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TELEVISION

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

INTEGRATED CIRCUITS

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

VALVES

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

EHT TRIPLERS

TCE950 Doubler	2.25
TCE950/1400 Tripler	3.50
TCE1400 (Pied system only)	4.00
TCE1500 Doubler	3.00
TCE500 Tripler	3.50
TCE1600 1/2 Wave	3.50
Decca CS1730/1830 Doubler	3.60
Decca CS1910/2213 Tripler	6.50
Decca 30 Series Tripler	6.50
Decca 80 Series Tripler	6.50
Decca 100 Series Tripler	6.50
GEC Hybrid 2028 Tripler	6.50
GEC2110 Tripler Pre Jan 77	7.00
GEC2110 Tripler Post Jan 77	6.50
ITT CVC5/8/9 Tripler	6.50
ITT VCV20/25/30 Tripler	6.50
Philips 520 Tripler	6.50
Philips 550 Tripler	6.50
Philips G9 Tripler	6.50
PYE 691/693/697 Tripler	6.00
PYE 731/725 Tripler	6.50
Philips 570 Doubler	6.50
PYE 713/CT2001 only/Doubler	6.50
RR1823 Tripler	7.00
RR1Z179/823 Tripler	6.00
TCE3000/3500 Tripler	6.50
TCE4000 Tripler	8.00
TCE8000 Tripler	3.00
TCE8500 Tripler	6.00
TCE9000 Tripler	6.50
TVK52 Continental Sets	6.00
Korting 90% Tripler	6.50
Autovox Tripler	6.50

MISCELLANEOUS PRODUCTS

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

TELEVISION

December 1978

Vol. 29, No. 2
Issue 338

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., King's Reach Tower, Stamford Street, London SE1 9LS.

SUBSCRIPTIONS
An annual subscription costs £9.50 in the UK, £10.50 overseas ($21 Canada or USA). Send orders with payment to IPC Services, Oakfield House, Perrymount Road, Haywards Heath, Sussex.

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Binders (£2.85) and Indexes (45p) can be supplied by the Post Sales Department, IPC Magazines Ltd., Lavington House, 25 Lavington Street, London SE1 0PF. Prices include postage and VAT. In the case of overseas orders, add 60p.

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

this month

OUR NEXT ISSUE DATED JANUARY WILL BE PUBLISHED ON DECEMBER 18

EX-EQUIPMENT SPARES

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

MONO TUNERS
6 - button integrated all at £6.50
U.H.F. P/Button D/S £4.50 U.H.F. P/Button S/S £6.50 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)

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.

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 p.p. per order

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	10.00	7.50	18.00	–	8.00	–	15.00	7.50
Thorn 3500	10.00	9.00	18.00	10.00	10.00	20.00	20.50	10.00

Korting and other foreign panels available on request.

Postage & Packing £1.25

COLOUR TUBES
19" 18.00
19" A49.192 £20
20" 20.00
22" 25.00
25" 18.00
26" 32.00
Plus P & P £4

COLOUR TUNERS
Bush 6.50
GEC 6.50
PhilipsG6 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
I.F. £10.00
POSTAGE & PACKING £1.25 PER PANEL.

MAIL ORDER TVs GOOD WORKING

COLOUR

Pye	19"	£55.00	22"	£65.00	26"	£75.00
GEC	19"	£55.00	22"	£65.00	26"	£75.00
Bush	19"	£65.00	22"	£75.00	26"	£85.00
Philips G6		–	22"	£63.00	26"	£75.00

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

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.

PERSONAL CALLERS WELCOME

12½% V.A.T. on all prices colour & mono.
P & P £8.00 per colour set. P & P £5.00 per mono set.

WHY NOT TRY OUR EXPRESS MAIL ORDER ON ANY OF THE ITEMS LISTED.
PLEASE ADD 12½% V.A.T. TO ALL ITEMS AND OVERSEAS AT COST. CASH WITH ALL ORDERS.

BRIARWOOD TELEVISION LTD.

Briarwood House, Preston Street, Bradford, West Yorkshire BD7 1NS Tel (0274) 306018

TELEVISION SALE

DISCOUNT FOR QUANTITY

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	40	45	45	45	50
Philips	–	–	45	45	50
Thorn	65	–	65	65	85
Bush	60	–	65	65	75
Kort	–	–	65	–	75
Pye Varicap	–	–	60	–	70

MAINS DROPPERS

All Popular Makes now in stock e.g.

1500 ●	60p	Philips 210 ●	40p
8000 ●	54p	Bush 161 ●	40p
G8 ●	36p	Pye 723 ●	47p

GEC 2110-41R ● 45p

PLEASE NOTE THERE IS 12½% V.A.T.

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

WE DO NOT SELL RUBBISH AT BRIARWOOD TV LTD

EXPORT

COLOUR & MONO T.V.s AVAILABLE READY FOR USE ABROAD

BRIARWOOD TELEVISION LTD.

Briarwood House
Preston Street, Bradford, West Yorkshire BD7 1NS.
Tel: (0274) 306018.

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.

TYPE	PRICE £
AC107	0.23
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	0.34
AC188K	0.34
AD130	0.50
AD140	0.65
AD142	0.73
AD143	0.70
AD145	0.70
AD149	0.64
AD161	0.41
AD162	0.48
AD161 / AD162	1.30
AF106	0.42
AF114	0.23
AF115	0.22
AF116	0.22
AF117	0.30
AF118	0.40
AF121	0.43
AF124	0.33
AF125	0.29
AF126	0.29
AF127	0.29
AF139	0.39
AF151	0.24
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	0.10
BAX13	0.05
BAX16	0.08
BC107	0.12
BC108	0.12
BC109	0.12
BC113	0.12
BC114	0.14
BC115	0.12
BC116	0.12
BC117	0.13
BC119	0.24
BC125	0.15
BC126	0.09
BC136	0.14
BC137	0.14
BC138	0.24
BC139	0.21
BC140	0.31
BC141	0.22
BC142	0.19
BC143	0.19
BC147	0.09
BC148	0.09
BC149	0.09
BC153	0.12
BC154	0.12
BC157	0.10
BC158	0.11
BC159	0.11
BC160	0.28
BC161	0.28
BC167	0.13
BC168	0.10
BC169C	0.12

TYPE	PRICE £
BC171	0.12
BC172	0.12
BC173	0.15
BC177	0.14
BC178	0.14
BC179	0.14
BC182L	0.08
BC183L	0.07
BC184L	0.11
BC186	0.18
BC187	0.18
BC209	0.14
BC212	0.13
BC213L	0.09
BC214L	0.14
BC237	0.07
BC240	0.31
BC281	0.24
BC262	0.20
BC263B	0.20
BC267	0.19
BC301	0.26
BC302	0.30
BC307	0.10
BC337	0.13
BC338	0.09
BC307A	0.12
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	0.40
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	0.30
BD222/T1P31A	0.39
BD225/T1P31A	0.39
BD234	0.34
BD222	0.50
BDX22	0.73
BDX32	1.98
BDY18	0.76
BDY60	0.80
BF115	0.24
BF121	0.21
BF154	0.19
BF158	0.19
BF159	0.24
BF160	0.23
BF163	0.23
BF164	0.17
BF167	0.23
BF173	0.21
BF177	0.26
BF178	0.24
BF179	0.28
BF180	0.30
BF181	0.34
BF182	0.30
BF183	0.29
BF184	0.23
BF185	0.29
BF186	0.30
BF194	0.09
BF195	0.09
BF196	0.12
BF197	0.10
BF198	0.15
BF199	0.14
BF200	0.28
BF216	0.12
BF217	0.12
BF218	0.12
BF219	0.12
BF220	0.12
BF222	0.12
BF221	0.21
BF224	0.12
BF256	0.37
BF258	0.27
BF259	0.27

TYPE	PRICE £
BF260	0.24
BF262	0.28
BF263	0.25
BF271	0.20
BF273	0.12
BF336	0.35
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	0.18
BFY51	0.17
BFY52	0.18
BFY53	0.27
BFY55	0.27
BHA0002	1.90
BR100	0.20
BSX20	0.23
BSX76	0.23
BSY84	0.36
BT106	1.18
BT108	1.23
BT109	1.09
BT116	1.23
BT120	2.08
BU105/02	1.87
BU105/04	2.25
BU126	1.40
BU205	1.97
BU208	2.49
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
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	0.81
TIP31A	0.38
TIP32A	0.36
TIP3055	0.53
T1590	0.19
T1591	0.19
TV106	1.09

DIODES

1N4001	0.04
1N4002	0.04
1N4003	0.06
1N4004	0.07
1N4005	0.07
1N4006	0.08
1N4007	0.08
1N4148	0.30
1N4751A	0.11
1N5401	0.10

TYPE	PRICE £
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
PC189	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
PCF200	1.00
PL36	0.90
PL84	0.74
PL504	1.10
PL509	2.45
PY88	0.63
PY500A	1.60
PY81/800	0.57

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
TV 20 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	1.45
TBA530Q	1.20
TBA540Q	1.45
TBA550Q	1.60
TBA560CQ	1.80
TBA570Q	1.00
TBA800	1.00
TBA810	1.50
TBA920Q	1.80
TBA990Q	1.60
TCA270SQ	1.45
TCA270SA	1.45
TCA1327B	1.00

E.H.T. TRAYS COLOUR

Pye 691 693	4.50
Decca (large screen) CS2030/2232/2630/2632/2230/2233/2631	5.87
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

TRANSISTORS, ETC.

Type	Price (£)
AC107	0.48
AC117	0.38
AC126	0.38
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	0.38
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	1.59

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	0.38
BC141	0.44
BC142	0.35
BC143	0.38
BC147*	†0.12
BC148*	†0.12
BC149*	†0.13
BC152	†0.42
BC153	†0.38
BC154	†0.41
BC157*	†0.13
BC158*	†0.12
BC159*	†0.14
BC160	0.52
BC161	†0.58
BC167B	†0.15
BC168B	†0.14
BC169C	†0.15
BC170*	†0.15
BC171*	†0.15
BC172*	†0.14
BC173*	†0.22
BC174A & B	†0.26
BC176	0.22
BC177*	0.20
BC178*	0.22
BC179*	0.28
BC182*	†0.15
BC182L*	†0.15
BC183*	†0.14
BC183L*	†0.14
BC184*	†0.15
BC184L*	†0.15
BC185	0.36
BC186	0.25
BC187	0.27

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

Type	Price (£)
BC377	0.29
BC394	0.39
BC440	0.52
BC441	0.59
BC461	0.78
BC477	0.30
BC478	0.25
BC479	0.33
BC547*	†0.13
BC548*	†0.13
BC549*	†0.15
BC550	†0.24
BC556	†0.23
BC557*	†0.16
BC558*	†0.16
BC559*	0.17
BCY10	0.30
BCY30A	1.06
BCY32A	1.19
BCY34A	1.02
BCY72	0.27
BD115	1.35
BD123	1.50
BD124	1.85
BD130Y	1.56
BD131	0.58
BD132	0.68
BD133	0.70
BD135	†0.37
BD136	†0.38
BD137	0.40
BD138	0.42
BD139	0.48
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	0.86
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	0.88
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	0.68
BD599	0.87
BD600	1.23
BD663BR	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	0.51
BF137F	0.78
BF152	†0.19
BF158	†0.25
BF159	†0.27
BF160	†0.20
BF161	0.84
BF163	†0.66
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	1.88
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	†1.36
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
ME0404/02	†0.18
ME6001	†0.18
ME6002	†0.18
MJ2955	1.30
MJ3000	1.58
MJE340	0.66
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
2N2926O	†0.14
2N2926Y	†0.14
2N2955	1.12
2N3053	0.48
2N3054	0.66
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	†0.18
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
2N5084	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	†0.40
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	1.65
CA3012	1.45
CA3014	2.23
CA3018	0.71
CA3020	1.89
CA3028A	0.80
CA3028B	1.09
CA3045	3.75
CA3046	0.70
CA3065	1.74
CA3068	1.90
CA3130S	1.57
FCH161	†2.40
FCJ101	†3.32
LM309K	1.98
LM380N-14	1.65
LM1303N	3.08
MC1307P	†1.82
MC1310P*	†1.94
MC1312P	2.34
MC1327P*	†1.86
MC1330P	†0.93
MC1350P	†1.22
MC1351P	†1.42
MC1352P	†1.42
MC1357P	†2.92
MC1358P*	†2.30
MC1458G	1.43
MC1496L	1.15
MC3051P	0.58
MFC4008	0.85
MFC4060A	0.98
MFC6040	1.11
MIC1P	2.58
ML231	†3.57
ML232	†3.57
NE555	0.72
NE556	1.34
NE566	1.95
SAA1024	†5.70
SAA1025	†10.35
SAS560A	†2.01
SAS570	†2.01
SC9503P	†1.40
SC9504P	†1.38
SL414A	1.91
SL432A	2.52
SL450	5.10
SL901B	†4.20
SL917B	†6.60
SL918A	†5.95
SN72440N	†2.21
SN76001N	†1.67
SN76003N	2.22

Type	Price (£)
SN76008KE	1.56
SN76013N	1.56
SN76013ND	1.40
SN76018KE	1.56
SN76023N	1.56
SN76023ND	1.40
SN76033N	2.22
SN76110N	1.20
SN76115N	†1.62
SN76116N	1.78
SN76131N	†2.10
SN76226N	†2.60
SN76227N	†1.61
SN76228N	†1.80
SN76502N	†1.92
SN76530P	†0.97
SN76533N	†1.38
SN76544N	†1.85
SN76546N	†1.85
SN76570N	†1.81
SN76620AN	†0.99
SN76650N	†1.48
SN76660N	†0.64
SN76666N	†0.96
TA7073P	†3.51
TAA263	†2.20
TAA300	†3.85
TAA320	1.10
TAA350A	†2.48
TAA370A	3.18
TAA435	†1.70
TAA450	†3.39
TAA521	1.10
TAA522	2.09
TAA550	0.45
TAA560	1.93
TAA570	†2.30
TAA611A	1.67
TAA611B	1.89
TAA621AXI	2.33
TAA630Q	3.91
TAA630S	4.18
TAA661A	2.39
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	2.66
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	0.48
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	0.26
/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	1.65
PL509	3.10
PL519	3.10
PL802	3.25
PY81/P810	0.60

BRIDGES

Rating		Price (£)
1½A	50V	0.27
	100V	0.28
	200V	0.32
	400V	0.40
	600V	0.50
	800V	0.58
3A	100V	0.52
	200V	0.55
	400V	0.61
	600V	0.67
	800V	0.80
	1000V	1.20

Rating		Price (£)
2A	100V	0.36
	200V	0.40
	400V	0.47
	600V	0.53
	800V	0.60
	1000V	0.87
6A	100V	0.66
	200V	0.68
	400V	0.74
	600V	0.80
	800V	0.86
	1000V	0.95

10A and 25A ranges also stocked.

RESISTORS

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

	Ea	10 of one value	50pc	100pc	500pc
½W 5.6Ω-330kΩ (E12)	3p	25p	95p	£1.40	£6.40
½W 10Ω-10MΩ (E24)	3p	25p	95p	£1.40	£6.40
1W 10Ω-10MΩ (E12)	5p	45p	£1.95	£3.40	£15.25
2W 10Ω-10MΩ (E6)	9p	80p	£3.60	£6.40	£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/D8. VHF/UHF gives standard 8 band colour bars + variable tuning + front panel on/off switch + sync trigger output + blank raster + red raster + crosshatch + greyscale stepwedge + colour bar + centre cross + dot pattern + centre dot. £182.25

TELEVISION COLOUR RECEIVER MK II

SEMI CONDUCTOR PACK No. 1 (Power Supply)

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

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

CONVERGENCE POTENTIOMETERS
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

EAST CORNWALL COMPONENTS

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TELEVISION

Selling Teletext

The National Teletext Week came and went. A good idea, but did you notice it? We can't say that it made all that much of an impact. Yet on all sides the pontiffs are urging that the idea of teletext should be sold to the public: the UK is still ahead in this exciting new field, and we don't want yet another British achievement to be handed over to others to exploit and reap the potential benefits. Quite so. The broadcasters should publicise teletext; the press should give it plenty of coverage; dealers have their part to play with leaflets and displays. Yes indeed.

So are we all pulling together then? Probably as well as we ever do with such things. But where are we getting? It's worth recalling that teletext transmissions (Ceefax and Oracle) were first demonstrated over five years ago, in early 1973. Transmissions have continued ever since, while an initial period of rapid technical development soon resulted in the adoption of a common system by the BBC, IBA and BREMA. Yet the number of teletext equipped receivers and separate decoders in the hands of the public remains quite insignificant. The way it looks at present, the take-off certainly won't occur in the UK. Much more likely that you know who will produce some highly competitive, reliable and probably quite simple teletext sets and adaptors and wipe up the world-wide market. Meanwhile, the time is running out for UK manufacturers.

The problem is neither simple nor easy. The start of TV in the UK in 1936 presented similar problems. There was considerable public interest, but three years later, when the service was suspended at the outbreak of the 1939 war, there were only a few thousand sets in people's homes. There was of course a chicken and egg problem. Sets were expensive when produced in small quantities. Programmes were limited because the funds to make them with were limited. We face similar problems with teletext. The service already available is relatively very much better – producing teletext is a low-cost operation. But the sets are above the prices that the vast majority of people are prepared to pay. As on previous occasions, rental may help: paying a little more each week is less of a financial burden. But the problem could then become an egg and chicken one instead: it's not much good the rental organisations pushing the idea too hard if the public then responds only to find that the sets aren't available.

It's a problem then of getting the market started. And here one sees the difference between the rather confused way in which a service involving some high technology is handled by UK firms and organisations and the rather more successful way in which say a detergent or dog food manufacturer goes about selling what he's got to sell. No self-respecting commercial organisation goes about its marketing without plenty of market research then, when it thinks it's got the product right, a thumping great advertising budget and campaign. It doesn't work out every time of course, but you don't get very far on enthusiasm alone.

Things would be a bit different if the setmakers and broadcasting authorities could get together over selling teletext with the same sense of purpose they demonstrated in getting the system going technically. The question of course is that this is all very well, but where does the money come from? The seller of soap powder or baked beans commits substantial advanced funds to his promotional campaign. Perhaps the setmakers should be stumping up? It's interesting incidentally to compare the promotion of teletext with the promotion being given at present to the Sony, VHS and Philips VCR systems. It's hard to sell high technology to the British public however, and it would probably be better to concentrate on selling the service rather than the piece of equipment that enables you to receive it. But who to tap?

To our way of thinking there's a curious anomaly in the whole situation. A free service is being offered! Why, and do people fully appreciate something they get for nothing? It would seem to us quite logical to make a charge for the service, in the form of an addition to the TV licence fee. We do it already with colour, so why not with teletext? The charge need not be great, so would not act as a deterrent. But what it would eventually do is to generate funds. Which would enable the broadcasters and industry to pay for the promotional campaign that's clearly needed.

CORRECTION

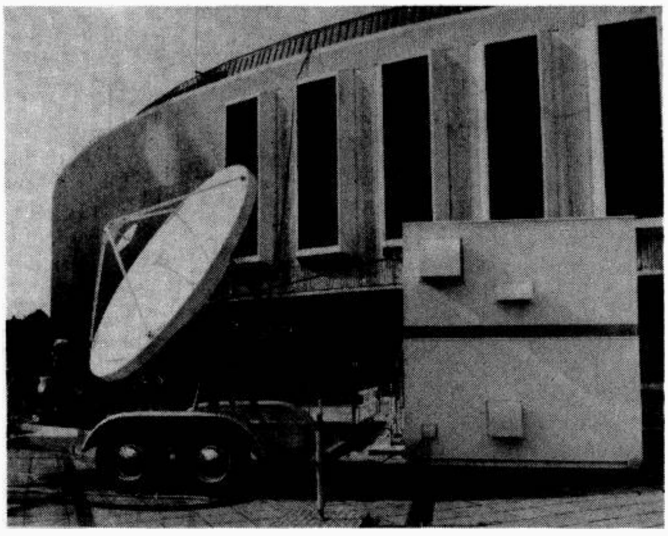
An error occurred in Fig. 1 page 40 last month, where a 33kΩ resistor (R90) should be shown connected from the junction of C70/C75 to chassis. This resistor forms part of the feedback pulse shaping network, providing differentiation in conjunction with C75.

Teletopics

ANOTHER IBA FIRST

The IBA's new, experimental transportable 14GHz "up-link" station for space TV relay use, the first of its type in Europe, was on show at the recent International Broadcasting Convention in London. It became the first transportable space station to provide a link via the European orbital test satellite (OTS) when ITN transmitted its 5.45 p.m. newscast from IBC-78 at Wembley on September 25th. The first successful transmissions of Oracle teletext via space were made from Wembley the following day. The station is housed in a container carried on a conventional medium-sized lorry, with the 2·5m diameter parabolic dish aerial mounted on a one-ton trailer. An output of 2kW is provided by a 14GHz klystron, the station being capable of providing a link from almost anywhere in Europe, opening the way to the use of satellites for instant news gathering at distances beyond the capabilities of conventional terrestrial microwave links. Since the operational provision of such links in Europe is the concern of the telecommunications authorities, the IBA's experiments are being conducted in conjunction with the Post Office. Major components used in the station include a Marconi high-power amplifier, EEV travelling-wave tube driver, EMI-Varian 14GHz klystron and GTE modulator. The two-stage up-converter used was designed and built by IBA engineers.

Meanwhile the IBA-developed system of digital video recording, said to be the most advanced system yet demonstrated, has been taken up by two of the world's leading VTR manufacturers, Bosch Fernseh and Sony Broadcast. Negotiations with several other manufacturers are at an advanced stage. Under the agreements, IBA engineers will provide full know-how and technical advice on the world's first digital system capable of producing colour pictures on one inch tape at tape speeds of less than 10 in/sec. An important feature of the system is that no bit-rate reduction of the picture information is necessary, the information being recorded directly at a bit-rate of approximately 80 million bits/sec. The agreements were negotiated by the Authority's marketing consultants Sinor Conrath Ltd.



The IBA's new experimental, transportable 14GHz up-link space station is the first of its type in Europe.

The IBA has just published a new 20-page brochure entitled *IBA Engineering Progress,* describing recent developments in the transmitter networks for independent television and local radio. Copies of the booklet, edited by Pat Hawker, can be obtained from the IBA Engineering Information Service, 70 Brompton Road, London SW3 1EY.

SKANTIC INTRODUCE VCR

The latest addition to the growing number of VCRs on the market is the Skantic 9281. This machine adopts the Philips VCR standard, giving two and a half hours' playing/recording time. There's a built-in tuner, and recording features include automatic cut-out when the programme being recorded ends.

TRANSMITTER NEWS

New links have been installed to improve the quality of the BBC-1 and BBC-2 transmissions from the **Belmont** high-power transmitter. The link will also improve the reliability of the teletext service in the station's service area.

The final high-power u.h.f. transmitter in the UK network has now come into operation, at **Brougher Mountain** near Enniskillen, Co. Fermanagh. BBC-1 is on channel 22, Ulster Television channel 25 and BBC-2 channel 28. Horizontally polarised group A receiving aerials should be used.

The following relay stations are now in operation:

Eastwood (Nottingham) ATV channel 23, BBC-2 channel 26, BBC-1 channel 33. Receiving aerial group A.

Mynydd Emroch (Port Talbot) BBC-Wales channel 40, HTV-Wales channel 43, BBC-2 channel 46. Receiving aerial group B.

Porlock (Somerset) HTV-West channel 42, BBC-2 channel 45, BBC-1 channel 48. Receiving aerial group B.

The above relay transmissions are all vertically polarised.

NEW POCKET TV

It's understood that a new version of the Sinclair Microvision pocket television receiver – the present version works on most TV systems world-wide – is to be introduced shortly. The new version is likely to be a UK only unit, at a much lower price – a price tag of around £100 has been suggested. Sales of the current version are running at some 4,000 a month.

INCREASING USE OF SWAFs

Last month we mentioned that Rank have started to use a surface-wave filter to form the i.f. bandpass response in their new TV chassis signals board. Previously the use of a SWAF in UK produced chassis had been limited to the recently introduced ITT CVC40 16in. portable colour chassis, but ITT have now announced that the use of SWAFs is to be extended to their complete range of chassis. ITT comment that "the development of mass production and encapsulation techniques has made the use of these devices in the mass consumer market an economic proposition."

A couple of other interesting points from ITT. First, the e.h.t. tripler in their solid-state chassis is now being mounted on spacers so that it operates at a lower temperature level. Suitable spacers are available to dealers from ITT's Spares Department. After fitting, the tripler leads should be carefully dressed to avoid brushing. Secondly, a couple of hints on dealing with the switch-mode power supply used in these chassis. If the BU126 chopper transistor's 1Ω emitter resistor goes open-circuit, check the excess current trip potentiometer and its 1kΩ series resistor for damage and possible value change. When dealing with intermittent shut-down, first check the TDA2640 control i.c. by substitution then, if the fault persists, replace the 125V (HT3) rectifier (BYX71/600). Also ensure that the line hold control is correctly set.

SOUNDS VINTAGE

No, not the editor. A new bi-monthly magazine which will be devoted to information, news, views, advice and general information on both the "hardware" and "software" of vintage sound. The first issue is due for publication in January 1979. Well, I take it some of you are interested in things other than old tellys. If it tells me how to get Brian Rust's *Mardi Gras* on a Lissen set with bright-emitter valves I'll be well pleased.

PHILIPS' LONG-LIFER

Twenty-three years ago Albert Dyke of Mill Hill, London decided to buy his wife their first television set, a 14in. Philips 1757U console receiver. The set has been regularly switched on each evening and it's estimated to have given some 35,000 hours' viewing, apparently without ever breaking down. Well, a nice big airy cabinet probably helped, but even so this must be a record and says something for the quality of these Philips sets. Eventually the set did fail however, and when Philips heard of the couples' difficulties they were presented with a brand new 20in. G11.

METZ COLOUR RECEIVERS

A new range (Metz) of W. German colour receivers now being marketed in the UK includes some interesting technical features. The range is being handled by Paul Spring Electronics. The most interesting technical aspect is yet another variation on the power supply/line output stage theme. The system adopted (see Fig. 1) is unusual in combining a shunt chopper switch-mode power supply with a thyristor line output stage. Since it's relatively simple to effect stabilisation within such a line output stage, you may wonder why this solution was adopted. The answer is that it provides mains isolation (transformers T1 and T2) without the need for a substantial mains transformer. This solution could have been adopted for our own colour receiver. We felt however that a 50Hz mains transformer, though more expensive, is more suitable for a constructors' project than the added circuit complexity of the Metz approach.

The chopper transistor is Tr1801, which is driven by Tr1381. In addition to providing a pulse to switch on the flyback thyristor, the line oscillator also triggers a monostable circuit which provides a wider pulse. This is converted to a sawtooth waveform, which is one of the inputs to a pulse-width modulator circuit consisting of a long-tailed pair. The other input is a sample voltage from the line output stage, set by the set e.h.t. control. From these two inputs the pulse-width modulator provides a drive pulse for Tr1381 (in practice a stage of amplification is interposed), the width of the pulse varying as required to effect stabilisation by adjusting the on-off time of the chopper transistor. A start-up supply is required for the line oscillator of course, also a protection circuit, but to simplify matters these have been omitted from our diagram.

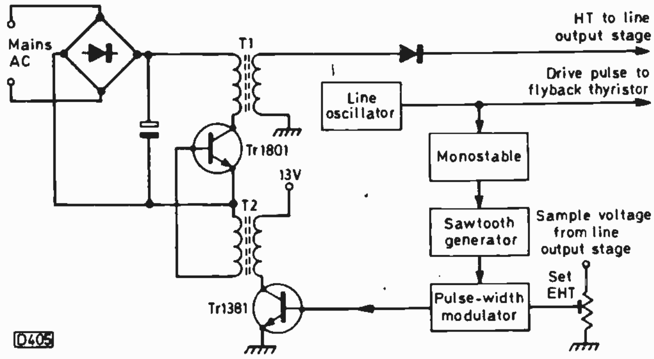


Fig. 1: Switch-mode power supply used in Metz colour receivers.

NEW TV JOURNAL

A new quarterly magazine, *Television and Home Video*, has been introduced by Link House publications. The first issue is dated Winter 1978/79 and costs 50p. It's aimed at the user of the ever increasing amount of TV/video equipment being marketed, the first issue containing interesting articles on the sorts of subjects you'd expect, such as TV games, VCR formats, projection TV equipment, teletext and viewdata, videodiscs, a report on the US scene, and a buyers' guide.

MORE TELETEXT EQUIPMENT

A 26in. colour receiver with teletext facilities and full remote control has been added to the Philips range. Other features of Model 674 include twin speakers and a headphone socket. The set can also be connected to a tape recorder or hi-fi system. Amongst the teletext facilities are a timed page to give an on-screen reminder, a hold button, and reveal facility.

Radofin have introduced an add-on teletext decoder at a suggested price of around £200. It comes complete with a remote control system and can be used with most colour and monochrome sets. The aerial plugs into the decoder, which then plugs into the receiver. Facilities include full colour display, doubled character height, and doubled resolution for easier viewing. Enquiries to Radofin Electronics (UK) Ltd., 91/3 King Street, London W6 9HW.

