APRIL 1979

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TELEVISION

SERVICING·VIDEO·CONSTRUCTION·DEVELOPMENTS

Servicing the ITT CVC20 SERIES CHASSIS Part 1

RANK Z504 SCAN DRIVE PANEL

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PHD COMPONENTS

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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
BC1821 Transistor	0.10
BC183 Transistor	0.10
BC183L Transistor	0.10
BC184L Transistor	0.10
BC184S 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
TIP2955 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 811 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
SL9018 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	0.75
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
6/3012 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

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

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

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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.

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.

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	0.1B
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
8F198	0.11
BF199	0.14
BF200	0.28
BF216	0.12
BF217	0.12
BF21B	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
8FY55	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.

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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.

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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Ready built and tested (less batts) but inc. V.A.T.	**£13.95**

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- ★ PLUG-IN I.Cs AND SENSITIVE SYNC PICK-UP CIRCUIT
- ★ FUNCTIONS TO FULL PROFESSIONAL AND COMMERCIAL REQUIREMENTS
- ★ FOR PROMPT, NO DELAY DELIVERY
- ★ IN KIT FORM OR READY-BUILT, TESTED AND GUARANTEED

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Telephone (03708) 5543.

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Westcliff-on-Sea, Essex SS0 9DF.
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Postage and Packing 70p

All Lopts NEW and GUARANTEED for SIX MONTHS

WE ALSO SUPPLY SEPARATE WINDINGS FOR THE FOLLOWING COLOUR L.O.P.T.S
Pye 691 or 697 Chassis.

Bush CTV25 Mk. 1–2–or 3

Decca CTV 25 Non-Tripler Version.

Philips G.6 Single or Dual (Overwind for this Model on Exchange Basis Only).

Philips K.70 Underwind Only.

EMO 90°

COMPLETE L.O.P.T.S
Philips G.8, ITT C.V.C. 5-9 and Decca Bradford.
Prices for the above Colour L.O.P.T.S and Windings on application.

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

Type	Price (£)
AU103	2.40
AU107	2.75
AU110	2.40
AU113	2.60
BC107*	0.16
BC108*	0.15
BC109*	0.16
BC113	†0.22
BC114	†0.22
BC115	†0.24
BC116*	†0.25
BC117	†0.30
BC118	†0.24
BC119	†0.34
BC125*	†0.30
BC126	†0.30
BC132	†0.20
BC134	†0.22
BC135	†0.21
BC136	†0.22
BC137	†0.30
BC138	†0.35
BC140	0.36
BC141	0.44
BC142	0.35
BC143	0.38
BC147*	†0.12
BC148*	†0.12
BC149*	†0.13
BC152	†0.42
BC153	†0.38
BC154	†0.41
BC157*	†0.13
BC158*	†0.12
BC159*	†0.14
BC160	0.62
BC161	†0.58
BC167B	†0.15
BC168B	†0.14
BC169C	†0.15
BC170*	†0.15
BC171*	†0.15
BC172*	†0.15
BC173*	†0.22
BC174A & B	†0.26
BC176	0.22
BC177*	0.20
BC178*	0.22
BC179*	0.28
BC182*	†0.15
BC182L*	†0.15
BC183*	†0.14
BC183L*	†0.14
BC184*	†0.15
BC184L*	†0.15
BC185	0.36
BC186	0.25
BC187	0.27

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

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

Type	Price (£)
BD234	0.68
BD235	0.63
BD236	0.63
BD237	0.68
BD238	0.68
BD253	1.58
BD410	1.65
BD433	0.65
BD435	0.70
BD436	0.71
BD437	0.74
BD438	0.75
BD519	0.88
BD520	0.88
BD599	0.87
BD600	1.23
BD6638R	0.86
BDX18	1.55
BDX32	2.95
BDY16A	0.63
BDY18	1.55
BDY20	2.29
BDY38	1.38
BF115	0.48
BF117	0.45
BF120	0.55
BF121	0.85
BF123	0.48
BF125	0.68
BF127	0.61
BF137F	0.78
BF152	†0.19
BF158	†0.25
BF159	†0.27
BF160	†0.20
BF161	0.84
BF163	†0.65
BF164	†0.95
BF166	0.50
BF167	0.38
BF173	0.35
BF177	0.36
BF178	0.46
BF179	0.58
BF180	0.53
BF181	0.53
BF182	0.44
BF183	0.52
BF184	0.44
BF185	0.42
BF186	0.42
BF194*	†0.14
BF195*	†0.13
BF196	†0.14
BF197	†0.15
BF198	†0.29
BF199	†0.29
BF200	†0.25
BF218	†0.42

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

Type	Price (£)
BPX29	1.62
BR101	0.53
BR103	0.64
BR303	1.06
BRC4443	1.76
BRY39	0.60
BRY56	†0.44
BSS27	0.92
BT106	1.50
BT109	1.99
BT116	1.45
BT119	5.18
BU102	2.85
BU105	†1.80
BU105/02	†1.95
BU108	†2.98
BU126	†2.91
BU204	†2.50
BU205	†2.78
BU206	†3.09
BU208	†4.88
BU407	†1.38
BUY77	2.50
C106D	0.80
C106F	0.43
C111E	†0.46
D40N1	0.64
E1222	0.47
E5024	†0.19
GET872	0.46
MC140	†0.36
ME0402	†0.18
MF0404/02	†0.18
ME6001	†0.18
ME6002	†0.18
MJ2955	1.30
MJ3000	1.58
MJE340	0.68
MJE341	0.72
MJE370	0.74
MJE371	0.79
MJE520	0.85
MJE521	0.95
MJE2955	1.20
MJE3000	1.95
MJE3055	1.22
MPF102	†0.40
MPS3702	†0.33
MPS3705	†0.30
MPS6521	†0.36
MPS6523	†0.36
MPS6566	†0.44
MPSA05	†0.30
MPSA06	†0.32
MPSA55	†0.43
MPSA56	†0.45
MPSA93	†0.56
MPSL01	†0.33
MPSU01	0.61

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

Type	Price (£)
ZTX500	†0.18
ZTX502	†0.22
ZTX504	†0.28
2N404	1.30
2N696	0.46
2N697	0.46
2N706A	0.33
2N708	0.29
2N914	0.32
2N916	0.46
2N918	0.54
2N930	0.29
2N1164	8.29
2N1304	1.40
2N1305	1.29
2N1306	1.49
2N1307	1.32
2N1308	1.53
2N1711	0.47
2N1893	0.52
2N2102	0.71
2N2217	0.55
2N2218	0.38
2N2219	0.42
2N2221A	0.26
2N2222A	0.41
2N2369A	0.40
2N2401	0.80
2N2484	0.35
2N2570	0.74
2N2646	0.82
2N2784	1.15
2N2869	2.08
2N2894	0.45
2N2904*	0.40
2N2905*	0.39
2N2906*	0.36
2N2926G	†0.15
2N29260	†0.14
2N2926Y	†0.14
2N2955	1.12
2N3053	0.48
2N3054	0.86
2N3055	0.72
2N3250	0.52
2N3254	0.58
2N3391A	0.38
2N3633	12.70
2N3703	†0.17
2N3704	†0.19
2N3705	†0.17
2N3706	†0.16
2N3707	†0.18
2N3708	†0.17
2N3715	1.70
2N3771	2.39
2N3772	2.58
2N3773	3.90
2N3794	†0.40

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

Alternative gain versions available on items marked*.

For matched pairs add 20p per pair.

LINEAR IC's

Type	Price (£)
BRC1330	†0.93
CA810QM	2.44
CA3005	1.85
CA3012	1.45
CA3014	2.23
CA3018	0.71
CA3020	1.89
CA3028A	0.80
CA3028B	1.09
CA3045	3.75
CA3046	0.70
CA3065	1.74
CA3068	1.90
CA3130S	1.67
FCH161	†2.40
FCJ101	†3.32
LM309K	1.98
LM380N-14	1.65
LM1303N	3.08
MC1307P	†1.82
MC1310P*	†1.94
MC1312P	2.34
MC1327P*	†1.86
MC1330P	†0.93
MC1350P	†1.22
MC1351P	†1.42
MC1352P	†1.42
MC1357P	†2.92
MC1358P*	†2.30
MC1458G	1.43
MC1496L	1.15
MC3051P	0.58
MFC400B	0.85
MFC4060A	0.98
MFC6040	1.11
MIC1P	2.58
ML231	†3.57
ML232	†3.57
NE555	0.72
NE556	1.34
NE566	1.95
SAA1024	†5.70
SAA1025	†10.35
SAS560A	†2.[illegible]
SAS570	†2.01
SC9503P	†1.40
SC9504P	†1.38
SL414A	1.91
SL432A	2.52
SL450	5.10
SL901B	†4.20
SL917B	†5.60
SL918A	†5.95
SN72440N	†2.21
SN76001N	†1.67
SN76003N	2.22

Type	Price (£)
SN76008KE	1.56
SN76013N	1.56
SN76013ND	1.40
SN76018KE	1.56
SN76023N	1.56
SN76023ND	1.40
SN76033N	2.22
SN76110N	1.20
SN76115N	†1.62
SN76116N	1.78
SN76131N	†2.10
SN76226N	†2.60
SN70227N	†1.61
SN76228N	†1.80
SN76502N	†1.92
SN76530P	†0.97
SN76533N	†1.38
SN76544N	†1.85
SN76546N	†1.85
SN76570N	†1.81
SN76620AN	†0.99
SN76650N	†1.48
SN76660N	†0.64
SN76666N	†0.96
TA7073P	†3.51
TAA263	†2.20
TAA300	†3.85
TAA320	1.10
TAA350A	†2.48
TAA370A	3.18
TAA435	†1.70
TAA450	†3.39
TAA521	1.10
TAA522	2.09
TAA550	0.45
TAA560	1.93
TAA570	†2.30
TAA611A	1.67
TAA611B	1.89
TAA621AXI	2.33
TAA630Q	3.91
TAA630S	4.18
TAA661A	2.39
TAA661B	1.75
TAA700*	†2.80
TAA840	†3.38
TAA861A	0.95
TAA930A	1.43
TAA930B	1.43
TAA960	†2.25
TAA970	†2.48
TAD100	†2.66
(Filter)	0.98
TBA120A	†0.90
TBA120S*	†0.99
TBA120SA	†1.02
TBA231	1.12

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

* Indicates Q version is also available.

