JANUARY 1979 Australia 85c; Malaysia $2.50; New Zealand 85c 50p

# TELEVISION

SERVICING·VIDEO·CONSTRUCTION·DEVELOPMENTS

## RENOVATING COLOUR RECEIVERS

ALSO:

METER CARE

625-LINE RECEIVER REJIG

# PHD COMPONENTS

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

**ALL COMPONENTS PRICED EACH (INCLUSIVE OF VAT AT 12½%)**
**NO MINIMUM ORDER CHARGE**
**PLEASE ADD 35p POST & PACKING**

## CAPACITORS

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

## DROPPERS

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

## DIODES & RECTIFIERS

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

## TRANSISTORS

| | |
|---|---|
| AC107 Transistor | 0.20 |
| AC126 Transistor | 0.20 |
| AC127 Transistor | 0.20 |
| AC127/01 Transistor | 0.30 |
| AC128 Transistor | 0.20 |
| 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 |
| TIP2955 Transistor | 0.96 |
| TIP3055 Transistor | 0.96 |
| TIS91M Transistor | 0.21 |
| 2N2904 Transistor | 0.33 |
| 2N2905A Transistor | 0.36 |
| 2N2905 Transistor | 0.36 |
| 2N3053 Transistor | 0.36 |
| 2N3055 Transistor | 0.88 |
| 2N3703 Transistor | 0.12 |
| 2N3705 Transistor | 0.12 |
| 2N3710 Transistor | 0.12 |
| 2N5296 Transistor | 0.57 |
| 2N5298 Transistor | 0.57 |
| 2N5496 Transistor | 0.63 |
| 2N6178 Transistor | 0.90 |
| 2N6180 Transistor | 0.90 |

## INTEGRATED CIRCUITS

| | |
|---|---|
| TAA550 Int Circuit | 0.25 |
| TAA570 Int Circuit | 2.10 |
| TAA611 B12 Int Circuit | 2.00 |
| TAA630S Int Circuit | 2.50 |
| TAA661B Int Circuit | 1.60 |
| TAA700 Int Circuit | 3.50 |
| TAD100 Int Circuit | 1.75 |
| TBA120AS Int Circuit | 0.63 |
| TBA231 Int Circuit | 1.05 |
| TBA325 Int Circuit | 0.50 |
| TBA480Q Int Circuit | 1.94 |
| TBA520Q Int Circuit | 2.80 |
| TBA530 Int Circuit | 2.25 |
| TBA530Q Int Circuit | 2.40 |
| TBA540 Int Circuit | 2.60 |
| TBA540Q Int Circuit | 2.60 |
| TBA550 Int Circuit | 3.15 |
| TBA550Q Int Circuit | 3.15 |
| TBA560C Int Circuit | 3.15 |
| TBA560CQ Int Circuit | 3.48 |
| TBA570 Int Circuit | 1.62 |
| TBA570Q Int Circuit | 1.74 |
| TBA641 BX1 Int Circuit | 2.61 |
| TBA641 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 |
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# TELEVISION

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

Alternative gain versions available on items marked*.

For matched pairs add 20p per pair.

## LINEAR IC's

| Type | Price (£) | Type | Price (£) | Type | Price (£) |
|---|---|---|---|---|---|
| BRC1330 | †0.93 | SN76008KE | 1.56 | TBA240A | †3.98 |
| CAB10QM | 2.44 | SN76013N | 1.56 | TBA281 | †2.07 |
| CA3005 | 1.85 | SN76013ND | 1.40 | TBA395* | †2.58 |
| CA3012 | 1.45 | SN76018KE | 1.56 | TBA396 | †2.40 |
| CA3014 | 2.23 | SN76023N | 1.56 | TBA400 | †2.20 |
| CA3018 | 0.71 | SN76023ND | 1.40 | TBA480Q | †1.84 |
| CA3020 | 1.89 | SN76033N | 2.22 | TBA500* | †2.21 |
| CA3028A | 0.80 | SN76110N | 1.20 | TBA510* | †2.21 |
| CA3028B | 1.09 | SN76115N | †1.62 | TBA520P* | †3.40 |
| CA3045 | 3.75 | SN76116N | 1.78 | TBA530P | †2.24 |
| CA3046 | 0.70 | SN76131N | †2.10 | TBA540* | †2.88 |
| CA3065 | 1.74 | SN76226N | †2.60 | TBA550* | †3.13 |
| CA3068 | 1.90 | SN70227N | †1.61 | TBA560C* | †3.18 |
| CA3130S | 1.57 | SN76228N | †1.80 | TBA570* | †1.29 |
| FCH161 | †2.40 | SN76502N | †1.92 | TBA611B | 2.68 |
| FCJ101 | †3.32 | SN76530P | †0.97 | TBA641 | 2.55 |
| LM309K | 1.98 | SN76533N | †1.38 | TBA641A12 | 2.35 |
| LM380N-14 | 1.65 | SN76544N | †1.85 | TBA641B11 | 2.61 |
| LM1303N | 3.08 | SN76546N | †1.85 | TBA651 | †2.12 |
| MC1307P | †1.82 | SN76570N | †1.81 | TBA673 | †2.19 |
| MC1310P* | †1.94 | SN76620AN | | TBA700* | †2.50 |
| MC1312P | 2.34 | | †0.99 | TBA720AQ | †2.38 |
| MC1327P* | †1.86 | SN76650N | †1.48 | TBA720Q | †2.38 |
| MC1330P | †0.93 | SN76660N | †0.64 | TBA750* | †2.18 |
| MC1350P | †1.22 | SN76666N | †0.96 | TBA800 | 1.65 |
| MC1351P | †1.42 | TA7073P | †3.51 | TBA810AS | 1.69 |
| MC1352P | †1.42 | TAA263 | †2.20 | TBA920* | †3.80 |
| MC1357P | †2.92 | TAA300 | †3.85 | TBA940 | †3.52 |
| MC1358P* | †2.30 | TAA320 | 1.10 | TBA950 | †2.78 |
| MC1458G | 1.43 | TAA350A | †2.48 | TBA990* | †2.90 |
| MC1496L | 1.15 | TAA370A | 3.18 | TCA270A* | †3.55 |
| MC3051P | 0.58 | TAA435 | †1.70 | TCA280A | 1.43 |
| MFC4000B | 0.85 | TAA450 | †3.39 | TCA290A | 3.46 |
| MFC4060A | 0.98 | TAA521 | 1.10 | TCA420A | 1.98 |
| MFC6040 | 1.11 | TAA522 | 2.09 | TCA440 | 1.67 |
| MIC1P | 2.58 | TAA550 | 0.45 | TCA640 | 2.76 |
| ML231 | †3.57 | TAA560 | 1.93 | TCA650 | 2.76 |
| ML232 | †3.57 | TAA570 | †2.30 | TCA660 | 2.76 |
| NE555 | 0.72 | TAA611A | 1.67 | TCA730 | 3.54 |
| NE556 | 1.34 | TAA611B | 1.89 | TCA740 | 3.04 |
| NE566 | 1.95 | TAA621AXI | 2.33 | TCA750 | 2.53 |
| SAA1024 | †5.70 | TAA630Q | 3.91 | TCA760 | 1.52 |
| SAA1025 | †10.35 | TAA630S | 4.18 | TCA820 | 3.29 |
| SAS560A | †2.01 | TAA661A | 2.39 | TDA440 | †4.16 |
| SAS570 | †2.01 | TAA661B | 1.75 | TDA1003 | 1.52 |
| SC9503P | †1.40 | TAA700* | †2.80 | TDA1004 | 2.73 |
| SC9504P | †1.38 | TAA840 | †3.38 | TDA1005 | 3.04 |
| SL414A | 1.91 | TAA861A | 0.95 | TDA1022 | 6.89 |
| SL432A | 2.52 | TAA930A | 1.43 | TDA1024 | 0.97 |
| SL450 | 5.10 | TAA930B | 1.43 | TDA1034 | 1.98 |
| SL901B | †4.20 | TAA960 | †2.25 | TDA2610 | 2.86 |
| SL917B | †5.60 | TAA970 | †2.48 | TDA2640 | 2.86 |
| SL918A | †5.95 | TAD100 | †2.66 | ZN414 | 1.45 |
| SN72440N | †2.21 | (Filter) | 0.98 | | |
| SN76001N | †1.67 | TBA120A | †0.90 | | |
| SN76003N | 2.22 | TBA120S* | †0.99 | | |
| | | TBA120SA | †1.02 | | |
| | | TBA231 | 1.12 | | |

* Indicates Q version is also available.

## DIODES

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

### ZENER DIODES

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

## VDR's, etc. (†)

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

## VALVES (†)

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

## BRIDGES

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

10A and 25A ranges also stocked.

## RESISTORS

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

| | Ea | 10 of one value | 50pc | 100pc | 500pc |
|---|---|---|---|---|---|
| ¼W 5.6Ω-330kΩ (E12) | 3p | 25p | 95p | £1.49 | £6.40 |
| ½W 10Ω-10MΩ (E24) | 3p | 25p | 95p | £1.49 | £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)

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

## TELEVISION COLOUR RECEIVER MK II

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

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**Giro A/c 23 532 400.** *A/c facilities available*

## CAPACITORS

**Metallised Paper (†)**

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

**H.V. Disc Ceramic (†)**

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

## 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

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TELEVISION



## The VCR Market

What an extraordinary state of affairs the world of VCRs has got itself into. Talk about competition raw in tooth and nail. Well, that's going a bit far perhaps, but all that advertising in the national press and on TV, what exactly is it after? A market that can't possibly be large enough now or in the foreseeable future to support the systems at present on offer – all four of them, Philips, the Sony Betamax, VHS and Grundig's SV system. And that's not the end. As mentioned overpage Philips have a new system up their sleeves, while Grundig are to extend the playing time of their SV system to five hours later this year. No, it's clear enough that the advertising and marketing effort are not simply after customers, but rather to decide which system will eventually come to predominate. The stakes are certainly high. Grundig have just opened a new VCR factory which is said to be the largest in Europe, turning out 400 VCRs a day and with a planned capacity of 2,000 a day. Both Grundig and Sony have declared that they consider VCRs to be the key to their future. The idea seems to be that once the colour TV receiver field has become a static one, some other product must be found to provide future Growth. If you look at the history of Sony you will see a clear demonstration of this philosophy: in and out of transistor radios to start with; then into audio tape recorders in a big way; next colour TV with the Trinitron system; then video, with Betamax the latest hope.

It's all rather strange when you go back to the early days of domestic VCRs, back in 1970. Then it wasn't so much whether one VCR system would become the standard, but whether the VCR or an alternative system would become the standard home video system. EVR – electronic video recording, in which special film was recorded via an electron beam, with a tiny flying-spot scanner for replay – was one contender; RCA, with a system using holographic recording on cheap plastic sheeting under development, was another; and discs of various sorts were (and still are) being worked upon. EVR and the holographic system have long since been abandoned. But in those early days there did seem to be genuine attempts to adopt an agreed VCR format, as indeed had occurred earlier with audio cassettes. In particular, Philips and Sony were talking together. What went wrong?

For the answer, you have to look to the USA. There, the first VCR system to be introduced, the Cartrivision system, in 1972, was something of a disaster, being abandoned less than two years later. At much the same time, Philips introduced their VCR system in Europe. Seeing the Cartrivision flop in the US, they appear to have decided to stay out of that market, keeping to the European market which remained largely theirs until 1978 when the VHS and Betamax systems arrived. During the early 70s, the Japanese TV industry had been busying itself literally taking over the US TV receiver industry. That completed, what next? VCRs were the obvious next step, and with Cartrivision out of the way and no competition from Philips various Japanese systems were launched and battled it out in the manner we are now witnessing in the UK. The VHS and Betamax systems succeeded, the others being withdrawn. Then something that doesn't seem to have been anticipated happened. The US VCR market went into a rapid decline. Once the video buffs had got their machines, it became clear that even in the USA VCRs weren't going to be a mass market. In fact sales to date have been only a sixth of some of the more optimistic predictions. The obvious course was for Sony and JVC to look elsewhere – to Europe. Hence their hasty arrival on the scene in 1978 with PAL VCRs. A rather desperate gamble, since there's no real reason to suspect that the VCR will be a mass market item in Europe either.

So the brief history of domestic VCRs consists of one dramatic move after another. The end to date is all that advertising we're seeing – and with the public being asked to decide between the systems.

Now we're all in favour of giving the public a free choice. But when it comes to choosing between alternative high technology systems, the public is likely to be at something of a loss. Especially as the alternatives seem to give much the same results – give or take an hour or so which, unless you're an Eisenstein enthusiast, is unlikely to count for much. Reliability, yes that's indeed something to go by. But how on earth do you assess the reliability of alternatives that have only recently appeared on the market?

The video world must stand accused of a massive bungle – for which it's likely to pay dearly. Especially as it could well be that the present systems will be interim ones anyway. Digital video recording systems offer many advantages, and are being worked on by several companies, including Philips. Perhaps by the time we get to that stage we could hope to have a standard mechanical format?

# Teletopics

### *THE NEXT PHILIPS VCR*

Those who've watched the succession of Philips VCRs from the N1500 through to the N1700 may well have wondered whether the process has still further to go. Well, history repeats itself as they say, and the news is that Philips is indeed developing yet another VCR standard which is due to be officially unveiled at the Berlin Radio Show later this year. The V2000, as it's known at present, will use a cassette similar to the original Philips compact audio one but larger and with half-inch tape. It's in many ways similar to the Sony Betamax cassette, with a running time of four hours, ten minutes – as long as any of the Japanese competition. Philips has another surprise however: when the cassette has run for its four hours plus it can be turned over, as with an audio cassette, and run for a further four hours.

### *THE RANK-TOSHIBA PLANS*

We commented in our leader column a couple of months ago on the production know-how which Rank will be obtaining from Toshiba under their agreement to set up a joint company. Now that the new company has been officially inaugurated, it's interesting to see what the plans are. The present eight colour chassis production lines at the Ernesettle plant, installed only three years ago, are to be stripped out completely, in two phases so that production can be maintained. In their place, two production lines with double the capacity of the previous eight are to be installed. Furthermore, the length of the new lines need be no more than a day, giving greatly improved flexibility since it will be simple to introduce short runs to meet changes in market requirements. The first phase, which will increase production to 800 sets a day, is due for completion on September 1st, 1979: the second phase will double that capacity by June 3rd, 1980. The Redruth printed board plant is also to be updated, going to semi-automatic operation, with the aim of meeting the company's entire PCB requirements. Increased quality control will involve more attention to the condition and specification of components prior to use, thereby reducing the amount of time and space devoted to correcting set faults. Dip-soldering is to replace flow-soldering. Despite the doubled production, the work force is expected to increase by only ten per cent.

### *THORN TEAM VISITS JAPAN*

Meanwhile, a team of six union representatives and four senior managers from Thorn Consumer Electronics has been paying an official visit to Japan to inspect Japanese TV and audio plants – with a view to establishing what has gone into making the Japanese consumer electronics industry so successful. The tour was arranged by Thorn and the Department of Industry in conjunction with the Electrical Industries Association of Japan, and included visits to JVC, Sharp, Sony, Hitachi, Toshiba, Matsushita (National Panasonic) and Mitsubishi plants.

On their return a press reception, at which we were able to discuss the delegation's observations, was held. We'll be commenting on this next month.

### *PILING ON THE AGONY*

As if the above two news items aren't enough to make you weep over the state of the UK's consumer electronics industry, a confidential report prepared for the National Economic Development Office's consumer sector working party by independent consultants presents a bleak picture of the ability of UK firms to withstand competition from abroad. According to the report the Japanese, Taiwan, South Korean and West German consumer electronics industries are all "more efficient, more advanced and have lower costs than their UK counterparts".

### *JVC's VIDEO DISC SYSTEM*

A new video disc system has been introduced by JVC in Japan. It seems to be something of a cross between the Philips' and the now abandoned RCA system, employing the grooveless feature of the former and the capacitive information storage feature of the latter. A capacitive pickup with a sapphire stylus traverses the disc, on which both the picture and sound information are recorded in the form of a spiral of pits. In addition to the picture and sound signals a control signal has to be recorded so that the pickup's position can be controlled, via a servo system. The sapphire stylus senses all the signals – control, full colour vision and stereophonic sound. Because of its relatively large contact area, wear is minimised giving the disc a life of greater than 10,000 replays. The 12in. disc is made of inexpensive plastic – conductive PVC – and rotates at 900 r.p.m., the playing time being two hours (one hour per side). A stylus life of more than 2,000 hours is claimed, with a track pitch of $1{\cdot}4\mu$m. Frequency modulation is used to record the vision signal, the luminance bandwidth being 3·1MHz and the chrominance bandwidth 0·5MHz. The audio bandwidth is 20kHz, with the signal recorded in the form of pulse code modulation. The player can also replay the digitally recorded (p.c.m.) super hi-fi audio discs developed by JVC.

The discs can be produced by the simple pressing techniques used for conventional audio records. Recording is done by means of a laser, using a glass master disc coated with ordinary photo-resist.

Random access to the material on the disc is possible, along with special effects such as still frame and slow and quick motion. A remote control version is also available.

At present there are no plans to market the system outside Japan.

### *SERVICE BRIEFS*

We got it wrong in our note on the correct fuses to use in the Rank T20A chassis in the October *Teletopics*. There are two 1·6A fuses in the T114A switch-mode power supply. The mains input fuse 7FS2 should remain as a slow-blow glass cartridge type. It's 7FS1, on the output side of the mains bridge rectifier, that's been changed to an HRC type.

Rank emphasise the importance of ensuring that the scan coil leads and the pincushion correction magnet on the A774 hybrid monochrome chassis are positioned well clear of the e.h.t. rectifier area after service work has been carried out – they must certainly not be in contact with the line output transformer's insulation card.

To avoid premature tripping on the T20A chassis due to leakage in the two transistors 5VT1/2 in the trip circuit, a 2,200pF capacitor has been added across 5R1, i.e. between the base and emitter of 5VT2. Under excess voltage conditions, 5VT1/2 conduct to remove the input to the line driver transistor 5VT3. Intermittent black lines which can be temporarily cleared by almost any chassis movement in these sets can be caused by poor contacts on the signals board connector 3Z6 – usually the earth return pin 9. Thoroughly cleaning the plug and socket should cure the problem: alternatively, connect pin 9, on the component side of the panel, to the top panel fixing screw. A lead for this purpose is available from Rank.

Philips point out that before the deflection yoke on the TX portable chassis is rotated the clamp should be completely loose – otherwise the sharp edges on the plastic clamp can score the tube neck and affect the c.r.t. vacuum. To help prevent this, some tubes are fitted with a strip of glass fibre tape around the neck of the tube.

Some cases of line striations on the G11 chassis have been reported: to avoid this, a ferrite tube is now fitted on the lead between the line output transformer (pin 14) and the flyback tuning correction capacitor C3128 in the EW modulator circuit.

## PLESSEY REMOTE CONTROL ICs

Best Electronics (Slough) Ltd. point out that all the i.c.s mentioned in our article on Plessey's versatile remote control system (November issue, page 44) are available from them. Prices are as follows: ML920 £6·93; SL490 £3·63; SL748 £0·56; TBA560C £2·14; TBA120U £1·09. These prices are inclusive of VAT: a small order charge of 54p should be added to all orders under £10. Data sheets on these devices are also available from Best. The address is : Unit 4, Farnburn Avenue, Slough, Bucks SL1 4XU.

## NEW SINCLAIR MICROVISION TV

The new version of the Sinclair Microvision pocket TV set mentioned last month has now been released. Unlike the previous multi-standard version – which remains in production – the new model is designed specifically for UK use. The simplified circuitry has enabled the price to be reduced to £99·95 plus VAT. The new set is also smaller – 3¼in. wide, 2in. deep and 7 in. from front to back, weighing 20oz. The screen size remains 2½in., with electrostatic deflection and an e.h.t. of 2kV. The set is powered by four penlight batteries which give about eight hours' viewing – this works out at just over 5p for a half-hour programme. There are only two user controls, volume/on-off and tuning, the brightness and contrast being adjusted automatically. Optional extras include an a.c. mains adaptor, exterior aerial adaptor and a 12V battery lead.

## FAMILY VIDEO CENTRE LAUNCHED

Vista Video Ltd. of Nottingham, a member of the Thorn group, has opened a specialist home video centre which could be the forerunner of similar centres throughout the UK. The aim is to provide a service to meet the predicted market boom in domestic video equipment. Rental, retail and short-term hiring facilities are available. Vista Video's move is being backed by Thorn Television Rentals.

## RATIONALISED TRIPLER

Phab Electronics Ltd. has introduced an e.h.t. tripler which can be used to replace 16 existing types of tripler used in some 51 different models. The tripler was developed by one of the country's largest TV rental companies with a view to reducing service costs and improving service to the customer. The tripler is BSI approved and its mounting kit is manufactured in accordance with BSI principles. The trade price is £5·10. Phab's address is: Unit 7, Centenary Estate, Jeffreys Road, Enfield, Middlesex EN3 7UF. Further details on models will be given next month.

## MICROCOMPUTER BASED TV CONTROL SYSTEM

SGS-ATES showed on its stand at the Electronica 78 exhibition a new microprocessor based TV receiver control system using channel selection by means of frequency synthesis and with many special features such as the possibility of pre-scheduling up to 16 TV operations in a week's time. The user can either enter the required channels via their number, or the corresponding frequencies, or use the automatic search facility and store in the system's memory up to 16 of the most frequently required channels. A new interfacing chip, the M106, has been designed specially for the system. The M106 can be fully programmed and besides standard TV applications can be used as a general-purpose microprocessor-orientated interface for c.r.t. displays. The proposed i.c. kit for frequency synthesis includes a standard 12-bit up-counter, a standard fixed ratio prescaler, and one or other of two memory options, either a standard CMOS RAM or a newly developed i.c., type M120. The latter is designed around an original memory cell developed by SGS-ATES and incorporates on the same chip a read-only memory and a sophisticated user interface that enables the memory to act as a random-access type from the external point of view.

## RELAY STATION OPENINGS

The following relay stations are now in operation:

**Ballachulish** (Highlands) Scottish Television channel 23, BBC-2 channel 26, BBC-1 channel 33. Receiving aerial group A.

**Ballycastle** (Antrim) BBC-1 channel 39, BBC-2 channel 45, Ulster Television channel 49. Receiving aerial group B.

**Craig-Cefn-Parc** (W. Glamorgan) BBC-2 channel 40, HTV Wales channel 43, BBC Wales channel 46. Receiving aerial group B.

**Kinlochleven** (Highlands) BBC-1 channel 55, Scottish Television channel 59, BBC-2 channel 62. Receiving aerial group C/D.

**Onich** (Highlands) BBC-1 channel 58, Scottish Television channel 61, BBC-2 channel 64. Receiving aerial group C/D.

**Romiley** (Greater Manchester) Granada Television channel 41, BBC-2 channel 44, BBC-1 channel 51. Receiving aerial group B.

**Skriaig** (Skye) BBC-1 channel 21, Grampian Television channel 24, BBC-2 channel 27. Receiving aerial group A.

**Tenby** (Dyfed) BBC Wales channel 39, BBC-2 channel 45, HTV Wales channel 49. Receiving aerial group B.

The above transmissions are all vertically polarised.

# Equipment Review:

# Technalogics PG6RF Pattern Generator

**Roger Bunney**

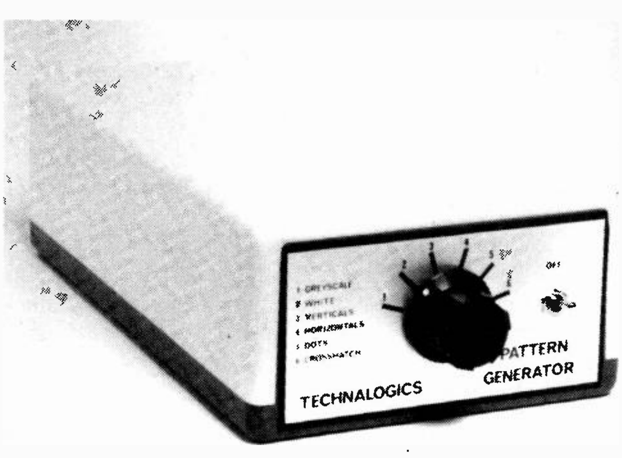
EXACTLY three years ago I reviewed in these pages the Manor Supplies Mk II crosshatch generator kit. The unit has served me well and reliably ever since. The original version provided a crosshatch, peak white or black raster, but at a later stage an optional grey-scale board was made available, greatly increasing the unit's usefulness. The main problem with this unit however has been its relatively high battery consumption. The consumption of the test unit is approximately 100mA, and in these days of very high priced batteries this is perhaps something of a luxury!

It was interesting therefore to note a Technalogics advertisement for a pattern generator giving crosshatch, peak white, dots, vertical bars, horizontal bars and grey scale for a claimed consumption of 6mA! I sent off, and in due course the kit arrived.