LEDCo's REPLACEMENT CDA PANEL

We have received further details – and a sample – of the LEDCo Model 705 solid-state CDA replacement panel for use in the Pye group hybrid colour chassis. In addition to the panel, a circuit and setting up instructions are provided. The luminance channel consists of a Darlington pair (compound emitter-follower) driving a BF459 video output transistor. The colour-difference signal channels consist of preamplifiers a.c. coupled to two-transistor driver/output circuits incorporating feedback clamps of the type familiar in the Rank A823 and ITT CVC5 chassis. BF259 transistors are used in the colour-difference output stages, a 200Ω resistor on a substantial heatsink replacing the valve heaters. The panel is a direct plug-in replacement, and has undergone a long term testing programme in conjunction with leading rental companies. The one-off price is £18.67 (excluding VAT) from LEDCo., 62 High Street, Croydon CR9 2UT. Discounts are available on quantity orders and delivery is normally ex-stock. LEDCo. also have a direct solid-state plug-in replacement for the PL802 (module PL802S) at a one-off price of £2.40, and a direct plug-in audio module, Model 702, designed as a replacement for the hard to get Mullard LP1162 used in the Pye group hybrid colour chassis and certain audio equipment. The latter is of the same physical size as the LP1162, fitting exactly in place of the original. Only six soldered connections are required, and the terminals are marked to avoid any confusion. The one-off price is £5.75 excluding VAT.

TELETEXT/VIEWDATA DEVELOPMENTS

Cherry Leisure is planning to introduce coin-operated viewdata terminals and has already received Post Office approval of its prototypes. This will enable the service to be used without having to purchase a set costing several hundred pounds. The main aim however is to get sets rented by high street dealers for demonstration purposes. Customers could then have a try out for "a few pence". The PO has recently altered its construction requirements, which will help in keeping down costs: instead of being based on a standard television chassis, a Prestel unit can now consist of a monitor/decoder feeding into an ordinary set for display purposes. ITT have produced a TV-linked printer to enable teletext or Prestel pages to be produced on paper at the touch of a button. This is obviously an aid where it's required to have several pages available simultaneously for comparison or for subsequent study. ITT are now carrying out a feasibility study into the production of a hard-copy printer to sell at a price acceptable to buyers of Prestel receivers. In view of the need to aim at a world market, the printer should ideally be able to cater for a wide range of language signs and accents in addition to the standard Latin-based alphabet. In ITT's latest prototype printer the range has been widened to include almost 200 accented characters, giving full on the spot print-out facilities in 37 languages used by about 500 million Europeans. This development has been carried out in close collaboration with the PO.

EVERY HOME NEEDS AN IVT

According to a report recently published in the USA the IVT – integrated video terminal to you – will be on the market within four years and will be a billion dollar industry within ten years. The IVT will be a combined TV set, telephone, VCR and home computer. The report also introduces the interesting new term "narrowcasting" – where everyone in the street's glued to the box but watching something different.

Frustrating Follies

Les Lawry-Johns

SOME very funny things have been happening around here lately. Take the other morning for instance. In came this fellow, well turned out and apparently friendly.

"Fark you" he said, and held out his hand.

Not wishing to return such offensiveness, I took his hand and merely said "Good morning."

Peacock Tale – Start

"I have a Peacock" he confided. "It's got a bit missing. I know what it is but it gets red hot when I put it in and I wondered if you have a bigger one that won't get so hot."

Now I'm very easily confused. Most people get muddled when under stress. I start off muddled and when the stress starts I just go to pieces. My only salvation then is pure habit. So I reached for the job pad and started the routine.

"Could I have the name please?"

"I've already told you" he said impatiently. "Farqueue." He spelt it out, to my relief.

"What type of set are we on about?"

"A Finlux Peacock of course."

The penny began to drop, and the panic subsided.

"What value did you put in that got so hot?"

"I don't know much about these things, but my friend told me that I needed a 47Ω wirewound resistor and I got a 17W one but it got red hot. So I thought if you could let me have say a 30W one it would do the job."

This sounded reasonable enough, so I managed to find a 47Ω dropper of adequate wattage and off he went, leaving me to tackle an Ultra 6816 (1590 chassis) portable which had the complaint "not working".

A White Ultra

Lifting off the shell, a meter applied to the regulator body (l.t. rail) showed about 7V, varying slightly. This proved a couple of things: the l.t. fuse was intact, and the current being drawn was not enough to blow it – provided it was of the correct rating. To check the latter point it has to be removed, due to its awkward position. So out came the fuse. It was correct at 2·5A. The next step was to check just what the current being drawn was. If it was low, the regulator itself could be faulty, if it was higher than normal the regulator was probably o.k. but was being overloaded. It was high, at about 2A, and varying. The 10Ω resistor in parallel with the regulator transistor (on the front left) was also getting hot. On switching on and moving the volume control however some slight audio noise could be heard, so it was unlikely that the fault would be in this area.

Attention was therefore directed to the line output stage, where our old adversary the AU113 line output transistor was getting quite warm. This meant that it was unlikely to be at fault, since there are no half measures with this: if it shorts, it blows the fuse with none of your 2.5A niceties. Since it was warm it was being driven by the line oscillator and driver. There was an overload on the line output stage therefore, and the first step was to unload whatever could be unloaded.

We didn't actually have to get that far. A finger on the 95V supply rectifier W14 was hastily withdrawn. The fact that the diode was hot meant that it was either shorted or had a short across it, probably its reservoir capacitor C111. Whichever it was disconnecting the diode at one end would remove the overload, so off it came.

There was an immediate response. The sound hissed into life, frightening the dog out of his life, the tube heater lit up, and we smiled. For a moment that is. There was a funny crackling noise, and we were back to square one. Voltage low, no hiss, tube heater out. Oh dear. Check this, that and the other to no avail. Precisely the same symptoms as before, except that there was no overheated diode to blame. Scan coils? Unhook the scan-correction capacitor C108 to check this possibility. No difference. With all else unloaded, only the line output transformer was left. What will Mrs. Carp say? Ring Mrs. Carp.

"Hello Mrs. Carp. Your little white portable needs a transformer and a couple of bits: it'll cost a bob or two."

"Never mind, it's all I've got so you do it and I'll be in at the end of the week."

"Righto Mrs. Carp, bye."

So in went the transformer and a diode. Check the regulator and solder up the bar of the tuner unit (it was practically off at one end). That was that.

Peacock Tale – Resumed

Enter Mr. Farqueue.

"It's no good, that thing you gave me. It still gets hot and the set doesn't work properly with it. Will you have a look at it?"

So we got the Peacock on the operating table. The item in question was on the left side, or rather there was a space for it with two leads dangling nearby with clips on. There was already a dropper or large wirewound next to the empty space, and this was marked 47Ω.

"I took out the one you gave me, as it was obviously wrong."

"It was your idea that it was 47Ω, not mine" I protested stoutly.

"Well, what the dickens should it be?"

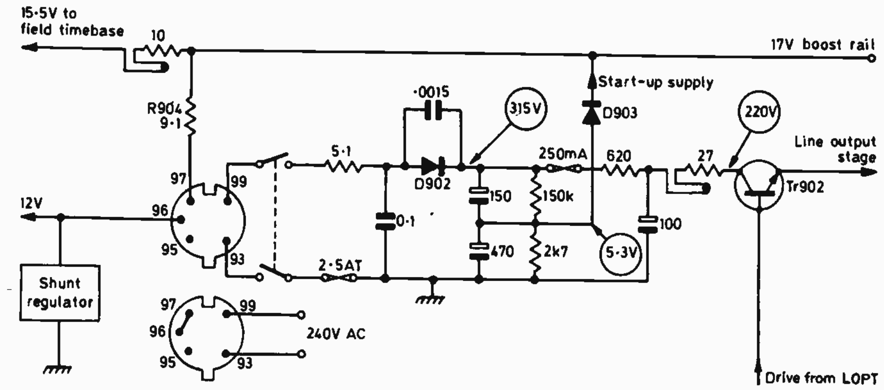
"I'll have to look it up." So saying I rummaged through my service sheets and wished I'd left them in the right order. There they were. Three separate sheets. Check on the layout diagram. The resistor in question was given as R111. Check the value of R111. On the power supply list this was shown as 390Ω! I whipped the sheet under Mr. Farqueue's nose.

"Look. 390 bloody ohms. Not 47, 390. Would you believe it?" Privately I was thinking to myself what funny things these Peacocks are. Who was I to argue?

Rake out a 390Ω wirewound. Fix clips and switch on. Funny noise and the resistor smoked, but the Peacock didn't really respond. Apart from the noise, not much else happened, though the resistor was obviously uncomfortable.

Switch off and see what the circuit had to say about R111. Across the degaussing coils! Were the coils open-circuit? In any case the current should have fallen away quickly. And why didn't the set work without it? Panic set in and reason went out of the window.

Look more carefully I told myself. Recheck and be methodical, like wot you always tell other people to be. Check the degaussing circuit. The 390Ω resistor is there on the board on the left side. If it's there, it can't be somewhere



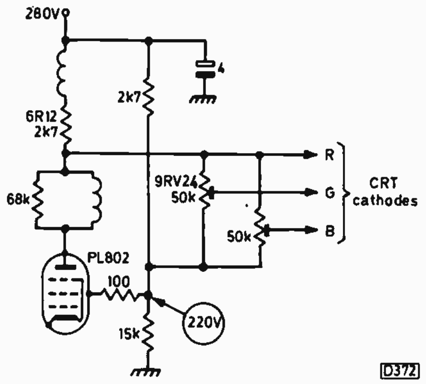


Fig. 1 (left): Since all the stages in the Indesit T12LGB monochrome portable are powered from supplies obtained from the line output stage, a start-up system is required. At switch on diode D903 feeds a reduced (5.3V) voltage to the boost rail to get the line oscillator, which is powered from the stabilised 12V rail, to start. Once the line output stage comes into operation, the 17V boost supply is developed and D903 switches off. With no link between connections 96/97 to the mains plug, the line oscillator can't start. Hence no results.

Fig. 2 (right): Luminance drive to the c.r.t. cathodes, Bush CTV25/CTV162 series. An intermittent heater-cathode short in the green gun led to the demise of 9RV24, leaving the green cathode without drive.

else, can it?

So we have two items marked R111 on the sheets. One is obviously right. So what should the other one be? Check the power supply layout shown against the circuit, and check the values. The large 47Ω wirewound is shown as R115. Its listed value is 1kΩ! Is there a 47Ω resistor on the list? Yes, R104. Ah.

If that's marked wrong, what else? The one item not in the set is R102, 4·7Ω. It's also not shown on the layout.

It's a good bet therefore that if R115 is actually R104, R111 should really be marked R102. Proceeding on this tack, we fitted a large 4·7Ω resistor and checked the flyleads back, just to be sure. Yes, a bullseye! Connect up and switch on.

O.K. sound. O.K. vision, R102 normally hot only. Mr. Farqueue departed with his Peacock, having witnessed a triumph of mind over wrongly marked service sheets. Trader service sheet, 3154/T411. Horizontal chassis layout. Change R115 to R104, R111 to R102.

An Orange Indesit

An orange Indesit. No not colour, just one of those little T12LGBs. We've had our share of these in for repair, as most have I suppose. Usually they're not a lot of trouble, neither would this one have been if....

Chap by the name of Beaton brought it in with just the message that "it doesn't go."

When its turn came we plugged it in. Sure enough, nothing. Off came the shell and we checked the supply from the socket up to the on-off switch. Everything in order so far. The fuses were intact and our tiny mind started saying "pump circuit, start-up supply to the line oscillator," and funny things like that.

We had full h.t. at the collector of the pump transistor TR902 (see Fig. 1), but this was not switching on. We had very nearly 300V in fact, instead of about 220V. Reaching for the circuit and looking at the line output and power circuit, we missed what was right under our nose and continued the search, moving on to the start-up supply diode D903. This should have 5·3V at its anode, but the reading was only 2·5V. We then started to panic. Check here, there and almost everywhere. Everything read right, transistors, electrolytics – nothing escaped examination. At last my spirit broke.

I turned the convergence mirror and looked at my ravaged face, careworn and despair written on every line. I let out a despairing cry and buried my head in my hands.

At this, my little honey bee came on the scene.

"Now what" she asked. "What's all the noise about?"

"I'm finished, that's what. I'm going to do away with myself and end all this suffering."

"You said that last week" she said sympathetically. "I saw the insurance man, but you didn't do anything."

"Well I'm going to, you'll see. You'll miss me. At the going down of the sun and in the morning, you'll remember me. You'll be sorry when I've gone to New Zealand and walked into the water at some lonely beach, never to be seen again."

"New Zealand? Why all that way when the river's only a few hundred yards off."

"The water's cold, that's why."

"What's it all about. Can't you find out what's wrong with that little set?"

"No I can't, and I've checked everything."

"Probably the plug. Anyway I've got a lot of things to do."

So off she went. The selfishness of women never ceases to appal me. Wearily I turned back to the horror.

Glancing down at the circuit again, I saw some funny drawings of the mains input and battery input plugs. As well as the actual mains input connections, there's also a link on the mains plug connecting pins 97 and 96 to feed the 12V shunt regulator. On reversing the small input panel, and with the plug in but not connected to the mains, we found that there was no continuity between the two pins. Slapping a shorting link between them and applying the mains brought on full sound and a raster.

All that suffering for nothing. I should have tried it on battery first. Removing the link and examining the moulded mains input plug (socket) showed that it had been tampered with, so that the connectors on the link side could not make proper contact. When will I learn?

And a Mauve Bush

Some years ago we had sold a Bush CTV162 (a 19in. development of the CTV25). It came in the other day with the complaint that the picture had gone mauve.

As far as we could see (not very far), it was simply a matter of finding out where the green had gone. The best place to start is at the tube base, to see if the green first anode is low or the grid-cathode voltages too close compared to the red and blue guns. The first anode of the green gun was about the same voltage as the red and blue first anodes, so we checked the green cathode. This seemed much the same as the other two cathodes, but there was a sudden surge of green illumination when the meter touched the pin.

Noting this fact we checked the three grids, which were all 100V give or take a volt or two. So we went back to the green cathode and checked again. The meter swung up to the 200V mark (approximately) and the screen glowed green. When the meter was applied to the red or blue cathode there was no increase of either colour, which was queer since all three voltages are obtained from the PL802's anode, the blue and green via two presets (see Fig. 2). Presets, that's it.

Sure enough the green preset 9RV24 read open-circuit, and in fact was found to be burned out. Must have been a nasty flashover, we stupidly thought. To see what would happen we fitted a new preset and set it up. This resulted in fully adjustable green, and after a bit of fiddling a well nigh perfect grey scale. Turning up the colour presented a very creditable picture indeed.

Nothing untoward happened for quite some time, and we were beginning to think that our fears were groundless when there was a sharp metallic click and off went the picture. Scrambling for the meter was rendered unnecessary because the green preset smoked up and the PL802's anode resistor 6R12 became red hot. Heater-cathode short in the green gun.

Look at circuit. The tube heater was not alone on the 6·3V winding, so we couldn't play tricks with it. We had an RS heater isolating transformer on the shelf however, so this was pressed into service – screwed on the centre woodwork under the tube. Connecting the primary of this to the mains 5A fuseholder and chassis, with the secondary to the tube to replace the original heater leads, resulted in normal results once the preset had again been replaced and the PL802's load resistor checked. We added a 100kΩ resistor from the green cathode to the heater to remove any potential stress however, and it's been as right as ninepence ever since.

Series Voltage Stabilisers

S. W. Amos, C. Eng., B.Sc., M.I.E.E.

ONE of the disadvantages of transistors when used in analogue equipment is that their performance varies with the supply voltage – users of battery-driven transistor recievers are well aware of this. For consistent performance the supply voltage must be constant, and it's normal practice in television receivers and hi-fi sound equipment to incorporate a voltage stabiliser in the power supply circuits. In portable television receivers designed to operate from car batteries or the mains supply, the stabiliser circuit must be capable of working with an input voltage as low as 12V.

The stabiliser has two distinct functions. First, to maintain a constant output voltage (which can be predetermined) despite variations in input voltage, whether from the mains or batteries. Secondly to maintain a constant output voltage despite variations in the current drawn by the receiver. This latter quality is often termed "good regulation", and is achieved by giving the stabiliser circuit a low output resistance. This also has the advantage of minimising any tendency to instability in the receiver due to the common impedance of the power supply circuit.

Most of the circuits used to give a constant supply voltage are series stabilisers, which can take many forms although using a common principle. A number of these circuits are analysed in this article to demonstrate their advantages and disadvantages. But first it's useful to consider series stabilisers in general, so as to identify the functions which are necessary for their proper operation.

The block diagram shown in Fig. 1 shows the essential features of a series stabiliser. The stabilised supply is derived from an unstabilised supply (e.g. a mains rectifier or a car battery) via a series stabiliser stage which is controlled so that it maintains a constant output voltage. The control signal is derived from a comparator stage which compares a sample of the stabilised voltage output with a constant reference voltage. If the sample of the stabilised voltage is obtained from a potential divider as suggested in Fig. 1, this divider can be adjusted to give a desired value of stabilised voltage. The constant reference voltage can be obtained from a zener diode which can be fed via a series resistor from the stabilised or the unstabilised supply.

The Classic Circuit – and Variants

The comparator stage can for example be a single npn transistor (see Fig. 2) with the sample voltage applied to the base and the constant reference voltage applied to the emitter. The zener diode then effectively presents the emitter with a very low impedance, so that the full gain of a common-emitter amplifier is available from the comparator transistor. If there's a sudden increase in the current drawn from the stabilised supply there's a tendency for the output voltage to fall. This causes a fall in the base voltage of the comparator transistor, and its collector voltage therefore rises. This positive voltage step is applied to the base of the stabiliser transistor and, to supply the additional current required, the stabiliser transistor must be made more conductive by this positive step in the control signal. The stabiliser transistor must therefore be an npn type. A second requirement of the stabiliser transistor is that it must not introduce phase inversion: the positive step applied to the base must cause a positive step in stabilised output voltage so as to offset the fall in stabilised voltage assumed initially. An emitter-follower is therefore the obvious choice

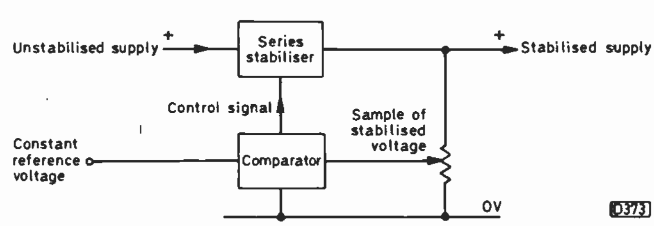


Fig. 1: Basic features of a series stabiliser circuit.

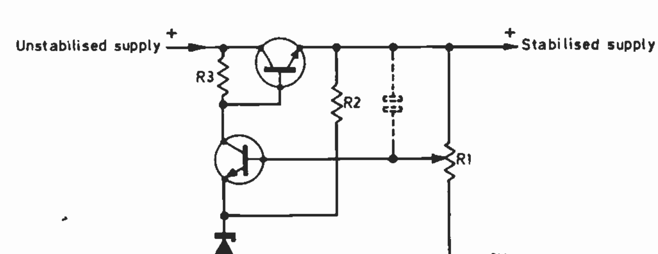


Fig. 2: The "classic" series stabiliser circuit, requiring an npn emitter-follower as the series stabiliser element.

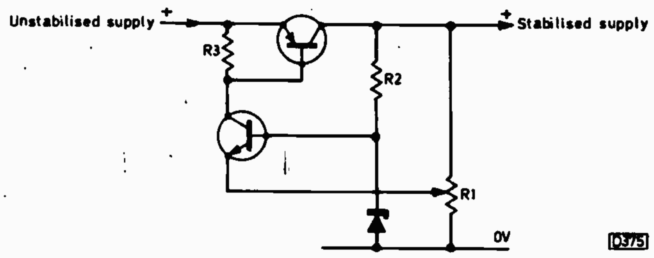


Fig. 3: The classic circuit with the connections to the base and emitter of the comparator transistor interchanged. This modification means that a pnp transistor in a common-emitter stage is required as the stabiliser.

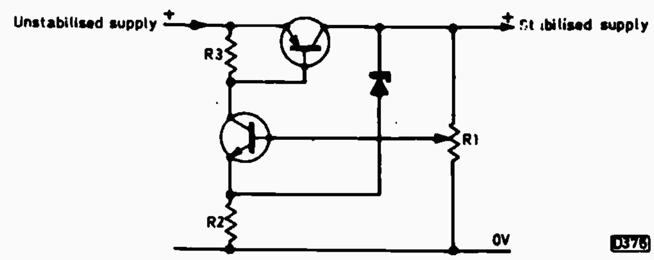


Fig. 4: The arrangement as in Fig. 2, but with the zener diode and its feed resistor interchanged. This can give improved stabilisation and is a very popular circuit.

for the stabiliser transistor, and the circuit so deduced is shown in Fig. 2. It can be considered the "classic" series stabiliser circuit.

The above account explains the process by which variations in the stabilised output voltage are minimised: it's in fact one of negative feedback, the potential divider R1 controlling the degree of feedback. As the slider of R1 is moved upwards, the degree of feedback is increased and the variations in stabilised voltage decreased. Moving the slider of R1 upwards also has the effect of reducing the stabilised voltage. From this we can deduce that if the upper arm of the potential divider is shunted by a large capacitor (as shown in broken lines in Fig. 2) then the degree of feedback will be increased for any alternating voltages present on the stabilised supply output terminal. Thus if the capacitor is made large enough for its reactance at 50 or 100Hz to be negligible compared with the resistance of the lower arm of the potential divider, then any ripple on the stabilised supply will be minimised.

Now suppose that the connections to the base and emitter of the comparator transistor in the classic circuit shown in Fig. 2 are interchanged, the sample voltage going to the emitter and the constant reference voltage to the base (see Fig. 3). An increase in load current will now cause the comparator's emitter voltage to fall so that its collector current increases and its collector voltage falls. The comparator transistor now operates as a common-base amplifier, which does not invert the polarity of signals applied to the emitter. The stabiliser transistor must now be such that it's made more conductive by the negative voltage step at the comparator's collector, a pnp transistor therefore being required. We also want the stabiliser transistor to introduce a phase inversion, so that the increased current output from the stabiliser is accompanied by an increase in stabilised voltage. A common-emitter stage is therefore required, the circuit taking the form shown in Fig. 3. This is not such an effective circuit as Fig. 2, because the negative feedback due to the resistance in the external emitter circuit reduces the voltage gain available from the comparator transistor.

Both circuits suffer from the disadvantage that changes in the stabilised voltage caused by changes in the load current are not passed on in full to the comparator transistor. This is a consequence of using a potential divider to convey the voltage changes: yet a potential divider is desirable to enable the stabilised voltage to be set to the desired value.

The effectiveness of the circuit could be improved if the whole of any changes in the stabilised voltage could be transferred without loss to the comparator transistor. This can almost be achieved by interchanging the positions of the zener diode and R2 in Fig. 2, as shown in Fig. 4. This version of the circuit is interesting because any changes in stabilised voltage are applied to both the base and emitter of the comparator transistor, and the effects on its collector current are of course opposite. The voltage changes are

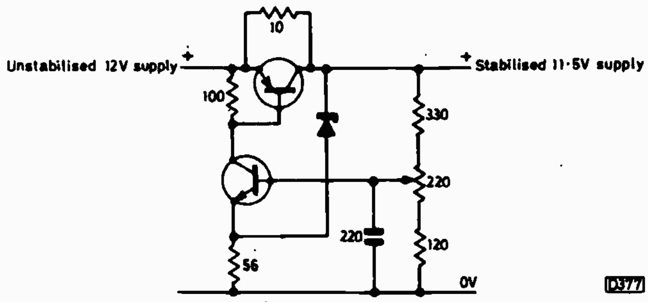


Fig. 5: Stabiliser circuit used in Thorn 1590/1591 monochrome portable chassis.

applied to the emitter unattenuated (the voltage across the zener diode being constant) but attenuated to the base by the potential divider. Thus if we can arrange for the potential divider to be at near the bottom of its travel, then nearly all the changes in stabilised voltage effectively reach the comparator transistor.

And they are applied to the emitter. Thus an increase in load current causes a decrease in the comparator transistor's emitter voltage and a decrease in its collector voltage. Thus a pnp transistor as a common-emitter amplifier is required for the stabiliser stage, as shown in Fig. 4.

A further advantage of this circuit is that the zener diode gives a useful attenuation of ripple on the stabilised supply because it has negligible impedance at ripple frequencies and thus behaves in the same way as the capacitor across the upper arm of the potential divider described earlier. It's not surprising that this circuit is greatly favoured by television receiver manufacturers.

Gain

The comparator stage has been regarded so far as a voltage amplifier, for the purpose of deciding the transistor type and the form of circuit to be used for the regulator stage. This may be justified when the stabiliser is an emitter-follower with a high input resistance. When the stabiliser is a common-emitter stage however it's clearly more accurate to think of the coupling between comparator and stabiliser as one which transfers current rather than voltage. Indeed if any meaningful calculations of gain are contemplated, it's essential to think of the circuit as a current amplifier even when the stabiliser stage is an emitter-follower. The current gains of a common-emitter amplifier and an emitter-follower are in fact approximately equal, so it doesn't greatly matter which of these two forms of connection is used for the stabiliser stage.

There is one significant difference between the two forms of stabiliser stage worth stressing however. To achieve maximum current gain, all the current changes from the comparator stage should be passed on to the stabiliser stage. This requires that the collector load resistor R3

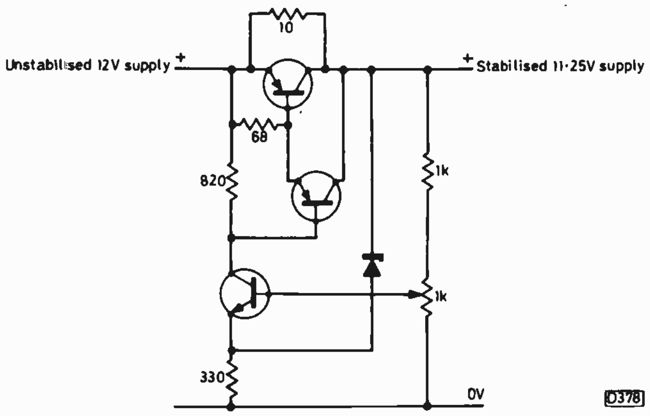


Fig. 6: Stabiliser circuit used in the Decca Gypsy portable.

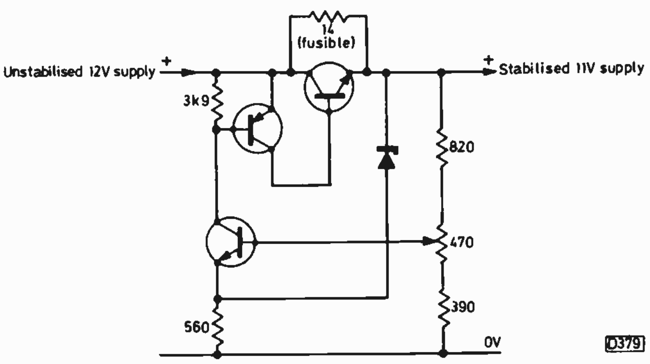


Fig. 7: Stabiliser circuit in the Rank BM6514 portable.

should be large compared with the input resistance of the stabiliser – a normal requirement, of course, in any current amplifier. If the stabiliser is an emitter-follower stage supplying say 100mA of output current, its input resistance could be as high as 1kΩ and R3 should ideally be several thousand ohms. If the average collector current of the comparator stage is several mA, it's clear that a considerable voltage drop – easily 10V – is required across R3. This clearly precludes the use of such a circuit in a portable television receiver intended to work from a 12V battery, but it is used in mains-driven receivers where such a voltage drop causes no problems. For example this circuit (Fig. 2) is used in the Thorn 8000 chassis to give a 25V regulated supply for the signal stages, the input voltage from the mains rectifier being about 35V.

If the stabiliser stage is a common-emitter circuit supplying 100mA of collector current the same problem doesn't arise. The input resistance of a common-emitter stage is possibly only 25Ω, so that R3 need be only 250Ω to secure maximum gain. This circuit then is likely to be favoured by designers of sets destined for operation from 12V batteries, and Fig. 5 shows the circuit of the stabiliser used in the Thorn 1590 chassis.

Degree of Stabilisation

The degree of stabilisation achieved depends on the current gain of the circuit. This can be shown by a typical calculation. Suppose the mean collector current of the comparator transistor is 5mA. Its mutual conductance is then about 200mA/V, and a voltage change of 5mV at the base (or at the emitter) will change the collector current by 1mA. Let us assume that this change is handed on to the stabiliser stage without loss, and that the stabiliser has a current gain of 50. Then for a 1mA change in comparator current, the stabiliser output current will change by 50mA. We must now make an assumption about the transfer of

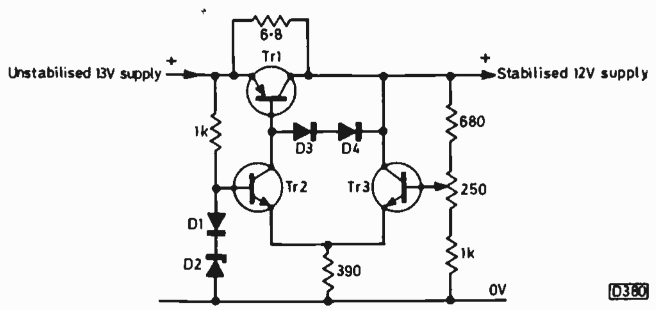


Fig. 8: Stabiliser circuit using a differential amplifier as the comparator. Used in the Tandberg CTV3 chassis to provide a stabilised 12V supply for the signals board.

changes in regulator output voltage to the comparator transistor. This depends on the circuitry used, but a reasonable assumption is that half the changes are effectively transferred to the comparator. Then the change in stabilised voltage is 10mV for a current change of 50mA. This represents an effective output resistance of 0·2Ω.

