of a black square backing the centre part of the grill which remains peak white in the centre due to the presence of grill on this part of the mating signal.

Castellated Border

As with the other patterns, mating/gating waveforms are needed for the castellated border. For the top and bottom it was decided to make the height one half the duration of one grill square, whilst for the left- and right-hand side one whole square width, half the width of each colour bar, was thought necessary. IC14 and IC15 provide the vertical timing for the former, which are combined in IC17 to give the necessary gap at the top and bottom.

For the line, the AND gates IC28 and IC29 give the side pieces which are combined in the OR gate IC24 and then in IC24 again with the top/bottom to give the mating signal which is inverted and fed to IC35. This is quite straightforward.

The castellations pose a problem since there is an even number for both the line and field to match the grill lines. These are provided by the 4 and 9 waveforms which, if undoctored, would give the rather untidy appearance of some corners of the pattern culminating in black and others in white. This can be corrected by ensuring that the centre castellations remain black for the duration of two squares. Due to the different make-up of the line and field waveforms, a slightly different approach is used for each.

For the border at each side we need field waveforms combined to define the centre halfway down the raster. Waveforms 11 and 10 are combined in OR gate IC18 to give a single pulse at logic 0 at the centre. This is fed into IC17, together with waveform 12, resulting in half the scan at logic 1, the other at 0. Our waveform 9 is fed into NAND gate IC37 with this waveform, as shown in Fig. 4, resulting in an output of squarewaves from pin 11 for half the scan only, terminating in one long pulse at logic 1.

The 50Hz half scan pulse is inverted in another NAND gate, with pins 1 and 2 strapped, and the result is fed into pin 4 of another gate. The $\overline{9}$ waveform is fed in here to give the opposite effect to that above, i.e. a long pulse at logic 1 followed by a train of pulses at waveform 9 frequency. The result is ORd in the final NAND gate and inverted to give a complete vertical pattern of bars with a thick one in the centre. This waveform is fed to IC17, which is gated only during the period of the side border. The output is a castellated border at the left and right of the raster.

Generating the symmetrical pattern for the top and bottom is a little easier. Waveforms 4 and 7 are fed into IC23 pins 1 and 2. The output from pin 3 is a train of pulses terminating at the centre, followed by a broad pulse at logic 1. Similarly, waveforms $\overline{4}$ and $\overline{7}$ are fed into pins 4 and 5 to give the opposing effect of a broad positive pulse followed by a train of pulses. These are ORd in the other NAND gate, pins 12 and 13 of IC23, with the combined output from pin 11 going to pin 1 of IC25. Pin 2 is fed by the top/bottom border from IC30, giving at pin 3 the castellated border for the top and bottom.

Both castellated borders are ORd together in IC24a and fed to IC24b where the letterbox is inserted. The output is fed to the remaining NAND gate in IC23, where the signal is blanked to ensure that the borders do not trespass into the sync period. It then goes to IC42, where the frequency gratings are inserted as previously described, giving a complete output of the black/white parts of the pattern. These are then resistively mixed with the background and the grey scale.

Service Notebook

– continued from page 361

in this chassis are connected in series with each other across +20V and −20V rails. Meter checks revealed only positive voltages, implying no −20V supply from the line timebase/power supply unit to the field timebase panel. This at first suggested a break inside an edge connector, but on tracing back to the line timebase/power supply chassis we found no −20V line here either. This meant going back to the small panel on the rear of the chassis, where the supply rectifiers and feed resistors reside. Here we found that the 27Ω series resistor R309 was intermittently open-circuit – it's a wirewound component – and on replacing it we assumed that our troubles would be over.

On plugging up again however – making sure to fit the back row of connectors first – we were still greeted with field collapse. Some rather difficult test probing revealed that while there was −20V at R309 there was nothing on the fixed edge connector pin it is supposed to supply.

As this was all taking place in front of a steadily increasing gathering of people, and with a steadily increasing alcoholic intake (including yours truly), it was decided that the quickest remedy was to fit a new supply lead. After doing this we at last had a picture.

After years of service at comparatively high working temperatures it's so easy for wirewound resistors, thermistors and their soldered connections to just break away merely on chassis handling or panel strain. In extreme cases, as here, you can end up with a fresh fault more time consuming to put right than the original one. Wilding's Law therefore is to aim for minimum chassis and connection handling: the older the set and the more power consuming the circuitry, the more important this rule becomes.

TV Servicing: Beginners Start Here...

Part 20

S. Simon

You said that disconnecting the line scan coils could well produce a white line down the centre of the screen. What sort of fault condition could produce this effect?

The fact that the white line (vertical) is present denotes that the line timebase is functioning, since the e.h.t. for the tube's final anode is derived from the line output stage and if this were not functioning there would be no illumination at all. Therefore there must be a break between the line output transformer and the line scan coils. It is becoming increasingly common to find this defect, particularly in portable sets with a capacitor employed to couple the scanning drive to the coils. Depending upon the design, the value of this will usually be between 2μF and 6μF – compare this to the value of the scan-correction capacitor found in larger screen mains sets: since these operate at higher voltage and lower current to produce the equivalent energy, the value is more like 0·1μF. This coupling capacitor will often be found damaged (swollen or punctured) and a replacement will restore the width provided the correct value is employed.

What if the value cannot be read and the circuit is not to hand?

Try a 2μF capacitor (not electrolytic) and if the picture is oversized increase the value to say 4μF – made up of two 2μF capacitors if necessary. It may be thought that a larger value would *increase* the picture size, but this is not so. The coils and transformer must be matched for correct operation – a mismatch will detune the output stage and reduce the e.h.t., thus producing an enlarged picture.

If large screen sets also employ a capacitor in series with the coils, is this not just as likely to become open-circuit to produce the same vertical white line?

No. That is, it's not just as likely. It can and does happen, but not often. The point however is that this possibility may have to be checked, together with the circuit print, leads and contacts.

What is the most common point of failure?

We are dealing with high energy. Sparking can occur if the connections are not 100 per cent good. Suspect points are where the pegs of the output transformer are soldered to the panel, where any series coil, e.g. linearity or width, or the capacitor referred to above, is soldered. Sparking will decompose the solder and in a short time a complete break will occur at this point. This is a common failing found on many types of printed panel, and although we are concerned here with the connections to the scan coils it's well worth bearing in mind that the line output transformer provides many "services" to other parts of the receiver, by way of clamping and gating pulses to "time" various circuits. Poor soldered connections are often the cause of many baffling fault symptoms which may appear unrelated. This is a *must* for your memory bank. Write it large, and remember it well.

This also applies to the earthing points scattered around the average panel. The metal frame may have several tags protruding through the panel, and these are used to provide common earth returns. All too often they are not properly cleaned off in production, which means that the solder cannot "bite". After a period they become oxidised beneath the solder blob, which may still look good, and all sorts of fault conditions may occur, perhaps intermittently as contact is made and lost. The only solution is to clean off thoroughly, removing the existing solder, ensure that the tag is bright (file if necessary) and resolder using a large iron.

As the line output stage provides so many services, how does one proceed to sort out whether the line timebase is not providing the services, or the services are affecting the timebase, in the event of a fault condition?

By adopting a methodical approach, coupled with one or two "aids". No serviceman (serviceperson, please) is ever without a neon screwdriver to tell him (or her) where the juice is and where it isn't. As you know, the higher the difference or potential across the two ends, the brighter it will light to a point where the neon itself will burn out if the voltage is excessive – despite the presence of a limiting resistor of about 1MΩ. Therefore one does not apply a neon screwdriver to a working line output stage. There is considerable radiation from such a stage however, particularly from the transformer, and if a neon is in the vicinity it will light up, thus providing an immediate indication of whether the timebase is working, or when it is restored to life by say disconnecting a faulty service, for example a defective e.h.t. unit.

Can we stop here a moment and clear up what is meant by disconnecting a defective e.h.t. unit?

The rather general expression was used as there are so many variations on the basic theme of transforming a pulse voltage produced in the line output stage into a high, smoothed d.c. voltage suitable for application to the tube's final anode. As you well know by now, one can wind on to the transformer lots more turns to step up the potential of the pulses, then rectify and smooth them. Rectification can be done with a valve which requires a heater winding to get its cathode emitting, or with a stick rectifier which consists of lots of little discs which pass current only in one direction. In either case the resulting d.c. is still rippled and thus needs to be smoothed either by a separate capacitor or by the capacitance formed by the tube's inner and outer graphite coatings, the latter one being earthed.

To disconnect, one needs only to remove the top cap of the valve (ensuring that it is well clear), or the c.r.t.'s final anode connector, or the transformer end of a stick rectifier.

Alternatively, the high voltage required can be produced not by winding on the transformer many turns to step up the pulse, but by taking a comparatively low-amplitude pulse and multiplying the rectified output by means of a series of rectifiers which charge up capacitors each of which sits on the end of the preceding stick so that each step takes you higher up the staircase as it were. The rectifiers and capacitors are contained in a convenient tray, which can be unclipped or unsoldered from the transformer as the case may be.

What can happen in such circuits to render the line output or perhaps the receiver inoperative?

Obviously a short of some sort will impose a heavy load, and this can happen in several ways. Let's take a few practical examples which will be of use to you.

If a valve rectifier is used, this can short as the result of the internal assembly becoming loose, the cathode leaning over to touch the anode. In this case there will be an a.c. pulse voltage on the cathode, which "sees" the tube capacitance as a short-circuit (see Fig. 1). A severe overload is presented therefore and is relieved when the top cap is removed from the valve, or the e.h.t. clip is removed from the side of the tube (assuming that there is no separate capacitor involved – there may be on some portables).

A very common failing is a breakdown of the insulation of the single turn of cable wrapped round the transformer to energise the heater of the valve. The heater is at the same potential as the cathode (say 18-20kV). Now it's one thing to ask a straight cable to contain a high voltage; it's another to loop the cable sharply and expect it to live near a hot valve such as a PL504. The insulating material hardens and splits, and the eighteen thousand volts crack sharply across to anything at a lower potential (which is everything).

It's no hard task to renew this loop of cable once the valve base has been removed from its plastic housing, but the cable used *must* be suitable for e.h.t. applications.

The cable from the valve to the e.h.t. connector can also break down, but this is less common except where the cable is screened and earthed as in the case of quite a few portables and some large screen sets.

As far as portables are concerned, the e.h.t. rectifier is usually a single stick which can itself give trouble, and incidentally give off quite a pungent odour, or be damaged by either a short from the inner of the e.h.t. cable to the outer screening (if any) or by a shorted capacitor if one is used in addition to the tube coating. Such a capacitor may be found directly connected to one end of the stick, or incorporated in a housing close up to the tube.

Some larger screen sets use the single stick arrangement, fed from a fairly large overwinding on the transformer; others, including most colour sets, do not use a large overwinding but instead use the multiplier idea already outlined. Such doublers, triplers, quadruplers or simply "trays" are a frequent cause of breakdown, and their disconnection is an essential initial step to take if the line output stage is showing any sign of stress.

This seems to imply that only colour sets use the tripler (etc.) idea. Is this so?

By no means. All large screen Thorn monochrome sets produced in recent years have used a tray – the portables use a single stick. Depending upon the model, the tray usually contains three or five sticks which with the integral capacitors perform the multiplier action.

Can individual sticks be replaced if only one is obviously faulty (as indicated by its appearance and smell)?

Sometimes, but the fact that access to the sticks is possible means that the tray is of the open variety: these are more prone to break down. It's better from a reliability point of view to fit a sealed replacement.

Are such units used to supply the tube's e.h.t. supply only?

In the case of monochrome sets yes, but units for use in colour sets often have leadouts to supply the focus control (say at 5kV) and other services. The internal construction can be quite complicated therefore, making a unit for one set quite unsuitable for use in a different set (before you ask).

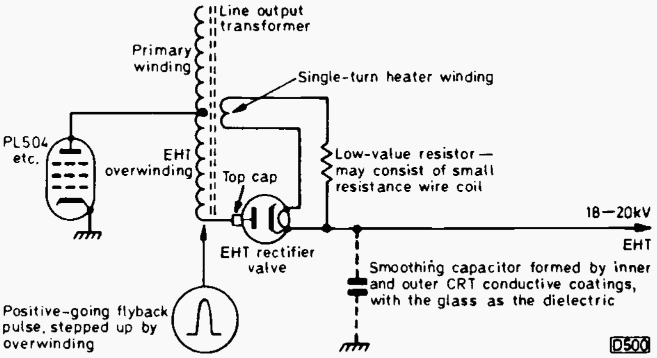


Fig. 1: One method of generating the e.h.t. The positive-going flyback pulse at the anode of the PL504 line output valve is stepped up by the e.h.t. overwinding on the line output transformer and rectified by the valve e.h.t. rectifier.

Apart from shorting out to overload the line output stage, what other common faults affect e.h.t. units and what is the effect on the displayed picture?

They can become open-circuit or partially so, in the latter case offering a high resistance to the beam current they are supposed to pass. As you know, a high resistance drops a correspondingly higher voltage across it for a given current, thus leaving less voltage where it's really required.

As the beam current increases (brighter picture), the voltage across the unit also increases, so that there is less voltage at the tube's final anode to give the c.r.t.'s beam current the velocity it requires. The effect of this is to defocus and enlarge the picture to a degree dependent upon the current passing, so that at low brightness the picture may appear almost normal but as the brightness is increased the picture "balloons" out dramatically, perhaps with a dark spot or patch in the centre before the screen blanks out completely. This is typical of a low-emission valve rectifier, or one which is not able to emit properly due to being under-supplied.

How does one tell the difference?

It isn't always easy. Now remember that we are talking about a valve rectifier, usually driven from a valved line output stage. Remember also that the rectifier's heater is supplied by a loop of cable wound round the transformer. Depending upon the energy radiated by the transformer, the loop may supply too much energy to the valve's heater if directly coupled to it. It's common practice therefore to take one end of the loop to one side of the heater directly but the other to a blank pin, the connection to the other side of the heater being completed either by a small resistor which looks like a resistor or a length of resistive wire which doesn't. The resistor or the wire can decompose (become a higher resistance), thus robbing the valve heater of its current.

The valve heater in this case will not glow, and this is perhaps the clue. We say perhaps because the series resistor may be intact and there may be other causes. One may be that the valve pins are not in good contact with the holder clips (another high resistance possibility). This is a distinct possibility, as the high voltage present can have a chemical effect. Again, these are only possibilities.

The heater loop may not be picking up enough energy because the energy is not fully there in the first place. If the line output stage is not working at full efficiency, the e.h.t. rectifier cannot be properly supplied. Shorted turns in the transformer could be damping down the efficiency, the line output valve or the associated boost diode (efficiency diode) could be low emission, the width control or an associated resistor could be defective resulting in incorrect bias of the output valve – there are many possibilities.

If the picture is darkened so that it is only just visible, you may observe a distinct lack of width which may not be obvious if the picture is viewed at a lighter setting. This gives us the clue that the output stage is not functioning properly, and should direct attention to the line output valve and its biasing. The latter is backed off by the width or "set boost" control, which could have a dud spot on it, or an associated resistor could well be defective. A voltmeter should record the negative drive applied to the control grid of the line output valve. The actual reading is not so important as the effect of applying the meter between the control grid and chassis. If the meter is set to the 100V range (positive lead to chassis, negative to the control grid) it will show the approximate negative bias, but the resistance of the meter will provide an alternative path to chassis. Thus if there's a fault in the "width" circuit (control, resistors etc.) there will be a dramatic change of width and e.h.t. It's worth carrying out this quick check early in the chase rather than later.

If connecting the meter in this way makes no difference, it's fair to suspect the valves and in some cases the line output transformer.

What is meant by "some cases"?

Like most things, line output transformers have their own particular characteristics. Some develop shorted turns far more readily than others, which tend to short more between windings thus breaking down in a far more definite manner, whilst there are makes of transformer that very rarely break down at all. Avid reading of past issues of this journal will reveal the names and models. If one is dealing with e.h.t. trouble in a Thorn monochrome set for example, particularly if there is line break up or "sizzling" when the brightness is advanced, one would suspect the e.h.t. tray itself. If width is lacking, one would suspect resistors or valves. The line output transformer would not be suspect.

Which brings us to the subject of the different symptoms displayed when the e.h.t. unit is a solid-state one.

Yes. As there's no valve involved, no heating energy is required from the line output stage and fault location is easier. Thus the lack of width denoting line output stage inefficiently is more obvious before the picture balloons to hide it as the e.h.t. falls.

There are two main systems to consider. As in the case of a valve e.h.t. rectifier, the voltage step up may be obtained by an overwinding on the transformer, in which case the rectification is done by a single stick which merely replaces the valve. Alternatively there may be no overwinding as such, the lower pulse voltage being stepped up by a staircase of rectifiers and capacitors as previously described. A recent variation on this theme is for the diodes to be incorporated within the transformer itself.

In these solid-state systems the presence of a high resistance in the stick or one of the sticks shows in no uncertain way. There is either no e.h.t. at all or precious little, and consequently no screen illumination; or the picture expands and "sizzles" when the brightness is increased.

There's a complicating factor in the "no e.h.t." condition however when a separate smoothing capacitor is employed, as in the case of many portables. This consists of a thick disc with one lead to earth, which can be the screening of the e.h.t. lead where a screened lead is employed. It's not uncommon for this capacitor to short, causing excessive current through the stick, probably damaging it and possibly damaging the transformer as well. Thus a "smelly stick" can mean more than merely a new stick, and where a capacitor is present it should be suspect.

Long-Distance Television

Roger Bunney

AT long last there's been F2 propagation in the lower v.h.f. TV channels, and for many enthusiasts the last few weeks have presented glimpses of really exotic DX-TV. Unfortunately many of the signals were very badly smeared or distorted, or were accompanied by several co-channel signals. At times however the signals cleared to give quite acceptable quality, and the actual picture content could be resolved. Station clocks showing times six hours ahead of GMT were certainly dramatic! We've also received reports of possible times nine-ten hours ahead of GMT, taking the point of signal origin to the far eastern seaboard of the USSR. Chinese faces, programmes with Chinese figures and other oriental signals have been noted, again on ch. R1, and certainly from the various radio harmonics received Chinese signals must have arrived in the UK, albeit generally unbeknown.

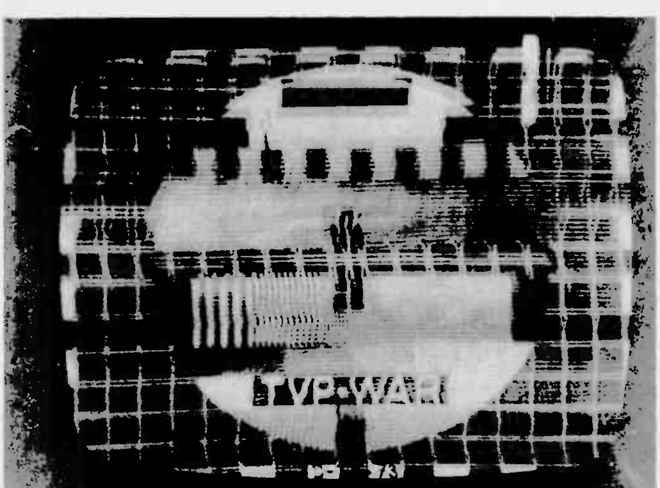
Conditions first opened up on February 6th, just after 0800, with Russian test cards on ch. R1 – in fact a variety of test cards floating over each other. Programmes started at 0900 with a clock – showing 1500! Thereafter each day produced similar conditions, normally from 0800, sometimes fading out by 0930 and on other days continuing until midday. A variation on the 0249 test pattern was noted by both Mike Allmark and Kevin Jackson in Leeds – one with a predominantly white background. An unfortunate result of the excellent v.h.f. conditions to the east was the considerable amount of interference accompanying the Russian video signals. With the multitude of communications, ch. E2 was virtually blotted out, rendering any chance of Malaysian reception impossible, though a close watch on this channel was kept.

In total, distant F2 Russian signals were noted daily on ch. R1 between the 6th-12th and the 14th-18th, with further reception on the 20th, 24th and 26th. By normal standards the signals were very strong – David Martin at Shaftesbury measured an input of 350μV from his four-element array on one occasion, and several days later, on the 15th, ch. R1 peaked at 650μV!

Strangely, the improved conditions did not affect ch. E2 to the south until late in the month, though Hugh Cocks, now at Robertsbridge, noted an F2 signal on ch. E2 on the morning of the 9th, with frequency-grating and grey-scale test patterns – too early for the "usual" African stations. Both the 24th and 25th produced relatively strong (peaking at 40μV) African signals on ch. E2 during the mid-afternoon, from the south/south west – most likely from Ghana or Nigeria.

Not surprisingly, I've received many letters during the past few weeks reporting on these remarkable conditions, and I'm encouraged to have heard from several newcomers. Anthony Wishing (Croydon) saw Chinese material on the 13th – some sort of educational programme with Chinese script, thought possibly to be a schools programme of Russian origin. Frank Lumen and Donald Bassnett in Glasgow both logged strong but ghosty signals from Russia. Hugh Cocks has been extremely active these past three weeks. His local Band I BBC-1 relay transmitters, which translate ch. B1 Crystal Palace off-air to chs. B3 and B4, have been switched on by the high-level F2 signals. Radiating the lower 40-45MHz signals in the ch. B3-4 spectrum, they've caused some confusion to say the least. He reports that on the 8th-9th the MUF to Mexico and Cuba reached just under 50MHz, while on the 15th there were strong contacts between UK and American radio amateurs in the 50MHz band (the UK amateurs had to reply using the 28MHz band, since 50MHz is not a licenced amateur band in the UK). Earlier, on the 6th, there were Indians at 42MHz with English speech.

James Burton-Stewart tells me that his BBC ch. B2 transmitter has been radiating a 625-line test card with positive vision modulation. Ian Beckett has also received this. It seems that only the Oxford transmitter has been radiating this signal, and if the reason for this unusual transmission can be established I'll report further. I've again seen the 1982 period mentioned as the possible time for ending the 405-line transmissions, and one wonders about the future use of Band I in the UK, certainly a useful spectrum and, it's understood, of great interest to commercial users



The Polish PM5544 test pattern, received on ch. R29 by Ryn Muntjewerff in Holland.

DFF (East Germany) identification slide – TV2 on ch. R31, courtesy Ryn Muntjewerff.

for mobile communications. There's also the possibility of a citizens' band, the home office having made it clear that should CB ever come to the UK it will be at v.h.f.

News Items

Malaysia: Colour transmissions have commenced, with some nine hours weekly. The aim is for full colour by 1984.
China: There seems to be a possibility that within the next few years the USA will supply and launch a TV satellite for use by China.
Canada: Brian Fitch reports that a second Anik satellite has been launched, carrying two channels – one for the CBC and the other for remote area linkage. The cost of a 12GHz receiver for use with the CTS satellite project in Canada is expected to be about $2,500 assuming a production run of 10,000 units, falling to around $500 with mass production.
Europe: The Koblenz and Muenster transmitters in West Germany were damaged by explosions following the screening of Holocaust. A Catalonian TV programme service, financed through foreign programme sales, is to be established. Based in Barcelona, it will have a nine-transmitter network and use the PAL colour system. One transmitter would beam signals into France. The service could start within a year, but the date of starting construction is being delayed for political reasons. The Italian broadcast service RAI is buying equipment for the start of an RAI-3 service, which is expected to start sometime next year.
Sunspots: Kevin Jackson reports that the monthly average Zurich sunspot number for January 1979 was 165·8, the highest value since August 1959.

Commercial Corner

Antiference Ltd., Bicester Road, Aylesbury, Bucks have introduced an ultra wideband (40-860MHz) low-loss combining unit, intended for either combining two signals or for splitting inputs between two receivers. The insertion loss is less than 5dB and the isolation between inputs/outputs greater than 15dB. It's intended for indoor use.

The Schrader tunable masthead varicap amplifier is now in production in Holland. The gain is 22-26dB and the noise figure 4·5dB maximum. We hope that Ryn Muntjewerff will be reporting on its performance.

Varicap Tuning Arrangement

In the May 1978 issue of *Radio Communication* Pat Hawker reported on a sensitive tuning control suitable for use with varicap tuners. The arrangement, which provides a performance equivalent to that of a ten-turn helipot, is shown in Fig. 1.

From Our Correspondents . . .

Geoff Perrin has been rejoicing in the enhanced TV conditions at Abu Dhabi, with Pakistan ch. E4 and many un-

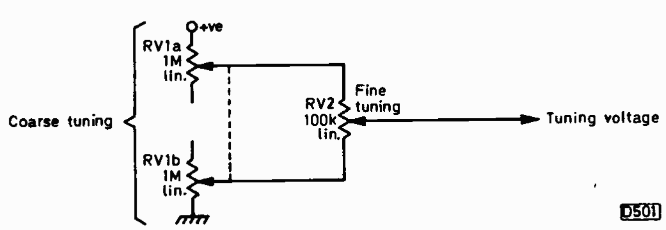


Fig. 1: Inexpensive tuning system for use with varicap tuners.

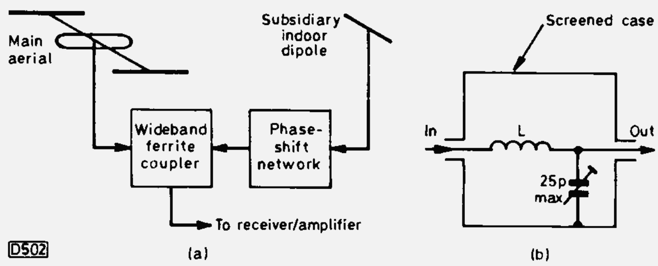


Fig. 2: (a) Basic layout of a system using two aerials and a phase-shift network to provide signal cancellation. (b) Simple phase-shift network. L consists of 10 turns, 3/16in. diameter, 1½in. long, of 20 s.w.g. wire, self-supporting.

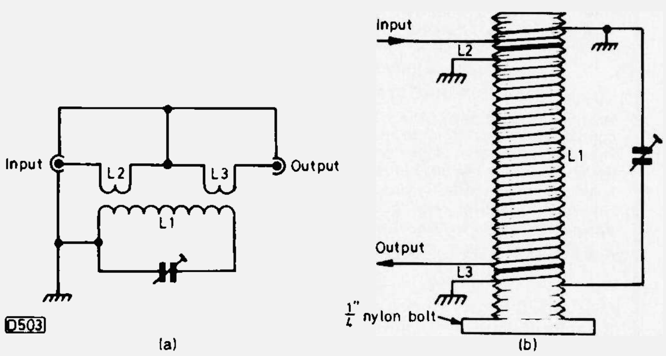


Fig. 3: Brian Williams' coupling filter for Band I. (a) Circuit. (b) Physical details. L1 consists of 16 turns of 24 s.w.g. enamelled wire spaced over 1in., wound on a nylon bolt, L2 of 1½ turns, tightly coupled, wound over the earthy end of L1, and L3 of 1½ turns, similar to L2 but wound at the live end of L1. Trimmer: 5-25 or 30pF, with spindle. The filter can be housed in a tobacco tin with lid.

identified signals. One unusual signal was the Bob Hope Christmas Show – received in mid-January! Dubai is now transmitting strong signals on ch. E33. Geoff is at Al Ain, some miles away from Allan Latham who has also been receiving both daytime F2 and evening spread-F signals. China chs. R1 and R2 are well received, Malaysia is received at times, and there are many African stations on Band I channels. Of greater interest however is a programme from the south on ch. E4: this can be only Mauritius. System M 525-line signals from the SE have also been seen from time to time. This suggests Thailand or Korea.

Co- and Adjacent-Channel Interference

The problem of co-channel and adjacent-channel interference on weak signals is of great importance to DXers. A local or semi-local Band I BBC signal can cause severe distortion of distant signals of even moderate strength. More fortunate enthusiasts may have to contend with only a ch. B1 local signal, which can be filtered away, but most will suffer in varying degrees from the effects of BBC-1 signals on chs. B2-5. Take for example the ch. E2 video frequency (48·25MHz), which is shared by the ch. B2 sound frequency. Tuning to ch. E2 when a ch. B2 sound signal is present will result in a display of moving bands – the movement relating to the BBC sound modulation at any given instant. A narrow-band notch filter will obviously attenuate both signals.

A method of successfully minimising the ch. B2 sound problem, mentioned in these pages before, is to combine with the signal from the main aerial another signal consisting mainly of ch. B2 sound information phase shifted so as to provide partial or complete cancellation of the ch. B2 sound information (see Fig. 2). This technique has been advocated in the past with outdoor aerials and varying degrees of success, though there can be a problem when the subsidiary aerial's signal also produces cancellation of the wanted DX signal from the main aerial. We've recently seen this system used on ch. E2 with an indoor dipole adjacent to the operating position, the arrangement being optimised to give complete cancellation in one specific direction, e.g. with the main aerial pointing south. An indoor aerial will give considerably reduced pickup of the wanted signal, and can be positioned to provide a reasonable amount of the unwanted signal. Rotating the main array would obviously vary the signal and phase values: a fine tuning control can be fitted to maintain a reasonable degree of cancellation. The two signals are combined using a wideband ferrite coupler, such as the Antiference CS100 or Labgear CM6011/OS, thus providing good isolation (20dB) between the two inputs. A practical demonstration of the system proved that it's capable of giving exceptionally good results.

When the local signal carrier frequency is say 250kHz away from the wanted carrier the notch filter approach will normally provide sufficient attenuation of the unwanted signal.

Brian Williams (Penarth, S. Wales), who lives under the Wenvoe mast, has brought up the subject of the cross-modulation/overloading effects produced by a nearby high-power transmitter, especially when a wideband transistor amplifier is being used. Brian experiences high-strength signals on chs. B5 and B13, three group B u.h.f. channels, and various v.h.f./f.m. services – St. Hilary is also not too far distant, with transmissions on chs. B7 and B10. With so many high-strength signals present in the low-Q wideband transistor circuits, we have the classic conditions for the onset of overload distortion. With all these signals the use of notch filtering is clearly inconvenient if not impossible due to the additive insertion losses. Brian has come up with an inexpensive bandpass filter however (see Fig. 3). Inserting this in circuit ahead of the aerial amplifier completely removes the overloading effects. The two low-impedance coupling coils are wound on to each end of the tuned circuit, the main coil being tuned by a 5-30pF r.f. trimmer. The bandwidth (3MHz) is sufficient to pass a single channel, and there's up to 35dB attenuation off-resonance. Brian comments that it certainly gets rid of unwanted signals etc. from local stations.

Field Strength

In the September 1978 issue I wrote an article on *U.H.F. Reception Problems*. Towards the end of the article some formulae to calculate field strength were given. The fact that we're no mathematician obviously showed, and we've received from Tony Harwood of the IBA, Crawley Court, more accurate information on the subject of calculating field strength. One has to take into account the effect of ground-wave reflection. Following a calculation of Tony's relating to phase angle, we arrive at the following formula:

$$E = 88\sqrt{P}\frac{H_t\,H_r}{\lambda\,d^2}\ \text{volts/meter}$$

where P is in watts and the other quantities are in metres. This formula is fairly accurate at v.h.f., under conditions where the ground reflection is strong. If the ground reflection is not strong, the following formula applies: $E = (7{\cdot}014 \times \sqrt{P})/d$ volts/metre. At u.h.f. the situation becomes even more complex, since calculations for both maximum and minimum reflection values must be found. For more information, refer to the ***IBA Technical Review No. 10, A Broadcasting Engineer's Vade Mecum.*** My thanks to Tony for his help.

Notes on the Philips G11 Chassis

Larry Ingram

THIS popular chassis is the Philips group's successor to the G8 chassis. Amongst its technical features are the use of the 20AX c.r.t., a diode-split line output transformer, and a class D field output stage in i.c. form. As a general observation, it seems to follow the trend of design simplification based on "lumps of circuitry" centred around i.c.s. This means complication in the power supply however, in order to take into account anything nasty that might happen to disturb the peace of these little oblong blocks. Although the chassis has been around for a couple of years now, little trouble has been experienced apart from a tendency for diodes D4092/1 in the mains bridge rectifier to go short-circuit, and noisy mains filter chokes.

Other things do go wrong however. A simple one first. A new set was taken out of its carton and when switched on there was no field sync. The field sync pulses appear at pin 8 of the TDA2590Q sync separator/line oscillator i.c. and pass via R2037 and R2044 to the TDA2600 field timebase i.c. They are also taken via R2037 and then plugs and sockets 2D11 and 5D2 to transistor T5060 in the a.f.c. anti lock-out circuit. Connecting a scope to 2D11 proved that the TDA2590Q was producing field sync pulses, but there was nothing on either side of R2044. The panel was removed therefore and it was found that where the plastic support went through the board the corner of the print was neatly broken off, taking with it part of the copper track. A similar thing could happen on the other side of the board, between plugs 2D16 and 2C3, so care must be taken when removing or replacing this board.

Another of these sets was reported to have only a "three-quarter inch wide band down the centre of the screen" after a couple of weeks' use. From what could be seen of the picture, the brightness and focus seemed to be normal. It seemed likely therefore that there was a fault in the scan coils or the connections to them. So we removed plug 3D and made a resistance check between 3D1 and 3D4/5, i.e. via the line scan coils and their series windings – line linearity etc. A sensible low-resistance reading was obtained, so we took a look at the line timebase panel. Careful examination showed a suspicious bulge on the side of the scan-correction capacitor C3135 (0·91μF). Removing it and temporarily fitting a couple of 0·47μF capacitors in parallel restored the picture to normal, but what to use as a replacement? – 0·91μF is not a value readily to hand in the spares cupboard, while the panel is tightly though neatly packed. The only course was to obtain an exact replacement from the makers.

The next fault was a little more difficult, and would appear after a few hours' use. The problem was that the h.t. rail would then cycle on and off, due to the beam limiter circuit coming into operation. The circuit is shown in Fig. 1 and has two modes of operation, both based on sensing the e.h.t. current flowing via the e.h.t. overwinding on the line output transformer and R3122 to chassis. D211, T4085 and T4086 are all normally non-conductive. When the c.r.t.'s beam current exceeds 1·5mA, D211 begins to conduct, reducing the brightness though its action on the black-level clamp in the TBA560C i.c. in module U6200 on the decoder panel. In the case of an excessive e.h.t. overload however, due say to a short-circuit RGB output transistor, the voltage across C3123 will swing negatively – limited by the clamping action of the 4·7V zener diodes. T4085 and T4086 will then switch on, reducing the emitter voltage of the mains-rectifier thyristor trigger-pulse phase-control transistor T4045. The effect can be great enough to reduce the output voltage from the regulated power supply virtually to zero. The c.r.t. heater, which is fed from the line output transformer, will then cool, and if there's no fault present the circuit will return to normal operation. In the presence of a serious overload however the circuit will cycle on and off.

Reverting to our fault condition, we found that switching off any two of the c.r.t. first anode switches would stop the cycling, leaving a flooded raster of just one colour. We also noted that the brightness and colour controls were not functioning, while the collector voltages of all three RGB output transistors were of course low. So the fault was common to all three channels: our previous experience of modern colour processing panels shows that a small d.c. variation earlier in the circuit can cause dramatic changes in the d.c. conditions in later stages.

A check at TP3, the luminance output from module U6200 (luminance/chrominance control unit), revealed incorrect voltage and, on connecting a scope, no luminance – just a strange pulse at line frequency. The l.t. supply to the module was correct, but on connecting the scope to pin 7 (plug 6D1) a weird waveform was observed. The waveform here should be the burst gating and blanking pulse – a composite "sandcastle" pulse consisting of a square pulse with another square pulse sitting on top. The pulse was of about the right height and width, but it looked as if the tide had been over it (and left a flag there!). The combined pulse comes from the TDA2590Q sync separator/line oscillator i.c., so a replacement was tried. This cured the problem, and goes to show that some faults on modern sets would be almost impossible to trace without the manual and a scope.