DIODES

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

Type	Price (£)
BY114	0.60
BY118	1.10
BY126	0.20
BY127	0.21
BY133	0.35
BY140	1.40
BY164	0.75
BY176	2.80
BY179	0.83
BY182	1.14
BY184	0.44
BY189	5.30
BY190	4.90
BY206	0.26
BY238	0.25
BYX10	0.30
BYX38/600	0.70
BYX70/500	0.53
ITT44	0.08
ITT210	0.63
ITT827	0.80
MCR101	0.43
MR854	1.10
OA5	0.88
OA10	0.58
OA47	0.20
OA81	0.19
OA90	0.13
OA91	0.15
OA95	0.20
OA200	0.13
OA202	0.13
OA210	0.89
TIL209	0.14
TIL211	0.18
TV20	2.25
IN914	0.06
IN916	0.06
IN4001	0.06
IN4002	0.07
IN4003	0.08
IN4004	0.08
IN4005	0.09
IN4006	0.10
IN4007	0.12
IN5400	0.15
IN5401	0.17
IN5402	0.20
IS920	0.09
IS921	0.11

ZENER DIODES

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

VDR's, etc. (†)

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

VALVES (†)

Type	Price (£)
DY86/87	0.75
DY802	0.75
ECC81	0.78
ECC82	0.95
ECC83	0.78
ECH81	0.83
ECL80	0.82
EF80	0.60
EF183	0.75
EF184	0.75
EH90	0.94
EL34	3.08
EY51	1.20
EY86/87	0.67
PCC84	0.61
PCC85	0.79
PCC89	0.74
PCC189	0.94
PCF80	1.20
PCF86	0.87
PCF200	2.32
PCF801	0.74
PCF802	1.20
PCF805	3.37
PCF808	2.00
PCL82	0.93
PCL83	1.12
PCL84	0.65
PCL86	1.27
PCL805/85	1.00
PD500	3.75
PFL200	1.40
PL36	1.20
PL81	0.94
PL84	0.79
PL504	1.50
PL508	1.85
PL509	3.10
PL519	3.10
PL802	3.25
PY81/PB10	0.60

BRIDGES

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

10A and 25A ranges also stocked.

RESISTORS

Carbon Film (5%) (†) — Mixes of a minimum of 10 of one value / 10pcs of any value:

	Ea	value	50pc	100pc	500pc
¼W 5.6Ω-330kΩ (E12)	3p	25p	95p	£1.48	£5.40
½W 10Ω-10MΩ (E24)	3p	25p	95p	£1.48	£5.40
1W 10Ω-10MΩ (E12)	5p	45p	£1.95	£3.40	£15.25
2W 10Ω-10MΩ (E6)	9p	80p	£3.60	£6.40	£26.90

Wirewound (5%)

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

Presets (†)

0.1W (Vertical and Horizontal) 100, 220, 470Ω, 1, 2.2, 4.7, 10, 22, 47, 100, 220, 470kΩ, 1, 2.5, 5MΩ all 14p each

0.2W (Vertical and Horizontal) Values as 0.1W all 14p each

FUSES (all packs of 10)

20mm Time Delay (BEAB)

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

20mm quick-blow (BEAB)

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

LABGEAR (Details of full range on request)

COLOURTEXT ADAPTOR 7026

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

COLOUR BAR GENERATOR

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

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SEMI CONDUCTOR PACK No. 1 (Power Supply)

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

P. & P. UK: £0.12 per order. **Overseas:** At cost. Please add VAT at 8% and 12½% on items marked†. It is only possible to show part of our range here. Our catalogue (30p refundable) shows Service Aids, 7400 series, CMOS, op amps, SCRs etc., hardware, capacitors, special TV items and many more transistors, diodes, i.c.'s and valves.
Giro A/c 23 532 400. *A/c facilities available*

CAPACITORS

Metallised Paper (†)

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

H.V. Disc Ceramic (†)

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

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

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

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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

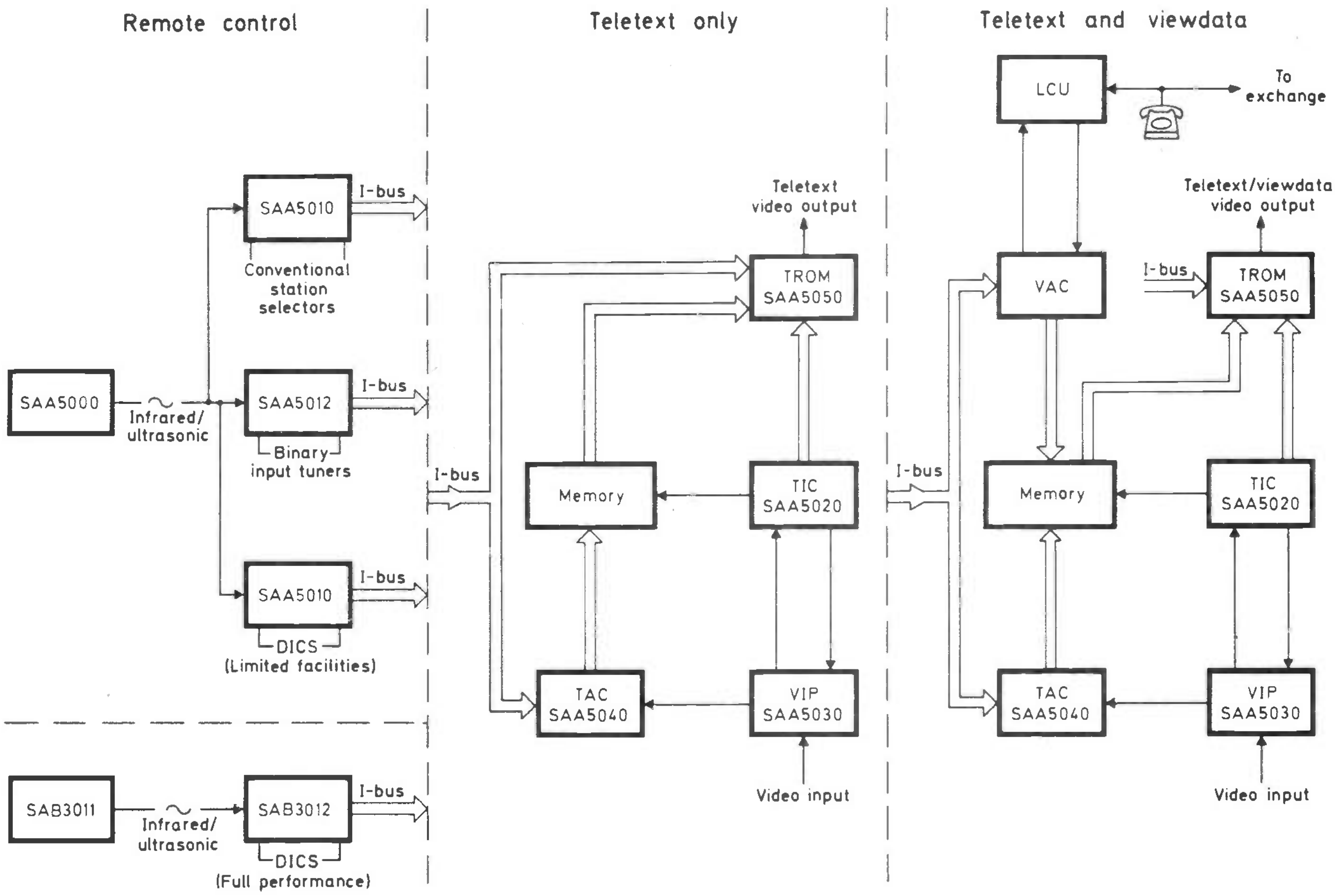

Fig. 1: The Mullard Multitext range of i.c.s.

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.

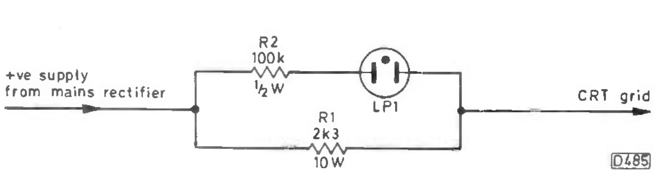

Fig. 1: This alternative to using a 15W pygmy bulb in a c.r.t. reactivator leads to a more compact design.

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.

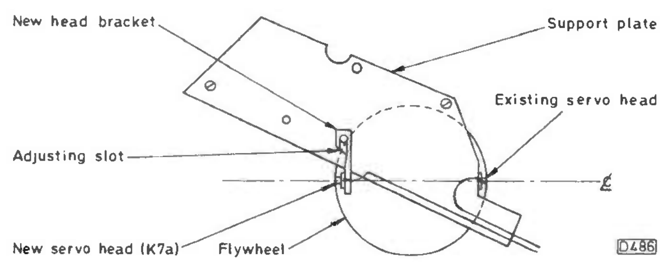

Fig. 2: Philips N1502 conversion to give two hours' playing time – fitting the extra servo head and bracket.

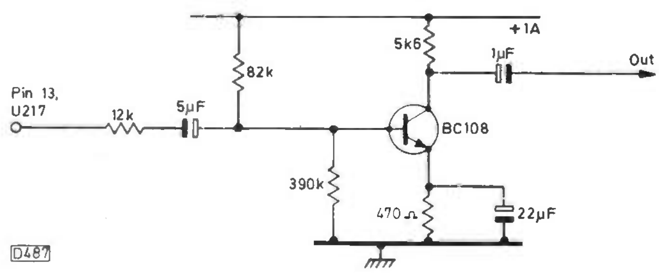

Fig. 3: Circuit of the additional amplifier.

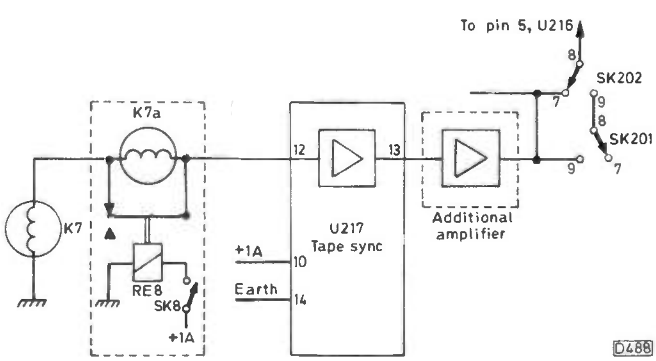

Fig. 4: Connections to the extra servo head and amplifier.