Clearly this figure could be improved by increasing the current amplification. One way of doing this is by using as the stabiliser stage two transistors connected as a Darlington pair. An example of such a circuit is shown in Fig. 6, taken from the Decca Gypsy receiver. Another way of increasing the current gain is to follow the common-emitter stage in a circuit such as Fig. 4 by a further stage of amplification. Clearly this additional stage must not introduce phase inversion, and must therefore take the form of an emitter-follower. An example of such a three-stage circuit, taken from the Bush Model BM6514, is shown in Fig. 7.

In a television receiver driven from a 12V battery very little voltage drop can be tolerated across the stabiliser stage: in practice it's commonly less than 1V. To minimise this drop, it's usual to connect a low-value resistor in parallel with the stabiliser transistor. Such resistors are included in the circuits shown in Figs. 5, 6 and 7. This resistor also reduces the dissipation in the stabiliser transistor, but necessarily impairs the degree of stabilisation achieved in the circuit, thus emphasising the need for high current gain.

Differential-amplifier Comparator Circuit

In all the circuits so far discussed the comparator stage has consisted of a single transistor with the two inputs applied to the base and emitter. A more elegant form of comparator is a long-tailed pair, with the two inputs being applied to the two bases. To conclude this article, an example of a stabiliser circuit using a long-tailed pair (differential amplifier) is shown in Fig. 8. It's used in the Tandberg CTV3 chassis to provide a stabilised 12V supply for the signals board. The 13V input is obtained from a rectifier fed from the pulse winding on the line output transformer. A fall in the output voltage will reduce Tr3's base voltage and thus the emitter voltage of the two transistors Tr2/3 in the comparator circuit. Tr2's collector voltage will thus fall, and this implies that the stabiliser stage Tr1 must be a common-emitter one as shown.

The advantage of using a differential amplifier is that drift in one transistor will be cancelled by the resultant effect on the other one. D1 and D2 compensate for the effect of temperature on each other. D3 and D4 are included to protect the stabiliser transistor Tr1 should the output be short-circuited. In this event D3 and D4 will reduce the voltage across Tr1 to a safe value until the fuse in the 13V supply goes open-circuit. ■

Letters

REDIFFUSION Mk. 1 COLOUR CHASSIS

I was surprised that Les Lawry-Johns had not come across a Doric TV receiver before. They are made by Rediffusion, and I suspect that the set concerned was the Mk. 1 colour chassis. This is a reasonably conventional hybrid chassis using just two valves (PY500A boost diode and PL509 line output valve). You may be interested in the following notes on it.

A fault which often appears is generally referred to as the "double-vision effect". It's caused by one of the earthed ends of the luminance delay line windings going open-circuit. These delay lines consist of a coiled length of wires (about 7-10 strands). If one strand breaks, the whole thing turns into a form of reverberation unit, with the result that two instead of one signal per line is received at the output, slightly separated. The fault is usually cured by changing the delay line. If the board is a BEAB approved one, the replacement must be of the same type.

Hanover blinds can be removed or reduced by manually adjusting, alternately and with care, the chroma delay line circuit delay gain and phase controls RV201 and L202. Note that various types of chroma delay lines have been used.

The decoder reference oscillator can be very simply set off-air by placing shorting links between TP16/17 and TP14/15 – to produce a display in which the colours run through – then adjusting the oscillator trimmer TC235 to obtain the slowest running through with the colours running horizontally. Don't use a screwdriver or similar instrument for this adjustment: the appropriate trimming tool is in the RS range.

Intermittent colour or luminance can be caused by plug/socket PL/SK2 at the top of the decoder panel fitting incorrectly, or by dry-joints or defective print in this area.

The ident transistor TR207 is at the bottom of the decoder board, adjacent to the ident coil L207. It's important to use the correct type of transistor in this position. It may need replacement if the following fault is experienced. At switch on there's no colour, the colour taking a time to appear – gradually. The colour remains so long as the set is warm. To prove that the transistor is responsible for this fault, spray it with freezer. On the BEAB board use a BC147B. On early panels use a BC107B or C. On newer boards use a BC107C only.

If it's necessary to replace the line output valve's 2·7kΩ screen grid feed resistor R503, use one of suitable wattage (7W) and ceramic construction so that it can be placed against the metal chassis.

When the PL509's 125μF cathode decoupling capacitor goes you know it – there's a bang, a whisp of smoke, an acrid smell and a mess of paper foil and acid in the back of the set. The usual causes are a heater-cathode short in the valve, an open-circuit cutout, or shorting to chassis (also causing other problems).

Another 125μF capacitor, C320, decouples the slider of the set beam current limiter control on the RGB output panel. This can be responsible for an unusual luminance fault: part of the picture is of the usual brightness with the other part dark, the ratio of the light/dark levels varying with adjustment of the brightness or contrast controls. The trouble may be due to a defective capacitor or a dry-joint. If the latter is suspected, resolder *all* the joints in the area and look for signs of high-resistance/burn-up in the immediate vicinity.

The focus unit used in older versions has a rod-type adjustment (as in the Rank A823 chassis). Replace it with a more modern type of unit – there's a fire risk with the older ones.

The screen grid of the PL509 line output valve is decoupled by an 0·1μF 400V working capacitor on the valve base: check for shorting, burn-up or open-circuit – this can cause some wierd faults if you don't check it.

When replacing the tripler, make sure that the leads are dressed away from the chassis and bare leads.

It's worth changing the 180/220pF fifth harmonic tuning capacitor (C505) on the line output transformer for either an up-rated or 270pF type, resetting the width – these capacitors have a habit of burning up at the most inopportune times.

I hope these hints will prove of help – good luck to all trouble-shooters.

Editorial note: Our kind reader didn't supply his name and address. Please write in so that we can make a payment for the useful information supplied.

Here are one or two more tips from our files. Cramping at the bottom of the screen – change the 2N3055 field output transistor (TR600). Varying purity – check for a dry-joint at 8J or 8H on the c.r.t. base panel (degaussing circuit earth return path). Poor colouring due to insufficiency of one colour, worse after an hour or so – check the appropriate 2·2μF feedback clamp reservoir capacitor in the RGB channels for leakage (C301 red, C305 green, C310 blue).

CRT REACTIVATION

While tube reactivators of the type described by G. T. Jones (*Letters,* October) and other contributors are doubtless very effective in many cases, I've found that tube reactivation is very much more effective when the heater is first over-run, as in various commercial units. In fact I had a very good commercial unit which suffered some damage, as a result of which heater voltage boost could not be applied during the reactivation process. This made it almost totally useless, but once repaired so as to give increased heater voltage it again proved highly effective on many occasions. – **G. R. Wilding,** *Paignton, Devon.*

TEST CARD GENERATOR MODIFICATIONS

The following modifications to the test card generator featured in the May/June issues may be of interest. First, where outputs are connected together, in particular IC24. This can be replaced by an open-collector 7403 i.c. Two pull-up resistors are required, from pins 8/11 and 3/6 to the 5V rail. They can be fitted on the PCB in place of through the board links. Plus 5V links are next to IC24 pins 1 and

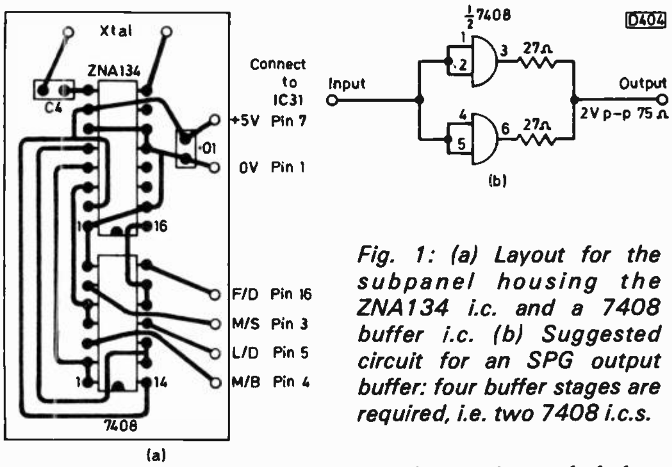


Fig. 1: (a) Layout for the subpanel housing the ZNA134 i.c. and a 7408 buffer i.c. (b) Suggested circuit for an SPG output buffer: four buffer stages are required, i.e. two 7408 i.c.s.

14. There's a link by pin 6, but not pin 11 where a hole has to be drilled. Solder the resistor leads to both sides of the board: 2·2kΩ is a suitable value.

More important however is protection of the sync pulse generator i.c. IC31. This is best done by using an i.c. to buffer the outputs. A small PCB (see Fig. 1) will take IC31, the crystal, and a 7408 buffer i.c. Mount it on the main PCB on stand-offs, making the interconnections to the relevant IC31 holes on the main board. Each IC31 output now feeds only two TTL loads, this being within the i.c.'s specification.

It's useful to provide outputs from the sync pulse generator to drive other circuits. The circuit shown will provide a 2V p-p pulse into a 75Ω load. Connections to the ZNA134 are easy if the above modification is used. As four outputs are required, and two gates per output are used, two 7408 i.c.s are necessary. – **I. Pawson,** *Leicester.*

TRIPLER CONVERSION

I read with interest P. Naylor's letter "tripler conversion" in the October issue, and feel that the following points on a similar conversion may be of interest to other readers. Just over a year ago the e.h.t. overwinding failed in my set, a 19in. Pye group monochrome receiver fitted with the 67 chassis. I decided to try experimenting along the lines suggested in the original March 1976 article – using a Siemens TV52 tripler since I'm not very fond of monochrome receiver triplers, especially selenium ones. The Siemens tripler is a very reliable component however. The line output transformer's e.h.t. overwinding was removed, and the tripler input connected to the anode of the PL504 line output valve, with the tripler's earth to chassis. Having access to an e.h.t. voltmeter and pattern generator, I was able to select a line flyback tuning capacitor value which gave optimum width and e.h.t. This turned out to be 100pF, and the capacitor was connected between the tripler input and chassis.

The arrangement worked very well for a year. A dropper section recently failed however, and when I inspected the set I found that the 100pF tuning capacitor had split, the insulation flaking away to expose an internal connection, which was arcing. I recalled that when the capacitor was first fitted it ran very warm, so it may have been faulty – the replacement runs much cooler. The important point however is that the set will still produce a watchable, though small, picture should this capacitor go open-circuit, the e.h.t. rising to a dangerously high value (with my set the e.h.t. rose to 23kV with no tuning capacitor present!). Since some people would continue to watch a set in this condition, I wouldn't recommend the modification in a set which is to be sold. – **John Adams,** *Oxford.*

Multiburst Generator

Ian Pawson

A COMMON method of checking the frequency response of a piece of electronic equipment is to feed in various individual frequencies, measure the outputs, and plot a graph of the results. This gives the frequency response of the circuit/equipment. For television work this lengthy process can fortunately be considerably shortened by sending the test frequencies consecutively along the television line, observing the results on an oscilloscope. If a dual-beam scope is used, the input and output waveforms can be compared directly.

This waveform is known as a multiburst, and an example is shown in Fig. 1. The present article describes a simple TTL logic circuit which generates a multiburst signal, with switchable line sync. A block diagram of the generator is shown in Fig. 2.

Circuit Description

The master oscillator N1 (see Fig. 3) operates at 216 times line rate, i.e. 3·375MHz. This is divided by two in IC2 to give 1·6875MHz, the third harmonic of which locks an oscillator N2 at 5·0625MHz. IC2 also divides the master oscillator frequency by six to give 0·5625MHz. We have thus generated the four frequencies used, and these are assembled in ascending frequency order as shown in Fig. 1.

The next part of the circuit generates the six time slots (four frequency plus white bar plus line blanking) along the line. The output of IC2 is divided by thirty-six in IC3 and IC4, giving a frequency of 15·625kHz, i.e. line frequency. The BCD output from IC4 is fed to IC5, a BCD-to-decimal decoder. The outputs of IC5 provide our six time slots. Q1 to Q4 are used to gate the frequencies and must be inverted – by N5 to N8 – to enable the frequency control gates N9 to N12. Thus each of the four frequencies is let through consecutively to IC8.

The Q0 output of IC5 provides the white bar at the start of the line (to check the low frequency response). As the line is divided into six equal parts, each of 10·66μsec, the line blanking is 1·5μsec short however. To overcome this, the start of the white bar is delayed by 1·5μsec (by R1, C6, N4). The delayed white bar is fed to IC8 along with the gated frequencies, and the output of IC8 is the complete multiburst signal. This is repeated every line.

For use with certain video equipment, television receivers

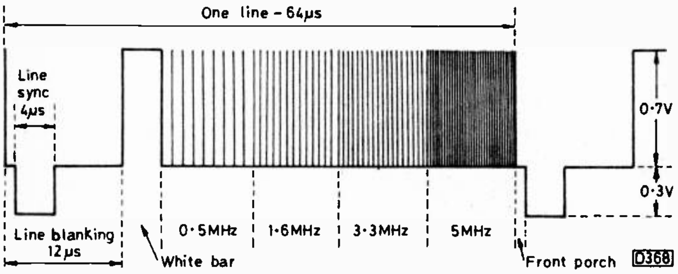


Fig. 1: Waveform produced by the multiburst generator.

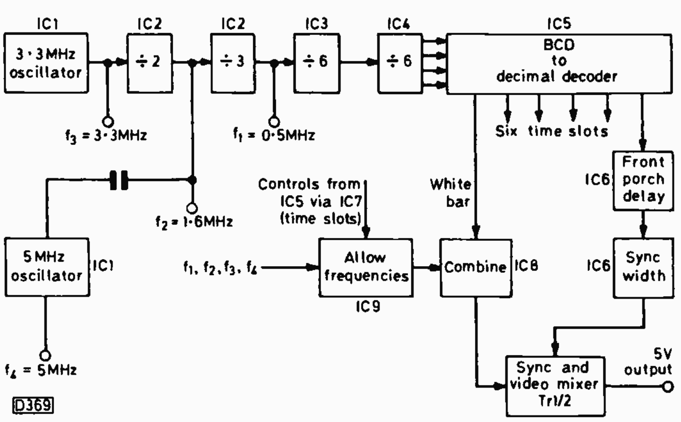


Fig. 2: Block diagram of the unit.

★ Components List

Capacitors:

C1	390pF	*polystyrene	C7	0·002	*polystyrene
C2	0·001	ceramic plate	C8	0·002	*polystyrene
C3	220pF	*polystyrene	C9	0·01	polyester
C4	0·001	ceramic plate	C10	4,700	25V electrolytic
C5	56pF	polystyrene	C11	0·22	polyester
C6	0·0022	*polystyrene	C12	0·47	polyester

*See text

Resistors:

R1	2·2kΩ	R5	1kΩ	R9	6·8kΩ
R2	2·7kΩ	R6	1·5kΩ	R10	1kΩ
R3	1·5kΩ	R7	56kΩ	R11	1kΩ
R4	2·2kΩ	R8	12kΩ	R12	82Ω

All ¼W, 5%

Coils

L1 40 turns
L2 50 turns
0·2mm enamelled wire on ¼in. former with core (Neosid grade 500).
T1 250V primary
12V, 0·5A secondary
(RS Components 196-303, with secondaries in parallel)

Semiconductors:

IC1, 6, 7, 9	7400
IC2, 3, 4	7490
IC5	7442
IC8	7430
IC10	7805
Tr1, 2	BC109
BR1	BY164

Miscellaneous:

SW1 s.p.s.t. switch
F1 1A anti-surge
PCB

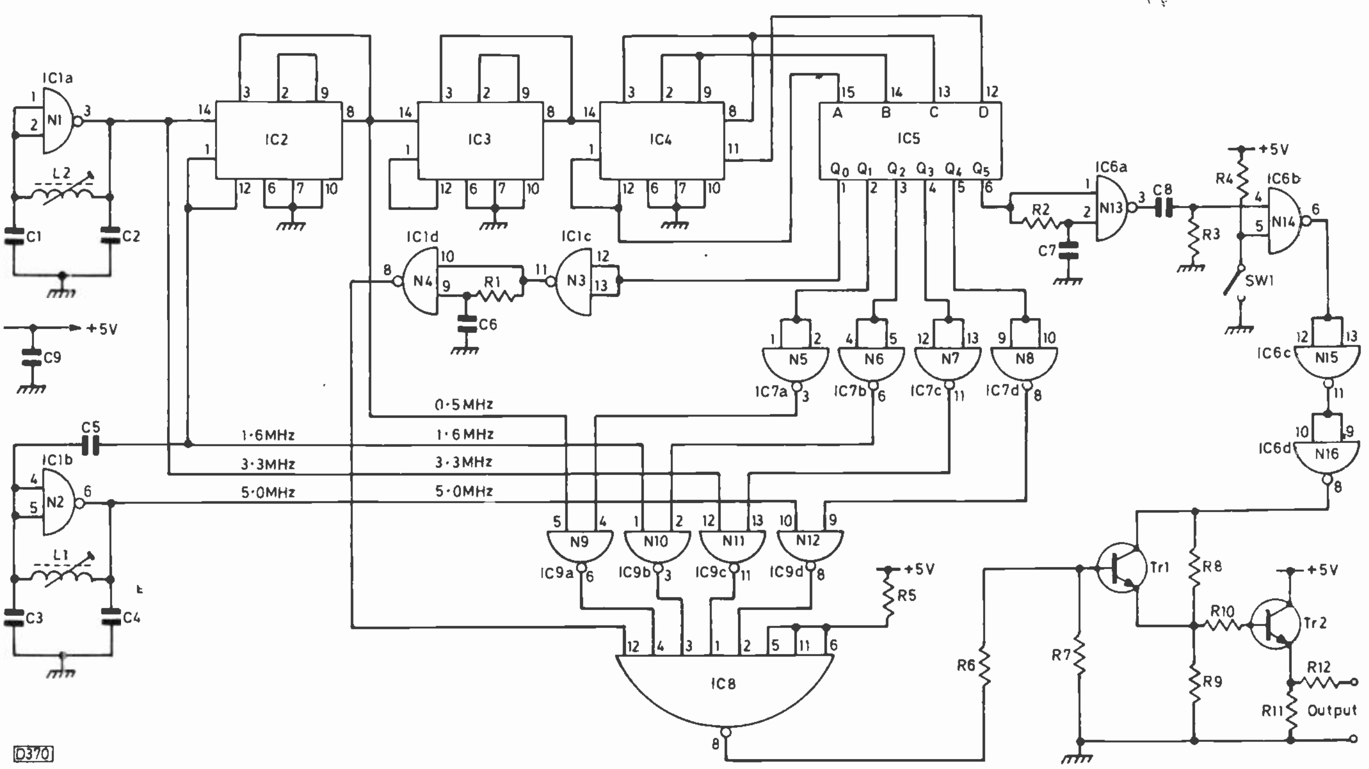


Fig. 3: Circuit diagram of the unit, excluding the power supply (see below). IC2/3/4 pin 5 +5V, pin 10 chassis; all others pin 14 +5V, pin 7 chassis.

etc., and for syncing a scope, a line sync pulse is required. This is generated from the line blanking output (Q5) of IC5. This is first delayed by R2, C7, N13, to provide the front porch, and is then fed via C8, R3 to N14. This gives a pulse width of 4μsec. When SW1 is closed, the sync pulses are blocked. Gates N15 and N16 clean up the pulse edges, pin 8 of IC6 providing negative-going sync pulses to the potential divider R8, R9. During a sync pulse the junction of R8, R9 is at 0V. Black level is approximately + 2V.

Tr1 is connected across R8, its base being fed from IC8 pin 8 via R6. This causes Tr1 to conduct in proportion to the video signal, increasing the potential at the junction R8, R9 to give a peak white level of approximately +5V. Tr2

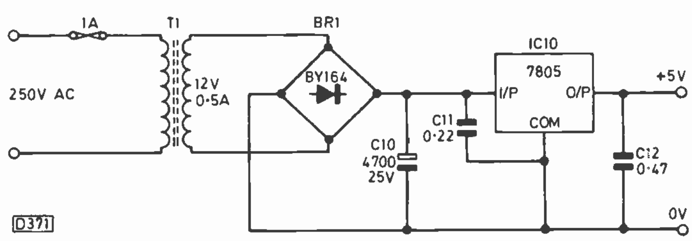
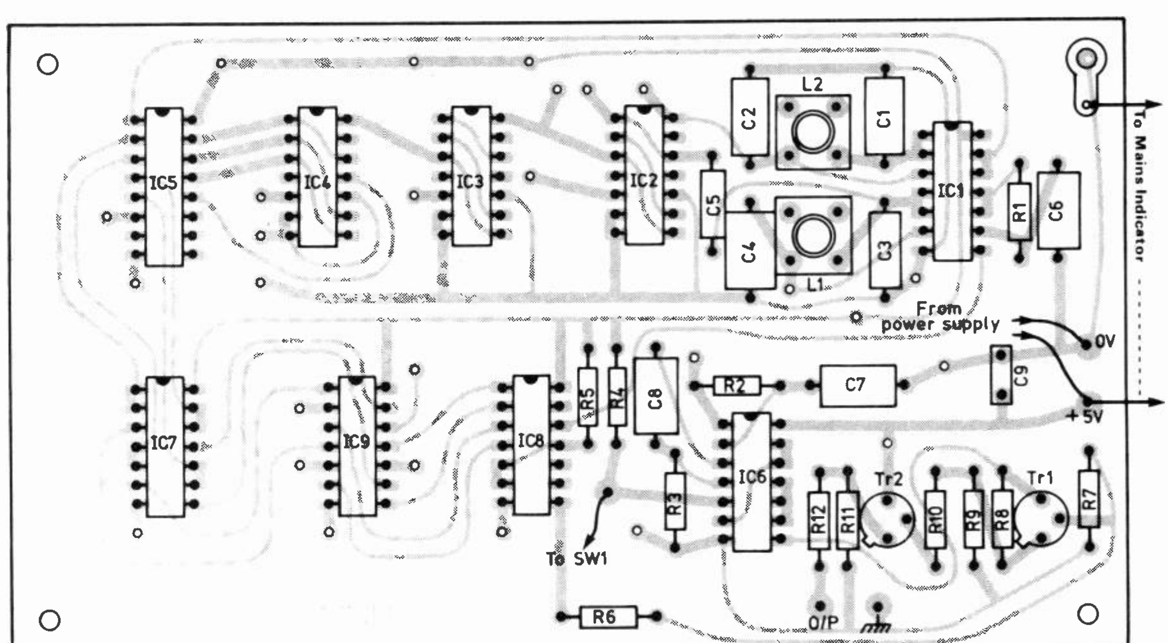


Fig.4: Suggested power supply circuit. A miniature toggle two-pole mains on/off switch is used in the prototype unit. Another feature of the prototype is an indicator to show that the unit is on. This consists of a 330Ω resistor in series with a LED mains indicator connected across the 5V supply.



○Denotes wire link through board

TMD651

Fig. 5: Printed board component layout.

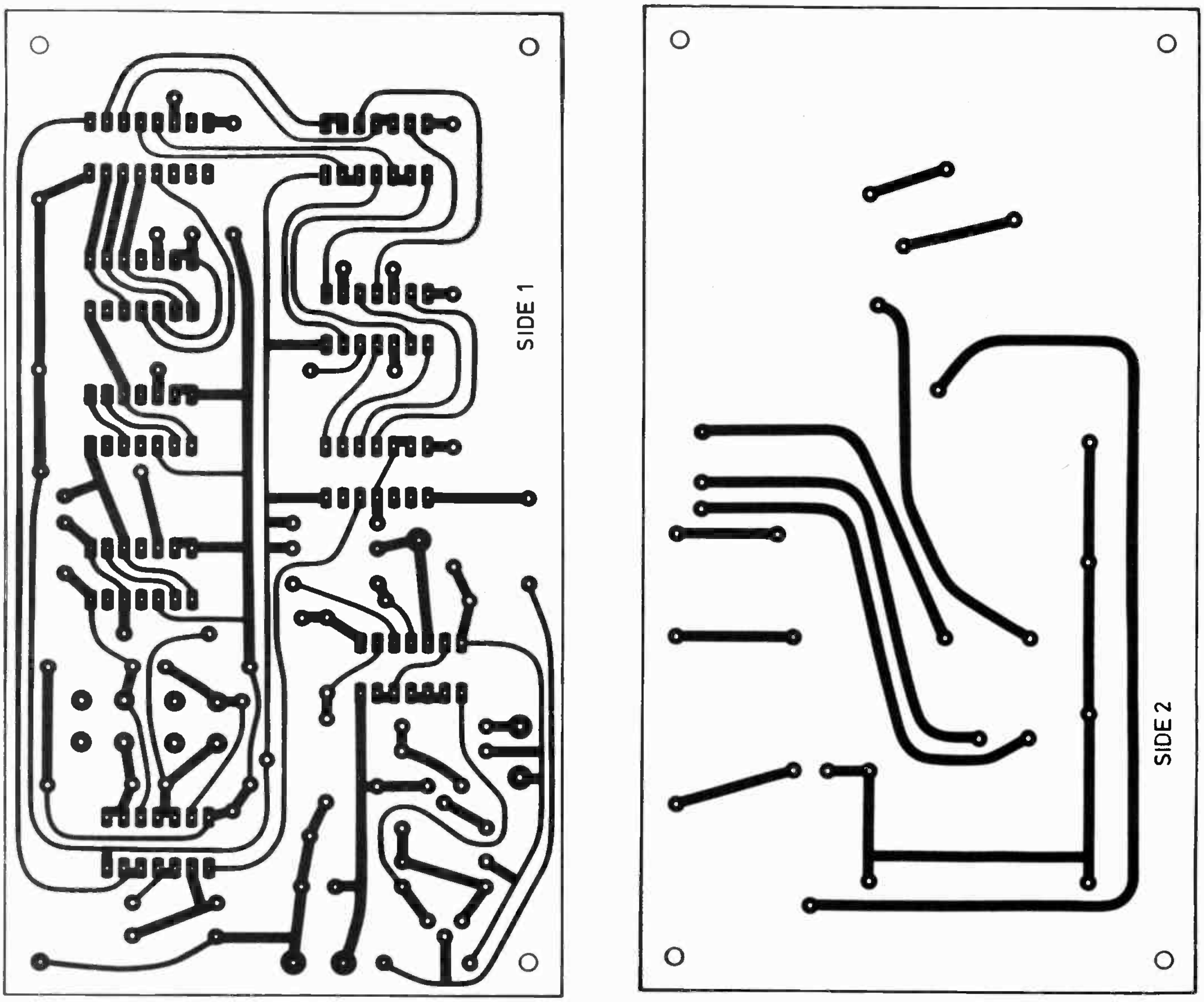


Fig. 6: The double-sided PCB used in the prototype. Scale 1:1.

buffers this signal and provides a 1V peak-to-peak composite video signal into 75Ω.

Construction

Construction is fairly straightforward, using a double-sided PCB. First solder wire links through the 27 top to bottom connections, then fit the i.c.s, resistors, capacitors, transistors and lastly the two coils. There are no solder joints to any components on the top side of the board, so i.c. sockets can be used if preferred. If the i.c.s are to be soldered into the board, first insert all the i.c.s, then solder pin 1 of each i.c., then pin 2 of each i.c. and so on. This will reduce the risk of heat damaging any i.c.

Setting up

Setting up involves tuning the two oscillators – first the master oscillator (L2). Adjust the core to obtain a frequency of 3·375MHz on a frequency counter, or connect the output of the unit to a video monitor and adjust for a locked picture. Next, using a scope, look at the last two frequencies on the line and adjust the core of L1 till the last frequency is locked. It will lock over several turns of the slug, so find the two extremes and then adjust to the middle of these. Secure the two slugs with a small spot of clear Bostik.

The values of the timing capacitors (C1,3,6,7,8) shown were correct for the prototype, but due to component tolerancies may need altering slightly to give correct frequencies/delays.

Complete Unit

The complete unit takes 130mA at 5V, and this is best supplied by an i.c. regulator (7805) as shown in Fig. 4. A u.h.f. modulator can be connected to the output of the unit to enable it to be used with domestic television sets. The field oscillator will free-run. ■

The Language of Logic

Part 3

E. A. Parr, B.Sc., C.Eng., M.I.E.E.

Flip-flop: A device for storing one binary digit. See Part 1 and *D-type* flip-flop *J-K* flip-flop; *Toggle* flip-flops. Basically a bistable multivibrator. Some old texts on logic call a *monostable* a flip-flop, sometimes using the term flip-flip for a bistable circuit.

Gate: See Part 1.

Glitch: An unwanted short pulse, usually caused by poor design. (See *counters.)*

Hex (hexadecimal): A number system based on 16. Its counting goes:

0 1 2 3 4 5 6 7 8 9 A B C D E F 10 11 12 etc.
where A stands for ten, B for eleven etc.

The columns in a hex number stand for units, sixteens, two hundred and fifty six etc. Thus a hex number 2B3 means,

3 units		3
plus B (eleven)	times 16	176
plus 2	times 256	512
		691 in decimal

The main use of hex is in representing binary numbers. The binary number is split into blocks of four bits, then the hex equivalent written.

For example 101101110110 becomes

1011	0111	0110
B	7	6

the hex number is B76.

Hex is also used in i.c. descriptions to mean six (e.g. hex inverter package).