There's another fault that we occasinally encounter in the beam limiter circuit. The 4·7V zener diodes can go short-circuit, resulting in loss of raster due to the beam limiter circuit being permanently on. They presumably don't like e.h.t. flashovers. Why two of them? Well, they're on different boards, so presumably no one noticed . . . In later production an 0·0022μF ceramic capacitor replaces D4090.

Loss of field scan is sometimes experienced, almost always due to failure of the TDA2600 field timebase i.c.

In the latest sets a TDA2591Q i.c. is used in place of the TDA2590Q sync separator/line oscillator i.c., and to reduce line striations a ferrite tube has been added on the wire link between tag 14 of the line output transformer and C3128. ■

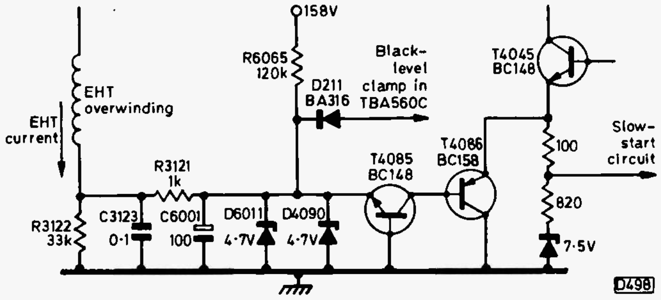


Fig. 1: Beam limiter circuit, Philips G11 chassis.

Servicing the ITT CVC20 Series Chassis

Part 2

E. Trundle

LAST month we covered the signal circuits and the field timebase. In this concluding instalment on the ITT series of solid-state colour chassis we'll be covering the line timebase, EW modulator, switch-mode power supply, and things that can go wrong on the tube base panel.

LINE OSCILLATOR/SYNC MODULE

During the evolution of these chassis most of the modules throughout the set have been changed or updated. Some newer versions are compatible with their predecessors, others aren't. The change that seems to cause the most confusion is the line oscillator/sync separator module on which the TBA920 i.c. resides – the change from the CMS10 used in the CVC20 and CVC20/2 to the CMS11 used in the CVC20/3 and CVC20/4. The differences are only minor, but the modules are not compatible without modification. To adapt the CVC20/3 chassis to accept the CMS10 module, remove C703 (330pF) from the CMS10 panel and use it to replace C2 (if 100pF) on the mother board. Discard the 100pF capacitor. To adapt the CMS11 module to suit the CVC20 or CVC20/2, change C712 from 150pF to 120pF and add a 330pF ± 20% ceramic capacitor between the junction R701/C702 and chassis. The 110° receivers use the CMS30 module, which is quite different.

Having got that out of the way, we'll go on to describe the stock faults that may be encountered on the line oscillator/sync module. R702 will cause weak sync if it goes high-resistance. Line wobble may well be due to the line hold control – clean or replace it if necessary. If C707 should fail and short, the picture will be displaced about three inches to the left. In our experience, the TBA920 i.c. has not proved itself very reliable in these chassis, giving rise to symptoms ranging from no sync to no line drive. Before condemning the chip on the latter count however check C711 (polystyrene) by substitution, while if the receiver is an early one the earthing of module pin F2 to the metal chassis is suspect. Check by grounding the pin with a clip-lead.

On models CS500, CS600 and CS700 the right-hand channel selector button does not have a VCR facility. Provided the off-air signal is good, the flywheel line sync filter time-constant can be shortened by grounding pin 10 of IC701 at module pin G7.

LINE TIMEBASE

Bearing in mind what has been said about the line oscillator/sync separator module, and assuming that line drive is emanating from this, the next possibility in the case of a dead line timebase is that the line driver transistor T13 has died. Sometimes it will come back to life to torment the technician with intermittent line drive. If in doubt, change it. If the set is an early one however there's a good chance that the emitter of this transistor has come off-earth. The cause and cure are obvious once the fault has been located.

Having arrived at the very threshold of its goal, our (rather vulnerable, it seems!) line drive may be thwarted at the point of connection with the BU208 line output transistor T14. Check for bad joints on the two legs, and also for hair-line cracks which can occur in some models on the print between T14's collector and the series choke L35.

Turning now to a line timebase with drive but no output, note first that most fault conditions here will cause the power supply to trip. First on the list comes a short-circuit BU208 line output transistor, not a common occurrence and one which generally takes place for internal reasons. More often the e.h.t. tripler fails, and it's a sad fact that the elaborate overload protection circuit does not always prevent the line output transformer being ruined by a defective tripler. When this happens the overwinding will run warm, even with no tripler connected, if the power supply continues to operate. The other nasty habit of the tripler, internal discharge causing interference on the picture, has already been mentioned in the section dealing with the i.f. amplifier. To increase its reliability, stand the replacement tripler off the chassis metalwork with longer bolts and spacers (available from ITT).

C57 and C58 (0·016μF each) tune the line flyback. If one goes open-circuit, the e.h.t. will rise and trip the power supply. In later chassis the equivalent component is C1102 (0·0082μF), which is proving much more reliable. All these capacitors are special high-ripple types, and only exact replacements should be used. The scan-correction capacitor C67 (2·2μF) is sometimes guilty of going short-circuit, again tripping the power supply by effectively grounding the 125V h.t. line.

A heavily-loaded line output transformer, which may or may not cause power supply tripping, is the result when the shift choke L30 in the CVC20 chassis develops short-circuit turns. Later sets have different arrangements.

The line shift circuit used in the CVC25 chassis is neat and worthy of note. As can be seen from the circuit (see Fig. 5), it works entirely on and from the feed to the horizontal deflection coils. L26/27 is simultaneously a step-down transformer and shift choke.

The CVC30 and CVC32 chassis are not fitted with any form of picture shift control, basically because the manufacturers of the 20AX c.r.t. deemed it unnecessary, claiming that close c.r.t. manufacturing tolerances ensure adequate picture centring. In practice this is open to considerable doubt, and whereas other setmakers have fallen foul of this

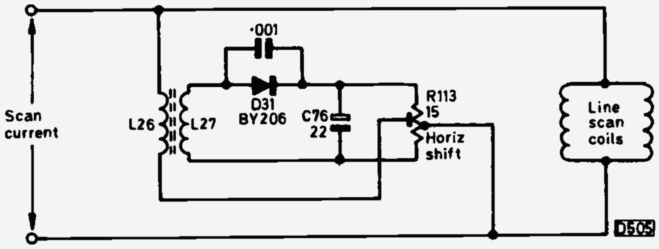


Fig. 5: The horizontal shift circuit used in the CVC25 chassis operates by rectifying the scan current.

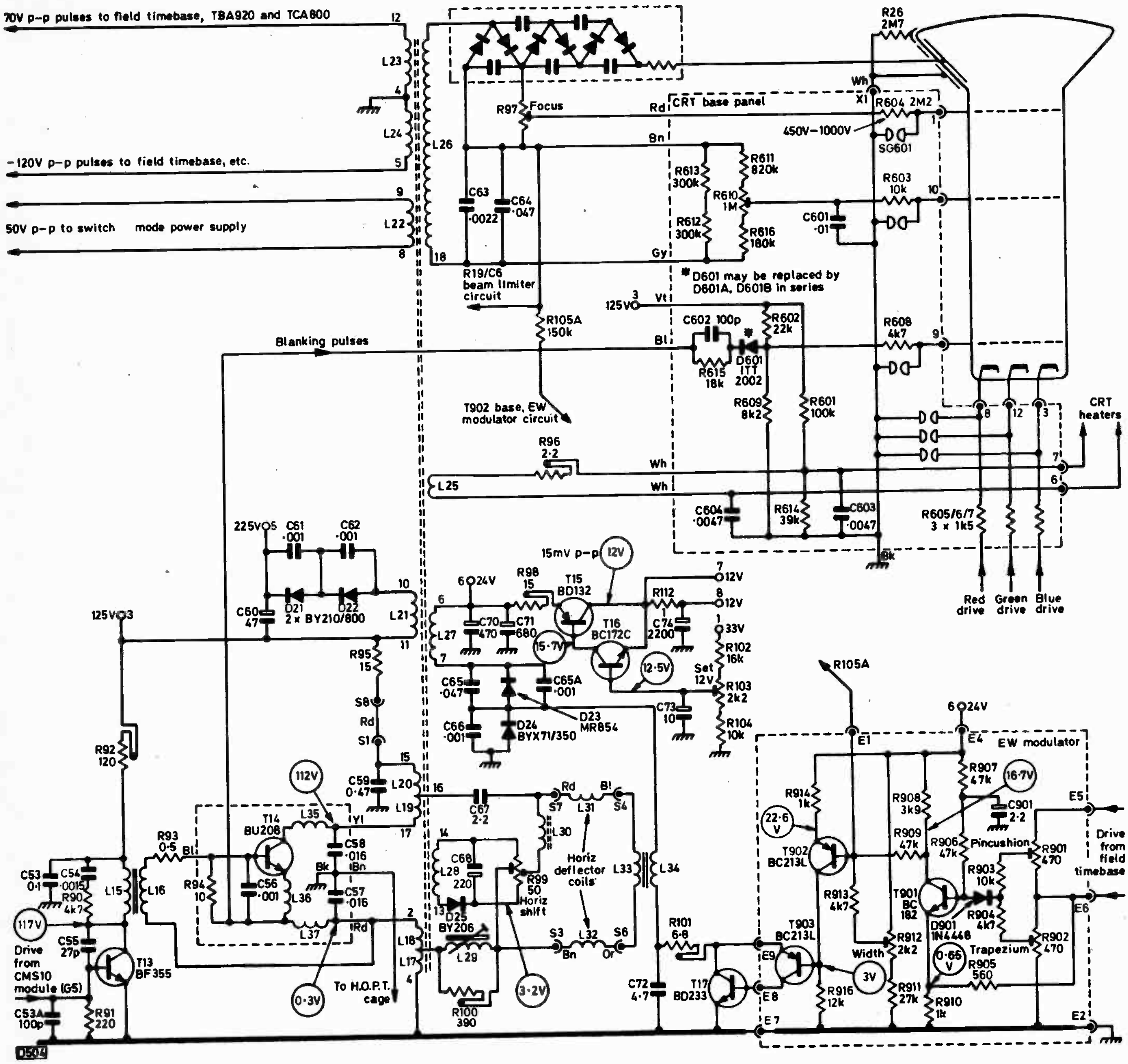


Fig. 6: The line driver and output stages, the EW correction and modulator circuits, and the tube base panel circuitry, as used on the basic CVC20 chassis. The 70V pulses from tag 12 of the line output transformer are fed to the NS correction transductor, to the TBA920 IC701 as the reference pulses for the flywheel line sync system, and to the TCA800 IC503 to provide PAL switch triggering. The −120V pulses from tag 5 are fed to the NS correction transductor circuit, to the TBA560C IC501 to provide line flyback blanking, to the TBA440N IC301 for a.g.c. gating, and are rectified to provide the supply for T7 in the field timebase.

one ITT prudently made provision for line and field shift on the mother board. Where shift facilities are needed on these chassis, three components must be added for vertical shift and five for horizontal shift. The following components are merely fitted in the positions marked on the mother board:
Vertical shift: Remove R34. Fit R34A 250Ω shift control part no. 02460, R34B 100Ω 4W part no. 07733, R34C 150Ω 4W part no. 071006. Add a wire link from the junction of R34/R39 to R34A's wiper.
Horizontal shift: Add L26/27 part no. 04165, C75 0·001μF 20% 500V part no. 08954, C76 22μF 16V part no. 08461, R113 15Ω shift control part no. 02459, and D31 BY206 part no. 12735.

There's a lot of energy in the scanning yoke, and the high current through the linearity coil L29 (back to the CVC20 again) means that a minor burn-up can occur if, as sometimes happens, it becomes dry-jointed. Usually the fusible damping resistor R100 opens to call attention to the fault.

An annoying audible whistle can usually be traced to the transductor L3-L7, although the line output transformer, the linearity coil L29 or the driver transformer L15/16 can also be responsible. Firm pressure on the suspect inductor with an insulated tool will quickly pinpoint the offender.

A low-emission c.r.t. effect, gradually disappearing during a lengthy run, should direct attention to the resistor in series with the c.r.t.'s heaters – R96 in the CVC20, R99 in 110° sets. Check its jointing and resistance, as it can go high. We once found that a 6·8Ω resistor had been fitted in production!

EW RELATIONS

Where the picture width is incorrect and there is no sign of distress from the line output stage or the power supply, the chances are that the EW modulator is in trouble. The modulator diodes themselves (D23/4 in CVC20 etc., D24/5 in 110° sets) can fail in various ways – most commonly D23 goes short-circuit to open the fusible resistor R101. The modulator driver transistor T17 (T13) can go open-circuit to give low width. On early CVC20 chassis, T17's emitter came off earth with the same result. In either case, the quick check is to ground T17's collector – or T13's emitter as the case may be – whereupon the width should jump out. T903 on the EW modulator panel is also suspect in cases of incorrect width.

In 110° sets, the EW correction transformer L22/23 can develop short-circuit turns, resulting in excessive width. The same symptom occurs sometimes when the BD238 transistor in the T13 position goes short-circuit. This can be brought on, we believe, by e.h.t. tripler failure.

Still on 110° sets, C69 (value varies with chassis) has been known to go open-circuit, this time reducing the width.

Turning now to the EW control department, the width, pincushion and trapezium control potentiometers in all chassis can become "junky", giving rise to intermittent changes in width and picture geometry. Very often cleaning is all that's required, our old enemy flux usually being at the root of the trouble. A degree of compensation for picture breathing is introduced into the EW control circuit via R105A (150kΩ). This resistor has been known to go open-circuit, and is worth checking if regulation of the width with brightness changes is poor.

CRT BASE PANELS

The c.r.t. base connector panel varies somewhat with different chassis types. Each type of panel contributes its quota of faults, so we'll briefly look at them individually.

On the CMB10 c.r.t. base panel fitted to 90° sets, vertical striations will appear if D601 goes open-circuit. The first anode preset control R610 can develop an open-circuit track, brightening or extinguishing the picture depending on the position of the wiper relative to the break. A bright, broad streak down the left-hand side of the picture will usually be resolved by checking R609, which may be open-circuit or badly jointed. Finally, failure of R615 will manifest itself as a vertical striation on the right-hand side of the display.

The CVC25 chassis uses c.r.t. base panel type CMB25, which is broadly similar to CMB10 just dealt with. It's prey to many of the faults described above. The first anode supply potentiometer is fed from a 180kΩ resistor, R616, and in some component batches this resistor could fail, giving a low brightness or no picture fault. A reading of less than 450V at pin 10 of the c.r.t. betrays this one. In some CVC25 chassis the line flyback blanking pulse feed diode D601 was replaced by two 1N4148 diodes connected in series.

The CVC30 and CVC32 chassis use c.r.t. base panel type CMB30. This is quite different from the other types, incorporating as it does three first anode presets and two gun switches. Common troubles here are confined to failure of R603 (510kΩ) and R608 (100kΩ), causing excessive brightness in either case.

SWITCH-MODE POWER SUPPLY

In discussing the power supply we'll disregard the CVC40 and CVC45/1 chassis altogether – they are relatively new as yet, use a totally different power supply circuit, and we've had no failures to date.

In the other sets it's important to be sure that the switch-mode module is correct for the chassis type, as they are not interchangeable. On sets whose chassis type number starts with the five characters CVC20, the CMP10 module is used, providing an output on the main h.t. line 3 of 125V. The CVC25, CVC30 and CVC32 chassis, also the /1 and /3 variants of these, all use the CMP30 module, which is designed to produced 160V on the h.t. 3 line. To distinguish them, look at R814 – in the CMP10 it's 18kΩ, in the CMP30 it's 27kΩ.

A comprehensive write up on this power-supply circuit will be found on page 576 of the September 1977 issue of *Television*. Since the appearance of that article, a revised setting-up procedure has been produced.

To set the over-current trip potentiometer R810, remove pin 1 of the module and apply an external source of 4V to TP801. The potentiometer may now be adjusted so that the power supply just trips. The over-volts trip potentiometer R817 should next be set so that the power supply trips out at 29kV e.h.t.

This power supply has been around long enough for a few stock faults to have emerged. It's an excellent circuit however, and much less trouble than some other manufacturers' designs. We regret its passing as the CVC40 and CVC45/1 come into the limelight: it's whispered in gaul that the TDA2640 power supply module might diappear from the new production scene soon.

Suspicion naturally falls on the power supply in cases where "pumping" takes place. Very seldom is the power supply responsible however. If the output voltage rises, the trip will operate due to excessive e.h.t. voltage; much more commonly, excessive current will cause tripping, with a short on the h.t. 2 (20V) or h.t. 3 (125V) lines, or a heavily loaded and damped line output stage drawing excessive current from the 125V line.

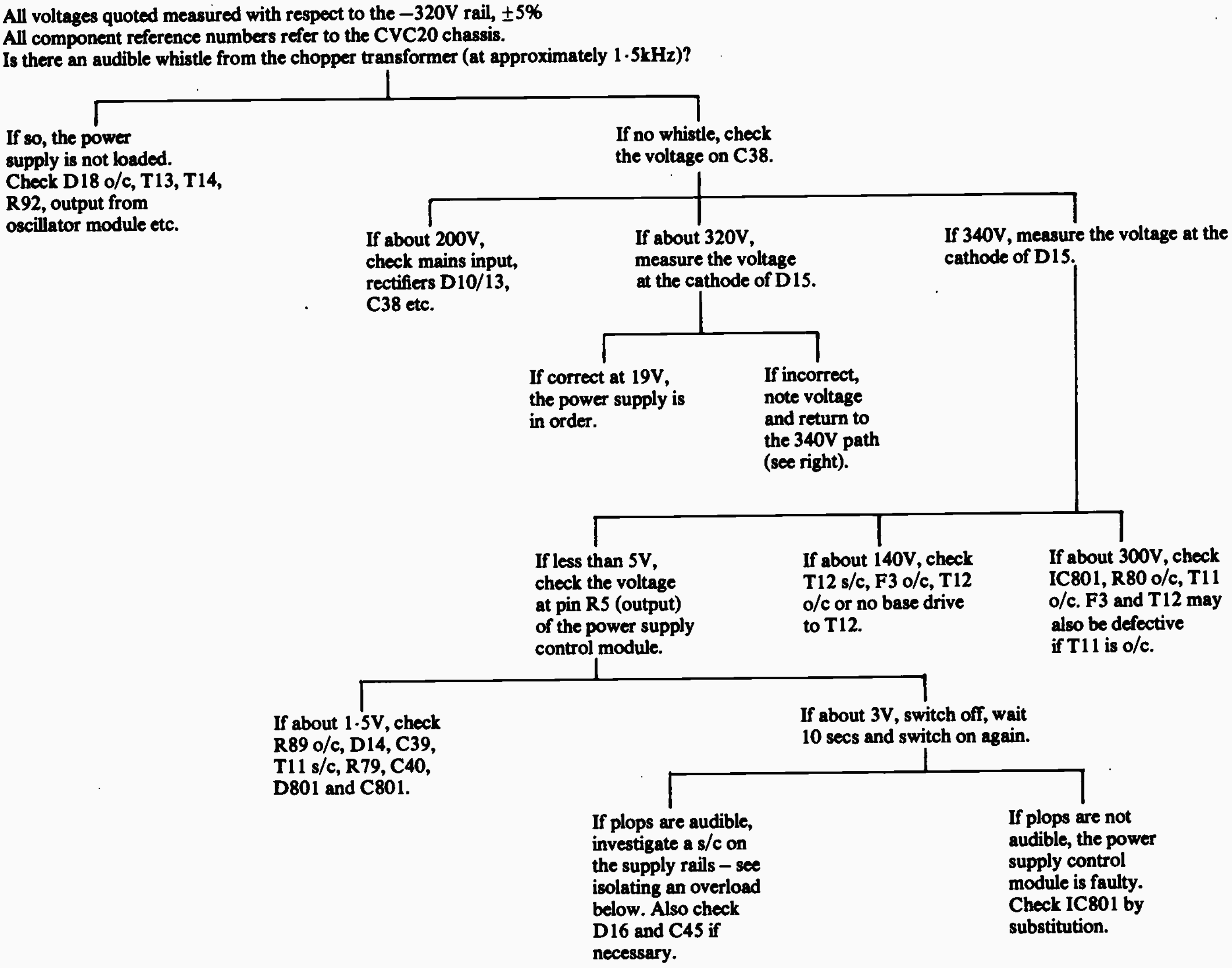
Chart 2 may be found helpful where the power supply is tripping. Remember however that the i.c. will do only five or six pump cycles before shutting down. This state of affairs is indicated by the presence of about 6V on pin 15 of the TDA2640, and necessitates switching off the set for a few seconds – when the mains power is restored, the power supply will again sample conditions.

In cases of intermittent shut down, check the TDA2640 by substitution then if necessary replace the h.t. rectifier (D18 in the CVC20, D19 in 110° sets). Ensure that the line hold control R710 is correctly set.

The BY133s in the mains bridge rectifier circuit and the 1μF mains filter capacitor (on the mother board on some chassis, on the control panel on others, and on both in other cases) are uncommonly well behaved in this chassis, so that a blown mains fuse is quite a rarity. When it does happen, C44A (C44 in 110° sets) is as likely a culprit as the filter capacitor and bridge. This is a disc ceramic capacitor across the –320V line – it's on the mother board. A very much less likely possibility is a defective chopper transformer. We've had some mains switch failures – they generally fizz and grumble internally, thus causing sporadic failure.

No sign of life in the set, with the mains switch and fuses intact, should lead to a check of the zener diode D801 which sets up 12V to operate the TDA2640 i.c. Beware of switching on the set with the switch-mode power supply control module removed, as C40 on the mother board, robbed of its shunt load, will instantly go short-circuit. Beware even more of the –320V line itself. It has a very low source impedance, and is derived directly from the mains. The problem is that the voltages in the power supply are referred to this line, which forms an "apparent earth". One

Chart 2: Power supply fault guide.



To isolate an overload, proceed as follows:

(1) Unplug the line oscillator/sync separator module. If this clears the overload, check the a.c. load components in the line output stage – the tripler, rectifiers D21/22, shift rectifier D25, shift blocking coil L30, EW modulator diodes D23/24, flyback tuning capacitors C57/8, and the associated components including the line output transformer.

(2) If the overload remains after unplugging the line oscillator module, remove the scan coil plug. If the overload is cleared, check the BU208 etc. for a d.c. short-circuit.

(3) Refit the module and the scan coils plug and check for a short-circuit in each by removing one at a time. Check power supply outputs for short-circuits, and the power supply module by replacement.

real earth and one apparent earth, the two 320V apart and both capable of giving a nasty shock to true earth (earthy stuff this, isn't it?).

Within the control module, C803 can go open-circuit to give width flutter. In some production, R816 is suspect for open-circuit. This deletes the line sync pulses from the chip, which will then free run at about 18kHz. This has no effect on the performance of the i.c., but gives rise to an interesting little fault condition which may stretch your powers of diagnosis a bit: striations appear on the display, roughly $\frac{1}{4}$in. wide and $\frac{1}{2}$in. apart, disappearing when the chassis is lowered.

If the current trip potentiometer R810 is burnt, along with R805 and R809, resolder or replace the 1Ω current sampling resistor on the mother board (R89 in the CVC20, R86 in 110° receivers) and pray that the TDA2640 has survived – it usually does.

The output voltage from the power supply as a whole is based on the reference zener D802, which should be checked in cases of output voltage drift or difficulty in setting the h.t. It's worth knowing that the correct e.h.t. of 25kV gives rise to just about 38V across C809, its measuring point within the module.

Components on Main Board

The rest of the power supply is on the mother board, starting with the driver transistor T11 (T10 in 110° sets). In early production versions of the CVC20, its base bias resistor R80 (150kΩ) acquired a certain notoriety on account of its habit of going high-resistance or open-circuit, often intermittently. Unfortunately, this usually results in the destruction of the BU126 chopper transistor.

D19 and D20 are there to protect the chopper transistor from over current and over voltage respectively (in 110° sets they are designated D20 and D21). They should be checked along with the associated components and R80 in cases of BU126 failure. If the BU126 has shorted, the 5·6 and 100Ω resistors in its base circuit (R84/86 in CVC20) should be checked for damage.

A mysterious case of low h.t. can arise if the h.t. reservoir/smoothing capacitors C51/52 dry up or lose capacitance. The h.t. will fall to about 80V on load, rising to virtually normal when the load is removed. Under normal conditions, a lightly loaded power supply (under no line drive conditions for instance) will give rise to a whistle at about 1·5kHz from the converter transformer.

Scoping the Power Supply

When investigating the power supply module, oscillograms can be taken peacefully with fuse F3 removed, thus de-energising the receiver and preventing damage to the BU126 when a test probe is connected to the base or collector of the driver transistor (T11 or T10).

MISCELLANEOUS MATTERS

Resistor value changes in the beam limiter circuit were listed in the caption to Fig. 2 last month. Note that R20/21/22/23/25 should all be 2% tolerance types.

The following modifications were made at the front end of the decoder board. T501's emitter resistor R501 has a series *RC* network added across it: a 470Ω resistor (R501b) is connected to T501's emitter and is taken to chassis via a 470pF capacitor (C501b). The wiper of S501 is taken to the junction of these added components instead of to the emitter of T501. The value of R505A was increased to 470Ω. And an addition diode, type 1N4448 (D505a), was mounted on the copper side of the board in an insulating sleeve, with its anode to pin 10 of IC501 and its cathode to the junction of D501/D502.

Finally, one or two odds and sods not associated with any particular module or circuit section. Flux may contaminate the pins of any of the modules, so that these are worth checking in all cases of "flag-waving" faults. On some early production sets, the earthing of the print on the mother board to its metal frame was suspect, again leading to intermittent effects when the set or chassis is tapped.

Looking back over this chronicle of misery and disaster, we are prompted to restate the comment we made at the beginning, that the reliability is generally good and that these receivers are not the rogues we seem to have made them out to be. We've had many sets of the CVC20 type out on rental for periods of up to two and a half years with few or no service calls having been required. Our own records bear out the fact that the reliability is increasing as feedback from the trade takes effect in ITT's design and production departments.

It could well be that future production will be based on the CVC45/1 type of chassis, and it seems unlikely that in future chassis the designs will be produced and updated and outmoded quite so quickly as in the past three rather hectic years. If necessary, we'll return to these chassis and their successors in a couple of years or so, when the habits of the CVC40 and CVC45 series are better known.■

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 383 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.

TELETON TH14

There's very little brightness on this set, despite a new line output transformer and a complete set of power transistors and diodes. When the set is switched on, there's a small flash in the tube gun. Do you think there's a short in the tube?

We doubt it. This would result in no picture of any entertainment value. Check the tube base voltages: there should be 11·5V across the heater pins 3-4, 0-90V at the cathode (pin 2) depending on the setting of the brightness control, zero voltage at the grid (pin 1), and about 290V at the first anode (pin 6). The voltage at pin 7 depends on the setting of the focus tapping. Low voltage at pin 6 could indicate leakage in the tube if the voltage returns to 290V when the tube base socket is removed. If the voltage is low with the tube base off, the first check should be of the associated electrolytic decoupling capacitor C432 (3·3μF, 350V) which could be leaky.

TANDBERG CTV2

The raster went off suddenly, accompanied by a smell of burning resistors, and smoke. The sound is o.k., but the horizontal centring potentiometer R772 is completely burnt.

The potentiometer has burnt out because the a.c. blocking choke L752 in the horizontal shift circuit has gone short-circuit. It can be taken out of circuit altogether if the picture is reasonably centred without it.

BAIRD 700 CHASSIS

This set has given excellent pictures until now. The set was operating normally, then the picture suddenly went very much brighter. It was noticed that the brilliance of the heaters had increased. On switching off, there was a frying sound for a couple of seconds.

The usual cause of this trouble is heater-cathode leakage in one of the valves, and from the symptoms it would seem that the PFL200 luminance output/reference oscillator valve is a hot favourite, in which case its cathode components should be checked as well. It should be possible to see where the fault is since the valves on the earthy side will probably be glowing less brightly. If necessary, check the heater voltages systematically from the PY500 at the high-voltage end of the chain to the ECC82 at the earthy end. There are also two decoupling capacitors in the chain, C315 and C194 (in the v.h.f. tuner), either of which could be defective.

KB WV05

The trouble with this 19in. dual-standard set is lack of width. It's normal on both systems on switching on, but after about a quarter of an hour on 625 lines the width starts to come in from the left – the last time the set was left on the width started to come in from the right as well. On 405 lines the fault takes longer to appear – about an hour and a half. All the line timebase valves and the boost capacitor have been replaced, and the value of the resistors in the tapped width control chain checked and found to be correct. The associated decoupling capacitor C125 has also been replaced. I now suspect the line output transformer, which hisses when the set is switched off.

It's possible that the h.t. is dropping as the set warms up – if the voltage at the anode of the PY801 boost diode (pin 9) is less than 180V when the fault is present, replace the h.t. reservoir/smoothing block C138/C136. It would be worth checking the line drive coupling capacitor C123, and the condition of the focus control. Also ensure that the heater current is correct. Otherwise the line output transformer is suspect – also the scan coils, though this is much less likely.

THORN 2000 CHASSIS

The trouble is poor field hold, especially on ITV. The field hold is reasonably steady on an indoor aerial, but when the set is connected to the communal aerial the hold becomes intermittent. Hold can be kept if the contrast is reduced to a low level, but at an acceptable contrast level the conditions are as described above.

This sort of thing is usually caused by incorrect sync separator biasing. We suggest checking the bias resistor R25 (3·3MΩ) and the series diode W2, also C8 (50μF) which decouples the base of the pre-sync amplifier transistor VT4. These components are on the video board. Defective a.g.c. filtering can also give rise to field roll: C54 and C55 (both 50μF) on the i.f. panel are the capacitors to go for.

SONY KV1810UB

There are about 25-30 light horizontal bars across the screen, about a quarter of an inch apart, especially noticeable on dark scenes. They run all through the picture, from top to bottom. Sometimes they run upwards, stop for a second, then run downwards. The speed at which they run up and down varies. The picture and colour are otherwise satisfactory, and I can't see any ripple on the picture.

We are inclined to suspect the smoothing downstream from the chopper transistor – faults here can do strange things to the display. The capacitors to check are C621 (33μF) and C623 (10μF). If this fails to cure the problem, the best course would be to obtain an oscilloscope and a pattern generator capable of giving a plain raster, so that the fault can be traced to its source – starting at the c.r.t. cathodes.

REDIFFUSION Mk 1 CHASSIS

The trouble with this set – which carries the identifications BWE President and Rediffusion CU2213 – is that the field will trip (roll) when certain shots occur, also on camera changes. Is there any modification to overcome this?

If the collector of the a.g.c. amplifier TR007 is decoupled by a 125μF capacitor (C062), this should be changed to 25μF. Otherwise, we suggest you check the value of R401 (1MΩ) in the sync separator circuit and C045 (5μF) which smooths the distribution amplifier transistor's base bias.

THORN 9000 CHASSIS

There's a vertical line down the screen, just to the left of centre, with a kink in it. The kink moves slowly up or down. There's no hum bar across the screen. There are also multiple images, rather like ghosting, but the fault is really noticeable only when the picture consists of a light background, e.g. a cloudless sky.

We have traced the first fault on more than one occasion to the zener diode W603 on the Syclops control panel – it's in series with the base of the line driver transistor VT412. In early production it was a 6·2V type: it was changed to a 4·3V type to improve the driver transistor's switching performance. For the second fault we suggest you check whether C125 and C116 in the a.g.c. circuit are 100µF and 0·001µF respectively, as in later production. The luminance delay line could also be responsible. Another point that might help is to ensure that W712 is type MR914.

DECCA 10 SERIES CHASSIS

The picture is normal when the set is first switched on, but after an hour or so a 1½in. vertical band of incorrect colours (green on red, magenta on blue) develops on the left-hand side of the screen, remaining there. It disappears very quickly if the back is removed, so I've been unable to check around the ident/PAL switch area with freezer or a hairdryer.

The ident signal itself is used to drive the PAL switch on this chassis, i.e. there's no bistable. This fault can arise when the ident signal is incorrectly phased, and can be demonstrated by adjusting the ident coil L207. We suggest you replace C238 (0·1µF) which tunes the ident coil, and the colour-killer rectifier diode D208 (BA154), then retune L207 to eliminate the effect. If the fault drifts back, replace the coil itself.

GEC C2040 SERIES

The problem with this hybrid colour receiver is lack of sync. I cannot get either the field or line timebases to lock. The field timebase can be synchronised, but lock cannot be held, while the line will sometimes produce a sort of false lock with three or four flickery images. The sound is o.k., and there's a full range of brightness, contrast and colour.

The main suspects are the sync separator transistor TR109 and the two electrolytics C169 (47µF) and C135 (1µF) – the former provides coupling between the luminance delay line and the luminance emitter-follower, the latter providing coupling between the emitter-follower and the sync separator. It would be worth checking the values of R500 and R501 on the timebase panel, since these set the sync separator's collector voltage and tend to change value.

ITT CVC9 CHASSIS

The set gives a perfect picture when switched on from cold. After about half an hour however the picture reverts to monochrome, though with horizontal bands of colour across the screen (these are not all that pronounced). A correct colour picture can sometimes be regained by turning the set off and on again, though this is less likely to be effective the longer the set has been on.

The trouble is that the reference oscillator in the decoder is going out of lock. Next time the fault occurs, try adjusting R311d (on the left-hand side of the decoder panel) until the bars just disappear to give a colour picture, then rotate the control a few more degrees in the same direction. If the fault persists, C208d (6·8µF) and the 1·5V zener diode D36d in the reference oscillator control loop, also the crystal, are suspect (in that order).

TELETON TW12BS

The trouble with this set is no field scan – just a horizontal white line across the screen. I'd appreciate advice on tackling the fault.

Check whether R525 (100Ω) in the supply to the field output stage is burnt. If so the output transistors TR504/TR505 are suspect, and the driver transistor TR503 could be damaged. If R525 is intact, ensure that 26·5V is being developed on the positive side of the boost reservoir capacitor C419, then as before check TR503/4/5. The field drive waveform is developed across C506 in the Miller integrator circuit. There should be 26V or so on one side – if not check D501 – and 0·35V at the junction of R516/7 on the other side. If these voltages are incorrect, check the Miller integrator transistor TR502 and the discharge transistor TR501.

DECCA MS1700

The basic problem is sound but no raster. When either the brightness or the contrast is increased, a fairly good but reduced size picture appears which then increases in size and fades away. The picture appears intermittently for two-three seconds, the process repeating. The boost voltage and thus the voltage at the c.r.t.'s first anode is low, but the boost diode and capacitor are in order.

The line timebase is at least operational, though at reduced efficiency. We suggest you try a new PL504 line output valve, and check the values of R111 (3·9MΩ) and R106 (1·5MΩ) in the width circuit – R111 is the most likely suspect. If these are in order, check the ECC82 line oscillator valve and the 27kΩ load resistor R102 across which the output is taken.

THORN 1590 CHASSIS

The problem is sound distortion after the set has been on for approximately an hour and a half. It disappears when the back has been removed from the cabinet. The TBA120B intercarrier sound i.c. has been replaced (with a TBA120A), also the preamplifier transistor VT10. All voltages in the audio circuits are within tolerance, and all the electrolytics in this area have been checked by shunting them with appropriate value capacitors when the fault is present.