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COLOUR BAR GENERATOR
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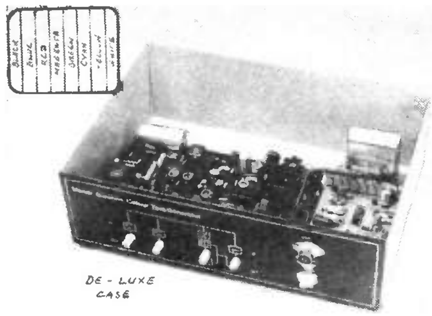

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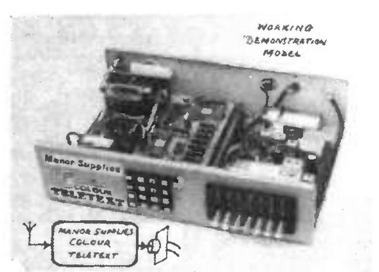

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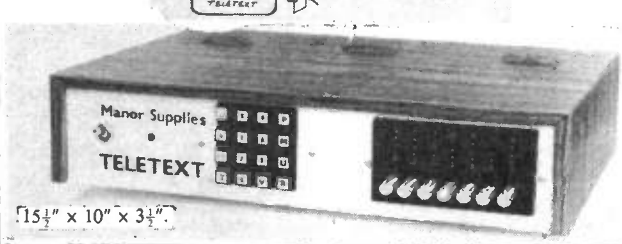

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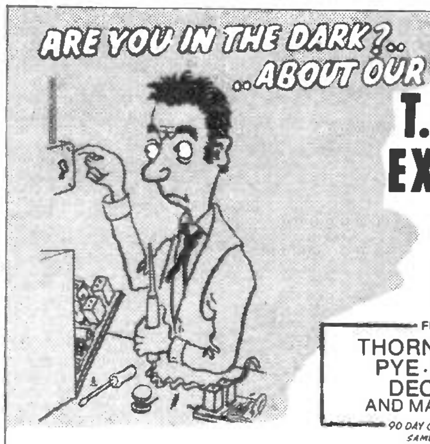

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The stop-motion switch fitted on the N1502 was commandeered to select either normal or half normal speed, as the stop motion facility is not available on this machine. The associated relay was disconnected from the printed circuit board and moved to 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.

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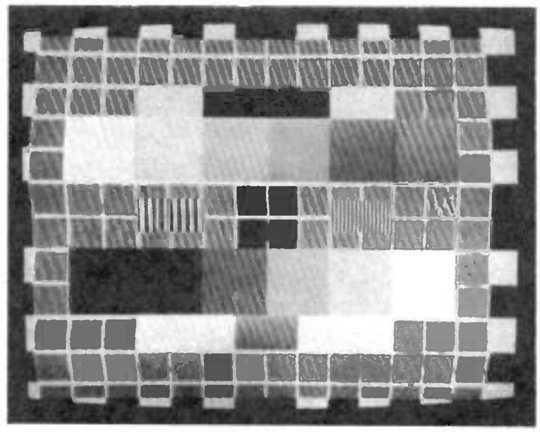
● COLOUR PATTERN GENERATOR



Intended as a low-cost means of checking the performance of colour receivers, the pattern provided consists of a castellated border, white crosshatch background, colour bars, a grey scale, frequency gratings, letterbox and colour fit pattern. Apart from the sync pulse generator chip, inexpensive i.c.s are used throughout. Easy to construct on the boards which will be available. A particularly useful item for the engineer dealing with colour sets without a scope.

● THE RANK TELETEXT RECEIVER

The first commercially available teletext receiver was the BC6333 from Rank, which incorporates a Tifax module. R. Fisher describes the technicalities of the receiver.

● SERVICING FEATURES

Service Notebook. S. Simon with line timebase faults and how to interpret the symptoms. A more than usually harassed Les Lawry-Johns. And some notes on the G11 from Larry Ingram.

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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 5THY1 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.

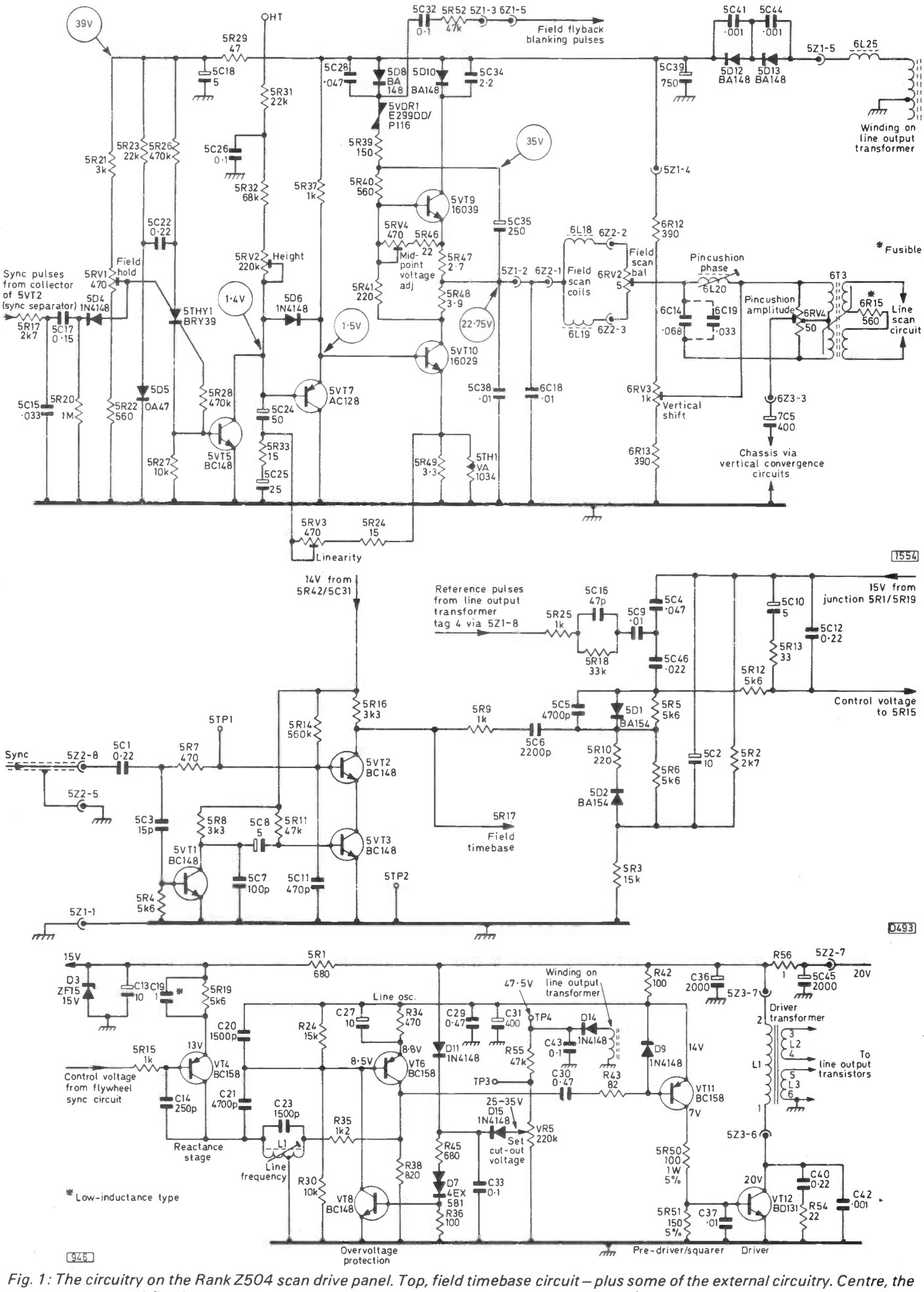


Fig. 1: The circuitry on the Rank Z504 scan drive panel. Top, field timebase circuit – plus some of the external circuitry. Centre, the sync separator and flywheel line sync circuits. 5R7 later changed to 560Ω, with 5VT1/3 and associated components deleted. Bottom, the line generator and driver circuits.

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 th earlier articles. A couple of further points. The transducto 6T3 on the scan drive panel can be responsible for fiel collapse. A faulty transductor may result in the therma cutout resistor 6R15 springing open. The set will continu to operate, but the sides of the picture will be curved, witl incorrect pincushion adjustment. The 2·2Ω resistors i series with the bases of the line output transistor 6VT1/6VT2 can cause trouble, going open-circuit or in creasing in value. They can well increase to 4Ω or 5Ω, up setting the line output stage with the result of low e.h.t. anc 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 innard 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

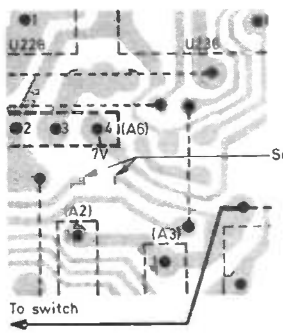
To erase a previously recorded tape, Philips say tune the VCR to a blank channel and set the machine to record. This is very unsatisfactory of course, as it records all the video and audio noise. What's really needed therefore is a switch to mute the sound and video recording whilst leaving the erase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



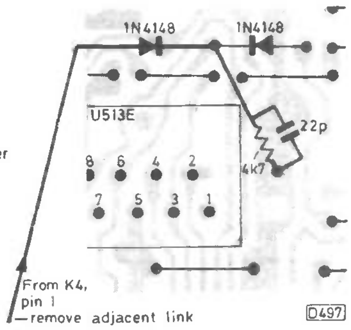


Fig. 1 (left): Part of the erase modification, on the print side on panel 21.

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.

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

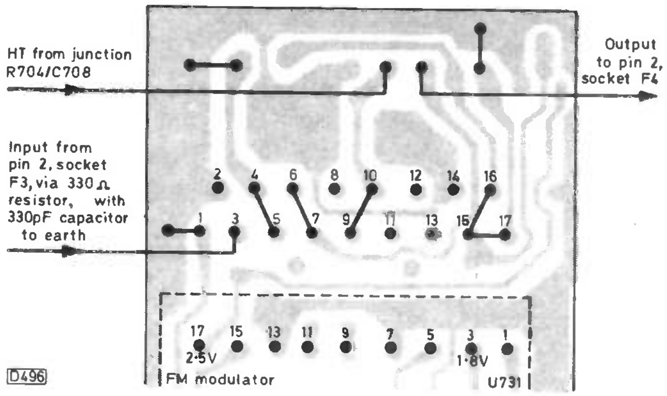


Fig. 3: Adding a crispener module on panel 71. The printed pattern is already present at the end of the board. Earth pins 1, 2, 4, 5, 14, 15, 16 and 17 of the crispener module. View from the print side of the board. Remove diode D701, which is roughly midway along one side of the board.

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.

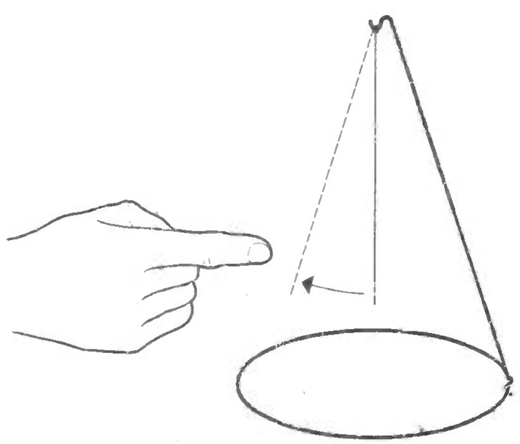


Fig. 10: Before handling MOS devices, check whether you are charged – if the cotton thread moves towards your finger, you are.