The assembly instructions provided are basic and brief but to the point. All the components are mounted on a single printed circuit board, which is silk-screen printed to aid location of component positions. The board is in turn bolted into an attractive polystyrene box which is similar to the two-tone grey boxes supplied by Doram/RS Components and made by the Vero Company. The subminiature toggle on/off and six-position pattern selector switches are mounted on the front panel, the attractive metalised label acting as a template to ensure accurate alignment. The output signal is taken from the rear of the unit: it's necessary to drill a centrally positioned hole of approximately 12mm to accommodate a phono plug.

### Construction

The circuit employs a total of nine CMOS i.c.s plus a couple of BC207 transistors. Construction starts with fixing the compact u.h.f. modulator (interesting to note that it's made in Malaysia) in the box, followed by ten wire links, the two miniature presets, resistors, capacitors, diodes, transistors and i.c.s in that order. Stress is placed in the constructional notes on using an earthed soldering iron, since the type of i.c. used can be damaged by static build up across the pins. Once the main board has been assembled and the connections to the selector switch made, a close inspection should be carried out to ensure that there are no errors or shorted pins – the latter is important since shorts between pins can damage the i.c.s.




*The Technalogics PG6RF pattern generator.*

### Setting Up

Setting up is relatively simple. Adjust the line frequency control VR1 for 15,625Hz by observing a 64$\mu$sec period waveform from test point 1 on an oscilloscope: VR2 is then similarly set to the 50Hz field frequency by observing a 20msec signal from test point 2. If you don't have a scope, the potentiometers can be set reasonably accurately by observing a locked, stationary pattern on a TV set's screen. The output is at u.h.f. – approximately channel E36. There should be 10mV at 75$\Omega$. The one I constructed peaked at 10mV, and had an overall battery consumption of 7mA. The unit can also be obtained from Technalogics preassembled.

When complete the unit is relatively light and of attractive appearance due to the neat case and the professional look of the front panel. Internally, the unit is neatly laid out.

### Testing

In construction it was found that wire link 10 came within a hairgap of touching the modulator chassis, which is earthed. So a square of paper was glued within the gap to maintain the isolation.

Came the moment to switch on! The measured current was over 20mA, and the patterns appearing on ch. E36 were incredible, resembling dotted crosshatches, shaking bars and corrugated grey scales! All my fault however. Since Technalogics will assist in clearing any faults, I decided to send the unit back to see how the service worked. It came back a week later with the comments "IC6 pin 7 (earth) not soldered at all, and IC9 pins 9-10 short-circuited with a solder blob". Well, I'm being honest! Do make sure about the soldering around the i.c.s!

### Recommendation

Everything then worked correctly, and I'd strongly recommend it as an attractive and versatile test unit. Excellent value both in kit form or preassembled if you don't feel inclined to carry out construction and testing.

The prices are as follows. Kit, £21·50 plus 90p postage/packing plus 8% VAT. Ready built and tested, £28 plus 90p postage/packing plus 8% VAT. From: Technalogics, 8 Egerton Street, Liverpool L8 7LY, Merseyside. ■

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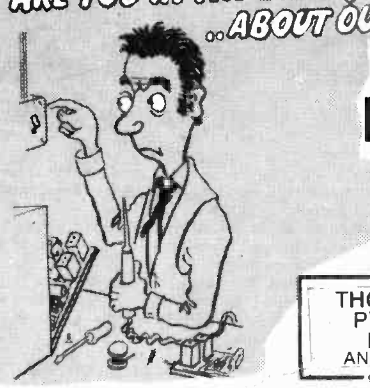

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| 6CU5 | 0.90 | 20P1 | 1.00 | ECC83 | 0.62 | EY500 | 1.45 | PL504 | 1.05 | U801 | 1.00 |
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# TV Teletext Decoder: Improved Signal Combining Circuit

**Alan Kitching**

In the original TV teletext decoder design the TTL sync and video pulses are combined in the resistor network R2-4 and D1 on the display board. There is some interaction between the signals, resulting in poor sync and video in the text mode. The circuit described here minimises these problems, and produces a high-definition video signal using a minimum of discrete components.

The circuit operation is as follows. Negative-going line sync pulses ($\bar{S}$ in Fig. 1.) from edge connector pin 2 are inverted by IC1a (see circuit Fig. 2.) which is a nor gate. They are then fed into one of the inputs of the second nor gate IC1b. Since a logic one at any input of a nor gate results in the output dropping to zero, the output goes low irrespective of the video input to the other input pin (which should be at logic zero). This low is applied as an enabling signal to pin 1 of the tri-state gate IC2. The logic state at the output of IC2 is the inverse of the input, which consists of the logic one at pin 2. The output (pin 18) thus goes to logic zero (our new sync pulse). At the end of the sync pulse, the output of IC2 goes to the tri-state condition and the voltage at pin 18 is then set by the two resistors R1-2 to black level (about 1·6V). The input pin 2 of IC2 then remains at logic zero until the next sync pulse arrives.

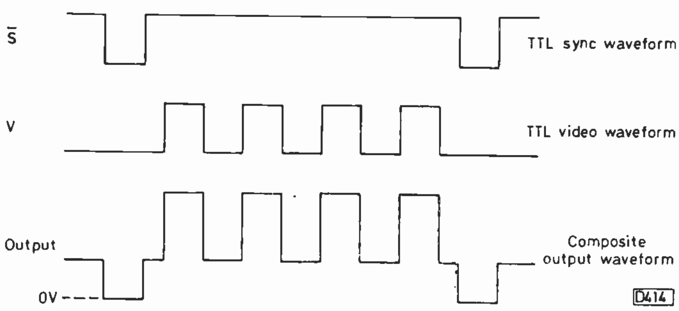



*Fig. 1: The input and output waveforms.*

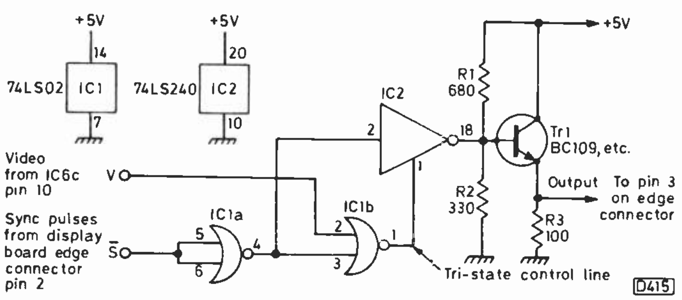



*Fig. 2: Improved signal combining circuit.*

The video information (V, in the form of positive-going TTL pulses from IC6c, pin 10) is presented to the second gate input of IC1b (pin 2), which inverts the pulses to provide the correct level to once again enable IC2. This time the input (pin 2) of IC2 is at zero, so the output will pull the junction of R1-2 to the logic one level (positive-going video).

We thus have a three-level composite video signal. This is buffered by the emitter-follower Tr1 which also offsets the 0·6V logic zero output of IC2, placing the sync pulse tips at the emitter of Tr1 very near to 0V.

The 74LS240 was chosen for IC2 because of its high sink and source capability, which ensures that the effects of stray capacitance are minimised. This results in a video display with sharp edges. The output is suitable for applying to the input of the modulator, and is connected to pin 3 of the display board edge connector.

The circuit can be built on a small piece of Veroboard and mounted "piggy-back" on the display generator board. The only modifications required to the display board are the removal of R2-4 and D1, and the connection of the five leads to the sub-board. The first lead connects edge connector pin 2 to pins 5-6 of IC1a, the second connects pin 10 of IC6c (on main board) to pin 2 of IC1b, the third connecting the emitter-follower's output to pin 3 of the edge connector. The other two leads go to the 5V rail and chassis.

The results obtained are excellent, much better than was expected. ■

# Letter

## TV TELETEXT DECODER

Other constructors may be interested in the following points which arose while I was finalising my *Television* teletext decoder.

First, the correction given in the March 1978 issue on the display logic board. The advice to connect pin 9 of IC5 to chassis is incorrect since this leaves gate IC5a inhibited, thus preventing any alphanumeric output arriving at the composite video output. Pin 9 should in fact be connected to the 5V rail.

Secondly, I found that a more central display could be obtained by altering the top margin generator on the display board so that the header row starts on line 46 instead of line 58. This can be easily done by cutting the track around pin 10 of IC19 to disconnect it from chassis, taking a short link to pin 4 (5V rail) instead. This presets the count to seven instead of five at the arrival of the field pulse, enabling the dot clock generator at line 46.

Finally, beware of 74L series TTL devices supplied as alternatives. I found that a 74L123 supplied for the dot clock generator would not run at the required 6MHz, the upper limit being 3·8MHz!

Can we expect a follow-up, maybe adding subtitles, conceal/reveal or maybe colour? – **Dennis Downie**, *South Wirral.*

*Editorial comment:* We apologise for the error in detailing the modification to pin 9 of IC5 on the display card. We've not had any experience of the 74L123 being used as the dot clock generator, so can't comment on that. It's our plan to publish various optional additions to the decoder in the near future, including colour.

# Renovating Colour Receivers

**Mike Phelan**

AS there are many early single-standard colour sets still in existence, most of which are not giving the results they are capable of, it was felt that an article on this subject would be helpful. Also, many readers may purchase their first colour set through a trade disposal outlet, while others may be deterred from doing so through fear of the unknown.

First, let's dispel a few misconceptions:

(1) Old colour sets are unreliable. In most cases this is not so. If you have the time to repair all the faults on the set *properly,* and carry out a little "preventive maintenance", then an older set should be as reliable as most.

(2) They don't give very good pictures. Most of those in use don't simply because, in the trade, time is money and the set has collected a backlog of unrepaired faults, some intermittent. Also the tube may have lost its first flush of youth.

(3) Spares are difficult to obtain. Most manufacturers parts can be obtained from trade disposal houses, and indeed a complete spare chassis can be picked up for as little as £10.

Next, let's be clear about the sets we're talking about. The Pye and GEC hybrids are updated versions of the dual-standard chassis, and use similar circuitry with valve line timebases and luminance and colour-difference output stages. They are moderately reliable, and straightforward to work on. The Decca Bradford and ITT CVC5 chassis are similar, but with transistorised RGB output stages. Performance and reliability are better than average. The hybrid Philips G6 chassis, although rather frightening to the unwary, is better than most. It also doubles as a room heater – power consumption 400W! We will also include the Philips K70. Although an imported set (Swedish), it bears certain similarities to the G6. It has a lot of unusual circuit features, and probably the best performance of any of the sets we are dealing with. The GY501-PD500 e.h.t. circuit valve combination used in both these chassis gives better e.h.t. regulation than any tripler, though wasteful of power. The Philips G8 and Rank A823 are similar solid-state chassis and have been well covered in these pages recently; the BRC 3000 is substantially different to other chassis and has also been covered recently. We won't go into any detail on these three all-transistor chassis therefore.

## Poor Colour

It's of interest to analyse why a lot of sets give what the customer terms "poor colour". The golden rule in colour servicing is to obtain a perfect monochrome picture before looking for chrominance faults. It's not surprising that many sets giving "poor colour" do so because of purity, convergence and grey-scale errors. Many also have misaligned decoders (there should be *no* Hanover blinds) or flat tubes.

When colour sets first appeared, the manufacturers' instructions for setting them up were closely followed by engineers, i.e. we used to go through the whole purity, convergence and grey-scale procedure when a set was installed. Experience soon told us however that this was usually unnecessary – most people don't notice slight deviations. These three adjustments are well worth spending a little time on with an old set however. Check for "noisy" convergence controls before starting, and replace any if a few quick twiddles don't improve matters. When you discover a defective control in the middle of setting up, the temptation is to forget it!

## Initial Steps

Trying to set out an article of this sort in a logical order presents a problem: we'll assume that you have purchased a receiver secondhand, and that you have checked the set for completeness and a good tube. Try to obtain a service manual for it.

It is not a bad idea first to remove everything from the cabinet and blow out all the dust with the help of a vacuum cleaner and paintbrush. Don't take out the tube however unless you feel absolutely confident in handling it, and you're wearing protective goggles. The cabinet can be finished to match your furniture – if you're any good at this sort of thing. Give the area around the tube's anode cap a good wipe with a damp cloth to remove the accumulation of dust and goo that usually lives there. Remove all valves to avoid damage. Examine each part of the chassis for burnt or damaged components, particularly in the timebases.

When the set has been reassembled, switch on and await results. When all the apparent faults have been repaired and the receiver set up, the best thing to do is to use the set for a few weeks, noting any faults that occur, then have a second session repairing these.

## The Line Timebase

Valve timebases are quite straightforward to repair. Most sets of this era use a PCF802 sinewave line oscillator, and some have a few polystyrene capacitors in this part of the circuit that go intermittently open-circuit to cause sync problems or no oscillation. The feedback resistor to the flywheel sync circuit is usually underrated too, so check the condition of this. If there's no protection for the line output stage should the oscillator stop, it's worth changing the line output valve's screen grid feed resistor to a fusible type. Make sure that the "set boost" or "set e.h.t." control is adjusted as per the manual, or the life of everything in the line output stage will be shortened. If the correct setting gives insufficient width, find out why. Don't forget that the line linearity control makes quite a difference to the picture width, and that no hybrid set will give enough width if the h.t. rail is way down because of an open-circuit reservoir capacitor. About 260-290V is normal.

Some people find difficulty in diagnosing faults where either the line drive or the width are insufficient, so here are a few hints.

If the width is low and putting your meter on the grid of the PL509 to measure the drive increases the width, then the fault lies in the width stabilisation circuit – most likely one of the high-value resistors, or the width control itself, has increased in value.

If the negative drive voltage developed is insufficient due to an oscillator fault or a leaky coupling capacitor, then the width will be excessive – until the output valve and efficiency diode fail because of the increased current.

If the width is not excessive, then the low drive is due to loading in the output stage, though this will usually kill the stage completely. On the Decca chassis, a common fault is for the line output valve's 330kΩ grid leak resistor R453 to fall in value, causing a voracious appetite for PL509s. On the G6, a glowing PL509 with an extra-long spark at its top cap but little spark at the GY501's anode brings one to examine the overwind casing with bated breath: any cracks mean that a new transformer is needed. It's possible to renew the overwinding only, if you can get one from a scrap unit with a defective primary. Set the boost voltage and shunt triode bias after the set has been running for half an hour. Lack of width on this chassis, with correct boost voltage, means that the $32\mu F$ capacitor across the line shift control is open circuit.

Mention of line shift controls brings us to the Philips K70 chassis, in which this component (R1290) enjoys a short but hot life if no one has put a 47Ω 1W resistor across it. This is not the end of the story though, as the tube heaters go out when this potentiometer fails. No, that's not a misprint: the shift choke is also the heater transformer! If you cannot obtain a replacement control, a small wafer switch with fixed resistors works well.

On sets with a PD500, remember to set the shunt bias after the width, but before adjusting the beam current limiter, as the latter is operated by the PD500's grid voltage.

## Reassembly

When reassembling the set, put all clips, etc. back on the wiring harness as before, with a few extra pieces of tape if necessary. Make sure no wiring is near anything that gets hot. See that on the G6 the bare earth wire on the tube shield is not dangling near the tagstrips on the bottom of the chassis. A little attention to these details will save trouble later on.

Take a second look at any parts that have been replaced in the past, and check that the values are correct. It's best to avoid sets in which a lot of work has been carried out on one particular part of the chassis.

## Field Timebase Troubles

Most field timebases of this era used a PL508 output valve preceded by a double triode multivibrator, one anode of which was fed from the boost rail via a high value resistor. On the hybrid GEC chassis this resistor gradually fell in value until it burnt a hole in the panel. On Philips sets there's a feedback system to stabilise the bias on the field output pentode (see Fig. 1). It works in the same way as its equivalent in the line output stage. It's important to adjust this correctly, or the PL508 will not last long. The K70 uses the output valve as half the field oscillator, together with the pentode section of a PCF80 as the other half. It's not used as a pentode, though. The anode is earthed, the screen grid

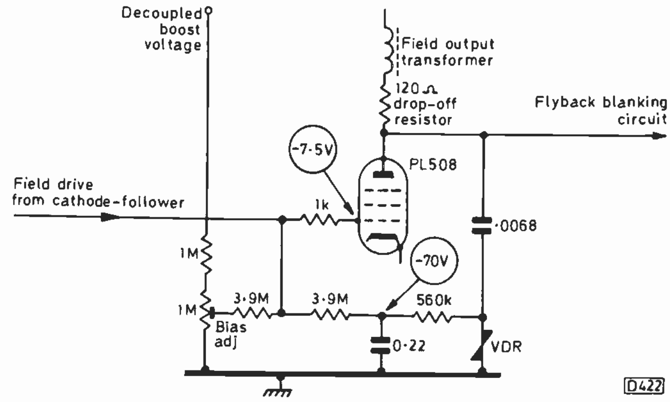



*Fig. 1: The field output stage bias circuit used in the Philips G6 chassis, incorporating VDR stabilisation.*

being employed as the anode. There are five controls for hold, height, bias, overall linearity, and top linearity, and they're all interdependent. This can mean several attempts at setting up before the field will stay locked from cold to maximum operating temperature.

The Pye chassis used a solid-state field timebase similar to the Rank A823 and Philips G8, but with a blocking oscillator instead of an SCS. The main trouble spot here is the electrolytics. The AC128 driver is best replaced with a silicon device, such as a BC126, with a silicon diode inserted in the emitter lead of the lower output transistor to compensate for the difference in emitter-base voltage. On this type of circuit the charging capacitor, which is always two in series so that linearity correction can be applied to their junction, will give too much height when its capacitance is reduced, since it will charge to a higher voltage in a given time. The same thing occurs if there exists an alternative charging path, e.g. a leaky driver transistor or discharge diode. This will cause incomplete collapse if the set-white switch is operated.

The hold controls in valve field timebases fall into two main groups. The first type, used on the GEC chassis, consists of a fixed resistor and potentiometer in series forming one of the multivibrator grid leaks. Either of these two components can cause variations in speed. The alternative arrangement, used on the G6 and most of the monochrome sets from the same maker, consists of a potential divider from h.t. to earth with the hold control connected from the mid-point of this to the grid. Any of the high-value resistors used here can give trouble. On both Philips hybrid chassis the $0{\cdot}0068\mu F$ feedback capacitor in the bias stabilisation network can short and give a very non-linear scan (C4040 in the G6, C853 in the K70). After this has happened you will need a new PL508, particularly in the K70 where this valve must be one of reputable make if drift of the field speed is not to occur. This applies to the PCL85 in the ITT sets as well.

Remember that the raster correction and convergence

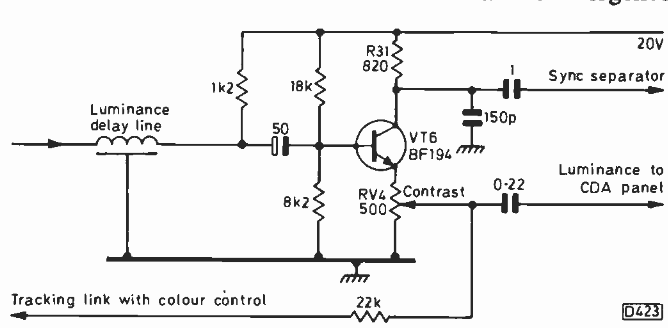



*Fig. 2: The "phase splitter" stage in the luminance channel of the Pye group hybrid chassis.*

circuitry can give rise to field fault symptoms; also that one of the convergence controls will be a potentiometer connected between the two halves of the field scan coils. If defective, this control will cause either trapezium distortion or no scan, depending on whether the track or the wiper has gone open-circuit.

Shorted turns in the raster correction transductor's field winding will give lack of height, though it's more likely that the line winding will fail – with much smoke! If the damping resistor across the transductor goes open-circuit, striations will be present at the top of the raster. The small potentiometer (RV41) fitted in this position on the Pye chassis can be replaced with a 10Ω 5W fixed resistor.

### Power Supplies

Power supplies of the type used in these sets do not merit much discussion. With one exception they are very simple and easy to repair. Bridge rectifiers can go partially or completely open-circuit. You will then have either no l.t. or *two* hum bars. The latter effect also occurs if an l.t. supply series stabiliser transistor shorts: the one in the CVC5 chassis can be replaced with a silicon device. L.T. rails must be set before carrying out other adjustments to the receiver. The exception is the K70 chassis, where most of the many supply rails come from the line output stage. We will not go into too much detail, as this would require a complete article on the chassis, but the two most common faults are: a massive burn-up on the bottom panel, started by one of the 4·7Ω surge limiters (R891/2) going open-circuit; and the 25V supply regulator transistor leaking (TS421, AC128). The former fault will not immediately stop the set working as there are two BY127s and surge limiters in parallel, but will show itself by reduced height and width. So if this happens, check the surge limiters immediately or sooner or later you will have a large hole where the power supply board used to be. When the l.t. regulator transistor TS421 leaks, a monochrome picture looks normal but a colour picture will lack red over the top third or so.

### Tuner and IF Strip

The tuner and i.f. strip are probably the most reliable parts of these sets. Mechanical tuners score better on this point than varicap ones. Lubricate the push-button mechanism with a light grease, and make sure that all screws are tight, particularly the set screws in the quadrant and pinion type. Noisy potentiometers or contacts on varicap units can often be cleaned with metal polish. Don't use switch cleaner: some types dissolve so many different kinds of plastics that their use in TV servicing is to be questioned.

Low r.f. gain is of course often caused by the r.f. amplifier transistor, and you will probably already know how to check this by holding the aerial lead near the collector tuned line. If it's a varicap unit using one of the newer flat plastic transistors, a BF180 will work in an emergency.

The aerial socket is also a possible cause of a snowy picture, particularly on the Decca chassis; fortunately it plugs into the tuner on this set.

There is little that needs to be said about i.f. strips, except don't twiddle. If you contemplate buying a set and find that the i.f. cores have obviously been moved, the best thing to do is to forget it. Ignore that last sentence if you have a sweep generator and scope and know how to use them.

It's permissible to adjust the sound i.f.s however. Tune the bandpass coils for maximum noise without a signal, then set the discriminator core for the best sound on a signal. A rasping buzz on one channel on the G6 occurs if the 33·5MHz trap is off tune: this is the left-hand core in the double horizontal can near the i.f. input plug.

### Luminance Channel

The luminance delay line on many sets seems rather prone to dry-joints. The result depends on whether the dry-joint is at a signal connection (no luminance) or the earth connection (no delay, and an impedance mismatch). The latter effect can be mistaken for an aerial ghost.

Luminance output stages are usually of the valve type, using a PL802. This rather expensive valve leads a hard life, which comes to an end when it loses emission, suffers an interelectrode short, or develops grid emission. The latter can be postponed if the value of the grid leak resistor is reduced to about 1·8MΩ. A 6F28 or EF184 can be pressed into service in an emergency, after cutting the print to pin 6. This need not be reconnected if a PL802 is subsequently fitted. A useful alternative is the "solid-state PL802" described in these pages recently.

Black-level clamps are either of the driven type or consist of a simple d.c. restorer. For those not familiar with this part of the set, the driven clamp employs diodes or a transistor in the control grid circuit of the luminance output valve. These are driven into conduction by line pulses, connecting the grid to a fixed potential, sometimes set by the wiper of the brightness control. On the G6 chassis the transistor used in this way is damaged if the PFL200 flashes

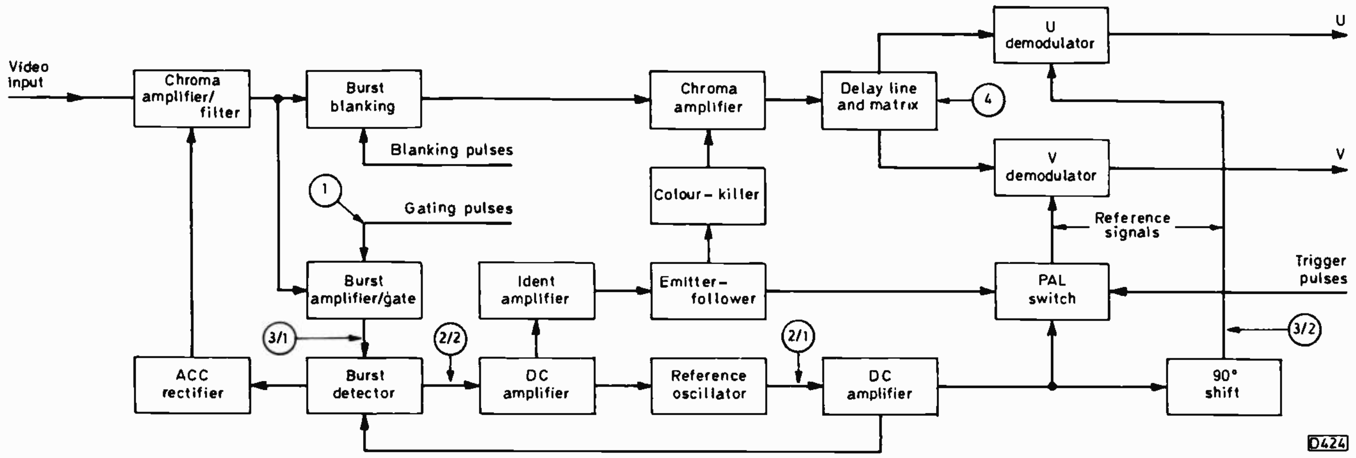



*Fig. 3: Block diagram of a typical decoder. The numbers in circles correspond with the alignment procedure given later.*

over. As the sync separator comes after this stage on the G6, field hold is lost on certain scenes when the clamp is inoperative.