While the output transistors VT12/13 or the bias transistor VT27 (if applicable) could be faulty, it's more likely that the loudspeaker cone is warping at high temperatures. Try a replacement speaker, ensuring that it's the correct impedance (12Ω). Note that when a TBA120A is used to replace a TBA120B, the 12kΩ resistor fitted on the print side of the board between pins 8 and 11 should be removed.

PYE 169 CHASSIS

The fault with this set is sound but no raster. All the line timebase valves have been replaced. Disconnecting the width control restored the picture, but with increased width. So the control and the v.d.r. in series with it were replaced, but still no difference. Replacing the 500kΩ width control with a 2MΩ resistor reduced the width of the restored picture, but the side of the screen started to jitter, and with the brightness control at maximum there's ballooning.

An unusual fault. There seems to be something amiss with the d.c. conditions at the control grid of the line output valve, possibly due to the coupling capacitor C69 (0·047µF) being leaky. The feedback capacitor C67 (820pF) in the oscillator circuit may have changed value, and it would be worth checking the values of R80 (1MΩ) and R81 (1·2MΩ) in the PL504's control grid circuit, also the pulse feedback capacitor C71 (120pF).

GRUNDIG 6010

The trouble with this set is that the safety cut-out keeps operating, removing the supplies, though there don't seem to be any shorts. Resetting the cut-out sometimes brings the set to life again, but it works for only ten minutes or so before cutting off again. I've monitored the shift voltage at tag c of the line output transformer, and this seems to remain steady before the set cuts off.

The problem is usually due to dry-joints in the line output stage. Check in particular the connections to L501 and L515, which are in series with the gates of the two thyristors, and the condition of the soldered joints on the pins of the large wirewound components in the line scan/e.h.t. circuit.

PHILIPS G8 CHASSIS

The BT116 mains rectifier thyristor on the power supply panel seems to last only two-three years and is now difficult to get. Any suggestions for alternatives?

A BT106 with suitable heatsink can be used, or a BT119 or BT120 as in some thyristor line output stages, again with metal work, or a BRC4443 can be used. A diode such as the BY127 can be added in series with the thyristor: this protects the thyristor against reverse breakdown, and also helps to prevent excessive e.h.t. in the event of a gate-cathode short in the thyristor. The latest official Philips recommended replacement is the 2N4444.

ITT VC53 CHASSIS

The trouble is that the DY86/87 e.h.t. rectifier valve keeps going out, with resultant loss of the picture. The valve has been changed and a check made for loose pin connections, but the fault remains.

There are two common causes of this trouble. First, you'll find inside the shroud carrying the valveholder a 2·5Ω 1W resistor which is in series with the valve's heater. Check this by substitution. Secondly, green corrosion often builds up on the sockets and their connections. A new valveholder is the only lasting cure for this.

TEST CASE

197

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 Bush Model CTV1526 (RRI Z179 110° chassis) arrived in the workshop with the complaint that the picture was falsely coloured and that there were coloured edges to the picture components even on a monochrome transmission or when the colour control was fully retarded. Using a crosshatch signal from a Pye Unicam pattern generator, it was dramatically revealed that the red and green horizontal convergence was badly out of adjustment.

Looking at the circuit diagram, it was noted that line pulses for this part of the convergence circuit are coupled to the top of the secondary winding of 5T1 (R/G amplitude) through an 0·1μF capacitor (5C4), the circuit then continuing to the green convergence coil 7L9 and the red convergence coil 7L10 via each side of the centre-tapped R/G differential amplitude coil 5L3.

Using the crosshatch, it was found that by adjusting 5T1 there was movement of only the red crosshatch lines. No combination of adjustment to 5T1 or 5L3 would produce accurate convergence of the red and green crosshatch lines however.

The blue horizontal and lateral adjustments appeared to be working reasonably well, since appropriate adjustments at the left and right sides of the display could be achieved, but the centres of the vertical lines of the crosshatch at the left and right sides could not be brought into proper registration. It was proposed to check the current in the red and green coils to see how this varied with control adjustment. A method of making this measurement was devised, and it was found that the current through the coils was not as would have been expected.

What was the most likely cause of the trouble, and what method do you think was adopted to measure the coil current? See next month for the answers and for a further item in the series.

SOLUTION TO TEST CASE 196
– page 328 last month –

The mistake made by the technician in the test case reported last month was not to extend his tests at the tube's base. The vital one he left out was pin 3, the first anode, for with no voltage here there can be no screen illumination. The first anode supply is obtained from the boost line via a smoothing network consisting of a 270kΩ resistor and an 0·22μF decoupling capacitor (3C38). The latter was short-circuit, robbing the tube of its first anode supply. The line output stage continues to operate in this condition – hence the ability to obtain a spark at the anode of the line output valve – but due to the overload will be working at reduced efficiency, explaining the low e.h.t.

QUERY COUPON

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TELEVISION MAY 1979

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STOP PRESS PC92/96, PCL200, PL95, PL519 available! Also EY500A, EL509, EL519

Note: Actual makers of NEW MICRO ALL GROUPS UHF AERIAL (625) – 3" × 1¼", amazing results. £3.70 all incl. SAE DETAILED LEAFLET

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MAIL ORDER ONLY
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ALL NEW & BOXED, "QUALITY" BRANDED VALVES GUARANTEED 3 MONTHS. BVA ETC. ARE OFTEN AVAILABLE WITHOUT ANY GUARANTEE. BELOW USUAL TRADE PRICE.

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DY86/7	55p	EF86	55p	PC86	80p	PCF802	82p	PL36	£1.00	PY500A	£1.80
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ECC81	60p	EF183	55p	PC97	72p	PCF806	75p	PL82	30p	UCC85	55p
ECC82	63p	EF184	55p	PC900	65p	PCF808	£1.75	PL83	46p	UCH81	60p
ECC83	63p	EH90	60p	PCC84	35p	PCL82	65p	PL84	50p	UCL82	75p
ECC85	52p	EL41	£1.00	PCC85	53p	PCL83	£1.00	PL500 }	£1.20	UCL83	99p
ECH81	55p	EL509	£3.00	PCC89	60p	PCL84	70p	PL504 }		UF89	55p
ECH84	85p	EM84	90p	PCC189	55p	PCL85 }	85p	PL508	£1.70	UL41	95p
ECL80	52p	EY86/7	46p	PCF80	80p	PCL805 }		PL509	£3.05	UL84	90p
ECL82	65p	EY500A	£1.60	PCF86	60p	PCL86	85p	PL802	£2.90	UY41	55p
ECL86	72p	EZ80	42p	PCF200	£1.60	PCL200	£1.40	PY88	90p	UY85	60p
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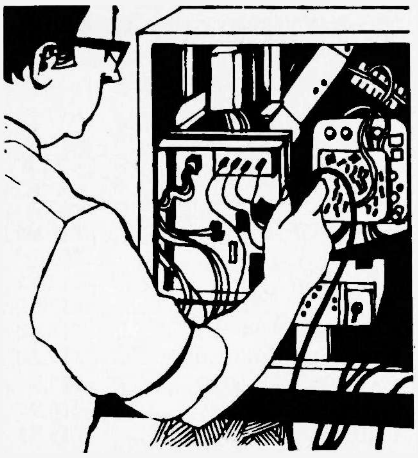

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Colour from £40.00

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ECC82	10p	PCC85	20p	PL504	25p
ECL80	8p	PCC89	8p	PY32/33	15p
EF80	8p	PCC189	8p	PY81/800	15p
EF85	8p	PCC805	15p	PY801	20p
EF183	10p	PCF80	8p	U191	15p
EF184	10p	PCF86	15p	6F23	15p
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20", 22"	**£33.00**
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26"	**£36.00**
Mono	
20"	**£11.00**
24"	**£12.00**

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

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PYE 200+300µf 350v	£2·00
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ADD 20p P/P ORDERS UNDER £10

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Here is what you pay.

17-18-19 inch	**£29.00**
20 inch	**£30.00**
22 inch	**£32.00**
25 inch	**£34.00**
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Guarantee 1 year.
Exchange basis.
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19" £29.50 MONO 20" £30.50
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One Year Guarantee.

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PLUS:—
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COSTS:—

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Send stamped addressed envelope for details.
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All sizes and makes available.
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Philips G8 550
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Send for full details and price list. Special rates for contract and bulk work.

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All types — **All tubes 12 months guarantee**

Including 20AX-P.I.L.-Japanese types

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

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All sizes £11·00

All tube prices subject to 12½% V.A.T.

NEW VALVES

DY802	67p	PCF805	£1 80
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EF80	40p	PCL84	80p
EF85	50p	PCL805	85p
EF86	80p	PCL86	85p
ECL80	80p	PL36	90p
ECL82	60p	PL802	£2 13
EF183/4	64p	PL504	£1·33
EL34	£1·80	PL508	£1·58
EL84	50p	PL509	£2 52
EY86	50p	PL519	£3·00
GY501	£1·40	PFL200	£1 18
GZ34	£1·75	PD500	£3·30
KT66	£3·50	PY88	71p
PC97	75p	PY800/1	69p
PC86	85p	PY5000	£1 50
PC88	85p	UCL82	75p
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Telephone enquiries welcome

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Immediate dispatch

Cash with order please. Any excess refunded

No minimum order limit. You may order as you please

Lancashire/West Yorks deliveries by arrangement

Carriage costs colour £4·50 incl. VAT

Carriage costs mono £3·50 incl VAT
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Send S.A.E. for full value price list many old types in stock

Post & packing charges

14p for 1 valve 7p for each additional valve 2p extra for large valves. MAX of 80p

Post free orders over £20
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COLOUR TV MANUALS

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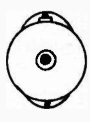
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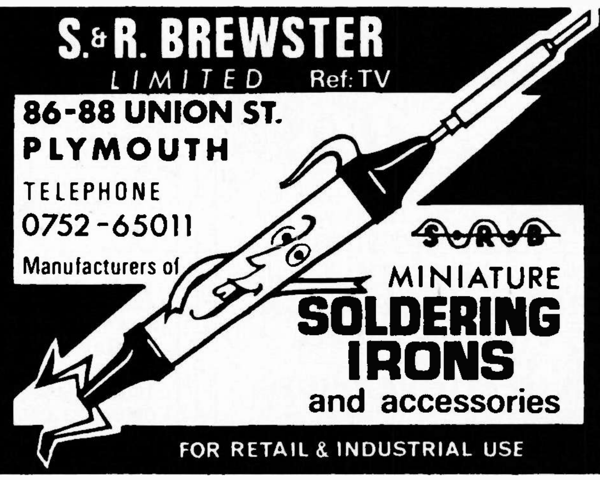

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TBA990	£1.00
SN76660N	50p
SN76650N	£1.00
TBA560Q	£2.00
TBA540Q	£1.00
TBA54Q	£1.00
TIS91	25p
TAD100	£1.00
SAB550	£1.50
TBA530	£1.00
RCA40506 Thyristors	50p
BC108	7p
BD610, BD619	50p PAIR
MJE2955	50p
TIP2955	50p
AC188	10p
BC149C	7p
Aerial Amp Power Supplies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

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

BC365	10p
BD561-2	PAIR 30p
BD183	50p
TDA2680	£1.00
TDA2690	£1.00
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SN76131N	£1.00
TBA651	£1.00
TBA750Q	£1.50
TBA920Q	£2.00
SN76003N	£1.50
SN7660N	£1.00
SAS570S	£1.50
1N4148	3p
BF198	7p
BF274	5p
BA159	10p
BY184	25p
BY187	50p
TAA550	20p
TBA396	£1.00
TBA510Q	£1.00
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TBA550Q	£1.50
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TBA800	95p
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TAA700	£1.50
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TBA550	£2.00
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SN76640N	£1.00
SN76033N	£1.00
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TCA270Q	£2.00
TCA270SQ	£1.00
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R2008B	£2.00
BU105	£1.00
BU105/04	£1.00
BU205	£1.00
BU208	£1.75
BU108	75p
BU126	£1.00
BD130Y	20p
2N3055	40p
BRC1693 Thorn	60p
BD138	20p
BD252	20p
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SCR957	65p
BRC4443	65p
5A 300, TIC106 Thyristors	25p EACH

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TELEVISION

SERVICING · VIDEO · CONSTRUCTION · DEVELOPMENTS

Servicing the ITT CVC20 SERIES CHASSIS Part 1

RANK Z504 SCAN DRIVE PANEL

EXPERIMENTAL SPECTRUM ANALYSER

TELEVISION

April 1979

Vol. 29, No. 6
Issue 342

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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We regret that we cannot answer technical queries over the telephone nor supply service sheets. We will endeavour to assist readers who have queries relating to articles published in *Television*, but we cannot offer advice on modifications to our published designs nor comment on alternative ways of using them. All correspondents expecting a reply should enclose a stamped addressed envelope.
Requests for advice in dealing with servicing problems should be directed to our Queries Service. For details see our regular feature "Your Problems Solved". Send to the address given above (see "correspondence").

this month

OUR NEXT ISSUE DATED MAY WILL BE PUBLISHED ON APRIL 17

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)
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24" Rimguard £6.00
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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.

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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	PL50B	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						

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WE DO NOT SELL RUBBISH AT BRIARWOOD TV

D/STANDARD COLOUR SPARE PANELS

	IF	LUM	CHROMA	EHT	REG	CON	S/OUTPUT	POWER	L/T8	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

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	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.

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19" £18.00
19" A49, 192 £20.00
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22" £22.00
25" £18.00
26" £28.00
Plus P&P £4.

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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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Scancoils from £5.00.
P&P £1.
Other spares available on request.

G8 PANELS SPECIAL OFFER
CHROMA £12.00
POSTAGE & PACKING £1.25 PER PANEL.

MAIL ORDER T.Vs. IN GOOD WORKING ORDER

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.

PERSONAL CALLERS WELCOME.

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.

Briarwood T.V. Limited
Britain's Mail Order T.V. Specialists
BRIARWOOD

THE PROFESSIONAL CHOICE. NATIONWIDE

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 }	1.30
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	0.08
BC183L	0.07
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	0.50
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	0.28
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	0.20
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	2.08
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

SPECIAL OFFER

SL901B	3.50
SL917B	5.00

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	0.10
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
PL504	1.10
PL509	2.45
PY88	0.63
PY500A	1.60
PY81/800	0.57

SPECIAL OFFER

Philips PL802 2.55

E.H.T. TRAYS MONO

950 MK2 1400	2.26
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	5.67
Philips G8 520/40/50	5.66
Philips G9	5.79
GEC C2110	5.50
GEC Hybrid CTV	5.40
Thorn 3000/3500	5.50
Thorn 800	2.42
Thorn 8500	5.23
Thorn 9000	6.10
GEC TVM 25	2.50
ITT/KB CVC 5/7/8/9	5.50
RRI (RBM) A823	5.89
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

All transistors, IC's, offered are new and branded. Manufactured by Mullard, I.T.T., Texas, Motorola etc. Please add 12½% VAT to all items and overseas at cost P & P U.K. 25p per order, overseas allow for package and postage. Cash with all orders. All prices subject to alteration without notice.

TELEVISION SALE
DISCOUNT FOR QUANTITY

Please note all mono sets sold as 100% comp.
No broken masks, no broken panels etc.
Colour sets sold with good c.r.t.s and 100% comp.

Working Mono £3.00 extra.
Working Colour £15.00 extra.
Supplied in 1's or 100's.

MONO Rotaries 19" & 23"

GEC	£3.00
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	45	50	50	45	60
Philips	—	—	45	45	60
Thorn	65	—	65	60	85
Bush	55	—	60	60	60
Kort	—	—	65	—	75
Pye Mechanical	45	—	50	—	50
Pye Varicap	55	—	55	—	55

MAINS DROPPERS

Mono

Bush 161	60p
Philips 210 30+125+2K85	45p
Philips 210 118R+148R	40p
Thorn 1400	75p
GEC 2018	55p
Decca 2K5+90+100+167+5	72p
Thorn 1500	60p

Colour

Bush A823	72p
Pye 723 27Ω+56Ω	47p
GEC 2110 –41Ω	45p
GEC 2110 –12R5+12R5	47p
GEC2110 –27R5	45p
Thorn 3500	54p
Thorn 8000	54p
Thorn 8500	54p
Philips G8 47R	25p
Philips G8 2.2+68	36p

All plus VAT at 12½%.

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TELEVISION

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TELEVISION

The Television Age

There is no doubt that television has had an enormous impact throughout the world. There seem to be few countries now with no TV service at all, and the main restraint to extending coverage, the cost of serving populations spread over vast areas, has been solved with the coming of satellite TV links. The final step along this path will be individual reception from satellites the world over. For that we shall have to await an increase in satellite TV broadcasting, and the advent of cheap, mass-produced s.h.f. aerial/converter units. A huge potential market for these is going to open up eventually: research into suitable receiving equipment has been going on in several countries, including the UK, for a decade or more, and one hopes this will not be yet another field that will come to be dominated by you know who! The Japanese already have their own TV satellite however, and have produced interesting receiver designs: so anyone else who wants to get a foot in the door is going to have to look smart.

Returning to the present time however, it's surprising the extent to which TV, now well established in the industrial world, has come to be a force in third world countries – an everyday factor in urban life almost world over. Many years ago we were surprised to see a photograph of slum conditions in Mexico City: the sort of conditions you'd expect, except that the skyline was a mass of TV aerials. It seems that TV is regarded as one of the first priorities in the exploding cities of the third world, ranking with water, electricity and drainage once housing of some sort has been put up. It's said that in Sao Paulo, where 75 per cent of housing is self built, 95 per cent of homes have television though most lack water and drainage. This may be an extreme example, but wherever TV is not thick on the ground it's probably due to government policy – as in India where severe import controls together with a minute, finance-starved indigenous TV industry ensure a scarcity of TV sets.

One wonders what the viewers of Mexico City, Sao Paulo, Jakarta and so on watch, since local programme origination must be limited. They can't sit watching test patterns all day, as some of our readers seem to do! One suspects that much of the programme material originates in the US. Some interesting tales are told of the SITE experimental TV transmissions to Indian villages: it seems that with the less than stable power supplies available, and various set problems, many viewers were found watching unlocked rasters. Waiting perhaps for the oracle to come up with something?

What all this world wide interest in TV means commercially of course is huge markets. For TV sets, for programme material, and for transmission and studio equipment. To what extent has the UK industry exploited these markets? Well, we all know that few TV sets have been exported, while it's probably true that UK programme material has limited international appeal – there have been some successes in the USA, but it's interesting to note that the programmes have gone out almost entirely over the US public service network. There have also been successes with the export of capital equipment, but one doubts whether the percentage of the market taken has been very great.

This world wide spread of basic TV services is now being paralleled with the possibilities of active as compared to passive TV – the use of the TV set as part of a complex data service rather than as a simple method of displaying off-air programmes. The UK has certainly much to offer the world here, and the PO in particular is to be commended for its demonstrations of Prestel in many capitals, and for developing the system to cater for different alphabets rather than adopting the traditional staunchly parochial UK approach to world markets.

It seems to us however that active TV applications will find their main markets in business and industry – simply because the human animal tends to be rather lazy. Why should he engage himself in cross-examining the PO's computer when he can simply switch on and watch? Why should he bother even to set up and switch on a VCR – always assuming that one can be afforded? We feel that this is one possible explanation for the failure of VCRs to catch on. The video disc could be a different matter. You don't have to decide whether to record or not, merely to pick up your favourite programme when you feel like it. This seems to be borne out by what has happened in the audio field, where records are perennially popular but few people do much recording, even though it's simple enough and relatively inexpensive.

But even if active TV fails to establish itself in the domestic mass market, it could well become as indispensible as the pocket calculator in other fields, and thus a substantial market prospect. Which brings us back to that burgeoning market represented by the television age – and the question as to exactly what we in the UK, having got it all going, are doing about it?

FRONT COVER

The ITT CVC20 chassis, shown in the horizontal position. To make the photograph more interesting, we removed the right-hand side line output stage screen. Note the PIL tube with its toroidal yoke.

CORRECTION

We regret that the values of R3-4-5 in the f.e.t. meter adaptor circuit (February issue, page 210) were shown incorrectly. R3 should have been shown as 10MΩ, R4 as 1MΩ and for R5 as 91kΩ.

Teletopics

RCA TO LAUNCH NEW VIDEODISC SYSTEM

RCA's president E.H. Griffiths has announced that RCA will be introducing a videodisc system on the US market at an early date. This follows the announcement, reported last month, that the Philips videodisc system has been launched in the USA. There is also the JVC system in the offing, so it seems that RCA felt it essential to make its plans known.

Whilst RCA will be using the trade name SelectaVision for its disc system, it seems that the system is not the original one which was given that name and used a coated disc with a capacitive pickup. RCA say that the present system started two years ago, when certain aims were laid down – development of a player that could be sold for $400 or less in the shops, an uncoated disc carrying one hour's playing time per side, and an adequate catalogue of recorded material. The new system uses a grooved disc that's played with a diamond stylus. The disc revolves at 450 revolutions per minute, with up to an hour's programme material per side, and the player can be attached to any television receiver.

The disc is housed in a plastic sleeve resembling an audio record album cover. When the sleeve is inserted in a slot in the front of the player, the disc is deposited on the turntable. To remove the disc, the sleeve has to be reinserted in the player. As a result, there is no human contact with the disc. RCA say that talks with major sources of programme material have indicated that an adequate supply will be available, and the initial catalogue will contain some 250 records, including feature films, and children's, DIY, sports, cultural and educational programmes. The discs are expected to sell at around $10-17.

It seems that RCA have been looking into their crystal ball, which has told them that the videodisc will become a multi-billion dollar business in the 1980s. We wouldn't be all that surprised, provided the quality and price can be got right.

PHILIPS CUT VCR PRICE

The Philips Video Division has announced a substantial cut in the price of the N1700 VCR, following the company's successful £50 off promotion during the Christmas period. The reduction is expected to bring the average retail price of the N1700 down to around £540-£550.

PRERECORDED VIDEOTAPES FROM RANK

Rank Audio Visual has announced its intention to enter the prerecorded videotape market, with plans for a catalogue of initial titles to be published next spring. There will be a range of Rank owned feature films, along with special interest programmes for the sports enthusiast, the music lover and hobbyist. The Rank Organisation is in a strong position to enter this field, with its long established film making interests, film hire library, and video laboratories. Gerry Dinlgey, director and general manager of Rank Photgraphic and Film Services at Rank Audio Visual, believes that the real boom will come "with the production of our own programmes and with the advent of videodisc technology." That last bit throws an interesting light on the story above. It's also interesting to note that initially Rank will be offering its videocassettes in the VHS format only. Tapes may be made available in other formats later, but Rank seem to expect that the major demand will be for tapes suitable for VHS machines.

STATION OPENINGS

The following relay stations are now in operation:

Builth Wells (Powys) BBC-Wales ch. 22, HTV Wales ch. 25, BBC-2 ch. 28. Receiving aerial group A.

Holmfirth (West Yorkshire) BBC-1 ch. 49, Yorkshire Television ch. 56, BBC-2 ch. 68. Receiving aerial group C/D.

Langley (Cheshire) BBC-1 ch. 21, Granada Television ch. 24, BBC-2 ch. 27. Receiving aerial group A.

Tenbury Wells (Hereford/Worcester) BBC-1 ch. 57, ATV ch. 60, BBC-2 ch. 63. Receiving aerial group C/D.

All the above transmissions are vertically polarised.

The ITV programme franchises will be coming up for renewal next year, the IBA now having announced the rules and timetable by which it will be awarding new programme contracts to come into operation in January 1982. Two new groups have already announced that they will be applying, one in the Tyne Tees TV area and the other hoping to establish a new, East Midlands, franchise area.

MULTITEXT IC RANGE

Mullard have registered the term Multitext as a trademark for their range of components, assemblies and systems for controlling and generating TV text displays. Their latest range of Multitext LSI integrated circuits has been developed to provide an "economical yet flexible" system, and consists of six devices all of which are now in mass production. These are as follows:

SAA5000: Transmitter i.c. for remote control. 32 commands, with no critical timing components.

SAA5010: Receiver i.c. for remote control. Controls tuning and four analogue functions.

SAA5020: Timing chain i.c. Presents a full broadcast standard sync pulse.

SAA5030: Video processor i.c. for teletext use. High quality adaptive data slicer for reliable recovery of the teletext data from the incoming video signal.

SAA5040: Teletext data acquisition and control i.c. Recovers the required teletext pages and feeds them to a RAM page memory i.c. Also provides on-screen display information, e.g. BBC-1 etc. A version without this display feature, known as the SAA5040B, is to be made available.

SAA5050: Teletext character generator. Provides full colour teletext alphanumeric and graphic display, with character rounding, double height, etc. Incorporates the full September 1976 teletext/viewdata display standard.

Mullard have a compact (120mm × 160mm) module, type VM6100, which contains the four teletext LSI chips and two 4k RAM chips and requires no interfacing with the SAA5000/SAA5010 remote control system. The remote link can be by ultrasonic or infra-red transmission.

A more sophisticated remote control system, offering 64 commands and a number of additional facilities, uses i.c.s type SAB3011 (transmitter) and SAB3012 (receiver).

An interesting feature of the SAA5020 is that data can be

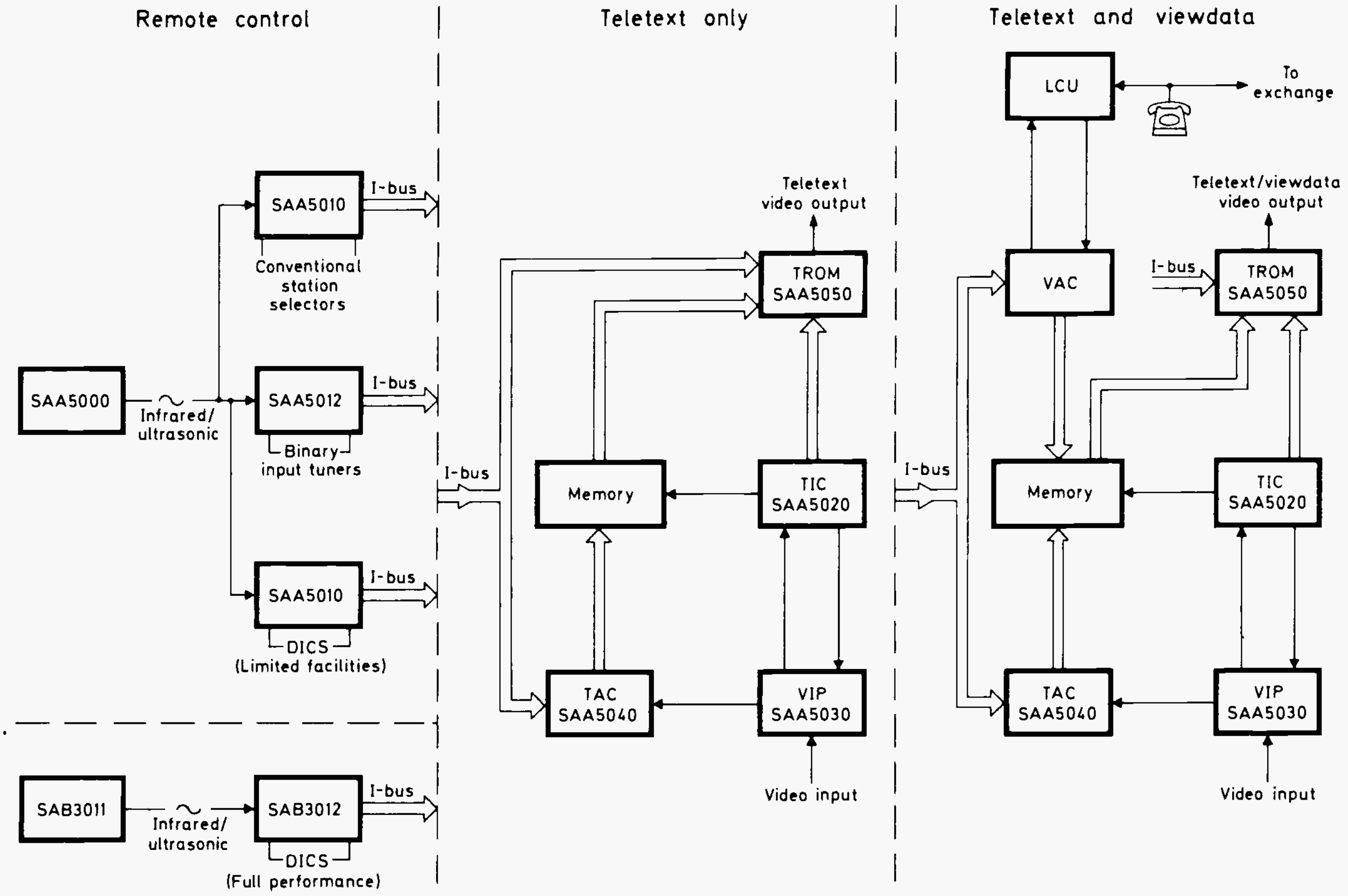

Fig. 1: The Mullard Multitext range of i.c.s.

fed into the page memory during the line as well as the field flyback period, giving rapid data refreshing.

NEW PUBLICATIONS

If, like me, you were brought up on the acoustic gramophone and are still addicted to the sound of those days, or if you simply like old recordings and are interested in the vast history of recording and broadcasting past, then a new publication, *Sounds Vintage*, will intrigue you. The first issue, dated January-February, has been published and details can be obtained from 28 Chestwood Close, Billericay, Essex.

And what's this? A little book entitled *Radio Repair – Questions and Answers* by our very own Les Lawry-Johns, 88 pages, available from Newnes-Butterworths, Borough Green, Sevenoaks, Kent or through booksellers. You know what to expect: plenty of practical guidance on what to do about what goes wrong with radio receivers.

SERVICE BRIEFS

Thorn point out that the copper patterns used on many of their standard TV receiver printed boards have been revised to enable automatic component insertion equipment to be used in assembling the boards. The revised boards have a distinctive appearance, with straight lines instead of curves for the copper patterns, but remain as direct replacements for the earlier versions of the boards. Thorn are making increasing use of computer-controlled automatic component insertion equipment in the interests of maximum product reliability and manufacturing efficiency – the machines are capable of inserting upwards of 11,000 components an hour.

The TDA2590Q sync separator/line generator i.c. used in the Philips/Pye G11 chassis has now been replaced by the later type TDA2591Q. This is a direct replacement and will be supplied under the same service code number.

NEW RECEIVERS

Two interesting smaller screen colour receivers are being added to the **Decca** range. The CN701 is a 14in. transportable which was designed and is being produced at Decca's Bridgnorth plant. It features a mains-isolated switch-mode power supply, and should be available from next month. The four-station pushbutton channel selector has three preset positions while the fourth, which uses the Decca Varitune facility, allows rapid tuning to a local station when the CN701 is being used away from home. There's an earphone socket, and integral aerial. The CN701 uses the new 70 series chassis. The other Decca set, Model CP897, is a stylish 16in. receiver using a version of the 80 series chassis.

The latest addition to the **Sony** range is the 14in. Model KV1400UB, which incorporates the new "Trinitron Plus" tube, said to give clearer, sharper pictures. There's a recessed carrying handle, an earpiece, and touch sensor controls. A channel is set aside for use with VCRs. The recommended retail price is £329.

NEW VIDEO TRANSISTORS

The latest range of video transistors announced by Mullard features a new encapsulation, type TO202, with built in heat tab to provide cooler operation. The BF857/858/859 are for use in class A circuits and have a power rating of 2W at 25°C and collector-base voltage ratings of 160V, 250V and 300V respectively. The BF869/870 comprise an npn/pnp pair for use in class B output circuits. Both have a power rating of 1·6W, with collector-base voltage ratings of 250V and –250V respectively.

Letters

CRT REACTIVATOR SUGGESTION

The following tip may be of interest to others who build their own simple c.r.t. reactivators. In most designs a 15W pygmy bulb is connected in series with the grid of the c.r.t., lighting up to indicate that grid current is flowing. The reactivator can be made smaller and more compact however if the circuit shown in Fig. 1 is used in place of the pygmy bulb. This consists of a neon (LP1) and series resistor (R2) across another resistor (R1) through which the grid current flows. With grid current flowing, the voltage developed across R1 will result in the neon flashing: as the current and the voltage across R1 increase, so the neon glows brighter.

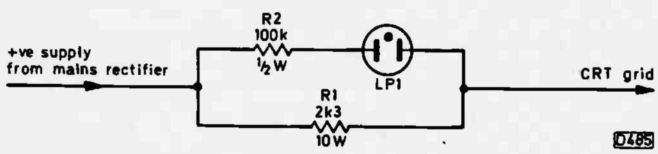

Fig. 1: This alternative to using a 15W pygmy bulb in a c.r.t. reactivator leads to a more compact design.

I've used this circuit for several months now and find that the success rate using it is just as good as with the conventional bulb circuit. The neon I used was a spare one for the GEC touch tuner head (Vitality type 3L). The value of R1 was made up by using a couple of RS 4.7kΩ, 5W resistors connected in parallel. *S. J. Vasey, Hayling Island, Hants.*

YOUR PROBLEMS SOLVED

In the February *Your Problems Solved* you comment on the trouble of pincushion distortion at the top and bottom of the picture on a Grundig Model 5011. This fault can occur when C475 (0·27μF) changes value – it tunes the north-south pincushion distortion correction transductor, and must be of the exact value. On some sets it's made up of two capacitors in parallel, only one of which may have drifted out of tolerance.
G. E. Crownshaw, Sheffield.

REPLACEMENT LINE DRIVER

A Sonar 77 monochrome portable (Model P12, SIC6) came our way recently with the fault sound but no raster. The culprit turned out to be the line driver transistor Q403, which was type NT092ET. This had us beat for a replacement at first, but we eventually found that a BC337 did the job. We hope this information may be of help to others.
E. K. Meldram, Blythe, Northumberland.

Editorial comment: The BC337, used in Thorn and Philips portables, should work in most monochrome portables.

THE DECCA THAT ATE RECTIFIERS

I'm sure there are many other readers who, like myself, play a further game of "test case" with the queries discussed in *Your Problems Solved* – comparing our own solutions with those suggested.

In the February issue there was a query about a Decca 30 series set that ate h.t. rectifiers and 3·9Ω surge limiting resistors. A further point worth checking is one that a careful engineer may never come across but is nevertheless quite a common self-inflicted problem for the unwary. The rear edge of the power supply/sound panel is located between pairs of pressed out metal tabs on the chassis frame. If the panel is allowed to rest on the top tab when refitted, instead of between the tabs, the insulation between a passing h.t. track and the chassis frame is merely a coat of varnish. Need I say more?!
Peter Sargent, Chester.

CONVERTING THE PHILIPS N1502

You may be interested to hear of our experiments in modifying a Philips N1502 VCR to give two hours' playing time. A new servo head (K7a on diagram) was obtained from Philips Service and fitted on to the same support plate as the existing servo head, but at 180° to it – see Fig. 2. A small piece of aluminium was shaped to hold the new servo head on the flanged edge of the support plate – an adjusting slot was cut into the plate.

With the new servo head connected in series with the original one, and the machine running at half speed, there was found to be insufficient drive to the sample gate of the ramp generator module (U216) via the sync head amplifier in U217. Therefore a simple amplifier, shown in Fig. 3, was constructed and mounted on spacers on the heatsink between the motor drive transistors.