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

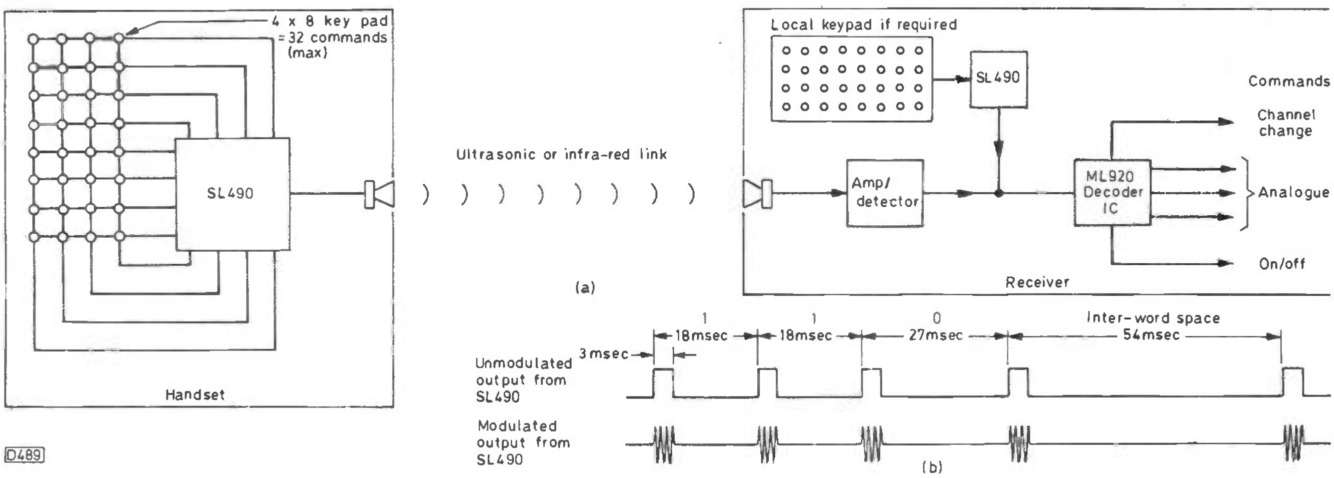


Fig. 11: The Plessey two-i.c. remote control system. (a) Block diagram, (b) the pulse-position code used – one equals a pulse every 18msec, zero a pulse every 27msec. The SL490's modulated output is for use with ultraviolet systems, its unmodulated output (internal oscillator disabled) being for use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

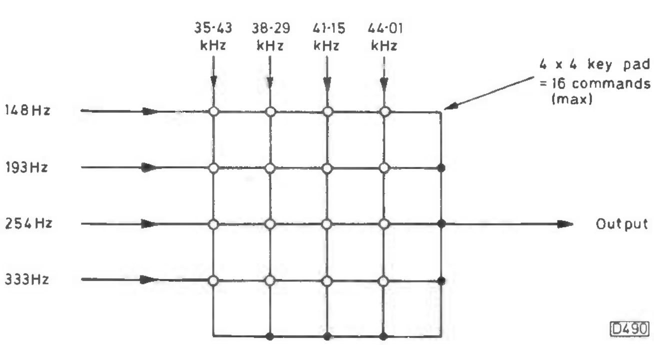


Fig. 12: An example of matrixing – the Bang and Olufsen two-tone modulation system. Pressing any handset button results in one of the four ultrasonic oscillators being modulated by one of the four l.f. tones available, giving a total of 16 different command signals.

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,

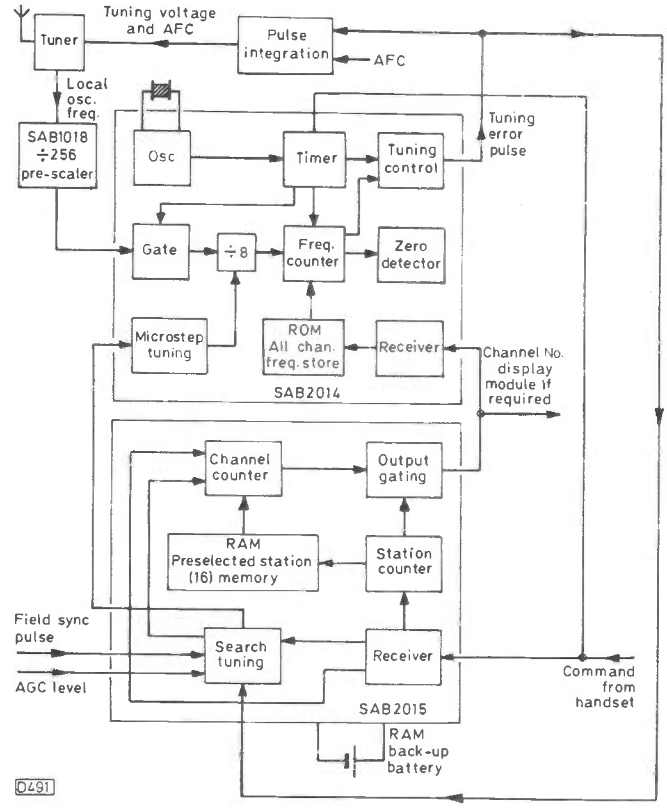


Fig. 13: Block diagram of the Mullard DICS system. The ROM contains the binary-coded local oscillator frequencies of 100 channels (labelled 00 to 99). Up to 16 preselected channels can be stored in the RAM. There are two tuning modes – "station" or "channel". In the station mode, the stations stored 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.

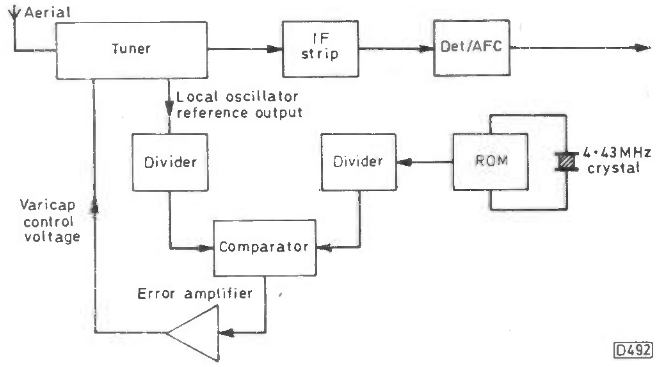


Fig. 14: Block diagram showing the basic principle of the Plessey direct channel tuning system. The local oscillator frequency is compared with the selected channel presented in digital form by the ROM, the difference signal being amplified and used to pull the local oscillator into lock.

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.