The simpler type of clamp works by conduction on the sync pulse tips in order to establish the black level. A leaky diode here, and you will get a "plastic" picture with poor sync, due to the change of d.c. levels in the previous stage which also supplies the sync separator. This idea is used on the GEC and Pye chassis, and a very peculiar fault occurs when the contrast control increases in value. This potentiometer forms the emitter load of the phase-splitter stage (see Fig. 2), whose collector feeds the sync separator. If the contrast control goes high in value, then all the signal will be developed across it and none at the collector.

## Flyback Blanking

Flyback blanking normally takes place at the cathode of the luminance output valve. A transistor in the cathode lead has a standing base current which is sufficient to saturate it except during the blanking period when it's turned off by field and line pulses. An alternative system used in the G6 chassis feeds large-amplitude, negative-going pulses to the c.r.t. first anodes. On the K70 chassis both arrangements are used.

Faults in this part of the set may produce no blanking at all, or a dark band at the top of the picture, maybe on only one colour. This latter condition can occur when one of the 0·047$\mu$F capacitors C1028/9 on the tube base of the G6 goes leaky. No blanking in this chassis will probably be the PCC85 blanking amplifier, or its 100k$\Omega$ anode feed resistor R4128. On sets using PL802 cathode blanking, the transistor is in a rather vulnerable position. It can be checked by shorting its base to chassis – this should blank out the raster if the device is not short-circuit.

## Convergence

Noisy controls are the main trouble in the convergence circuits, also the electrolytics which lose capacitance with age. Some sets use diode-connected AC128s as clamps. These can develop thermal runaway, causing a drift in static convergence with increasing temperature. This is a common fault on the Pye chassis, where one of these transistors is mounted next to a large wirewound resistor.

There is no easy way to trace convergence faults. Note which controls have no effect, also whether anything is overheating, then study the circuit. Bear in mind that many convergence circuits carry the full scan current in several parallel paths. An open-circuit component in one branch will cause overheating of the resistors in the other branches.

## First Anode Controls

The first-anode switches and controls are usually on the convergence board. If they show any sign of being faulty, replace them: nothing is more irritating than a grey scale that continually varies. On the GEC chassis, replace the 22M$\Omega$ resistors (R606/611/612) on the switches with 10M$\Omega$ metal oxide ones. On the other sets, any high-value components in this part of the set are suspect.

## The Decoder

Many words have been written about decoders, so we'll assume that the reader knows basically how a PAL decoder works (see Fig. 3). It seems strange that this part of a colour set is regarded by many engineers with awe and mystery. No other section of the set is more straightforward to find faults on. Many sets are in operation with faulty or misaligned decoders, unnoticed by those who watch them. Misalignment shows as Hanover blinds, and later we'll give a method of aligning the decoders on our six chassis without the use of a scope or pattern generator. A test card is preferable however. This method will give results only slightly inferior to using an X–Y display, but far better than haphazard twiddling. Most decoders of this era used many polystyrene capacitors, particularly in the reference oscillator circuit, and these are a common cause of trouble. Use either the same type or silver mica ones for replacement.

## Decoder Alignment

Assuming that all faults in the decoder have been repaired, we can proceed with its alignment. The process has been split into several parts, the numbers corresponding with those shown in Figs. 5-11. We will first explain in detail the reasons for the various adjustments, then the chart and diagrams can be referred to while doing the work. The steps should be followed in strict order, and if a certain step or steps are missing from any diagram it simply means that they do not apply to this set. In all cases the first thing to do is to override the colour killer.

*(1) The burst gate.* The essential thing here is that the gating pulse coincides with the transmitted burst. Either an *RC* circuit or a ringing choke will be used to give the required delay. The latter produces a train of damped oscillations, the first peak of appropriate polarity being used to gate out the burst. The choke is adjustable in some sets, e.g. the Pye chassis.

It's of interest to consider what happens when the core is adjusted. If we start with the core screwed out (minimum inductance) and gradually screw it in, the resonant frequency of the ringing choke and its associated capacitor will decrease, so that the gating pulse will occur progressively later in time. With the core fully out, the gating pulse will probably occur during the latter half of the sync pulse, missing the burst. As it's screwed in, the gate pulse travels along towards the burst, admitting more and more of it until the correct setting is passed. Beyond this point the burst falls toward zero, but the gate pulse starts to pass the chroma information at the start of the line. The reference oscillator then tries to lock in quadrature with whatever chroma phase exists at the start of the line. This causes irregular stripes of incorrect hue (if the killer does not operate). As the mean burst phase is –U, i.e. greenish yellow, the effect will be at its worst on lines that start with +U, i.e. blue chroma. The oscillator will then attempt to lock in opposite phase to normal, giving –V stripes. For convenience, we'll use U and V except when referring to the demodulated signals.

The Philips and Pye chassis use this type of gate, but only the Pye circuit is adjustable. Best results are obtained with a scope, but it's possible to align the gate visually providing there's a test card or other stationary picture being transmitted. Unscrew the core until chroma lock is lost or the colour goes off, then screw it in slowly. Locked chroma will be restored, then the saturation will decrease as more of the burst is gated through and therefore more a.c.c. potential is produced. Stop at the point of minimum chroma. Going beyond this point will cause the saturation to increase until chroma is passed by the gate.

Any tuned circuits in the burst channel are adjusted next, remaining blinds on B—Y.

This concludes the main decoder settings, but there are a few odds and ends left, such as a.c.c., ident etc.

## Colour Matrixing

Some sets have adjustable gains on two or all the colour-difference outputs, and possibly a G—Y phase adjustment. The latter is accomplished by varying the amplitude of one of the inverted signals that are added to form the G—Y signal. These matrix adjustments are difficult to do without colour bars. These are transmitted in some areas early in the morning. The method is to turn off two guns, leaving on the one whose signal is not variable (usually red). Adjust the saturation and brightness until the four red bars are of equal intensity. Turn off the red gun and turn on the blue, then adjust the B—Y gain for four equal blue bars. Repeat with the green gun and the G—Y gain control, and the G—Y phase adjustment if present. No pretence is made that this method is as accurate as using a scope, but it's unlikely that these adjustments are anywhere near correct on a secondhand set.

## Automatic Chrominance Control

A.C.C. is normally set to give a slightly oversaturated colour with the front colour control at maximum. The G6 has two potentiometers for this. Both should initially be set halfway. The set is then detuned, and the upper potentiometer turned towards the chassis edge until the coloured noise disappears. The lower control is then set to give an acceptable range of saturation.

All these adjustments are covered in the diagrams, and should be left until the decoder has been aligned.

## RGB Circuits

The RGB output stages used in the ITT and Decca chassis are fairly simple. The main trouble spots are the transistors themselves and dry-joints on the load resistors. The three large potentiometers for setting the highlights on the Decca 10 series chassis usually need renewing. On the ITT CVC5 chassis there's a vertical metal strip next to the chassis member adjacent to the RGB output stages. This links several earth points and is prone to dry-joints. The result is bright flashes of one primary colour, usually green. In passing, we'll mention a similar metal strip on the K70 chassis, below the five output valves. This serves a similar purpose, but here the symptoms are intermittent loss of line sync or crackling on sound. As anyone who has handled many Rank A774 monochrome chassis will know, the only permanent cure is to clean off all the existing solder and remake the joint with a *large* iron.

When replacing RGB output transistors remember not to mount them tight against the board (as indeed some manufacturers do) but leave a slight gap or use a mounting pad. Otherwise the leads will be left in tension when they contract after soldering: eventually the glass seals on the device will crack, leading to its failure.

## Colour-Difference Amplifiers

Colour-difference output stages usually employ PCL84s, the Philips chassis being the exception – they use PCF200s. These latter are the more reliable of the two valves, PCL84s having quite a high mortality rate, mainly because of grid emission. This is in no small part due to the high value of the grid leak resistors fitted – typically 2·2MΩ. The positive bias on the grid causes the valve to overheat, and the anode load resistor likewise. The latter can become so hot that the solder melts and the panel cracks, giving rise to many intermittent faults. Yes, we do mean the Pye hybrid chassis! On sets using this type of circuit, the pentode anode voltages should lie between 120 and 170V. Voltages below 100V mean a "soft" valve. The permanent cure is to fit new valves and reduce the grid leak resistors to 680kΩ. Idealists will increase the value of the coupling capacitors to maintain the frequency response, but this is not necessary.

When the print on the Pye CDA panel cracks this is not always obvious to the eye. The result is loss of one or more colour-difference signals, and can be provoked by flexing the panel. If the anode voltage remains the same when the fault occurs, then the print to the grid is open-circuit; if the anode voltage rises to h.t., then it's either the screen grid or cathode track that is cracked. Bridging the cracks with solder is no good: they must be repaired with wire bridges.

The PCL84/PCF200 triodes act as unidirectional clamps, with 8·2 or 10MΩ anode load resistors which should be replaced with high-stability types as a matter of course in order to prevent grey scale drift. Shading of one colour from one side of the picture to the other is nearly always caused by one of the output pentode load resistors being open-circuit or dry-jointed.

Two horizontal green streaks on the test card on the Pye chassis when the saturation is advanced, or overall green on the monochrome part of the test card on the G6 chassis, may be due to a failing tube. First check that the first anodes are not turned right down however. This effect occurs when the tube runs into grid current on peaks of drive, this current causing a voltage drop across the clamp triode's anode load resistor. The clamp recovers in a time dependent on its time-constant: sixty lines or so on the Pye chassis, more than one field period on the G6 chassis. On the former set the symptom can be made less noticeable by increasing the values of the coupling capacitors to something in the region of 0·047$\mu$F.

On a colour-difference drive set, the highlights are set by altering the luminance drives to the tube cathodes. The red drive is normally fixed, with the other two adjustable. It's often the green gun that starts to lose emission first however. The remedy is to change the red and green cathode connections so that the green gun now receives the full drive.

## Setting the Highlights

Setting the highlights should be done in a darkened room after the set has been running for at least half an hour, and is not easy to do accurately. Comparison with a "warm white" fluorescent tube is useful. Highlight and first anode adjustments must be done alternately until everything is right. The whole exercise is a waste of time if the tube is not

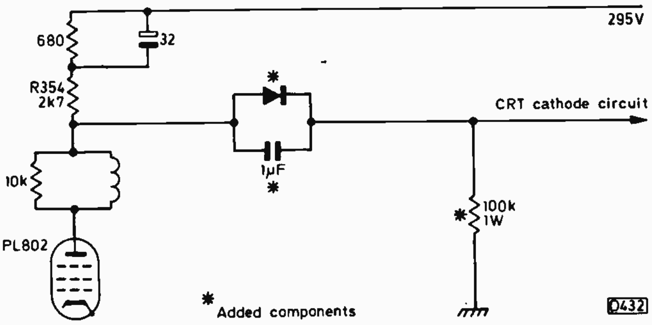



*Fig. 10: Adding a beam limiter in the feed to the c.r.t. cathodes. Components shown as in the Pye hybrid chassis.*

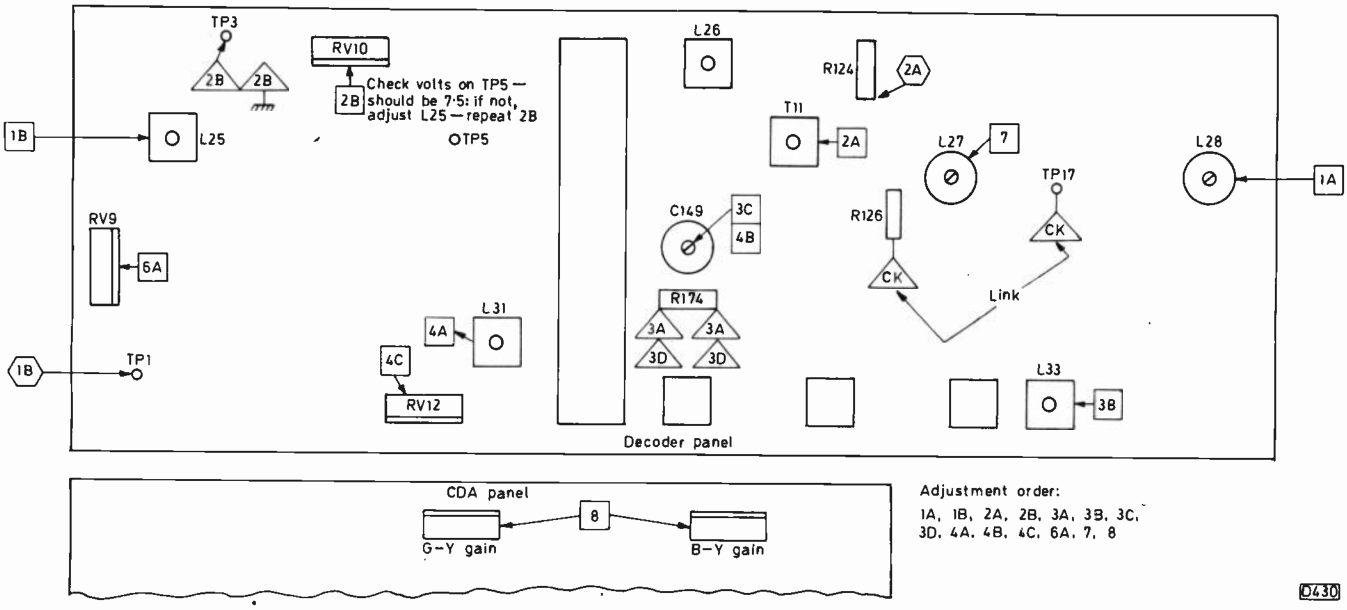



*Fig. 11: Aligning the Pye hybrid chassis decoder.*

in good condition. Remember that the darkest parts of the raster should be a neutral grey, but the highlights should be "warm".

On the K70 there's a potentiometer with one track and four wipers which are switched by a small relay on the tube base. The relay is operated by the colour-killer circuit. Three of the wipers are adjusted to give bluish highlights on monochrome, then the remaining one is set to reduce the blue drive on colour to give the correct warm tone. The relay often becomes intermittent, causing loss of one primary colour on a monochrome transmission. It's possible to pull out the rivets holding the coil to gain access to the gold-plated contacts. Don't use switch cleaner.

## Audio Circuits

We'll now turn attention to the audio stages, which will probably be either a valve job or one using germanium transistors. E.H.T. flashovers can destroy the latter, particularly on the Pye hybrid chassis. The AC128/AC176 output pair can with advantage be replaced with the AC187/AC188, and the driver changed to a BC143 or BFX88. Leaky output transistors in this module give rise to a variety of symptoms, among them severe distortion, "motor-boating" or variations in height in sympathy with the sound. In view of the number of botch ups we see on these modules, people must have difficulty in removing the output devices from their heatsinks. On close examination it will be seen that they are locked in with a silvery compound: this will soften if heat is applied with an iron. Fill the cavity with heatsink compound before fitting the new transistor.

Valve audio stages suffer from little except interelectrode shorts – particularly with the PCL86. Raising the value of the cathode bias resistor by one or two preferred values will lengthen the life of the valve by reducing its anode and screen grid currents. This is a trouble spot on the Decca 10 series, and the end result is a damaged panel and failure of the output transformer.

## Modifications

Now that we have our set (hopefully) in good order, we can see if the design can in any way be improved. Starting with "major operations", the two that are often mentioned are conversion from a 25kV overwind to a tripler, and from a mechanical to a varicap tuner. The tripler conversion is often done when the overwind has failed, saving the cost of a new line output transformer and reducing the load on the line output stage which runs flat out all the time when a shunt stabiliser is employed. The shunt triode gives better regulation however. Don't overlook the fact that the beam current limiter will be rendered inoperative by this modification, so it will be necessary to fit a different one. This can be easily done by breaking the connection from the luminance output stage to the c.r.t. and inserting a 1$\mu$F paper capacitor and a silicon diode in parallel in the lead, with the diode's cathode to the c.r.t. (see Fig. 10). Then fit a 1W resistor of about 100k$\Omega$ from the cathode to earth. Some experimentation with this value may be necessary. Varicap tuner conversions are often done with a view to adding touch tuning or remote control. It should be noted however that some mechanical tuners incorporate an i.f. preamplifier stage, so that fitting another type of tuner may give loss of gain. Mechanical tuners perform better and are more reliable than their varicap counterparts, but sometimes the mechanisms let them down. The best varicap tuners are those fitted to the Rank A823 and the Philips K70 chassis. The early G8 tuner was also fairly reliable. A.F.C. may or may not be needed.

There never seem to be enough fuses fitted to these older sets, so these are a worthwhile addition. The screen grid feed resistor in the line output stage can be changed to a fusible type: this will offer protection in the case of oscillator failure or PL509 trouble. Fuses can be added to the supply rails, and must be anti-surge types. Mount the fuseholders properly on the chassis – don't let them dangle from the wiring.

On sets with an e.h.t. tripler, this expensive component can be protected by a 33k$\Omega$ resistor inside the anode cap. It must be fitted entirely inside the cap, which may have to be changed for a different type if the resistor will not fit safely.

The two 4·7$\Omega$ surge limiter resistors in the K70 chassis can be converted to fusibles to prevent the eventual destruction of the print on the power supply when the set continues to run after one of them has gone open-circuit. A mains transformer can be fitted to these sets to prolong the life of an ageing tube and to prevent the problem with the line shift control referred to previously.

The main consideration with any alterations to the original design is to make sure that everything is *safe*. ■

# Long-Distance Television

**Roger Bunney**

OCTOBER – November is traditionally the time of the year when tropospheric propagation is enhanced, and indeed during October there has been some improvement at both v.h.f. and u.h.f. Once again however the main excitement relates to F2 reception: with increasing sunspot activity the maximum usable frequency has risen and there's been some dramatic F2 DX-TV.

### F2 Reception

Probably the first daytime F2 reception occurred on October 4th, from about 1300 on ch. E2, when Hugh Cocks in south Devon noted the familiar Gwelo, Rhodesia checkerboard pattern. At 1420 this signal was swamped by a much stronger one that appeared to consist of a grey scale. I noted this signal from about 1445, but for some reason or other the transmitter seemed to be having problems with intermittent loss of video modulation. The transmitter eventually went off-air at 1600. Gwelo remained however, rising in strength until about 1755. At 1820 another ch. E2 signal (not Gwelo) put in an appearance for twenty minutes. Gwelo was noted on several days throughout October, but the main news for UK enthusiasts was the reception on the 18-20th and the 21st.

During this period the m.u.f. rose sufficiently to reach the ch. R1 vision carrier (49·75MHz), and from mid-morning until about 1330 (all times BST) on these four days such signals were received from the east. They were generally of programme material, but often with the 0249 electronic blockboard pattern as a floater. The characteristic smearing and ghosting was evident. Fortunately a clock was seen on two days at around 1245, showing the time as 1754 (i.e. plus six hours GMT!). This must place the signal source in the far east of the USSR, the indications being the Alma Ata area and adjacent to the Chinese border. The signals were received in various parts of the UK – reports have come from Devon, Dorset (on the 22nd), Hants, Norwich and Derby.

Further surprising signals were received by Clive Athowe (Norwich) on the 20th, consisting of a blank PM5544 test pattern via F2 from the ESE at 1326, being replaced at 1355 with what seemed to resemble a large letter M filling the whole screen. Programmes followed, until fade out at 1417.

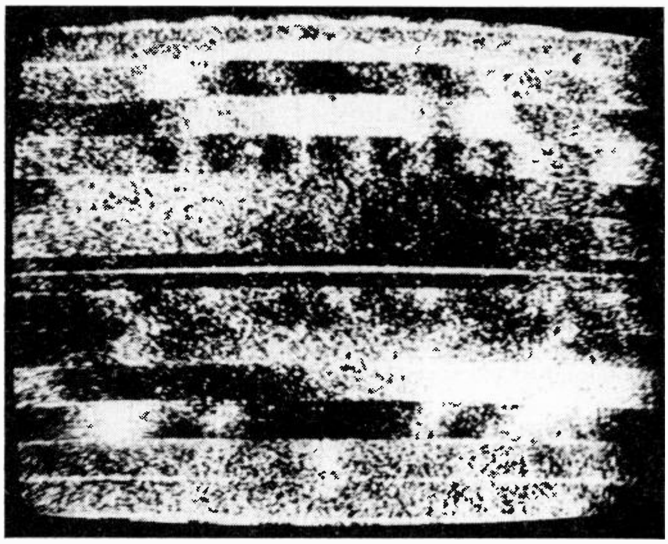
This week seemed to be very active, since on the afternoon of the 16th Hugh Cocks received a ch. E2 carrier so strong that it came in from the side of the aerial.

### UK TV Received in Australia

The most remarkable news however is contained in a letter just received from Anthony Mann (Western Australia), who reports reception of ch. B1 (UK) sound and vision on the 13th and 14th, with strong signals between 0930-1020 GMT on the 13th. The programme content consisted of schools' broadcasts. This must give us hope of receiving New Zealand ch. 1 (45·25MHz vision) and the Australian ch. 0 (46·25MHz).

For those with receivers covering 30-50MHz, listening has if anything been painful. Generally a relatively dead band, apart from US paging stations, a local beacon and not forgetting local industrial v.d.u. interference, the spectrum suddenly became crammed full of highway patrols, USSR talkback, whistles, bangs and squeeks! Pity Crystal Palace ch. B1 viewers with South African police as additional sound effects or the Rhodesian army with coded communications on 45MHz. Hugh has offered an excellent clue to the likely appearance of early evening transequatorial skip reception: listen for a whistle just above the ch. B1 vision buzz (I measured this at 46·150MHz) after which ch. E2 vision will usually appear. My logging of football from Africa on ch. E2 on Sunday evening (22nd) seemed rather

*North-bound F2 signal propagation: Nigeria ch. E3 received in Holland by Ryn Muntjewerff on August 26th, 1978.*



*South-bound F2 signal propagation: RAI-1 (Italy) ch. IA received in South Africa by Ian Roberts on September 14th.*

"domestic" compared to possible Tashkent TV reception on the preceding Friday!

### Tropospheric Reception

There was good tropospheric reception over the period 7-13th, many European stations being received in the UK at both v.h.f. and u.h.f. Michael Drury (Faversham) reports excellent reception from the Low Countries using just a Wolsey Colour King – with no amplifier! The signals were as strong as the local UK ones, and Michael watched the Muppet Show noise free. Clive Athowe and Ray Davies in East Anglia logged many East German, Czechoslovakian and Polish v.h.f./u.h.f. stations. Ray's suspected Czechoslovakian ch. R35 signal seems as if it came from the Susice CST-2 outlet.

### Conditions Overseas

Conditions have been humming overseas as well! In Abu Dhabi, Allan Latham logged Malaysia ch. E2 and suspected Chinese ch. R1, with Gwelo almost daily. An unusual signal consisted of a frequency grating received from the north west. This could have been logged in the UK as well recently. Any ideas?

More news from South Africa. Ian Roberts (Pretoria) is using a horizontal Band I wideband Yagi feeding a Wolsey Saturn wideband amplifier. His first letter describes events up to early September, mentioning reception of BBC and TF-1 (France) and other European signals at up to 55MHz. The 5B4CY 50·5MHz Cyprus beacon was heard for probably the first time in S. Africa on September 1st, with ch. IA video also audible. A rising m.u.f. was indicated, with a ch. R2 vision carrier (59·25MHz) received on September 4th. A ch. E2 grey scale (Kenya?) was also received. By 2130 the m.u.f. had dropped to 26MHz, but surprisingly the ch. B1 vision was still riding above the noise.

A second letter indicated that the m.u.f. hit 63MHz on the 10th, with the ch. E4 vision present. Four days later vision signals were noted on chs. B1, E2, IA, E3 and E4, with most of the matching sound channels! A turbanned gentleman on ch. E2 put in an appearance on the 15th, with the Kenyan news (in English) on the 17th from Kisimu ch. E2. A solar storm/blackout resulted in the m.u.f. dropping like a brick on the 23rd. Ian also mentions that a radio amateur at Pietermaritzburg received the USSR Stat-T TV satellite at 714MHz.

To sum up then, a great deal's been happening, and with the sunspot maximum still at least a year away one wonders what lies in store for us yet.

### News Items

*USA:* The first demonstration of a teletext system called Info-text took place in Philadelphia during June, sponsored by Micro TV Inc. who are marketing a decoder for the service.

*Spain:* The PAL colour system has been officially chosen by RTVE following comparative SECAM/PAL tests. The decision requires government ratification.

*West Germany:* Certain Hessischer Rundfunk transmitters now carry an identification, consisting of a letter in the lower black bar on the FUBK pattern. Grosser Feldberg uses F, Biedenkopf B, Hoher Meissner M, etc. A solar-powered relay station has recently been installed by the Sudwestfunk, at Lasel.

*China:* K. Ushigome (Tokyo) has provided us with a list of corrected channel allocations for the Republic of China. These are as follows: ch. C1 49·75MHz vision, 56·25MHz sound; C2 57·75MHz and 64·25MHz; C3 65·75MHz and 72·25MHz; C4 77·25MHz and 83·75MHz; C5 85·25MHz and 91·75MHz. The band is 92-100MHz.