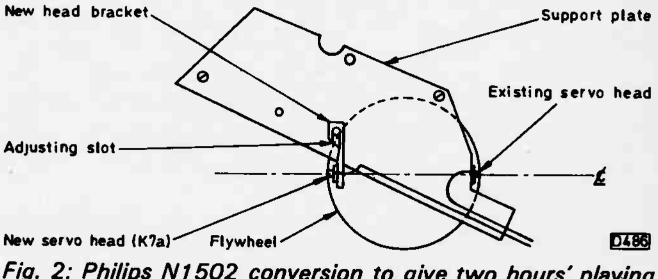

Fig. 2: Philips N1502 conversion to give two hours' playing time – fitting the extra servo head and bracket.

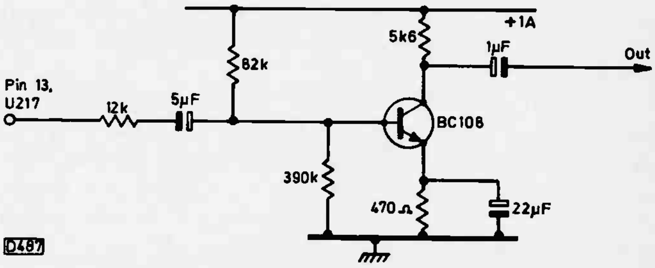

Fig. 3: Circuit of the additional amplifier.

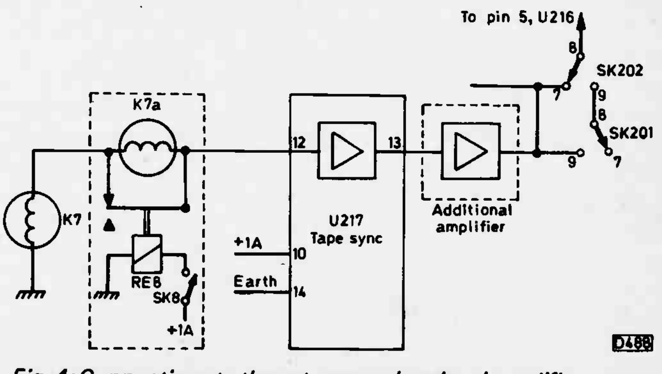

Fig. 4: Connections to the extra servo head and amplifier.

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BC157/8	8p	BU208A	175p	LM380N	95p
BC159	8p	MJE340	43p	LM1303	148p
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BC213/L	9p	OC35	78p	76013N	130p
BC214/L	9p	OC201	72p	76023N	130p
BCY70	14p	R2008B	170p	76033N	170p
BCY71/2	14p	R2010B	170p	SN76227N	119p
BD131/2	34p	TIP29/30	38p	SN76666N	80p
BD135/6	35p	TIP31A	38p	TAA621AX1	185p
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A19	2 × BD695A or 6A	110p
A20	3 × BF180, 1 or 5	70p
A21	6 × BF183	65p
A22	4 × BF324	80p
A23	4 × BFR80	75p
A24	5 × BFY50 or 52	75p
A25	5 × BSX19 or 20	65p
A26	10 × BY127	80p
A27	3 × C106D	120p
A28	25 × IS44 or 941	70p
A29	5 × 2N930	60p
A30	10 × 2N3702, 3, 4 or 5	65p
A31	10 × 1 Megohm preset 0·25W	60p
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The stop-motion switch fitted on the N1502 was commandeered to select either normal or half normal speed, as the stop motion facility is not available on this machine. The associated relay was disconnected from the printed circuit board and moved to the new amplifier board mentioned above. Where possible, the existing wiring was employed to connect up the stop-motion switch and relay. The new servo head was wired into the main servo panel (20) by breaking into the printed circuit at the input pin 12 of U217. The amplifier was connected into the printed circuit from pin 13 of U217. With the machine running in the record mode, an oscilloscope was connected to point B32 (pin 3 of U220) and the new servo head was carefully adjusted to give minimum ripple on the output waveform.

It's worth noting that transistor TS202 was found to run warmer than usual. This was overcome by reducing the diameter of pulley 195 to half its original size so that the motor voltage, during record or play mode, returned to its design figure. This means of course that when the VCR is operated at the original higher speed the voltage applied to transistor TS202 and the one inside the tape servo will be higher than normal. No problems have been experienced however with this additional modification on two machines that have incorporated it.

Clifford Springer, Clifford Radio and Television, Bristol.

THE PROBLEM OF GRID EMISSION

Your contributor Mike Phelan is without doubt correct concerning the possibilities of damage due to grid emission in power output pentodes, particularly where a high-value grid leak resistor is used in a circuit employing a high mutual-conductance valve such as the PL802 (40mA/V). In the case in question however the argument is not likely to apply.

The two most common chassis using the PL802 are the Pye and GEC hybrid ones. In the Pye chassis there's a 4.7MΩ resistor (R352) from the control grid to chassis. There's another much lower resistance d.c. path to chassis however – via R351, R201, R201A, RV14 (say half) R202 and R312, i.e. the d.c. restorer/brightness control network, the total resistance of this path being of the order of 370-380kΩ. The GEC chassis uses a similar arrangement, with no high-value chassis-connected resistor being present. So reducing the value of the 4.7MΩ resistor in the Pye chassis would offer no improvement in insuring against grid emission effects – impairment of definition is immediately evident however. R352 is surely there simply as insurance cover against the bias network mentioned above going open-circuit – there are other d.c. returns incidentally, e.g. via the beam limiter transistor.

John S. Charles, Sheffield.

OVERRIDING THE G6's COLOUR KILLER

The information on decoder alignment given by Mike Phelan in his article on renovating colour receivers has proved most useful. It's stated however that before carrying out alignment on the Philips G6 chassis the colour killer should be overridden by removing the PCC85 on the decoder panel. This action may be o.k. for quick checks when investigating no colour symptoms. It also renders the a.c.c. circuit inoperative however, resulting in a fully saturated colour bar display regardless of the setting of the user control. This makes adjustment of the reference signal phase etc. difficult. The correct way to override the colour killer on this chassis is to short the junction of R7198/R7199 to chassis.

Paul C. Coles, St. Austell, Cornwall.

Send in the Clowns

Les Lawry-Johns

YOU'VE probably gathered that we have some comical and sometimes strange characters in our neck of the woods. They keep on coming. Take Mr. Black for instance. Just about knee high to a grasshopper, but oh so aggressive.

"I want to see you" was his friendly greeting almost before he came through the door. "You know who I am."

"Of course Mr. Grey, I remember you well. How's your wife?"

"My name is Black and my wife is hopping mad, just like I am. I wouldn't like to be in your shoes if she cops alongside you."

So I had two hopping mad people on my hands and wondered why. I didn't have to wonder long.

"You repaired our set a few months ago and charged us through the nose just like all you people do and now its gone again. Didn't make a very good job of it, did you?"

So saying he thrust a bill under my nose. It was dated eight months earlier and stated that a BT106 had been replaced along with a 3·15A fuse, convergence set up, etc. Charge, £5·60 plus 70p VAT.

"Six pounds thirty chucked down the drain. My missus went through the roof when it went off last night, and I got the blame. She's down the town now. Shouldn't be surprised if she hasn't gone to the advice brewrow like she did when the kettle blew up."

"Did they advise her to put water in it next time?" I asked, with genuine concern.

"Never mind about the kettle. What are you going to do about our telly?"

"Nothing. It's your set, not mine. It's up to you what you do. If you think it's so unreliable, what about a nice new one?"

We had a few words after that. Something about fifteen rounds and a duel at dawn, but it didn't amount to much. When he saw that I was not impressed with his aggression he dropped it like a cloak and the true reason for it emerged. He was scared stiff of his wife and would be glad of my co-operation to get her off his back.

Once this was obvious I was on his side. After all, when a bloke's wife is on the war path he needs all the help he can get. Don't we?

So we got the set in and had a look. Bush A823 or one of that ilk. Anyway, it was one of those with thermal cutout wirewounds as the load resistors of the three colour output transistors on the top of the decoder panel. I wasn't interested in the exact type, more in the fact that all three wirewounds were sprung open.

"What have you done Mr. Black?" I accused him.

"Me? I ain't done nothing. What's happened? Is it finished? She'll do her nut. Oh my gowd." Mr. Black looked bleak.

I wasn't feeling all that happy either. If all three resistors had overheated at the same time, all three must have been taken down to chassis at the same time. All three BF337 amplifiers bottomed at the same time? What was common? Well, one possibility was absence of pulses to operate the feedback clamps, since with no clamp action the three RGB amplifiers are biased hard on. The pulses do sometimes get lost due to a faulty connection in plug 3Z. The pulses were there however. So what then? The tube? Oh no! Black day at bad rock, or bad day at black rock. More like picnic at hanging rock.

"All three Mr. Black. Not just one, not just two, but all three." Let him suffer too. I reached for the soldering iron.

"What are you going to do Les?" queried a now friendly Mr. Black.

"I'm going to solder them up and see what happens, 'cause I can't see why they all went together unless the tube's buggered or just messed about a bit."

On went the set and on came the picture. No trouble.

"Looks all right to me" said Mr. Black, his face still white.

I refitted the back cover and reflected upon the situation.

"Leave the set here for a few hours Mr. Black, and if it's all right it will prove my theory that there's a disturbing influence in your house causing peaks in the mains voltage and making things go wrong. Like the kettle and this, you see?"

"Must be my missus. I'll tell her that things will go better if no one gets excited."

So far so good. It hasn't happened since. If it was the tube, I wonder what would have happend if the earth returns and the spark gaps had not be in place and in order. A little more than sprung springs I fancy.

Mr. Bakewell's Pye

We had to do some service calls on people who for some reason or the other were unable to bring their sets in. Mr. Bakewell was the first, and of course it just had to be a Pye 691 which had given long and valiant service but which is now nearing retirement age. The list of complaints about the set looked a bit formidable, but we plodded on through.

First it didn't work at all. Blown fuse. Short from top cap of PY500 to chassis. Shorted 0·47μF boost capacitor on line output transformer. No trouble. PY500 worse for wear. With both replaced, picture came on but with fault number two. Picture going yellow intermittently, which was blue drop out.

Check blue PCL84 base contacts and print. Solder up all suspect joints and rock valve. No results. Blue drive plug not making good contact in socket? Plug o.k. Tap tube base socket. Blue drops out with each tap. Clean up tube socket and pins. No more blue drop out.

Fault number three. Poor line hold. Turn up power unit. Reference pulse integrating resistor R203 (47kΩ) turned to powder. Makes one wonder how there had been any line hold at all. Lucky this time: it often goes very low and blows the discriminator diodes. Everything o.k. Goodbye Mr. Bakewell. The next one was Mr. Winder the clockmaker.

Another Oldie

Another aged set, but good. An ITT CVC2. Dead. Not really, as the valve heaters were glowing merrily enough.

Up on the top left there's a group of four fuses, and nearby is a wirewound surge limiter to the h.t. rectifier. Resistor open-circuit. We just happened to have a 6·8Ω 10W with us, so in it went. The grey scale looked a bit dicey, and Mr. Winder said it varied over the evening. The red PCL84 seemed cooler than the other two, so we put in another and this seemed to do the trick. Not being sure, we said we'd call back later to confirm that it had. It had.

Two down, one to go. We thought. It didn't work out like that.

Mrs. Liquorish

Go on. Laugh. There's more than one in the book. As true as I'm standing here waiting for this bus. Anyway . . . some weeks previously we had fitted a new line output transformer to the lady's Bush TV181S, due to a breakdown of insulation between the overwind and the yoke – not the DY802 heater winding this time. Now she'd phoned to say there was some sparking on the same side. In the event the transformer was not at fault. It was no more than a defective print contact to the PY88 base. Clean up, tidy up, no trouble. "I wonder if you could find time to call next door as they are new in this area and their set has broken down." Time was pressing but being a kind hearted cove I graciously consented to take a quick look.

Help from Wellington

She was a pretty little thing but her set was a brute. A sloppy great red setter dog didn't help much either. With one foot in my tool box and another in the spares box he just stood there, tail wagging and barking his stupid head off as I struggled with the rear cover of the Decca Bradford.

"Push off you daft bugger" I bawled. "You're mucking up my whatsits." Kneeling down, I tugged at his feet and received a great wet tongue all over my face. Mrs. Lightfoot came to my aid and dragged Wellington out to the kitchen.

When she came back she told me that the cutout had cut out, or that was what her husband had said.

Armed with this information we checked for shorts and scored a bull's-eye straight away with a short from the top cap of the PY500 to chassis. Just like the Pye we thought. In this case the suspect capacitor is on the panel under the line output section, and is 0·22μF 1kV. Sure enough, a dead short. Our glory was short lived however.

Make sure there were no more shorts and switch on, pressing in the cutout which was still cut out you see. The valves lit up brightly and settled down. After a while the sound started to appear (sound) and the e.h.t. hissed away – but with sparks from the PY500. All off. Only one PY500 in box. Fit it and try again.

Up came the e.h.t., but with spitting around the e.h.t. connector cap. All off again. Clean around e.h.t. connector with silly stuff and try again. More hissing, this time from leads from top caps of PL509 and PY500 as they go down to the transformer. Not nice, rather brittle. Take all off, rake new leads from box and fit. E.H.T. now o.k., no hissing.

I was just leaning round to have a look at the screen when Wellington escaped from the kitchen and came lolloping straight across to me. Bash. I put my hand out to steady myself and touched the top caps of the PL509 and PY500. Ahhhhh! I toppled over and landed on the dog, who naturally didn't take kindly to my weight. He struggled, I struggled. Mrs. Lightfoot dashed forward to save the set toppling over as I got off the dog who cannoned into Mrs. L who bit the dust. Chaos and confusion continued for a few seconds, but order was quickly restored and Wellington was put out to graze in the garden. I found two white burns on my hands, but otherwise no harm had been done.

We could now see what the screen looked like. Decidedly green. It then became normal, before reverting to green. Surely not a poor tube base contact again? No, this time it was the green preset control VR296: faint sparking could be seen under the wiper. I searched through the spares box, but nowhere could I find a 2kΩ preset.

Not wishing to make a return visit, I decided to wire in two 1kΩ $\frac{1}{2}$W resistors to simulate the preset set halfway, which was where it had been anyway. A slight touch up and Mrs. Lightfoot was satisfied. Er, that's to say she was satisfied with the picture, but if it was all the same to me could she have some sound?

I turned up the volume, but there was no trace of noise at all. My heart sank. Working on the timebases is one thing, access to the PCL82 audio output valve is another. Laying underneath the thing I could just about take some voltage readings – if I could remember the pin connections that is. I could remember that pin 7 is the screen grid and that this should have some h.t. on it. It didn't, although pin 6 (anode) did. My mind was by now becoming somewhat muddled. I could remember that it was a fairly high-value resistor, and I could see by the print where it lived. Did it die or was it killed?

"Mrs. Lightfoot. Would you turn the set off please?" She did. There were no shorts to chassis, so in went a 10kΩ 1W resistor (should have been 12kΩ but never mind).

With the set back on there was plenty of sound with no distortion and the cathode reading on pin 2 seemed normal. So we concluded that the resistor had just died after all.

Time to tidy up and bid farewell to Mrs. Liquorish, Mrs. Lightfoot and Wellington.

Back at the Ranch

After that lot you would think a little peace and quiet had been earned. Well maybe it had been earned, but we didn't get it. Mr. Goosey was waiting for me.

Now hang on just a second. This was not the Mr. Goosey that some years ago kept a pub called the Darnley Arms at Cobham (Kent). Oh no. You see, that Mr. Goosey had a next door neighbour called Mr. Gander. And what's more, Mr. Gander is still there.

Anyway, Mr. Goosey was waiting for me with his Philips G8.

"It's gone again. Same as it did before. What do you repair these sets with, dynamite?"

I managed a ghost of a smile at this dazzling display of wit. We had fitted a new tripler some months earlier, but doubted whether this was the cause of the trouble this time.

Anyway, off came the rear cover. The 3·15A mains input fuse was o.k., so the trouble was unlikely to be on the left side. Over to the right the 800mA fuse in the supply to the line timebase had gone.

Check for obvious shorts. None. Could be the tripler. Unhook it from the line output transformer. Hopefully stick in another fuse and switch on. Bonk. Not an immediate bonk, but a slightly delayed one. Leave the tripler off just in case, and remove the fuses from the supplies obtained from secondary windings on the transformer (saves checking the diodes etc.). Stick an ammeter across the fuse to see just what the overload is. 1·5A. Line output transistors warm when meter removed. Check transistor readings with base and emitter leads off. No leaks. Feeling sad now. Transistors could be breaking down under load, or

– continued on page 305

Servicing the Rank Z504 Scan Drive Panel

John Coombes

THE original version of the Rank A823 solid-state, 90° colour chassis was covered in some detail in a series of articles which appeared in the November 1977 – January 1978 issues of this magazine. Although the power consuming sections of the chassis – the line output stage, power supply unit and convergence circuitry – remained much the same in later versions, there were considerable differences elsewhere – a modified i.f./sound output panel, a two-chip decoder panel, and a new scan drive panel with almost entirely different sync and line generator circuitry. The i.f. panel calls for little comment, and the two-chip decoder panel was dealt with in an article in the March 1976 *Television.* One small correction to the latter is required: an all red, green or blue picture arises if the clamp diode in the channel concerned goes either short- *or* open-circuit. The purpose of the present article is to deal with the Z504 scan drive panel, whose circuit is shown in Fig. 1. It will be noticed that a much more conventional flywheel line sync/line oscillator circuit is used. In the sync separator department however a noise-cancelling circuit (5VT1/5VT3) was added, though this was later deleted. The field timebase is virtually identical to the original one: since different component reference numbers are used however, we shall have to go over this ground again here.

Field Timebase Faults

One of the most common faults is simply field collapse, due to a defective field output transistor (5VT9/10). Another common cause of this fault is failure of 5D12, 5D13 or 5C39, as a result of which there is no 40V supply to the field timebase. If these points are in order, it's worth checking the field scan balance control 6RV2 on the scan control panel, since this may have developed a dud spot. Another fairly common fault on this panel is intermittent loss of field scan due to a faulty connection at the base of the pincushion phase coil 6L20. Returning to the scan drive panel, a less common cause of field collapse is either 5D8 or 5D10 going open-circuit. If it's necessary to replace any of the diodes mentioned so far (5D8/10/12/13) it's better to use a BY206. Another possibility is a defunct field oscillator – the silicon controlled switch 5THY1. In this event however there will probably be a burn-up in the output stage. Note that voltage readings should not be taken around 5THYl since this will stop the oscillator with the result just mentioned. So beware! If you suspect field oscillator failure, check the voltage at the emitter of the driver transistor 5VT7 – you should find about 1·4V here. It may be necessary to replace 5R47 and/or 5R48.

Lack of height is another fault which is not uncommon. Suspects are the field output transistors 5VT9 and 5VT10 (mainly the latter) and the driver transistor 5VT7 if the loss is not too severe. Where there is severe loss of height, check the bootstrap capacitor 5C35 which could be open-circuit, and the presets in case of dud spots. The presets can be cleaned, but it's best to replace them as necessary. Lack of height, maybe intermittent, can also be due to the pincushion amplitude control 6RV4 on the scan control panel.

If the customer's complaint is of teletext dots across the top of the screen, check the setting of the midpoint control 5RV4 before making checks for lack of height. The adjustment is simple: measure the voltage at pin 4 of 5Z1, which should be about 40V, divide by two then add two, e.g. 22V, and adjust 5RV4 to obtain this voltage at pin 2 of 5Z4.

The setting of 5RV4 and the condition of the field output transistors are also the suspects in the event of foldover.

The field charging capacitors 5C24 and 5C25 are suspect where the fault is poor linearity. 5C24 has been found to cause intermittent height/linearity variations on occasion. Another suspect is the field linearity preset 5RV3, particularly where the fault is intermittent. The diode (5D5) in the field charging circuit can be responsible for many different symptoms: the most common however is poor linearity, with bottom cramping and expansion at the top of the screen. The driver transistor 5VT7 is also suspect when this fault is present.

Intermittent field bounce can occur when the 40V reservoir capacitor 5C39 is defective. This can sometimes be observed visually, when white goo oozes from the side of the capacitor. Another suspect for this fault is the bootstrap capacitor 5C35.

In the event of field jitter, check the setting and condition of the field hold preset control 5RV1. The field oscillator SCS 5THY1 can cause this trouble. More likely however is a fault in the main power supply – a faulty thyristor 8THY1 or trigger diac 8D3. Make sure that 8R13 is the later value (1kΩ).

Lack of field sync can be due to the sync separator transistor 5VT2. In some sets the differentiating network 5C17/5R20 was omitted. Check whether these components are present when intermittent field roll is experienced – especially in areas where there is co-channel interference. The noise-cancelling circuitry – 5VT1/3 and associated components – was omitted in later production, with 5VT2's emitter taken direct to chassis.

Line Timebase Faults

On the line timebase side, probably the most common fault is no e.h.t. due to the line driver transistor 5VT12 going short-circuit. In this event the 2A fuse 8F1 will blow of course. 5VT12 has also been known to go short-circuit collector-to-base, producing the same symptom (no e.h.t.) with damage to its base resistor 5R51. In the event of 5VT12 failing again a few days later, check the driver transformer damping components 5C40/5R54. The capacitor sometimes goes open-circuit, while the wirewound resistor may well be dry-jointed (it gets very hot). Two capacitors in this area can be responsible for no line drive – sometimes intermittent – the electrolytic decoupler 5C31 and 5C42.

Over-voltage protection is provided by 5D14, 5D7 and 5VT8. 5D14 rectifies the line flyback pulses, developing a positive voltage across 5C43. If the amplitude of the flyback pulses is excessive, this voltage will rise sufficiently to switch on 5D7, which then turns 5VT8 on, killing the line oscillator. A defective trigger diode (5D7) can cause false tripping.

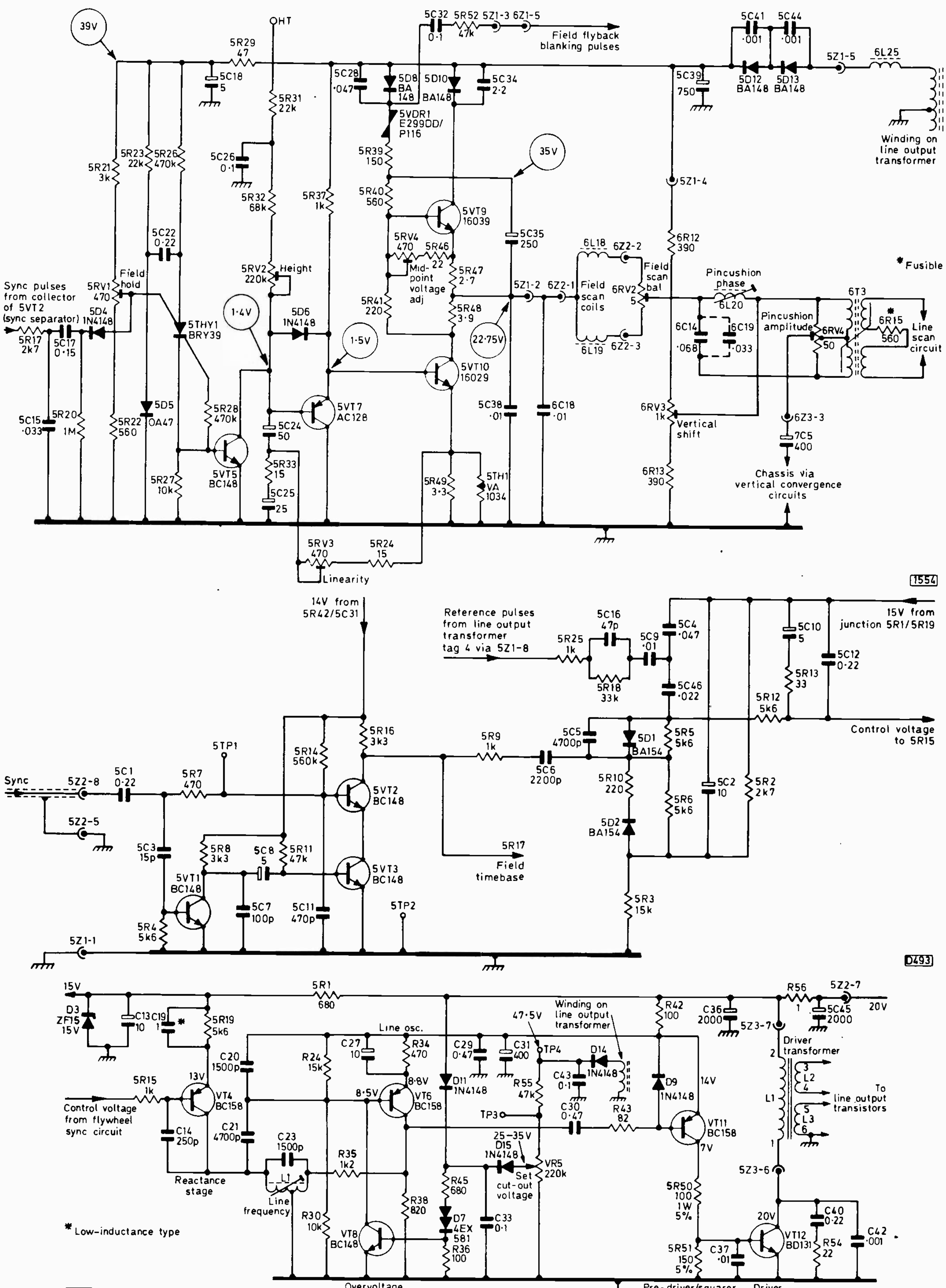


Fig. 1: The circuitry on the Rank Z504 scan drive panel. Top, field timebase circuit – plus some of the external circuitry. Centre, the sync separator and flywheel line sync circuits. 5R7 later changed to 560Ω, with 5VT1/3 and associated components deleted. Bottom, the line generator and driver circuits.

Line oscillator failure, or possibly incorrect frequency, should direct attention to the polystyrene capacitors in the line oscillator circuit – 5C14/5C20/5C21/5C23. Another cause of incorrect line frequency is when the 15V zener diode 5D3 is faulty and fails to stabilise the voltages applied to the reactance transistor 5VT4.

Loss of line sync, or weak line sync, is usually done to the flywheel line sync discriminator diodes 5D1 and 5D2. Line sync disturbances such as cogging and pulling can be caused by the 10μF electrolytics 5C13 and 5C2. 5C31 can be responsible for bent verticals – in addition to no or intermittent line drive.

Line output stage faults were covered in detail in the earlier articles. A couple of further points. The transductor 6T3 on the scan drive panel can be responsible for field collapse. A faulty transductor may result in the thermal cutout resistor 6R15 springing open. The set will continue to operate, but the sides of the picture will be curved, with incorrect pincushion adjustment. The 2·2Ω resistors in series with the bases of the line output transistors 6VT1/6VT2 can cause trouble, going open-circuit or increasing in value. They can well increase to 4Ω or 5Ω, upsetting the line output stage with the result of low e.h.t. and a large picture. ■

Modifications to the Philips N1700 VCR

Nick Lyons

THE N1700 is the current Philips VCR format in the ever escalating battle for supremacy in the home video field. I say current, as the N1500 series ran previouslay to this until around the Autumn of 1977. Despite using the same cassette, recordings are not interchangeable – as regular readers will know. The 1500 series on the domestic scene is now as dead as a door nail, though it's still around in educational service.

Thoughts on the N1700

The future of the N1700 is interesting to contemplate: when Grundig made an N1700 compatible machine (together with several manufacturers on the continent, whose machines were not seen in this country), the European video manufacturers provided a somewhat united front against Japanese imports. The situation was too good to last however, and it was not long before Grundig brought out yet another variation, running at a slower speed but using yet again the same cassette – and of course incompatible.

This fragmentation of European standards will doubtless allow the Japanese to pounce in, as all the Japanese companies are juggling with only two standards whereas two European manufacturers alone have so far managed to produce three domestic standards! But worse still rumour has it (see *Teletopics,* January 1979) that Philips is to introduce another standard totally different from their existing ones. In fact a spokesman for a large tape manufacturer told me that the reason they were not going to make Philips cassettes is because they believe that in eighteen months' time the format will be phased out in favour of the new one.

Having said all this however I must say that the N1700 is not a bad machine, and probably has the best picture quality of the current "toy" formats. Also better sound quality. The fact that it uses around three times the linear tape speed of a Betamax or VHS machine to achieve this quality has to be borne in mind. I should say though that the cost for a given recording time on the N1700 is not three times that for say VHS but around one and a half times as much. As for facilities, the N1700 is pretty basic, not having the video in or out of the Betamax or VHS, but then again it's about £150 cheaper – and how many people require base-band video anyway in domestic use?

The purpose of this article is to make the machine a little more versatile than it starts life – but using its own innards in order to keep down the cost.

Aerial Through Pass

Normally, when switched off but left plugged in to the mains the machine passes the aerial signal through to the set, which is normally left plugged into the VCR. When the machine is in the E to E mode (threaded up but in stop mode), in record, winding or rewinding, this through pass of aerial signals continues. When the VCR is put into play however, this through pass ceases, only the VCR output being available (on its modulator channel).

Now in my opinion this is an unnecessary evil, and is included only in the British model. It can be remedied very simply be means of a solder link on board 51 (the board with the tuner, modulator, etc. on) – the link is already there open-circuited. The link is between pins 4 and 5 on plug L4, which is the seven-pin plug at the front of the board (looking from the front). The board can be hinged up for access: undo the two crosshead screws on the right of the board, and release the white clip at top right. After making this alteration, aerial through pass will continue no matter what function the machine is performing.

Incidentally, there's an inaccuracy on the circuit diagram (by my reckoning anyway) for board 51. Point JK, module U552,is fed by +1B on the continental version and on 15/65 models (i.e. British) from +5 and +1 via diodes: +1 should be a +1B however.

Off-tape Monitoring

Off-tape monitoring during stop, wind and rewind can be a great aid to finding sections of programme on the tape. Although sets will lose sync whilst the tape is being shuttled back and forth, it's usually still possible to see captions and so forth passing by. Stopping the tape will give a stop frame off the tape, saving the need to keep putting the machine in play to see where you are. The stop frame on a slant-azimuth machine could hardly be said to be superb, but serves a purpose and can with a bit of juggling on the start key be made quite good. Off-tape stop and shuttling can also be advantageous as constantly reverting the machine to E to E can be a nuisance at times.

So, you say, select a disused channel. Very good, but the white noise ensuing can be more distracting still. The course resorted to therefore was to give E to E only when the record button is depressed. The record button alone does not put the machine into record: as with audio machines, the play button must be depressed as well. E to E is still obtainable without using any tape therefore, and continues when the tape is in motion. At all other times, off-tape is shown. This is effected as follows.

The off-air signal must be removed from the signal path. This is done for luminance by changing the power (+12V) feed for the potential divider R530/531 feeding pin 13 of U506 to the +3 rail instead of the +5A rail; and for the chroma by changing the +5 rail feed to R532 (TS503's collector load) to the +3 rail. The audio is similarly disconnected by changing R542 (l.t. feed to U508 pin 17) from the +5 rail to +3. The modifications required to the switch units involve shorting out two switches on the switch unit Sk202: pins 15, 16 should be shorted out, so should pins 18, 19. Take care to get the numbers of the pins on the switch unit correct. Use the numbers given on the print layout diagram. These may not agree with those on the board itself – mine didn't. If you trace the lands on the board however, you will see that the drawing is correct. Later boards may have correct numbering.

To change over the supplies as detailed above it will be necessary to add four links across the board, remove four links already there, and sever one land on the board (from pin 3 of module U507 to R530). Also, add a 100μF capacitor between R506 and chassis as shown (C503) on the circuit for panel 51. The switch links are fitted on to panel 21.

Erase Modification

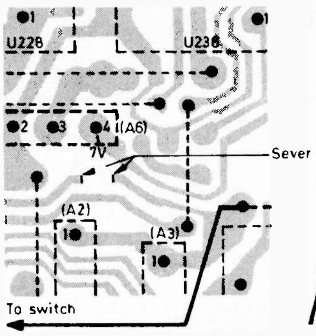
To erase a previously recorded tape, Philips say tune the VCR to a blank channel and set the machine to record. This is very unsatisfactory of course, as it records all the video and audio noise. What's really needed therefore is a switch to mute the sound and video recording whilst leaving the erase head on.

To do this relays 901 and 902 have to be de-energised on board 91; similarly the feed to pin 17 of U508 via R542 has to be removed. This sounds rather involved, but in fact is achieved very simply. As shown in Fig. 1, sever the land adjacent to pin 4 of socket A6 (board 21) and take a wire to the switch from the land feeding pin 1 of socket A3. Two return wires are required from the switch, one to S203 and the other to R542 on panel 51. If this is done, it's necessary to remove the link added for the previous modification – between R542 and C502. This will in no way affect the off-tape monitoring facilities.

With the machine in record and with the switch open, E to E video is seen but sound is muted. You will know therefore if you've left the switch open or not. Although E to E video is seen, as I've said it's not recorded.

Readers more familiar with video recorders will by now have realised that the drive to the control track head has not been muted. This is so, but there's no problem – in fact a slight advantage. Suppose that the machine is put into record with the switch open while tuned to a broadcast. What happens is that the video and audio tracks are not recorded, and any previous ones are erased. Besides this however, stable control track pulses are being laid down on the tape and if the mute switch is now closed the machine will start to record sound and pictures instantly.

The advantage of this may not be instantly obvious, but look at it this way. Normally, to record a programme the machine has to be started say 20 seconds before the start of the programme to give the machine a chance to lock up,



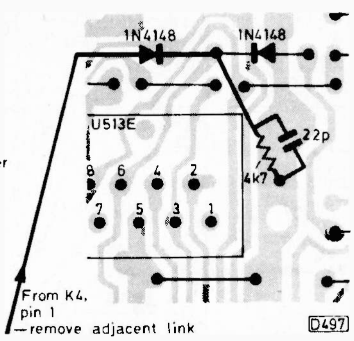


Fig. 1 (left): Part of the erase modification, on the print side on panel 21.

Fig. 2 (right): Crispener modifications on panel 51 (Component side). Remove the wire link beside plug/socket K4. The off-tape monitoring modifications are also carried out on this board.

thus recording all that continuity and globes etc. that you don't want. What looks better is pictures appearing on the first frame you want so see, and fully locked. With this switch added you simply start the machine recording in the normal way, but with the mute switch open. The machine is thus "locked up" when the switch is closed, and the recording starts at the instant required. Similarly at the programme end. If the switch is opened the machine can be left to erase the rest of the tape without recording further unwanted programmes. Those of you who like a bit of presentation may consider this modification well worth while.

Fast Erasure

With the off-tape monitoring facility added, drive is connected to the heads whenever the record button is depressed. There is a great advantage when the mute switch is also added. With the mute switch open and the record and fast forward (or fast rewind) keys depressed together, the machine will erase tapes beautifully – saves buying a bulk eraser. It's difficult to do this accidentally, though it's a point to beware if, because the record button pops up when any function is selected and has to be purposely held down when the other keys are pressed, whereupon it latches down.

Clock Board Modification

To prevent mistriggering of the clock when engaged in the lock position, change the value of resistor R327 on the clock board 32 from 820kΩ to 120kΩ. What can happen is that if the machine is set to record a fixed duration, i.e. in the lock mode, at the time the machine is due to thread up it can release the depressed record and start keys and hence not record. This can occur when R327 has gone just a little high – it doesn't take much – or if additional smoothing has been added to one of the 12V rails – even the 100μF capacitor mentioned above (on panel 51) can cause problems if the value of R327 has the circuit balanced on a knife edge. The addition of a video matching board with extra smoothing would certainly cause this mistriggering. Reducing the value of R327 as above produces rock-steady operation however.