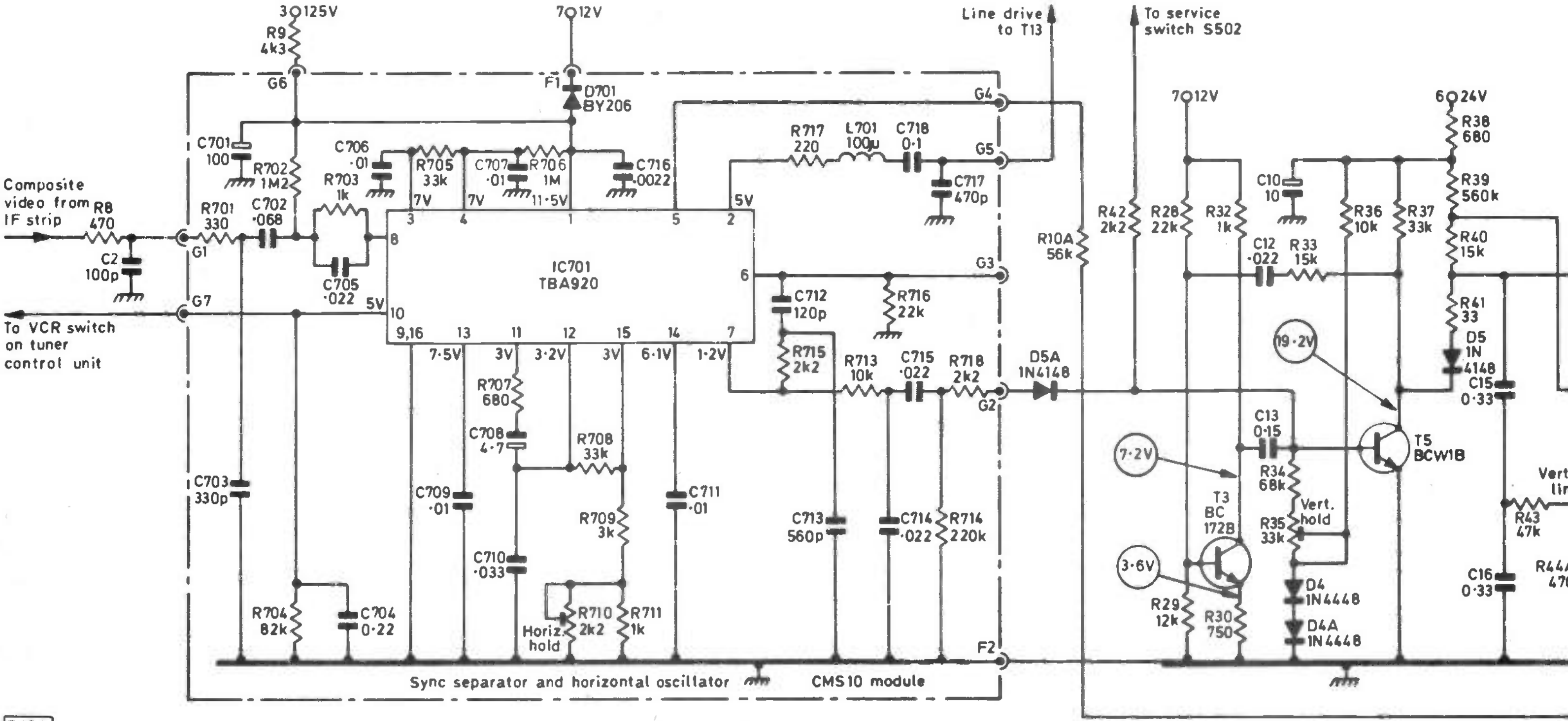
AUDIO MODULE

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 the ITT CVC20

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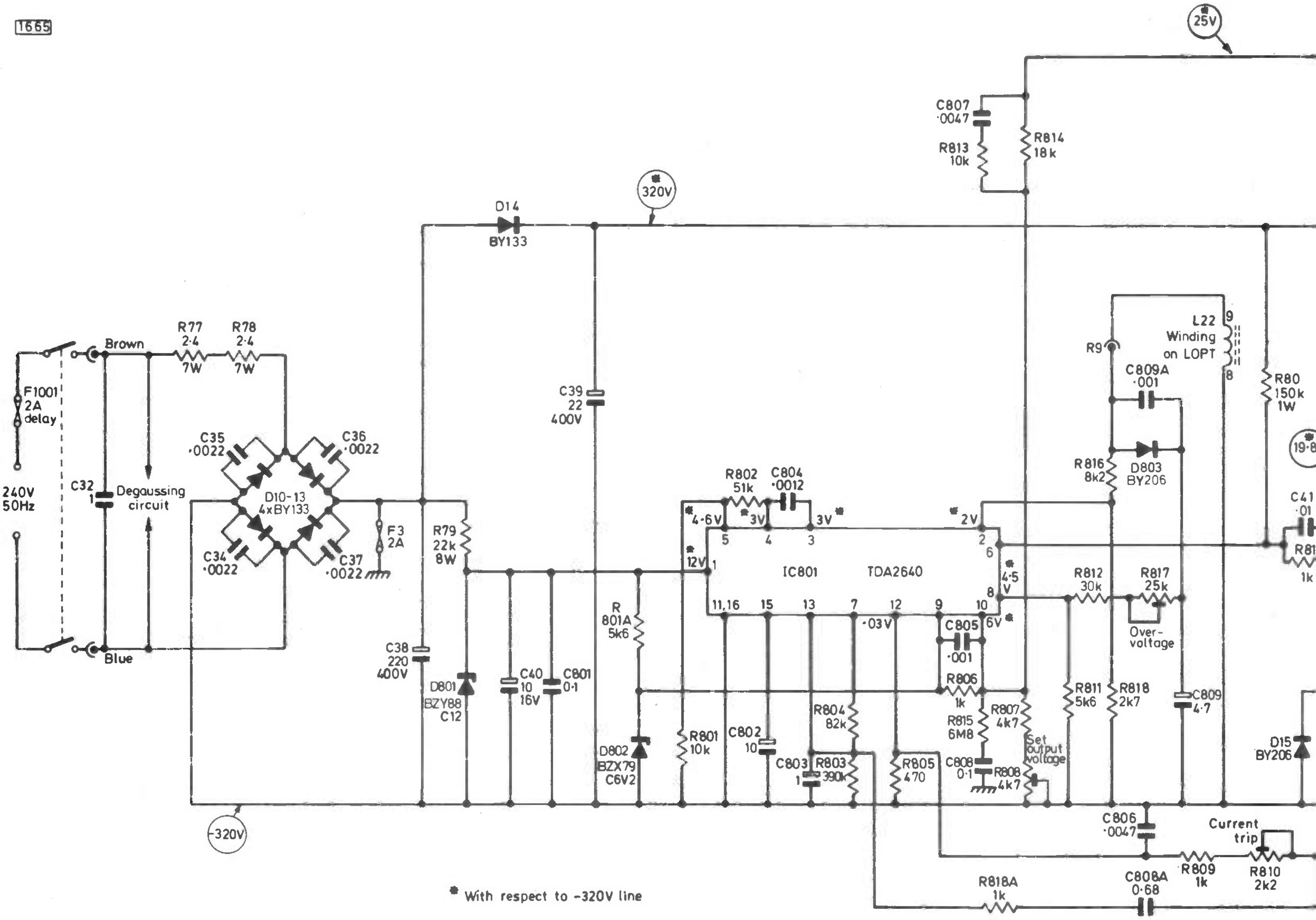
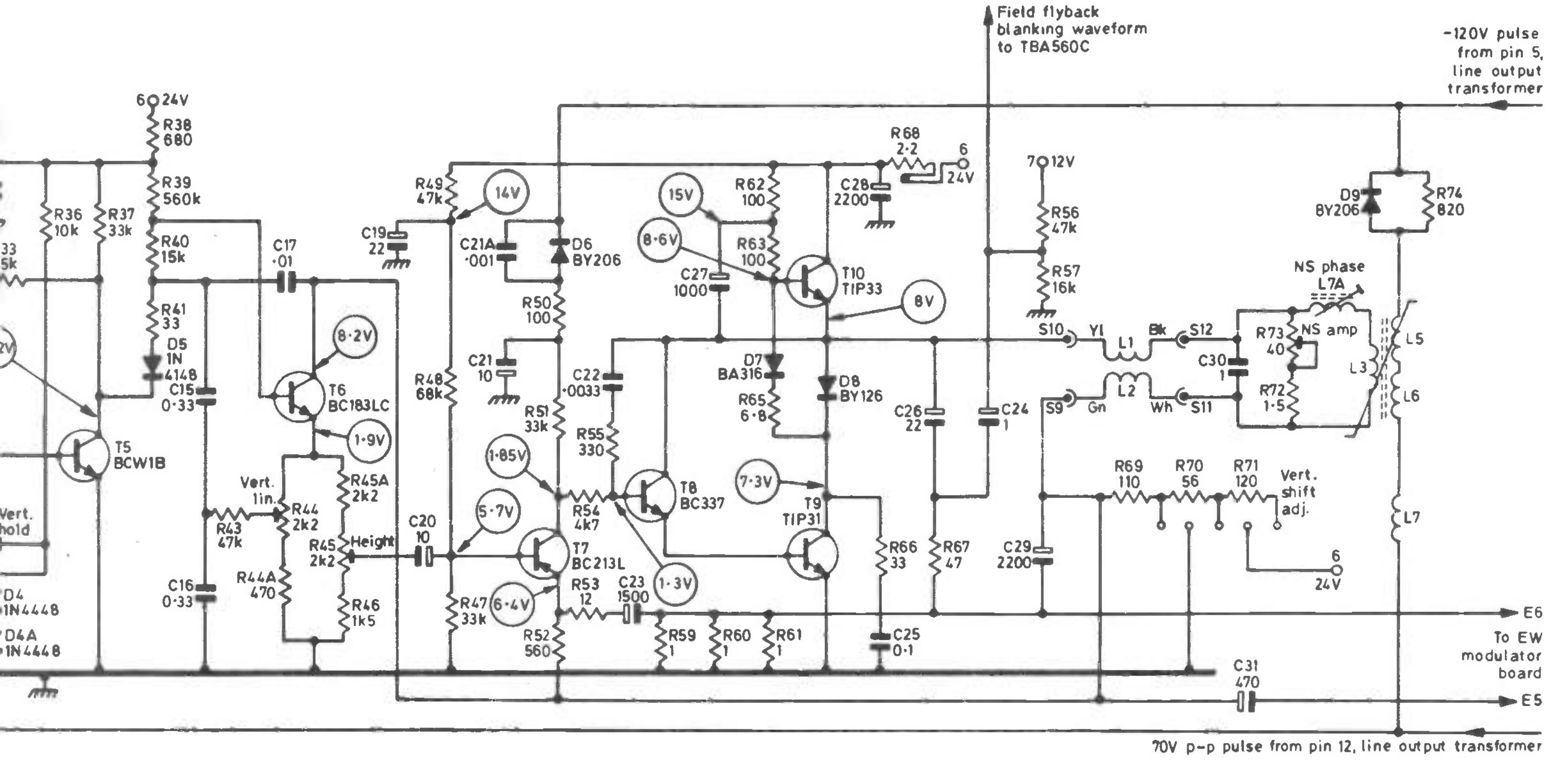
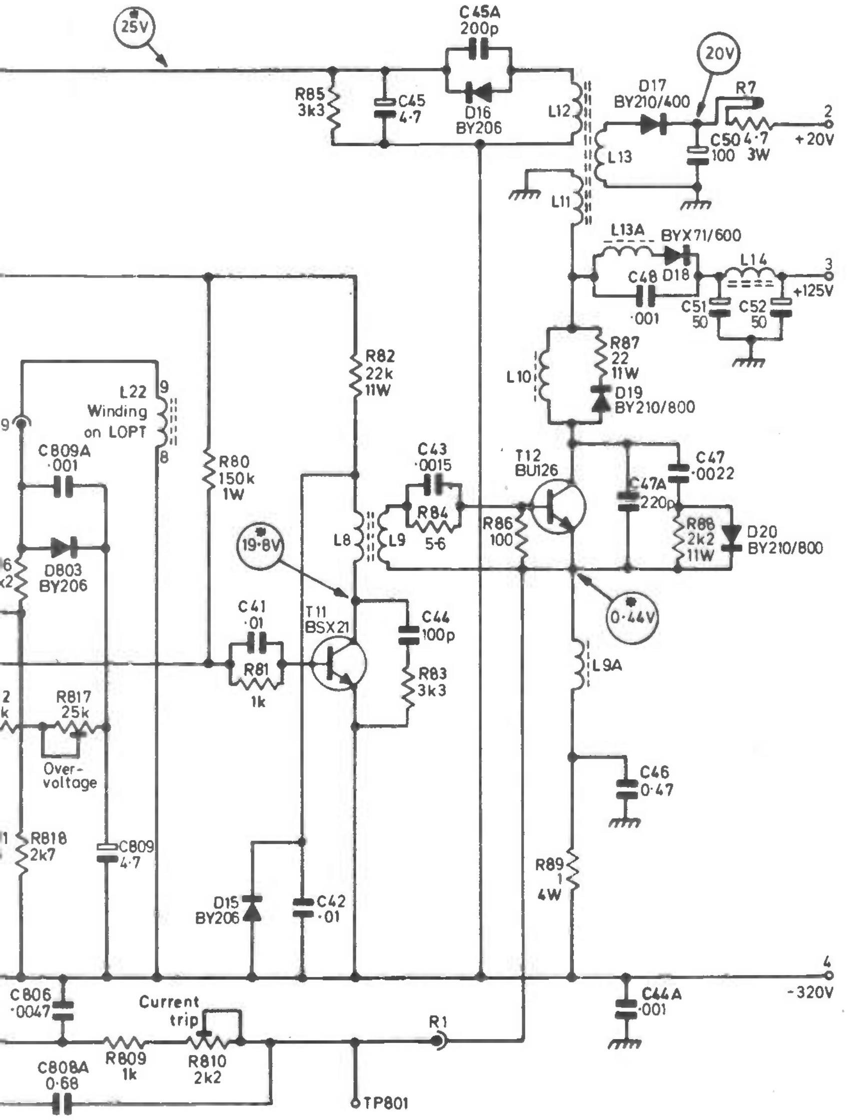




cuit used in the ITT CVC20 chassis.



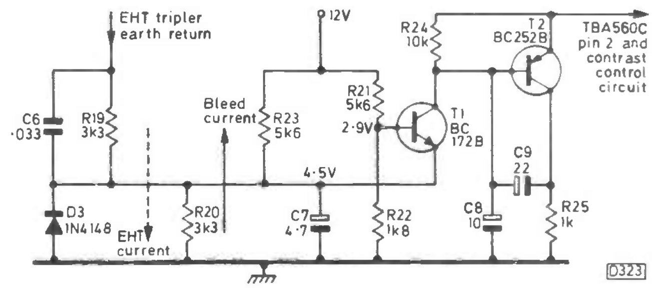


Fig. 2: The beam limiter circuit comes into operation when the e.h.t. current flowing via R19/R20 exceeds the bleed current flowing via R20/R23 so that T1 and T2 start to conduct. Component reference numbers as used in the CVC20 chassis. In later production R23 is 10kΩ, R22 910Ω and R25 470Ω.