Highway: A collection of wires connecting several points in a logical system. A highway is usually one or more words wide. See *bus*.

Increment: To increase by 1. Thus 7 incremented is 8 and 1011 incremented is 1100 (see also *decrement*).

Inhibit: An inhibit signal prevents an output being given or stops a logic gate from working (see *disable*).

Inverter: A logical gate. See Part 1.

ISO: A seven-bit code used for representing alphanumeric characters. An eighth *parity* bit is usually added. ISO differs in detail from *ASCII* although the basic ideas are the same.

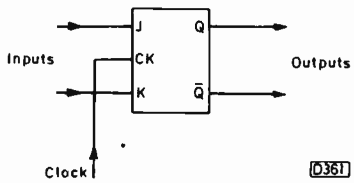


Fig. 15: JK flip-flop arrangement.

J-K flip-flop: A J-K flip-flop has three inputs and the usual two outputs, Q and $\bar{Q}$ (see Fig. 15). The operation of this flip-flop is *synchronous*, i.e. changes occur only when a clock pulse is applied to the clock (CK) input. There are four possible states J and K can be in before the clock pulse, and the J-K flip-flop reacts to each one differently.

Case (1) $J = 1, K = 0$. After clock, $Q = 1, \bar{Q} = 0$.

Case (2) $J = 0, K = 1$. After clock, $Q = 0, \bar{Q} = 1$.

Case (3) $J = 0, K = 0$. After clock, no change in output.

Case (4) $J = 1, K = 1$. After clock, Q and $\bar{Q}$ are inverted, i.e. if before clock $Q = 1$ and $\bar{Q} = 0$, after clock $Q = 0$ and $\bar{Q} = 1$.

Cases (1) – (3) are very similar to the normal S-R flip-flop (except that the operation is clocked, i.e. synchronous). Case (4) turns the J-K flip-flop into a 1-bit counter. Data sheets specify the polarity of the clock pulse required.

K: In normal engineering this stands for 1,000, but in binary systems it stands for 1024. Thus a 1K 8-bit *RAM* can store 1024 8-bit numbers.

Latch: Another name for a *flip-flop,* though the term latch is usually given to a *D-Type flip-flop.*

LED: A light-emitting diode. Widely used in logic systems as their low current demands mean that they can be driven directly by logic gates.

Level: The levels of a digital system are the 1 and 0 states and their corresponding voltages. Thus for *TTL* the 1 level is 3·5V and the 0 level 0·2V.

LSI: Large-scale integration, in other words a large number of gates, transistors etc. on one chip.

Memory: A very loose term which can apply to any form of storage from a one-bit *flip-flop* through a large *RAM* to the massive stores used in a large computer system. See also *RAM.*

Microprocessor: The microprocessor is the latest addition to the ever growing range of electronic devices. It is, in effect, a computer on a chip.

The layout of any computer system consists of the four blocks shown in Fig. 16. Instructions for the computer to follow and data for it to work on are stored in the store. Data comes to and from the computer via the input/output

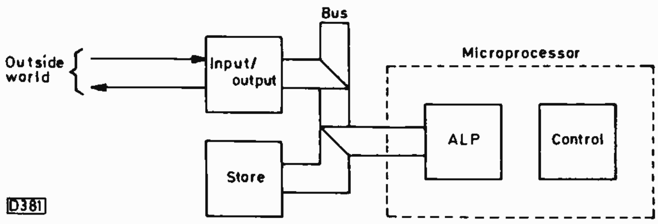


Fig. 16: Microprocessor computer system.

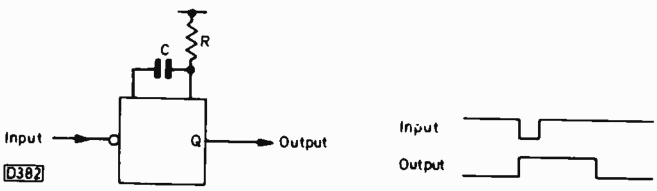


Fig. 17: Simple monostable.

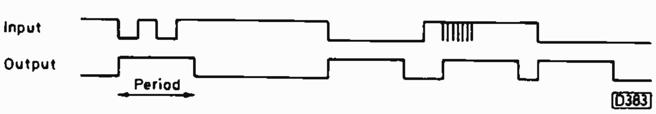


Fig. 18: Edge-triggered monostable waveforms.

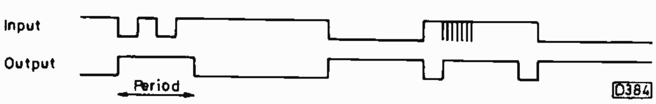


Fig. 19: Direct-coupled monostable waveforms.

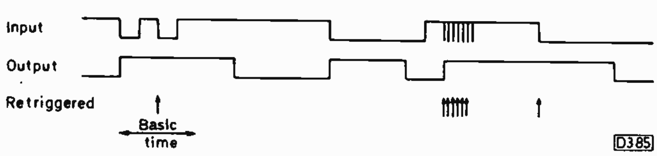


Fig. 20: Retriggerable monostable waveforms.

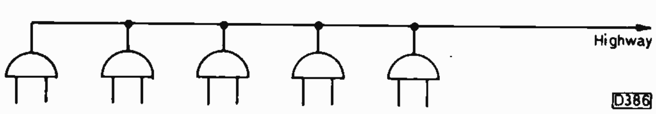


Fig. 21: Gating on to a highway.

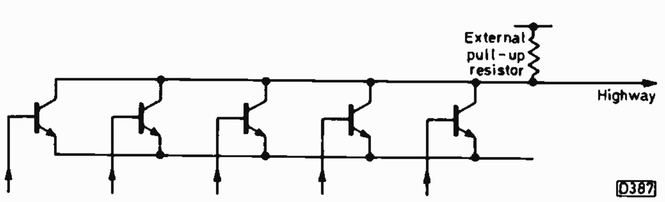


Fig. 22: Open-collector gates connected to a highway.

unit. The ALP (Arithmetic and Logical Processor) does the actual work on data in the store. The control unit keeps everything in step.

Up to a few years ago, the ALP and control would be a mass of printed circuit boards about the size of a TV set (and costing about £5,000). The ALP and control parts of a computer are replaced by a microprocessor costing about £20. An external store and input/output unit are still needed.

The cost of microprocessors allows computers to be used in applications where they would previously have been prohibitively expensive – a computer operated door bell with selection of many chimes is already on the market.

Microprocessors are already appearing in television. Teletext is an area where devices similar to microprocessors are used, and microprocessor TV games are now available, with an inbuilt games library.

Monostable: A monostable is basically a device for producing an output pulse when a required input condition is fulfilled. There are many variations on the theme, a typical example being shown in Fig. 17. This device gives an 0-1-0 pulse for every 1-0 edge at its input. Note the circle at the input showing that it's low triggered. The width of the output pulse is usually determined by an external resistor and capacitor, and the time is generally of the order of $0{\cdot}7RC$.

There are many types of monostable, and to get precise details of a particular device's operation the reader should see the data sheets. Some of the variations are listed below.

(1) *Edge triggered.* Once the monostable is fired, the output pulse is completely independent of all further happenings at its input (see Fig. 18).

(2) *Direct coupled.* The input pulse has to be shorter than the output pulse time, otherwise the output stays at 1 until the input returns to 1 (see Fig. 19).

(3) *Retriggerable.* Each triggering edge starts the monostable timing again and extends the timing period as a result (see Fig. 20).

(4) *Other features.* True and complement outputs are usually available. Most devices have facilities for triggering on either positive or negative edges. Many have the facility for a reset to terminate the output pulse prematurely.

MSI: Medium scale integration. A term describing any chip with more than a few gates on it. (see LSI).

Nand gate: A type of logic gate. See Part 1.

Negative logic: A logic system in which the binary 1 state is more negative than the binary 0 state.

Negation: Negation has two meanings. The first is the act of *inversion.* The second is the replacement of a positive number by its negative equivalent (e.g. replacing +41 by −41). Representation of negative numbers in binary form is a little beyond the scope of this article.

Nor gate: A type of logic gate. See Part 1.

Octal: A number system to base eight. It thus uses numbers 0 1 2 3 4 5 6 7. Like *hex* it's useful for representing binary numbers. To represent a binary number in octal, take the bits in groups of three and replace each group with its octal equivalent. Thus 10111011011010001 becomes:

binary	10	111	011	011	010	001
octal	2	7	3	3	2	1

Open-collector: It's often required to connect several gates to a *highway,* (see Fig. 21.) The easiest way for manufacturers to provide this is to make the gates with a simple common-emitter transistor output and no integrated collector load (see Fig. 22). If any of the transistors is turned on, the voltage on the common line will go to 0V. The gate outputs thus perform an or function, and this is called a *"wired-or".*

Note that a 1 on the highway is 0V and a 0 is 5V. The highway is thus operating on negative logic.

Open-collector gates are also used as a cheap way of providing an or function, or when a multiple-input or gate is required.

A final use of open-collector gates is in applications such as lamp driving, where the output is required to go outside the logic supply rails.

Or gate: A type of logic gate. See Part 1.

Parallel: In digital systems (particularly number crunching systems) it's often required to send entire words of data around. This can be done in a parallel or *serial* manner. In parallel transmission, one wire is used for each bit (see Fig. 23). In serial transmission, the data is sent in pulses down a single wire.

Parallel transmission is expensive, but the logic is simpler and faster. Serial transmission is preferred for long cable runs where speed is not important but cable cost is.

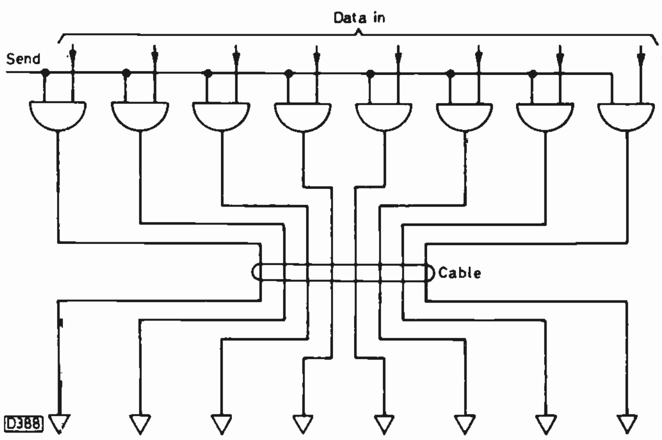


Fig. 23: Parallel data transfer.

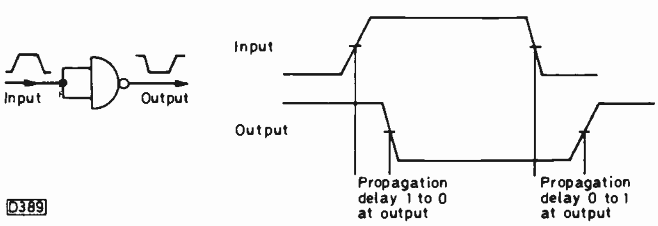


Fig. 24: Propagation delay.

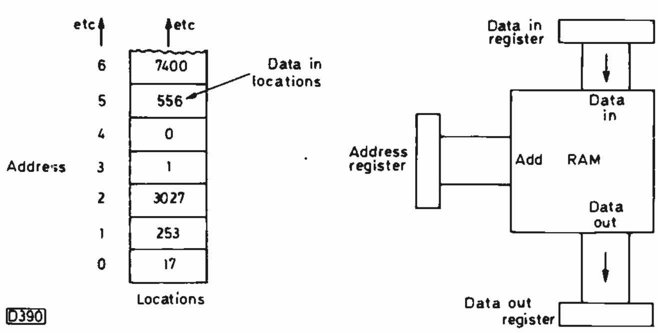


Fig. 25 (left): RAM schematic.
Fig. 26 (right): Registers around a RAM.

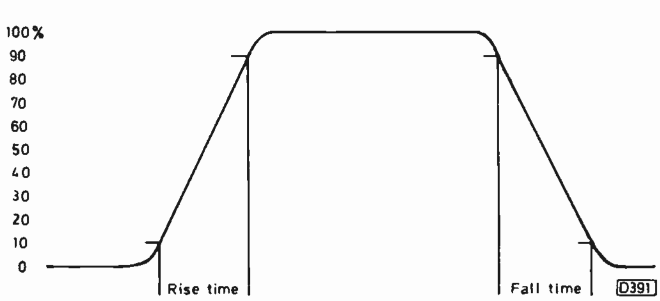


Fig. 27: Rise and fall times.

Parity: A form of *error checking* code.

Positive logic: A logic system where the 1 level is more positive than the 0 level. See Part 1.

PROM: A read-only memory which cannot be changed. An example of a PROM is the character look-up chip in teletext decoders.

Propagation delay: A measure of the speed of a logical function. It's the time from the midvoltage of an input voltage change to the midpoint at the corresponding output voltage change (see Fig. 24). Propagation delays for most functions are measured in nanosecs.

Pull-up resistor: External resistor used with *open-collector* gates.

RAM: Stands for Random Access Memory, i.e. data can be fed in and *read* out. It's a store for many words of data. Each word is stored in a location. The best way to visualise any store is to think of a line of pigeon holes into which numbers can be put for later reference (see Fig. 25). Each location (or pigeon hole) has a unique address, so we can tell the electronics to "put the number 57 into address 259". The data and addresses are in binary of course but *hex* and *octal* are usually used when humans write about RAM locations. A typical RAM application is to store one page of teletext data, the RAM size being 960 locations, each location holding a 7-bit word.

Read: To read is to fetch data from a store location.

Register: A store for holding one *word*. Data read from a store is usually placed in a register called a memory buffer register, so that the rest of the system can use the data from the store whilst the store is doing something else (see Fig. 26).

Reset: To set the Q output of a flip-flop to zero (and the $\overline{Q}$ to a 1). The pin used to do this is called the reset pin.

Ripple-through counter: A non-*synchronous* counter. As one bit changes from 1 to 0 it triggers the next and so on. Its big disadvantage is that to go from 0111111111 to 1000000000 takes *N* propagation delays in time (where *N* is the number of bits), and during the changeover all sorts of odd *glitches* come out. A ripple-through counter is far simpler and cheaper than its synchronous counterpart however.

Rise time: A measure of the speed of a positive edge. It's defined as the time taken to go from 10% to 90% of the maximum pulse amplitude (see Fig. 27). The fall time is similarly defined for a negative edge.

ROM: Stands for Read Only Memory. It's a memory whose contents are loaded in by the manufacturer and cannot be altered. The generation of the characters from the binary data in teletext is done by a ROM.

Schmitt trigger: A device which can convert an analogue input into a two-level digital signal. It's defined by two voltage levels at the input. The first is the upper trigger point (UTP). If the input voltage is above the UTP, the output is at 1. The second voltage is the lower trigger point (LTP). If the input voltage is below the LTP, the output is at 0. Between the LTP and UTP the device exhibits backlash (or

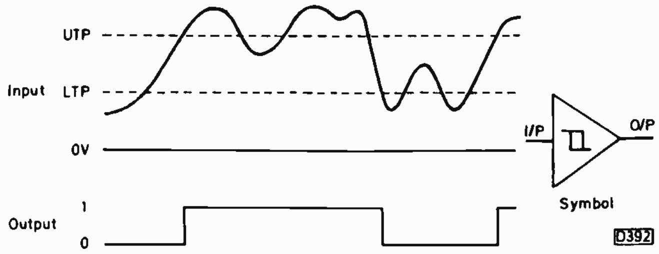


Fig. 28: Schmitt trigger operation and symbol.

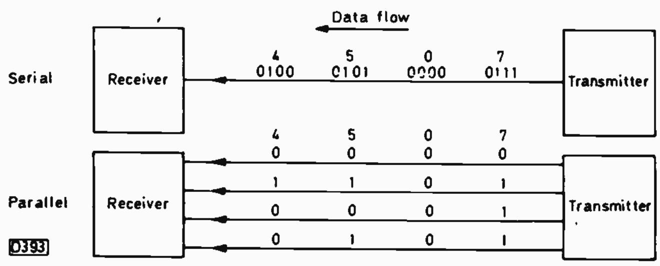


Fig. 29: Comparison of serial and parallel data transmission.

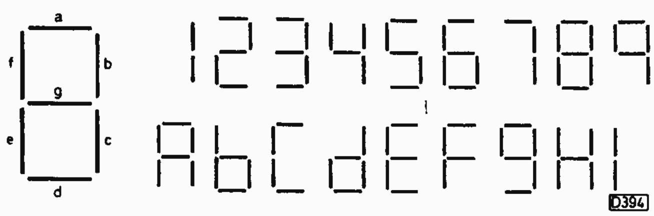


Fig. 30: Seven-segment display.

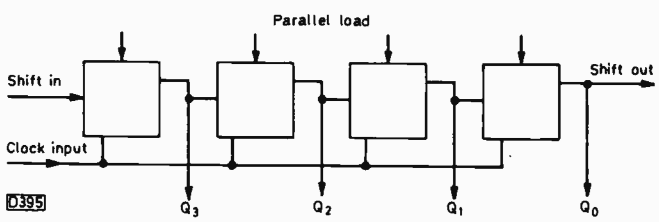


Fig. 31: Four-bit shift-down shift register.

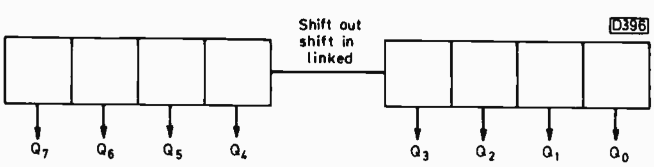


Fig. 32: Eight-bit shift register.

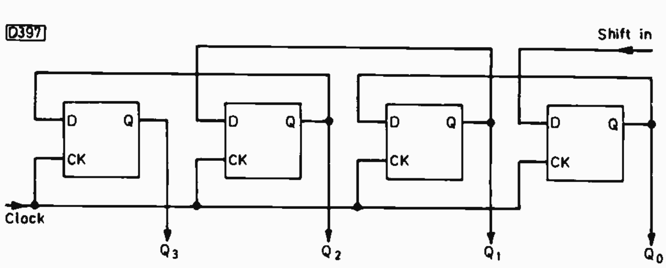


Fig. 33: Four-bit shift-up shift register using D-type flip-flops.

hysteresis). This is best summarised as shown in Fig. 28.

Schmitt triggers are used to speed up edges and to digitise a.c. waveforms. The hysteresis gives a certain amount of noise immunity.

Serial: Data transmission can be done in serial or *parallel* form. In serial data transmission the information is sent as a pulse train (see Fig. 29).

Parallel-to-serial conversion is done by a *shift register*. The parallel data is loaded into the shift register, then the data is clocked out on to the line. At the receiving end, the serial data is clocked into another shift register to make it available in parallel form again. Obviously timing is important.

Serial transmission is simpler and cheaper than parallel transmission, but is inherently slower. If you think about it, a TV signal is an excellent example of a serial transmission system since the picture information is sent sequentially.

Set: To set a *memory* is to make Q = 1 and $\bar{Q} = 0$.

Seven-segment display: A display for showing the digits 0 to 9 and the *hex* characters A to F. This is done by having the display constructed of seven LEDs as shown in Fig. 30. Chips are available which take in a 4-bit number and light the required segments.

Shift register: A shift register is a device for moving a binary *word* one or more bits left or right. A typical shift register is shown in Fig. 31. Data is loaded in on the input lines. Suppose we load in 5, i.e. 0101. We thus have:

Q_3	Q_2	Q_1	Q_0
0	1	0	1

Shifting up, after one clock pulse we have:

1	0	1	0

After two clock pulses:

0	1	0	0

i.e. the bit in Q_3 is lost. And so on.

Similarly we can shift down. Suppose we load in twelve (1100). We get:

	Q_3	Q_2	Q_1	Q_0
	1	1	0	0
after one clock pulse	0	1	1	0
after two clock pulses	0	0	1	1

And so on.

The shift in pin can be used to link stages for more than four bits (see Fig. 32).

The easiest way to make a shift-up shift register is simply to use *D-type flip-flops* and couple the Q outputs to the D inputs (see Fig. 33).

A shift-down shift register is similarly constructed. A bidirectional shift register is easily made, but needs some external gates. It's usual however to use i.c. shift registers rather than to build your own.

Shift registers are used in *serial/parallel*/serial conversion and arithmetic applications. If you think about it, shifting up by one bit is the same as multiplying by two, and shifting down is the same as dividing by two.

SR: A type of *flip-flop*. See Part 1.

Stat: Another name for a *flip-flop*.

Store: Probably the most overworked word in digital logic. It can mean anything from one *flip-flop* to a 64K computer *memory*.

As a verb, it means the act of putting data into a memory location.

Synchronous: Operations in a synchronous system are controlled by a central *clock*, so that the whole system looks

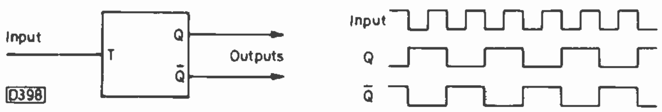


Fig. 34 (above): Toggle flip-flop.

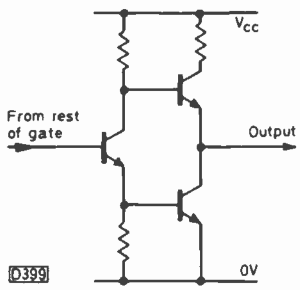
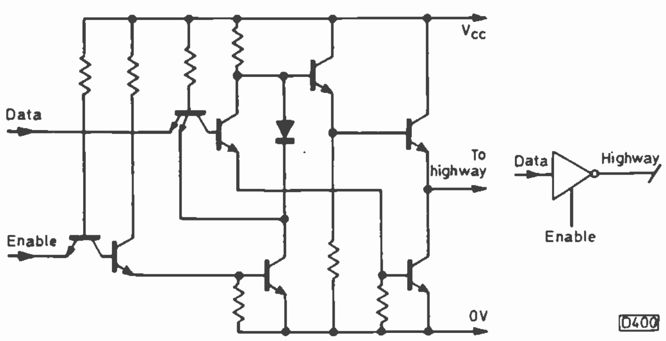


Fig. 35 (left): Totem-pole output circuit.

Fig. 36 (below): Tri-state gate.



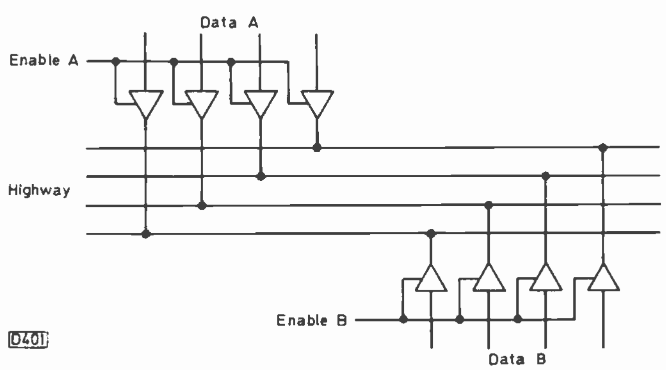


Fig. 37: Tri-state highway.

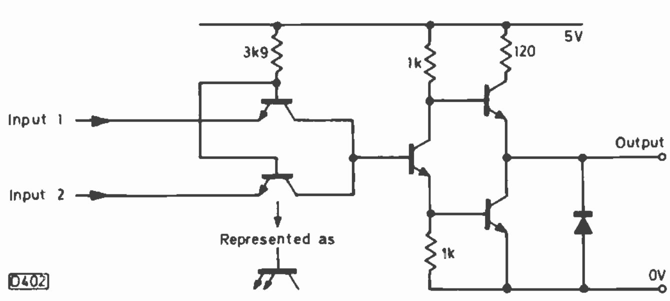
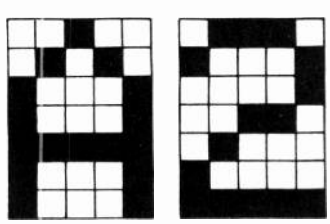


Fig. 38: Two-input TTL nand gate.



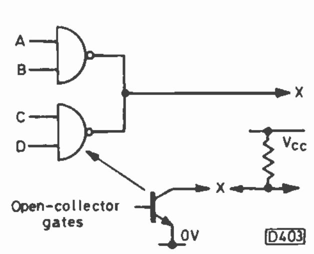


Fig. 39 (left): Typical VDU 5 x 7 matrix characters.
Fig. 40 (right): Wired-or operation.

like troops being drilled by a regimental sergeant major. Synchronous operation usually means freedom from *glitches*. Devices such as *D-type flip-flops* and *J-K flip-flops* are inherently synchronous.

Toggle stat: A form of *flip-flop*. It has one input and the usual Q and $\overline{Q}$ outputs (see Fig. 34). The Q and $\overline{Q}$ inputs change from 1 to 0 and 0 to 1 for each negative edge at the T input.

A toggle stat is the basis of a binary counter. The easiest way to make a toggle stat is to use a *J-K flip-flop* and tie J and K to a binary 1. The flip-flop will then toggle on the clock input. Alternatively the $\overline{Q}$ output of a *D-type* flip-flop can be coupled to the D input. The flip-flop will then toggle on the clock input as well.

Totem-pole output: A design of gate output with transistors to pull to both the 0 and 1 states. This gives excellent capacitive driving characteristics. See Fig. 35.

Tri-state gate: A form of *highway* driver with better characteristics than the simpler open-collector gate. A tri-state gate has an *enable* pin as well as the usual gate inputs. See Fig. 36. With the enable pin at 1, the gate performs like a normal gate. With the enable pin at 0, the gate output goes to a float or high-impedance state. The gate output is thus at 1, 0 or Hi-Z, hence the name.

Tri-state gates can thus be used for constructing a highway (see Fig. 37). They are better for highway driving than *open-collector* gates because they usually employ a *totem-pole* output.

True: The Q output of a *monostable* or *flip-flop* is often called the true output. Some texts on logic call 1s a "true" and a 0 a "false".

TTL: Stands for Transistor Transistor Logic, and is the packhorse of digital logic. The circuit of a typical TTL gate is shown in Fig. 38. Note the *totem-pole* output. TTL runs on a 5V rail and is virtually bullet proof. The commonest TTL series is the 74 series, whose codes all start 74xxx (e.g. 7420).

Up/down counter: A binary *counter* that can count in both directions. These usually have either a direction line and *clock*, or separate up/down clocks.

VDU: Stands for Visual Display Unit, i.e. a TV screen used to display data (e.g. teletext).

The characters are usually generated on a 7 by 5 dot matrix, along the lines shown in Fig. 39. The data to be displayed is usually loaded into a *RAM*, the data being converted into suitable bright-up pulses by means of a look-up table in a *ROM*.

Wired-or: Some gate designs have a simple one-transistor output stage along the lines shown in Fig. 40. Several of these can be connected together as shown. The common line will go to 0 if any transistor turns on, so the arrangement has performed:

$$X = \overline{(A.B) + (B.C)}, \text{ i.e. an or function.}$$

Because it performs an or function, it is called a wired-or.

Word: A chunk of binary data, usually 4, 8, 12 or 16 bits long.

Write: Writing is putting data into a store location.

Colour Receiver Project

Part 3 **Luke Theodossiou**

The decoder and RGB output circuits

PHEW! A rather frantic month. Just as we were passing the November issue for press, we learnt from RCA that the decision to put the TA10313B i.c. into production had been shelved, leading to the warning paragraph at the end of last month's article. There was nothing for it but to look around for another decoder solution – and quickly!

Decoder Solutions

Readers may be disappointed at first to note a two-chip decoder in the circuit diagram (Fig. 3), as compared to the single-chip RCA solution given last month and advertised previously: especially as single-chip decoders are now being developed commercially. For example, Philips have a single-chip solution at sampling stage, and a Japanese company also has one which we know has been accepted by at least one big U.K. manufacturer.

The Philips version is not scheduled for production till the end of next year however. As for the Japanese design, we have had to discard this since it required a number of preset adjustments which diluted its attraction. It was also incompatible with some of our existing circuitry, and with time against us we decided to settle for a two-chip solution – one which does have some advantages however.

The chief advantage of our design is the ability of the TDA3500 to accept 1V pk-pk RGB data inputs directly, and the brightness and saturation controls work on the data signal as well as the normal video signal. This would not be the case if either of the existing single-chip decoder systems had been used. In fact this chip can also be used to advantage in colour monitor systems – but that's another story.

Two of these chips, when used in conjunction with a third, can also be employed in designing a PAL/SECAM receiver with a very low component count. Surprisingly, when we changed our design, we expected to increase the component count substantially, but found this was not the case.

Before we get down to a detailed description of the re-designed decoder however, we would just like to take this opportunity to thank our freelance technical artist Terry McCulley for doing a magnificent job under tremendous pressure – with his help we had a new board designed and running in about one week, which is no mean achievement. We'd also like to extend our thanks to Mullard, who quickly appreciated our difficult position and reacted swiftly and efficiently to enable us to present readers with the new circuit.