Adding a Crispening Module

The final point to be made in this epic concerns the addition of crispening to the N1700. The N1502 has a good

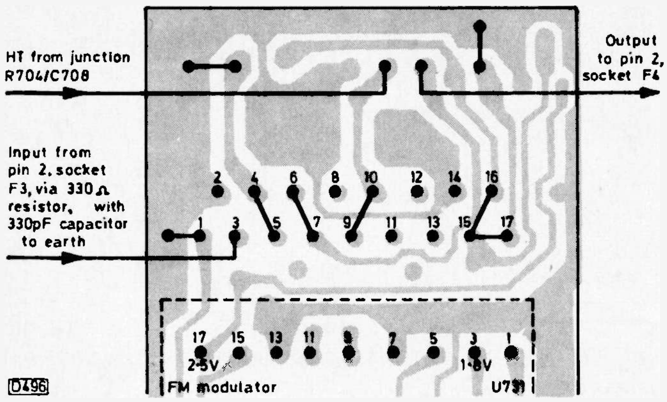


Fig. 3: Adding a crispener module on panel 71. The printed pattern is already present at the end of the board. Earth pins 1, 2, 4, 5, 14, 15, 16 and 17 of the crispener module. View from the print side of the board. Remove diode D701, which is roughly midway along one side of the board.

crispening unit, Philips Service part No. 4822 210 20227, which can be very easily added to the N1700 although Philips say it can't. It works splendidly on mine however.

A brief glance at panel 71 reveals a blank area where a crispening module may be inserted, the holes being predrilled. The module usually comes with its socket, so you will have the full plug-in replacement facility. I would advise that you take the socket off the bottom of the module and solder this in first so as not to damage the module. The socket base will fit into the circuit board only one way round, so there should be no problem. The module will then plug straight in. When ordering the module, it's advisable to specify that the socket is required.

Fig. 3 shows the appropriate connections to the unit. D701 is removed – but save it because it's used in another part of the modification. From the anode side of the diode, take a lead to pin 3 of the crispener. Also from the anode side, connect a 330Ω resistor to pin 2 of socket F3. Also add a 330pF capacitor from pin 2 to earth. The output from the crispener can be taken from the land shown, connected to pins 6 and 7, via a wire to where the cathode of D701 was previously connected. Finally on panel 71, the h.t. feed required to the land connected to pins 9 and 10 of the crispener module can be taken via a wire to the hot side of C708.

Pin 2 of socket F3 goes back to pin 2 of L3 (panel 51) and thence to K4 pin 1 where the burst key pulse is available for checking only. This series of lands is disconnected therefore by removing the wire link alongside socket K4 on the component side, and K4 pin 1 is then connected via a diode (1N4148, BAW62 or OA200) to pin 6 of module U513E (see Fig. 2). A wire link in the path from pin 17 of module U507 to pin 6 of U513E is removed and replaced with another diode, same type as above – D701 can be re-used in either position. The cathode end goes to pin 6 of U513E in both cases. The final step is to connect a 4·7kΩ resistor in parallel with a 22pF-33pF capacitor from pin 6 to earth.

The crispener should then be adjusted for correct operation. Looking at panel 71, with the crispener at the top the control on the left-hand side controls the crispening depth and the other the threshold at which it crispens. Be careful not to overdo the adjustment. Leave the threshold alone at first and adjust the depth, using the test card. Adjust the depth looking at the verticals, adjusting just to sharpen these up. The newsreader in close up is also useful for setting the depth, because the facial features will be badly exaggerated if you over crispen and will look as if they've been drawn in.

The threshold control will probably not require adjustment. It sets the minimum contrast level change at which the unit will crispen. If it's set too fiercely it will crispen the noise and also small changes in level along the line – say crispening the shadows on someone's face, giving everything a flat plastic look. When judiciously used however the results from this unit are very good indeed. ■

Service Notebook

George Wilding

No Raster

The owner of a solid-state GEC colour receiver (C2110 series) said that the width had suddenly increased and within a few seconds the raster had completely disappeared. On inspection we found that the mains fuse was intact but the fusible resistor R601 in the BU108 line output transistor's emitter circuit was open-circuit. Since there was no evidence of any overheating, we decided to resolder the resistor and switch on. A normal picture developed, but within minutes the excessive width symptom developed. We switched off before R601 had time to reopen, then on again to once more get a normal picture followed within minutes by reappearance of the fault symptoms. It seemed likely that the trouble was due to excessive h.t. from the BT106 thyristor regulated power supply circuit, and we were able to confirm this diagnosis with a voltage check. This placed quite a few components under suspicion, but as these thyristors give a fair amount of trouble in one way or another, and also because of the way in which the fault could be cured by quickly switching off for a while, we decided to replace the thyristor. This completely cured the trouble.

Touchy Line Hold

The fault with a single-standard hybrid monochrome Philips set (300 chassis) was extremely touchy line hold which was not improved by changing the two ECC82 valves used in the flywheel line sync and line generator circuits. The field locking was solid, so the PFL200 video/sync separator valve was discounted. The next step was to take voltage readings around the two ECC82 valves. The voltages were found to be near normal, but on contacting one of the line generator ECC82's control grids (pin 2) the locking improved tremendously, indicating that the grid was floating. The grid leak resistor (R2164) is returned to the h.t. line rather than to chassis in this particular stage, and a replacement cured the trouble.

On refitting the chassis and testing again a fresh line fault appeared – line tearing at regular intervals down the screen – and on handling the chassis we received a distinct electrical shock, despite working via an isolating transformer. Further tests showed that the chassis was not earthed to the tube's aquadag coating, due to the earthing spring not making contact. Once this was remade, normal results were obtained.

When investigating erratic oscillation, weak sync or squegging in valve line or field generator circuits, always check that the relevant grids are not floating – by using the meter as a high-value "check resistor".

Modern Tuning Techniques

Part 2

Harold Peters

As noted at the beginning, it's not the intention of this article to go deeper into modern tuning systems than to give an abridged description. As you may have noticed from the ITT article in the January-February issues last year, to describe the various systems in detail would require a double article for each one. Things might have been different had there been common features linking them all, but this is not so. Before we go any further however, a few words to stop you getting put off whenever "digital techniques" are mentioned.

Digital Techniques

When you are trying to take in at your leisure (as you are doing now) a whole new technique, there's nothing more off putting than pages of theory, formulae and mathematics. Having managed to avoid them for a quarter of a century, despite the complex circuits we have looked at together during this time, the writer does not intend to break with the tradition now.

Despite the high-sounding world of shift registers, floppy discs, and Boolean algebra, basic digital techniques are as simple as you need them to be. Everything can be equated to the "on" or "off" state of an electronic device, called "logic 0" and "logic 1" respectively. A single 1 or 0 is called a "bit", which is short for binary digit, while a string of bits is a "word" or "byte". Here is a table showing how the first eight binary numbers line up against their decimal counterparts:

binary 000 is decimal 0
binary 001 is decimal 1
binary 010 is decimal 2
binary 011 is decimal 3
binary 100 is decimal 4
binary 101 is decimal 5
binary 110 is decimal 6
binary 111 is decimal 7.

Notice that we've lined up the decimal numbers to start at 0. If they were the buttons on a handset, they would probably slip one and be printed 1-8. But no matter.

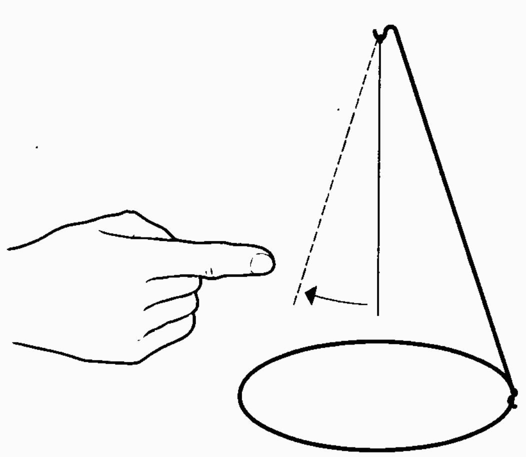


Fig. 10: Before handling MOS devices, check whether you are charged – if the cotton thread moves towards your finger, you are.

Notice also that there is regular change down the binary columns. The first column changes every fifth line, the second every third line, and the third every line.

From this we get two ways of representing a decimal number digitally. First by a *train* of pulses, where decimal five would consist of two positive-going pulses with a zero between or 101. Secondly, suppose we have three pins available from an i.c., and that a voltage on the first pin counts as 4, on the second as 2 and on the third as 1. Decimal 5 this way would be represented by voltage on pin 1, voltage on pin 3 and nowt on pin 2. This way is called "binary coded decimal" notation (BCD for short), giving us the number simultaneously instead of as a train or series of pulses.

If the table we've just given looks familiar, it should do. Supposing we substitute primary colours for the three columns:

Green	Red	Blue	
0	0	0	= Black
0	0	1	= Blue
0	1	0	= Red
0	1	1	= Magenta
1	0	0	= Green
1	0	1	= Cyan
1	1	0	= Yellow
1	1	1	= White.

Now you must recognise this as the format of the colour bars: you've been using binary notation for years!

Gates

Gates are the building of blocks of all digital systems, and once more you must think of them only in terms of what they do and not what lies within. We are now in a world of 1 or 0, so in fault finding the philosophy is "it either works or it doesn't." The basic gates are as follows:

And: The output of an and gate is at 1 only when all the inputs are at 1. The output is otherwise 0.

Nand: The output of nand gate is at 0 only if all the inputs are at 1. It stays at 1 so long as any input is at 0.

Inverter: By joining its inputs together, a nand gate becomes an inverter, i.e. if a 1 appears at the input the output goes to 0 and vice versa. Inverters can be manufactured specifically, and are called not gates.

Or: The output of an or gate is at 1 when any of the inputs are at 1. So the output is at 0 only when all the inputs are at 0.

Nor: For a nor gate output to be at 0, at least one of its inputs must be at 1. So for its output to be 1 all the inputs must be 0.

The or gate has two variants, called the "inhibit" and "exclusive-or" gates. For further information see last October's *Television* ("The Language of Logic").

Fault Finding

Most ordinary fault finding work can be done with a multimeter and a general purpose scope. A multimeter in fact comes into its own for digital servicing, since most of the time is spent establishing the presence or absence of 1s and 0s at the pins of various i.c.s.

The working of analogue controls can also be checked this way, by noting whether the control voltages rise and fall as the appropriate handset button is depressed.

To check an ultrasonic handset, simply connect a spare transducer to the scope input, on high gain, and press buttons. Don't expect to be able to count the pulses: the carrier will be seen quite distinctly however.

The advice about not trying to count the pulses also applies to the complex parts of the receiver. Because of the transient nature of these pulses, you would need a good storage scope with one-shot triggering to catch and display them. It's much simpler to establish that pulses of a sort are present where they should be, and of the correct amplitude, then to check the various outputs on a meter to see if they are responding to the commands.

Most i.c. devices will be of the MOS type, and therefore sensitive to static charges. So before handling them, check with a suspended cotton thread that you are not charged up (see Fig. 10). When measuring around MOS devices, use voltage and current checks in preference to continuity tests. This avoids damage to the i.c. due to the meter's internal battery.

Today's Systems

As many of today's systems as are familiar to the writer are summarised from here onwards, starting with the remote control systems proper, and ending with the frequency-synthesis systems.

Plessey Remote Control

Plessey offer a flexible two i.c. system as a ready-to-use package for setmakers. Its versatility is such that it can be used for other applications such as opening garage doors etc.

The handset transmitter (see Fig. 11) uses a single i.c., the SL490, which is capable of producing up to 32 commands from an 8 × 4 matrix keyboard. Pulse-position modulation is used, the commands consisting of a five-bit word with the 3ms pulses spaced 18ms apart for a 1 and 27ms apart for a 0. A gap of 54ms separates one word from the next. The i.c. has its own modulator section optionally available, so that the command signals are available with or without a carrier frequency (for ultrasonic or infra-red transmission respectively).

Since the handset i.c. passes only a few microamps when no buttons are pressed, it can be left in circuit all the time without impairing battery life – a common practice with most of the handsets which follow.

At the receiver, an amplifier (e.g. an operational amplifier such as the SL748 i.c.) is needed to lift the signal for detection if ultrasonic, or to lift the detected signal if infra red – the system can operate with either. The detected signal then goes to the second i.c. of the package, an ML920 decoder, which has an inbuilt oscillator running at twenty times the handset 0 rate. Binary coded outputs (see below) on pins 16-20 permit the choice of up to 20 TV channels. Similarly to the ITT arrangement previously mentioned, the stepping of the output channels in sequence is performed quickly enough to appear instantaneous. It's also possible for the user to hunt through the channels if step-up and step-down buttons are added to the handset. Each of the three usual analogue outputs has a range of 32 steps, which are symmetrical about a preset "granny" position.

To add an on-set control panel to this package it's necessary only to add another SL490, working in the unmodulated mode, and a duplicate keyboard. This combination feeds directly into the decoder ML920.

The code used for the 32 commands is as follows:

Command Number	*Code*	*Function*
1	0 0 0 0 0	Programme 1
2	0 0 0 0 1	Programme 2
3	0 0 0 1 0	Programme 3
4	0 0 0 1 1	Programme 4
5	0 0 1 0 0	Programme 5
	and so on till	
20	1 0 0 1 1	Programme 20
	followed by 12 analogue commands starting with	
21	1 0 1 0 0	Increase colour
22	1 0 1 0 1	Programme stepping through, upwards
23	1 0 1 1 0	Increase volume
24	1 0 1 1 1	Increase brightness
	and so on till	
32	1 1 1 1 1	Decrease brightness
	E D C B A	Decoded output reference letter.

It's common practice to refer to the five bits comprising the command word as the A, B, C, D and E outputs from the decoder i.c.

By reducing the channel number available to ten instead of 20 and interposing a number of extra gates between the ML920 decoder i.c. and the rest of the set, the system can be used to control a teletext receiver. By similarly reducing the number of channels available, a fourth analogue command can be incorporated. This facility can be extended, as we shall see later, to control a frequency-synthesis tuning system such as the Plessey Direct Channel Tuning system.

By fitting a switch (e.g. TV/hi-fi) to the handset to enable the pulse time intervals to be shifted by more than 30 per cent, the same handset can be used to command other equipment without interacting with the TV control system.

An illustration of the way in which the command signals can be used to set in motion the various control operations in the set was given last month when we described the Philips full remote control system. That used a different modulation system for the commands of course – a combination of different frequencies and pulse-width modulation.

For further information on the Plessey system, see the November 1978 *Television* ("Versatile Remote Control System").

Grundig Telepilot

The Grundig infra-red Telepilot 21, introduced in 1976, was the forerunner of the current infra-red systems. Twenty commands are possible, using five frequencies between 34·69kHz and 42·7kHz. These are obtained by division from a 920kHz tuned master oscillator.

At the receiver, a conventional three-stage amplifier raises the signal level, driving a single decoder i.c. which processes the command signals and delivers to the set, as in the Plessey system just described, analogue stepped controls (three) and four binary outputs for channel selection.

Bang and Olufsen

The basic principles of and the facilities provided by the Bang and Olufsen system are very similar to those of the

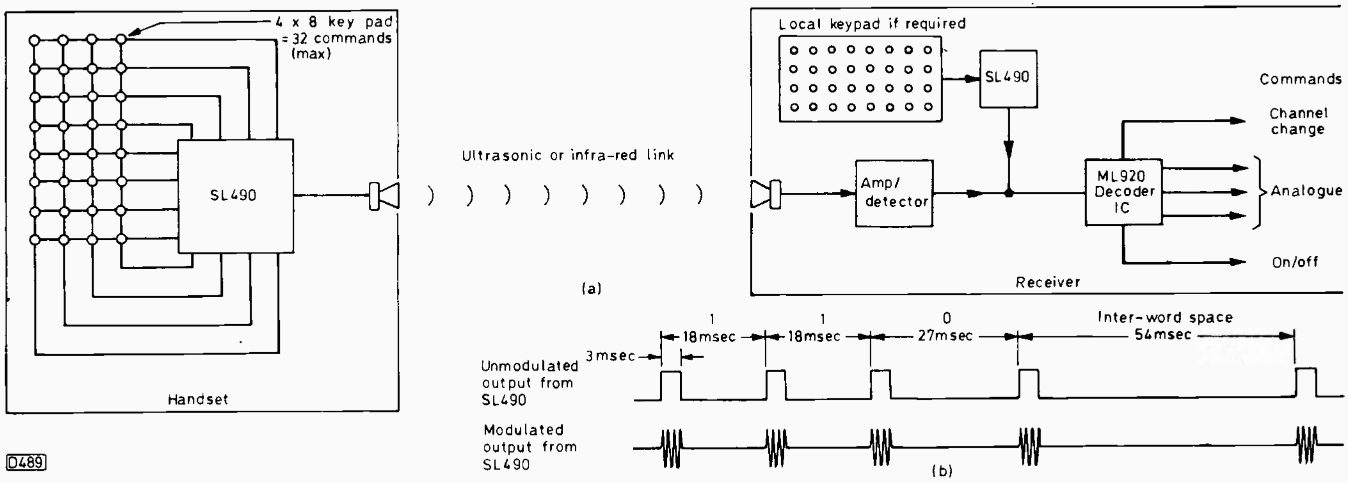


Fig. 11: The Plessey two-i.c. remote control system. (a) Block diagram, (b) the pulse-position code used – one equals a pulse every 18msec, zero a pulse every 27msec. The SL490's modulated output is for use with ultraviolet systems, its unmodulated output (internal oscillator disabled) being for use with infra-red systems.

Philips full remote control system described last month. In order to provide some improvement in performance in the presence of noise and spurious signals however a two-tone system of modulation is used. Four ultrasonic signals can be generated at the handset, from 35kHz to 44kHz. Each of them can be modulated by any of four low-frequency tones, namely 148, 193, 254 and 333Hz. By suitable filtering at the receiver, the four × four frequency combinations yield 16 commands – selection of eight channels, three analogue up/down controls and remote on/off – see Fig. 12.

ITT System

The ITT system was covered in detail in the January/February 1978 issues of *Television*. Its basic features will be summarised here for completeness.

It makes use of the ubiquitous 4·4336MHz subcarrier crystals – one in the set and one in the handset. The handset has a single SAA1024 i.c. which counts the crystal down to a block of thirty different ultrasonic command frequencies in the 33kHz-44kHz range. Command selection is done by blanking out from 1 to 30 pulses in the second divider stage of the counting down chain, the final ultrasonic command frequency thus being a direct division of half subcarrier frequency less the pulses that have been removed.

At the receiver end, the conventional transducer amplifier uses bandpass tuning to give good gain at all parts of the command spectrum. A second subcarrier crystal is used with the decoder i.c., type SAA1025, but not to restore the pulses

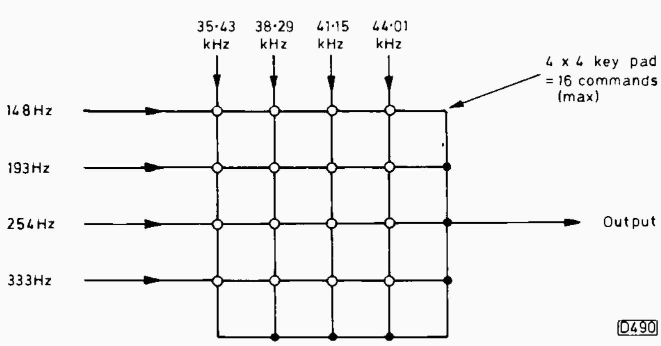


Fig. 12: An example of matrixing – the Bang and Olufsen two-tone modulation system. Pressing any handset button results in one of the four ultrasonic oscillators being modulated by one of the four l.f. tones available, giving a total of 16 different command signals.

to their original frequency. This time it's used to count the number of received pulses accurately. It can do this since they are all exact submultiples of subcarrier frequency.

Once again, four binary outputs permit the choice of up to 20 TV channels, and the three analogue controls are fed with pulses of variable length according to the setting required.

It was not mentioned in the earlier article that the system is usable for Teletext, and is fitted to the Thorn Model 3782 for this purpose.

The Ultimate Step

The writer has on occasion accused set designers of being bent upon removing from the set everything that moves. Probably their philosophy began in response to a cartoon in Punch in the 1960s, heralding the dawn of Hi-fi. The caption read: "It's supposed to be fully automatic, but you actually have to press a button." Without comment, he now has to report that this state of affairs has at last come to TV.

We have already seen that it's possible to adjust the volume etc. without turning a knob. The remaining variable controls to be disposed of are the channel tuning presets and, if you are in Europe, their associated band switches. This is in hand however.

There are two ways of "fixing" the tuning. One way is to store within the set all the precision voltages needed to set the varicap tuner to the channels available. The other way is to simulate, by synthesis, all the exact local oscillator frequencies needed to tune in any of the available channels wherever the set is used. These frequencies will of course be 39·5MHz (38·9 in Europe) above the vision carriers of the wanted stations. Storage involves the use of memory i.c.s.

The "voltage" method is used in the Philips Song and the Telco systems, whilst Mullard and Plessey have announced frequency-synthesis systems.

Philips' Song and Telco

The Philips Song and the Telco systems have a lot of common features, the main difference being the way in which the system presents information to the decoder. The Telco system does it in serial form, i.e. a single bit train, whilst the Song system does it in parallel form on a data bus. The handset invariably uses infra-red transmission, with facilities for 12- or 24-channel selection.

Stations are selected by applying preselected voltages to the varicap tuner control line, these voltages being derived from binary pulses stored in a memory. To turn the binary pulses into voltages, they are rectified and the resultant d.c. is fed to a reservoir capacitor, with the component values carefully chosen so that the charge upon the capacitor is proportional to the number of pulses rectified. Approximately 2,000 voltage levels are available to cover a band, depending on the number of stored pulses. For example, only a few stored pulses would be needed to tune in channel 21, but more would be needed to charge the reservoir capacitor so that higher channels in the band are selected. The band-switching commands are stored in the same way.

To be able to do all this without an expensive, retentive memory, it's necessary to refresh the memory i.c. regularly at a fixed rate. This means that the memory i.c. must be kept running even when the set is off and disconnected from the supply. A calculator type rechargeable battery is used for this, and is float charged from the l.t. line to last for up to three months of set disuse without letting it forget which channels the user has preselected.

In doing so it presents a rather unique servicing hazard. As well as having to take all the usual precautions when handling MOS devices, you have to remember that if you remove a decoder panel from one of these sets for service, its memory will carry on working from the on-board battery whilst you have it in your hand.

The Mullard DICS System

Designers who favour frequency-synthesis systems, such as the Mullard DICS system (DICS = DIgital Channel Selection), claim that the voltage-synthesis systems we have just described rely heavily on the long term stability of the reference voltage and its relationship to the oscillator frequency. Furthermore, they claim that the storage capacity of memories is taxed to the limit by a bunch of high number channels. Frequency synthesis overcomes all these difficulties.

The heart of the DICS system (see Fig. 13) is a Read Only Memory (ROM), which is programmed to deliver the local oscillator frequency (vision carrier plus i.f.) of all CCIR channels 00 to 99 and is stabilised against a 4MHz crystal oscillator. The frequencies are presented in 10-bit binary form, and are given to the nearest MHz, relying on the set's a.f.c. to counteract the discrepancy. For example, the CCIR channel 00 video carrier frequency is 44·25MHz and the standard CCIR i.f. 38·9MHz. The ROM content for this channel, video carrier plus i.f. rounded to the nearest MHz, is 83, which is presented as an eight-bit word. An extra binary code is included for band indication and switching.

The i.c. containing the ROM (the SAB2014) also compares the selected binary code with the local oscillator frequency (which could be a long way off if you have just watched a very different channel). Any discrepancy between the two results in an output pulse whose length is proportional to the error. By integration, this pulse is turned into a d.c. voltage which is applied to the varicap tuner, bringing the local oscillator into lock with the ROM.

The working principle outlined above is reasonably straightforward. The complications come with the support system and the extra facilities which have been made possible. As we are giving only broad outlines here, these are best explained by going through the way(s) in which the user can operate the set.

Pressing any of the 16 station buttons (and some others) turns the set on and within ten seconds displays the chosen channel with all the analogue controls at nominal (i.e. granny). For station hunting, or for tuning in other channels,

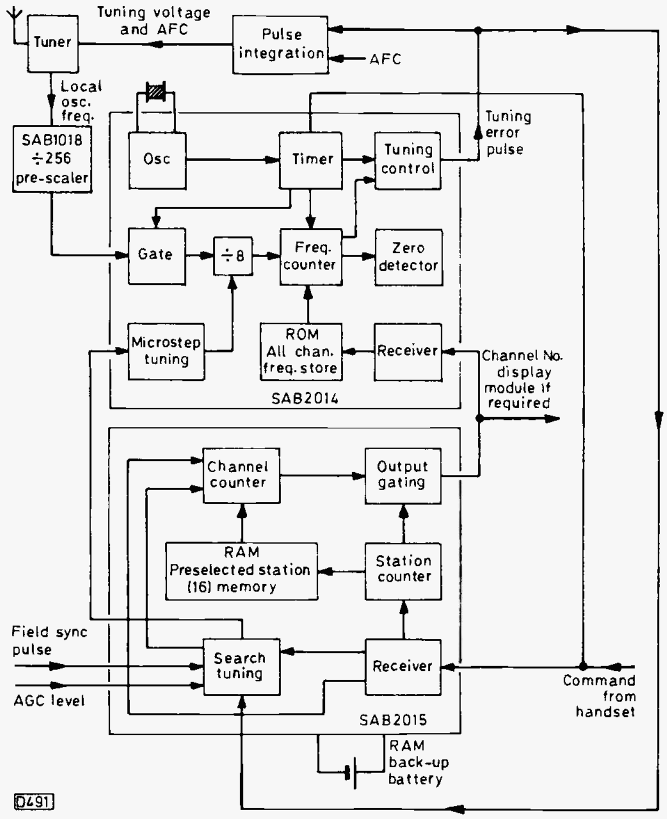


Fig. 13: Block diagram of the Mullard DICS system. The ROM contains the binary-coded local oscillator frequencies of 100 channels (labelled 00 to 99). Up to 16 preselected channels can be stored in the RAM. There are two tuning modes – "station" or "channel". In the station mode, the stations stored in the RAM can be selected individually or by sequential stepping through. In the channel mode, all channels stored in the ROM can be selected individually or stepped through, or alternatively continuous search tuning through all channels can be selected, with an automatic stop on location of a transmission. The presence of a transmission is established by sampling the a.g.c. and the field sync pulses, which are applied to the search tuning facility. The basic mode of operation is to compare the local oscillator frequency with the required frequency, producing a tuning error pulse whose width depends on the frequency difference. This pulse is integrated and used to pull the varicap tuner into lock – in conjunction with the set's a.f.c.

other modes are possible. If we press "channel mode" for example and then buttons 5 and 8, channel 58 will automatically be selected even if there's no broadcast available. The channel number may also be displayed on screen, teletext style, or on a seven segment display. As well as direct channel selection, the channels can be stepped through at the rate of two per second. For countries with non-standard frequencies, fine tuning is available to home on to the station.

Having found your channel, it's now possible to store it on any of the buttons 1-16 by pressing the "store" key and the button of your choice. The on-screen display will now show the button number as well as the channel tuned in, and the next time you select that button the same station will appear. The preselected channels are stored in the RAM in the SAB2015 i.c.

The system is versatile enough to permit the omission of some facilities by setmakers who do not need a particular feature. The full system is built around seven MOS and two bipolar i.c.s.

Like the Song and Telco systems previously described, the ability to store a programme of preselected channels entails a RAM (random access memory) being kept going all the time, and again this is done by building a rechargeable battery into the decoder board.

A special tuner with a local oscillator sample feed outlet is needed, and the current U321 has been adapted to become the U321-LO. This has a coaxial supply outlet (at the top) which delivers a typical 33mV of local oscillator output at 75Ω impedance.

Although designed as a complete package, this system will interface with the Mullard remotely controlled teletext system. This too is a flexible system which has many extra features optionally available to setmakers by having them built in – to be discarded as desired. The handset keyboard can be made to operate in any of four modes – TV, teletext, Prestel and DICS.

Plessey Tuning System

Like the Mullard DICS system, the Plessey Direct Channel Tuning system (see Fig. 14) is a frequency-synthesis system to dispense with the tuning resistor bank. Again, a stable 4MHz crystal controls a ROM programmed with the local oscillator frequencies of 70 TV channels. Again, by comparison with the varicap tuner a voltage is produced to correct any error and to pull the local oscillator on to the selected ROM frequency. Six i.c.s form the complete package, to which can be added the two remote control devices previously described.

A novel feature is the absence of a battery to keep the RAM information permanently stored. The memory chip is a CT1116, non-volatile MNOS memory (metal-nitride-oxide-silicon) which has gates made of very thin layers of oxide and nitride. If the gate is made negative with respect to the source and drain, a positive charge tunnels through the thin oxide layer and is trapped in the oxide-nitride dielectric. This stores the charge for at least 28 hours, and in practice considerably longer. To erase the memory, the polarity of the gate to source and drain voltage is reversed. This avalances "hot" electrons into the oxide-nitride interface, neutralising the previously trapped charge. The method is known as "punch-through erasure". To read off the stored charge without erasing it requires an applied voltage which is midway between the negative charge and positive discharge potentials.

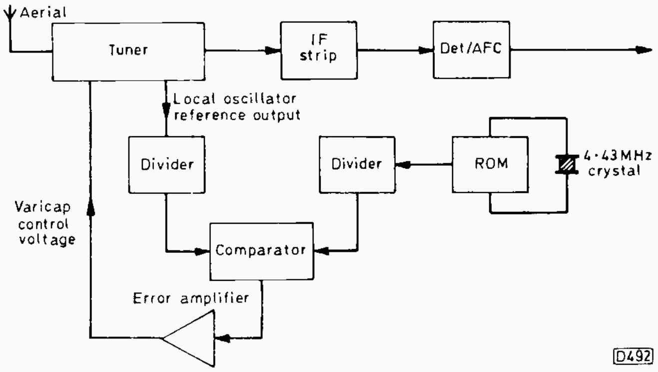


Fig. 14: Block diagram showing the basic principle of the Plessey direct channel tuning system. The local oscillator frequency is compared with the selected channel presented in digital form by the ROM, the difference signal being amplified and used to pull the local oscillator into lock.

Conclusion

We've come a long way since describing the advent of the varicap tuner. The TV set front end is getting steadily more complex.■

Send in the Clowns

– continued from page 295

they could be on too long. Check R521 (4·7kΩ resistor in series with 0·0012μF capacitor C522 across driver transformer's primary winding – they are essential for correct drive pulse timing, as they damp the primary). R521 o.k. Suspect flyback tuning capacitors on top left of board, but seeing type fitted not really convinced that replacement would at this stage help. As the leads were off the BU205s it didn't take long to whip them off the heatsinks and plonk in a replacement pair – without much conviction that this was it. It wasn't.

"What is it?" queried Mr. Goosey.

"I'm not sure, but I think you need a new line output transformer you poor soul."

"Have you got one?"

"Yes."

"How long to make sure?"

"Ten minutes."

"I'll wait if you don't mind."

"I don't mind if you want to watch a right cock up".

Make a little sketch, just in case, and note direction of turns on 7 and 8. New transformer the same so proceed unsoldering etc.

"I wouldn't like your job."

"Neither do I at times."

In went the new tranny, back went the panel. Check current. Nicely low. Fit fuses. Nice hiss on sound. Fit tripler cap. Nice rustle up of e.h.t.

"O.K. Mr. Goosey. Now, about the bill."

Servicing the ITT CVC20 Series Chassis

Part 1

E. Trundle

BACK in November 1975 we described the hybrid range of colour receivers from ITT. Little did we realise at the time that as far as the makers were concerned these were a dying race! As a swan-song, the CVC9/1 appeared, a most excellent set with touch-tuning and simple remote control. These must have been amongst the last colour TV sets in production in the UK to incorporate valves: at that time, the ITT organisation could not be accused of rushing into things...

All this was to change in early 1976, when the long-awaited new solid-state ITT chassis, designated the CVC20, appeared. A marked family resemblance to the previous hybrid range of receivers was immediately obvious. The screening can over the line output department had a familiar look about it, and the excellent three-position hinged vertical chassis arrangement had been retained. Externally, the first of the new sets were almost identical with the hybrid models.

Evolution

The CVC20 was designed to drive the Hitachi 90° PIL c.r.t. The main printed-circuit panel is the mother board, with daughter boards or modules as plug-in units. Not all functions are modulised however: the line scan and switch-mode power supply output stages, the field timebase and sundry odds and ends are arranged on the mother board.

The modules on the main panel are as follows: tuner/i.f. preamplifier; i.f. amplifier for vision and intercarrier sound; sound output; decoder/RGB drive; sync separator and horizontal oscillator; EW modulator; switch-mode power supply control. Each module can be withdrawn and reinserted on the print side of the mother board, facilitating easy repair of individual modules.

Features of the CVC20 are no convergence adjustments, thanks to the PIL tube; a switch-mode power supply based on the TDA2640 control i.c.; and a "half-live" chassis.

Later variants on the CVC20 theme cater for simple or full-function remote control; incorporate diagnostic LEDs on the chassis to aid fault-finding; and use the 110° deflection 20AX and black-matrix c.r.t.s, SAW filter circuitry to form the i.f. bandpass response, and a diode-split line output transformer. As new models and chassis were introduced, basically to cater for the needs of several different types of c.r.t., so new modules became necessary. The result is that at present there's a bewildering variety of permutations of c.r.t., chassis, module and control-unit types. Fortunately later production chassis bear a label giving a list of module types incorporated, and the chassis type is clearly marked.

Chassis Types

A brief list of chassis types released to date, with their main features, is given below:

CVC20: Basic solid-state chassis for use with the 90° 20 in. PIL c.r.t.

CVC20/2: Detail circuit modifications, and remote control option with the RG1 simple sequential remote control unit.

CVC20/3: Diagnostic LEDs introduced; introduction of the CMS11 line oscillator module which is not compatible with the CMS10 type fitted to the CVC20.

CVC20/4: As CVC20/3, but for use with full ultrasonic remote control.

Some sets in the /3 and /4 series were fitted with improved tuners, i.f. and decoder modules.

CVC25: A further development of the CVC20 concept, for driving Hitachi 110° 22in. c.r.t.s using an integral scan yoke. A new field timebase module, incorporating the output stage, is fitted. H.T. up from 125V to 160V.

CVC30: A version to drive the Mullard 110° 26in. 20AX tube. Convergence trimming adjustments provided.

CVC32: To drive the Mullard 22in. 110° 20AX tube. Differs from CVC30 in the convergence correction module only.

CVC30/1, CVC32/1: SAW filter i.f. strip introduced.

CVC25/3, CVC30/3: SAW filter and full ultrasonic remote control.

CVC40: Broadly similar to the foregoing chassis, but with many circuit changes. Designed to drive the 16in. 90° PIL black-matrix tube, this chassis has a switch-mode power supply using discrete components (seven transistors). A diode-split line output transformer is featured, and the SAWF i.f. is standard. Mains power consumption is lower than that of the previous chassis.

CVC45/1: A modification of the CVC40 for use with the 20in. 90° PIL black-matrix tube. Full remote control option, with the RG15 remote transmitter.

Remote Control Units

The remote control units that have been used are as follows:

RG1: Simple mute, off and sequential channel-change unit. For use with the hybrid CVC9/1 chassis and the CVC20/2 and CVC20/3 chassis.

RG5: The first "full" remote control unit – the "take the control panel back to your armchair" one. Plugs into the receiver via a two-pin plug. Used with the CVC25, 30 and 32 family, in conjunction with the CMC33 receiver system.