### Publications

I gave the wrong price for the Radio Telefis Eireann annual handbook in a recent column since VAT, which is changed on publications in Eire, was not taken into account. The RTE Press Office (Donnybrook, Dublin 4) tells us that the correct price for the 1978 RTE Handbook is £2·75 in Eire, £2·50 in the UK and $7·5 in the USA. This is for the updated and expanded second edition incidentally.

My DX-TV book has now been published by Bernard Babani (Publishing) Ltd., The Grampians, Shepherd's Bush Road, London W6 7NF. Entitled *Long Distance Television Reception (TV-DX) for the Enthusiast,* it runs to 120 pages and consists of an updated version of the third edition previously published by Weston Publishing (which, please note, no longer exists). The price is £1·45 from bookshops or £1·65 by post from the above address.

### New EBU Listings

Aachen ch. E37 reduced power to 320kW from 500kW; Ravensburg ch. E37 reduced power to 270kW from 500kW; Aachen ch. E58 reduced power to 400kW from 450kW.
*France:* Caen TF-1 ch. E22 1000kW e.r.p.; Rennes TF-1 ch. E39 1000kW e.r.p.; Parthenay TF-1 ch. E52 300kW e.r.p.; Hirson TF-1 ch. E54 500kW e.r.p.; Cherbourg TF-1 ch. E65 60kW e.r.p. All with horizontal polarisation.

### From our Correspondents . . .

Keith Jones (Banbury) started DXing recently, using an Antiference MH308 aerial, a Teldis masthead preamplifier, and JVC 3050 receiver. He's logged a large number of Sp.E signals this season, ranging from RUV (Iceland) and YLE (Finland) to RTVE (Spain) and RTP (Portugal) – amongst others. The aerial is fixed, pointing east, and is in the loft, but Keith intends to change to external, rotatable mounting shortly.

Chris Scott (East Finchley, London N2) has had excellent tropospheric reception using a fixed Anglia u.h.f. array. He's received signals from Holland, Belgium, W. Germany and Sweden on his Sony KV2000UB receiver without the use of a preamplifier.

More from Anthony Mann (Western Australia), this time on the F2 scene during September. TE/F2 reception commenced around September 2nd, when the m.u.f. rose to 47·5MHz. On the 3rd, four ch. R1 transmitters, and Malaysia ch. E2, were received. Sp.E plus TE produced strong Chinese schools' signals, Malaysia and the Indonesian Islands on the 16th. The Chinese test card is similar to the PM5544 and originates from the Central TV Station, Peking. A grey scale is also in use. This could cause problems with identification in the UK. Signals above ch. R1 were not generally received up to the 23rd.

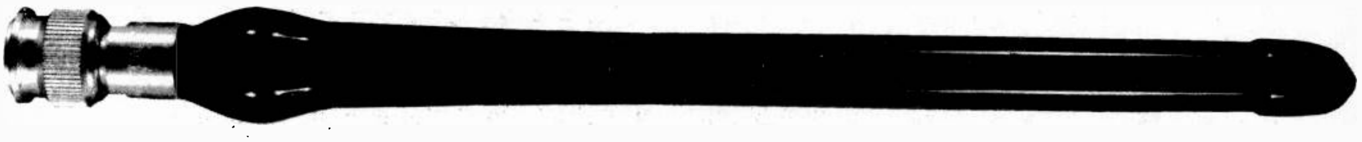
### More on Aerials

We're currently looking into the possibility of constructing a compact active aerial for Band I use and would be pleased to hear from any readers who have constructed, dismantled or experimented with such systems. The hybrid amplifier we featured in the July 1978 issue should be the answer to providing a suitable head amplifier for the system. As to the aerial structure, consideration was first given to the use of inductively loaded elements with or without v.h.f. ferrite. Recently however a catalogue, that included low v.h.f. band helical aerial whips came to hand (from Antenna Specialists (UK) Ltd.). These devices consist of a continuous flexible helix covered in Neoprene/PVC and intended for mounting in a ground plane configuration for mobile communications use. The important feature is that a performance almost equivalent to that of a quarter-wave element is obtained with an overall length of only $\frac{1}{12}$ wavelength. This may well be the answer for the elements, and I'm at present awaiting samples with which to experiment. The head amplifier will obviously have to be mounted directly on the aerial structure in order to overcome the losses from the inherently smaller structure and possible mismatching problems with the output feeder.

Pat Hawker, writing in the October 1978 issue of *Radio Communication,* featured an interesting aerial based on the switchable quad principle and evolved by a Russian amateur. Although the system is perhaps orientated towards h.f. short-wave band use, tests have been made at 144MHz and the gain is thought to approach 4dB. The switchable quad consists basically of four half-wave loops, joined electrically at the tops (see Fig. 1) but with the lower terminations individually connected to a relay system. By selecting different combinations and inserting additional phasing sections to give reflector action, each of the four basic directions can be selected in turn without the aerial being rotated. The optimum length of the half-wave loops is $0{\cdot}53\lambda$, and the two extra phasing sections should be $0{\cdot}04\lambda$ each.

It occurs to me that an aerial switching system could be based on the use of forward and reverse biased diodes, and might prove capable of balanced or unbalanced working. With a single low-loss relay it would be possible in the balanced mode to switch four circuits. I must emphasise however that these are just thoughts on paper at present. The relay would select either pair of inputs and pass an appropriate bias to reverse bias one diode and forward bias the other (see Fig. 2).

I've on several occasions in the past mentioned the use of balloons for supporting aerial structures, often at considerable heights. This can give greatly increased TV coverage. Balloons have been used in Iran, Nigeria, and for propagation tests in Europe. Recently the magazine *Broadcast Management/Engineering* featured a variation on this theme. The problem was to obtain coverage of the complete golf course during the US Open Golf Tournament at Denver, Colorado in June 1978. The solution adopted was to use seventeen cameras rigged in the traditional manner and a further three mobile ones, each being equipped with a 2GHz microwave transmitter on a golf



*A neoprene covered helical aerial (Antenna Specialists (UK) Ltd.).*

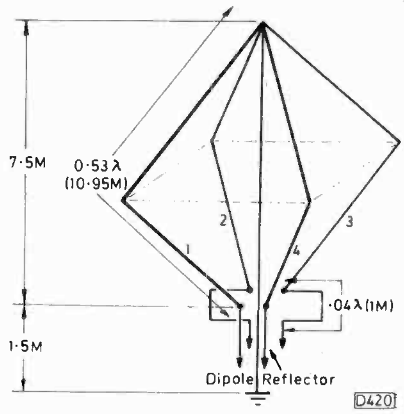



*Fig. 1: Basic switchable quad aerial, with legs 1 and 4 acting as the active element (dipole) and legs 2 and 3, with the extra phasing sections, acting as a reflector.*

cart. A helium-filled balloon was equipped with a platform carrying three 2GHz receivers, one for each camera. In addition, the balloon carried three 950MHz transmitters to provide engineering and communications links to each mobile camera. The balloon's operational height was 400ft, power supplies and signal feeds being integrated with one of the holding tethers. The project was successful as an outside broadcast operation: it took only minutes for the remote camera positions to establish a perfect r.f. link to the next tee.

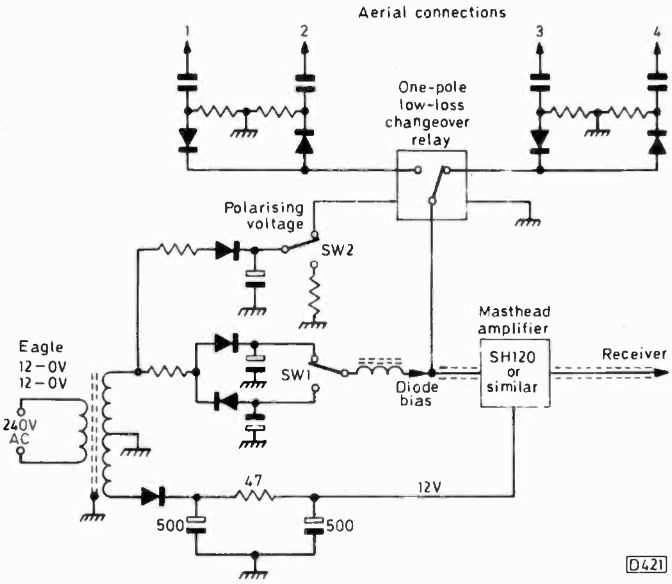



*Fig. 2: Thoughts on a possible aerial switching unit.*

Radio amateurs have in the past used balloons to lift vertical wires for 160 metres, and certain DX-TV enthusiasts have contemplated the use of a balloon to lift an omnidirectional aerial skywards. Be warned however: I understand that in the UK special permission is necessary from the aviation authorities!

# New Signal Circuitry for the 625-line Receiver

**Keith Cummins**

POSITIVELY the last appearance, folks, of this well-known constructors' project of yesteryear. Seriously though, some 3,000 or more of these receivers are believed to have been built, most with the bought-in surplus Pye i.f. strip and tuner. The latter had mechanical limitations which sometimes made it necessary to reset the tuning at frequent intervals as the wear and tear over the years took its toll. The writer was on the point of despatching the prototype to that great TV lounge in the sky when it suddenly dawned that all might not be lost after all. The results could well be of interest to other constructors faced with the same dilemma of maintaining the by now ancient tuner.

The conclusion we came to was this. Why not investigate the possibility of discarding the original tuner and i.f. strip, replacing them with the varicap and Philips modules used in the fairly recent monochrome portable project? Come to that, why not go the whole hog and lift the complete portable TV r.f. and video circuits, then interface them with the 625-line receiver? In theory the idea seemed very attractive: the +12V supply was available from the 625-line receiver, an h.t. rail existed to feed the TBA550 varicap tuning voltage stabiliser, while video and audio amplifiers were already available.

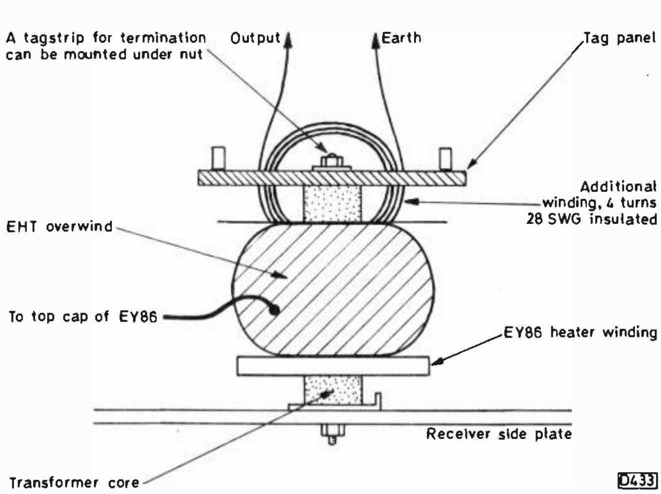



*Fig. 1: The position of the extra winding required on the line output transformer. Viewed from the top.*

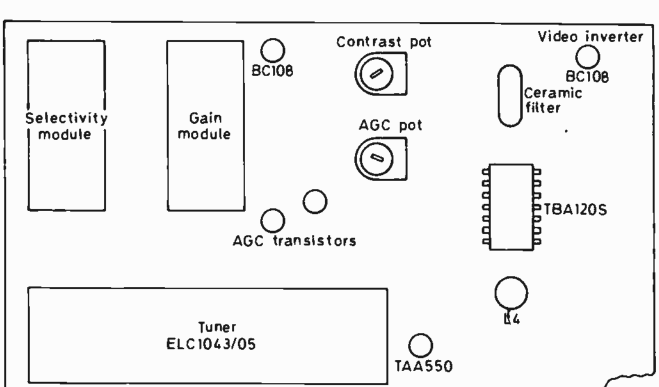



*Fig. 2: Suggested layout for the tuner, i.f. components, etc. The tuner, i.f. modules and other components can be arranged on a piece of Veroboard.*

In practice the scheme worked out very well, and the old receiver came bouncing back with a new lease of life and a really good picture. For those readers then who have a 625-line receiver with tuner problems and would like to keep it going, the following information should be of interest.

In order to provide a video signal of correct amplitude and polarity, the video output transistor in the portable circuit is replaced by a BC108 inverter which is fed from the +12V supply. This gives a positive-going output signal which can drive the PCL84 video amplifier valve in the 625-line receiver. Since the portable circuit contains its own a.g.c. system, the original a.g.c. circuit is removed from the 625-line receiver. Conversely, the 625-line receiver includes a sync separator, so the sync separator in the portable circuit can be omitted.

The TBA120S intercarrier sound circuit from the portable is used, but the output is taken to the top end of the volume control in the 625-line receiver circuit. The d.c. volume control connected to pin 5 of the TBA120S in the portable is simply omitted.

Because there's plenty of video drive, the video output pentode's anode load resistor can be reduced in value (from 8·2kΩ to 4·7kΩ), providing a wider bandwidth at the expense of reduced gain. The stage is also biased differently: the 47Ω resistor common to the video and field output stages is reduced to 22Ω.

The TAA550 varicap tuning voltage stabiliser is fed via a 20kΩ 5W resistor from the h.t. reservoir capacitor, ahead of the 2N3055 smoothing transistor. This reduces the load on the 2N3055.

Everything is pretty straightforward so far, so where's the snag? Those readers who know the circuit of the monochrome portable may recall that a −5·6V supply is derived from a line output transformer winding which also provides the a.g.c. gating pulse. The 625-line receiver's line output transformer has no suitable winding, so a four turn winding has to be added. This is wound on the leg of the transformer as shown in Fig. 1. Note that the sense of the winding is important, to ensure that the pulse is negative-going.

The job of adding this winding to the line output transformer requires just a little care and patience, to ensure that the lead-out wires from the existing windings are not damaged.

As this exercise is not regarded as a project in its own right, but rather as a potentially useful account of how to prolong the useful life of the 625-line receiver, no PCB layout for the r.f. section is provided. The tuner and i.f. section can be built up completely satisfactorily on Veroboard, with an 0·1in. matrix. The modules and tuner will all "drop-in" to this matrix, and with care a neat, compact unit can be constructed. Earthing should be consolidated by the use of parallel 16 s.w.g. links from the main modules to each other and to the chassis. This

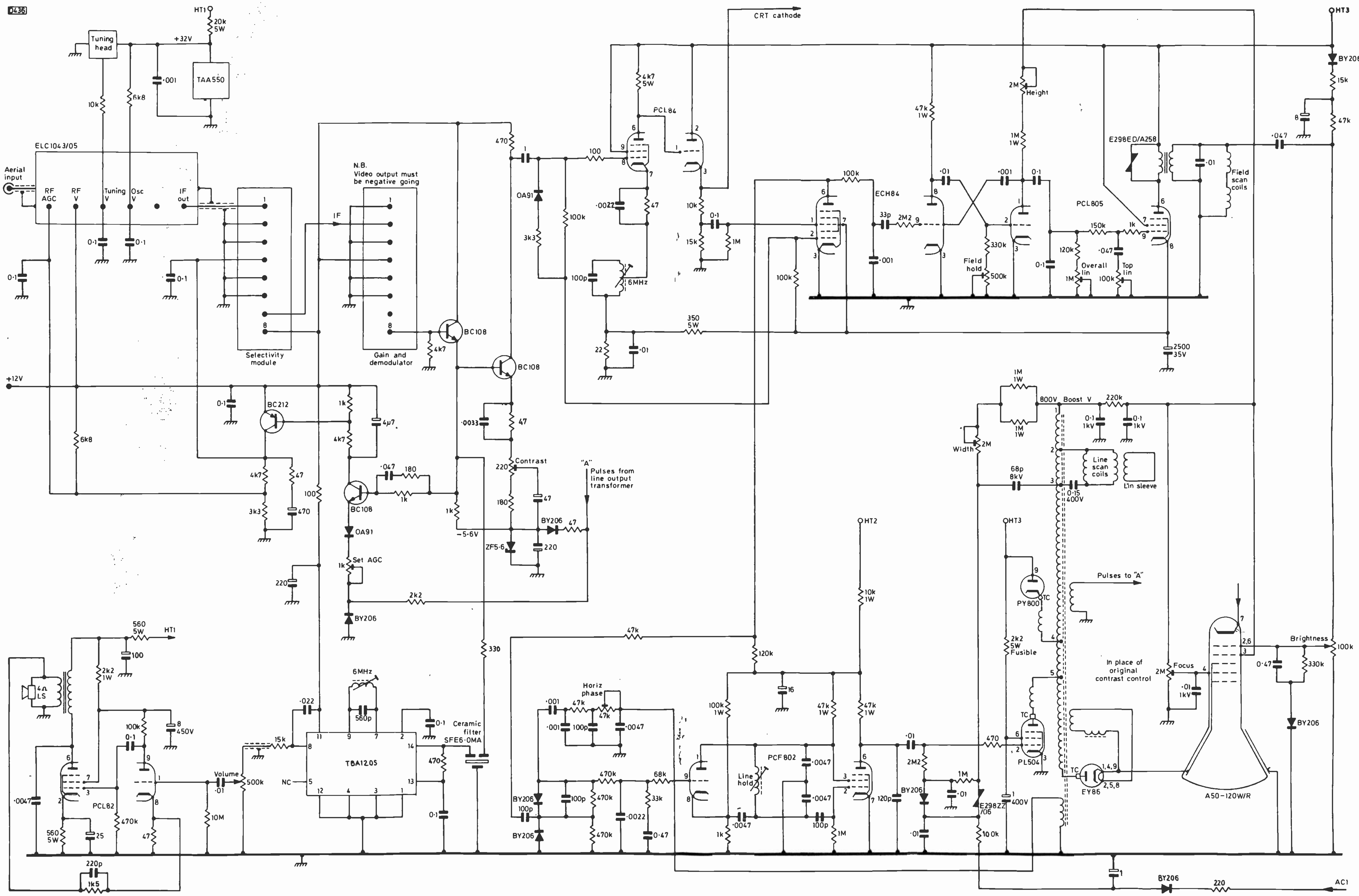



*Fig. 4: The signal and timebase circuits of the latest version of the 625-line receiver, incorporating the r.f./i.f. circuitry used in the Television monochrome portable project.*

# Meter Care

*John Law*

THE value of a meter lies in its accuracy when connected to the circuit under test, this in turn being determined by its internal resistance. Until recent years, a cheap meter was a poor meter mainly because of the insensitivity of the basic meter movement: a high proportion of the available current was absorbed by the coil, so that false readings were given. The Japanese penetration of the electronics market in recent years has, however, meant that there is now a wide choice of small, cheap multimeters with excellent accuracy. This is only one factor that has to be taken into account in choosing a test meter however. Ease of reading the resultant figures is also important, a factor determined largely by the length of the meter's scale. The pointer on the Avo Model 8 traverses five inches between zero and full scale deflection on each voltage and current range. This is suitable for normal use: compare it with some imported meters which have scale lengths of around 2½in.

Solidity and weight are other aspects of goodness. The Avo Model 8 weighs over 6lb., and the writer can testify from many years' experience to its ability to withstand falls and bounces in circumstances where a lighter, cheaper meter would shatter and fall apart.

Short-circuits and overloads are other hazards to which meters are subject, despite every care. Some cheap meters do not incorporate protection against these possibilities, while others have overload diodes to give some degree of protection. Avo meters are fitted with overload cutouts which break the circuit completely on the sudden application of a times ten surge. Again, the writer can vouch for the efficacy of the Avo's cutout, which has never let him down despite years' of hair-raising shorts and burn-ups.

The availability of replacement parts is another consideration: for many cheap meters there are no spare parts, since it's not worthwhile importers carrying stocks of components for which they may never be asked.

A prime question of course is the price of the meter. Paying £70 or so for an Avo Model 8 is a sensible investment for the professional service engineer since the meter will be the most important of his tools of trade. For the amateur, however, a better choice would be a lighter, imported meter, accurate and with some degree of overload protection, a three-four inch scale, around twenty ranges of voltage, current and resistance, and an internal resistance of 20,000Ω/V. Such meters can be obtained for around £20.

For those who are prepared to wait and look around, quality meters are occasionally on offer second-hand in shops or the small advertisements columns of radio and electronics magazines. It's worth looking out for a meter such as the Avo. It is indeed an investment: my present one cost under £20 some twelve years ago.

## Checking a Meter

Regular use and occasional misuse mean that a meter ages and requires attention from time to time, while a second-hand meter would probably require checking if not actual repair and restoration to normal accuracy. The fault-finding guide given in Table 1, prepared by Avo and based on the Avo 8, is a useful guide to the condition of any good test meter. Running through it will quickly show the condition of a meter and indicate the likely cause of any defects.

Over the years, Avo have specialised in making available spare components and ready-calibrated subassemblies so that the engineer with a minimum of tools can repair a faulty meter, restoring it to its original accuracy. Components can be ordered from stock, or the faulty parts returned for repair. The address is: London Instrument Repair Centre, Archcliffe Road, Dover, Kent.

Many of the defects mentioned in Table 1 can be cleared with care and common sense. Other work, such as diagnosis and replacement of damaged jewels, replacing one or both hairsprings, or balancing the pointer, calls for experience allied to watchmaking skill plus the availability of a lathe and specialised tools.

## Intermittent Ohms Readings

Amongst faults which can be tackled easily is the common one of intermittent ohms readings. This can be due to dirty battery connections, intermittent connecting leads to the meter, or corroded or tarnished tracks on the ohms adjusting potentiometers. Replace worn or frayed leads whenever they become suspect. Those supplied by the makers are not cheap, but are intended to give many years' hard service. For less arduous use, replacements can be assembled from good quality flex, spades and prods.

The battery connections are accessible after removing the two cover plate securing screws in the top of the meter. Batteries are relatively cheap but tend to be forgotten. Replacement at regular intervals can avoid intermittent readings with, possibly, battery leakage and corroded connections.

To clean the ohms adjustment potentiometers, the meter movement has to be removed from the case. Before attempting this, place a clean sheet on the workbench and clear the area of steel tools, loudspeakers and other ferrous objects. This is necessary because nearby ferrous objects will drain away some of the magnetic flux surrounding the meter movement, and could ultimately leave the movement with insufficient range of adjustment. This would necessitate remagnetisation.

Removing the meter from the case involves extracting six screws around the top edge of the case plus a recessed screw whose head is embedded in wax. The screws are not all of the same length, so the position of each should be noted. Removal is facilitated by pressure on the glass as the screws are taken out: this is because they are inserted under pressure in order to exclude dust.

The component parts of the meter are secured to the top plate. Note that the two magnet system retaining nuts *must not be removed* – this would also affect the magnetic flux stored in the movement.

Having exposed the three ohms adjusting potentiometers, inject on to the tracks with a hypodermic syringe a few spots of Servisol. Then give the knobs a few brisk rotations to allow the oil to penetrate the windings. This will clean the accumulated grit and grease from the potentiometers.

## Sticking Pointer

Another common meter fault is a pointer that sticks erratically when traversing the scale. This can be very frustrating, especially when tapping the glass temporarily clears the trouble. Should this fault appear without warning,



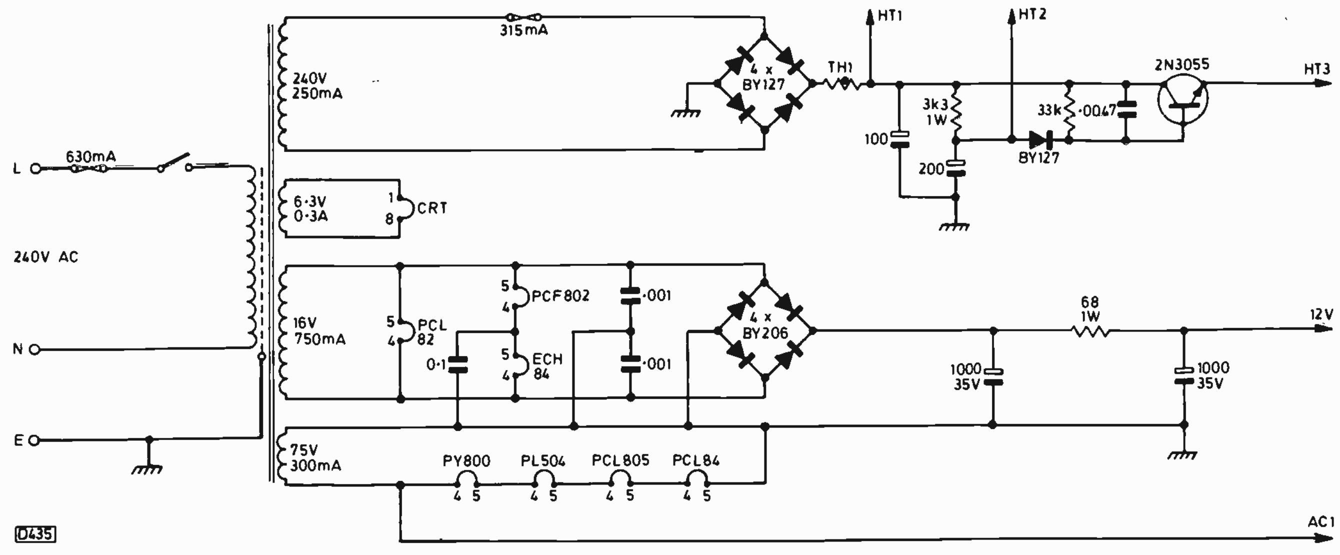



*Fig. 3: Power supply circuitry. The 2N3055 transistor acts as an active filter, providing a very smooth h.t. supply.*

prevents patterns and any risk of instability.