Circuit Description

Now down to business. Last month we described the path of the main video signal up to the point where it is split up (inside the Philips vision detector module) into luminance and chrominance. Following the chroma path first, it enters IC3 (TDA3510) at pin 1 via d.c. blocking capacitor C17. The block functional diagram of this i.c. is shown in Fig. 1; it comprises the local oscillator, a.c.c., burst phase detector, colour killer, ident, PAL switch and p.l.l. demodulators. It is almost self-explanatory, but there are a couple of points worth mentioning. Firstly it uses an 8·8MHz oscillator with a ÷2 circuit, thus dispensing with the usual external 90° phase shift network. Secondly the undelayed chroma signal path is inside the i.c., which makes the chroma delay line circuitry somewhat simpler, with VR4 adjusting the delayed chroma signal amplitude. Synchronous detection for identing and colour killing, together with a sample-and-hold technique, eliminate the usual two preset controls. Peak detection for a.c.c. gives a smooth control range without a sudden increase of saturation before the killing threshold is reached. Colour killer

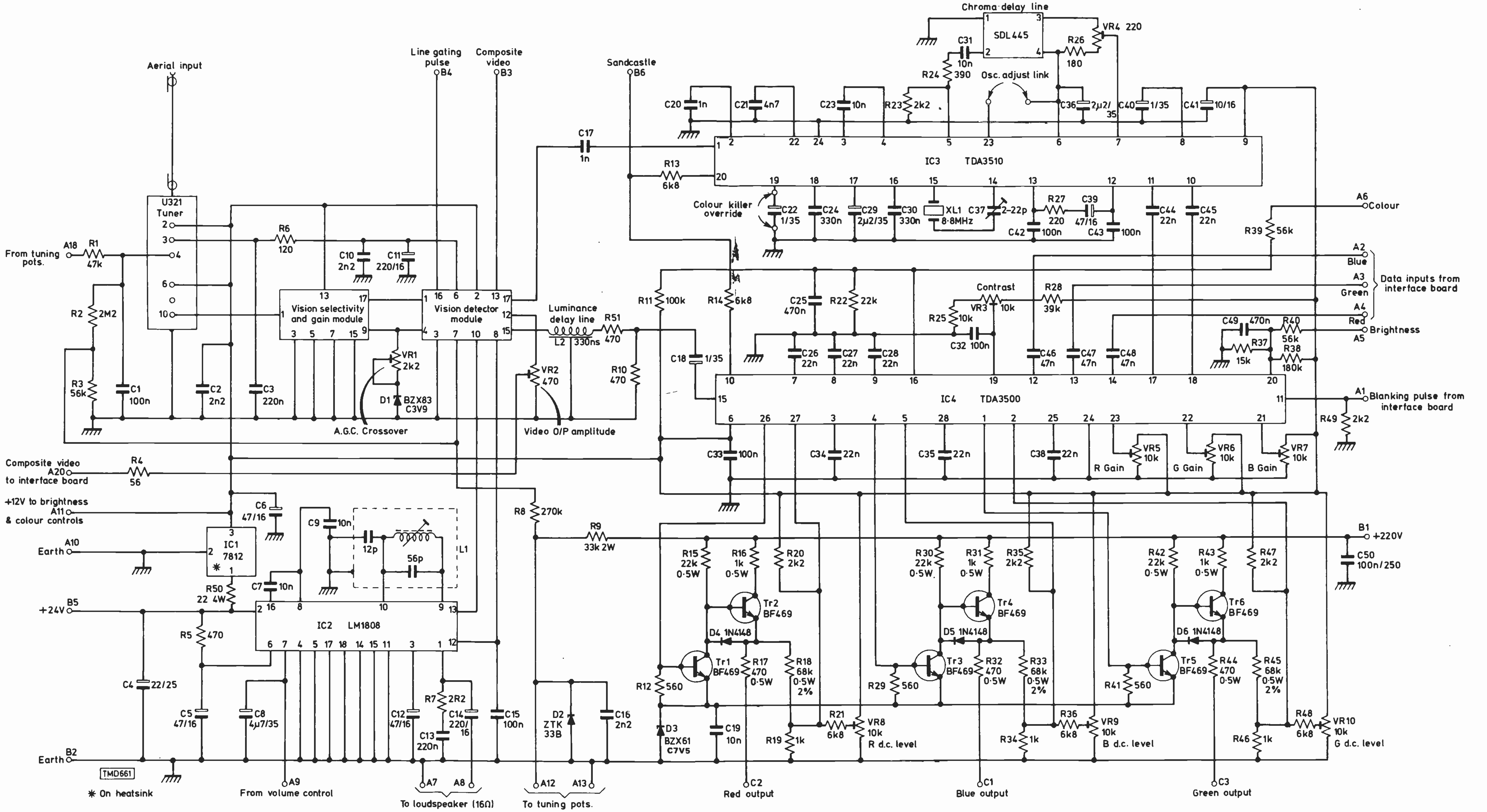


Fig. 3: Signals board circuit with two-chip decoder.

hysteresis (with capacitor C22) reduces colour flashing on weak signals.

Fig. 2 shows the block diagram for the TDA3500 (IC4) control i.c. This incorporates d.c. controlled contrast, brightness and saturation circuits, G – Y and RGB matrix, output stages with feedback and clamping, flyback blanking, RGB character and blanking inputs. The luminance signal from the delay line is attenuated to its correct level by R51 and R10, which also provide the necessary impedance matching. The contrast control is in fact a preset on the p.c.b. This was decided on for two reasons: the contrast control is very easily misused if it is a customer control on the front of the set; and secondly, the remote control system we have chosen allows for only three analogue controls – volume, brightness and colour.

Gain Controls

The gain for each of the RGB outputs is adjusted by preset controls VR5, 6 and 7 respectively, instead of the more usual attenuator network at the input of the video output stages. The blanking pulse input on pin 11 can be regarded as more of a changeover switch – it effectively blanks the normal programme video signal and allows the data signals through. This occurs when the pulse on pin 11 exceeds 0·7V.

RGB Output Stages

The video output stages we've used are the famous class AB. We will examine the red output stage as an example. The circuit operates basically as a class A amplifier with Tr1 being the usual common emitter amplifier, with R15 as its load. In order to reduce the power consumption, the usual lowish-value load resistor is replaced by an active load (Tr2). In essence this active load consists of a considerably higher value load resistor which is temporarily bypassed by the second video transistor during positive output transients. This allows fast transients and high bandwidth despite low quiescent currents. D3 matches the d.c. (static) level of the i.c. output to the video stage. R16 serves to limit the current through Tr2, as well as to reduce its dissipation. Feedback is applied via R18 to the i.c., and gain is set by the ratio of R18 to R20 in parallel with R19. The d.c. output (black level) of the amplifier is made adjustable by VR8. R17 protects the stage from flashovers in conjunction with another resistor on the c.r.t. base panel.

Next month we shall be describing the construction of the signal board.

Renovating Monochrome Receivers

With reference to the GEC 2010 Series

John Law

THE vast increase in colour viewing in recent years has resulted in a flood of monochrome receivers being returned to the rental companies. Such sets are often disposed of in bulk and offered for sale at rock bottom prices by firms active in this field – often in working order. There can be an element of risk about purchasing such a set, but a great deal of pleasure and experience can be obtained by putting a set of this type into top condition – with an excellent picture and good quality sound. Even non-workers can be a good buy, since they contain a large number of components, valves and a c.r.t. which can in some cases be extracted in almost new condition.

The final GEC group dual-standard monochrome chassis remained in production for a number of years and was used in a vast range of models sold under the GEC, Sobell, McMichael and Masteradio banners. It's basically a well designed and reliable chassis and, apart from the v.h.f. tuner, access is easy and most faults straightforward. The general layout consists of a flat chassis which contains two printed panels, the signals one on the left and the timebase one on the right. Identification is sometimes tricky because the model number was printed on a sticky label attached to the back of the set, the label inevitably tending to fall off.

The circuitry used in the basic all-valve (except for the u.h.f. tuner) version of the chassis is fairly typical of the period, so an account of fault finding should provide a useful guide to dealing with similar sets. Running briefly through the valves and their functions, the field timebase uses a PCL85 (use a PCL805 as a replacement), the line timebase consists of a PCF802 sinewave oscillator followed by a PL504/PY800/DY86 line output department, there's an EF183 and EF184 in the vision i.f. strip, a PFL200 video output pentode/sync separator, and an EF80 followed by an EH90 quadrature detector in the sound i.f. department. The only rather unusual feature is the use of a PCL84 as the audio output valve (pentode), with its triode section used as an a.g.c. clamp (anode and control grid connected together). The series heater chain is fed with a.c. via a dropper resistor (i.e. no diode). The BY108 mains rectifier feeds an *LC* filter to provide a 220V h.t. line, with two other h.t. lines (205V and 180V) obtained via separate *RC* filters.

The original models bore numbers such as the 2000 and 2001 (GEC), later models bearing numbers such as the 2010, 2018, 2020, 2028 and 2038. Though the chassis remained the same, the component reference numbers were changed. We shall use the later reference numbers in this article. There was also a hybrid version with (usually) germanium transistors in the small-signal stages and a PCL86 audio amplifier/output valve.

Power Supply Faults

Perhaps the most common fault is failure of one section of the mains dropper resistor, usually the 15Ω section R148. When it goes open-circuit there's no h.t. (no sound or raster), though the valves all light up. A 10W replacement can be wired across the section's leads – make a firm physical connection in addition to soldering the leads. Occasionally a section in the feed to the heater chain goes open-circuit, giving the symptom no sound or raster with the valves not alight. More often however this symptom

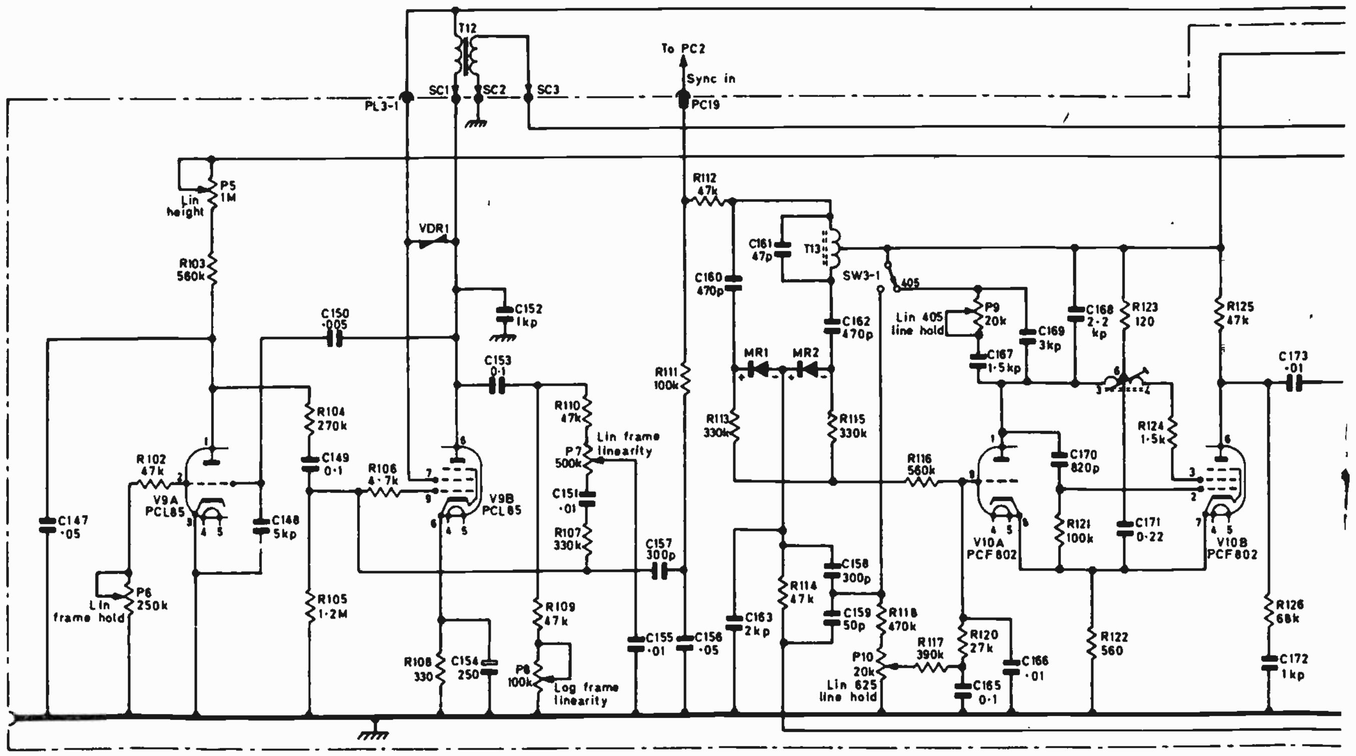


Fig. 1: Power supply and timebase circuits, GEC 2010 series. R112 is series was very similar, but with d.c. coupling between the line output and 180pF capacitor should be shown connected across T14's primary

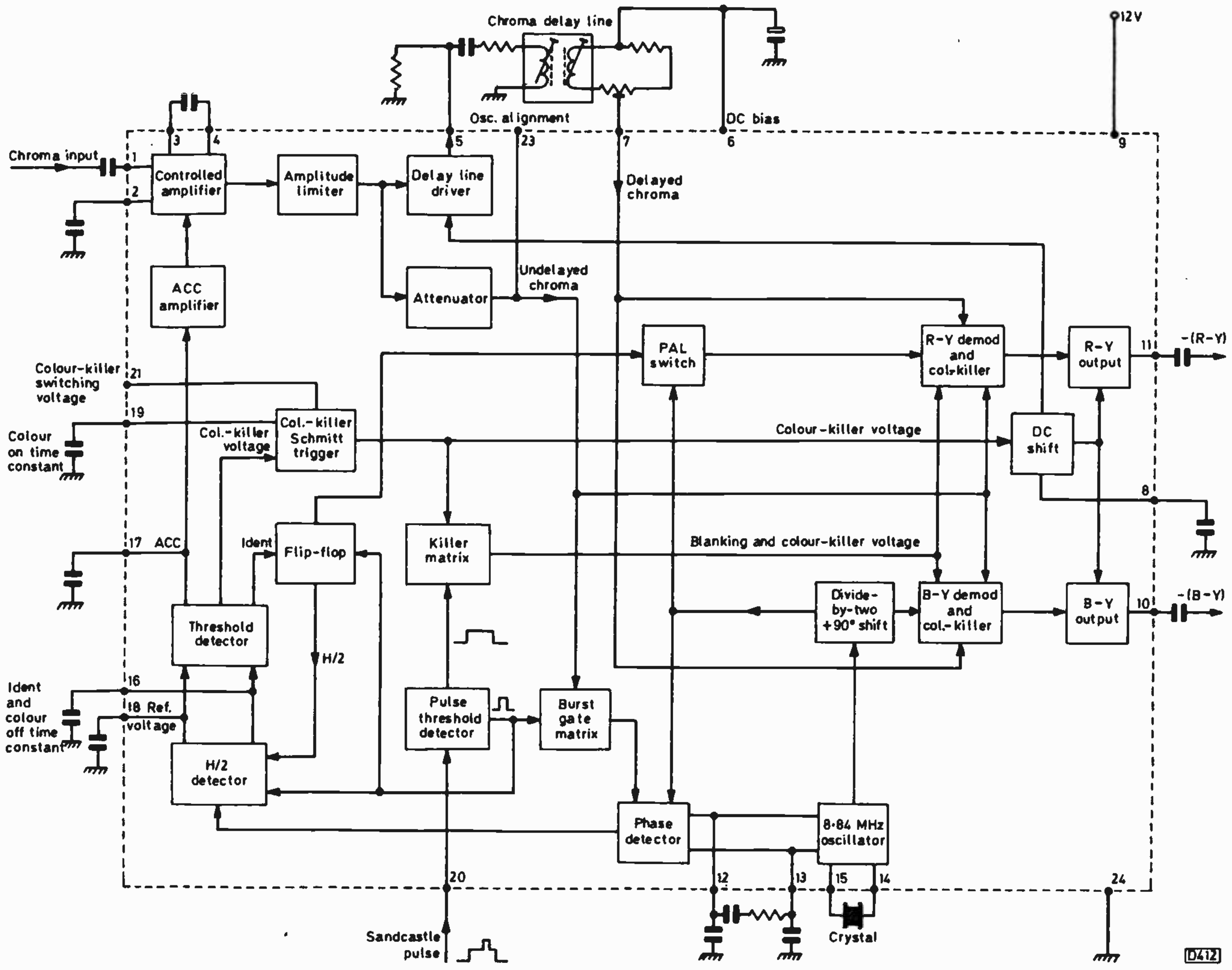


Fig. 1: Block diagram of the TDA3510 PAL signal processing i.c.

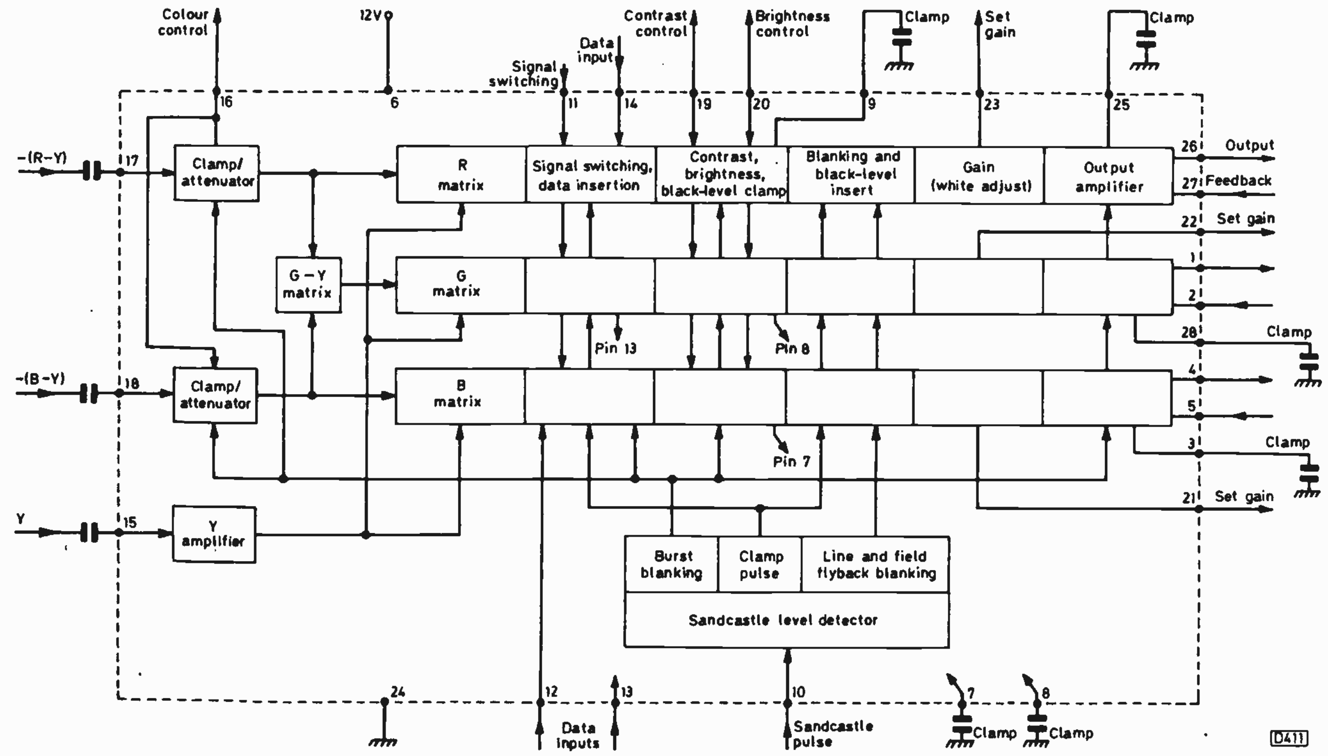


Fig. 2: Block diagram of the TDA3500 matrixing /control i.c.

indicates that one of the valve heaters is open-circuit, the usual offender being the PY800 boost diode (V11) which is the first in the heater chain.

Reverting to the h.t. side of the mains input circuit, between the dropper resistor and the h.t. rectifier there's a thermistor (TH2). This can deteriorate over the years as the connecting wires corrode – the component can in fact fall apart. It can be replaced with a 4·7Ω, 5W resistor. Failure of one section of the two-pole mains on/off switch can also occur: shorting across the open-circuit section will enable the set to operate, but in the interests of safety a replacement should be fitted as soon as possible.

A not uncommon cause of no results is a short-circuit mains filter capacitor (C193, 0·1μF). This should blow the mains fuse FS1. Replace it with a capacitor rated at 1kV. The fuse itself can die of old age, and should be replaced with one rated at 1·5A. Another cause of a blown mains fuse is a short-circuit h.t. rectifier (use a BY127) – or its parallel 0·0018μF protection capacitor C191.

Field Timebase Faults

Field timebase faults – no field scan (horizontal white line), lack of height, poor linearity, or a tendency for the picture to roll – are common in sets of this type. The PCL85 field timebase valve should be the prime suspect, and in a large number of cases replacing it will cure the fault.

If there's a gap at the bottom of the screen and a replacement valve doesn't effect a cure, suspect the output section's 250μF cathode decoupling electrolytic C154 (25V). Also inspect the 330Ω cathode bias resistor R108 which may have overheated and fallen in value. Replace it if in any doubt. Since the usual cause of these troubles is a defective valve, it's clear that the PCL85, the resistor and capacitor must all be replaced to cure the fault. If the output pentode's cathode resistor has risen in value, the symptom will be compression at the top of the picture.

In the case of a horizontal white line, try a new valve then check the voltages around it. Faulty scan coils are not often encountered, but the miniature thermistor TH1 in series with the field scan coils can fail (check by linking across). No voltage at pin 6 (pentode anode) could mean that the primary winding of the field output transformer is open-circuit.

Leakage between the line and field scan coils will give erratic, intermittent results with audible arcing.

Loss of height with the height control P5 at maximum usually means that the resistor feeding the height control has increased in value. This is R132 (1·2MΩ), mounted at the other end of the board near the PY800. R103 (560kΩ) on the other side of the control should be checked if necessary, also the field charging capacitor C147 (0·05μF) and C179 (0·01μF, decoupling R132), either of which can leak.

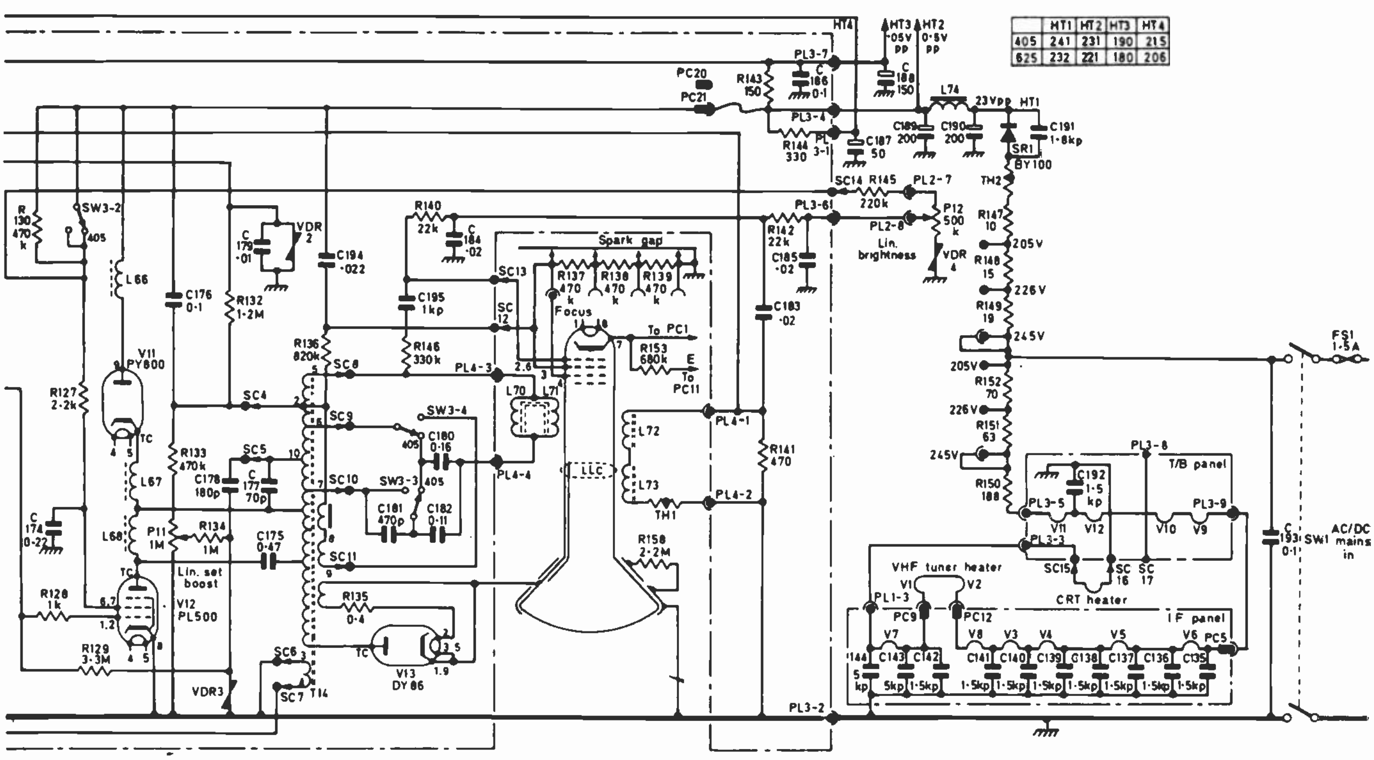
In the case of bottom compression, again try a new valve, check the output pentode's cathode components, then suspect a leak in C151 or C155 in the linearity feedback circuit or a faulty 100kΩ linearity control P8.

In the event of loss of field hold, check the field sync pulse integrating capacitor C156 (0·05μF) which can go open- or short-circuit. Field hold problems can also be caused by C150 and C148 in the coupling circuit between the pentode anode and the triode control grid. Note that C150 (0·005μF) is rated at 1kV working.

Line Timebase Faults

Faults for which the line timebase is responsible are: sound but no raster (no e.h.t.); lack of width with poor e.h.t. regulation (picture size varies with picture brightness); ballooning (picture expands and disappears when the brightness is turned up); and loss of line hold.

Loss of line hold is often due to a faulty line oscillator valve (PCF802). If a replacement doesn't cure the fault, check the flywheel line sync discriminator diodes MR1/2 (replace with a pair of BA157s) and if necessary the associated components in this area.



the sync separator's anode load resistor. The earlier 2000 valve and transformer. A series-connected 1·8kΩ resistor winding.

Note that in addition to loss of line hold unbalanced flywheel line sync discriminator diodes can stop the oscillator completely. The result will be no drive to the PL504 line output valve, which will be very hot. This will damage the valve, so the fault should be cleared as soon as possible (to stop the line output valve overheating while checking for loss of drive, disconnect its 2·2kΩ screen grid feed resistor R127). Apart from the symptom of hot line output stage valves, there'll be no raster of course.

Most line timebase troubles occur in the line output stage however. A common fault is no raster/no e.h.t. If the line whistle is audible, check whether the DY86 e.h.t. rectifier is lighting up. No glow suggests a faulty valve and a replacement DY86 may well clear the trouble. The next suspects are two capacitors, C176 and C175. The former is the boost capacitor and may be short-circuit: use a replacement rated at 1kV. The latter is slightly unusual in providing a.c. coupling between the anode of the PL504 line output valve and the line output transformer, with the desaturating choke L68 forming a d.c. path for the PL504's anode current. Either the PL504 or the PY800 could be in need of replacement of course, while the PL504's screen grid feed resistor R127 (2·2kΩ) could be open-circuit. The latter is fed via break-before-make contacts on the system switch, so check that all's well here. If the line output valve is overheating, check back to the PCF802 line oscillator valve – a replacement will probably restore oscillation – and then if necessary back to the flywheel line sync discriminator circuit as already mentioned. If the checks made so far haven't located the cause of the absence of e.h.t., check the condition of the desaturation choke, then suspect the line output transformer.

In a few of these sets the c.r.t. first anode (pin 3) is decoupled by another 1kV capacitor, C197. If this goes short-circuit there's the same sound but no raster symptom, but the e.h.t. is present.

Ballooning should be cured by fitting a new DY86.

Lack of width can be caused by a low-emission line output valve, but more often the set boost control P11 is defective. A burnt spot on the track will give erratic width variations as the control is turned. Another common cause of lack of width is R133 (470kΩ), which is in series with P11, going high in value. Check whether the ferrite rod has fallen out of the desaturation choke – you might find it at the bottom of the cabinet. It's just possible for the PY800 to be responsible for lack of width. If all the points mentioned so far have been checked, the line output transformer comes under suspicion.

Signal Circuits

Apart from dry-joints, faults in the i.f. stages are generally due to valve failure. Loss of emission will lead to a general deterioration in performance. Check the colour of the screen grid feed and cathode bias resistors. Any discolouration suggests heater-cathode leakage and the need for a new valve. The anode circuit resistors can change value over the years.

A common fault in the video output stage is C93 (32μF) going open-circuit. This capacitor decouples the video output valve's screen grid and also the supply to the anode of the EH90, which acts as the sound demodulator on u.h.f. and as an audio amplifier on v.h.f. So when C93 goes open-circuit, there's buzz on sound varying with picture content.

Where normal results are obtained on v.h.f. but not on u.h.f., the PFL200 is the first suspect. The valve can also distort the sync pulses, leading to line or field slip. Check the sync separator section's anode and screen grid feed resistors, as a change of value will upset the rather critical electrode voltages. The coupling capacitor C104 (0·22μF) between the video and sync sections of the valve should have a high insulation resistance – in case of doubt, fit a replacement.

The v.h.f. tuner is not so important, which is a good thing since the type most often fitted (the five-position tuner) tended to deteriorate over the years, with contact troubles.