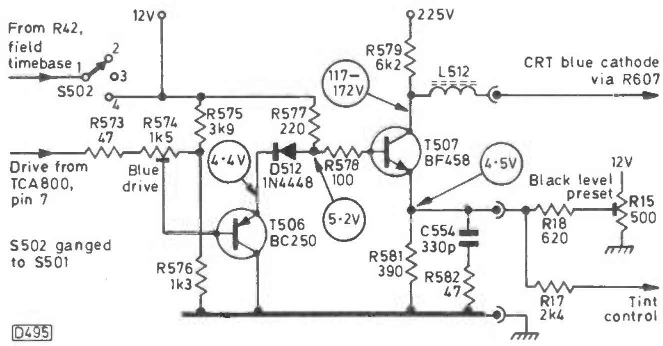


Fig. 3: The blue driver and output stage circuit. The circuits used in the R and G channels are identical except for the tint control connections.

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.

No colour with colour control at maximum. Monochrome reception satisfactory.
Check IC502 by substitution (pluggable).
Override colour killer – connect TP507 (free end of R532) to 12V (adjacent to tag).

- Colour satisfactory. Check C538 s/c or C529 leaky.
- Slight or no effect. Measure voltage at pin 9 of IC502.
  - If les than 1V, check C542 o/c, no 7·8kHz signal due to faulty IC503 – measure voltage at pin 12 with Avo on 10V a.c. range using 0·1μF capacitor. Reading of 1·5V is satisfactory.
  - If greater than 1V, measure voltage at pin 13 of IC501.
    - If less than 3V, check C522 and C529 for s/c.
    - If greater than 3·3V, measure voltage at pins 4 and 6 of IC502.
      - If less than 2V, check C532 and C540 for s/c.
      - If greater than 3V, measure voltage at pin 13 of IC502.
        - If less than 4·5V, check C537/8/9 and C522 for s/c.
        - If greater than 5V, check earthing on divider screen adjacent to crystal, defective crystal etc.
- Colour beat present. Decouple C526 with a parallel 0·01μF ceramic capacitor and adjust trimmer C534. Is zero beat obtainable?
  - If so, remove decoupling. Does colour lock?
    - If not, check burst network – L508, D506 s/c etc., and IC501.
    - If strong colour lock is obtained, suspect C534 being intermittent or mis-set.
    - If weak colour lock is obtained, check setting of R537, IC501 and network C518, C519, C522 etc.
  - If not, check C526, crystal etc., including L505, L509, C515 o/c.

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 $10\text{-}100\mu V$ 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-

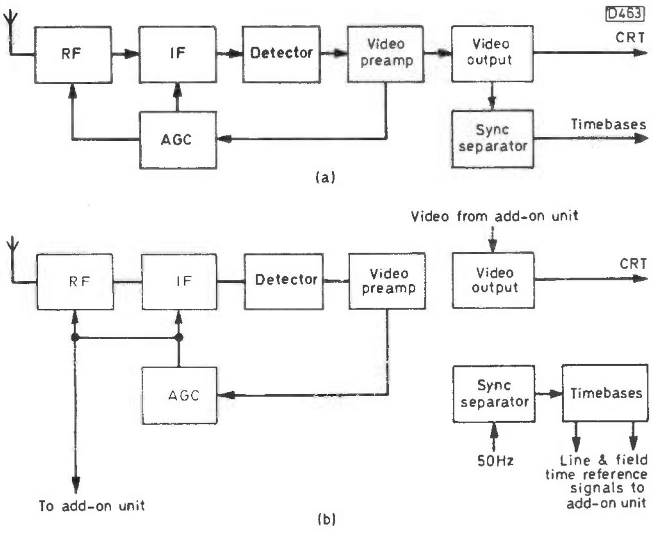


Fig. 1: Block diagram showing the modifications required to the TV receiver. (a) Original arrangement of the receiver. (b) Modified arrangement for spectrum analyser use.

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,

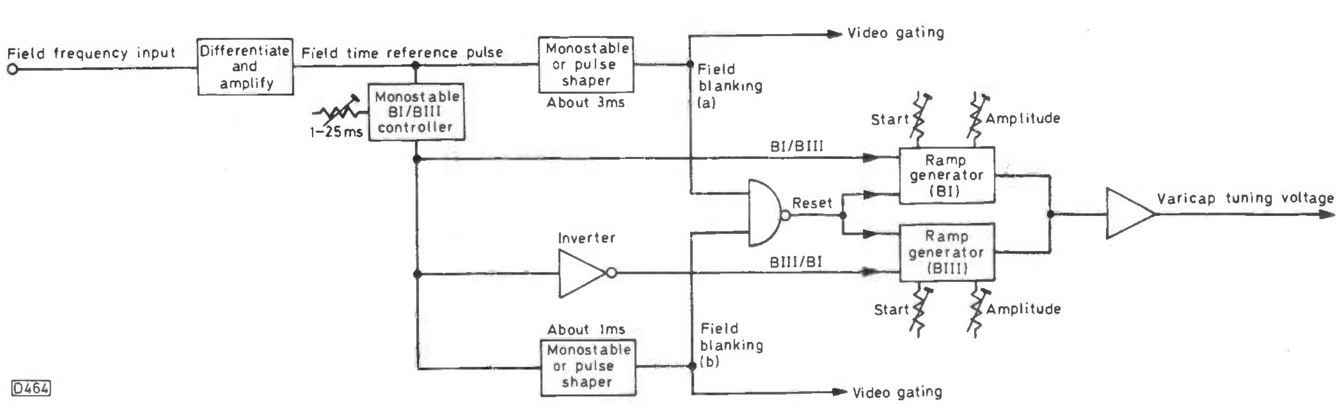


Fig. 2: Block diagram of the field-frequency section of the add-on unit.

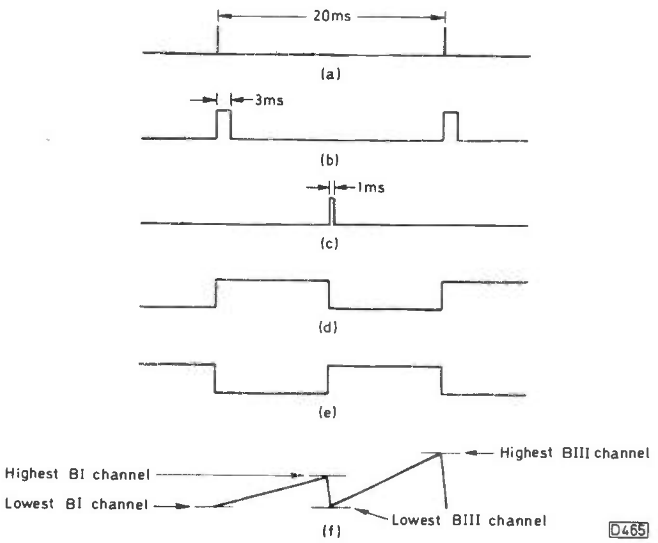


Fig. 3: Field-frequency waveforms. (a) Field time reference, corresponding to the field flyback. (b) Field blanking (a) waveform. (c) Field blanking (b) waveform. (d) BI/BIII waveform. (e) BIII/BI waveform. (f) Varicap tuning waveform.

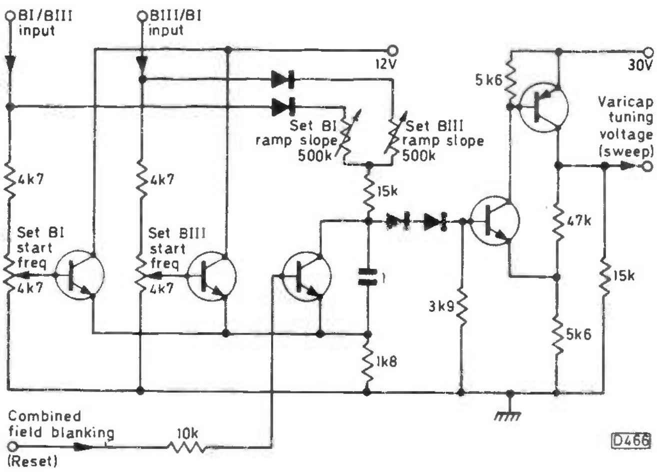


Fig. 4: Circuit of the ramp generators used to produce the varicap tuning voltage, and the following amplifier.

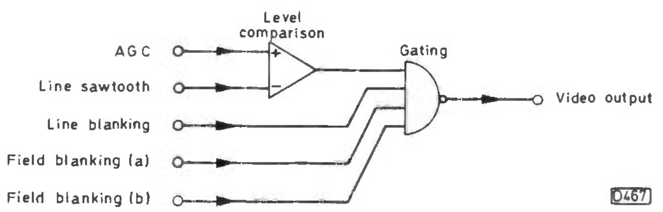


Fig. 5: Block diagram of the line frequency section of the add-on unit, and the gating to provide the composite video output signal for the modified receiver.

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.

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.

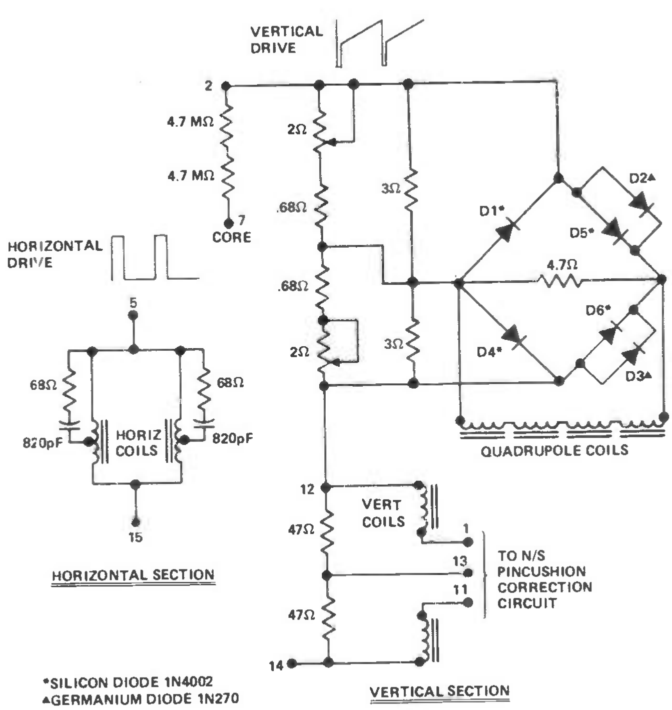


Fig. 1: Deflection yoke circuit.

