# TELEVISION

20p

SERVICING · CONSTRUCTION · COLOUR · DEVELOPMENTS

AUGUST 1973

# receiver debugging


**ALSO:** VALVE AND TRANSISTOR SUBSTITUTION GUIDE
SERVICING THE GEC 2032 SERIES : UHF FAULTS

# B. BAMBER Electronic Surplus

20 WELLINGTON STREET, LITTLEPORT, CAMBS.

**COLOUR MONITOR DECODER** units by leading Brit. maker. Designed to BBC standards. Units consist of chrominance module, PAL filter & delay module, luminance module & encoded video input module. All units brand new & tested complete with service manual & edge connectors. **£30.00** each set. Also complete switchable PAL/NTSC decoder by same maker built in Isep rack with power unit & sync separator. **£75.00.** Manuals separately **£1.50** each.
**PHILIPS MONITOR DECODER** panels type EL6818/50F, PAL **£20.00.** NTSC **£15.00.** no details.
**PLESSEY** colour scan coils **£5.50** each.
**MULLARD** black & white scan coils **£1.10** each.
**MAZDA** C.R.T.s CME 1906 unused & boxed **£8.80.**
**MAINS ISOLATING TRANSFORMER** 375 VA. tapped primary, 240 volt output. Brand new **£5.50.**
**CAPACITORS** 200-200-60mfd. 300v., 50-50mfd. 500v., 4000mfd. 40v., 6400mfd. 40v., all **44p** each.
**CAMERA** lens 'C' mounts **33p** each.
**PYE 'LYNX'** manuals **£1.50** each.
**CAPACITORS** 0.05mfd. at 7.5kv. **22p** each.
**EHT** Valve holders B9A **10p** each.
**C.R.T.** bases B8A brand new **5p** each.
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**PYE** Colour monitor panels S.A.E. for details.
**VALVES** 6080 brand new **55p** each.
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Belling Lee T.V. sockets 12 for **50p.**
Jack Plugs standard ¼" 4 for **50p.**
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Mixed bag of rubber grommets **50p.**
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Resistors Mixed bag for **50p.**
Valves 6BH6 used, 4 for **50p.**
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12AU7 used, 4 for **50p.**
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Silver plated coils mixed bag for **50p.**
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**POWER TRANSISTORS** 2N3773 silicon NPN 150W 140 volt. Used and tested. Two mounted on heat sink. **£1.10.**
**POWER TRANSISTORS CP704** Silicon NPN 30W 80 volt. Used and tested. Mounted on heat sink. **20p** each.
**MAINS TRANSFORMER** 140 volt input, 2000 volt at 10 mA output. Brand new **£1.25.**
**MAINS TRANSFORMER** 240 volt input, 500 volt tapped at 340 volt at 240 mA, 315 volt at 135 mA, 50 volt at 50 mA, 6.3 volt at 8.5 amp. Brand new **£3.30.**
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**SO239 SOCKETS 15p** each, ex-equipment few only.
**RECTIFIERS** BY126 **10p** each (4 fo 30p).
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**TUNING CAPACITORS** pre-set airspaced 100pf **15p** each.
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**VALVES,** ex-equipment 5B254M tested **£1.00** each.
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**TERMS OF BUSINESS** cash with order, mail order only, or callers by appointment.

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**We are Breaking-up the following TV Sets:**
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EX TV SPEAKERS—all 3 Ohm 2½ Watts: 7 x 4", 6 x 4", 8 x 2½" 25p each. Post on any Speaker 10p.

**RECLAIMED TV TUBES:** AW43/80, £1.50; AW43/88 £1.50; MW43/69 £1.00. Many other types in stock. Carriage and insurance on any Tube £1.50.

**TOP QUALITY TAPE:** Reel to Reel 5" ST. 44p; 5" LP. 50p; 7" ST. 60p; 7" LP. 75p. Tapes, Cassette Types: C60 30p; XXX 7" ST. 60p; 7" LP. 75p. Tapes, Cassette Types: C60 30p; C90 40p; C120 50p. Post on any tape 10p.

**EX EQUIPMENT VALVES.** All tested on our Mullard Valve Tester before despatch. 3 Months Guarantee on all valves. Single Valves Post 3p; Over, Post Paid.

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|---|---|---|---|---|---|---|---|
| ARP12 | 5p | EF183 | 20p | PL83 | 10p | U191 | 20p |
| EB91 | 4p | EF184 | 20p | PL33 | 17p | 6BW7 | 12p |
| EF80 | 8p | PCF80 | 5p | PL36 | 17p | 6F23 | 20p |
| EBF89 | 15p | PCC84 | 5p | PY81 | 10p | 20P1 | 20p |
| ECC81 | 12p | PCL82 | 12p | PY800 | 17p | 20P1 | 15p |
| ECC82 | 12p | PCL83 | 15p | PY801 | 17p | 20P3 | 12p |
| EF91 | 4p | PCL84 | 15p | PY82 | 10p | 30F5 | 12p |
| EY86 | 20p | PL82 | 10p | PY33 | 20p | 30FL1 | 20p |

**Add V.A.T. at the STANDARD RATE AFTER APRIL 1st on all goods.**

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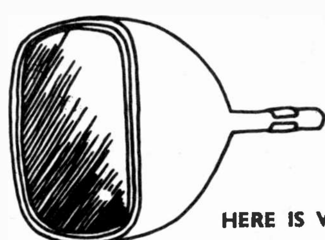

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**HERE IS WHAT YOU PAY:**

| Mono | | Rimband & Twin Panel | | Colour | |
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| 15-17" | **£5.00** | 19" | **£7.00** | 19" | **£25.00** |
| 19" | **£5.50** | 23" | **£9.00** | 22" | **£25.50** |
| 21" | **£6.50** | 24" | **£10.00** | 25" | **£30.00** |
| 23" | **£7.50** | | | 26" | **£32.50** |