To provide some assistance, a recommended basic layout for the tuner/i.f. board is shown in Fig. 2.

The contrast control is now a preset potentiometer on the tuner/i.f. board, so the contrast control at the front of the receiver is not required. It can be rewired to act as a variable focus control if desired.

The tuner buttons are fitted in the position previously occupied by the original buttons. As the assembly is smaller, a spacing-off bracket has to be built and the cabinet fitted with a blanking plate. The reader is left to his own ideas in this area.

To avoid confusion over any small details not described, a complete circuit diagram of the "hybrid" receiver, incorporating all the previous "up-dates" (e.g. the sinewave line oscillator, transistor smoothing, and line output stage protection) is shown in Figs. 3-4. This could form the basis for a useful DX receiver. ■

*MAIN CIRCUIT (FIG. 4) OVERPAGE* →

# Simple CRT Tester

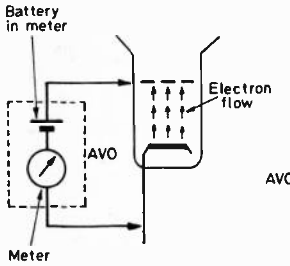
*R. Verge*

THE simple c.r.t. tester described below consists of an adaptor which can be used in conjunction with an AVO 8 or any other meter that reads resistance. I've found it a very useful way of checking c.r.t.s for low emission. No constructional details are given due to the simplicity of the circuit.

When the grid of a c.r.t. is made positive with respect to the cathode, current will flow from the cathode via the grid to the external circuit. By connecting an Ohmmeter between the grid and cathode, current will flow due to the meter's internal battery (see Fig. 1). This fact can be used to check the c.r.t. since the greater the cathode-grid current the lower the resistance reading recorded by the meter. Note that in most meters, including the AVO, the red lead is connected to the negative side of the internal battery while the black lead is connected to the positive side. Thus the "negative" meter lead has to be connected to the grid of the c.r.t. and the "positive" lead to the cathode.

Connect the meter as shown in Fig. 2, remembering the point just made about the meter leads. Switch the AVO's ranges to resistance and Ohms. Fit the c.r.t. socket to the tube being tested, and let the heaters warm up. Finally check the meter reading – on each gun in the case of a colour tube.

A good tube should give a reading of about 700 Ω. The tester can be calibrated by checking known good and poor tubes. ■



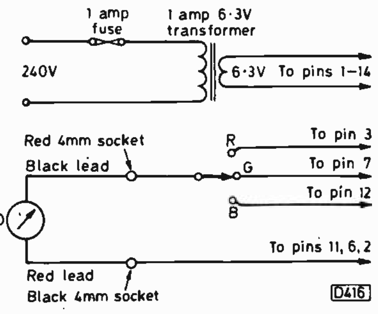




*Fig. 1 (left): Electron flow from cathode to grid when the c.r.t. is biased by the meter's internal battery.*

*Fig. 2 (right): Simple c.r.t. tester circuit. The c.r.t. pin numbers apply to delta-gun colour tubes. In the case of a monochrome tube with a B8H base the heatre pins are 1 and 8, the grid is pin 2 and the cathode pin 7.*

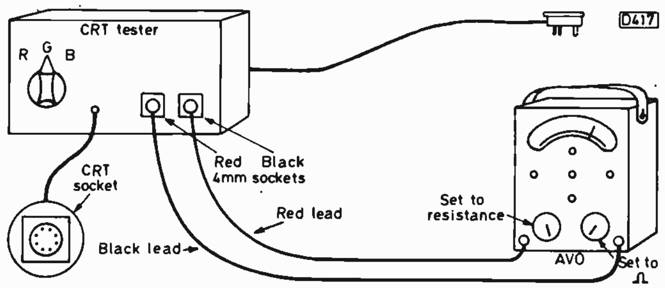



*Fig. 3: Physical arrangement of the tester.*

**Table 1 : Meter fault-finding guide**

| *Symptoms* | *Probable cause* |
|---|---|
| No reading on any range. | Open-circuit or intermittent leads or a circuit fault. Note whether current is flowing on the current or voltage ranges with no meter movement. |
| Low readings on all ranges. | Hairspring turns caught up or stuck together. The fault is sometimes associated with change of zero. |
| Ohms ranges inoperative, irregular or intermittent. | Check battery/cell contacts, "zero Ω ÷ 100" rheostat winding for tarnish, faulty carbon potentiometers. Intermittent lead connection can be diagnosed on a resistance range (preferably the lowest). |
| No reading on an isolated current, voltage or resistance range. | Open-circuit in a resistor beyond the last working range. The three lowest a.c. voltage ranges of the Avo 8 have independent resistors. |
| No reading on an isolated current, voltage or resistance range. | Suspect a faulty connection between the switch contact and the shunt, multiplier or transformer concerned. |
| Pointer movement checked at one particular point on scale. | Dust or other dirt fouling movement. Could be in the gap or on the scale plate or window. |
| Slight pointer stick at about the same degree irrespective of pointer deflection length. | Blunted pivots, or possibly damaged jewels. |
| Movement out of jewels. | One of the jewels depressed through excessive shock. Remove moving coil and pivots and examine jewels for damage. Then reswing coil and lower both jewel screws a minute amount so that any further shock will result in the moving-coil former touching the concentrator before either pivot can leave its jewel. |
| Reading instability. | Examine leaf-switch contacts, main switch contacts and reverse moving-coil switch contacts. |
| Ohms zero varies shortly after being set. | Check cell and batteries. |
| D.C. readings correct, a.c. readings low. | Suspect faulty rectifier or transformer. Check by substitution. |
| Cutout fails to reset. | Mechanism set too finely, or jewel in bellcrank chipped. |
| Cutout fails to operate. | Mechanism set too coarsely, operating rod bent, or plunger rod dirty. Don't use oil. |

suspect rough handling or a recent fall. The trouble can be due to a bent pointer fouling the glass at various points, or the dial itself may be bent, touching the pointer as it moves across the scale. The cause should be readily seen once the meter has been removed from its case. Careful manipulation with a pair of fine tweezers or a small screwdriver should clear the trouble. The scale is secured by two small screws, which can work loose.

A less common though perhaps more tricky cause of a sticking pointer is a speck of bakelite varnish which has dropped into the magnetic gap or hair spring. There's a hairspring at each end of the pivot, with a tip radius of only 0·0006in. Very gentle handling is clearly necessary. A finely pared down cocktail stick, a good light, an optician's eyeglass, a steady hand and great patience are required to remove any bits from the area of the magnetic gap. Occasionally a sliver of iron dust may get into the gap. Careful manipulation with a very fine steel needle should enable it to be removed successfully. Ensure that the gap is clear before reassembling the meter in its case. A photographer's air bulb brush will help to clear it.

Bent pivots or damaged jewels can be responsible for the meter sticking, but this work is outside the capabilities of the average engineer.

Occasionally you might find that a chip of bakelite varnish has broken away and adhered to the glass: it may not be easy to see unless a bright light is used.

## False Readings

If the meter has been dropped, adjacent turns of one of the hairsprings may have caught up, with the result that the pointer gives false readings. To unravel the hairspring once access has be gained, insert the point of a very fine needle between the turns of the spring nearest its centre and carefully follow the turns spirally outwards to the periphery of the spring. Provided the turns have not been distorted, the coil should revert to its original natural state and position.

If there's any doubt about the accuracy or freedom of movement of the moving-coil assembly, remove and return it to the makers for repair or replacement. To remove, unsolder the connections to the magnetic system and the swamp bobbin, which is mounted on the movement itself, then remove the two retaining screws on each side of the movement. The replacement will be precalibrated, but the cutout mechanism must be reset after insertion.

## Resetting the Cutout

The cutout operates when the meter is subjected to a sudden times ten overload. Place the meter face down on the bench, after removing the case. Slacken screw 24 (see Fig. 1) and pillar 18, then turn the cutout table 25 slightly clockwise and tighten the screw and pillar. If the mechanism is now too sensitive, the cutout table has probably been turned too far clockwise. Slacken the screw and pillar and retard the table fractionally, then retighten. Repeat until the cutout operates satisfactorily with the meter in its normal position.

Note that a prolonged overload of less than ten times full-scale deflection on one of the higher current ranges, or a slowly increasing overload which may eventually exceed ten times, can overheat the shunts without the cutout operating. Its contacts can become burnt however, with soot deposits. They can be cleaned, but a new set of contacts or a complete cutout is preferable.

Another possible cause of damage is when a very high overload is applied on a.c. The rectifier may be punctured immediately, before the cutout has time to operate. Similar damage can be caused when a sudden d.c. discharge, for example from a charged electrolytic, passes through the meter on a.c.

### Intermittent Faults

Intermittent faults are usually due to defective leads, though a dry-joint may occasionally be responsible. Gently flexing the panels or components will often reveal the seat of the trouble. When extra pressure on the reversal switch appears to cure the intermittent action, it's best to strip out the switch, clean it and reset the contacts.

### Replacement Panels

In addition to replacement movements, preassembled and calibrated boards containing most of the voltage multiplying resistors and rectifiers are also available. The multiplying resistors are high-stability carbon types brought up to precise values by smaller low-tolerance resistors. Complete boards can be supplied, or bobbins or resistors as required. Ensure that the panel itself has not been burnt or carbonised.

A second board which is available carries the various shunt windings and some a.c. voltage multiplying resistors.

Panels can also be returned for repair and calibration.

### Faulty Readings on Particular Ranges

You may come across a meter which reads correctly on all the d.c. ranges but reads low or not at all on the a.c. ranges. The cause may be a defective rectifier unit or poor leaf switch contacts. Very occasionally the transformer may be faulty. In some meters the rectifier is a bridge type, in others it's a smaller 1mA unit. The two types are interchangeable, provided the correct types are obtained from Avo. The replacement rectifiers are specially selected, and the meter should not need recalibration after a replacement is fitted. A surge limiting rectifier is connected across the bridge on later meters to provide additional protection against peaky transients which can puncture the bridge. It's worth fitting if not present in your meter. The anode is connected to the negative bridge output, with the cathode to the positive bridge output.

If no reading above a particular range can be obtained, inspect the boards for burnt or broken resistors. Where a burnt resistor has to be removed, ensure that the panel is not carbonised – scrape and file clean if necessary before fitting the replacement resistor.

The switch assemblies, leaf and rotary, give many years' arduous service but can fail in time due to metal fatigue or wear. When normal cleaning no longer restores trouble-free action, don't resort to abrasives. Replacements can be obtained from Avo.

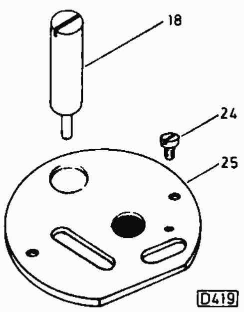



*Fig. 1: Resetting the cutout – simplified view of the cutout table (25). Screw 24 and pillar 18 should be slackened and the table turned slightly clockwise. Then tighten the screw and pillar. See text above for further details if the cutout is then too sensitive.*

### Replacing the Switch Assemblies

To remove the a.c. and ohms range switch assembly, first withdraw the centre 4BA screw from the switch cam. The cam can then be removed from the spindle. Set the a.c. and ohms ranges switch to the 100V position, and push the pin in the brush arm carrier. Turn the switch through 180°, and remove the pin with a pair of pliers if it was not dislodged by the initial push. Lay the parts out carefully as you remove them, identifying their locations for later replacement. Next lay the panel face upwards on the bench. On gently lifting the a.c. switch knob, the click ball should remain in position, supported by its spring, and the cam and brush arm assembly should drop off.

To replace the switch, place the cam and brush arm loosely in position in the centre of the switch ring and place the meter panel on the bench. Apply some Vaseline to the click ball spring, and push it into its hole in the panel. Next apply a spot of Vaseline to one of the slots on the underside of the knob, and press the ball into it. Turn the panel over and, holding it in one hand, push the knob spindle into the panel, ensuring that the click ball seats down on its spring and compresses it correctly. Turn the knob to the 100mA position and place the panel on the bench with the cutout assembly towards you. Turn the brush arm until the contacts which run around the switch ring contacts are pointing away from you. Place the carrier pin in its hole in the brush arm carrier, and push it home. Replace the cam and its locking screw and set as follows.

When the switch is set to ohms×100, both contacts of the set of leaf contacts nearest the cutout should be lifted to their full extent. Turn the cam until this occurs, then tighten the cam locking screw.

Removement and replacement of the d.c. ranges switch assembly is the same. In this case however, the set of contacts nearest the cutout contacts should be fully lifted when the switch is in the resistance position. Turn the cam until the contacts are in this position, then tighten the screw.

### General Comments

The foregoing information, taken in conjunction with Table 1, should enable an Avo Model 8 to be restored to first class condition. It's also worth paying attention to its appearance, since first impressions count with customers. If the case's crackle finish is grubby, scrub it with a stiff hair brush and a few spots of light oil to freshen it up. Worn or defaced lettering can be restored by careful use of a fine needle to clean out the old paint, which can be replaced by careful use of a fine brush or mapping pen. A steady hand is necessary. If you make a mistake, remove it with cellulose thinners before the paint dries. ■

# Service Notebook

## G. R. Wilding

### Rapid Fault Diagnosis: No Picture

The secret of rapid fault diagnosis is to make the minimum number of valve swaps, voltage checks and can or plug removals. Apart from saving time, this is especially important in older receivers where tugging at a recalcitrant plug can easily result in an open-circuit connection. With multi-contact connectors in colour sets, a defective connection can take a lot of time to track down and put right. With even the simplest faults therefore, a little prior thought and assessment of possibilities can save time, effort and reduce possible damage.

For example, the raster on a Bush TV161 dual-standard monochrome series receiver had suddenly vanished, leaving the sound unaffected. Changing to 405-lines produced a pronounced line whistle but still no raster. So the line timebase was working, and the main possibilities were a defective e.h.t. rectifier, zero or very low c.r.t. first anode voltage, or failure of the d.c.-coupled PFL200 video output pentode.

To check for e.h.t., you can either remove the c.r.t. final anode cap connector and check whether a discharge is obtained on touching it to the chassis metalwork, or slip the narrow blade of a long, insulated screwdriver under the cap and listen for arcing. Now pulling off an old anode cap connector can sometimes cause the lead to become unsoldered. This is an awkward repair. Removing the screws that hold the line output stage screening can in order to get at the e.h.t. rectifier is also a fiddly business. My usual first move therefore is to short-circuit the grid and cathode of the c.r.t., which is easily done with a couple of screwdrivers. Usually, the grid is pin 2 and the cathode pin 7 (B8H base). If this results in a full brilliance raster, then the e.h.t. and first anode voltages are present and in most cases it will be found that a d.c.-coupled video output valve is non-conductive, due either to an internal disconnection or an open-circuit screen grid feed or cathode bias resistor. If no raster appears, check the c.r.t's first anode or e.h.t. voltage. Which step you take first depends on accessibility.

In our particular case shorting pins 2 and 7 produced a brilliant raster, and a new PFL200 restored the picture.

### Slow Colour

A Pye hybrid colour receiver gave a good monochrome picture, but it was often up to ten minutes before the colour appeared. The owner commented that its appearance could sometimes be hastened by mistuning and then tuning back again.

On switching the set on a good monochrome picture appeared and it was found that slight pressure on the decoder panel would produce the colour. A dry-joint seemed likely, so the panel was removed and inspected. No definite evidence could be seen, but a few suspect joints were resoldered. On refitting the panel there was still no colour, while pressure on the panel, particularly on the case of the reference oscillator crystal, restored normal results. One occasionally comes across a lazy crystal, i.e. one that requires an electrical impulse or slight mechanical pressure before it will start to operate. This turned out to be the case with this set, a replacement crystal giving colour from switch on.

### Absence of One Colour

The most common causes of absence of one colour with the Thorn 3000/3500 chassis are failure of the relevant BF179 output transistor or c.r.t. first anode supply. The usual cause of the latter fault is leakage across the relevant c.r.t. first anode supply switch and/or increase in the value of the $1M\Omega$ or $1{\cdot}5M\Omega$ resistor feeding the c.r.t. first anode preset potentiometer. On occasion, a leak may develop in one or other of the $0{\cdot}001\mu F$ first anode supply decoupling capacitors.

The other day we encountered the opposite symptom, excess of one colour (red). Suspicion naturally fell on the red BF179 output transistor, but resistance checks on the board gave almost equal readings in all three output stages. Nevertheless a replacement BF179 completely cured the fault.

Another 3500 gave a very good picture, but on occasion a line of bright spots appeared at the extreme left-hand side of the screen. There were simultaneous crackling noises on sound. This suggested an incipient e.h.t. transformer or e.h.t. tripler breakdown. The transformer looked all right, so as the tripler was the original one, about six years old, it was replaced. This eliminated the fault effects.

It's always wise to replace a suspect tripler: when they break down completely the load imposed on the output transformer and transistor can lead to either or both being damaged.

### Unusual Display

A hybrid Bush monochrome set fitted with the A774 chassis was suffering from poor definition, accompanied by quivering verticals near the top of the raster. Even more annoying however was a series of tiny, almost rectangular dots which formed sloping lines across the picture – the lines tending to move downwards. The effect suggested interference from an electric motor, but vanished when the aerial plug was removed.

There was no corona discharge anywhere in the line output stage or from the c.r.t. top cap connector, so in view of the poor definition and the fact that the sync separator is driven by the BF178 video output transistor it was decided to replace this. This removed all the fault symptoms, and it can only be assumed that minute sparking was occurring internally.

In another of these sets the picture would be normal for the first few minutes after switching on but would then suddenly disappear, leaving a blanked out screen. There would be a simultaneous slight degradation in sound quality, while advancing the brightness control would produce a raster with very slight, vague modulation. A defective video output transistor again seemed likely, and on switching the set off and on again to restore the picture it was found that the fault could be produced by shorting the video output transistor's base-emitter connections with a screwdriver. A replacement transistor restored normal operation, but as expected forward and reverse resistance checks across the junctions of the defective transistor produced normal readings.

# Colour Receiver Project

## Part 4

**Luke Theodossiou**

THE signal sections of the receiver are built on a single-sided pcb measuring only 220 × 150mm. The copper track pattern is shown in Fig. 3 and the component locations in Fig. 5. Construction is very straightforward, but it's preferable to start with the links, progressing on to the resistors and capacitors, followed by the active devices, connectors and finally the modules and tuner.

The two colour decoder i.c.s (IC3 and IC4) are mounted in sockets, but a socket must not be used for IC2 (LM1808) – this ensures maximum heat transfer from the i.c. to the copper track, which acts as a heatsink.

The only coil used is for the sound detector. Winding details are given in Fig. 4. We understand that the coil will be made available shortly as a ready-built item from regular advertisers in *Television*.

### Detector Module Modification

A modification is required in the Philips detector module to enable a positive-going video signal to be fed to the

### ★ Components list: signal board

Where a capacitor is simply specified as a Siemens type, these are type B32560 ±5% 100V. Those specified as 250V are identical except for the voltage rating.

**Capacitors:**

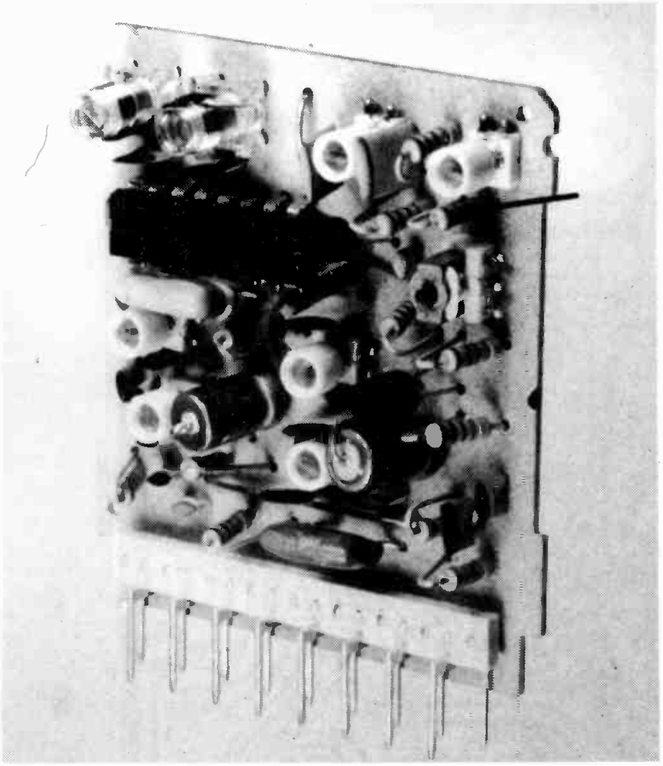
| | |
|---|---|
| C1 | 100n Siemens |
| C2 | 2n2 ceramic plate |
| C3 | 220n Siemens |
| C4 | 22μ 25V tantalum bead |
| C5 | 47μ 16V tantalum bead |
| C6 | 47μ 16V tantalum bead |
| C7 | 10n Siemens |
| C8 | 4μ7 35V tantalum bead |
| C9 | 10n Siemens |
| C10 | 2n2 ceramic plate |
| C11 | 220μ 16V plug-in electrolytic |
| C12 | 47μ 16V tantalum bead |
| C13 | 220n Siemens |
| C14 | 220μ 16V plug-in electrolytic |
| C15 | 100n Siemens |
| C16 | 2n2 ceramic plate |
| C17 | 1n ceramic plate |
| C18 | 1μ 35V tantalum bead |
| C19 | 10n Siemens |
| C20 | 1n ceramic plate |
| C21 | 4n7 ceramic plate |
| C22 | 1μ 35V tantalum bead |
| C23 | 10n Siemens |
| C24 | 330n Siemens |
| C25 | 470n Siemens |
| C26 | 22n Siemens |
| C27 | 22n Siemens |
| C28 | 22n Siemens |
| C29 | 2μ2 35V tantalum bead |
| C30 | 330n Siemens |
| C31 | 10n Siemens |
| C32 | 100n Siemens |
| C33 | 100n Siemens |
| C34 | 22n Siemens |
| C35 | 22n Siemens |
| C36 | 2μ2 35V tantalum bead |
| C37 | sub-miniature p.c.b. mounting trimmer 2–22pF |
| C38 | 22n Siemens |
| C39 | 47μ 16V tantalum bead |
| C40 | 1μ 35V tantalum bead |
| C41 | 10μ 16V tantalum bead |
| C42 | 100n Siemens |
| C43 | 100n Siemens |
| C44 | 22n Siemens |
| C45 | 22n Siemens |
| C46 | 47n Siemens |
| C47 | 47n Siemens |
| C48 | 47n Siemens |
| C49 | 470n Siemens |
| C50 | 100n 250V Siemens |

56p and 12p with L1 assembly – both are ceramic plate types

**Resistors:**

All ±5%, 0·25W unless otherwise specified

| | |
|---|---|
| R1 | 47k |
| R2 | 2M2 |
| R3 | 56k |
| R4 | 56Ω |
| R5 | 470Ω |
| R6 | 120Ω |
| R7 | 2·2Ω |
| R8 | 270k |
| R9 | 33k 2W |
| R10 | 470Ω |
| R11 | 100k |
| R12 | 560Ω |
| R13 | 6k8 |
| R14 | 6k8 |
| R15 | 22k 0·5W |
| R16 | 1k 0·5W |
| R17 | 470Ω 0·5W |
| R18 | 68k 0·5W ±2% thick film |
| R19 | 1k |
| R20 | 2k2 |
| R21 | 6k8 |
| R22 | 22k |
| R23 | 2k2 |
| R24 | 390Ω |
| R25 | 10k |
| R26 | 180Ω |
| R27 | 220Ω |
| R28 | 39k |
| R29 | 560Ω |
| R30 | 22k 0·5W |
| R31 | 1k 0·5W |
| R32 | 470Ω 0·5W |
| R33 | 68k 0·5W ±2% thick film |
| R34 | 1k |
| R35 | 2k2 |
| R36 | 6k8 |
| R37 | 15k |
| R38 | 180k |
| R39 | 56k |
| R40 | 56k |
| R41 | 560Ω |
| R42 | 22k 0·5W |
| R43 | 1k 0·5W |
| R44 | 470Ω 0·5W |
| R45 | 68k 0·5W ±2% thick film |
| R46 | 1k |