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

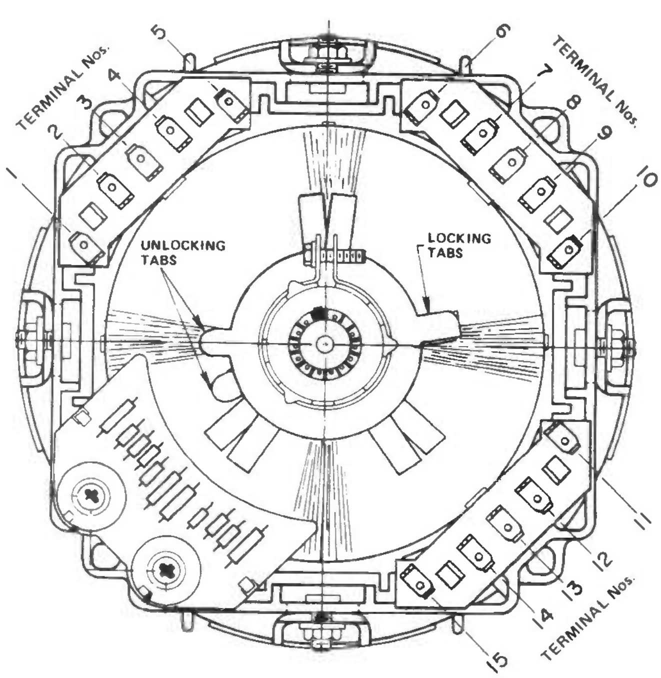


Fig. 2: Deflection yoke terminals. The numbers correspond to the circuit diagram shown in Fig. 1, i.e. the line scan connections are to pins 5 and 15, the field scan connections to pins 2 and 14, with the pincushion correction applied to pins 1, 11 and 13. The other pins are internally connected.

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

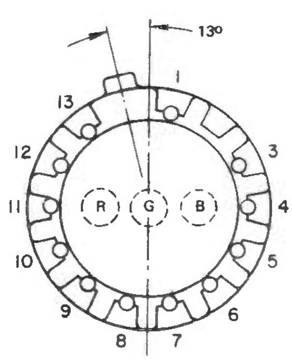


Fig. 3: Tube base connections.

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

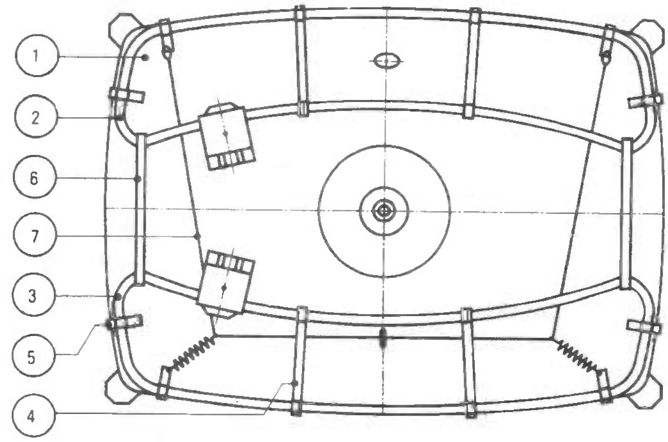


Fig. 4: Mounting the degaussing coils. The encircled numbers refer to the items listed in Table 1.

a piece of the outer sheath over the soldered joint and taping this in place – remember that there are 8·5kV pulses here!

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.

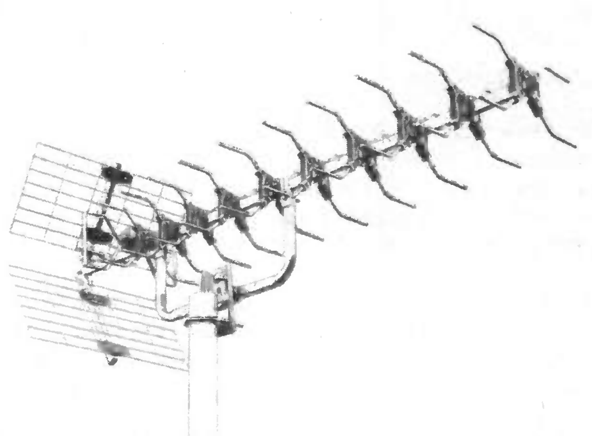
There were several Sporadic E openings during the month. On January 2nd there were two Russian signals on ch. R1 and a strong Finnish (YLE) signal on ch. E2 from 0820-0950. Auroral enhanced Sp.E is thought to have been responsible for the strong Iceland (RUV) signal on ch. E4 seen by Kevin Jackson and 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

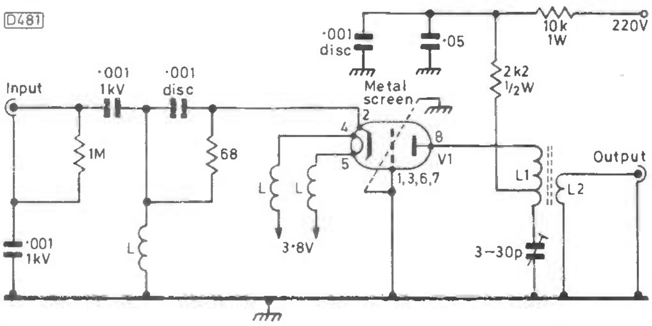


Fig. 1: Band I aerial preamplifier circuit using a PC88 or similar valve. The layout is not critical, but a metallic screen should be inserted across the valveholder to separate the input and output. The r.f. chokes L are 28 s.w.g. enamelled wire, close wound, air cored and self-supporting, approximately 15 turns (not critical). L1 consists of 11 turns spaced over $\frac{3}{4}$in., tapped at 8 turns, wound on a $\frac{3}{8}$in. 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.

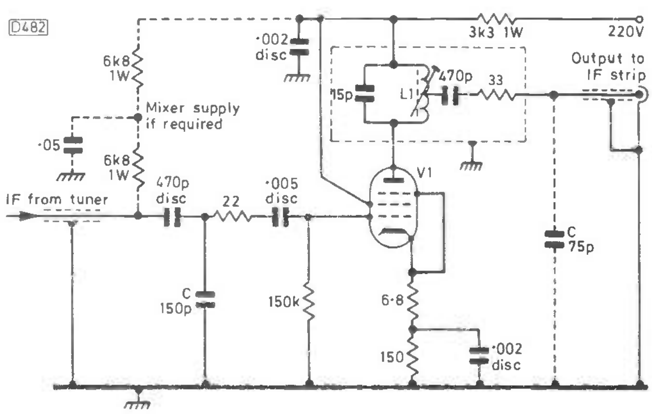
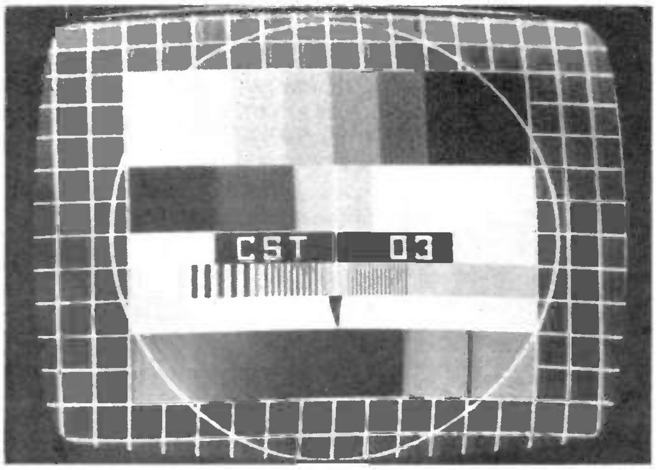
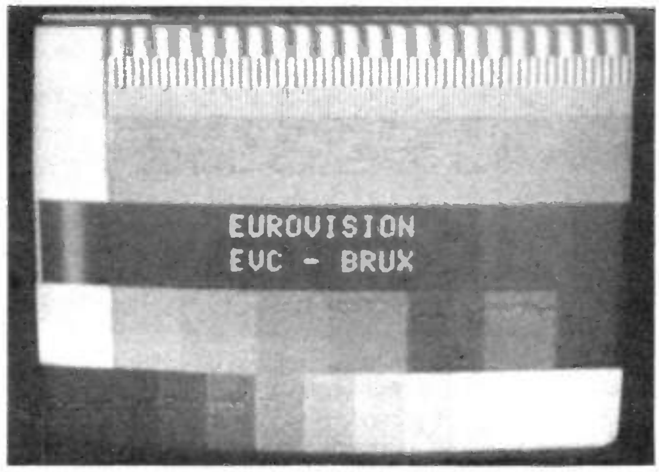


Fig. 2: 36MHz i.f. amplifier for connecting between the tuner and the i.f. strip. Most v.h.f. tuners have a series tuned output circuit which also feeds h.t. to the mixer. Any r.f. pentode, such as an EF91, EF80 or 6AG5 can be used. L1 consists of 12 turns of 26 s.w.g. enamelled wire close wound on a $\frac{1}{4}$in. 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

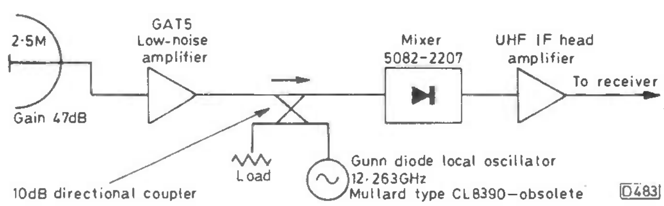


Fig. 3: Steve Birkill's head-end electronics for reception from the OTS-2 satellite.

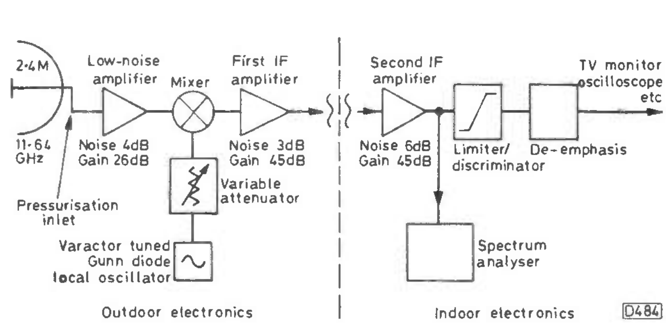
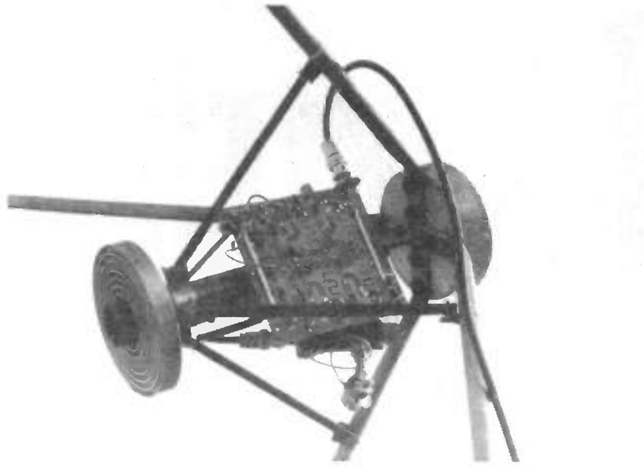


Fig. 4: Block diagram of the University College, Cork receiver for use with the OTS-2 and Sirio satellites.

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.



Close-up view of S. Birkill's 11·6GHz head unit, mounted at the focus of an 8ft. dish.