The transistor u.h.f. tuners give little trouble. With the no signals symptom, check that the 12V supply (yellow lead) is reaching the tuner. The collectors of the transistors are connected to chassis, with their emitters taken to the 12V rail via resistors. The r.f. amplifier transistor Tr1 fails more often than the mixer Tr2 – both are type AF186. Take great care not to disturb the layout and thus the tuner's alignment when replacing them.

There are two valves in the v.h.f. tuner, a PC900 r.f. amplifier and a PCF801 mixer/oscillator. The mixer doubles as an extra i.f. amplifier on u.h.f., a point which should be remembered when dealing with weak results on this system – a new PCF801 may well restore normal signals.

Before checking valves in a set giving weak or noisy reception, make sure that the system switch moves fully in both directions when the knob is operated, and that the contacts are clean. Loosening the screw securing the vertical rod to the switch arm permits the switch range to be adjusted: be sure to tighten the screw again after adjustment.

Poor contact in the aerial socket, dry-joints in the soldered print behind the panel, and loose connections in the coaxial plug should not be overlooked when dealing with this fault.

Sound faults include no sound, intermittent sound, distortion and hum. Loss of or intermittent sound is frequently due to a defective PCL84 (or PCL86 in some versions) audio output valve. Alternatively the volume control may have a dirty track, or there may be a dry-joint on the printed panel. Although not common, the loudspeaker or audio output transformer (T7) can go open-circuit. An unusual fault followed withdrawal of the chassis from the cabinet for servicing. The vertical system switch operating rod had been removed from the bottom of the switch and was swinging loose. As the set was switched on for testing, the loose rod contacted a tag on the sound output transformer, which is mounted on the side of the chassis, burning the transformer out. So before working on the chassis, secure all loose parts and avoid having loose tools lying around.

The audio output valve can also be responsible for weak or distorted sound, and the cathode bias resistor R96 (150Ω on some sets, 120Ω on others – its R99 with the PCL86) and the associated 25μF (50μF with a PCL86) decoupling electrolytic may be damaged in the process. The fault condition is similar to that mentioned when dealing with the field output pentode.

A very common cause of sound distortion in these sets is when R92/R93 change value. They form a potential divider feeding the screen grid (pin 6) of the EH90. The value of R92 is 18kΩ and of R93 5·6kΩ. Be sure to fit 2W types.

Hum on sound suggests that one of the electrolytics in the power supply has lost capacitance. Bridging the sections with a 32μF capacitor will usually cure the hum, but it's possible for the trouble to be due to leakage between sections inside the can. Interelectrode leakage in the EH90 or audio output valve is another possible cause of hum.

One or two other differences in the hybrid version of the chassis are worth noting. First, there are rectifiers in both the h.t. and the heater supply lines, while the thermistor is in series with the heaters. A different dropper is used, and the supplies for the transistors are derived from a resistor network at the end of the heater chain. The audio amplifier triode's 220kΩ anode load resistor can go high in value to cause loss of volume, while the 0·01μF coupling capacitor between the two sections of the valve can cause distortion when it develops a leak.

There were two types of valved v.h.f. tuner, a conventional turret type used in earlier models and a slug-operated oblong tin box used in later ones. The turret tuner was subject to the usual dirty/worn contacts and spring leafs, but apart from this and occasional valve failure it was very reliable.

In the later tuner the band coils were selected by a sliding bar controlled by indentations on a rotating disc behind the tuner. A loose disc can restrict the action of the operating bar, but this can be tightened to take up undue play. Tuning is by slugs sliding inside the coils, selected by a cam-operated lever with a return spring. Dirt and wear can lead to sloppy and noisy action. Apart from the occasional valve fault, the oscillator's 6·8kΩ anode load resistor can change value so that all Band III signals are lost. Replacing this resistor involves partially dismantling the tuner. This requires care – in particular make a note of the position of each miniature PK screw holding the casing in position (the lengths depend on which hole they occupy).

The transistor v.h.f. tuner used in some later versions uses the same rotating disc system. Ensure that the moving and sliding parts are adequately greased, and move freely and smoothly.

The accumulation of grease and dirt over the years can inhibit the smooth action of the slow-motion tuning system used with the u.h.f. tuner. Stripping, cleaning and reassembly with the application of a light oil will clear this trouble.

A still later version of the chassis used a transistorised multiband tuner and silicon transistors in both the tuner and the i.f. strip.

Buying a Secondhand Set

Before buying a secondhand set, inspect it carefully. A clean, polished cabinet suggests that it's had one owner who looked after it. Remove the back and check for signs of rough service work – resistors hanging in mid air, capacitors wired outside the chassis (especially electrolytic cans), and dropper sections wrap-wired instead of wrapped and soldered securely. A particular horror is a dropper section shorted across: this could mean that the valve and c.r.t. heaters have been over-run. Inspect can capacitors for leakage of electrolyte, especially over the system switches – dripping electrolyte will corrode the switch contacts.

If you're buying a set in working order, look for a clear, bright picture. Check for ballooning as the brightness control is turned up. Glossing of the whites as the brightness is increased indicates a poor c.r.t., which might respond to boosting. Try the system switch for station change, and the other customer controls for smooth action. ■

Service Notebook

G. R. Wilding

Korting Hybrid Colour Chassis

A hybrid Korting colour set came in the other day with the complaint no raster. There was ample e.h.t., so clearly there was a fault somewhere in the other tube supplies. The chassis is rather unusual, using colour-difference drive with the brightness control providing the supply for the colour-difference output stage clamps. This is associated with an ingenious tube protection system. The field flyback pulses are rectified by the action of a v.d.r. to provide the positive supply for the brightness control. Hence lack of field scan removes the positive supply to the brightness control and instead of a damaging white line across the screen there's a blank raster. As a first check we momentarily shorted together pins 2 and 3 – the red gun grid and cathode – on the tube base connector, thus removing the bias from the red gun. The result was a brilliant red line, confirming that the supply to the first anodes was present. Since the cathode voltages were normal, it was clear that the trouble had to be due to the grid voltages being incorrect. This was confirmed, so suspicion pointed to the field timebase. A new PCL805 resulted in a good picture, but with some cramping at the base of the raster. Changing the field output pentode's cathode bias resistor overcame this final problem.

Transistor Equivalents

Even in the heyday of valves there was never the multiplicity of types that are found with transistors today. We knew most equivalents from memory, and if in doubt there were excellent data booklets issued free by the major manufacturers to guide us. If you need a fairly rare transistor however, especially for a power stage, you can find yourself waiting quite a time for an exact replacement when a more widely known equivalent is all along available. Thus the following list from Mullard of various power types used in TV sets and their Mullard equivalents should be of help:

General-purpose power	*Mullard equivalent*
BD220/1/2	BD951/947/949
BD223/4/5	BD952/948/950
BD277	BDT92
BD278, BD278A	BDT91
MJE3055, TIP3055	BDV91
MJE2955, TIP2955	BDV92
TIP29 BD239 series	BD933 series
TIP30 BD240 series	BD934 series
TIP31 BD241 series	BD947, BD949 series
TIP32 BD242 series	BD948, BD951 series
TIP41 BD243 series	BD201/203, BDX77
TIP42 BD244 series	BD202/204, BDX78
High-voltage power	
BDX32	BU209A
BU105	Now BU205
BU108	Now BU208
BU157	BU208
BU308	BU208
BU426, BU426A	BU426, BU426A, BU433
BU500	BU208A
BU526	BU326
2SC643A	BU205
2SC937A	BU205
2SC1172/A/B	BU207A, BU208A, BU209A
2SC1922	BU205
2SC1942	BU208
2SC2027	BU208A

TV Reception via the F2 Layer

Hugh Cocks

As the current sunspot cycle heads toward its peak, so propagation of signals in the lower part of the v.h.f. spectrum via the F2 layer is becoming more frequent. The greater the number of sunspots, the higher the electron density in the F2 layer. As a result, higher frequency signals are reflected. The sunspot peak, likely to be in early 1980, is expected to be very high this time. We can hope therefore for the propagation of many v.h.f. TV signals over very long distances – similar maybe to the 1957/58 peak, when Crystal Palace BBC-TV on ch. B1 was received in Australia. The last peak, ten years ago, was not so pronounced. Frequencies to note are ch. E2 vision (48·25MHz) and sound (53·75MHz) and ch. E3 vision (55·25MHz).

Earlier this year I received several signals from Africa via this mode of propagation. With the hope of better things still to come, this article has been written to help others interested in receiving and identifying these exotic signals.

F2 Propagation

The F2 layer is the highest one in the ionosphere, being on average some 200 miles high. Thus a signal reflected from this height above earth will have a skip distance of some 2,000-2,500 miles. During a sunspot peak the maximum usable frequency (m.u.f.) can rise to 60MHz or so, giving reception of such signals over great distances. The m.u.f. is higher in winter than in summer, since the ionised gas layer is denser due to decreased heat from the sun. This is why most really long-distance TV reception in the past has been during the winter.

The shallower the incident angle of a signal, the easier its reflection by the F2 layer will be – if the angle is too steep and the ionisation too weak, the signal will pass through the ionised layer into space.

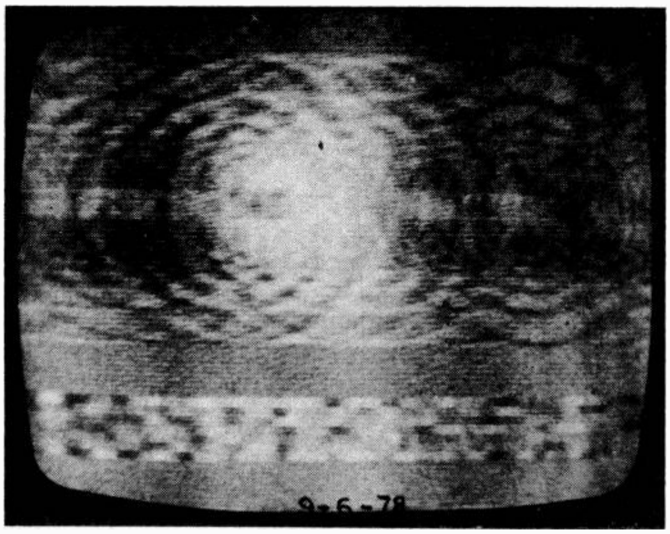
A point to bear in mind is that optimum reception occurs at the m.u.f. So when a relatively clear signal on ch. E2 begins to become stronger and more blurry, it will pay to check on ch. E3.

Unfortunately, the UK is a "fringe area" so far as F2 propagation of v.h.f. signals is concerned. The equatorial belt receives the greatest radiation from the sun, so the F2 layer above this belt is densest. In consequence, higher m.u.f.s more commonly occur for transequatorial propagation. The higher one is above say latitude 40°, so reception falls off. It often happens that transequatorial (F2/TE) signals just make it into the southern UK, but are not seen farther north. Don't be discouraged if you live in the north however – Gwelo Rhodesia ch. E2 was received in the very north of England in May 1973. Use a very high aerial wherever possible, because the F2 signal may be only just scraping over the horizon. Note that due to the sun's 27-day period of rotation, exceptional reception may be repeated approximately 27 days later.

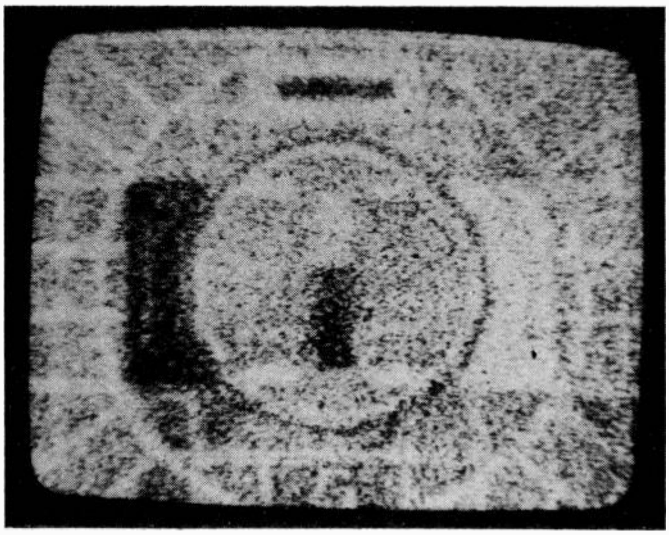
Certain signals, particularly Rhodesia ch. E2, have been received during southerly Sp.E openings. Double- or even triple-hop Sp.E signals would not reach the UK over such a distance however, so it's possible that the signal arrives in north Africa via F2 reflection and then continues its long journey to the UK via Sp.E. Reception of certain mid-African countries via Sp.E in the UK (notably Nigeria) is virtually ghost free and probably via double- or triple-hop. Some tropospheric enhancement at either end of the F2 path may also help the signal to travel marginally farther. For more detailed information on F2 reception, see Roger Bunney's *Long-Distance Television* book (a new edition has just been published by Bernard Babani (Publishing) Ltd., The Grampians, Shepherd's Bush Road, London W6 7NF at £1.45 (plus 20p via post).

TE Skip Reception

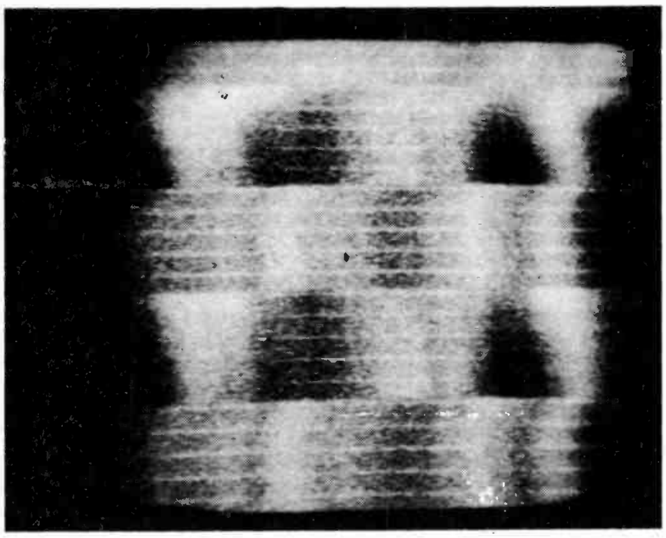
As we've seen, the most common form of F2 propagation is transequatorial skip reception. From dusk onwards, the two F layers break up and a single night-time F2 layer forms. While dispersal is taking place, the m.u.f. can rise to a higher level than during the day – radio amateurs in north/south America have noted reception at up to 420MHz! Most signals propagated in this way remain



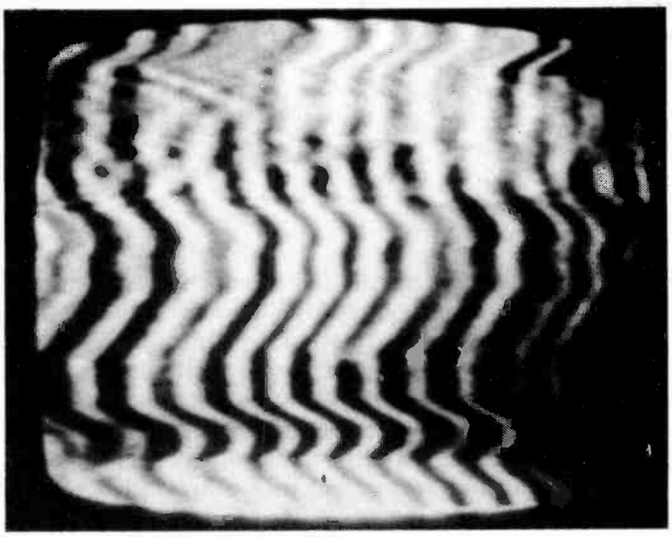
Rhodesian TV, ch. E2, received by Ryn Muntjewerff in Holland in June this year. Note the multiple images.



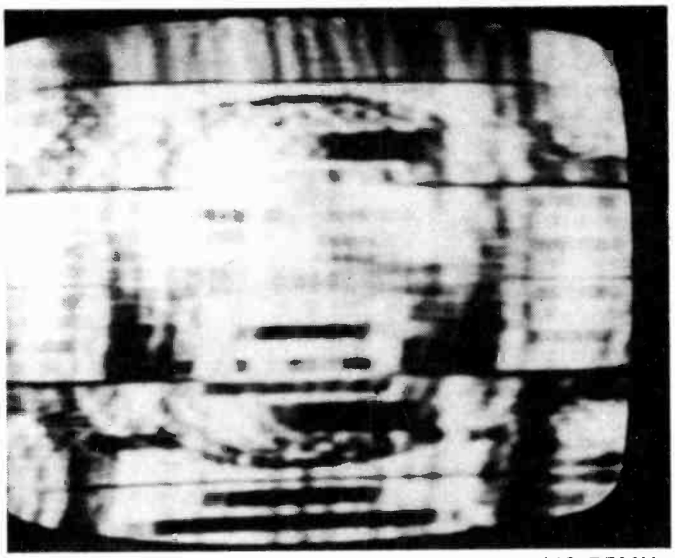
West Malaysia ch. E2 test card G received in Southern Australia in November 1977.



The Rhodesian checkerboard pattern, received on ch. E2 in May this year in Norfolk.



Nigerian TV received by the writer in April this year. Weak programme material was present before this stronger, more smeary signal appeared. This time the channel was E3.



Chinese test card received in Australia on ch. R1 (49·75MHz vision carrier). This test card is no longer in use.

within the equatorial belt, but on the odd occasion one finds its way into the UK – in April 1978 a very strong Nigerian signal was received over the period 1730-1830 GMT on ch. E3 (there was little on ch. E2 at the time, so always check on ch. E3 even if there are only very weak signals on ch. E2).

Obtaining Reception

In the UK, F2 reception from Africa is easiest. This is because for low v.h.f. F2 reception the mid-point between the transmitter and the receiver should be at noon. Since noon in Europe and Africa are at approximately the same time, this means that north-south reception is far less critical.

The best period for reception from Africa is from 1200 GMT onwards. If, like the writer, you don't have facilities for monitoring the 30-40MHz band, check whether the receiver is displaying the following signs of a rising m.u.f. (1) After 1200 GMT, check for weak morse code over the ch. B1 vision buzz – obviously a fairly weak B1 signal is needed. (2) Check whether by 1300 GMT the ch. E2 vision frequency (48·25MHz) is forming lines – audible as a low whistling note. (3) Tune the TV set to below ch. E2 – the lower sideband usually appears first. It's best to switch to positive modulation, as the negative-going sync pulses are more easily seen (as a thin, jumbly white line running down the screen). A short time after all this, the main carrier should appear. The time varies, but the main signal has never appeared before 1315 GMT and never later than 1445 GMT. It's usually quite strong, with several ghosts. The ch. E3 sound channel has never been heard so far, but on one occasion a weak ch. E3 vision carrier was noted. The duration of reception varies – from just five minutes to well over an hour.

If African reception occurs regularly, east/west reception may occur later in the year. As noon must be at approximately the mid-path, reception from the far east should occur from 0700 GMT onwards, middle eastern reception from 1000 GMT on and reception from north/south America from about 1400 GMT. Reception from the Americas is more difficult, due to the high frequency of ch. A2 (approximately 55MHz). If the m.u.f. is rising in that direction however, the 50MHz amateur band used in the Americas will become active, giving a good clue.

Identifying Signals

As reception tends to occur at the same time each day, the same material will tend to be received. Several African countries, notably Nigeria, now transmit in colour, and a vertical interval test signal should thus be present. The country I received on several occasions on ch. E2 last March appeared to use frequency grating charts. Rhodesia uses the checkerboard pattern (similar to Spain) till 1500, when it goes on to programmes. VITS are not used, and the line frequency is more or less 15,625kHz (some monochrome networks are not). There's generally a distinctive star symbol between advertisements on Rhodesian TV, and this may help with signal identification, though it's not always used. Gwelo ch. E2 produces a very distinct pattern of several diagonal bars when beating with the local (North Hessary Tor) ch. B2 sound signal here – in other parts of the country the B2 offset frequencies are different so this won't help.

Incidentally, last June I received an African station which used a symbol similar to the old Rediffusion star. I'd like to hear from anyone who can throw any light on this.

If conditions allow, listening to the sound channel will often yield more clues than trying to identify the messy vision signal (it also avoids eyestrain!). Once you've seen your first African signal, recognising further ones will become much easier since you will be aware of the signal's characteristics and be watching at the right time.

Finally, thanks to Roger Bunney and others who have sent photographs, and good viewing this winter! ■

Semiconductor Replacements

Andy Denham

You must know the situation. *It* stands there on the bench, obviously of Eastern origin (who says the Orientals have ceased to be mystical with the advent of capitalism?), the job card declaring: picture faulty; knock hard, customer deaf – and can you improve the sound since the customer is hard of hearing? You connect the thing to the mains, the screen lights up and a rustle is heard. Connect the aerial, and you get thin reedy sound with a faint, unlocked and apparently negative picture. After stripping the threads on the back screws and removing all signs of guides from the Phillips-headed screws, which don't quite fit UK screwdrivers, you crack your way into it.

In the process, you discover that it's a Unisonic PT400, foreign made. With the back laid on the bench and the set balanced across two boxes to give access to the tuner, which lies buried under a mass of wires, behind the mains transformer, you prod around for the a.g.c. feed to said tuner – by a process of elimination, since one must be the supply, one earth, one the i.f. output and hopefully the other the a.g.c. feed. You then discover that the a.g.c. doesn't vary. Simple! Follow the wire to its home, and there lie two unmarked e-line style transistors. You've never heard of a Unisonic before, and certainly have no gen on it. Take a closer look at the layout: one leg of the transistor goes to deck through a resistor, another's connected to a preset, and the third goes to the cathode of a diode. The chances are that it's an npn type, probably gated by 30V pulses.

Low-power Transistors

On the basis of this, a BC108 is fitted and hey presto it works! So if this little wonder does the trick, why shouldn't it always work? In fact the famous BC108 will do for most applications where an npn transistor is required, provided the collector-base voltage doesn't exceed about 30V, either while the transistor is working or when it's cut off. This latter point is most important in inductive circuits, where the total theoretical voltage developed across the coil can be Q_0 times the applied voltage. For general use in such circuits as ident amplifiers and decoder reference oscillators, use a transistor whose collector-emitter voltage rating is about twice the supply line voltage. Here, a BC107 is safe up to about 45V. For low-voltage, low-noise applications, a BC109 is preferable, generating less noise than a BC108 under similar conditions. This may be desirable in audio preamplifier circuits and so on. Providing the board will allow, it may be preferable to use the BC147/8/9 instead, as these can handle a little more collector current, though the legs cannot be made to fit so easily.

This then gives us a choice of three readily available basic transistor types suitable for most low-power (up to 100mA collector current) applications. As pnp replacements, the BC186 or BC187 can be fitted, as also can the lockfit BC157/8/9. That's covered a few more hundred types for replacement purposes!

For low-power i.f. stages generally, with forward a.g.c., the BF196 is useful. The BF197 can be used where a.g.c. is not involved, and for video circuits and sound i.f. stages the BF194 is suitable. Where lockfit transistors can't be used, the BF199 can be employed where there's a.g.c. and the BF241 as a straight amplifier.

Tuner transistors *are* replaceable – with care. The BF180 is fine as a silicon npn r.f. amplifier and the BF181 as the corresponding frequency changer. Where a germanium pnp type is required, the AF239 will almost always do.

For Vintage Gear

For vintage gear, OC44s are just about still available and AF127s can be put to good use. In old audio output stages the OC81 and OC81D can be changed for AC128s with good results. The AC128 and AC176 will replace many Japanese audio and low-power types. For preamplifier stages the AC126 is a better bet.

Medium-power Transistors

For higher-power applications (up to 300mA), for example many Thorn audio units and TV sets – the 1590 chassis's audio output stage for example – there are two very useful e-line types, the pnp TIS91 and the npn TIS90.

Going up further, to the TO5 types, which are nowadays able to handle around 500mA at up to 50V, the pnp BFX88 and npn BFY50 are useful. These can be used in medium-power output stages and as drivers (replacing the driver transistors in the Thorn 3000 chassis power supply and line output stage for example).

Going up now in voltage terms, a video output transistor will require a collector-emitter voltage rating of at least 200V for mains operation. Thus a BF258 will replace most types, including the lower-rated ones used in portable sets. The older BF179 remains a useful device to stock, but is becoming outdated by later ones such as the BF258.

Where plastic encapsulation is desirable, such as in the Grundig 5010/5011/6010/6011 series and some ITT sets, an MJE340 is useful. This can also be found as a line driver in such foreigners as Telefunken and Nordmende etc. It's performance is as good as the video type sometimes used (BF459G).

High-power Transistors

These are all medium-power types, operating at fairly high voltage and low current. In some applications, such as for high-power audio amplifiers, the opposite conditions apply – higher current at fairly low voltage. Here the complementary BD131/2 pair will handle up to 3A at 45V. Where the supply voltage is higher (say 3A at up to 60V) the beefier TIP31A (npn) and TIP32A (pnp) are handy devices.

For power regulator and field output purposes, also as a replacement for high-power audio output transistors, the 2N3055 is very useful. The old AD149 is still widely used as a low-voltage germanium pnp regulator transistor however. Since the BD124 became obsolete, I've found that a BD131 or TIP31A will as a rule serve. For similar powers where a germanium device is required, use the widely acclaimed AD161/2 pair.

The line output stage can cause all manner of problems, especially where Japanese sets are involved (a 2SC what, Fred?). An AU113 will usually endure well where a low-voltage germanium pnp type is required. In high-voltage circuits, use a BU208 where a single device is required in a colour set, or a BU205 where a pair of transistors is used or for a single-transistor monochrome receiver line output stage. For small-screen (18in. or less) high-voltage use, a BDX32 is a cheaper device.

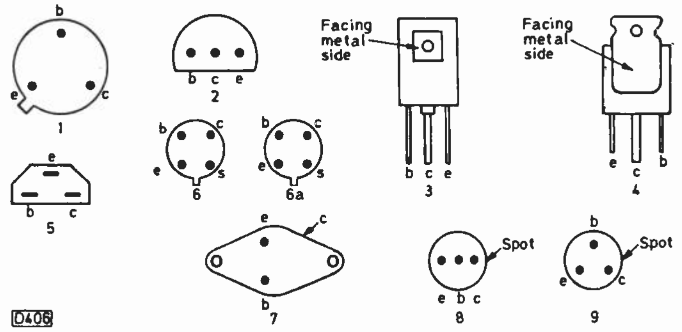


Fig. 1: Transistor base connections.

Diodes

The BY176 is a good device to stock for high-voltage rectification. Giving up to 15kV, it can be used in most small-screen sets, and can also be put to use as the focus rectifier in the Philips G6 chassis. The BY182 can be used in trebler circuits.

Suitable diodes for power rectification up to 1A at 1kV p.i.v. are the BY127, 1N4007, BYX94 etc. For lower voltages – 200V p.i.v. – the BY126, 1N4002 etc. can be used. For colour receiver first anode supplies, the BYX10 will handle up to 1·6kV p.i.v.

The 1N4148 is very handy for use in sync and a.g.c. circuits. For detection, the AA119, OA90 or OA91 can be used.

For supplies obtained by rectifying the output from a line output transformer winding, a high-speed switching diode *must* be used. The BY206 is suitable for lines at about 40V, 300mA or less. For field sync purposes an OA47 seems to be the thing. As a low-voltage bridge the BY164 is fine. For higher (mains) voltages use a BY179. Whatever you're replacing, check the connections: they do vary!

Transistor Stock List

The following list is by no means exhaustive, but should help storekeepers and enthusiasts alike to reduce their stock of odd balls which tend to gather dust long after the equipment in which they were used has been written off!

Suggested Transistor Stock List

Type	*Silicon or germanium*	*npn or pnp*	*Maximum collector-base voltage*	*Application*	*Base*
BC107	Si	N	50V	Low-power class A amplifier	1
BC108	Si	N	30V	Low-power class A amplifier	1
BC109	Si	N	30V	Low-power class A amplifier (low noise)	1
BC186	Si	P	40V	Low-power class A amplifier	1
BC187	Si	P	30V	Low-power class A amplifier	1
TIS90	Si	N	40V	Medium-power driver	2
TIS91	Si	P	40V	Medium-power driver	2
BFX88	Si	P	40V	Medium-power output	1
BFY50	Si	N	80V	Medium-power output	1
BF258	Si	N	250V	Video output	1
MJE340	Si	N	300V	High-power driver	3
BD131	Si	N	70V	High-power output	3
BD132	Si	P	45V	High-power output	3
TIP31A	Si	N	60V	High-power output	4
TIP32A	Si	P	60V	High-power output	4
BF180	Si	N	30V	U.H.F. r.f. amplifier	6
BF181	Si	N	30V	U.H.F. mixer	6
BF194	Si	N	30V	I.F./video amplifier	5
BF196	Si	N	40V	I.F. amplifier with a.g.c.	5
BF197	Si	N	40V	I.F. amplifier	5
AF239	Ge	P	20V	U.H.F. tuner	6a
2N3055	Si	N	100V	High power audio/field circuits (115W maximum dissipation)	7
AD149	Ge	P	50V	Medium power (22W maximum dissipation)	7
AD161	Ge	N	32V	Medium power (4W maximum dissipation)	7
AD162	Ge	P	32V	Medium power (3W maximum dissipation)	7
BU205	Si	N	*	Line output	7
BU208	Si	N	†	Line output	7
AU113	Ge	P	250V	Line output	7
BDX32	Si	N	1·7kV†	Line output	7
OC44	Ge	P	15V	I.F. amplifier	8
AF127	Ge	P	20V	I.F. amplifier	6a
AC128	Ge	P	32V	Low-power a.f. output	9
AC176	Ge	N	32V	Low-power a.f. output	9
AC126	Ge	P	32V	A.F. amplifier	9

* Maximum collector current 2·5A

† Maximum collector current 5A.