RG15: Similar to the RG5, but not compatible. Three-pin connection to receiver, with the control signals passed into the receiver via a plug pin rather than the ultrasonic link. Used with "text-ready" receiver system CMC60 fitted to the CVC20/4, CVC25/3 and CVC30/3, and receiver system CMC62/1 fitted to CVC45/1 receivers.

Servicing

In the main our remarks in the following text will be based on the CVC20, with which the longest experience has been gained. Most of them are also relevant to the later chassis types however. Some of the faults to be described afflicted early production only: ITT have a large and active Quality Assurance department, which maintained a close liaison with selected dealers during the introduction of the new chassis type and for long afterwards. For this reason, the later the set the less likelihood of finding any of the "stock" faults described here. Apart from the first batches of CVC20, the general reliability of these sets is quite good: not quite up to Japanese standards, but comparable to contemporary British production.

TUNER AND IF STRIP

We have very little to report on the tuner and i.f. strip. The habits and eccentricities of varicap tuners are now well known, and call for no comment here. Intermittent or permanent low r.f. gain can be due to a dry-joint at the earthy end of R203 on the tuner module. Intermittent loss of vision and sound into a snowstorm may be due to R3 on the mother-board going open-circuit. Where the CMU10 module using the Mullard tuner is fitted, its R222 can go open-circuit with similar results. Both these resistors are of a peculiar type, with metal bands around the ends forming the connections to the body. The trouble occurs when the bands split. We shall meet more resistors of the same type in the field timebase.

Earthing Troubles

Passing on to the i.f. strip itself, strange effects can occur if the earthing of the i.f. module's screening can is not right. If the earthing lugs at the ends of the module are not located in their sockets (and this can happen when it's plugged into the print side of the mother board too), slight vision instability along with a type of vision buzz on sound is the result. With the module plugged into its usual position, an earthing loop can be set up – again resulting in buzz – via the upper module fixing screw. Insulate the screwhead from the print land with a fibre washer to overcome this one.

AGC Faults

Intermittent a.g.c. overload can be a difficult fault to trace – in the CVC20 series R10 (12kΩ, on the mother board) should be suspected for this. In 110° receivers this resistor is designated R26.

Pin 4 of the TBA440N vision i.f. amplifier i.c. is associated with the a.g.c. system and is decoupled by C324, 22μF. This capacitor can be responsible for power-supply tripping when the receiver is being tuned. It can also incite the set to riot when a TV game is connected up, in spite of many dBs of attenuation in the aerial lead! Only green coloured capacitors in this position are suspect.

It May be the Tripler . . .

One fault which is often suspected of being in the tuner or i.f. sections is an intermittent loss of field hold, often with coincident loss of colour. It's more likely to happen on bright scenes, and may be provoked or made to disappear by altering the brightness level or changing programmes. A clue to the real identity of this fault is provided by the presence of a snowstorm at the left-hand side of the display – in fact, the e.h.t tripler is responsible, causing interference by radiation from an internal discharge. Replacement is the only cure: for a note on its mounting, see later.

Excessive Sibilants

The only other comment we have to make about the i.f. strip concerns the sound department. Sibilant distortion, where it cannot be cured by slight adjustment of the quadrature detector coil L312 (be sure the lids are on the i.f. module while tweaking this!), can be minimised by increasing the value of the de-emphasis capacitor C332 from 0·022μF to 0·047μF or 0·068μF.

DEFECTIVE REMOTE CONTROL

The RG1 transmitter used with the CVC20/2 chassis is prone to drifting off tune, so that some remote commands operate wrong functions. The polystyrene capacitors in the transmitter or in receiver CMC21 can be responsible, but often a tweak of L1801 in the transmitter is all that is required. The RG1 transmitter unit can also suffer from internal mechanical problems such as misaligned contact springs, poor electrical connections on the PCB and to its metal case. Transistor T5 may be dry-jointed. All these faults are revealed by careful examination of the inside of the transmitter unit before reassembly.

Regarding the comprehensive remote systems, we've had odd failures of the SAA1024 (encode) and SAA1025 (decode) i.c.s, but seldom twice with the same symptom. Sudden shut-off after a period of running may be due to the SAA1025. Substitution is the best check, but bear in mind that these CMOS chips require special precautions against static when being installed. There's no truth in what Jim told me however: conductive foam yes, isolated soldering iron maybe, but there's no need to chain that part of your anatomy to the bench... In the case of the RG5, it's dangerous to operate this without the battery cover in place since a shock hazard exists when it's plugged into the set under these circumstances.

On the receiver side, inability to tune to stations at the low end of the u.h.f. band with the CMC33 control assembly can be caused by leakage in one of the gating diodes D12/14/16/18/20/22/24/26. To isolate the faulty diode, set all tuning presets to mid-position. Select BBC-1, then monitor the tuning voltage across R61 (rear/right-hand side of tuning presets). If adjustment of any unselected preset affects the voltage reading, the diode connected to the track of the offending preset is suspect. Of course the culprit might be D12, associated with the BBC-1 preset! Check by selecting BBC-2 and winding BBC-1.

Erratic channel change when the transmitter is plugged into the set (but all is well when working remote!) can be due to the 10V zener diode D2 or the receiving transducer associated with the CMC33 control assembly.

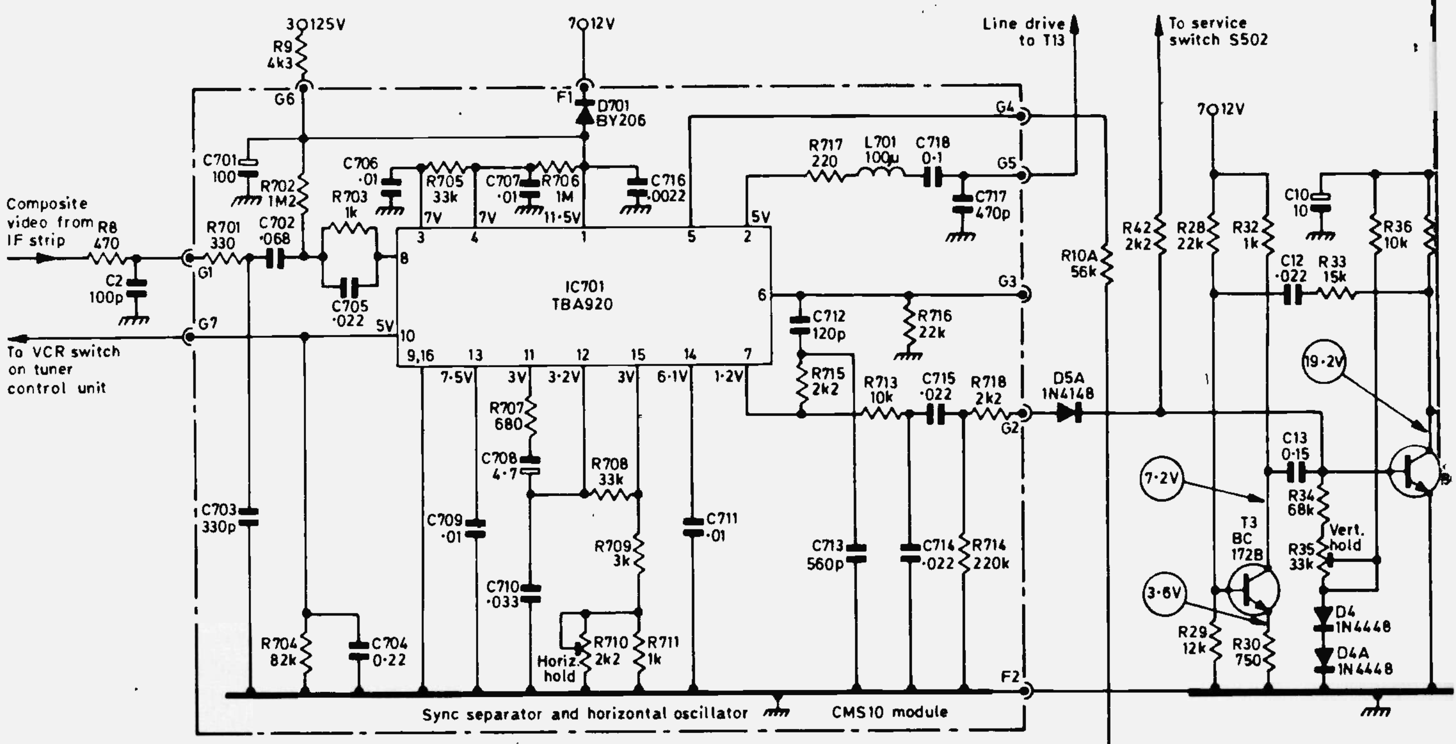
AUDIO MODULE

The audio module gives little trouble. A few escaped from the factory with the quiescent current preset potentiometer R407 set too low, resulting in distorted sound at low levels – rather like the effect of a rubbing loudspeaker. Set R407 for a quiescent current of 5mA through the output transistors. We've had odd random transistor failures in this module, and are told that C75 (fitted to CVC20 series only, in the audio preamplifier stage on the main board) can cause weak and distorted sound. Most complaints about sound performance however can be resolved in the i.f. module as previously described.

DECODER MODULE

The decoder module uses the Mullard three i.c. (TBA560C, TBA540, TCA800) package and is proving quite reliable now that some teething troubles have been eliminated.

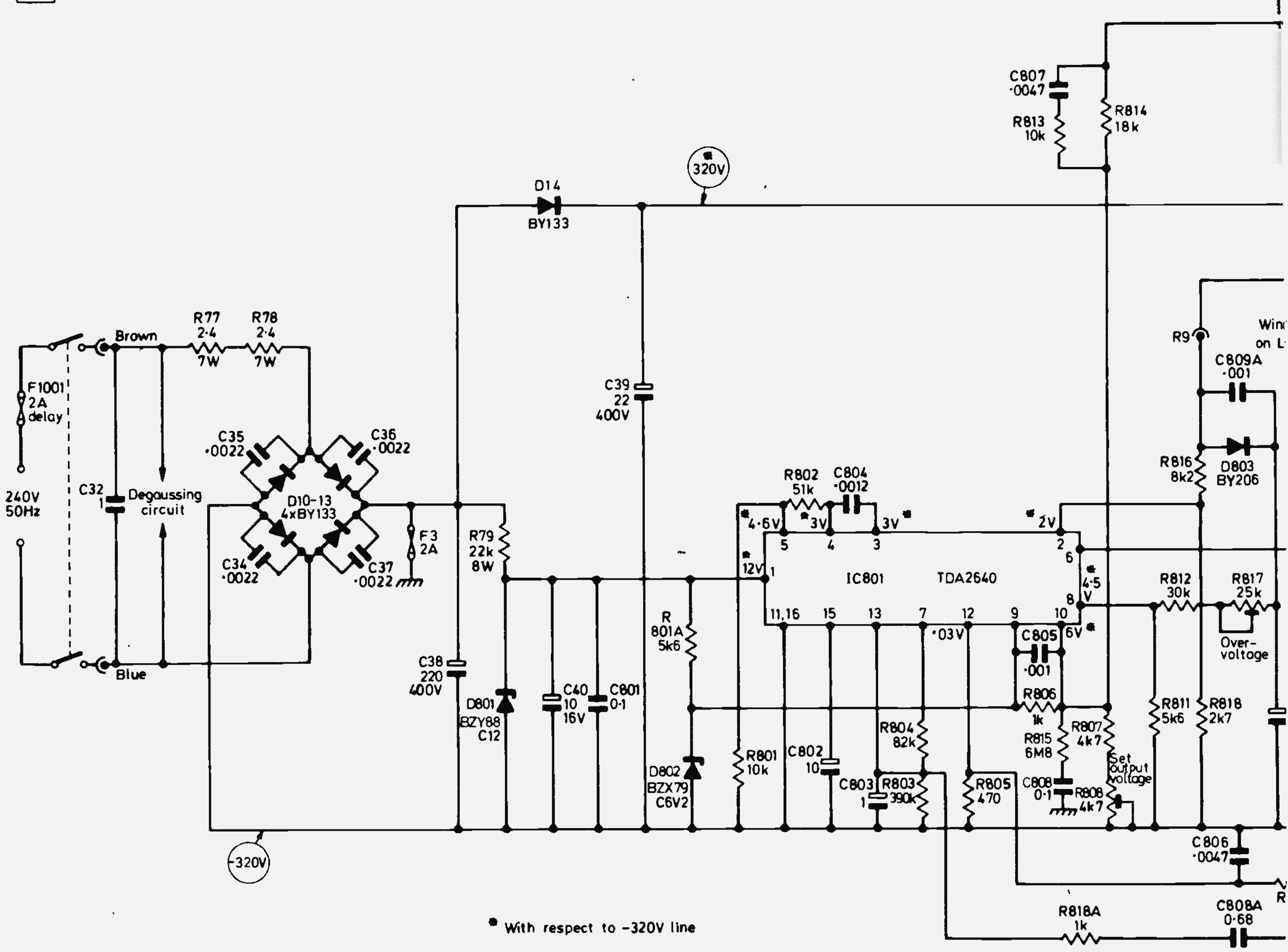
Let's start off with a fault that's not in the module at all! Low contrast, on a permanent or intermittent basis, is often due to a malfunction of the beam limiter circuit. D3 is the

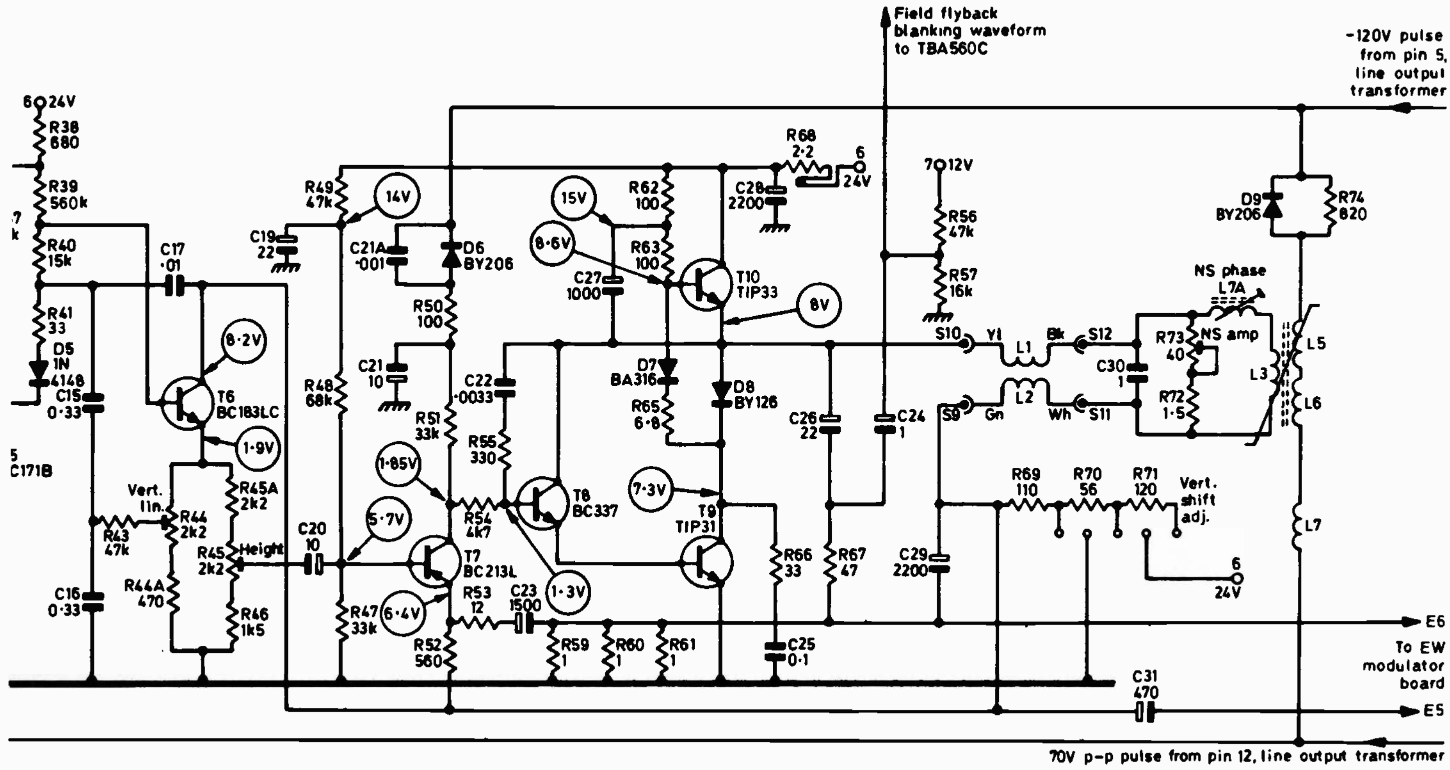


D494

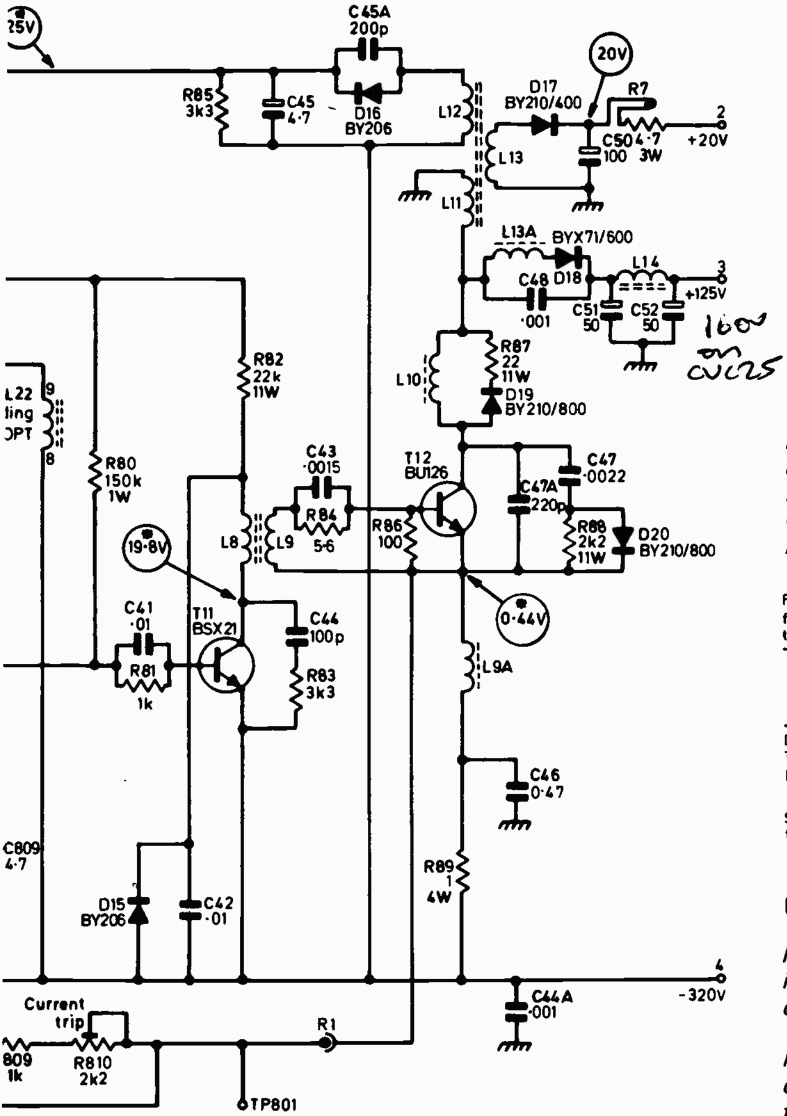
Fig. 1: Field timebase circuit used in

1665





·he ITT CVC20 chassis.



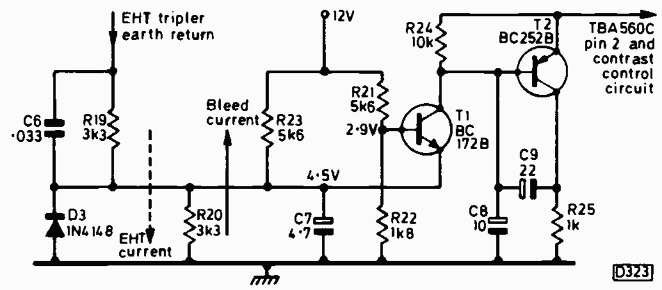


Fig. 2: The beam limiter circuit comes into operation when the e.h.t. current flowing via R19/R20 exceeds the bleed current flowing via R20/R23 so that T1 and T2 start to conduct. Component reference numbers as used in the CVC20 chassis. In later production R23 is 10kΩ, R22 910Ω and R25 470Ω.

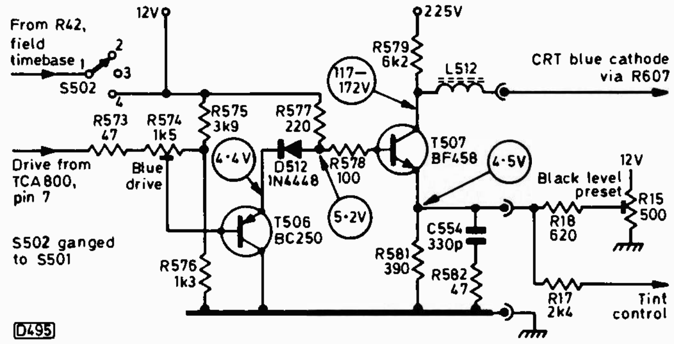
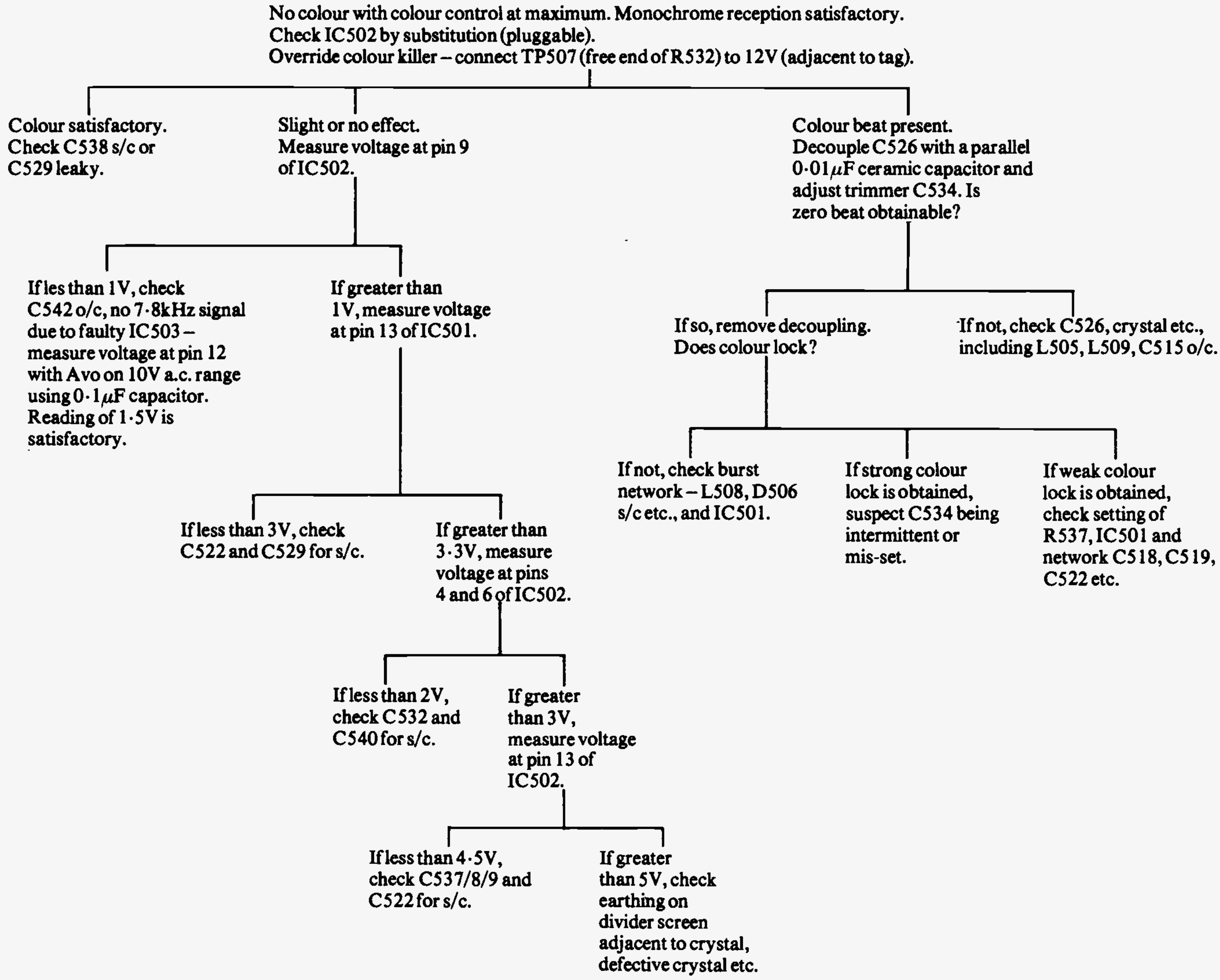


Fig. 3: The blue driver and output stage circuit. The circuits used in the R and G channels are identical except for the tint control connections.

Fig. 4 (left): Mains rectifier and switch-mode power supply circuits. T12 is the chopper transistor, which is driven by T11, the control circuitry being incorporated within IC801.

Chart 1: Tracing no colour.



primary suspect, but the two 3·3kΩ resistors R19 and R20 and the 0·033μF (C6) and 4·7μF (C7) capacitors associated with them (reference numbers vary with chassis, those given apply to the CVC20) are not above suspicion. To prove the point, check the voltage on pin 2 of IC501 (TBA560C). It will be below its customary 3·4V if the beam limiter is on.

Still out of the decoder module, shading of the upper half of the picture should lead to a check of the 12V and 124V rails – if mis-set the ripple content rises, and the decoder is very sensitive to this.

Intermittent Colour

As we pass into the decoder itself, first note that the module pins themselves – forming plug L – may be contaminated with flux, resulting in intermittent colour. In very early production, many CMD10 decoder modules were afflicted with the dreaded "off-earth" fault. The module's printed panel has two transverse screening/earthing strips, and these have tabs which pass through the board to earth print lands. If the tabs are dry-jointed to the lands, the result is intermittent colour. The problem can occur on any of the earthing tabs, but the one which grounds C531 etc, adjacent to the crystal, is the most troublesome. On later modules, precautions have been taken to prevent this problem by providing a separate insulated earthing wire on the print side of the panel. This is the best way to deal with this trouble.

While on the subject of intermittent colour, faulty i.c.s can be responsible for this though the types used are generally reliable and now well-tried. Check L508 and L509 for bad joints. We've also found that the oscillator trimmer C534 can give rise to intermittent colour.

No Colour

To assist in diagnosing decoder faults, override the colour killer by connecting TP507 to the 12V rail. In the maker's circuit diagram, test points are in diamonds and oscillogram reference numbers in circles – the best way to avoid confusion is to think of the circles as an (old-fashioned?) oscilloscope screen!

True to ITT tradition, it seems that the no colour symptom is less common than intermittent colour. No colour will be the result if C542 opens, deleting the colour burst, or if L508 or L509 is open-circuit. An odd fault which has cropped up a couple of times is an open-circuit C532. The result is no colour, and on overriding the killer an over-saturated picture appears with no ident correction, so that there's a 50/50 chance of the colours being reversed.

The accompanying chart may assist in tracing no colour faults. The voltage on the a.c.c. line (pin 14 of the TBA560C i.c.) is a useful checkpoint in cases of no colour. It should be 1·1V, but rises to about 4V when the burst signal is absent or the TBA540 is in trouble.

Brightness Troubles

There are one or two more stock faults in the decoder. Brightness faults of various types (we once found a black hole, almost circular, at the left-hand side of the picture) will often be due to gremlins in the bunch of diodes associated with pin 8 of the TBA560C. These are D501/2/3/4. C515 and L505 can also upset the brightness level if faulty. A further possibility for intermittent brightness is flux contamination of the track or slider of the preset brightness control R518. Where brightness problems are experienced, it's essential first to check the voltages at the tube electrodes, because the trouble may well lie outside the decoder module – as we shall see!

The RGB Channels

Moving on to the back end of the decoder, some early sets had the clamp reservoir capacitors C546/7/8 inserted in the panel back to front, i.e. incorrectly polarised, and it's surprising how long the decoder can continue to produce very acceptable colour under these circumstances! These capacitors are not immediately obvious as being connected with the RGB drives, being connected to the TCA800 i.c., but are well worth checking when one primary drive departs from the straight and narrow – C546/7/8 work for the red, green and blue channels respectively.

There was a batch of faulty 1N4448 diodes which found its way into the D508/10/12 positions (video couplings between the RGB driver and output transistors), causing flashing of the colour concerned, and fluctuating drive. Where this is encountered, it's prudent to change all three diodes.

We've had occasional failures of the BC250 driver transistors T502/4/6, which is easily diagnosed. The BF458 video output transistors are very reliable. In CVC40 chassis incidentally these transistors are selected for high-voltage operation and designated /T, because failure elsewhere in the receiver can push up their collector voltage beyond 300V.

FIELD TIMEBASE

The field timebase sits on the small panel above the c.r.t.'s neck. On the CVC20, access for replacement of the field output transistor pair is difficult. The 110° models use a pluggable module in the field department (CMF30 in the CVC30), and service is thus much easier.

Field collapse is a common enough symptom on any set – in the present case, turn off T6 by shorting its base-emitter junction. If the timebase "squegs" and the horizontal line stirs, the amplifier and output stage are working and the oscillator has stopped – check T3 and T5. More often, the fault will be downstream in the amplifier or output stages.

Occasional cases of thermal drift of the field frequency have been traced to T5. In the CMF30 module used in wide-angle sets, T5 is disguised as T2002. Additionally, check that R2001 is correct at 18kΩ. Depending on tolerances, the field hold control might set towards one end with some modules, in which case R2008 may be increased from 270kΩ to 330kΩ.

Leaving the oscillator now, and returning to the CVC20 circuit, C17 can leak to upset linearity, while C16 may cause intermittent cramping at the bottom of the picture. The base bias for T7 is critical, setting as it does the d.c. conditions in the output stage, and a tendency towards inadequate height with top foldover points the finger of suspicion at R47/48/49, C19 and C20. A –88V supply is developed across C21 by D6, which rectifies flyback pulses from the line output transformer. Absence of this negative supply results in the field scan collapsing to about one third height, with bottom foldover. If R50 is burnt, shorts or leakage in C21 or D6 will be found responsible.

Low height and loss of hold on the other hand is often due to low voltage on the 12V line. This may in turn be caused by an upward change in the value of R102, which is connected in series with the "set 12V" preset. Sometimes this resistor goes completely open-circuit: the only sign of life in the set will then be the c.r.t. heaters glowing.

Output Stage Faults

Most of the bugs in the CVC20's field timebase afflict the output stage. R62 and R63 have been found to go low resistance in some cases, increasing the output stage current to the point where the fusible supply resistor R68 opens (leakage in the decoupler C28 sometimes leads to the same thing). The connection bands at the ends of these resistors can split to cause partial field collapse with a 2in. high picture and bottom foldover, often as an intermittent effect. Opening of D8 (dear old friend BY126, do you live yet? – a BY133 is used on later variants) can also partially shut down the output stage, with about one-third scan and top foldover.

A good guide to the general state of the timebase is given by measuring the current flowing in the fusible resistor R68. When all is well, about 540mA is the norm, giving rise to about 1·2V across this resistor.

The output stage is rather unusual, operating in the class AB mode. During the first half of the scan, T10 is non-conductive, T9 driving the scan coils via D8. When the voltage at the collector of T9 rises to about 8V, D8 cuts off and T9 then drives T10 via R65 and D7 to complete the scan. Thus T10 (TIP33) provides the scanning current during the second half of the scan. In spite of its impressive size, some specimens can give rise to bottom foldover and even a poor interlace effect in the lower half of the picture. This sort of thing seldom prevents the device from checking good in a tester or ohmmeter, so substitution is recommended. The FT3055 transistors used in conjunction with the CMF30 module seem more reliable altogether.

Feedback is taken from across the 0·33Ω resistor formed by the parallel-connected resistors R59/60/61. If one of these resistors goes open-circuit, the picture height will decrease, but with good linearity maintained.

Physical Problems

To wind up the field timebase, a couple of physical problems. L7A is the pincushion correction phase adjustment coil, through which much of the scanning current flows. In some early receivers this coil was prone to going open-circuit due to joint troubles, leading to top and bottom cramping and possible over dissipation in R73. To quickly eliminate this one, short out C30 as a test.

Finally we were once led a merry (and prolonged) dance in a CVC20 by a very rare and intermittent collapse of the field. The symptom was a slightly curved horizontal line, at less than full width, about two-thirds of the way down the screen. This was finally traced to a thin finger of solder between the frame of R73 (NS pincushion amplitude) and the adjacent metal screen. It had obviously formed during the solder bath process.

CONTINUED NEXT MONTH

TV MEX — Exhibition Report

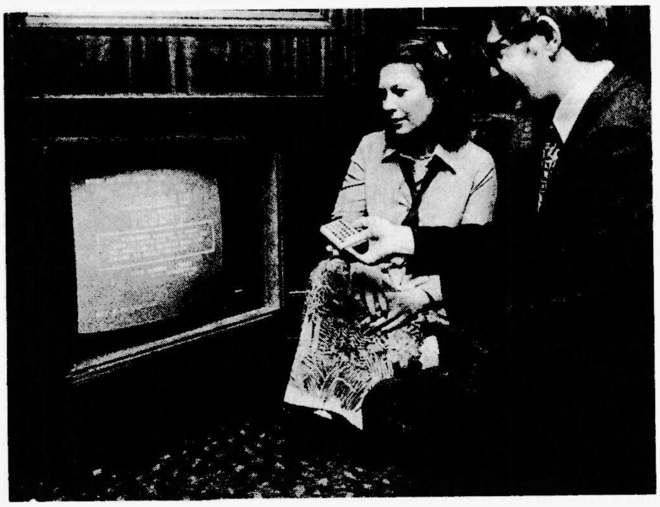
D. K. Matthewson, B.Sc., Ph.D.

THIS exhibition, held at the National Exhibition Centre in Birmingham on January 16-18th, was designed as an adjunct to the International Domestic Electrical Appliances Fair which was being held at the same time. The TV part of the exhibition was devoted to viewdata/telextext systems and TV games, with about an equal number of stands from each camp. This ensured a good mix (about equal proportions) of sensible and silly people.

I went on the Tuesday, which coincided with the first of a series of one day rail strikes. This may have accounted for the NEC charging £2·00 per car parking charge. On the other hand, maybe they just like money! On reflection I think the latter must be true, as borne out by the restaurant and bar prices.

Prestel and Teletext

The exhibition turned out to be interesting however, and demonstrated that both the PO and the set manufacturers are taking Prestel very seriously. My first introduction to Viewdata (as it was then known) was two years ago, in the form of a GEC/Hirst Research Centre prototype business terminal. This device functioned perfectly well, but was quite complex to use. For a start, it was linked to the PO wires by a "Data link" phone and associated modem. To use it you had to dial up the PO computer at Martlesham by hand, wait for the computer-on-line tone, then press the "data" button. If you were lucky the TV set would then display a Prestel heading and you had to type in your user number. *Then* you could start using Prestel! The current generation of Prestel sets have changed all that. To use the system now all you do is switch the mains on and press the Prestel button. The set will then autodial the PO computer and identify your terminal for billing. Obviously a great deal of thought has been given to keeping the system within the capabilities of the general public, as well as the hi-fi addict etc.