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 $\overline{4}$ (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.

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 327 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.

TELEFUNKEN 711 CHASSIS

The trouble with this set is bowing at the sides of the raster, plus slightly too much width. The east-west correction and width controls have been adjusted as per the service manual, but the bending at the sides remains – and the width control has no effect on the width.

There is clearly a fault in the east-west modulator circuit – the width control sets the bias conditions here. A common culprit is the bridge coil itself (L564) which tends to overheat, melting the plastic core and ending up with shorted turns. Other than this, the east-west output stage can prove troublesome, with both the transistors (T591 and T592) breaking down. T591 (BD135) is mounted on a heatsink, which will remain cold if the transistors have failed. If this is found to be the case, remove the transistors and check them with a multimeter to establish what faults are present – the most common is collector-emitter punch-through in the BD135. Take care when replacing the BD135 – some sets have incorrectly marked boards, making it easy to connect its base wrongly.

GEC 2012

The trouble is bending to the right whenever the top half of the picture is predominantly white. A new PCF802 line oscillator valve has been tried without success.

Try a new PFL200 video/sync valve, also check the coupling capacitor C111 (0·1μF) to the sync section of the valve and the value of the 47kΩ resistors (R74 and R75) supplying the sync separator's screen grid. There should be about 94V at pin 3.

THORN 3500 CHASSIS

The set works normally for an hour or longer, then picture jitter sets in. This may clear for a while, or alternatively the picture may disolve into a moving jumble of coloured lines. Again a normal picture may return – if one has patience!

There are several causes of horizontal jitter on the Thorn 3000/3500 chassis. In order of likelihood, these are as follows: the line generator supply decoupler C508 (100μF); the 22 or 25μF electrolytics C506 and C511 in the flywheel sync filter and reactance stages; the reactance transistor VT501 (BC183LA); and the flywheel sync discriminator diodes W501/W502 (type Y728 – BY206s can be used).

ITT VC200

A full raster develops following switch-on, but then disappears. The screen remains blank until the set is switched off, when the raster briefly reappears. The line timebase valves have been checked, and all voltages in this area appear to be normal. The sound is not affected.

The presence of sound indicates that the line timebase is working, since the signal stages are powered by a 20V line obtained from the line output stage. You should check the c.r.t. base voltages therefore: there should be at least 500V at the first anode (pin 3), 80-200V at the cathode (pin 7) depending on the brightness control setting, and 35-55V at the grid (pin 2) depending on the setting of the contrast control. If the first anode voltage is low, check the feed components R161, Cb1 and Rb3. If the cathode voltage is high, check the resistors in the brightness control network. The video output transistor TX8 drives the grid, so incorrect voltage here should direct attention to TX8 and its biasing. Its collector voltage should be 35-75V, its emitter voltage 2·9-3·7V, and its base voltage 3·4-4·2V.

THORN 1500 CHASSIS

There's a good monochrome picture when the set is first switched on, but after a few minutes something clicks and the picture goes foggy, with a tendency to field slip and line pulling. Sometimes the set will click back to normal, but at other times the picture remains foggy. I've replaced the coupling capacitor to the video output transistor, and its emitter decoupling capacitor, the tube's first anode decoupler and also the smoothing capacitors in the a.g.c. line, and the electrolytics which smooth the various supply lines. When the picture is foggy the brightness and contrast controls don't seem to alter it much: at other times they work normally.

We suggest you first check that the video output transistor's two collector load resistors R40 and R41 are in good condition and well connected, then suspect the video output transistor itself (VT9). If this fails to cure the problem check for dry-joints around the vision detector and its associated coils (L9/L10), also the condition of C32 which decouples the video driver transistor's base bias. Faults in the i.f. strip transistor emitter decoupling disc ceramic capacitors C8/C13/C25 sometimes occur to give strange effects on the picture.

GRUNDIG 6011

There's an intermittent field scan fault on this set – the bottom of the picture keeps contracting.

First make sure that there are no bad connections or dry-joints on the field timebase panel – this is a common fault on these sets. If not, check C456 (10μF) in the field charging circuit, the field output coupling capacitor C474 (1,000μF), and the 24V zener diode Di625 in the power supply – the latter stabilises the supply to the field oscillator circuit.

PHILIPS G6 CHASSIS – SINGLE-STANDARD

The width slowly decreased, then the raster disappeared. On checking, we found that the spring-off resistor feeding the line output stage had opened. This was resoldered and the PL509 and PY500 valves replaced. On switching on however there was sound but no raster, with the PL509 glowing bright red inside. A new coupling capacitor to the line output valve was tried, but without success. Just after switching on, the voltage across the boost capacitor rises to 370V: it falls to only 20V when the PL509 starts to overheat.

Oh dear! These symptoms strongly suggest a defective line output transformer in this chassis. But check for drive at the control grid (pin 8) of the PL509 – there should be around –60V here. Even a new valve can be duff, so another should be tried. If the voltage at pin 8 is lower than it should be, check the values of R4088 (anode load) and R4087 (screen grid feed) in the PCF802 line oscillator circuit – they tend to change value, giving wrongly shaped or reduced drive. If the drive is o.k. however, the PL509's anode circuit is being excessively loaded. The usual cause is a defective line output transformer overwinding, but another possibility is shorting turns in the desaturation choke L5502 – this will be accompanied by a smell of burning plastic and smoke from the coil. A less likely possibility is a defective PD500 shunt stabiliser valve.

THORN 1590 CHASSIS

We're baffled by a case of intermittent sound on one of these sets. The set will operate normally, sometimes for weeks, then the sound will suddenly cut out. There's no prior warning, i.e. onset of distortion etc., while turning up the volume control is usually sufficient to restore the sound. The fault is so intermittent that it's difficult to adopt normal fault finding procedures. All the voltages in and around the transistor audio circuitry and the intercarrier sound i.c. are normal, and all leads have been resoldered.

This type of fault just won't respond to reason! While any of the audio circuit transistors could be responsible, experience suggests that checking the following by substitution may well eliminate the fault: the electrolytic coupling capacitors C54 (1μF) and C58 (10μF), and the intercarrier sound i.c. The audio preamplifier transistor VT10 has been found responsible on occasion.

RANK A774 CHASSIS

The trouble with this set is false line lock – two pictures side by side, with a five-inch black bar in between. Altering the line hold control only produces either three pictures side by side or complete line breakup. I've checked the flywheel line sync discriminator diodes and the capacitors in the line oscillator circuit, but this has produced no improvement. On another of these sets there's a perfect picture apart from a one-inch wide band of white and black spots on the left-hand side of the screen, from top to bottom.

The flywheel line sync discriminator diodes are almost always the cause of the first fault, and the only sure check is substitution using a known good pair. If these are in order, check their load resistors 3R45/6, the feedback pulse integrating resistor 3R59, and its parallel phasing capacitor 3C40. The second trouble could be due to corona discharge (look for a blue glow around the line output stage, carrying out the examination in the darkened room), or to Barkhäusen oscillation in the line output valve – check the PL504 and its screen grid decoupling capacitor 3C37.

GRUNDIG 8630GB

The trouble with this set is a rope-like striation down the right-hand side of the screen, about two inches from the edge. It's more visible on dark scenes. The EW modulator module has been checked and seems to be o.k., also the aerial. We live in a good reception area.

This "pearl-string" effect can be due to several things on these Grundig chassis. First ensure that all the ferrite beads in the line output stage wiring are present and correct – one at the cathode of the flyback diode Di511, and another at the cathode of the scan thyristor Ty518. If necessary, check diode Di514 on the e.h.t. control module by substitution. Then try the effect of bridging the connecting points across L501 in the drive circuit to the flyback thyristor's cathode gate. This inductor must be left in circuit, but may need to be refitted.

PYE 725 CHASSIS

The trouble is low e.h.t. and severe heating of the e.h.t. lead at a point near where it connects with the c.r.t. (I assume that there must be a series resistor at this point, as the lead is much thicker here). The line driver and output transistors are operating correctly, and all capacitors and resistors in the e.h.t. department have been checked, also the focus unit. A new tripler was fitted, but with the same result (the lead heating as before). I now suspect the line output transformer.

There is indeed a series resistor in the e.h.t. lead, and the fact that it has cooked suggests that the other series resistors in the original tripler will have similarly cooked. The cause of the trouble is excessive beam current, usually due to leakage between the windings of the line output transformer – specifically between the windings connected to pins 10 and 11. This can be checked after desoldering the pins. R642 and R643 between the earthy end of the e.h.t. overwinding (pin 10) and the c.r.t. first anode controls usually cook as well.

BEOVISION 3400

The picture is perfect for about fifteen minutes, then the blue horizontal convergence curves upwards at the left and downwards to the right. At the same time the colour goes streaky, with grouping of the horizontal lines across the picture (with an effect like faulty aquadag earthing on a monochrome set). With the colour removed, a perfect monochrome picture is obtained except for the blue horizontal convergence being out. The same fault is present on two of these sets. Are you likely to publish a servicing article on this chassis?

Each time we've met this irritating blue convergence problem it's turned out to be due to a faulty transistor, 5TR6 (BC114), in the blue horizontal amplitude anti-modulator circuit. It's doubtful whether putting this right will cure the "sizzle" however, which could be the first sign of failure of the line output or e.h.t. transformer. We have a comprehensive guide to servicing this chassis on file, and this will be appearing later in the year.

GEC 2114 PORTABLE

At normal brightness, or when a darkish scene is being transmitted, a shaded vertical bar 4-5ins. wide is present in the centre of the screen. The shading can be minimised or eliminated by increasing the brightness to maximum. The mains bridge rectifier and its reservoir capacitor have been replaced, but the fault persists.

The trouble is probably due to line timebase radiation being picked up by the leads to the c.r.t. base. Try moving the leads, particularly those to the cathode (pin 2) and control grid (pins 1 and 5). If there's no improvement, try checking the 245V reservoir capacitor C235 (0·1μF), C236 (1μF) in the brightness control network and the line flyback blanking circuit clipper diode D211.

QUERY COUPON

Available until 17th April 1979. One coupon, plus a 50p (inc. VAT) postal order, must accompany EACH PROBLEM sent in accordance with the notice on page 326.

TELEVISION APRIL 1979

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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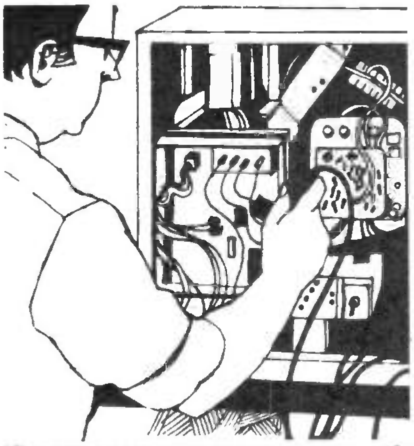

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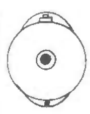

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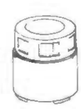

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