TV Servicing: Beginners Start Here . . .

Part 15

S. Simon

LAST month we discussed valve field timebases, in particular the charging and discharging of a capacitor in order to generate a sawtooth waveform at the field frequency, and the way in which these processes are timed. Whether we make use of a valve, transistor or any other suitable device to discharge the charging capacitor at the appropriate time doesn't matter: the basic idea is to produce a waveform to control the output stage, which in turn drives current through the scan coils, the resultant electromagnetic field produced in the c.r.t. deflecting the beam from the top to the bottom of the screen with the correct timing (accurate to a tiny fraction of a second).

When one studies the circuits of the solid-state field timebases used in the various models produced by different setmakers, the mind soon boggles at the almost infinite variations found on the basic theme. Our purpose is not to produce mind boggling and consequent loss of interest however, so we won't examine in detail the purpose of each and every component used in transistor field timebases. Instead, we'll confine ourselves to the relevant points that have to be considered in practical servicing.

Many times we are urged: first get the voltages right. This is fair enough in most situations, but the implication is that the voltmeter should be used to check the working conditions in each and every circuit. In some solid-state circuits however this can be fatal, and the reasons for this should be understood. Let's briefly consider the voltmeter you're going to use. Although it records voltage, the usual type of multimeter requires a flow of current to deflect its pointer and indicate the voltage. When such a meter is used on the Ohms range, to measure resistance, the current required is drawn from the meter's internal battery. Now some meters are very sensitive, requiring very little current. Others, usually the cheaper types, require a greater current flow in order to produce an indication. This sensitivity is often specified on the meter itself, in terms of Ohms per volt (Ω/V). Low sensitivities might be 1,000Ω/V or even less, requiring say 1mA to produce a full-scale deflection. Even a 20kΩ/V meter requires a significant amount of current to deflect its movement however. When the voltage is being measured, the internal battery plays no part, the current required being drawn from the circuit under test. Thus when the meter is connected to a circuit to measure the voltages present, the meter's own resistance is added to the circuit, presenting an additional load which can severely alter the operating conditions in the circuit being checked.

Depending on the arrangement of the circuit, connecting the meter may for example result in a transistor switching

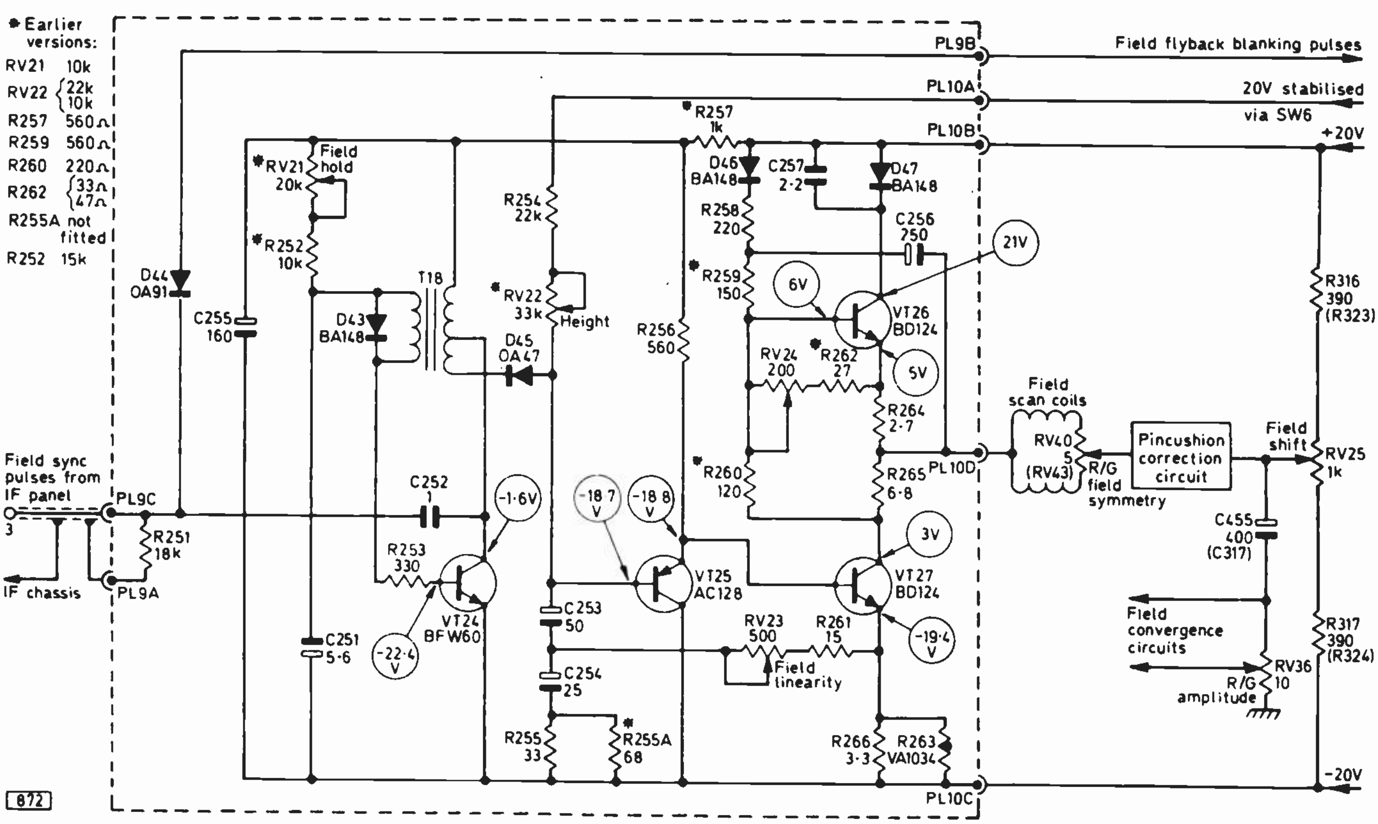


Fig. 1: Transistor field timebase circuit used in the Pye hybrid colour chassis.

on and passing current, or alternatively switching off. In a d.c.-coupled circuit this will have a tremendous effect at the end of the chain of stages, i.e. where the higher currents flow: output transistors and their associated components may in consequence burn out. This can apply to audio amplifiers as well as to timebases, to oscillators of various types and to anything which has a fairly high impedance likely to be affected by the sudden provision of an additional path of lower or significant resistance.

The lesson is to look at the component values used in the particular part of the circuit to be checked. If the resistance values are high (say over 200kΩ), the meter is likely to disturb the operating conditions — as well as giving a misleading reading. Such considerations can be ignored where the circuit impedance is low.

Just for the record, there is another interesting possibility worth noting. It's well known that a high-energy circuit radiates. To demonstrate this, just move a neon screwdriver near a working line output stage: it will light up at some distance from any actual physical contact. Under some circumstances, this radiation can induce a signal into the leads of test equipment, and if such items are being used to test an earlier stage a feedback pulse might for example be introduced, causing severe damage to the output components, i.e. the transistors and transformer, to name two costly items.

So you see then the pitfalls that can await the happy voltage tester.

Pye Transistor Field Timebase

One of the first all solid-state field timebases to appear in a UK produced chassis was that used in the Pye hybrid colour chassis. It's fairly simple, as the circuit shows (Fig. 1). The whole thing is strung between +20V and −20V rails, so the effective supply voltage is 40V. The first stage consists of a blocking oscillator, the main components here being the transistor VT24, transformer T18, and the timing components C251/R252/RV21 (field hold control). VT24 spends most of its time cut off by the negative voltage at its base (note the polarity of C251). When this voltage has fallen sufficiently, due to the negative charge on C251 leaking away via R252/RV21, VT24 switches on. Since T18 provides positive feedback between the collector and base of VT24, the transistor is rapidly driven to full conduction. During this process, C251 is charged negatively by VT24's base current. When VT24 saturates, i.e. reaches the state of maximum conduction, there is no longer any signal feedback to its base and, as C251 has acquired a negative charge, VT24 switches off again. The whole operation is repeated when the conditions in the timing circuit allow this. To make sure that the operation is synchronised, negative field sync pulses are fed to the collector of VT24 (via C252). These are fed back to VT24's base via T18, ensuring correct synchronisation. D43 is a protective device, included to prevent the base circuit ringing.

The field charging capacitors are C253/4 — two so that field linearity feedback can be applied to their junction. They charge from a zener diode stabilised 20V rail via RV22 (height) and R254. They are discharged via D45 and VT24 when VT24 is switched on by the timing circuit/sync pulses. The emitter-follower driver transistor VT25 is at full conduction at the end of the flyback, when the charging capacitors have been discharged. As they charge, VT25 is driven towards cut-off (being a pnp device) and in consequence the waveform at its emitter consists of a positive-going field-frequency sawtooth. This is d.c. coupled to the base of the lower field output transistor VT27, so that this transistor is driven progressively towards greater conduction as the field scan continues. The negative-going sawtooth at the collector is coupled to the base of the upper transistor in the output stage, VT26, so that this transistor is driven towards cut-off during the field scan. So if VT27 is being driven towards saturation and at the same time VT26 is being driven towards cut-off, where does VT27's collector current flow? Via the field scan coils and C455, so that the spot is deflected towards the bottom of the screen. How to get it from the bottom to the top again, i.e. effect the flyback?

At the end of the scan C253/4 are discharged by VT24/D45 and VT25 is switched fully on, connecting VT27's base to the −20V rail. VT27 switches off very rapidly, its collector voltage rising sharply. This rise is coupled to the base of VT26 via the bootstrap capacitor C256, so that VT26 switches fully on. The voltages around VT26 are now such that D46/7 switch off, and a curious thing occurs: C257 is connected in series with the field scan coils via VT26, and the resultant oscillatory action of this circuit deflects the beam back to the top of the screen. So the circuit is not quite the straightforward one it may at first appear to be.

We've glossed over one or two of the finer subtleties of the circuit's operation, but to anyone who feels inclined to complain we must point out that if a service engineer had to understand fully every function of every component in every set he serviced, then precious little time would be spent doing service work and a great deal would be spent on study. It's far more to the point to appreciate the basic idea of what is, or should be, happening; to have the circuit diagram and the maker's meter readings; and a good instinct for what is likely to go wrong rather than what could go wrong.

So, looking at the circuit, what are the likely trouble spots? As in every case, we must first establish that the supplies are present, in this case +20V and −20V rails (plus the regulated 20V supply). So, if we connect the negative clip of our voltmeter to chassis we should record with our positive probe 20V on the body (collector) of one output transistor (assuming that the original BD124 type of transistor is being used), and with the positive probe to chassis −20V at the emitter of the other transistor (VT27). One might think that the body of this latter transistor would be at zero voltage, i.e. the circuit's mid-point, but in fact this is not so and VT27's collector voltage is more likely to be about 3V positive, depending on the setting of RV24. The exact preferred adjustment is such that the voltage at the junction of R264/R265 is 22V with respect to PL10C (the −20V line). In practice between 2 and 4V may be found with respect to chassis.

If these conditions are correct there should be little wrong with the height. The other key voltage check is at PL10A, which is also a 20V supply but from a different source. PL10A supplies the height control, via R254. This 22kΩ resistor is near the height control and should have 20V at one end and a negative voltage at the other – when the timebase is working. The exact negative reading will depend upon the setting of the height control, but will be about 18V negative at the base of VT25. So here we have some useful check points. There is no point in making any field circuit checks if the three supply voltages are not present at PL10A, PL10B and PL10C (two positive and one negative).

We've often found the supply at PL10A low due to the zener diode D52 in the power supply being leaky, or a similar fault in the associated 250μF electrolytic capacitor C312. This results in lack of height.

If the supplies are correct, the timebase must be drawing approximately the right current. If the voltages are slightly high, it's likely that VT27 is not being turned on. Its collector may then be at something more like the full 20V positive instead of about 3V, whereas the base and emitter may read the full 20V negative, thus explaining the single horizontal line across the screen as the timebase is inoperative.

This could be the result of an inoperative field oscillator or D45 being open-circuit, but this is rarely the case. The first suspect should be the driver transistor VT25 (AC128). It will often be found mounted under the panel rather than on the normal component side, as it's then less likely to become overheated since it's away from the output pair of transistors which normally run hot. It's a simple matter to unsolder the collector and emitter leads to check for shorts, applying the usual transistor forward and reverse checks, also from the base to the other two to prove conduction once the item has been found to be free of shorts. If it's in order, refit it and check any other items which would take its emitter down to the negative line, e.g. a short in C255 or a base-to-emitter short in VT27.

Normally however the complaint is not of complete field collapse, rather of lack of height, severe compression, rolling etc.

We must also point out that complete loss of field scan need not be in the power supply of the field timebase circuit proper. The path followed by the field scan current in a colour receiver is somewhat less than direct. There's a field shift control (RV25) which puts a bias current through the coils in order to move the picture up or down (since a simple magnet cannot be mounted on the tube neck for this purpose as is done in monochrome receivers). A defect in this control can rob the scan coil drive of its d.c. return path. There's also a wirewound control that can cause field collapse (RV40 R/G field symmetry), mounted on the convergence panel. Thus once in a while one has to go on a merry chase to find the open-circuit that's preventing the passage of the field drive current.

As we've said, the complaint is more often of a reduction in rather than a complete loss of field scan, and one is then well advised to check the field timebase panel transistors and other components, particularly the electrolytic capacitors. We don't propose to outline tediously the fault symptoms caused by each and every one of them. Far better to jump in and check them, as this can be done with the panel out in a matter of moments . . . well minutes. There are only five, and one end of each can be lifted from the panel and the ohmmeter applied across each suspect in turn. Remember that one or more could still be retaining a charge, which could give misleading results. So the first action is to short one end of the capacitor to the other so that it's in its discharged state. Then apply the ohmmeter test prods, negative probe to the positive end of the capacitor, meter switched to the highest ohms range.

A 250μF electrolytic such as C256, which often causes severe loss of height due to loss of capacitance, should cause the meter's pointer to swing hard over as it charges, and then gradually recover and climb toward the 100kΩ mark or thereabouts to indicate that it is willing to store a charge. An infinity reading should not be expected with this type of high-capacitance, low-voltage component. C253 and C254 (also suspect) are lower capacitance types, and will or should cause a fair meter deflection and a quicker recovery. C255 should behave much the same as C256, being of higher capacitance. C251 is much lower in value so its charging time is much more brief, though of course should still be obviously readable. Thus all five capacitors can quickly be checked and cleared of suspicion.

In some later chassis the BD124 transistors are replaced by more up-to-date tab types, RCA 16181 for VT26 and 16182 for VT27.

Rank Circuit

A very similar driver and output circuit is used in the Rank A823A chassis (see Fig. 2), but the oscillator is completely different. One notices the same two diodes in the output stage, and we should have pointed out that field collapse could well be due to one of them going open-circuit. The fact is that we've found this rare in the Pye chassis but more common in the Rank one. Probably just one of those things, and the reverse might be the case in others' experience.

It's quite clear from this circuit that complete field collapse can be due to 6RV2 becoming defective, with a dud spot where the wiper contacts the track. Indeed this is a very common occurrence, and it's not difficult to check this control which is on the upper right side near the convergence strut pivot.

It's worthwhile reverting to the supply diode for a moment, and of course the supply itself which in this case is derived from the line output transformer instead of from the mains as in the Pye hybrid chassis. It will be seen that there are two BA148 diodes (5D12/13) in series to rectify a pulse output from the transformer. The d.c. output from the diodes is smoothed to become the 40V supply for the timebase. These BA148 diodes should be replaced by ones of more generous rating, such as the BY207, if the occasion arises. The purpose of the other two diodes 5D8 and 5D10 has already been explained: they could also well be replaced by the BY207 type.

The type of transistor used in the output stage may vary from those shown. These may not be directly interchangeable as the leadouts may be different. For example, the BD131 type has the collector lead in the middle, as is usual, but the base and emitter leads are transposed compared to some RCA types, so it's essential to check up on this point in your transistor information manual (you have one, haven't you?).

An AC128 driver is used to turn on 5VT10, as in the Pye circuit, but it will be seen that the height control is connected in series with high-value resistors to the h.t. line (200V). Capacitors 5C24 and 5C25 are charged via this height circuit (but not to 200V!). As they charge, 5VT7 is turned off, the driver/output circuits operating in exactly the same manner as the Pye circuit previously described (though the voltage conditions differ, a single 40V rail being used instead of separate 20V and −20V ones).

To produce the flyback, 5VT7 has to be driven to full conduction, and consequently 5VT10 cut off, very rapidly. This is done by placing a virtual short-circuit across the charging capacitors. In the Pye circuit this was done by the blocking oscillator transistor VT24 and diode D45 when they switched on briefly. In this Rank circuit the short-circuit/discharge action is provided by 5VT5, which is in turn controlled by a device which we have not discussed before in this series – the BRY39 silicon controlled switch 5THY1. This device is very similar to a thyristor, but has two gate connections instead of one – the anode and cathode gates. This means that it can be turned on either by raising its anode voltage above its anode gate voltage or reducing its anode gate voltage below its anode voltage, or by doing similar things to its cathode/cathode gate voltages. In this circuit, control over its switching is effected in the anode/anode gate circuitry. The timing capacitor is 5C22 which, while 5THY1 is cut off during the forward field scan, charges via 5R26 (5D5 is conductive, since it's forward

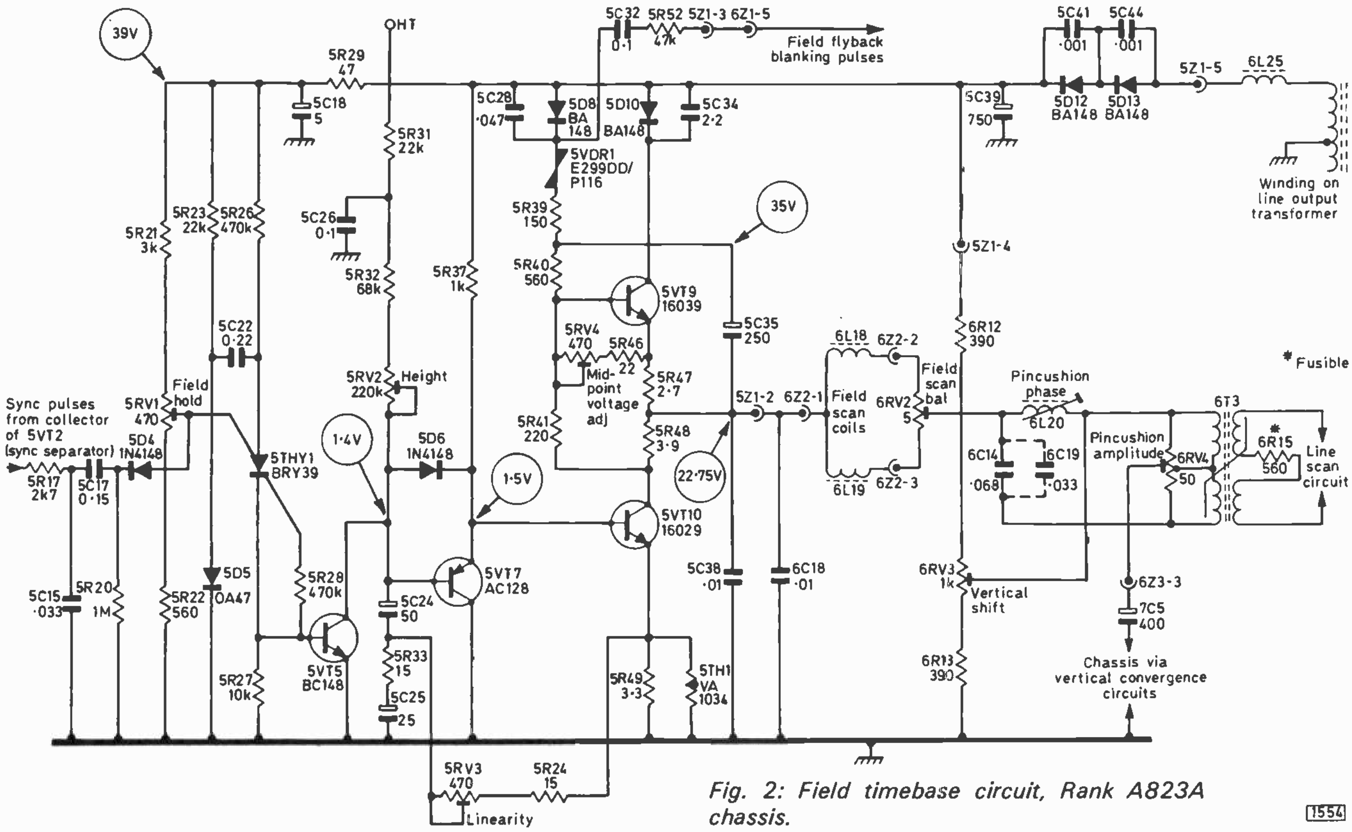


Fig. 2: Field timebase circuit, Rank A823A chassis.

biased by 5R23). When the charge on 5C22, i.e. the voltage at the junction of 5C22/5R26, reaches a critical figure (determined by the anode gate voltage, which is set by the field hold control) the SCS bursts into life, passing a lot of current. As a result, the voltage across 5R27 rises, switching on 5VT5 to discharge the charging capacitors 5C24/25 (the short-circuiting action). Another result of 5THY1 switching on is that the timing capacitor 5C22 gets discharged. Once this has happened, the current flowing through 5THY1 falls below its hold-on value and it switches off again. End of flyback. Exact synchronism is effected by feeding negative-going field sync pulses to 5THY1's anode gate (via 5D4 etc.) to ensure that it switches on at exactly the right time.

Now we come to the warning given earlier. Don't try to measure the voltages on the SCS. The application of a meter will upset its fine balance and stop it working. This will mean that neither 5VT5 nor 5VT7 gets switched on, while 5VT10 is left switched on drawing a heavy, continuous current. It will not like this, and the net result will be a nasty burn up in the output stage. So you see! This warning also applies to other chassis which use an SCS as the field oscillator. A corollary is that if you find a burnt up output stage, check that field drive is present before switching on with the replacement components fitted: the driver transistor's emitter voltage provides the clue.

So what goes wrong with this lot? Well, to start with let's consider what doesn't go wrong with the timebase itself though the symptoms might suggest that the fault is in this part of the receiver, e.g. jitter, bounce, weak field hold etc.

The Rank A823A is a fully solid-state chassis whose regulated h.t. supply is obtained from a thyristor acting as a controlled mains rectifier (something we'll come back to in a later instalment). Rapid up and down jitter is quite likely to be caused by rapid fluctuations of the h.t. voltage. The components that are supposed to stop such things happening are often responsible for their occurrence. In this context we can lump together several similar solid-state chassis which employ much the same sort of power supply and field timebase circuitry – in addition to the Rank chassis the Philips G8 and GEC C2110 series for example. The mains rectifier thyristor can well be responsible for this fault, as also can the BR100 diac which controls it (another four layer, i.e. pnpn, semiconductor device, but this time with only two external leadouts, anode and cathode). If in doubt change these items, since testing will not reveal the fault.

The cause of jitter can however lie in the field timebase, the culprit being the SCS. But first check the h.t. supply thoroughly (new BT106 thyristor, new diac).

Weak field hold can be due to faulty electrolytics either in the sync separator supply line or, particularly in the earlier A823 version of the Rank chassis, the a.g.c. circuit (check 2C37, 125μF, on the A809 i.f. unit), so here again we have to proceed with an eye to possibilites outside the field timebase itself.

Normally however the faults encountered will be lack of height, top compression with the teletext lines showing, total field collapse, or perhaps only the tendency to roll now and again simply because the field hold control requires resetting.

Lack of height may be due to ageing output transistors, and 5VT10 should be the first suspect since this leads a harder life than 5VT9. Severe lack of height could be due to nothing more than a dud spot on one of the preset controls, and it's always a good idea to check on the smooth action of these before suspecting such items as 5C35, the output transistors, etc.

5C35 can also cause a jittery picture before it becomes open-circuit altogether.

If the top of the picture is compressed to show the teletext information, check the preset 5RV4 and set this for 22·75V at the mid-point of the output pair, i.e. the junction of 5R47-5R48, which is brought out to pin 2 of plug 5Z1. This reading presumes that the supply at pin 4 of this plug is in fact the full 40V.

Long-Distance Television

Roger Bunney

WITH the approach of autumn, there's been a gradual change in reception conditions. Sporadic E propagation died away gradually, though there were several good openings into Eastern Europe during the mornings. The continuing increase in sunspot activity has produced a marked improvement in F2/TE reception, while high pressure during the mid/end September period produced enhanced tropospheric reception. The latter enabled several enthusiasts to receive excellent pictures from West Germany, the low countries and France, over the period 13-24th. Conditions peaked on the 23rd/24th, giving excellent CLT (Luxembourg) in Band III and at u.h.f., overloading French u.h.f. signals, and W. German stations from Band I through to Band V. The latter were very well received along the south coast – it's unusual for chs. E2 and E4 to appear via tropospheric propagation!

By the third week in September the F2/TE conditions were sufficiently good for Nigeria ch. E3 to be received by Hugh Cocks in South Devon – on the 18th and 21st. The latter reception, between 1830 and 1900, produced a strong though smeary signal at Hugh's location, though David Martin only some 40 miles away, 18 to the north, was unable to resolve anything on this channel at the time. A Nigerian ch. E3 signal on the 24th was monitored by Hugh, David (at Shaftesbury) and myself in Romsey between 1800 and 1900, there being a fade out at the first two locations at 1840 but a return of the signal at Romsey between 1855 and 1905. Unfortunately the signals were of the characteristic smeary, ghosty appearance, so a clear photograph could not be obtained.

Another unusual characteristic of the present F2/TE propagation is that the daytime F2 reception seems to bear little resemblance to the evening TE reception. Hugh received excellent South African mobile communications signals on the 19th at up to 39MHz, but the corresponding evening period gave no African TV whatever. There was extremely poor daytime reception on Sunday the 24th – I noted signals at up to 33MHz – but came the evening and we had the strong Nigerian ch. E3 signal. There was nothing on ch. E2 however, from either Rhodesia or the Nigeria/Ghana region. These signals are not reaching much farther north: to date only Clive Athowe/Ray Davies in Norfolk have received them, with but a single report of Rhodesian reception from Derby.

At the time of writing, there's been no further information on the ch. A2/3 reception on July 30th.

There was a good Aurora on August 28th over much of the country, when Kevin Jackson in Leeds received many of the Scottish 405-line v.h.f. transmitters including, unusually, the Whitehaven ch. B7 relay station. The night of August 27th also produced a large meteor shower: according to newspaper reports the sky over Yorkshire and Lincolnshire was lit by flashes and coloured lights, and one wonders whether maybe this was some form of Auroral manifestation.

News Items

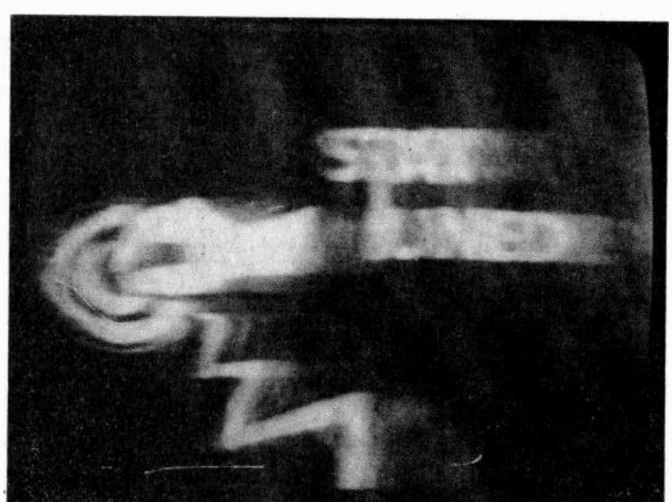
USA: The FCC has ordered that the noise figure for u.h.f. TV receivers be reduced from the present 18dB to 14dB as from October 1st 1979, with all receivers to meet this figure by October 1981 and a further reduction for newly manufactured receivers to 12dB by October 1982, with a possible improvement in interference rejection. Most u.h.f. tuners fitted in receivers used in N. America do not have a tuned r.f. amplifier stage.

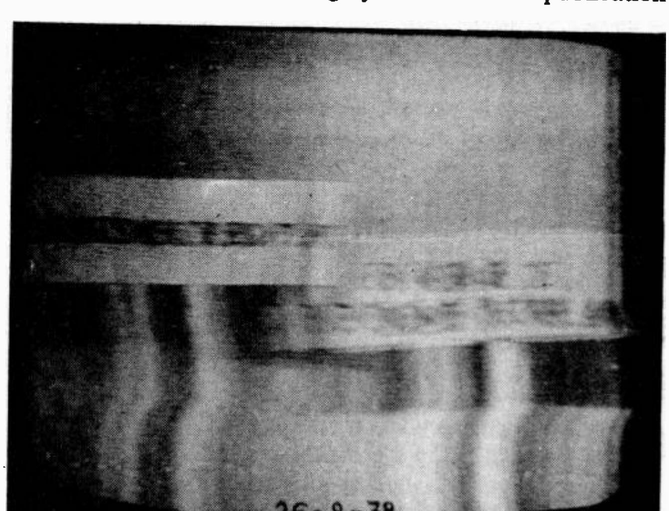
Tibet: A test monochrome TV service has been started, based on Lhasa.