This Thorn Prestel viewdata set has been installed for the use of guests at the Portman Hotel, London.

Most of the major Prestel/teletext manufacturers were represented, including GEC and Rank. The former had a very neat domestic colour set with both Prestel and teletext facilities, controlable (as are all the usual TV functions) from a remote key pad. For the business user a small monochrome unit was on show, with a full alphanumeric keyboard. This would be suitable for the information provider as well as the mail order trade. Rank, under the Bush brand name, demonstrated similar products, namely the BC6482 colour Prestel/teletext set and the BM6782 monochrome business terminal. Both have autodial facilities.

A small Lancashire firm was exhibiting a range of Prestel products including both colour domestic and monochrome business terminals, at prices of about £1400 and £800 respectively. This firm – Kirby Lester Electronics – has been producing up-market colour sets for some years now and has recently diversified into the viewdata and teletext markets, aiming to produce about 5,000 sets a year. They also market an add-on Prestel editing keyboard for use with their Hermes II colour set. This has full colour editing facilities and sells for around £350. A low cost, hard copy printer at around the same price is also under development, as are a range of "intelligent" terminals.

An interesting development on the teletext front was the introduction of an add-on adaptor by Teleng. This device is similar to, although more sophisticated than, the one already marketed by Pye/Labgear. Its features include remote control of all normal TV functions and the ability to add the channel number and real time to the normal TV picture, in addition to teletext with newsflash and alarm facilities. The normal TV sound is fed to a loudspeaker in the adaptor, and there is a socket to feed the audio signal to a separate hi-fi amplifier. The remote control unit controls TV channel selection, TV/teletext changeover, teletext page selection and TV volume etc. control, and there is also the ability to display either the upper or the lower half text page over the whole screen. This allows the text to be easily read from a greater distance than normal. The Teleng Teletext Super 3 Adaptor, which is said to comply with British Safety Standards, is finished in a wood effect case and retails for just under £200.

TV Games

The other part of the TV exhibition was devoted to a variety of TV games. Some of these showed a remarkable degree of sophistication, many having a large number of games held on plug-in cartridges. Some manufacturers were demonstrating various educational plug-in cartridges, including spelling and mathematical teaching games. Ingersoll Electronics displayed a range of TV games including the Atari programmable unit which has in the past been marketed by Cherry Leisure, the Swedish based vending machine company.

Another interesting gadget was the Chromascope Home Video Synthesizer, marketed by Chromatronics of Harlow, Essex. This device displays a constantly changing series of patterns and colours on a domestic TV set. Quite what it's intended for I'm not too sure, but it certainly gives some attractive synthesised displays.

Both the BBC and the Department of Trade and Industry were present, the former demonstrating teletext in a variety of forms and the latter giving information on the government's sponsorship arrangements for improving the country's position in the field of microelectronics. ■

Experimental Spectrum Analyser

Allan Latham

THIS low-cost spectrum analyser has been constructed as an aid to the author's DX-TV activities. The article traces the development from an experimental arrangement using an oscilloscope and varicap tuner to the final version based on an old TV set. This is not one of those constructional projects where it's necessary only to solder in the components to get a working product however: a lot of experimentation may be needed, so only those competent to use an oscilloscope and adjust and modify circuits to get the required results should tackle it. Also, since the project is based on the use of a normal TV set, the constructor should be fully aware of the dangers involved in modifying or operating equipment connected directly to the mains supply. In fact it's strongly recommended that an isolation transformer is used, and the metal chassis earthed.

What is a Spectrum Analyser?

What is a spectrum analyser? After all, it's not something usually found in the service department or amongst the average DX-TV enthusiast's equipment. In its basic form it's a piece of equipment for displaying amplitude against frequency. Commercial spectrum analysers which cover the part of the spectrum we're interested in are available. They consist of a small display screen – like an oscilloscope – on which frequency is represented along the X (horizontal) axis and logarithmic amplitude along the Y (vertical) axis. The main use of such commercial devices is for examining the output of v.h.f. transmitters to check for spurious radiation. Another use is as a panoramic receiver. By connecting the input to an aerial, it's possible to monitor a band of frequencies for the presence or absence of signals. Though it gives no indication of the nature of the signals, it does give their frequency and amplitude and also a good indication of the type of modulation. This use is seldom adopted commercially, but is of importance in defence and security applications.

DX Use

It's the panoramic receiver application for which our spectrum analyser is required. The frequency range we want is the TV Bands I and III, without the intervening band which includes public service, aeronautical, Band II f.m. radio, etc. U.H.F. is not of importance in the author's location, so I've not tried to apply the design to u.h.f. use. This should be possible however. A split-screen, Band I/III/u.h.f. display would be too cluttered to be useful however, so a separate u.h.f. unit would be necessary if simultaneous monitoring of all the TV bands is required. The usefulness of a panoramic receiver for DX-TV use should now be clear. It will not however indicate that a weak distant signal is floating over a stronger one, while for seeking weak signals such as those reflected via meteor showers there's no substitute for an accurately tuned receiver preset on a likely channel.

Practical Design

At the heart of the spectrum analyser is a varicap tuner. In normal use the tuner's tuning voltage is held constant except of course for the discrete steps between channels. In a spectrum analyser however the varicap tuning voltage is swept through the required bandwidth by a repetitive waveform – in our case a 50Hz sawtooth. If the resultant i.f. output from the tuner is amplified and detected in the usual way, the video amplitude at any instant will depend on the amplitude of the received signal – at the frequency to which the tuner is tuned at that instant by the sawtooth varicap tuning voltage. All that's required to produce a working spectrum analyser is to hook up a scope so that the video signal is displayed in the Y direction and the sweep in the X direction. If the scope has an X output available, this can be used as the sweep voltage (amplified if necessary) and the timebase allowed to free run at around 50Hz. A similar arrangement was described by Harold Peters in the November 1971 issue of *Television*.

Various refinements are necessary to make this system practical. First of all the i.f. bandwidth needs to be narrowed. The optimum bandwidth depends on the sweep rate and frequency range, though I don't claim to understand the theory of this. If the bandwidth is too narrow, the video amplitude falls rapidly to zero: if it's too wide, the resolution suffers. High resolution is fortunately not needed for our purposes. I found that a 405-line i.f. strip adjusted for a narrow bandwidth by peaking all the coils was satisfactory, while a 405-line sound i.f. strip (bandwidth about 50kHz) is too narrow.

The next refinement concerns the relative amplitude of signals. "Just above the noise" is about $1\mu V$, while a local signal may be 100mV. This is a range of 1:100,000, which quite obviously can't be displayed on a scope in a linear way. What's needed is some form of logarithmic presentation, i.e. the first cm. of the trace represents $10\mu V$, the next 10-$100\mu V$ etc. This is an ideal solution, but an adequate alternative is to scope the a.g.c. line instead of the video output. The a.g.c. system in a TV set is not suitable as it stands however since the a.g.c. is averaged over several fields by using a smoothing network. In our case we want the a.g.c. to move as fast as possible in trying to maintain a constant video output, so we feed the video signal directly to the a.g.c. amplifier and remove all the a.g.c. smoothing capacitors.

Adapting an Old TV Set

Although this arrangement works very well, it uses an oscilloscope full time while only Band I or III can be displayed (not both). The next step therefore was to see whether an old TV set could be adopted. One possibility is to remove the line scan from the set's coils and feed it instead into a dummy load. The scan coils can then be rotated by 90°. The TV set's field sweep can be used to sweep the varicap tuning voltage and, after amplification, the a.g.c. voltage can be fed to the line scan coils. The need to build an amplifier capable of providing large currents into an inductive load at frequen-

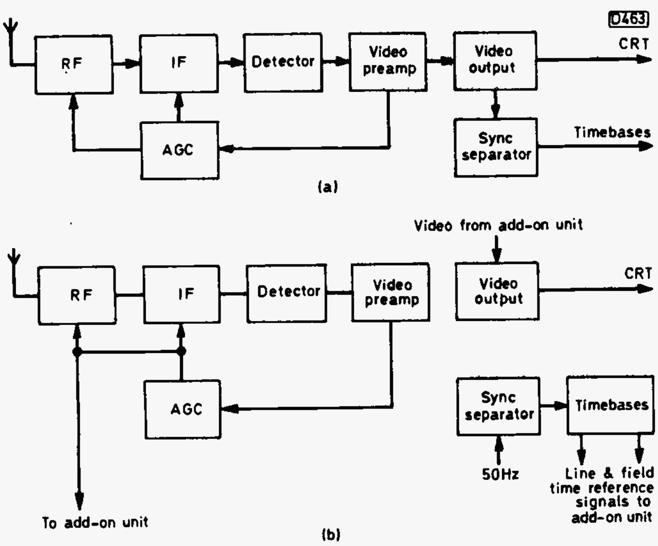


Fig. 1: Block diagram showing the modifications required to the TV receiver. (a) Original arrangement of the receiver. (b) Modified arrangement for spectrum analyser use.

cies varying from 50Hz to 20kHz deterred me from trying this method, though it should work very well.

The alternative to this is to use some sort of switching technique on a fairly conventional raster, i.e. the video fed to the screen is either black or white and is switched to give the appearance of a conventional spectrum analyser. This was the approach I adopted.

Since in addition to modifying the TV set it's necessary to build an add-on unit with various digital circuits, I decided to arrange for simultaneous presentation of Band I and Band III on the screen. This involves little added complexity.

The add-on unit provides the varicap tuning voltage, the Band I/III switching voltage, and the new video signal. It's inputs, besides power, are the a.g.c. voltage, a field time reference, and a line time reference (or line sawtooth). The time references are obtained by differentiating suitable waveforms obtained from the set's timebases. The constructor needs a scope and a circuit diagram of the set before trying to find these waveforms. I had no difficulty with this and by feeding them through a small capacitor to CMOS gates arranged as inverters a sharp pulse representing each time reference was obtained. It's very important that the capacitors used for this purpose are adequately rated: the waveforms used may be standing on high d.c. voltages, e.g. at the anode of the field output valve, and the working voltage of the capacitors must be greater than the peak voltage, i.e. the waveform amplitude plus d.c.

Besides obtaining these pulses from the receiver to drive the add-on unit, the following further modifications to the TV set are required (see Fig. 1). First, turn the scan coils through 90° so that the field scan is from left to right. Secondly, disconnect the signal feed to the sync separator. This is usually from the anode of the video output valve. Instead, feed a suitable 50Hz mains signal to the sync separator – I found a suitable waveform at a point along the heater chain. The effect of this modification is to force the field oscillator to lock to the mains supply and avoid hum bars on the screen. Next, disconnect the video feed between the video preamplifier and the video output stage. Take the video direct to the a.g.c. amplifier (it may need inverting – check with the circuit diagram) and remove all the capacitors associated with a.g.c. smoothing. The new video signal from the add-on unit goes to the video output valve/transistor at the point where the original feed was disconnected. These modifications require careful study of the circuit of the set used, and will vary from model to model.

Add-on Unit

The add-on unit I made used components to hand and was not optimised in any way – indeed this article is intended as a general guide for those trying out this idea rather than providing an exact solution. The unit has sections working at field frequency and others at line frequency: the signals don't merge until the final gating of all the waveforms to give the new video signal.

First, the part operating at field frequency (see Fig. 2). What's required here is a waveform to switch the tuner from Band I to Band III during each field; also a blanking waveform which blanks not only the flyback but also the Band I/III transition. This blanking waveform will of course be gated with the other signal to form the new video signal.

The field time reference pulse triggers two monostables, one giving the flyback blanking pulse (about 3msec, see Fig. 3) and the other a pulse which switches the tuner to Band I (this is inverted to give the external signal, since the varicap tuner I used needs a positive voltage on its switching terminal for Band III). This latter monostable was made adjustable from 1-25msec by means of a preset control, so that the exact division of the screen between Bands I/III can be varied. The Band I/III transition is broadened to give a transition blanking pulse of about 1msec (ideally another monostable should be used).

These are the easy on/off type waveforms: we also need the varicap sweep voltage. This must begin each field at the voltage corresponding to just below the lowest Band I channel, and rise to the voltage of the highest Band I channel just before the tuner is switched to Band III part way through the field scan. At the Band I/III transition,

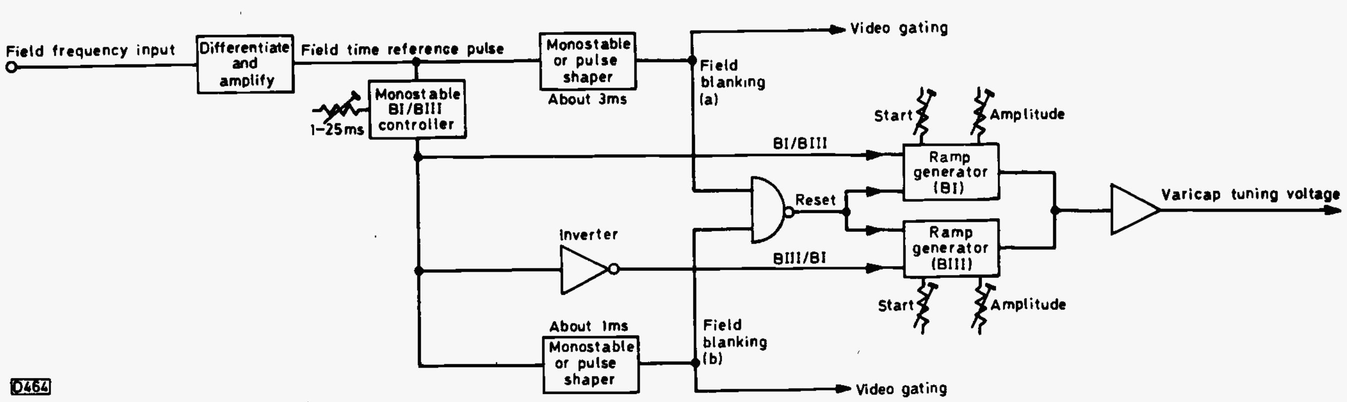


Fig. 2: Block diagram of the field-frequency section of the add-on unit.

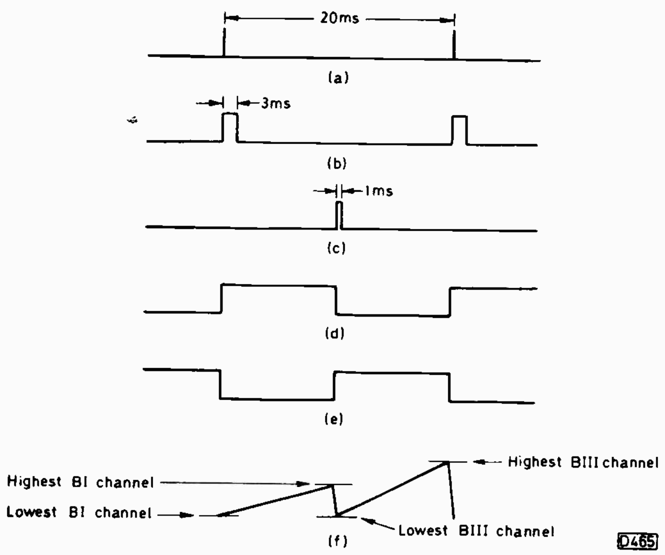


Fig. 3: Field-frequency waveforms. (a) Field time reference, corresponding to the field flyback. (b) Field blanking (a) waveform. (c) Field blanking (b) waveform. (d) BI/BIII waveform. (e) BIII/BI waveform. (f) Varicap tuning waveform.

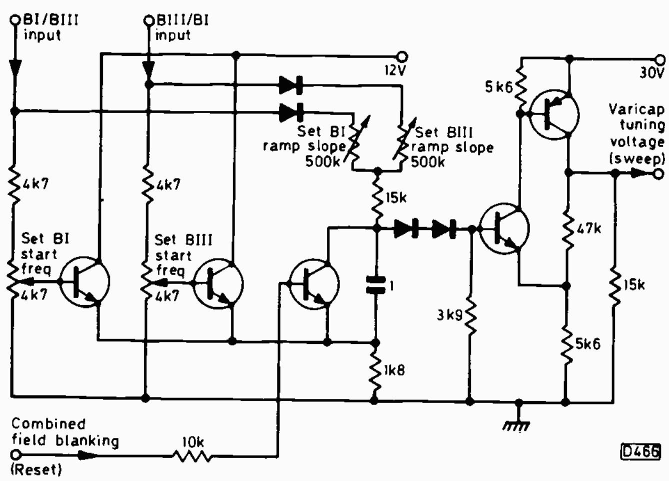


Fig. 4: Circuit of the ramp generators used to produce the varicap tuning voltage, and the following amplifier.

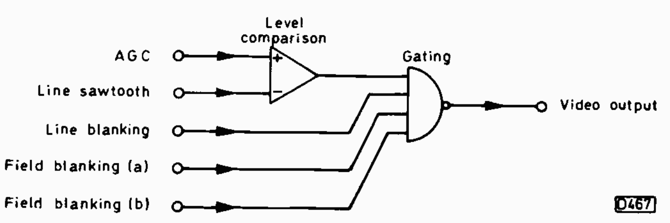


Fig. 5: Block diagram of the line frequency section of the add-on unit, and the gating to provide the composite video output signal for the modified receiver.

while the display is blanked, the varicap tuning voltage must fall to the voltage corresponding to just below the lowest Band III channel. The voltage then rises again until the field flyback occurs, reaching just above the highest Band III channel. It then falls once more to begin the cycle again. The circuit I used is shown in Fig. 4, but again I recommend that the constructor experiments to obtain the desired result.

The rest of the add-on unit works at line frequency (see Fig. 5). What's needed is a comparison of the a.g.c. voltage with a suitable line-frequency sawtooth. When the a.g.c. voltage is greater than the sawtooth, the video output is at white level. Thus a larger a.g.c. voltage (i.e. stronger signal) will produce a longer white line than a lower a.g.c. voltage. Since the line scan is now down to up (instead of left to right), a more or less conventional spectrum analyser display is obtained: the only detailed difference is that all the area under the amplitude/frequency trace is white instead of only the trace being white (as when using a scope).

The ideal way in which to compare these voltages is to generate the sawtooth at a known amplitude in the add-on unit and do the comparison using an operational amplifier. This allows preset resistors to be used to give more accurate control of the display. In my case a suitable line sawtooth was found in the set and added (by means of a resistive adder) to the a.g.c., then amplified to give the video signal.

Use

The spectrum analyser has proved very useful. Even very weak signals can be seen and tuned in very quickly. It's easy to see from the display whether the signal is TV, f.m. (i.e. the sound carrier) or some other signal (e.g. the harmonics of a short-wave transmitter). TV signals have a ripple which moves slowly left or right – this is because the spectrum analyser is sampling the TV transmission at almost field frequency (remember that the spectrum analyser is locked to the mains at 50Hz nominal). When the sampling takes place on the field sync pulse (the maximum transmitted amplitude) this is clearly visible in the form of dots diagonally over the normal display for that channel.

Calibration

To be of use the spectrum analyser must be calibrated. Do this by marking the screen with a felt-tip pen. In the prototype a warm-up drift of about half a CCIR channel occurred, and calibration should be done only when the set has warmed up. Known transmitters are the best markers, and a complete calibration can be quickly marked on the screen. None of the presets should be altered of course once a suitably calibrated display has been achieved.

Final Thoughts

Anyone with the patience and expertise required to build such a spectrum analyser will certainly find room for improvement. I suggest the following areas. First optimise the circuitry so that a reproducible design is obtained rather than one where everything is "adjust on test". Secondly, improve the temperature stability. Third, improve the linearity on the screen of scanned distance/frequency: the main problem is that the dependence of the tuned frequency on the varicap voltage is not linear. As a final thought, how about this? A device called VDF – v.h.f. direction finding – is used in airport control towers. A radial line from the centre to the edge of a scope tube is displayed, the radial line giving the direction from which a transmission is being received by the control tower. The system works in conjunction with a rotating aerial. I'd certainly be interested to hear from anyone who can devise a suitable system for TV, where direction is indicated by the angle of a radial from say due north as vertically upwards, frequency by the distance from the centre and strength by video intensity . . .

In conclusion, while the spectrum analyser is useful for locating signals, there remains the problem with DX-TV of detecting the signal (i.e. tuning the acquired signal to obtain lockable video), also of signal identification. The spectrum analyser is helpful in its present form, but there's great scope for experiment. ■

TV Servicing: Beginners Start Here . . .

Part 19

S. Simon

HAVING discussed the bare essentials of fault location with reference to our block diagram (page 267 last month) we're going to have another dig at this same cabbage patch since fault localisation is so very important. Whilst those who are well acquainted with the subject of servicing are the obvious people to write about it, we do have some difficulty in appreciating the viewpoint of those on the outside who may have trouble grasping certain factors which we tend to take for granted. It's like us asking our wives to explain a complicated knitting pattern which to her is so straightforward and to us is anything but.

So let's have a little questions and answers session, and see how we get on.

No Signals

We have a TV set, and although the screen lights up there are no sound or vision signals. Which part of the set is likely to be at fault?

It depends upon the symptoms, which have not been fully described. For example, is there any noise at all on the sound, or "snow" on the screen?

Sorry for not being more explicit: there's a lot of "snow" or mush on the screen and hiss on the sound.

That's better. When describing symptoms, it's important to include them all – whether we're asking someone else for help or asking ourselves. The omission of one factor can send us on an unnecessary chase.

The fact that there is noise denotes that most of the signal amplifying stages are working. This means either that the required signals are not being processed by the tuner, or that they are not being applied to the set at all. Therefore we check the aerial input and the tuner unit, plus the tuner supplies particularly if a varicap tuner is employed.

What difference does this make?

A varicap tuner does not require mechanical movement in order to tune it, i.e. it's not necessary to rotate a spindle carrying tuner vanes in order to vary the capacitance of the tuned circuits. Instead, the tuner requires a tuning voltage which can be varied from say 0-30V in order to tune the circuits over the whole of the required range (say channels 21-68).

This voltage is normally obtained from a higher voltage source than the other tuner unit voltages, through a resistor or resistors, and is stabilised at 30V by a zener diode. It's possible therefore that this voltage is missing though the others may be present. This is a common failing. Before condemning the tuner therefore it's essential to check that not only are the normal supplies present but also that required for tuning the varicap diodes.

Can a mechanically tuned unit suffer from "not tuning"?

Oh yes. There can be many reasons for this, depending usually upon the make of tuner. An external examination will usually show the reason – e.g. push bar off, spring broken, quadrant screws loose, or something of this nature. There are some types of tuner however that appear to be functioning normally when externally examined but when the cover is removed one finds that the tuning gang is not rotating – again possibly due to loose screws. The real horror in older sets with rotary tuners is when the nylon cord which transmits the drive from a spindle to one or more drums snaps or when the drum loses its shape so that the cord slips off, but this is another story.

If the tuning voltages etc. are all in order, is the tuner still suspect?

Yes. It's quite possible that a transistor has failed, and if you are not sure on this point it's best to try another tuner rather than to attempt transistor replacement in the confined space involved.

Before replacing the tuner, are there other points to check?

Some tuners have a.g.c. applied to one or more stages. This control voltage may be wrong and should be checked, particularly if there is a separate line to the tuner with its own preset control (possibly marked local-distant, or tuner a.g.c.).

Also check the output lead from the tuner to wherever it goes, which may be direct to the i.f. strip or to a separate unit (or, in the case of older dual-standard sets, to the v.h.f. tuner where the signal is amplified by the v.h.f. mixer stage).

Weak Signal with Noise

If the complaint is of a weak signal (rather than none) on a noisy background, is the procedure different?

Not really. Once again we start at the aerial and work through the tuner to the i.f. stages, this time including these in our checks. Note particularly the a.g.c.conditions. Do the base and emitter voltages of the first two i.f. stages depart from those given in the service information? Also check the filter components between the input to the i.f. panel and the first amplifier stage. The thing that requires attention here is the possibility of dry-joints, open circuit capacitors, etc. – the tuning should not be disturbed.

Despite all this, the most common cause of weak, noisy reception is still in the tuner, where the first stage (aerial amplifier) is likely to be at fault. This is fairly easy to check by connecting a small capacitor to the aerial lead and using this as a probe to inject a signal at the output of the first stage rather than its input. The result is often surprising, but gives some idea of the amplification efficiency of the first stage.

No Noise

What if the raster is relatively clean (no noise), but the signal is weak or non-existent?

In this case check the later i.f. stages, comparing the voltages obtained at the base, emitter and collector of the transistors with those expected or given in the service information. If these seem to be correct, check the detector diode and the following stages, including the a.g.c circuit as the early stages may be shut off completely. Remember what's been said previously about transistor supplies, and act accordingly.

If the supply line voltage is much higher than it should be (as can happen in the Thorn 1500 chassis for example), check the resistors which divide up or load the line. If the supply is absent, check back to the source where a wirewound resistor may again be found open-circuit, this time shutting the supply off completely instead of increasing it. This is common in some Decca and Philips sets.

The clue is how the sound is behaving when the picture signal is absent or weak, since the sound signals are usually tapped off after the detector diode and in some cases from the first video stage. In other words, look at the circuit and draw your conclusions from this according to the point of signal separation.

If the sound is loud and clear then, does this mean that the i.f. stages in a 625-line (intercarrier sound) receiver are above suspicion?

Almost, but not quite. We have had examples of a completely inoperative i.f. stage which completely removes the vision signal but still provides quite a healthy sound signal. This is presumably due to capacitive coupling in the otherwise dead stage.

Normally however this fault should be located in a post-detector stage, where transistors, electrolytic capacitors and the contrast control are the primary suspects, the latter item being less suspect when it is part of the a.g.c. system.

Sound but No/Weak Picture

Where would you start if the sound is loud and clear but the picture is weak or absent on a normally illuminated screen?

I'd start where the heat is, i.e. where the signal swings are large. This is the video or luminance output stage, whether using a valve or a transistor. Depending upon the design and our experience of it, I'd first check the device (valve or transistor) itself and then the associated resistors. If these are in order with correct voltages, I would check the coupling back to the preceding stage, including any coupling capacitor or contrast control, then the preceding stage itself, the transistor and associated resistors here and any chokes etc., the latter being small coils which can often become open-circuit, particularly at their soldering posts. In fact I'd check as necessary all the relatively few components between the detector and the video stage. I'd expect a goodly number of direct hits in the video stage itself, particularly if a transistor and carbon resistors are used.

Brightness Peculiarities

What if the picture is fairly clear when kept dark, but any attempt to brighten it results in only the whites becoming silvery and blurred?

Increase the brightness with what?

With the brightness control of course!

There's no "of course" about it. If the brightness control increases the brightness of the raster, but the contrast control causes the picture to become negative or silvery, there is a goodly chance that the video stage is at fault and is unable to cope with large signal swings, again due to the valve or transistor or more likely to defective resistors associated with it. If however the brightness control turns the picture negative or silvery, the tube itself is far more likely to be at fault, for one of two reasons. Either the cathode surface has become coated and is unable to release its full quota of electrons, in which case it can probably be reactivated for an indeterminate period by overrunning the heater and passing a relatively large current between the cathode and grid (by applying a positive voltage to the grid whilst holding the cathode at chassis potential). This will break up the hard coating on the cathode. Or the cathode coating has been worn away, which means a new or rebuilt tube.

One should beware however of possibly similar symptoms being present due to the tube's first anode voltage being low or absent. Whilst in a monochrome tube this condition usually results in a severe loss of brightness, so that there's little chance of confusion, the result in a colour tube can be misleading even to an experienced engineer, and it may not be until voltage readings are taken that the cause of the "flat" picture becomes apparent.

Loss of First Anode Supply

What is likely to cause loss of the first anode supply?

In valve or hybrid sets the supply is derived from the boost line. There will be a resistor from a point in the line output stage, decoupled by a capacitor rated at 1kV or so. This capacitor is suspect as is the resistor, particularly if the capacitor is found shorted. The arrangements differ a little in all solid-state chassis.

Which other "services" could be affected by such a fault in a hybrid receiver?

The height of the picture could be affected since the supply to the field charging circuit is derived from the boost line in receivers using valves. Less obviously, the focus may be affected.

Surely this sort of fault would result in extra loading on the line output stage, so that the e.h.t. would be affected?

Not necessarily, since the supply from the boost line is taken via a high-value resistor of between say 100kΩ and 200kΩ and if this value holds the current is limited. If the resistor overheats, it could change its value and if this occurred downwards the line output stage could then show signs of distress.

Tube Defects

Wait a moment! We'd like to know a little more about tube defects, since a fair amount of money is involved here. What is the most common tube defect, and how does one recognise this and others and, just as important, what can be done about them other than tube replacement?

If you'd been reading your past issues of *Television* a little more carefully, you wouldn't have to ask!

As we've said, when the tube's cathode becomes coated its ability to emit electrons is impaired. This is the most common complaint, affecting monochrome and colour tubes alike. Since a monochrome tube has only one gun (one electron-emitting cathode and a control assembly) the symptoms are easier to recognise.

When the current demand is low, i.e. the picture is dark, the display may appear to be acceptable. When extra beam current is called for, i.e. there's a bright scene, the cathode will be less able to supply the current required and the result will be a flat picture with pearly whites, perhaps inverting to a negative picture as the condition worsens. This may be accompanied by blurring, as the presence of even a slight amount of gas in what should be a hard vacuum will be sufficient to impede the reduced supply of electrons struggling to reach the tube face and illuminate the screen.

As far as colour tubes are concerned, the issue is complicated by the presence of three guns, since these can loose emission at a differing rate. The effect is not so obvious therefore, and may show up as an incorrect grey scale, altering as the brightness is increased so that it's impossible to set the three guns to give an acceptable black-and-white (more strictly grey) picture at all brightness levels.

The remedy, apart from tube replacement, is either to increase the heat of the tube's heater (what will they think of next?) by fitting a transformer with say a 20% boost tapping, or more elegantly by reactivation (see past issues for such a unit design or adverts for made up units) which gives the cathodes a new lease of life. Generally speaking colour tubes accept such treatment better than monochrome ones, probably because the original cathode coating of emitting material is thicker or, rather, was.

Probably the first obvious indication of failing emission in a colour tube is that a degree of flaring occurs on bright areas.

Other and less common defects include open-circuit electrodes, partially shorted heater elements, and leaks or shorts between electrodes.

Briefly (as we didn't intend to get immersed in this subject at this stage), the most common example of an open-circuit electrode is where a very dim raster is displayed with perhaps a vestige of picture information on it, with the tube not responding to the controls (brightness mainly). Voltage checks at the tube base may show that there's a variation of voltage between the grid and cathode, but that this variation is not producing the required variation of tube emission. Tapping the tube neck may produce a temporary seal, showing as a flash, or even restoration of full control, though this is unlikely to be lasting. Attempts to weld the break by applying a high pulse voltage between the grid and cathode can sometimes be successful, but only sometimes.

A partial short in the heater element results in only part of it being active, with consequent loss of cathode heating thus producing identical symptoms to a low-emission tube which of course it is. Again, tapping the tube neck may clear the short for a limited period.

Leaks or shorts between electrodes produce various symptoms such as an uncontrollably bright raster when the leak occurs between the grid and cathode or where the cathode shorts to the heater (more common, as the heater element is contained within the cathode "tube" as it were). The latter condition can be accepted if the tube heater can be divorced from the original circuit and supplied instead from an isolating transformer with little capacitance between its windings.

So there's a rather curtailed résumé of tube defects, just to help you on your way.

Can we get back to fault localisation? We have a dark or no picture condition due to lack of voltage at the first anode pin on the tube base. We have checked the boost voltage, the feed resistor and the decoupling capacitor but the voltage is still low. What could be the reason?

There could be a leak in the panel material in the region of the resistor and decoupling capacitor, but the more likely reason would be obvious if the tube base is removed and the voltage then returns to normal (make it quick but careful), thus taking us back to an interelectrode leak in the tube...

Before leaving tube faults there's another small point which is well worth bearing in mind. Many monochrome tube sockets have a little metal ring running round the plastic. It skirts the pins closely enough to act as a spark gap, and is brought out to earth at one point. Deterioration of the plastic can result in the ring touching one particular pin, perhaps intermittently, thus robbing it of its potential. This could be the explanation for low first anode voltage or quite a number of mysteries.

Lack of Height

A few moments ago you stated that the boosted h.t. from the line output stage also feeds the field charging circuit in most valved receivers. This seems to imply that lack of height (reduced vertical scan) can originate outside the field timebase itself.

Yes, but it's prudent to examine the displayed picture carefully before jumping to conclusions. If the height control is operated, it should reduce the vertical size evenly, leaving equal gaps at the top and bottom. If the fault produces this effect, it's a fair bet that the trouble is either in the supply to the height control from the boost line, in which case the fault may be nearer physically to the line output section than the field timebase, in the height control itself, or between the height control and the field oscillator.

Apart from the height control itself (which could well have a dud spot on it, which adjustment would prove) the suspect items are the resistors involved, which do tend to go high (in value), and any decoupling capacitors associated with the resistors, particularly if these are of the electrolytic type (there's normally only one). These tend to leak, thus providing a shunt path to chassis for the supply voltage.

Disconnecting the suspect capacitor and checking the value of the resistors takes no time at all. The trick is to locate these items if the set is unfamiliar.

There may also be a VDR (voltage dependent resistor) associated with the supply. This can usually be ignored. It can be spotted by its appearance – the size of a resistor, but with completely different colouring, perhaps having a yellow body with a blue end or green with a red end (depending upon where it's connected and the voltage at this point), though there's a wide variety of types. VDRs very rarely give trouble, and to suspect them is usually unfounded.

If the set is unfamiliar and information is lacking, find the height control and follow the tracks away from this. The valve itself can be responsible for this condition, due to loss of emission.

Uneven Loss of Height

Is loss of height which is not even unlikely to originate outside the field timebase then?

As far as valved timebases are concerned, generally yes. You could say that field compression, be it bottom (more common) or top, is an internal affair within the field timebase.

Bottom compression should first direct attention to the electrolytic capacitor associated with the output valve's cathode bias. This normally has a value in the region of 100-200μF, with a working voltage of 25V or so. We direct attention to this item first not only because it is the most likely offender but also because it is very easily checked – simply by temporarily connecting another one of similar rating across it.

The next suspects are the valve itself (normally a PCL805), the cathode bias resistor which may have fallen in value, the preset overall linearity control (sometimes marked "main lin"), or a capacitor in this or the control grid circuit. Less likely items include the thermistor in series with the field scanning coils on the tube neck.

Top compression is less common and should direct attention to the cathode bias resistor (may have increased in value), any resistor (other than a VDR) connected across the primary winding of the field transformer (may have fallen in value, thus damping the transformer), and again the preset linearity controls and associated capacitors.

No Field Scan

What if the lack of height is total, i.e. there's only a white line across the screen?

First observe whether the line is straight or curved. This is important from a fault location point of view.

If the line has a distinct curve, the trouble is unlikely to be in the field timebase proper. It's far more likely to be associated with the field scanning coils on the tube neck. These and the series thermistor should be checked. It's unusual to find the thermistor at fault but, since the two slabs of the field coils are in series, a break in one results in complete non-operation except for a small amount of inductance which accounts for the wavy aspect of the horizontal line.

If the line is straight however the fault is more likely to be in the timebase itself. Voltage checks here should reveal the cause of the fault without too much ado – showing whether the output section, the oscillator or both is/are at fault.

Does this mean that the field scan coils are at fault only when there's a curved white line across the screen?