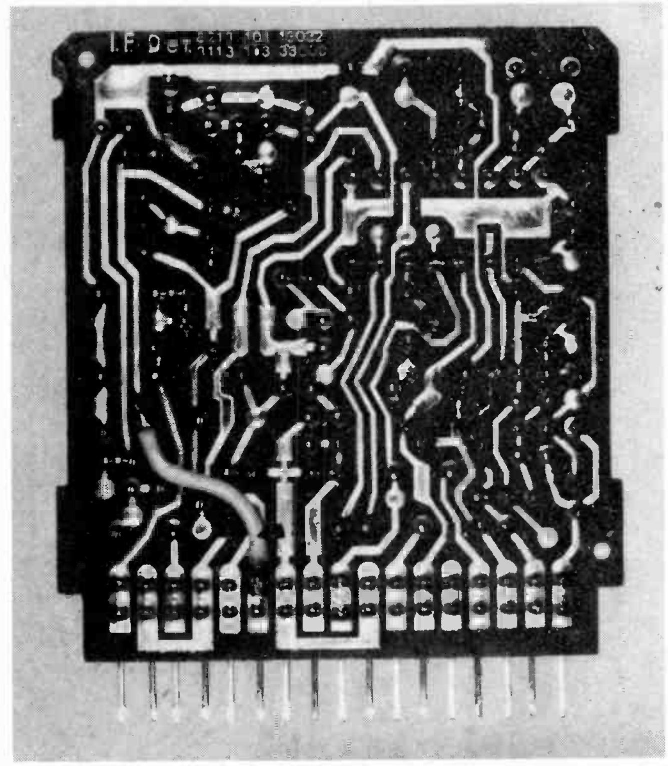


*Fig. 1 (above left): The Philips vision detector module, with the screening can and base removed. R654 (arrowed) has to be removed.*

*Fig. 2 (above right): Copper side of the vision detector module, showing the position of the added wire link.*

R47 2k2
R48 6k8
R49 2k2
R50 22Ω
4W wirewound
R51 470Ω
VR1 2k2
VR2 470Ω
VR3 10k
VR4 220Ω
VR5 10k
VR6 10k
VR7 10k
VR8 10k
VR9 10k
VR10 10k
All presets are subminiature horizontal mounting

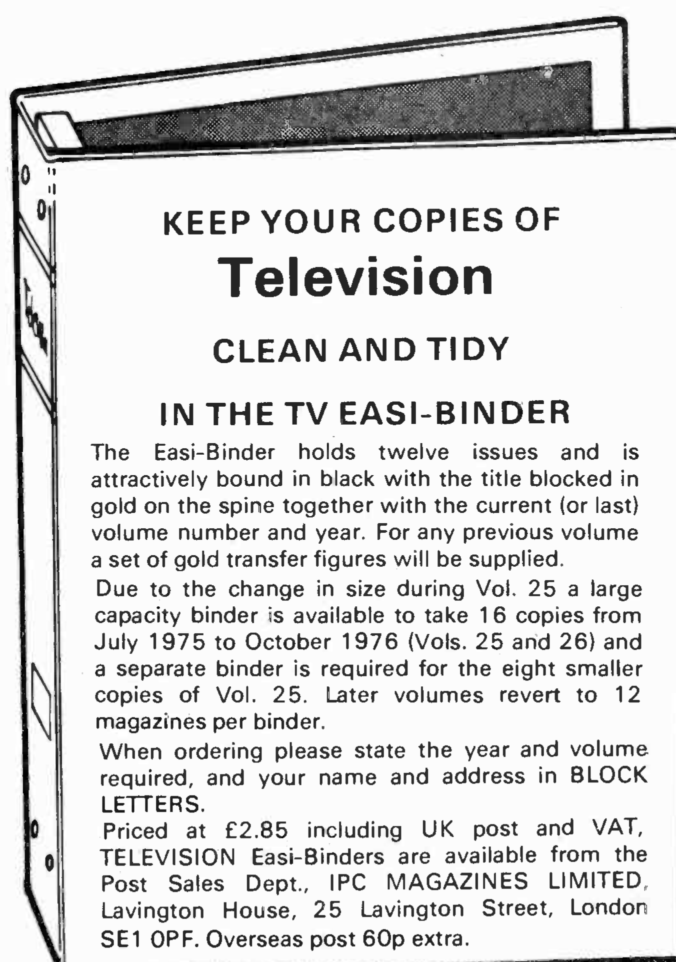
**Semiconductors:**

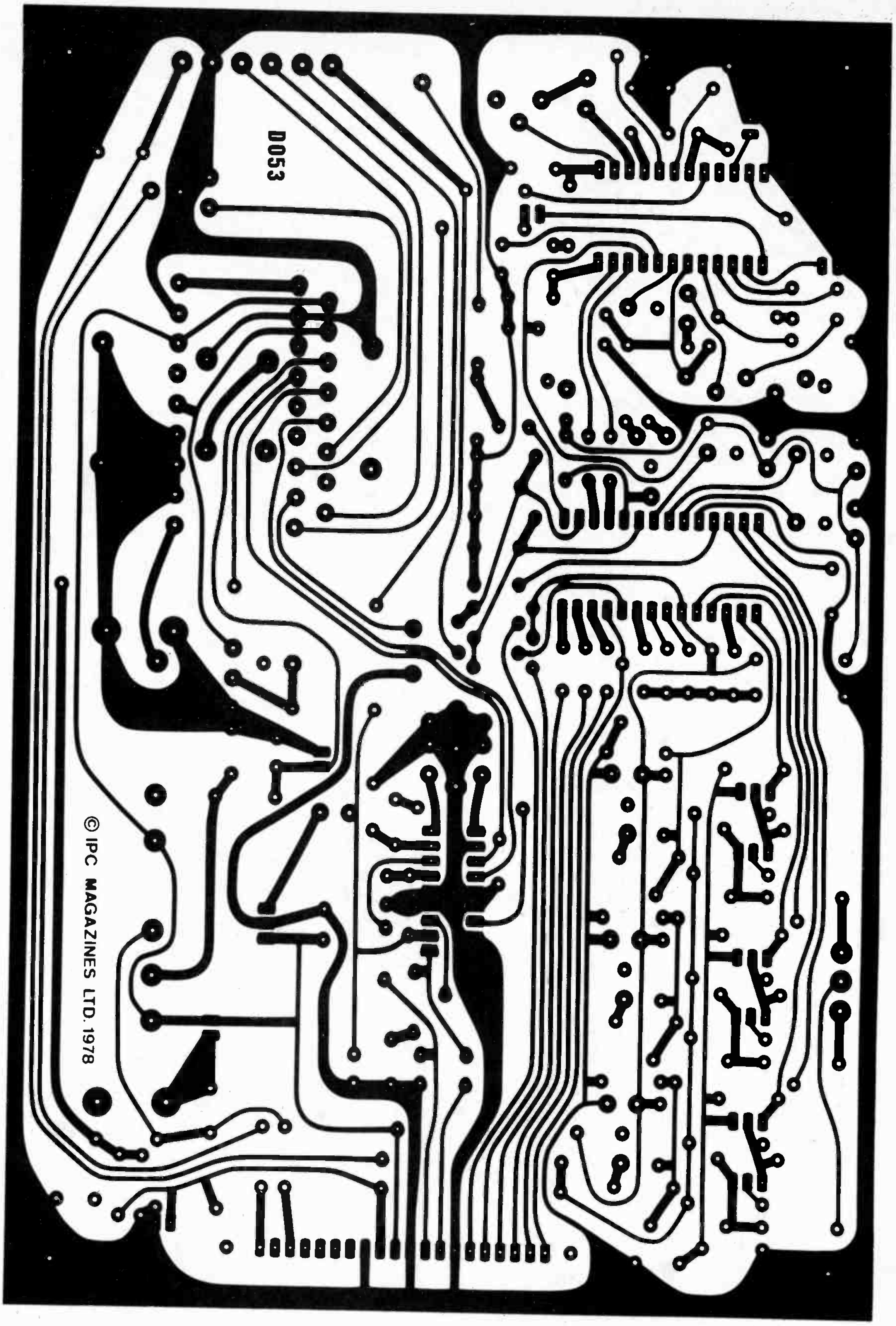
D1 BZX83 C3V9
D2 ZTK33B
D3 BZX61 C7V5
D4 1N4148
D5 1N4148
D6 1N4148

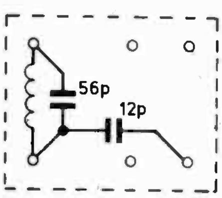
Tr1-6 BF469
IC1 7812 regulator (TO220)
IC2 LM1808
IC3 TDA3510
IC4 TDA3500

**Miscellaneous:**

Tuner: Mullard type U321
Vision selectivity and gain module: Philips 212 27386
Vision detector module: Philips 212 27385
Luminance delay line: Sprague type W3600.Z.146
Chrominance delay line: Sylvania type SDL445
Crystal: 8.867237 MHz
Sockets for IC3 (24-way) and IC4 (28-way)
L1: single layer 50 turns 38 swg e.c.w. on Neosid former, with base, screening can and 6mm grade 500 core. See Fig. 4 for connection details.
Connector A: RS Components 20-way stock no. 488-365
Connectors B and C: Molex 0·2" pitch 6-way and 3-way respectively.
Heatsink for IC1: RS Components stock no. 401-964.





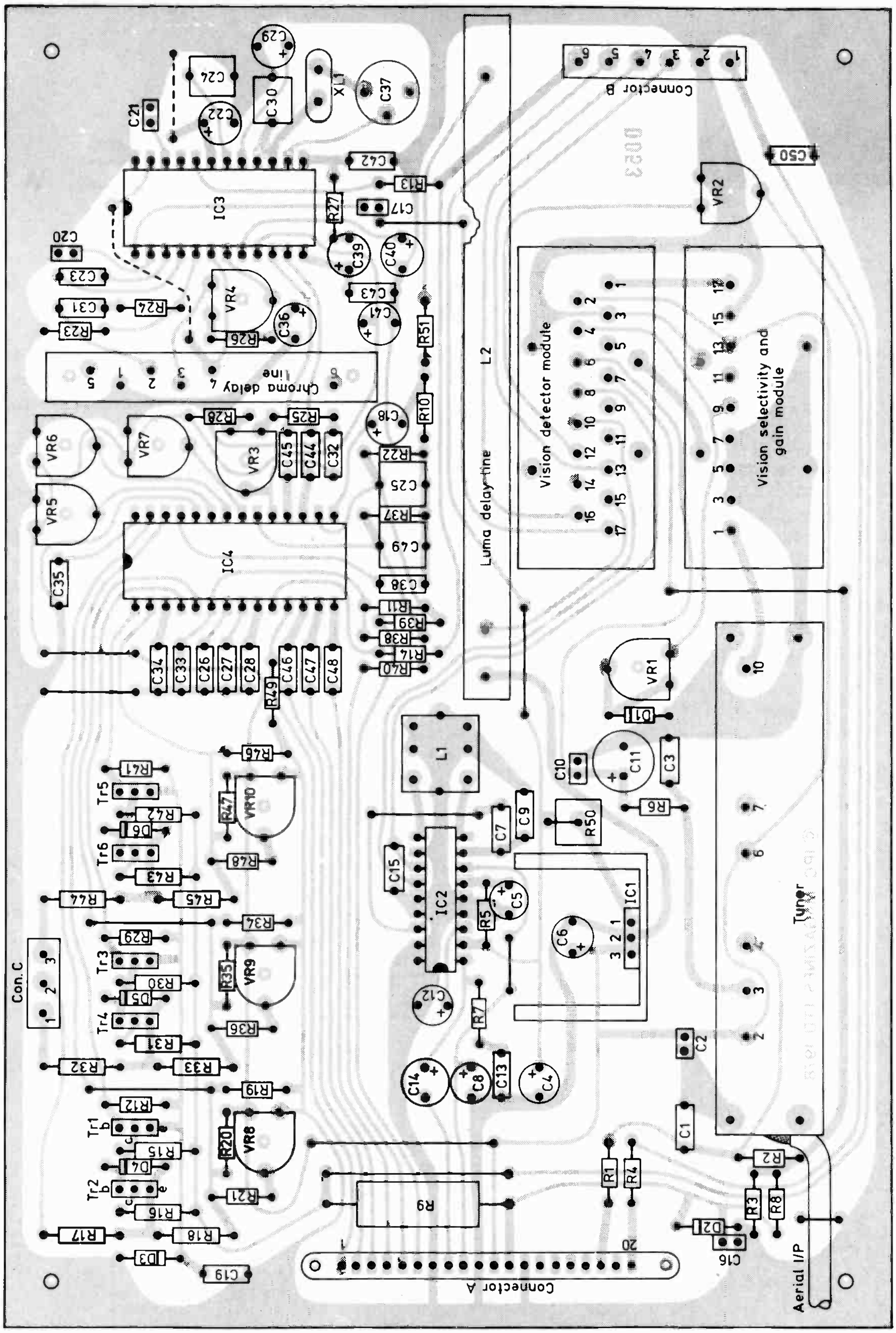




L1 details
(viewed from top)

*Fig. 3 (above): Copper track pattern for the signals board. Scale 1:1.*

*Fig. 4 (left): Details of the sound detector coil.*

*Fig. 5 (above right): Signals board component layout.*




teletext decoder when this is installed. The procedure is to remove T653's 560Ω emitter resistor and replace it with an external 470Ω preset – VR2 in last month's main circuit. In this way, the video level to the teletext decoder module can be adjusted for error-free reception. A link from the emitter of T653 is taken to pin 12 on the module. Fig. 1 shows the position of the resistor whilst Fig. 2 indicates the position of the link.

A length of coaxial cable must be soldered to the aerial input tag on the side of the tuner, with the braiding soldered directly to the case near the tag. Anchor the cable to the board with a plastic cable tie or lacing cord.

The two broken lines on the overlay diagram indicate the two wire links required for setting up the decoder. We suggest that pins are soldered on the board: the links can be soldered on during setting up and then removed.

Next month we delve into the timebase board and the intricacies of the thyristor line timebase.

# TV Servicing: Beginners Start Here . . .

## Part 16

S. Simon

WE have now looked at most sections of a monochrome TV receiver and the circuitry generally used therein. It must be pointed out however that there are some quite radically different ways of going about things in some parts of the receiver. A case in point is power supply circuitry.

In an all-valve receiver a simple half-wave rectifier feeding a large reservoir capacitor will suffice to provide the h.t. supply required. Simple *RC* filters can be used to smooth out the various supply lines within the set and hold them relatively steady. Any additional stabilisation necessary, for example for width/e.h.t., can be built into the stage concerned with little difficulty. When it comes to solid-state receivers however the situation is different, since transistors are much more sensitive to changes in the supply voltage. So the supplies to the transistors are generally stabilised in some way, e.g. by connecting a voltage regulator circuit between the mains rectifier and the rest of the receiver.

Consider for a moment a battery operated cassette recorder/player. Say it uses four 1·5V cells to provide a supply line of 6V. If the motor was connected to this supply directly, it would run at the correct speed only when the voltage was 6V. This means that on fitting new cells the voltage would be slightly high and the motor would run slightly fast. On the other hand as the efficiency of a cell falls, so its internal resistance rises. When this happens, an increase in sound volume with consequent increased current demand from the battery would mean that the voltage

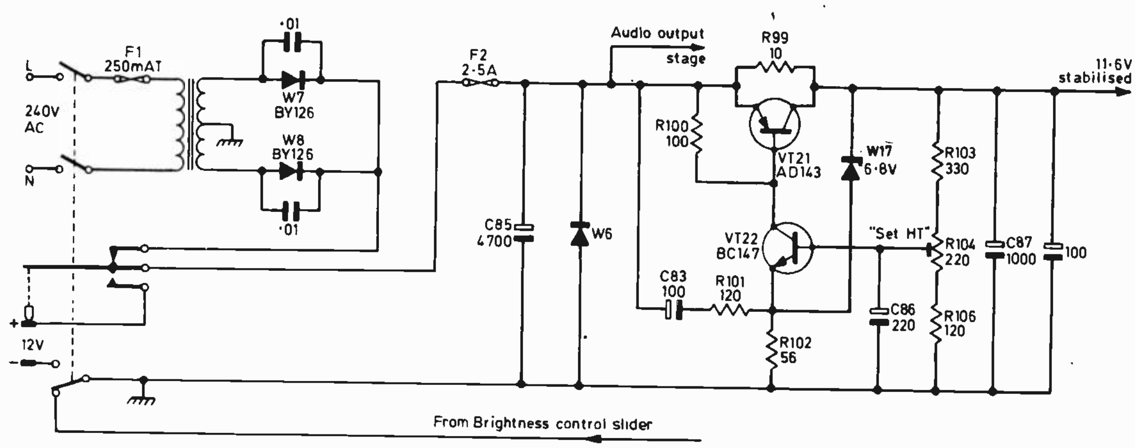



*Fig. 1: Power supply with series voltage regulator circuit. Used in the Thorn 1590/1/3 series portable chassis.*

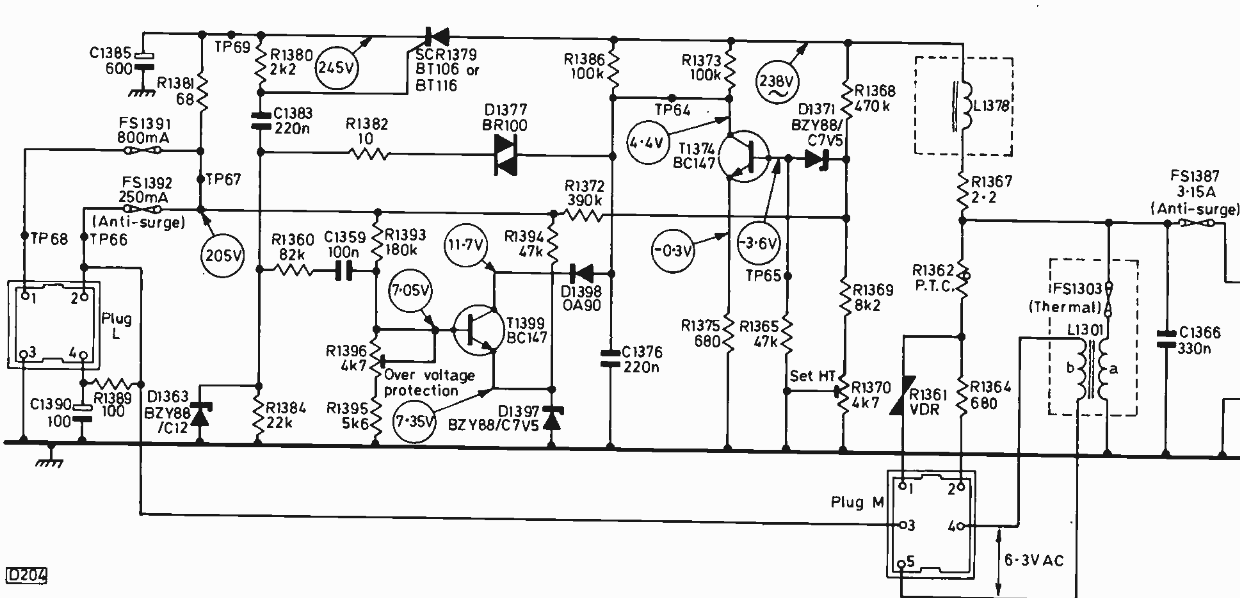



*Fig. 2: Use of a thyristor to provide voltage stabilisation. Circuit used in early versions of the Philips G8 chassis.*

applied to the motor would fall and the speed would thus vary. We can't have this sort of hanky panky of course, so we fit a motor designed to operate at say 4V and obtain this supply from a simple voltage regulator system consisting of say, a couple of transistors, one in series with the feed from the 6V source to the motor and the other to sense the supply to the motor and adjust the conduction of the series transistor so as to obtain the constant 4V supply required.

### Series Voltage Regulator Circuit

Similar arrangements are found in many TV receivers. We'll take as an example the voltage regulator circuit used in the popular Thorn 1590/1591 mains-battery solid-state portable chassis. This is shown in Fig. 1. The series regulator transistor VT21 is a pnp power transistor, an AD149 or similar type. Its base is driven by the smaller npn transistor VT22, type BC147, whose base is connected to a series resistor chain (R103/4/6) which is connected across the regulated supply. When the output voltage is at its correct figure of 11·5V, the voltage at the base of the control transistor VT22 is 5V (set by R104). Should the 11·5V regulated output voltage tend to rise, the 5V at VT22's base will also rise, thus tending to increase the current through this transistor. More important however is the fact that VT22's emitter is also biased by the regulated output, via the 6·8V zener diode W17. Since the voltage developed across a zener diode remains constant, any variations in the 11·5V stabilised supply will appear in full at VT22's emitter, across R102 (only a proportion of the variation will appear at VT22's base, due to the potential divider action of R103/4/6). Again then let's assume that there's a tendency for the regulated output voltage to rise. This rise will appear at VT22's emitter, and since this is an npn device the current flowing through it will decrease. This implies a rise in its collector voltage, which is also VT21's base voltage. Since VT21 is a pnp device, the effect will be to decrease the current flowing through it while this time the collector voltage will fall. With VT21's collector voltage falling, the initial voltage rise has been counteracted and the output stabilised.

It's worth pausing briefly to consider what happens when the set is switched on. The reservoir capacitor C85 charges, and VT21's emitter is presented with a positive voltage. If R99 wasn't there however there'd be no voltage at VT21's collector. VT22's base and emitter voltages would both be zero, so it wouldn't conduct. This would mean no current flowing through R100, so that VT21's base and emitter would also be at the same voltage – the reason for no voltage at VT21's collector, since it would be off. With R99 present however C87 will also charge on switching the set on, and the circuit will start up. R99 also serves a second purpose: in sharing the voltage drop with VT21, it reduces the dissipation in the transistor. So note that if R99 is open-circuit there'll be no results though C85 will be fully charged.

This sort of regulator circuit is commonly found in mains/battery portables, though there are a number of variations, as an article on the subject pointed out last month.

### Thyristor Power Supply Circuit

If you remember, we talked last month about the use of a silicon controlled switch as a field oscillator in some types of receiver. This sort of four-layer (pnpn) semiconductor device can also be used, though with a higher power rating of course, as a combined power supply rectifier and regulator. This is because it's essentially a one way street, thus providing rectification, while the point at which it starts to conduct is determined by the voltage applied to its gate. It can be used therefore with the mains applied directly to its anode (e.g. Philips G8 chassis or Rank A823 chassis) or preceded by a bridge rectifier (e.g. Philips 320 monochrome chassis or Pye 713 colour chassis). There are certain advantages in rectifying the mains supply with a full-wave rectifier, e.g. a bridge, before applying it to the thyristor (a pnpn power device with one gate connection). We don't need to go into these however since they don't in general affect the servicing aspect. It's worth noting though that the preceding rectifier will take some of the stress off the thyristor, which in consequence is likely to be more reliable.

Whether the thyristor is presented with the a.c. mains waveform or with the rectified mains (100Hz pulses from a full-wave rectifier circuit such as a bridge), the idea is that it's triggered on at some point during the *falling* slope of the waveform at its anode by the voltage applied to its gate. This latter voltage varies to adjust the switch on time and thus produce the regulating action. In practice the varying voltage is used to generate a pulse which switches the thyristor on at the required time.

Let's take a typical example, the circuit used in the Philips G8 chassis (early versions) shown in Fig. 2. SCR1379 is the thyristor, which is made to conduct when a positive-going pulse is applied to its gate. It then charges the reservoir capacitor C1385. We've pointed out that the thyristor is triggered on during the falling part of the waveform applied to its anode. Why? Because if the thyristor was triggered on during the rising slope of the positive-going half of the mains input waveform, C1385 would simply charge to the full mains voltage and there'd be no regulating action. SCR1379 switches off again as soon as the voltage at its anode falls below the voltage across C1385. So it's on for a brief period only, during the falling edge of the positive-going half of the mains waveform.

The trigger pulse is produced by another four-layer semiconductor device, the diac D1377. This has just two external connections, and conducts when one side is sufficiently positive with respect to the other. Since the idea is to trigger SCR1379 at the correct time, a timing circuit is required. The essential component here is the capacitor C1376, which charges via R1386 and R1373 in parallel. When the voltage across C1376 has risen sufficiently, D1377 conducts to discharge it (via R1382 and R1384), the resultant pulse (developed across R1384) being fed via C1383 to the gate of SCR1379 to switch it on.

There are two basic control systems. First the timing circuit charges from the mains, and is thus sensitive to variations in the mains supply. Secondly a sample of the h.t. voltage is returned via R1372 to the base of transistor T1374. Since this transistor is connected across C1376, it controls the charging of this capacitor.

We are not gathered here to discuss circuit niceties however, but to consider our part in putting things right when they go wrong. So what in practice goes wrong?

### Fault Finding

Let's imagine ourselves presented with a Philips G8 colour set which we are approaching for the first time. All we know is that it doesn't work at all. We plug it into the mains and remove the rear cover. We then have a look to see if anything is working after all. Are the tube heaters glowing? If they are (this is a colour set, so you want three heater glows) the set is not as dead as you thought and therefore the mains supply fuse (FS1387, Fig. 2.) must be intact in order to operate the transformer (L1301) which supplies the tube heaters. Note that in many colour sets the tube heaters are supplied from the line output transformer, so it's quite possible for the mains supply fuse to be intact although nothing can be seen with the naked eye. In the case of the G8 however, if there's no heater glow we turn our thoughts to the mains supply. With the rear cover off, the supply lead can be seen plugged into a socket on the left side main frame. With this plug off, the cover of the supply fuse can be turned back and the condition of the fuse examined. Did it die, or was it killed? If it's severely blackened, it's likely that it was killed by a something to which it connects directly or almost directly. On the reverse side of the frame is a green capacitor (C1366 0·33μF) which is connected directly across the mains, after the fuse, and has the job of absorbing spiky transients in the mains supply. Whilst these spikes may be of very short duration, they can nevertheless peak up to a very high potential and could thus damage items in the power supply circuit if allowed through. The mains filter capacitor C1366 leads a hard life therefore, and is a primary suspect. Before condemning this possibly innocent little fellow however we must make other checks. The first of these should be on the thyristor itself, which in this chassis has no series diode to protect it.