Afghanistan: The broadcasting service's new name is Ariana Afghanistan National Radio Television. Test transmissions started on March 21st, and at present there's one hour of test programme transmissions between 1900-2000 on Saturday-Thursday and two hours (1900-2100) on Fridays. For identification purposes the letters AANRT will be used.

Commercial Corner

The 22nd edition of the highly recommended publication





Nigerian captions received by Ryn Muntjewerff in Holland on August 26th, on ch. E3. At the same time, a mystery RETMA test card was present on ch. E2.

List of European Television Stations is now available from the European Broadcasting Union, Technical Centre, Avenue Albert Lancaster 32, B – 1180 Bruxelles, Belgium. The cost is 450 Belgian francs, and includes postage and six bimonthly supplements.

The Asian Broadcasting Union, Department of Broadcasting, Angkasapuri, Kuala Lumpur 22-10, Malaysia has published a 16-page booklet listing the broadcasting system, channels and other information on each ABU member. There are twenty photographs of test patterns and identification slides in common use. The price is two US dollars.

The new edition of my book, re-titled *Long Distance Television Reception for the Enthusiast,* has been published by Bernard Babani (Publishing) Ltd., The Grampians, London W6 9NF.

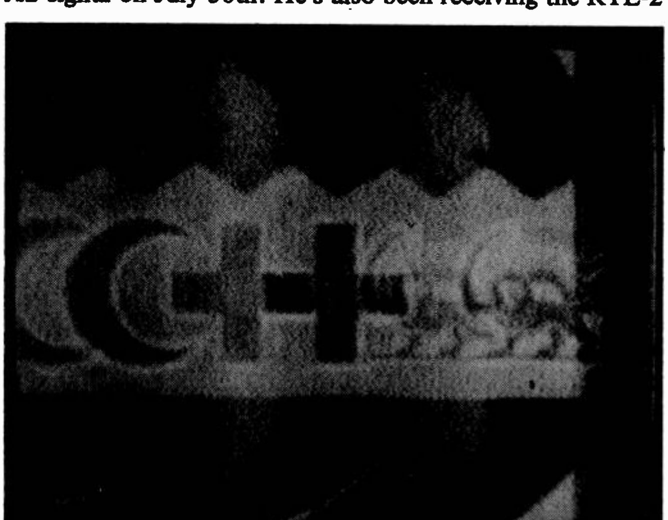
The GPO filter type F38A is being sold by A. H. Supplies, 122 Handsworth Road, Sheffield S9 4AE at four for £1·40. This is a high-pass unit with a 2dB insertion loss, giving a 40dB attenuation below 40MHz. It's intended as an i.f. filter, but is ideal for home-made v.h.f. preamplifiers which tend to suffer from radio breakthrough.

From our Correspondents . . .

Leslie Green of 16 Hawthorn Avenue, New Silksworth, Sunderland, Tyne-Wear was taken to hospital in September 1977 and subsequently underwent several operations. He'd been intending to start DXing, and had started to convert a Bush TV125/Murphy V849 chassis for this purpose. On returning home however he discovered that his workshed had been broken into and the TV125, Avometer and other components stolen. If anyone has a spare TV125, they might like to contact Leslie, who comments that his son could collect within a reasonable distance. Leslie has been active since 1928, and made several Scott Tagget radio receivers.

Neil Breward's receptions at Stoke-on-Trent include a mystery signal, which was difficult to lock, on July 30th. The time he gives confirms that he too received the North American ch. A2 System M signal. Neil has been thinking about Sp. E and the high field strengths encountered, and suggests that some form of ionospheric focusing may be involved – see Fig. 1 – with the strength of the received signal being dependent upon height, ionospheric density and the Earth's curvature. Any comments?

John Cowan (Ayr) is another reader who received the ch. A2 signal on July 30th! He's also been receiving the RTE-2



Iranian ch. E2 identification slide, received in Holland via Sp.E by T. Van Dalen on May 6th, 1978.

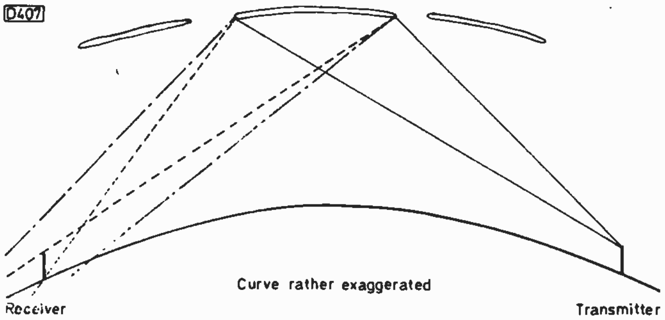


Fig. 1: Neil Breward has suggested that some form of ionospheric focusing could be responsible for the high field strengths encountered with Sp.E reception.

PM5544 test pattern from Truskmore on ch. G. Jim Cook (Newcastle) has received Iceland, Norway, Sweden and Finland via Sp. E this season. John Neary (Dukinfield, Cheshire) has been using a Bush Model TV161 fed from an omnidirectional crossed-dipole aerial. His reception of a checkerboard pattern on ch. E3 indicates, from the time (1830), the Lousa RTP (Portugal) transmitter. Care is needed since Rhodesia, Spain (both RTVE-1 and RTVE-2) and Portugal all use a checkerboard pattern on ch. E2 at times. A smeary, ghosty checkerboard at about 1500 GMT will usually be from Gwelo, Rhodesia.

Aerial Feedback

Back in July 1969 we featured an omnidirectional Band I aerial design centred on ch. E3 (55·25MHz) but with a reasonable performance over the 48-63MHz spectrum, i.e. encompassing the chs. E2-4 vision frequencies. It's ideal as a low-cost basic receiving array, but it must be realised that the signal output relative to a dipole has a negative gain. It's normally assumed that a half-wave dipole has an output of 0dB, gain always being expressed relative to this standard. On this basis, the omnidirectional aerial will have a power gain of −3dB at its centre frequency, falling to perhaps −6dB on chs. E2 and E4. Basically, the array (see Fig. 2) consists of two dipoles mounted at right angles and for horizontal polarisation. The two dipoles are connected together via a quarter-wave section of 75Ω coaxial cable, the output being taken through a quarter-wave matching section of 50Ω coaxial cable before being connected to the 75Ω downlead.

The first modification to the basic design was to adopt an improved dipole system (see Fig. 3) based on the Antiference Trumatch system. This gave an improved gain/bandwidth product, due to better matching over the wide bandwidth. To improve the output further, a modification based on an idea put forward by J. M. Osborne in *Wireless World* for an omnidirectional aerial for satellite weather pictures at 137MHz was tried. This consisted of adding reflectors at 0·3 × wavelength below the dipoles to reduce pickup from beneath and give a lift to the array's acceptance lobes (Fig. 4). For Band I a compromise must obviously be struck, since the bandwidth is wide, and it will be impossible to maintain the $0{\cdot}3\lambda$ spacing and the polar response. I opted for a spacing of $0{\cdot}3\lambda$ at 50MHz (5ft 11in.), which seemed to work well and certainly reduced interference pickup from below, with the reflector elements cut to 48MHz (9ft. 9in.). The cable section dimensions are less than the free space equivalent lengths to take into account the cable velocity factors. 50Ω cable can be obtained from amateur radio suppliers (see *Short-Wave Magazine* or the RSGB's *Radio Communication*).

The question of stacking aerials in Band I came up again recently (see Fig. 5). Rather wide dimensions are unfortunately needed for optimum performance. The spacing must be a minimum half wave, but for optimum gain the spacing will be wider. The optimum-gain spacing is related to the gain of each array, higher gain aerials requiring a wider spacing. For example, and assuming that we are using vertical stacking (i.e. aerials mounted horizontally, one above the other), a ch. E3 (55·25MHz) aerial system using say five elements will need a spacing of 12ft 3in., whereas for an eight-element system a spacing of 18ft 9in. will be required. One obviously has to be practical, and quite apart from the unlikely event of having an eight-element Band I system one should aim to rig for safety, with a $\frac{3}{4}\lambda$ spacing at the lowest frequency to be covered. The largest Band I aerials used for DXing tend to be four-element Yagis: for optimum gain with two stacked four-element aerials covering chs. E2-4 the spacing should be 15ft 3in.

It's sometimes necessary – as I know all too well from current experience! – to stack for minimum interference pickup. An interesting graph in the *ARRL Antenna Handbook* shows typical spacings per side lobe reduction relative to the half-power (−3dB) beamwidth points of the arrays being stacked. As an example, take an array with the −3dB points at 50°. For minimum side lobe pickup the spacing shown is $\frac{1}{2}\lambda$, for 20dB reduction $\frac{7}{8}\lambda$, while for maximum gain with 10dB side lobe reduction the spacing shown is $1\frac{1}{4}\lambda$. Such spacings are practical for Band III use, but difficulties arise in Band I. A compromise gain spacing for Band I would be $\frac{3}{4}\lambda$, but for interference reduction the lower $\frac{1}{2}\lambda$ spacing should be used. The formula $492/f$(MHz) gives the free space half wavelength in feet (48·25MHz = 10·1ft).

The corner reflector type of aerial has not been used much in the UK, though Premier Industries (Cheltenham) Ltd. have a u.h.f. version called the XS22 which is available in the various channel groupings, including E. Some years ago I recall that a company called Dale Engineering sold an anti-ghosting Band III corner reflector aerial. The Mk. 1

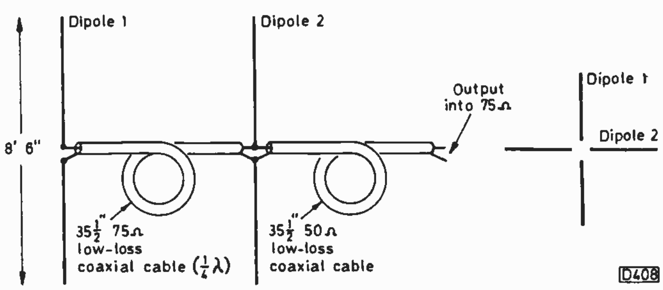
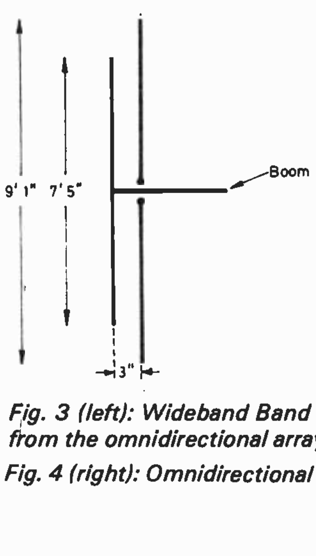


Fig. 2: Horizontally polarised omnidirectional Band I array.



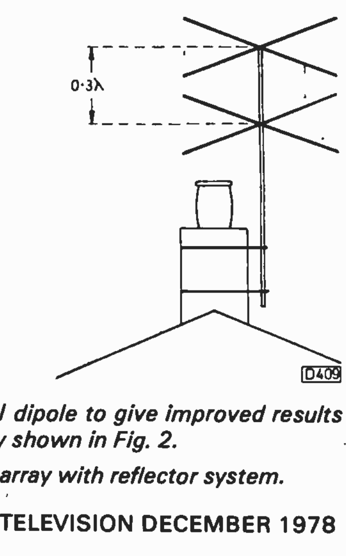


Fig. 3 (left): Wideband Band I dipole to give improved results from the omnidirectional array shown in Fig. 2.

Fig. 4 (right): Omnidirectional array with reflector system.

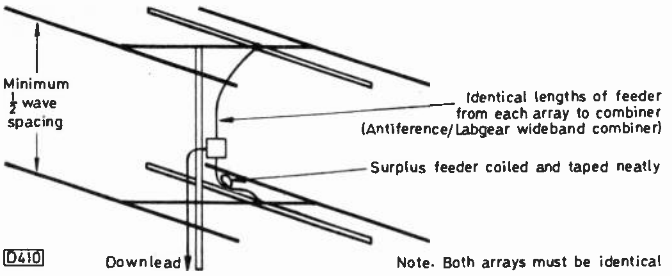


Fig. 5: Stacking wideband Band I aerials.

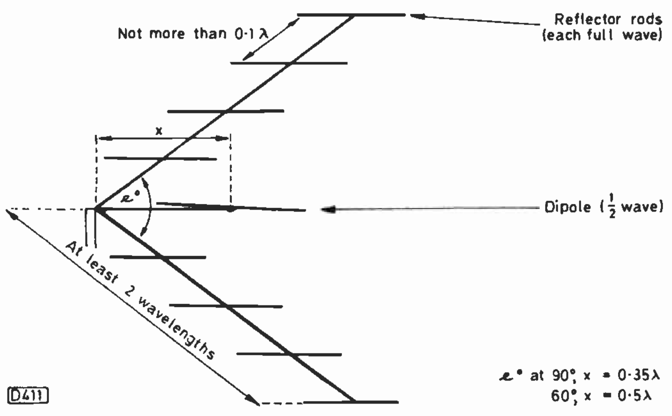


Fig. 6: Basic corner reflector aerial parameters.

version had about eight reflector rods mounted on a curved (parabolic) boom, with the single dipole at the focal point. The Mk. 2 version used a V-type reflector with three-four elements per arm, the aerial itself consisting of three directors plus a straight dipole (has anyone an illustration? – we'd like to feature it). I can recall visiting Ventnor, Isle of Wight, and seeing these aerials in profusion in an attempt to get reception of sorts from Chillerton Down (ch. B11) some four miles away over St. Boniface Down (over 800ft).

The corner reflector aerial (see Fig. 6) consists basically of a dipole with a reflector system bent around it. The normal design angle is either 90° or 60°, the former giving easier matching to a 75Ω feeder but the latter higher gain. The distance between the half-wave dipole and the reflector system directly affects the impedance at the centre point of the dipole. Assuming that only a dipole is used, for correct matching (75Ω) with a 90° angle the spacing should be 0·35λ, whereas with a 60° reflector the spacing should be 0·5λ. In practice closer spacing or a 60° angle can be used by folding the dipole and adding say a director (as in the Premier system). The reflector elements should be cut to the full wavelength at the lowest frequency, and the reflector assembly arms should be at least two wavelengths long.

Adjusting the dipole and director lengths would allow a certain amount of bandwidth tuning, so that we could well obtain a wideband system for Band III or u.h.f. use with careful tuning of the element lengths. The power gain of a narrow-band system should reach 13dB. A considerable investment in alloy tubing would clearly be needed at v.h.f., and would be prohibitive for Band I use (ignoring the mechanical problems!). Potential constructors would be well advised to consult G. R. Jessop's *VHF-UHF Manual* (an RSGB publication) which covers this type of aerial in detail.

I'd be interested to hear from anyone trying out any of the aerial systems mentioned.

Premier Industries tell us incidentally that they are going to produce a wideband version of their XS22 aerial, with changed reflector angle and dipole position. This should have a gain of 12dB over the bandwidth. The new aerial is to be introduced in the new year.

Your PROBLEMS solved

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GRUNDIG 5011GB

For some weeks there was slight pulsing of the width, i.e. a reduction by about ten per cent, returning to normal in much less than a second, for roughly the first ten minutes after switching on. Then on one occasion the picture was reduced in width by approximately two inches at each side at switch on, with excessive height and a two inch foldover at the bottom, the picture suddenly returning to normal after a few minutes. This happened the next time the set was used, but on the third occasion the cut-out tripped. Resetting this seems to have produced normal operation. In the November 1976 issue you comment that these sets are prone to dry-joints. Is this likely to be the trouble or is there a suspect component?

These sets do suffer from dry-joints, so a check should be made, particularly in the vicinity of the width control transductor and its associated components, especially the larger metal-oxide resistors used in this model. Also check Di504/5/6/9, R504 and Tr506, all in the same part of the circuit.

THORN 3000/3500 CHASSIS

The colour will disappear for a second or two several times during an evening's viewing, leaving a monochrome picture. Occasionally, yellow and blue bands appear across the picture – sometimes diagonal yellow ones. A manual is available.

The decoder appears to be in need of alignment. The instructions are given in the manual and are easy to follow. It's important to follow the correct sequence, as the adjustments are to a large degree interdependent. The procedure can be done on a colour picture, though it's better to do it with a stable picture such as a test card. Adjusting the burst coil, a.c.c. potentiometer and oscillator controls should do the trick. Allow the set to warm up for half an hour or so before starting, and first set the line oscillator since if this is way off the burst gate timing will be affected.

THORN 1580 CHASSIS

The height of this portable's picture was only about two inches. Replacing the PCL805 valve and R99, which is part of the coupling network between the triode and pentode sections of the valve, restored the picture to the correct height, but now it's back again at two inches.

The supply to the field charging circuit is obtained from the boost rail via R110, smoothed by C71 (1μF) and stabilised by the v.d.r. Z1. C70 charges via R96 (820kΩ) and R99. Check for around 300V at the top end of R96. If the voltage is low, check the feed components, particularly C71. If the voltage is correct, check R96 which will probably be found high-resistance.

ITT CVC5 CHASSIS

When the picture first appears it has a slight overall green tinge. This gets less after a couple of seconds, and after five minutes a normal picture is obtained. Just recently however the whole screen went brilliant green, with no picture, after the set had been on for an hour or so. The effect was present on all channels, and lasted for four-ten seconds.

Interchange the green and red leads from the RGB output stages on the large left-hand side panel at the c.r.t. base, turn the colour control to minimum and watch in black-and-white. If the fault remains in green, either the green gun's first anode feed circuitry, the c.r.t. base panel or, horrible thought, the tube itself is defective. If the fault now appears in red however, check carefully for dry-joints around the green emitter-follower and output transistors T25/T26. If all is well, suspect the output transistor T26. If necessary, replace it with a BF337.

THORN 1590 CHASSIS

After replacing the reservoir capacitor C85 a two-inch deep hum bar started to move down the screen. All earth connections and smoothing capacitors in the regulator section have been checked. The l.t. voltage remains steady at 11·6V, but the voltage at the base of the error detector transistor VT22 is 6V instead of 5V. The fault is less apparent when there's a strong signal, and can't be seen at all when the roof-top aerial is used.

Check the print around the replacement reservoir capacitor, then the two mains rectifiers W7/8 for poor reverse readings (you'll have to unhook one end of each, owing to the mains transformer). Check the security of the regulator transistor mounting, also for collector-emitter leakage in this device. Other things to check if necessary are the decoupling electrolytic C86 (220μF) at the base of VT22, the reference voltage zener diode W17, and VT22. VT22's base voltage depends on the setting of the "set HT volts" control R104.

ITT CVC20 CHASSIS

There's an intermittent field fault on this set. When the fault appears, the height decreases and increases very rapidly, accompanied by a bright, flashing horizontal line exactly half-way down the screen. The fault doesn't appear to be temperature dependent, since it can occur at any time after switching on, lasting for a few seconds to a few minutes. The set will sometimes function perfectly for hours at a time however. I've tried replacing the discharge diode D5 and the emitter-follower transistor T6 as suggested in a previous issue, but the fault remains.

First inspect the gap between the NS raster-correction amplitude potentiometer R73 and the line output stage screening can – you might find a sliver of solder bridging the two. We've known the resistors R62 and R63 in the bootstrap circuit in the field output stage cause this effect – check them by substitution. Another cause of the effect is dry-joints on the ends of the NS phase coil L7A. If these points are in order, suspect the lower field charging capacitor C16 and the 1Ω resistors R59/60/61 in the feedback circuit.

GRUNDIG 5011

The set was completely dead when switched on, though it had been working normally the previous day. On checking, a.c. was found to be present up to the mains bridge rectifier, but there was no d.c. output. All fuses were intact. A replacement rectifier bridge was fitted and the set worked for a couple of days, after which the fault recurred.

It's most important that the connections are correct if a bridge other than the original type is fitted. The problem is that some of these sets use a Siemens device which has the a.c. input to the top and lower centre and the d.c. on the upper centre and bottom: the normal types available in the UK have a.c. centre and d.c. top and bottom. This can cause confusion when fitting a replacement. Note that the BY164 is not suitable, as it's p.i.v. rating is too low. You could make up a bridge using four BY127 diodes. Assuming that the bridge rectifier is in order, check that the cutout is of the correct type (1·8A): it's possible that a Thorn type (2·5A) has been fitted, and this will give no protection at all. Check the small filter capacitors across the bridge (C606/7): for replacement purposes use BS415 types (1kV tested). The cause of the fault could be in the line output stage, but if the correct cutout is fitted this trouble should not occur.

PHILIPS G6 CHASSIS

There's full height, but the width is reduced by two-thirds, while the raster sides are wedge-shaped – wider at the top. The width control is at maximum. All voltages in the timebase area and the various supply lines appear to be normal. A new line output transformer had to be fitted to get the set going at all, but the connections have been very carefully checked. The boost voltage has been reduced from 590V to 570V as recommended by the transformer supplier.

It's quite possible that some stray field information is invading the line circuitry. Check the raster correction transductor by replacement. It's on the field panel, at the top right-hand corner, and almost any type will do so long as the pin connections are the same. If this doesn't effect a cure, take a look at the pincushion control at the top of the panel, next to the shift controls. If the wedge distortion is only slight, check the PL509's d.c. feed choke on the line output stage subpanel (in the screening can, between the top caps of the PL509 and the PY500). If these points are in order and the h.t. supply is correct, you'll have to try replacing the scan coils. The advice to reduce the boost voltage to 570V is sound.

PYE 733 CHASSIS

The trouble with this set is field bounce, along with what appears to be instability in the i.f. or a.g.c. stages. I've checked C194 (64μF) which decouples the a.g.c. to the tuner, and the smoothing of the i.f. strip l.t. rails. Also the fifth touch-tune position is automatically selected by the receiver when it's switched on, no matter which position was selected when the set was switched off.

The first trouble can be caused by a faulty demodulator i.c. – the TCA270Q IC165. Also check the a.g.c. reservoir capacitor C150 (47μF), and the soldering of the joints in the selectivity and gain module on the i.f. panel. The 1·2MΩ resistor R506 which biases the sync separator in the TBA920Q sync/line generator i.c. can cause impaired sync if faulty. The tendency to start on button five should be cured by replacing either of the two i.c.s in the control circuit – the SAS560S and SAS570S. Unfortunately it's impossible to say which one could be causing the trouble.

RANK A823A CHASSIS

The picture is frequently reduced to a horizontal bright line, but can be restored by tapping, rather heavily, either top corner of the cabinet.

There's clearly a dry-joint in either the field timebase (scan drive panel) or the pincushion distortion correction circuitry on the scan control panel. Check around 6L20 and 6RV4 on the latter, and 5VT7/9/10 on the former. Gentle tapping and probing should isolate the fault. The panels are on the right-hand side looking into the set from the rear.

RANK A816 CHASSIS

The e.h.t. stick rectifier has become faulty on three occasions during the last few months, the last one surviving for just a few hours. On the first occasion the rectifier became short-circuit, with consequent overheating of the series resistor 3R129 in the e.h.t. connector. On the other two occasions the rectifier became open-circuit, resulting in arcing from the top rectifier connection to chassis. On these latter two occasions there's been a noticeable smell from the rectifier, starting upon replacement and getting more noticeable as time passed. The smell was similar to that from an ultra-violet lamp.

Make sure that the correct type of rectifier is being used – the ITT TV20. Many similar types are in use in both small-screen and large-screen receivers such as this one. Also ensure that the dropper section 3R118 has not been shorted out if the mains supply exceeds 220V. Fifth harmonic tuning is used in the line output transformer circuit to achieve e.h.t. regulation, the components involved being 3L8 and the associated tuning capacitor 3C63. These components should be checked, especially if there's a tendency to picture breathing with brightness variations. Although incorrect tuning will mean that the e.h.t. is reduced, the pulse presented to the rectifier will be larger but of shorter duration, putting undue strain on the rectifier. The adjustment is detailed in the manual, an oscilloscope being required to carry it out.

One further point concerns dampness. If the atmosphere regularly becomes damp, corona discharge from the e.h.t. cap will result in a hissing sound and a vaguely perfumed smell. This can usually be traced by observation near the anode cap in a darkened room, while breathing over the area with saliva on the tongue – the resultant damp air will usually persuade any corona present to increase to a visible level. Corona discharge of this nature, particularly if a sharp crack is heard on switching on, will quickly destroy e.h.t. rectifiers. The rectifier will also be damaged if the tube is particularly prone to flashover. Since the series resistor in the anode cap is present to limit the current under flashover conditions, it would be advisable to change it, using the correct, approved part.

PYE HYBRID COLOUR CHASSIS

The picture is good except for light and dark striations on the left-hand side. Moving the aerial makes no difference, and the fault is still present with the colour control turned right down.

In early versions of the chassis this was usually due to the line linearity coil damping resistor R228 (1·5kΩ) changing value. A different type was used on later chassis, and in this case the trouble may be due to the width coil damping resistor R233 (1kΩ). The trouble can also be caused by the flyback blanking transistor VT22 on the colour-difference amplifier panel.

GEC 2010 SERIES

After an hour or so the top half of the picture falls while the bottom half rises, returning to normal height after a few minutes. This repeats. A replacement PCL85 field timebase valve and renewal of the resistors in the height circuit with high-stability types has made no difference. The voltages around the PCL85 are correct when the set is switched on, but the triode anode voltage falls and its grid voltage rises when the fault is present. I suspect the cross-coupling capacitor C150 from the pentode anode of going leaky when warm, but have not so far been able to obtain the correct type (1·2kV peak pulse).

C150 could well be faulty, but it would also be advisable to renew the field charging capacitor C147 (0·05μF).

TEST CASE

192

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 12in. Thorn mains/battery portable fitted with the 1690 chassis was used as a second receiver in the home, running from the 240V mains supply, and as a portable during weekends and holidays in a caravan, then running from a 12V car battery. Both in the home and field the receiver was initially sensitive enough to yield acceptable performance from its top-mounted loop aerial.

During the course of a caravaning holiday however the set developed a fault which resulted in the line lock weakening, the contrast reducing and the sound channel picking up more automobile and other electrical interference than previously. In fact in order to achieve usable results the owner was obliged to connect an outside aerial – albeit a simple one. But even then it was claimed that the picture lacked some of its earlier sparkle.

The set was brought into our seaside town workshop, which is located in an area of fairly reasonable signal strength, and just as the man said the picture was flat, the sound was buzzy and to get line lock critical adjustment of the core of the line oscillator coil (L12) was necessary, which is unusual since this model normally boasts really solid line lock.

Connecting the workshop aerial certainly improved matters, but even then we were not overjoyed with the display, which was marginally "ragged" and a trifle wobbly. The circuitry is on a single printed board, and as the layout is clean and accessible it didn't seem that the job was going to take too much time. Concluding that the trouble was sited somewhere in the small-signal stages, the technician designated to the problem commenced by checking the voltages on the i.f. transistors. All measured correctly until the probe made contact with the collector of the second i.f. amplifier transistor VT2. The buzz then vanished and the picture bounced back to the good quality expected of this model.

The set seemed reluctant to go wrong again – until the back was screwed on tightly that was! Removing the back with the set running resulted in intermittent horizontal streaks across the picture and spluttering on sound, symptoms which could be encouraged by applying pressure to the tuner side of the board with the handle of a screwdriver. A dryjoint or fractured printed conductor was suspected, but all the joints looked healthy and no fractures were readily apparent.

Was the technician correct in assuming small-signal stage trouble, based on the symptoms and the effect which occurred during initial testing? If so, what would have been the most likely cause? See next month for the solution and for a further item in the series.

SOLUTION TO TEST CASE 191

– Page 49 last month –

The technician looking at last month's ASA colour receiver was presented with two valuable clues. First, the modulation on the red and green rasters was clear-cut and not "diffuse", while that on the blue raster appeared to be astigmatic and defocused. This would point to a video circuit rather than a tube fault. Secondly, this conclusion was reinforced by the closely allied symptoms, and symptom change, when the test probes were connected to the blue output transistor's collector and emitter. The technician had already proved that the convergence was correct.

The effect of the impedance presented to the blue output stage by the meter indicated to the technician that there was some under (or over) phase compensation in the stage, this being responsible both for the "blurring" of the blue and its horizontal displacement. Each primary-colour output stage is compensated by a coil in the collector circuit and a capacitor in the emitter circuit. The latter is of relatively small value, thereby providing frequency-selective negative feedback, i.e. it provides complete decoupling at h.f. but not at l.f.

It was soon discovered that the 0·001μF emitter capacitor (C251) was at fault. Bypassing it with a test capacitor failed to clear the trouble completely: the old capacitor had to be removed and a new one fitted.

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TELEVISION DEC 1978

Published on approximately the 22nd of each month by IPC Magazines Limited, King's Reach Tower, Stamford Street, London SE1 9LS. Filmsetting by Pacesetters, London SE1. Printed in England by Carlisle Web Offset, Newtown Trading Estate, Carlisle. Distributed by IPC Business Press (Sales and Distribution) Ltd., 40 Bowling Green Lane, London EC1R 0NE. Sole Agents for Australia and New Zealand – Gordon and Gotch (A/sia) Ltd.; South Africa – Central News Agency Ltd. Subscriptions: Inland £9.50, Overseas £10.50 per annum payable to IPC Services, Oakfield House, Perrymount Road, Haywards Heath, Sussex.

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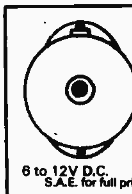

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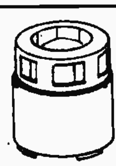

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