No. This symptom is present only when one section is open-circuit. This is obvious, since they are connected in series and any break in a series chain puts the lot out (as with fairy lights). Some coils are shunted by resistors however, and this may allow a small current to flow thus opening up a very small part of the raster where the coils are not broken.

The coils can also develop shorted turns, in which case the slab affected will cause compression at that part of the screen. This is not very common, but it does happen. And since it's not very common much time can be spent chasing the fault in the actual timebase when it's not there. So don't forget!

Line Scan Coil Faults

Can this sort of thing happen to the line scan coils? If so, is the effect similar?

The line scan coils are usually connected in parallel, which means that one slab can operate when the other doesn't. Since they affect one another however the effect is not quite what one might expect when one slab (say the lower) becomes open-circuit. One might expect the result to be that the top half is of normal width but the lower is only a thin white vertical line. In fact the effect is a V-shaped raster, since the top slab still has an effect on the scan in the lower half, albeit a diminishing one.

What about shorted turns?

The line output stage is a highly efficient circuit which doesn't take kindly to damping of any sort. Thus shorted turns in the scan coils have the same effect as shorted turns in the line output transformer. In the majority of cases, the effect is to reduce the e.h.t. to a low figure as well as causing a drastic drop of scanning efficiency. The usual outcome is overheating in the line output stage and no picture.

Disconnecting the line scan coils should then (the effects differ according to the design) relieve the excess loading and restore some life to the line output stage – perhaps enough to produce a bright vertical line down the screen. We cannot be definite about this (the effect of disconnecting the coils) as the result depends upon the type of circuit used.

Colour Receiver Project

Part 7

Luke Theodossiou

The tube assembly

THIS month we are covering the c.r.t., its degaussing arrangements and the base panel assembly. The degaussing coils can be attached to the c.r.t. prior to its installation in the cabinet, but it's up to the constructor whether he wishes to adopt this course.

The RCA PIL tube chosen for the project comes in two sizes – 56cm (22in.) and 67cm (26in.). All our prototypes were fitted with 26in. tubes, and the cabinet design we will be showing next month will be suitable for this size. If you're likely to incorporate the teletext option in the set we recommend using the larger tube size – on the grounds of text legibility – though in most average sized living rooms a 22in. set is likely to be more convenient.

The Tube/Yoke Assembly

The complete tube assembly includes the tube itself, the Precision Static Toroid (PST) self-converging yoke, which is permanently bonded to the neck of the tube, and an assembly of permanent magnets for purity and static convergence. The degaussing shield is incorporated within the tube, which has quick-heat cathodes. The additional convergence correction required for the 110° version of the tube we're using is provided by an integral quadrupole yoke winding which is driven by the field scan current. The circuit of the deflection yoke is shown in Fig. 1: note that the two preset controls are adjusted by the tube manufacturer and must *not* be tampered with.

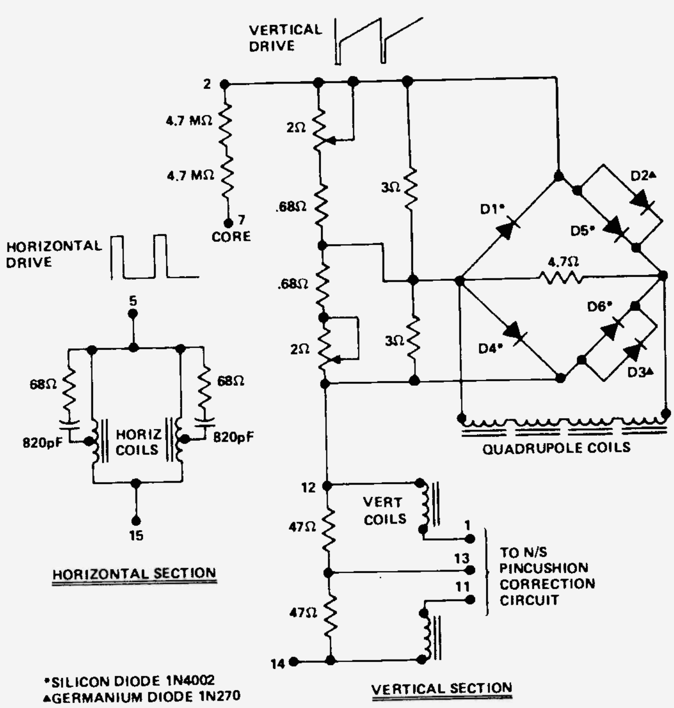


Fig. 1: Deflection yoke circuit.

An assembly of three pairs of magnets on the tube neck provides static convergence and purity adjustment: the assembly is preset and sealed at the factory for optimum performance.

In terms of installation, the tube assembly can be considered as a single unit, with the advantage that the yoke and the rest of the components are already aligned for the particular tube and permantly fixed. It's worth emphasizing that none of these components should be tampered with – this can result only in reduced performance, and invalidation of the guarantee.

The locations of the various connecting terminals on the yoke assembly are shown in Fig. 2, and will be referred to again when the main interconnecting diagram is given in a later part. The tube base pin configuration is shown in Fig. 3.

The Tube Base Panel

The design of the tube base assembly is critical if damage to the driving circuitry is to be avoided during flashovers. It was decided therefore to use the readily available assembly from the Thorn 9600 chassis – the part number is 90V6-893-001. In addition to the tube base, the assembly contains on a p.c.b. the resistors required in series with each electrode, the associated spark gaps, and the focus control unit. The p.c.b. clips into a protective moulded cover which prevents contact with the foil side of the board.

Unfortunately the connectors and wiring on this board are not compatible with our design, so some alterations are required. First, remove the three individual brown connectors on the red, green and blue video ribbon cable, replacing them

Table 1: C.R.T. and attachment part numbers

Reference	*Quantity required*	*Description*	*Part/type number 56cm tube*	*67cm tube*
1	1	C.R.T.	A56-611X	A67-611X
2 and 3	2	Ring coils	58515-00	58514-00
4	4	Double attachments	66406	66410
5	8	Single attachments	66405	66405
6	2	Strain buckles	58314	58314
7	1	Earthing braid assembly	58313	58313

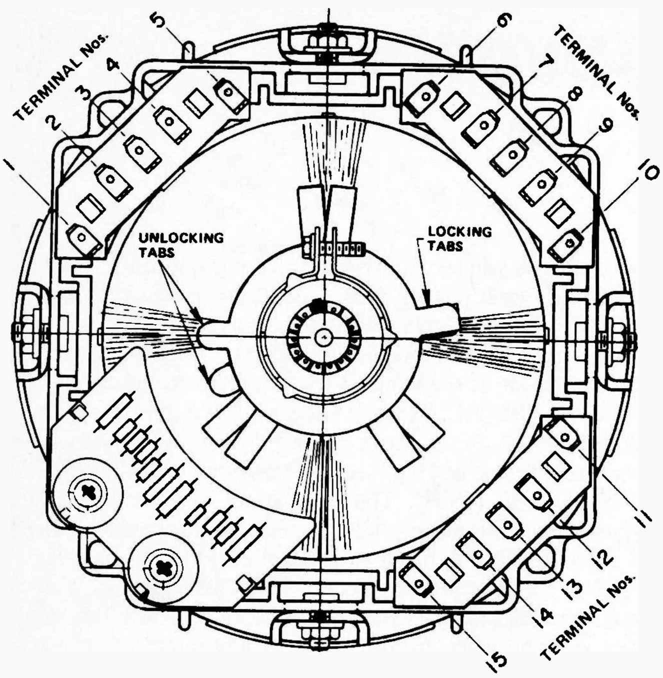


Fig. 2: Deflection yoke terminals. The numbers correspond to the circuit diagram shown in Fig. 1, i.e. the line scan connections are to pins 5 and 15, the field scan connections to pins 2 and 14, with the pincushion correction applied to pins 1, 11 and 13. The other pins are internally connected.

Pin 1: Grid No.3
Pin 3: Cathode of Blue Beam
Pin 4: NC
Pin 5: NC
Pin 6: Heater
Pin 7: Heater
Pin 8: Cathode of Red Beam
Pin 9: Grid No.1
Pin 10: Grid No.2
Pin 11: NC
Pin 12: Cathode of Green Beam
Pin 13: IC (Do Not Use)
Cap: Anode (Grid No.4, Screen, Collector)
C: External Conductive Coating

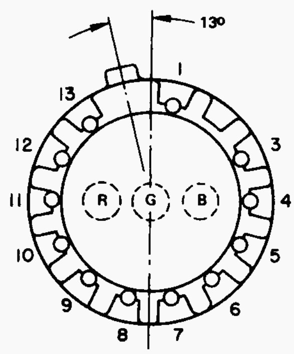


Fig. 3: Tube base connections.

with a single three-way 0·2in. Molex connector. Then remove from the p.c.b. all the wires that terminate at the white moulded socket – the wire length is insufficient. Replace with new wiring, except for the blue wire which was anchored to a terminal marked REF (next to resistor R461) – the lead goes to the width/height compensation circuit in the Thorn 9600 chassis, and is not required in our design.

Constructors now have sufficient information to terminate these wires correctly on a six-way Molex connector (only five connector pins are actually used). Alternatively, those who are a little uncertain could wait for the interconnection diagram we will be showing in a later part.

The focus input lead to the assembly cannot be changed since it disappears inside the focus control itself. Take care therefore when deciding where to mount the timebase board in the cabinet to allow this connection to be made to the focus tap on the tripler (this is the tag connector half way along one side – connection is made simply by pushing the lead connector on to the terminal). If extending the lead is unavoidable, we suggest using a length of e.h.t. cable, placing a piece of the outer sheath over the soldered joint and taping this in place – remember that there are 8·5kV pulses here!

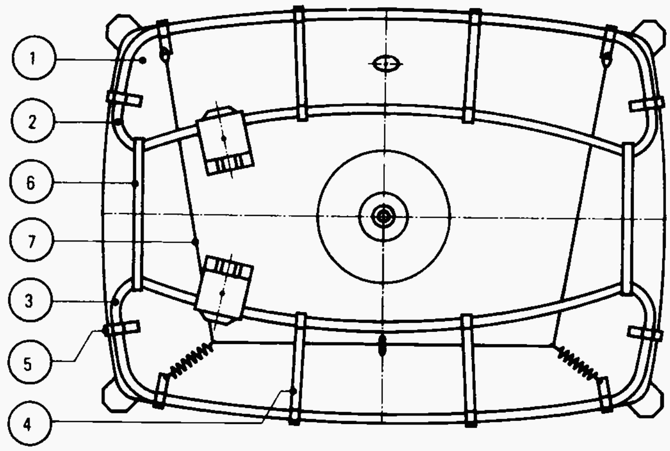


Fig. 4: Mounting the degaussing coils. The encircled numbers refer to the items listed in Table 1.

The Degaussing Arrangements

The use of an internal degaussing shield considerably simplifies the degaussing arrangements. All that's required are two ring coils connected in series, together with the necessary attachments. All these components are manufactured by Orega and are listed in Table 1.

The –00 suffix on the ring coil part numbers indicates wire output leads, which may be soldered directly to the Molex socket terminals which mate with connector C on the power board. Ring coils with a –40 suffix indicate that the leadouts are terminated with 0·25in. push-on terminals mounted in a moulded plastic block – in this case separate wiring is required, and should terminate on mating 0·25in. push-on connectors which must be of the insulated type (i.e. with plastic sleeves fitted).

Fit these components to the tube in accordance with Fig. 4. The circled numbers refer to the reference numbers given in the first column of Table 1. Slots for the plastic attachment clips are provided in the tube's metal Rimband, so no difficulties should be experienced.

Once this has been done, connection must be made between the earthing braid and the tube base board. Use two separate lengths of 20A cable (50 strands x 0·25mm), which must be soldered to the two terminals provided on the braid. The other ends of the cables are terminated with insulated 0·25in. receptacles which push on to the twin 0·25in. blades (earthing butterfly) next to the focus control on the c.r.t. base panel.

Matters Arising

We have received several requests for details of the pin connections to the BF469 transistors used in the RGB output stages. Looking at the metal heatsink side of the transistor, with the pins pointing downwards, the base is on the left, the emitter on the right and the collector is the centre pin.

In the components list for the timebase board, given in the March issue, many of the capacitors were specified as Siemens types. These are the ones that will fit in the positions allocated on the board. Constructors should obtain them from components suppliers however and not apply to Siemens direct since they are not able to deal with small quantity orders.

Long-Distance Television

Roger Bunney

THE first month of 1979 produced a sprinkling of most sorts of long-distance v.h.f. signals – and more than a sprinkling of snow and ice. The most notable event was a small but intense F2 opening on the morning of January 14th. By chance, Hugh Cocks was paying me a visit at the time, whilst on his way to his new home in East Sussex. The opening lasted from about 1045 until 1220 and, fortunately, being a Sunday morning several other enthusiasts saw the two ch. R1 signals present. Both seem to have originated from Eastern Russia, one the TSS-1 service and the other a somewhat weaker TSS-2 service showing the familiar 0249 test pattern. Some correspondents felt that one of the signals may have come from China, but the signal content observed here in Romsey definitely suggests Russia.

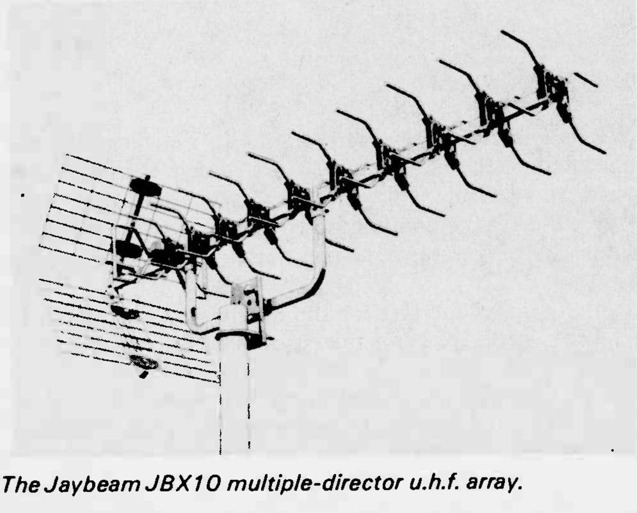
There were several Sporadic E openings during the month. On January 2nd there were two Russian signals on ch. R1 and a strong Finnish (YLE) signal on ch. E2 from 0820-0950. Auroral enhanced Sp.E is thought to have been responsible for the strong Iceland (RUV) signal on ch. E4 seen by Kevin Jackson and Ray Davies (Leeds) during the period 2200-2245 (the PM5544 test pattern was being transmitted). On the 15th they noted Sp.E signals from RAI (Italy) on ch. IA, RTP (Portugal) and RTVE (Spain) on ch. E3, and TSS (Russia) and TVP (Poland) on ch. R1 during the late morning. There were also unidentified signals.

The January Quadrantids produced strong signal pings on the 3rd, and congratulations are due to Mike Allmark (Leeds) who received strong pings from YLE and SR (Sweden) on ch. E7 during the afternoon period. Our Leeds correspondents also report that a weak Aurora on the 7th produced BBC-1 signals from Scotland.

In Australia, BBC-1 sound and vision and TDF (France) ch. F2 have been received on several occasions. Anthony Mann reports possible reception there of Shirwaz, Iran ch. E2 on December 17th via F2.

A calculation suggests that the Sunspot maximum in the present cycle will occur this November, and with a December average count of 119 (peak day December 12th, with 188) the peak could well equal the record 1957-9 period.

We have been waiting for further information on the possible reception of Australian TV in the UK by Kevin Jackson. You will recall that on November 19th Kevin noted a 625-line blank carrier plus audio tone at 46·25MHz and 51·75MHz respectively, corresponding to the Australian ch. 0. Australian friends have suggested that the only transmitter likely to be on at the time with after programme close tests would be ABMNO Wagga Wagga, NSW, and the type of transmission received does closely follow ABMNO's after programme close test signals. The time was 1246-1248 GMT (2346-2348 in NSW). The only other ch. 0 stations, the commercial TVQO and ATVO, were on programme at the time. ABMNO also has an ABC outlet that closes earlier. A more recent letter suggests that the Wagga Wagga transmitter officially closed down at 1230 GMT that night however. Enquiries are now being made direct to the transmitter. Reg Roper (Torpoint) also noted the signals, but was unaware of their significance at the time. Any further news on this front will of course be passed on.



The Jaybeam JBX10 multiple-director u.h.f. array.

Meteor Showers – 1979

April Lyrids	April 19-24th, peaking April 22nd.
May Aquarids	May 1-8th, peaking May 5th.
June Lyrids	June 10-21st, peaking June 16th.
Capricornids	July 10 – Aug 15th, peaking July 26th.
Perseids	July 25 – Aug 18th, peaking Aug 13th.
Orionids	Oct 16-26th, peaking Oct 21st.
Taurids	Oct 20 – Nov 30th, peaking Nov 8th.
Cephids	Nov 7-11th, peaking Nov 9th.
Leonids	Nov 15-19th, peaking Nov 18th.
Geminids	Dec 7-15th, peaking Dec 14th.
Ursids	Dec 17-24th, peaking Dec 22nd.

Our thanks to Keith Hamer and the British Astronomical Association for providing this information.

News Items

Swaziland: A single u.h.f. channel is in use, with colour. There are two 40W Pye transmitters, and plans for microwave links to receive programme material from neighbouring countries. Most of the programme material originates from a Sony U-matic VCR – up to five hours nightly. A Philips camera and telecine provide local facilities.

Afghanistan: The new service is limited to a 50km radius of the capital, Kabul. There are plans for a microwave link to Mazar-i-Sharif.

Argentina: The start of colour transmissions, using the PAL-N system, is planned for early next year.

China: For the benefit of our Australian readers we pass on the news that the often received Harbin ch. R1 station has been renamed Heilungkuang. It relays the Central TV programme on Tuesdays, Thursdays and the week end, local programmes on the other days.

India: A conference at New Delhi has decided that 1GHz TV broadcasting from a satellite is feasible: a request for frequency allocations will be made to the WARC at Geneva. The new satellite TV service is planned to come into operation in 1981, at both u.h.f. and s.h.f.

Rhodesia: Hugh Cocks has received a letter from the Rhodesian Broadcasting Authority pointing out that Gwelo ch. E2 operates with a 10kHz offset to minimise possible co-channel interference – with Kenya presumably. The checkerboard pattern is transmitted at the following times: 0700-1430 Mondays, Tuesdays and Thursdays; 1200-1430 on Wednesdays; 0700-1100 Fridays and Saturdays. All times GMT.

From Our Correspondents . . .

Brian Williams (Llandough, Penarth, South Wales) is currently modifying a Thorn 950 chassis for DX use. Brian has an inbred reluctance to buy anything when suitable junk is hanging around, and in consequence has come up with an interesting valve aerial amplifier (see Fig. 1) which he reports works wonders when preceded with a Band I notch filter. The PC88 operates in the grounded-grid mode, with the input to the cathode. It occurs to me that an older valve u.h.f. tuner could be used in this way, but with both stages converted to Band I amplification following Brian's circuit: this would provide a narrow-band preamplifier with very high gain. If the circuit is carefully arranged, it might be possible to use the

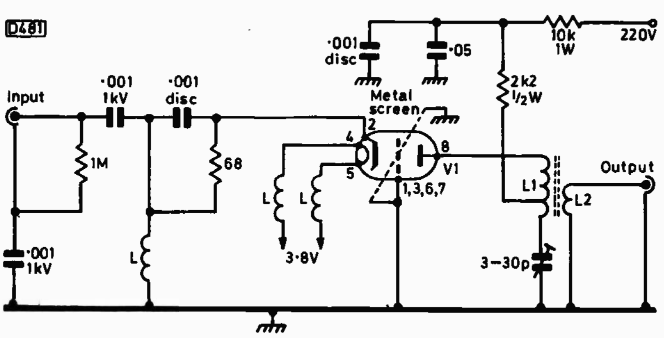


Fig. 1: Band I aerial preamplifier circuit using a PC88 or similar valve. The layout is not critical, but a metallic screen should be inserted across the valveholder to separate the input and output. The r.f. chokes L are 28 s.w.g. enamelled wire, close wound, air cored and self-supporting, approximately 15 turns (not critical). L1 consists of 11 turns spaced over ¾in., tapped at 8 turns, wound on a ¼in. diameter polystyrene former with dust core. L2 consists of two turns of insulated connecting wire wound over the centre of L1, with twisted output leads. The aerial safety components shown are required only if the unit is connected to the aerial directly. The trimmer is a Philips beehive type. Output to tuner via coaxial link.

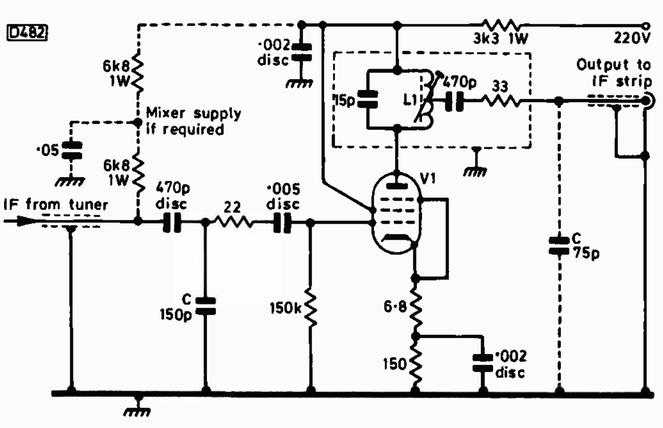
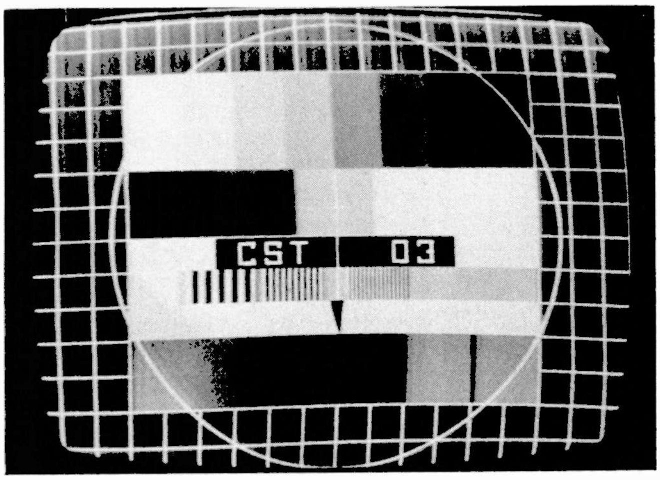
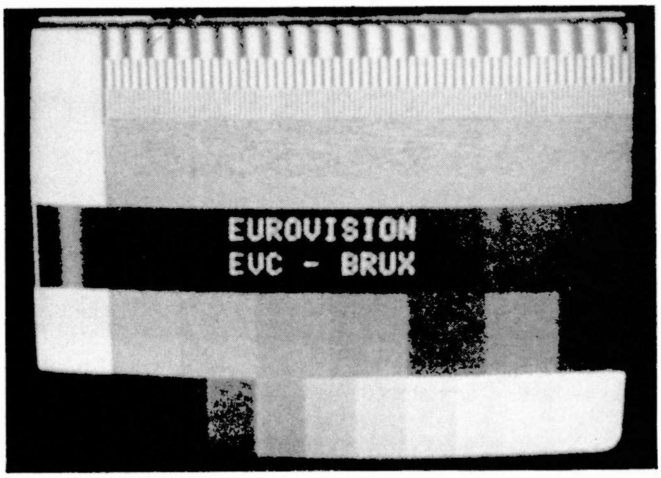


Fig. 2: 36MHz i.f. amplifier for connecting between the tuner and the i.f. strip. Most v.h.f. tuners have a series tuned output circuit which also feeds h.t. to the mixer. Any r.f. pentode, such as an EF91, EF80 or 6AG5 can be used. L1 consists of 12 turns of 26 s.w.g. enamelled wire close wound on a ¼in. former with slug tuning and screening can, tapped half way. Due to different input and output circuits, the values of the capacitors marked C may have to be altered. The above values will work with post-1963 sets! Some early tuners have link outputs: in these cases, a matching input transformer will be needed, increasing the risk of instability.



The Fubk test pattern being radiated from Prague on ch. R24. Photographed by a reader living in Czechoslovakia.



Test pattern received at Cork via the OTS-2 satellite, relayed from the Fucino (Italy) ground station.

original tuning gang to tune the Band I coil(s) over the ch. E2-4 spectrum. Certainly the heavy metalwork would be ideal for stability and screening. The i.f. valve preamplifier circuit (Fig. 2) is also basic, easy to make and cheap, and should bring a smile to the faces of more traditional readers weaned on EF80s and the like.

Hugh Cocks has now moved to East Sussex and is currently using the familiar omni-X array and an Antiference MH308 combined Band I/III export aerial. Hugh previously lived only two miles from the Stockland Hill transmitter, but his new site is some 60 miles from any group A and B transmitters and over 20 miles from the local group C/D transmitter. V.H.F. transmitters are similarly distant – in fact the local is now Lille, ch. F8a. Other signals present all the time at noise level are NOS (Holland) ch. E5/7, BRT (Belgium) ch. E11, West Germany ch. E9 and CLT (Luxembourg) ch. E7. No u.h.f. arrays have been tried yet, but I'd expect rather more "noise-level" signals from a radius of some 300 miles. I'm sure we all wish Hugh every success at his new location.

Commercial Corner

A catalogue for the Optimax range of Band I, III and u.h.f. aerials has arrived from Eastern Antennae of 87 Norwich Road, Ipswich, Suffolk. Of particular interest is a 20-element Band III aerial (16 directors plus folded dipole and a three-element reflector). It's a narrow-band type with a forward gain of 15·5dB, a front/back ratio of 23dB and a 30° forward beam width at the −3dB points. This is the longest Band III system I've seen.

The Dutch company Schrader Electronics of Amsterdam introduced a varicap tuned masthead u.h.f. amplifier some years ago. This was quite successful, particularly due to its selectivity which gave good discrimination against strong local signals. Ryn Muntjewerff reports that a Band III version covering chs. E5-12 has now been introduced. I'll report further on this unique amplifier when I've had a chance to test one.

Satellite Reception

Readers of this column will be well aware of Steve Birkill's expertise with satellite reception, which started when he was the first to receive video signals from the ATS-6 satellite then broadcasting to the Indian sub-continent as part of the SITE experiment. The next step was from the 860MHz used by ATS-6 during the SITE experiment to the higher frequencies (3·5-4GHz) used by certain Russian satellites to relay programmes to Eastern Russia, and signals were again successfully resolved. The latest development follows the successful launch of the OTS-2 satellite, which transmits beacon and test TV transmissions to Europe at 11·6GHz. Last month we reported that Steve had successfully received these signals on his home-built equipment, an incredible achievement. Steve describes his basic s.h.f. receiver (see Fig. 3) as follows:

"A single diode mixer was built around a 10dB directional coupler, in triplate stripline, with an integral i.f. (u.h.f.) head amplifier. This is fed by a one inch circular waveguide and scalar horn." The mixer diode is a Hewlett-Packard 5082-2207. As the beam width of the dish aerial is 0·7°, the video monitoring equipment was taken to the dish so that alignment could be carried out. The installation was checked and first switched on on Thursday, November 2nd, at 1700. The aerial was aimed at azimuth 166°, elevation 28°, and the CL8390 local oscillator Gunn diode tuned across the band. There was something there first time – video information with a signal-to-noise ratio of 13dB, on the OTS ch. P1, with horizontal polarisation – or rather +20° clockwise of horizontal. The

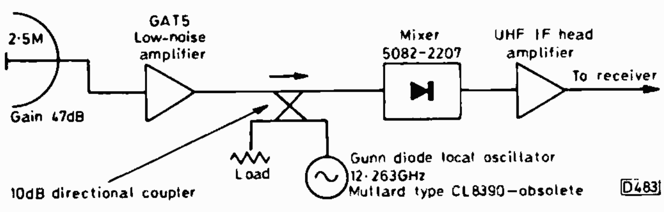


Fig. 3: Steve Birkill's head-end electronics for reception from the OTS-2 satellite.

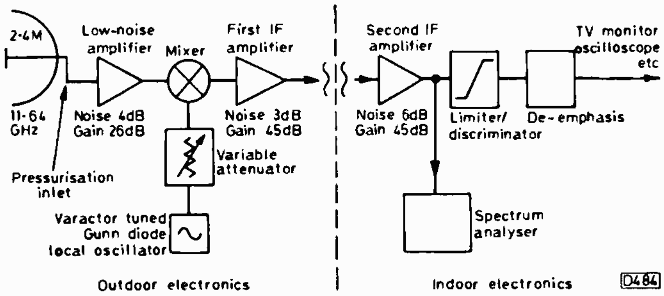
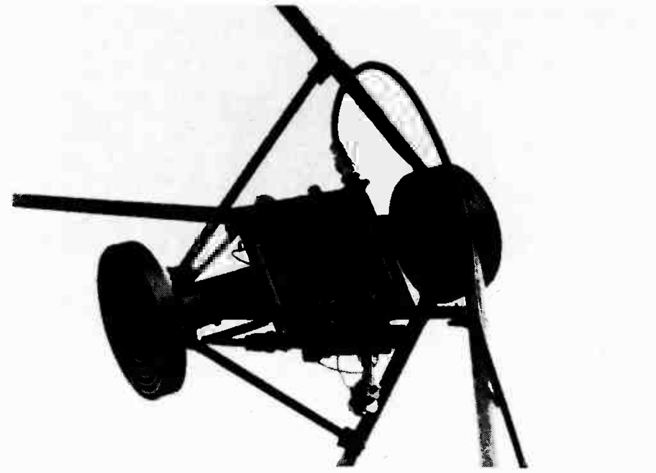


Fig. 4: Block diagram of the University College, Cork receiver for use with the OTS-2 and Sirio satellites.

satellite's vertical transmitter on the same frequency was at the time carrying video and syncs, with a colour burst and VITS. Tests were carried out, and the gear dismantled at 2215. The video deviation was established as being 25MHz, with pre-emphasis.

Further tests were carried out on the following day – when a short burst of the PM5544 test pattern appeared! Further improvements have included the use of a Plessey GAT5 gallium-arsenide f.e.t. as a low-noise head amplifier. An illustration in last month's column showed the quality of the reception. Considering that the installation was home-built, aligned and tested, all credit is due to Steve for his success in this demanding field – remember that it involves measurements of parts of a millimetre, the overall size of a half-wave dipole at these frequencies being little more than 2·5cm.

The Department of Electrical Engineering at University College, Cork, has been similarly active. Work has been going on for some four years, the aim being to test various theories and techniques in the low-noise amplifier and microwave propagation fields. Much of the measuring and receiving equipment was already available, and work has in recent months been carried out in connection with both the OTS-2 and Sirio satellites. The main effort recently has been directed at receiving channel 4 (11·64GHz). Signals and test charts were first received on October 19th, and have since been received on a daily basis. The accompanying photograph shows the good quality of the pictures. The Department comments that video noise is currently thought to arise mainly due to restricted i.f. amplifier bandwidth and local oscillator f.m. noise – further investigations are being made. The Department hopes that its work will enable compact, efficient and cost-effective receiving units to be developed. Our thanks to University College for the information supplied (via Paul Duggan). We'll be passing on any further information we receive on work in this field.



Close-up view of S. Birkill's 11·6GHz head unit, mounted at the focus of an 8ft. dish.

DECCA CTV19

The trouble with this set is lack of field scan at the top and bottom of the screen. Neither valve replacements nor adjustments to the presets in the field timebase improves matters.

The most likely cause of the trouble is over on the line output stage chassis, where the *RC* network R405 (1MΩ, 1W) and C403 (1μF) filters the supply to the field charging circuit. If necessary check R308 (470kΩ), which is in series with the height control. If the linearity is impaired, suspect the electrolytics associated with the field output stage – C308 (32μF), C311 (400μF) and C327 (400μF) – also the field output pentode's cathode bias resistor R314 (470Ω, 5W).

GRUNDIG 6011

The trouble with this set is pincushion distortion, with the top of the raster bowed down and the bottom bowed up. I'm not sure whether there is any adjustment for this, as the lettering seems to be in German.

There are three adjustments provided to deal with this, north-south amplitude (NSA), north-south phase (NSP) and north-south symmetry (NSS). The three controls are on the main panel, to the right of the c.r.t. neck when you look in the back. If adjusting these controls doesn't provide correct raster geometry, check for dry-joints on the controls and nearby wound components and check C475 (0.27μF) which could be defective.

INDESIT T24EGB

The screen went black, except for a few streaky lines like ignition interference, whilst viewing. We thought that the transmitter may have gone off, but on changing to another station the screen went completely blank. The e.h.t. rectfier is a stick type, and a.c. sparks can be obtained at either end after making contact with a screwdriver. The line timebase valves have all been replaced, but there is still no picture. I suspect the line output transformer, but as this is expensive would welcome your opinion.

If you find that there's a negative voltage swing of around –50V at one end of R425 (i.e. at the PL504's control grid) this denotes the presence of line drive and the line output transformer probably does have shorted turns. First however see whether a neon tester lights up when placed near the transformer with the e.h.t. rectifier disconnected. If so, the e.h.t. stick rather than the transformer is likely to be the cause of the lack of e.h.t.

TEST CASE

196

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 Bush monochrome receiver fitted with the A774 chassis had given several years' service without any trouble. The fault "no raster" had then occurred. All valves and the tube were alight, and the sound was unaffected. A likely cause seemed to be no e.h.t. voltage, so the technician concerned started making checks in the line output stage. Quite a fair arc could be drawn from the PL504 line output valve's anode connector with a screwdriver, indicating the presence of pulse voltage at this point, and a subsequent test showed that there was e.h.t. at the tube's final anode. This was below the correct figure, but was judged to be not so low as to be the cause of raster failure.

The tube biasing was next checked, by means of voltage measurements at the grid and cathode. Video drive seemed to be present at the cathode, since the mean positive voltage here (relative to chassis) was varying in sympathy with the video signal. There was also a positive grid voltage, which could be varied normally by operating the brightness control. The high-resistance testmeter was then connected between the grid and cathode, and gave a fairly conclusive indication that the tube's biasing was in order.

At this point the technician decided that the tube had expired due to loss of emission, and as a tube tester was not at hand he changed the tube. Sadly however the symptom remained.

What did the technician overlook, and what other test should have been made before suspecting the tube? See next month for the solution and another item in the series.

SOLUTION TO TEST CASE 195

–Page 272 last month–

It will be recalled that the problem was inadequate width in a colour set fitted with the ITT CVC5 chassis, that there was inadequate voltage at the control grid of the line output valve, and that the customer reported that the fault had occurred suddenly. Lack of width due to valve trouble rarely if ever occurs suddenly – it's much more likely to develop slowly over a number of months as the valve's emission falls. Similarly change of value of a resistor in the width circuit – a common cause of lack of width in valve line output stages – would be unlikely to occur suddenly. Much more likely was a defective capacitor in this area, and on making checks the 0.0022μF capacitor C300h turned out to be faulty. This capacitor provides decoupling in the width control network.

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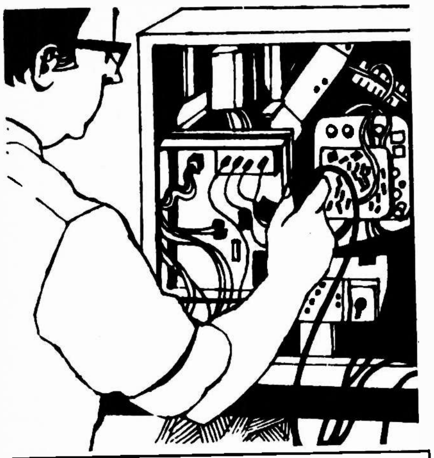

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