In order to check it, we must first find it. The power panel is on the upper part of the left side frame, and the thyristor is more or less in the centre of the panel. Most often a BT106 will be found, with its metal body and two legs sticking up, one longer than the other. The long one is the cathode, from which the h.t. is taken, the shorter one is the gate, and the body the anode which connects to the mains supply fuse via a choke (L1378) and the lower part of the long black wirewound resistor on the front end (2·2Ω, R1367, and we'll come back to this later).

A meter switched to the low ohms range should show no deflection when the prods are applied to the body and the long leg (cathode). If a reading is obtained, disconnect the red lead from the cathode and check again. If there's still a reading the thyristor is at fault and must be replaced. A new thyristor and a new fuse should restore normal working, provided the 2·2Ω wirewound resistor R1367 has survived the ordeal (which it usually does).

Now we must have a few words about the thyristor before moving on. A BT106 thyristor may be bolted direct to the print, it may be found on a heatsink, or it may be wearing a hat as a heatsink. On the other hand the thyristor may be of a different type, and may look more like a conventional power transistor with a flat body and three legs in a row. Whatever its guise, it's still a thyristor with the anode connection still brought out to a metal surface on the body and connected to the centre leg. This in turn may be bolted flat to a heatsink or may stand up with nothing more than a thick washer bolted to the body to dissipate the heat it generates. The recommended replacement for this type is the OT112.

If there's a short from the anode to the cathode, this will be the reason for the mains fuse shattering, as the raw a.c. will then have been applied almost direct to the 600μF electrolytic C1385 which has no defence against a current which is changing its polarity almost as fast as a woman changes her mind.

### Over-Voltage Protection

Now ponder this for just a moment. What we've just described is in fact not a bad state of affairs. The thyristor shorts, and bang goes the mains fuse. Thus the rest of the circuitry is protected, and no great expense is involved in putting things right. All nice and obvious, with no real mystery. Suppose however that for some reason, say a fault in the control circuit, the thyristor is turned on early. No fuse blowing of course, but unless excess voltage protection is incorporated we may be put to a good deal more trouble and expense. T1399 and its associated circuitry provide over-voltage protection in the G8 chassis, tripping to give an unmistakable picture flutter if the h.t. voltage tries to rise excessively. In other sets, for example the Rank A823 chassis, the protection is incorporated in the line timebase: excess voltage leads to the line timebase shutting down and with no e.h.t. there's no raster. When the protection circuit comes into operation, we're still left with the job of finding out why it's doing so – having first established that this is in fact what's happening (easy in the G8, because of the flutter, not as simple when what you're confronted with is a blank screen). So you see, life can get complicated, and you have to know the power supply and protection arrangements used in a particular chassis before you can start on the fault finding procedure.

### Faulty Filter Capacitor

Let's stay with simplicity a while longer however. If the mains fuse is shattered and the thyristor is not short-circuit, it's prudent to cast a suspicious eye on the mains filter capacitor C1366 after all. Unfortunately things aren't always as simple as one might wish. You might find that on checking C1366 no short can be found and that fitting a new fuse restores the set to normal operation – until, that is, the next time there's a sudden mains peak which causes the capacitor to break down. If in any doubt about the capacitor, replace it, observing that it's a special type designed to cope (though it doesn't always) with the spiky transients on the domestic mains supply.

### Picture Jitter

We must not however be misled into thinking that faults on the power supply panel merely result in the failure of a fuse or two from time to time.

A slightly leaky thyristor for example will not cause the same effects as a directly shorted one. The result could be impaired regulation, with consequent rapid variation of the supply line voltage. This will not be obvious on a voltmeter check, which incidentally should show 205V at either of the two fuses on the rear edge of the panel. The effect on the picture however is, or could be, misleading. There will be a high speed flutter, which appears to be in the vertical direction more than the horizontal. This tends to lead the unwary into believing that the fault can be confined to the field timebase. Which of course takes us back to last month when we said that although a faulty SCS in the field timebase can cause high speed jitter, the fault will far more often be found in the power supply. So here we are: the thyristor in the power supply may indeed be responsible, but there's another possibility. It could be that the thyristor is being triggered wrongly by the BR100 diac (D1377). These little devices, which look very much like a small diode, are quite cheap. So if there's any doubt, don't be mean: replace the diac as well as the thyristor.

### Tracing an Open-Circuit

Well now. Let's say that the set appears to be dead but that the tube heaters are glowing. This means that the supply fuse must be intact, and we must tip toe about a bit because there is probably some high voltage lurking around waiting to bite you. Here you need an a.c. voltmeter reading 300V or over, or your little neon which glows when excited. Assuming that you're using the latter, carefully check the bottom tag of the large wirewound resistor on the front left side, connecting directly to the supply fuse. It must light if there's a connection. Having assured ourselves on this point, does the neon light when applied to the other end of this section, i.e. the next tag up? If it does, the 2·2Ω element R1367 is intact and a.c. is in fact being applied to the thyristor anode (in practice we would not have been so methodical: we would have checked immediately at the body or anode of the thyristor, so proving the a.c. supply through the 2·2Ω resistor in one go). If there's no glow or no 240V a.c. at the thyristor the 2·2Ω resistor is almost certainly open-circuit, isn't it? (yes). Right now.

We must take a little care however if there's full supply at the thyristor anode, because there may also be full d.c. at the cathode. This means that it will also be present at the third tag up of the large wirewound resistor or dropper if you prefer to call it that. This also implies that the 600μF electrolytic reservoir capacitor C1385 is fully charged to the same voltage (some 300V or more). We next move therefore to the top tag, where we may well find that there's no glow (or only a faint one) or d.c. voltage reading.

If this is so and the 68Ω section (R1381) is open-circuit (as it often is) do beware of the live tag etc. When the set is switched off, it will still retain a considerable potential as the 600μF capacitor is fully charged and with R1381 open-circuit the charge has nowhere to go. 600μF charged to over 300V is no joke, and must be discharged via a resistor in order to prevent damage. The obvious thing to do is to connect a resistor across the defective one, the value not being very important if the object is simply to discharge the capacitor. Once the thing is rendered safe, the dropper can be replaced or the defective section bridged by robust wirewounds to total 66-70Ω at 20W. The latter course should be only a temporary expedient, and the whole dropper should be replaced as soon as possible. This is to preserve appearances and to proclaim that there will be no slipping of standards in our neck of the woods. Making do is necessary at times, but can be the start along the slippery slope downwards to untidy and possibly dangerous standards of workmanship.

### Reservoir Capacitor Faults

Before we leave the G8 power unit, we should revert again to the 600μF electrolytic capacitor. Once in a while it will be found responsible for mains fuse shattering (when it shorts). It's far more likely to deteriorate however, the end bulging out and issuing goo, losing capacitance in the process. One should cast an eye in its direction therefore when carrying out routine service. The whole panel can be lifted out by slackening the one top and two bottom screws, so there's no access problem.

### The Smaller Capacitors

A key item not stressed so far in the exposé is the 0·22μF capacitor C1383 which couples the diac to the thyristor's gate. It escapes attention because it rarely gives trouble. It can however become open-circuit on its own account, or a connection can be dry-jointed. In the former case it can't function at all. The thyristor won't be switched on therefore, resulting in the almost dead set we chatted about earlier. In the latter case the connection could make intermittent contact, and we then have the classic symptom of "we have to bash the set to make it come on". This is an item to bear in mind therefore.

Another capacitor that occasionally gives trouble in some chassis is the timing capacitor (C1376 here). When it goes short-circuit, you again have the almost dead set symptom.

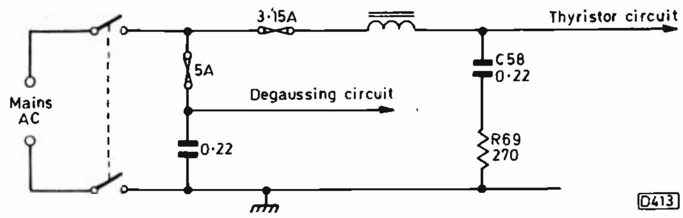



*Fig. 3: Mains input circuit used in the GEC C2110 series chassis. The filter network C58/R69 was added to later versions to provide extra protection for the thyristor.*

### Some Other Thyristor Circuits

The G8 circuit is representative of thyristor regulated power supply circuit designs. For example, the circuit used in the GEC 2110 series chassis works in exactly the same way, and most of our remarks also apply to this therefore. The original Bush/Murphy solid-state colour chassis (A823 on) was very similar, but used a thermistor (VA1104) of the disc type in series with the a.c. supply to the thyristor's anode in place of the low-value (2·2Ω) wirewound resistor. The casualty rate of this item is very high, and is usually the reason for the receiver not functioning if the c.r.t. heaters are glowing and the l.t. supplies are present. One does not have to look far. It's low down and in the centre of the left side power panel. The body disc may have simply dropped out, leaving the two arms sticking up forlornly searching for their lost love. One side on the other hand may still be attached securely, but with the other making only a sparkling effort as it were . . .

As far as the GEC chassis is concerned, although the circuit looks the same on paper it appears differently in the flesh, the thyristor control panel being a fairly small item on the lower centre. The 3·15A anti-surge mains fuse is at the top left, and the heat dissipating wirewounds lead off to the right. Whilst earlier versions used one 0·22μF mains filter capacitor, later models employ a second filter for added thyristor protection. This consists (see Fig. 3.) of an 0·22μF capacitor in series with a $\frac{1}{2}$W 270Ω resistor. These are also on the top left; the resistor on a small tag panel. The sad result is that when the capacitor shorts, the fuse doesn't immediately fail. The resistor cooks up, and can ignite the small panel. This can in turn scorch the woodwork, with consequent hysteria from one or more members of the family.

Why not leave the resistor out? Well, if you leave the resistor out the net effect may be a nice horizontal line travelling over the picture vertically. You have to leave this filter out therefore until you find a 270Ω resistor or one of the nearest preferred value (say 300Ω). Do not use a higher rating than $\frac{1}{2}$W, as a larger resistor will take just that little bit longer to burn out if the capacitor shorts.

Finally, a component value change that's been made in all these three chassis. We saw that the diac discharges the timing capacitor via a resistive path. The chassis connected-resistor has in each case been reduced in value. In the G8, it's R1384, reduced from 22kΩ to 4·7kΩ; in the C2110 it's R705, reduced from 12kΩ to 6·8kΩ; in the A823 it's 8R13, reduced from 22kΩ to 1kΩ. In the latter case especially, making this change helps when dealing with the problem of picture jitter.

# Vintage TV

*Ian Sinclair*

FACED as we are today with so many developments, design changes and modifications, there is something rather restful about looking at the circuits of vintage TV sets. The Murphy Model V200 appeared in the Festival of Britain year of 1951 and is a good early example – I recently came across my old handbook on it. So all aboard for a bit of nostalgia.

The first impression given by the circuit is of simplicity. The receiver was supplied for single-channel use, so no channel selector was needed, while the complement of 17 valves and a c.r.t., though large by mains radio standards, was modest compared to the US receivers of the same era. The power consumption was 195W, and the cabinet dimensions for the 12in. tube were 19in. wide by 21in. deep (no 110° tubes in these days) by 17in. high. The awkward problem of the owner who moved house to a district served by a different transmitter was dealt with by replacing the preset r.f. unit with one tuned to a different channel.

We complain about frequent innovations nowadays, but it seems likely that changes came as thick and fast then – judging anyway by the different circuits available for the V200 series. The version described in my handbook is a.c. only, but only because a heater transformer was used for the c.r.t. All the other heaters were supplied by a conventional a.c./d.c. type heater chain. The c.r.t. heater transformer was supplied from the 200V tapping on the heater mains dropper resistor chain.

A metal rectifier was used (the only semiconductor device in the circuit) to provide the h.t., with a reservoir capacitor of the modest value of 100$\mu$F. This was followed however by another stage of smoothing using a choke and a 200$\mu$F capacitor. The smoothed h.t. voltage was 224V under no-signal conditions. A reminder of the times is that a 500$\Omega$/V meter was specified for measurements. There was no PCB of course, the components being strung between valveholder tags or on separate tagboards. The circuit diagram showed tag numbers, a considerable aid for the serviceman.

Looking at the front end, the tuner section featured two r.f. amplifier stages, each double tuned. This was possible only because of the single-channel working. 10F1 pentodes were used, with both preset and variable r.f. gain controls. The frequency changer was a triode-heptode, a type of valve which was seldom to be used in production again. The i.f. frequencies were 13·25MHz vision, 9·75MHz sound.

Two vision i.f. stages were used, both 10F1 pentodes. The i.f. transformers were slightly unusual with what appears to be an additional coupling coil wound in series with the primary. An elaborate (for the time) system of traps was used – two for the selected sound channel, and one for the adjacent sound channel. A single sound i.f. stage was used – another 10F1. There was no a.g.c., so aircraft flutter must have been a pressing problem for some users at least.

The video detector and output stages were delightfully primitive (see Fig. 1). One half of a double diode valve acted as the detector, its cathode feeding the grid of the video output valve (another 10F1) through the frequency-peaking inductor L18. Further response correction was provided in the video amplifier's cathode circuit, by using a series *CR* circuit (C29, R39) in parallel with the bias resistor R37. This peaking started rather low down, at around 0·5MHz, which gives us some idea of the struggle for video bandwidth in those days. Much of the struggle was due to the relatively high value of anode load resistor used (R36, 10k$\Omega$), with no inductive compensation. The anode circuit drove the c.r.t. cathode directly, with a limiter circuit in parallel.

As old hands will remember, the limiter clipped interference peaks from the video signal in the days when interference pulses produced white, defocused blodges on the picture. Capacitor C26 was connected to the anode of V6b (the other half of the vision detector double diode) and acted as a reservoir, since the diode would conduct briefly on negative-going picture signal peaks (peak white). The time-constant of this system was set by C26, R32, potentiometer R33 setting the voltage to which the capacitor would return under no-signal conditions. On a negative-going interference pulse the diode would conduct and the capacitor would short the brief pulse to earth. Because of the time-constant, the brief interference pulses would not charge the capacitor noticeably. The potentiometer R33 was usually set so that the picture was just giving white peaks. Oddly enough, limiting techniques like this look like making a comeback – for f.m. car radios of all things.

The sound circuits were even simpler. The final sound i.f. transformer fed one half of another double diode, the other half being used as a series limiter. The output from this stage fed the volume control, which was directly coupled to the grid of the output valve (see Fig. 2). An ingenious economy was the use of this valve to feed the focus coil. The audio signal was smoothed by C53, and the steady bias current of V10 (a 10P14 beam tetrode), controlled by R71 in its cathode circuit, was used as the focus current in L23.

Timebases were still rather experimental in those days, and the use of an overwind on the line output transformer was still something of an innovation in the days when many receivers still used a massive 50Hz e.h.t. transformer with valve rectifiers. Great attention was paid to synchronisation in this design. The video output stage fed a sync separator valve, which then fed a further line sync amplifier valve, with two gain settings to cope with local or distant use.

The line oscillator and output stages were novel (see Fig. 3), using a PL38 output valve and a line output transformer which was connected in series with the oscillator transformer. The latter fed the grid of the triode that formed the other half of the oscillator. The efficiency diode produced a –46V supply for the cathode of the PL38, thus increasing the effective h.t. supply to the line output stage.

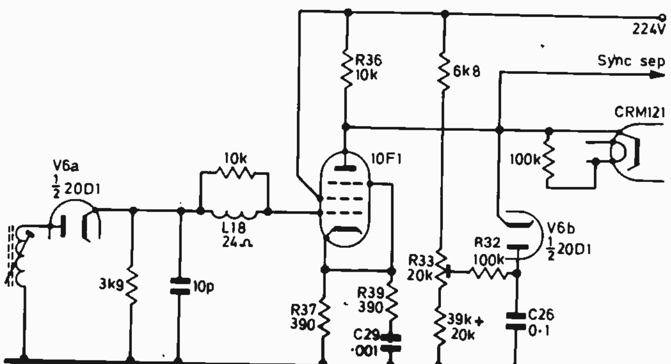



*Fig. 1: The simple video circuitry.*

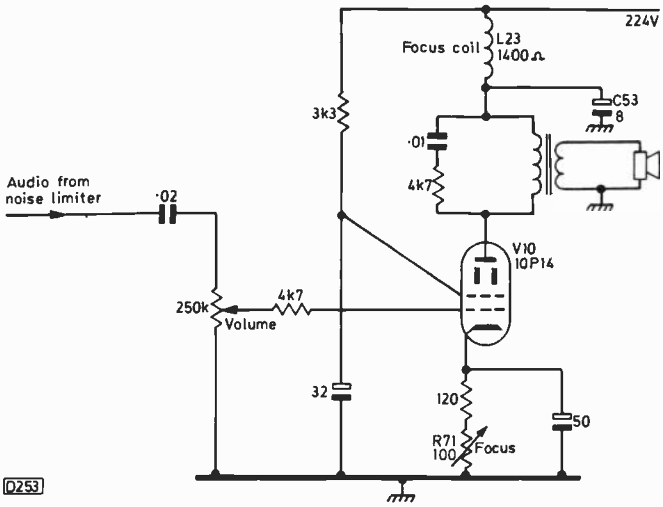



*Fig. 2: The sound output stage also provided the current for the focus coil.*

The reason for adopting this arrangement was that heater-cathode insulation was not too good in those days, this also being the reason for using a heater transformer for the c.r.t.

The field timebase started with another sync pulse amplifier triode, which was biased back. There was no field sync pulse integrating circuit. Another triode (the other half of a double triode) was used as a blocking oscillator, with the usual hold control. This was coupled to the 10P14 field output valve, an additional feedback winding on the field output transformer being used to provide linearity correction.

Of the remaining circuitry, an interesting point is the use of a v.d.r. as a stabiliser for the 7·8kV e.h.t. supply. The only potentiometer controlling the tube was the brilliance control, which operated on the grid.

And that was it! The chassis was built around the c.r.t. in the shape of a cross-braced circle, with components at all sorts of angles and lots of 2BA bolts. We thought it a wonder of complexity then – I had just seen TV for the first time, thanks to the construction of the Kirk o' Shotts transmitter, and was thankful for a strong signal reaching my homemade t.r.f. receiver (remember the EF50?). Perhaps I'll hang on to the manual for the G11 Philips colour chassis, with a view to an article in the year 2005. . .

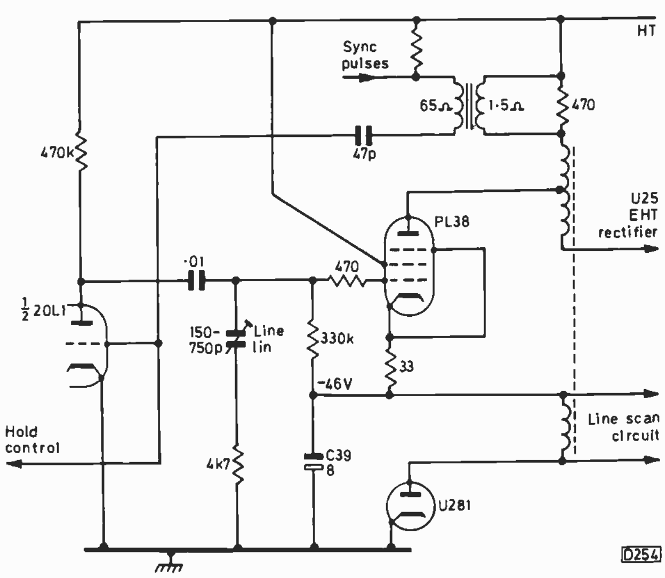



*Fig. 3: Simplified circuit of the unusual line oscillator and output stage, with its –46V boost rail.*

# Daymares

**Les Lawry-Johns**

NICE chap he was. Not at all the type who would string you a line. So when he brought in his ITT CVC5 for repair and said the picture was narrow and bright we just jotted this down on the job sheet and suggested he called in the following day. When its turn came to be placed on the operating table, we switched it on and allowed it to warm up. Sound OK; narrow, bright, defocused raster with barely a glimpse of modulation on it. Where to start? Lack of width. Right.

### Timebase Troubles

We didn't really suspect valves but, just to be sure, we put in a new PL509 and PY500. Result, no line output at all, with the valves overheating. Queer. Put original valves back in. Still overheating. Very queer. Check, check and check. Finally find we had put the top cap leads on wrong. They should cross over. Idiot. Try new valves again. No better.

Check line drive. High. Check values of width circuit resistors. R411 (560kΩ) very high. Ah, ha!

Fit new 560kΩ resistor. No different. Remember past experience and check R403 which turns out to be OK. Boost line voltage high.

Let's have another look at whatever picture there is. Can't really see much. Switch off green and blue guns, leaving just red. Some sort of picture could now be seen, just.

This showed that the line timebase was running at the wrong speed, although this was very difficult to see as the field was rolling like mad. Resetting the field hold control slowed the roll and then sent it tumbling the other way. Careful setting left it rotating slowly and also showed that a dark hum bar was travelling slowly upwards (our troubles were multiplying by the minute). The hum bar and rolling were put aside mentally as minor things, the multiple line images looming larger.

It was reasonable after the checks so far to assume that the lack of width was the result of grossly incorrect line speed. Since we'd had a similar tussle with a single-standard Bush receiver the previous day, checking all the usual things (capacitors etc.) and finally finding the flywheel line sync discriminator diodes way out of balance, our first onslaught was on these. They were perfect of course. Having tried a new PCF802, we next changed the polystyrene capacitors in the line oscillator circuit. No luck here.

At this point we noticed a tiny piece of white wool sticking out of the oscillator coil. The core turned out to be stuck fast, and it was evident that it had received attention. It was also evident that it would have to be drilled out.

At this point we started to get a little irritated, since there had been no suggestion that the set had received previous and unsuccessful attention. We would definitely have to have words with Mr. Fieldhouse upon his return.

We decided to press on however. Now the proper way to drill out a core in one of these angled chassis jobs is to remove the coil completely and put it in a vice. Being impatient types we did no such thing. Taking the angle into consideration, we first attempted to put through a pilot hole with a small drill. The angle was wrong of course, and when the drill came out it had little bits of copper on it to announce the fact that we had ruined the coil which would have to come out anyway. We just happened to have a replacement coil, so out came the damaged one and in went the replacement. The core of the old coil was the wrong type anyway, being much too short to tune down to 15kHz. Someone really had had a go Mr. Fieldhouse.

With the new coil and the right core, no adjustment was necessary. The rolling red picture had a single image of full width, but of course still with the hum bar. Switching on the blue and green guns showed terrible convergence – and no sign of a colour signal. To boot the picture, such as it was, was very noisy, which could account for the lack of colour signal. Hope springs eternal in the human breast. At this point we decided to consult Mr. Fieldhouse.

"No" said Mr. Fieldhouse. "No one has been at it since it was last repaired a couple of years ago, but I must admit the colour has been funny and we have had that bar going up the picture."

"Sorry Mr. Fieldhouse, but the set could not have worked since the last time someone had a dabble."

Mr. Fieldhouse looked puzzled. "Well we've been away for nine months, but it definitely worked when we left."

Then comprehension dawned. "Can I use your phone?"

He rang a number and the conversation got heated. He rang off and turned to me.

"Sorry old chap" he said. "You're quite right, someone has been at it while we've been away and my relatives know more than they're letting on."

Having cleared up that point, it was a matter of whether I could do it, how long it would take and how much. I didn't relish the job, but we decided to press on.

Rolling responded to a new PCL805, with a check on the interlace diode and the sync separator circuit. The hum bar was banished by fitting a new l.t. bridge rectifier, and the nearby fuse was replaced because it was bridged by a length of fuse wire and dobs of solder. The line output stage supply fuse was also too heavy, which explained why it didn't fail when we got the leads mixed up.

The convergence and grey scale were painstakingly brought into line, and the grainy picture responded to a.g.c. setting up.

### And a Got at Decoder

Faint colour bars were seen running through what was now a reasonable black and white picture, and it was noticed that the subcarrier oscillator preset R311 on the edge of the panel was actually touching the metalwork. It was moved and adjusted. The bars now resolved into a cyan picture, with no red in sight. Voltage checks next revealed that the bistable (see Fig. 1) was inoperative, one transistor being hard on, with practically no collector voltage, while the other was turned off.

Some time was spent looking for an explanation for this. Then the phone rang and the high priest of *Television* himself enquired about our health and about an article recently submitted. I poured out my heart to this kindly (occasionally – *editor*) soul who listened for a while and then said:

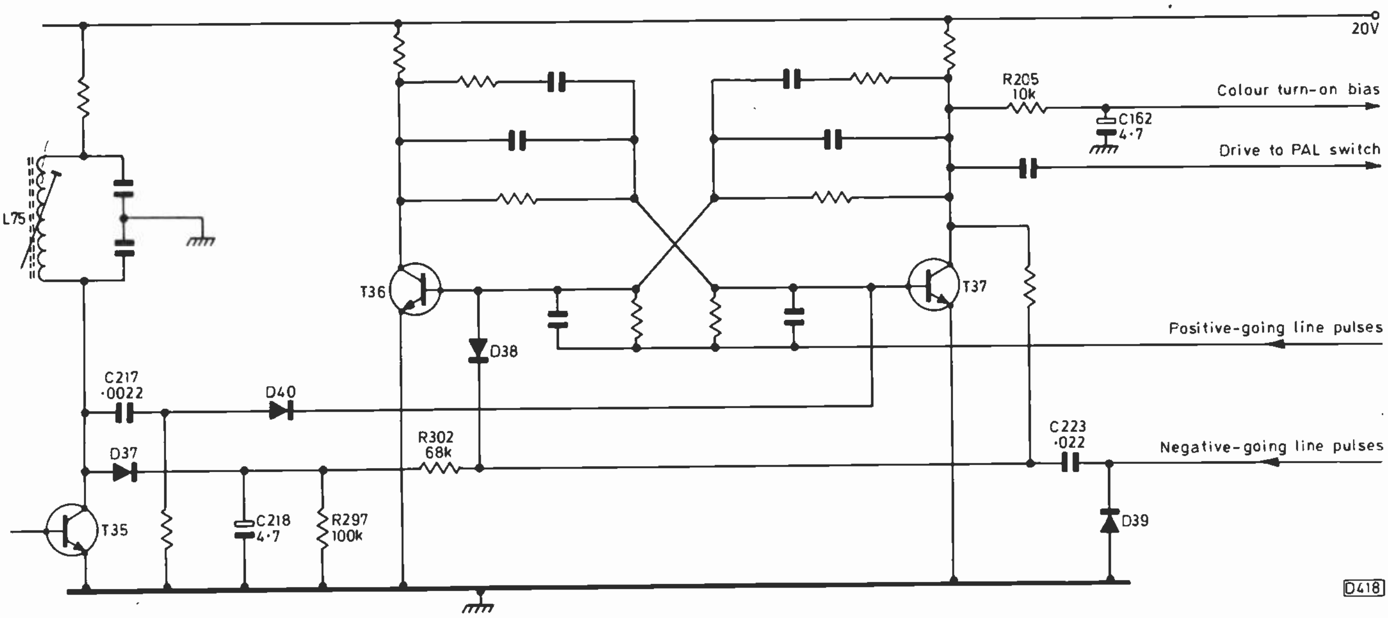



*Fig. 1: The ident amplifier (T35), bistable (T36/37) and colour-killer arrangements in the ITT CVC5 chassis. On colour, the squarewave produced at the collector of T37 is smoothed by R205/C162 and used as a turn-on bias for the delay line driver transistor in the chrominance channel, with the positive-going line pulses triggering the bistable. This means that on monochrome the bistable circuit has to be stopped. This is done by applying negative-going line pulses, clipped by D39, to the base of T36 via C223 and D38 to ensure that it remains cut-off. T37 will then be permanently on, and there'll be no colour turn-on bias. On colour, D37 rectifies the ident signal produced by L75, and the positive bias developed across its reservoir capacitor C218 cuts D38 off so that the negative-going pulses no longer reach T36's base. D40 provides the ident action on colour to ensure that T36/7 switch in synchronism with the V signal line-by-line polarity inversions.*

"But there shouldn't be any colour at all on the CVC5 if the bistable isn't working. You must have ditched the colour killer." I hadn't.

He then suggested that all I had to do was to unditch the killer and find out why the bistable wasn't switching. All the agony would then be over.

I thanked him humbly and rang off. Just who does he think he is? "All I had to do" was find out why the bistable wasn't working . . . Suppose I'd better do as he says . . . .

Examining the panel on the print side, I found a nice little 12kΩ resistor wired from the 20V l.t. line to the junction of R204, R205 (TP18), thus over-riding the colour-killer . . . Someone had left it in, having failed to sort out the bistable.

Mr. Fieldhouse had said that "the colour had been funny". He wasn't kidding. So we removed the 12kΩ resistor and sure enough the green faces became white. We next found that there was no 7·8kHz output at the collector of the ident transistor T35. At that moment the whole horrible truth burst upon me. There was another tuft of white wool, this time just protruding from the ident coil (L75). Oh no, not again. Investigating the core showed that it could be easily moved, but that it was nowhere near long enough to tune the coil to half line frequency. Wearily we sorted out the right type of core and screwed it in. The bistable started flip-flopping, and lots of lovely colour flooded the screen, the right ones at that. A final trim up was all that was left to do.

Mr. Fieldhouse called and declared he'd never seen such lovely colours since he'd had the set. He also confided that he'd found out who'd had a go.

## *Woodman Spare that Tree*

Now you're not going to believe this but, on a stack of bibles, it's true so help me. Mr. Wood is a regular customer and is a very nice jovial sort of man, which is just as well since he appears to be a very strong fellow indeed. You should see the way he carries his old Philips G6 (26in.) solid teak monster from his Range Rover into the shop, and then lifts it on to the bench as though it were a portable, laughing like mad at the thought of the money it is going to cost him for its repair. They don't come like him very often. By profession he's a woodsman, or tree surgeon, and a very good one at that.

His set doesn't really come into this, but in fact it took a little while to knock into shape. The complaint was "no picture" which we confidently thought would turn out to be an inoperative line output stage. With the top cage off the line output section, we waited for the thing to warm up. A neon waved near the PL509 glowed healthily enough.

"Is there a tingle when you put the back of your hand on the screen Mr. Wood?" we enquired.

"No, not a sign" said Mr. Wood.

Now I know what you're thinking. These names he keeps on drumming up: surely he could do better than this? I'll have you know that his name is definitely Wood however, so there, and just to brighten your day a little more I'll also acquaint you with the fact that our butcher's name is Reg Butcher, while the name over the baker's shop down the road is Baker.

Now. Ah yes, no e.h.t., line output OK.

Take cover off to reveal the PD500 shunt stabiliser and GY501 e.h.t. rectifier valves, and risk instant sterilisation by X rays . . . There was plenty of life at the bottom, er, top cap (it's mounted upside down, as you know) of the GY501, i.e. the output of the transformer, but little else. No visible heater glow. The PD500 looked OK, but there was no life on its glass. Open-circuit GY501 heater? Slacken screws and lift PD500 (set off, of course); free off plastic shroud and remove. Lift out GY501. Check heater. OK. Check continuity of heater winding. OK. Check continuity of resistive element on valve base. Open-circuit. Should be 2·7Ω. Remove resistor and fit replacement. Reassemble while listening to the fascinating story being related by Mr. Wood. E.h.t. now OK. Nice picture. Tweek up convergence and set up grey scale. Set wrapped up. Now to the story.

A certain gentleman had some land that verged on a fairly well used road. On his land was a large elm tree which had escaped disease. A large bough overhung the road however, and the local council decreed that it must be removed. Mr. Wood had been called in to advise and estimate. This he did.

The estimate did not please the gentleman, who said he could do the job himself – with the help of his wife.

With stout ropes to lift and guide the bough, a long rope was passed up through a pulley and back down and tied to the back of a vehicle. His wife was entrusted to keep the rope taut with the vehicle in first gear and pulling. Told to move forward when instructed. You see?

So there was hubby up the tree sawing away at the hefty bough. "Stand by." "Right." "Take the strain." "OK." "Here she goes." "Right."

Crack went the bough. The vehicle strained forward.

Then down came the bough and up in the air went the Mini.

### *Return of Mr. Doubleday*

I was busy trying hard to understand a little book which a young boy had left on the counter, called "How Transistors Work", and had almost got to the third page when an estate car drew up outside. Oh dear, it was Mr. Doubleday from Bluebell Hill, Hill.

"It's gone again, again" he moaned. "I swear it spends more time in your shop than it does in my house house."

My heart sank and I offered him £10 to take it away as it had cost me twice that in transistors the last time.

"No" he said. "I'll have it done once more and then out it goes goes."

"But it costs me more than it does you" I protested.

"Just this last time."

So off he went and I got down to the 8500 Thorn again again.

The cut out was cutting out (it gets you, this repetitive business).

Lifting the line output transistor's collector lead from the transformer stopped the cutting out, so we were back to the old routine again. Checking the transistor (BDX32) confirmed that it was in no fit state to operate, with an emitter to collector leak. All the feeds were checked, and to be on the safe side a new e.h.t. unit was hooked up.

Switch on. For a second all was well, then there was a nasty flashover from the e.h.t. connector to earth. The cut out opened and another BDX32 bit the dust.

The one thing I hadn't done was to clean off round the e.h.t. connector on the tube. Now this I'd done most thoroughly quite recently, which I suppose was a partial excuse.

Re-examining the connector of the e.h.t. unit previously in the set showed that the "claws" were rusted to the point where they just broke off when touched. But the thing hadn't been in all that long. The bitter truth now dawned. Even the connections to the recently fitted focus unit were green. What sort of conditions had the set been living in?

In the event we fitted another BDX32, another e.h.t. connector, thoroughly cleaned off the tube area with silicone and polished up the focus connections. The set then functioned quite well.

Mention has been made in past *Televisions* about the adverse conditions many sets operate in or are expected to operate in. Kitchens are obviously not the ideal place. Many people leave a paraffin stove working all day however, and these give out as much water as the oil they consume.

When Mr. Doubleday returned we laid it on the line for him in no uncertain terms. It transpired that he was out all day, and used the set for only a few minutes in the evening. All the rest of the time the set was gathering all the dampness it could from a paraffin heater. These bachelors!

# Your PROBLEMS solved

***Requests for advice in dealing with servicing problems must be accompanied by a 50p postal order (made out to IPC Magazines Ltd.), the query coupon from page 161 and a stamped addressed envelope. We can deal with only one query at a time. We regret that we cannot supply service sheets nor answer queries over the telephone.***

## *PYE 731 CHASSIS*

**The set worked normally but the next time it was switched on the picture was very poor – grainy with wavy verticles. The picture improved slightly when the a.f.c. was switched off, but is still not good. The sound is not affected.**

The usual cause of this trouble is a dry-joint somewhere in the selectivity/gain module, particularly around the printed coils. There are griplets where the printed coils are connected through the board: these tend to become loose with time.

## *RANK A823 CHASSIS*

**The trouble is loss of field hold whenever there's a band of white at the bottom of the picture, i.e. when the last few lines of each field are at peak white. The vertical hold is perfectly stable at all other times. Adjusting the field hold control produces no improvement, and the fault is still present after fitting a new scan drive panel (which includes the sync separator circuitry).**

It's likely that the field sync pulses are being crushed or distorted at an earlier stage in the set. This could be due to a fault in the a.g.c., i.f., or video circuits. We suggest you check the setting of the gain control 2RV2, the a.g.c. reservoir capacitor 2C71 (10$\mu$F), the a.g.c. detector diode 2D3 and 2C35 (4·7$\mu$F) which smoothes the bias at the base of the luminance emitter-follower 2VT5.

## *THORN 8000 CHASSIS*

**The trouble started with loss of colour lock on changing channels, the colours turning to ¾in. wide horizontal bars across the screen, at reduced saturation. This would last for a few minutes, then correct colour would return and remain provided the set was not disturbed. More recently however the loss of colour lock has started to appear with a scene change, e.g. from programme to an advert, only switching the set off and on again restoring colour. Adjustment of the reference oscillator frequency control R163 has been tried, but this doesn't seem to make much difference.**

It's strange that R163 has little effect: it normally has a profound effect on the reference oscillator frequency, setting as it does the bias applied to the source of the f.e.t. d.c. amplifier transistor VT110 in the reference oscillator control loop. Confirm that the voltage (nominally 9V) at VT110's drain varies as R163 is adjusted. If not, suspect VT110 or the burst detector diodes W106/7 which must be of the correct type (1S44 or ITT44). If the voltage at VT110's drain does vary, suspect leakage in the control voltage smoothing capacitor C155 (0·01$\mu$F), or the varicap diode W108.

## *RANK A774 CHASSIS*

**When the set's been on for several hours both the sound and vision black out. Normal results are usually restored after some seconds, and the fault may occur many times while the set is on. The c.r.t. and valve heaters remain alight when the fault is present. Trying to check the cause of the loss of h.t. with the back off is tricky however, since the fault then doesn't occur.**

The most likely cause of the trouble is that the 6·2Ω surge limiter resistor 3R77 is becoming intermittently open-circuit when hot. Wire a 10Ω section (or similar value) across it to see whether this stops the trouble. If it does, remove 3R77 and wire in the replacement permanently. Check also for cracked printed tracks to and from the h.t. rectifier 3D11.

## *BAIRD 700 CHASSIS*

**The trouble is that the screen has gone green. If the green gun output is reduced, the other colours can be seen but the background is still green. The reference oscillator circuit has been thoroughly checked, including the varicap diode and all small-value capacitors.**

Concentrate on the small preset controls at the top of the decoder panel. These often fail with age. Check also the R – Y/B – Y clamp valve V9 (EB91), and the printed board in this area for dry-joints or cracks. Comparing the electrode voltages on the three c.r.t. guns should lead you to the source of the trouble. There could be a grid-cathode leak in the c.r.t.'s green gun, but this is not so likely.

## *SABA CHASSIS H*

**The main problem with this set is that the top and bottom quarters of the picture move up and down. Usually a line appears at the top and bottom when the picture contracts. All the controls in the field timebase and the NS raster correction circuitry have been replaced without altering the situation. Other problems are rather critical line hold control setting, with only half the picture locking correctly; slightly excessive width with the width control L677 having little range of adjustment; and occasionally the picture appears as if the signal is weak.**

The first fault is very often caused by arcing within the preset controls P723 and P724, the top and bottom correction controls in the NS raster distortion correction circuit. Since you say that all relevant controls have been changed however, we suggest you check the field output transistors. When the sets are assembled, the legs of these transistors (T726 and T728) are bent at right angles to their bodies: this results in a weakening of the connections within the device, and this can lead to field twitching as described. Critical line lock is usually caused by the TBA920 sync separator/line generator i.c. (IS641). It often breaks down after the set has warmed up, causing complete loss of line sync. The width should be set by adjusting the set e.h.t. control P672 for 76V at test point U5. The width should then be correct. Intermittently weak, snowy reception is generally due to a defect in the tuner, though an a.g.c. fault could give rise to this trouble. We've never known the TBA500, which produces the a.g.c. voltage, to be responsible for gain troubles however. Before condemning the tuner, check the a.g.c. voltage at pin 9 of the tuner: if all is well with the TBA500, this should lie between 5·5-8V depending on the strength of the incoming signal.

## PHILIPS 210/230 CHASSIS

**There was a crackling sound, during which the picture reduced to a single, vertical white line down the centre of the screen. When the crackling ceased, the picture returned to normal. This happened on several occasions, then seemed to clear up. Some months later a picture of universal greyness without any clear definition or contrast appeared on switching on, though it returned to normal after a while. Soon afterwards however the set again crackled and the picture was reduced to a vertical band about threequarters of an inch wide. It then faded out completely.**

The first item to check is the 1kΩ line linearity coil damping resistor which is slung near one of the line output transformer windings. If it's too near, arcing will occur and the line scan will be lost. On the other hand the line output transformer itself could be at fault, with a short between windings. The grey picture could be due to the PFL200 video output valve or an associated feed component, or could perhaps be in the preceding transistor stage if the voltages in the output stage are found to be correct when the fault is present.

## DECCA SERIES 10 CHASSIS

**This set gave good service for several years, but has started to give trouble. The first problem was striations, due to the line linearity coil's damping resistor going open-circuit. Then the width decreased, which was cured by fitting a new PL509 line output valve. The next problem that developed was a severe, uniform vertical ripple all over the screen, the effect disappearing if either the contrast or the brightness setting is reduced or the width increased. The fault takes about half an hour to develop. The width seems to be excessive, full scan still being obtained when the width control is at minimum. The tripler and line output stage valves have been replaced, and R452 and R453 in the line output valve's control grid circuit changed. There's also slight hum on the picture, but not on sound.**

We suggest you check R458 (390Ω) in the e.h.t. tripler's earth return circuit, also VDR401 and R450 (5·6MΩ) in the width circuit and the width control itself which can deteriorate. The hum on picture is commonly caused by deterioration of the h.t. reservoir/smoothing electrolytic can C601/2 if the edges of the raster are affected, or the equivalent l.t. electrolytics C604/C606 (both 1,000μF) if the hum is in the form of a horizontal drifting bar.

## PHILIPS G8 CHASSIS

**The trouble with this set is intermittent loss of colour, the picture and sound being otherwise normal. The picture flashes to black-and-white for periods of fractions of a second to about five seconds, at irregular intervals, though the set sometimes operates for hours without the fault appearing. The fault occurs on all channels, and with the push-button unit unhinged and the a.g.c. disconnected.**

At least you've eliminated the a.f.c., though the trouble could be any of the following: loss of input to the decoder from the i.f. panel; intermittent loss of the burst gating pulse; intermittent loss of the ident signal or colour-killer turn-on bias; the reference oscillator stopping; failure of the chroma amplifier or delay line driver.

Hook a meter to the colour-killer bias line, at TP26. If the voltage disappears (around 1V instead of 15V) when the fault is present, the fault is before the d.c.-coupled second chroma amplifier/delay line driver transistors T7268/T7271. In this event connect test point TP26 to the supply line (TP80), soldering the connection since crocodile clips tend to fall off on to a resistor with 200V at one end.... Bear in mind that there will be no ident, so you might get red/green changeover. If the fault vanishes, look for a dry-joint in the ident circuit or the bias path. If the fault changes to coloured bands which remain, then the burst channel or reference oscillator control loop is at fault: if on the other hand the bands appear and then rapidly vanish, the d.c. amplifier in the control loop or the reference oscillator is playing up. If there's still no colour, then there's no input from the i.f. strip or the first chroma amplifier is faulty.

In the event of the bias at TP26 remaining when the fault is present then the fault must be in the second chrominance amplifier, which is biased on by the rectified ident signal, or in a following stage. Possible faults are the delay line having dry-joints on its transducers, or the reference feed to the demodulator i.c. disappearing due to a crack in the panel or something similar. Philips tend to include in the signal paths small coils which can (and do) cause these types of faults. A can of freezer and a hairdryer may help, while a slight adjustment to the reference oscillator coil L7008 to increase the output may save a lot of time spent checking.

## ELIZABETHAN T12

**I require a replacement mains bridge rectifier for this set, but have been unable to obtain the original type. Any suggestions?**

These little portables draw quite a lot of current through their rectifiers, so we wouldn't suggest making a bridge up from the widely used BY127 type rectifier diode. RS Components now have a 4A bridge in an in-line package, and this should be suitable. Alternatively, you could make a bridge up from the 6A diodes available from RS Components. The type numbers are 262-113 and 261-823 respectively. You will have to order through a dealer.

## B AND O 5000 CHASSIS

**The NS geometry on this set is incorrect, the problem being at the top right and bottom left corners which slope upwards. Neither the NS phase control 78 nor the NS amplitude control 75 gives any improvement.**

Assuming that the convergence is correct, the usual offender is 5C39 (0·047μF) in the NS correction circuit. There are two other controls available for NS correction, the NS centring control 79 on the transductor core and the second harmonic tuning coil 77 (5L4) which should be adjusted using a plastic tool.

## PHILIPS G6 CHASSIS

**A number of these sets have exhibited the following fault, the width decreasing after the set has been on for a couple of hours, with the boost voltage falling from 570V to 500V. The fault takes longer to appear if the back is left off the set. Replacing the line output stage valves and transformer and all the small components associated with the PL509 has failed to effect a cure. The drive remains correct. The scan-correction capacitor and deflection coils have also been replaced.**

This is not uncommon on these sets, and we've usually found that replacing the desaturating choke L5502 has solved the problem. In one case we found that the PL509's screen grid feed resistor R5030 was falling in value when hot, increasing the voltage from 190V to over 260V. How it managed to do this, being a wirewound type, we don't know. Many people resort to leaving the back off the set, which is highly dangerous of course if children are around.

### GEC 2010 SERIES

**There's a very good picture when the brightness is turned down, but when it's turned up the picture goes negative – distant scenes also turn negative. The picture's dark when the set is first switched on, coming up bright shortly after. The e.h.t. rectifier and the other line output stage valves have been replaced.**

The trouble could be due to a defective c.r.t., but could also be due to the PFL200 video valve or an a.g.c. circuit fault. Check the PFL200 first, then check the PCL84 (the triode section is the a.g.c. clamp) and the a.g.c. line decoupling capacitors C68 and C69 (both 0·22$\mu$F). Check the c.r.t.'s heater and electrode pin voltages when first switched on and later when the picture is brighter.

### ITT CVC5 CHASSIS

**The trouble with this set has always been the colour-killer occasionally not working. Other people I've spoken to tell me they've had the same experience with this chassis.**

This is a common occurrence on these sets, and is caused by noise on a monochrome transmission triggering the sensitive colour-killer circuit. A complete cure is to interchange R196d and R197d on the decoder panel.

# TEST CASE

# 193

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

*A Bush Ranger Model BM6514 mains/battery portable gradually started to give poor vision. The symptom occurred on both 12V battery and 240V mains operation, and there was no significant difference between channels. Sound was normal, but the display was flat and sadly lacked the wide contrast range expected from this model. According to the customer, the brightness control setting required had altered as the trouble developed.*

*On test there was a fair amount of raster brightness with the control fully advanced, and the contrast was not too bad when the set was viewed under low ambient lighting conditions, provided the contrast control was at a low setting. Turning up the contrast control tended to compress the display, giving the impression of a bad picture tube.*

*In common with most other portables, the main voltage rail is derived from a series voltage stabiliser circuit. This supply also energises the c.r.t. heater, so it was first thought that low rail voltage could be impairing the effective emission of the tube. The voltage was found to be a shade below the specified 11V, but could be set to the correct level by slight readjustment of the "set volts" potentiometer. So the problem wasn't here.*

*The tube's final anode voltage is provided by the usual line output transformer overwinding and e.h.t. rectifier, and was found to be normal. The first anode voltage is obtained from a separate winding and rectifier. This was also correct. The pulse output from another tap on the transformer provides, after rectification, 100V for the video amplifier and the tube's focus electrode. The tube's bias – the voltage between its grid and cathode – was measured and the range appeared to be normal with rotation of the brightness control.*

*Further study of the picture revealed a ragged vertical line towards the left of the screen, while the definition of the horizontal scanning lines was not very sharp.*

*At this point the technician concluded that the picture tube was at fault, and proceeded to check this possibility by replacing it. Do you think that the technician was correct in his diagnosis, or was there something he overlooked? See next month for the solution and for a further item in the series.*

### SOLUTION TO TEST CASE 192
### – Page 49 last month –

In the case of the Thorn 1690 chassis mains/battery portable mentioned last month the technician had good reasons to believe that the trouble was in the small-signal stages. The picture faults of reduced contrast and weak line lock are certainly indicative of low vision signal, while the tendency of the sound channel to produce intercarrier buzz and respond to electrical interference is a fair indication that the signal reaching the intercarrier sound i.c. (the T6001N) is of insufficient level for good amplitude limiting.

The technician was thus relieved of the toil of going round the whole PCB with a hot iron! Attention was instead directed to the passive components on the tuner side of the board. A non-metallic probe was used to apply pressure to those components in the i.f. channel, and it was quickly found that by exerting pressure on C25 (0.01$\mu$F) – one of a group of four capacitors adjacent to the centre of the tuner – the fault could be evoked or cleared. Bad soldering or a printed conductor fracture was not in evidence, but when one side of C25 was heated the leadout wire virtually fell from its hole since it was retained not by solder but by flux or varnish. A resoldering job cleared the trouble and the customer went happily on his holiday. C25 is the fourth i.f. amplifier transistor's emitter decoupling capacitor.

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**TELEVISION JAN 1979**

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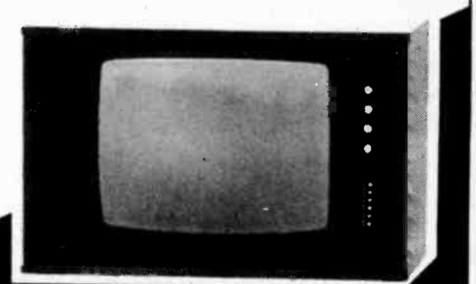

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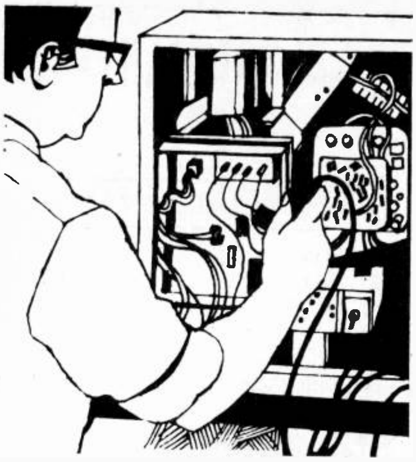

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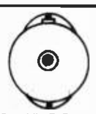

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