Carriage 75p — Exchange Basis (carriage-ins. £1·50)

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*Cash or cheque with order, or cash on delivery*

★ Each tube is rebuilt with a completely new gun assembly and the correct voltage heater.
★ Each tube comes to you with a guarantee card covering it for Mono Tubes, two years against all but breakage.
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## RE-VIEW ELECTRONIC TUBES
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**DIRECT REPLACEMENTS FOR MULLARD-MAZDA BRIMAR GEC, ETC.**

| | | | | |
|---|---|---|---|---|
| A47-11W | MW43-69 | C21/KM | CME2302 | 7601A |
| A47-13W | MW43-80 | C23/7A | CME2303 | 7701A |
| A47-14W | MW52/20 | C23/10 | CME2305 | A50-120W/R |
| A47-17W | AW47-97 | C23/AK | CME2306 | MW36/24 |
| A47-18W | AW59-90 | CME1601 | CME2308 | MW36/44 |
| A47-26W | AW59-91 | CME1602 | CRM172 | CRM141 |
| A59-11W | C17/1A | CME1702 | CRM173 | |
| A59-12W | C17/5A | CME1703 | CRM211 | |
| A59-13W | C17/7A | CME1705 | 23SP4 | |
| A59-14W | C17/AA | CME1706 | 171K | |
| A59-15W | C17/AF | CME1901 | 172K | |
| A59-14W | C17/FM | CME1902 | 173K | |
| AW43-80 | C17/5M | CME1903 | 212K | |
| AW43-88 | C19/10AP | CME1905 | 7405A | |
| AW43-89 | C19/AK | CME1906 | 7406A | |
| AW47-90 | C21/1A | CME1908 | 7502A | |
| AW47-91 | C21/7A | CME2104 | 7503A | |
| MW43-64 | C21/AF | CME2301 | 7504A | |

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18 CHURCHDOWN ROAD,
MALVERN, WORCS.
Malvern 2100

**2 YEARS' GUARANTEE FULL TUBE FITTING INSTRUCTIONS**

**Tubes are despatched day of order by passenger train, road or goods taking far too long for customers satisfaction.**

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**LAWSON "RED LABEL"** *CRTS are particularly useful where cost is a vital factor, such as in older sets or rental use. Lawson "Red Label" CRTS are completely rebuilt from selected glass, direct replacements and guaranteed for two years.*

| | New Tubes £ | Red Label £ | Colour Tubes old glass not required |
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| 14" | 3·85 | — | |
| 17" | 6·87 | 5·47 | 19" £43·45 |
| 19" | 7·97 | 5·77 | |
| 21" | 9·35 | 7·65 | 22" £47·85 |
| 23" | 10·70 | 7·97 | |
| 19" Twin Panel | 11·28 | 9·07 | 25" £52·25 |
| 23" Twin Panel | 17·05 | 10·72 | |
| 16" Panorama | 9·35 | — | 26" £54·45 |
| 19" Panorama | 10·32 | 7·65 | |
| 20" Panorama | 11·55 | — | carr. £1·65 |
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Carriage/Insurance: 14"-19" **68p.** 20"-23" **82p**
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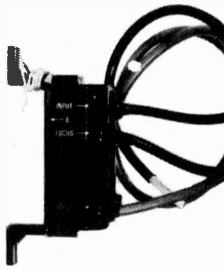

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**GEC 2028 SERIES**
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200 + 200 + 100 + 32
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**E.H.T. RECTIFIRE STICKS**
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Tuner Units
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**100 MIXED W/W RESISTORS**
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**PACKS** (incl. p.p.). No. 2 **£4·90**, No. 5 **£1·05**, No. 9 45p, No. 12 31p, No. 13 35p, No. 14 **£9·90**, No. 15 **£2·28**, No. 16 **£10·95**, No. 17 **£2·72**, No. 19 **£2·30**, No. 21 **£10·40**, No. 22 **£2·20**, C.R.T. Base 30p. C.R.T. Shields **£2·05** p.p. 55p, Varicap ELC1043 **£4·50**, TAA550 62p, AE Isolpanel 30p, Pack No. 23 **£2·95**, Pack No. 24 **£1·60**.

**MAINS TRANSFORMER** for Colour Receiver, guaranteed to give correct outputs under actual load conditions, plus additional 6·3V C.R.T. heater tapping **£9·50** p.p. 50p.

**C.R.T. HEATER TRANSFORMERS** 6·3V 1 amp **£1·10** p.p. 25p.

**SPECIAL OFFER** I.F. Panel, leading British maker, similar design to "Television" panel. Now in use as alternative, incl. circuit, **£8·90** p.p. 35p.

G.E.C. Colour decoder panels (for parts) incl. DL20, crystal and approx. 50% of resistors. Conds., diodes, transist., etc. for "Television" decoder **£3·50** p.p. 30p.

**PHILIPS** G6 single standard convergence panel, incl. 16 controls, switches etc., and circuits **£3·75** p.p. 30p, or incl. Yoke **£5·00**.

**PHILIPS** G8 decoder panel part complete incl. I/C **£2·50**. I.F. Panel part/compl incl. modules **£2·50** p.p. 30p.

**BUSH** CTV25 timebase units, line frame, E.H.T. surplus **£4·50** p.p. 80p. Mk. III Quadrupler Trays/E.H.T. **£8·25** p.p. 25p.

**VARICAP/VARACTOR** ELC 1043 UHF tuner (for "Television" colour receiver) **£4·50**, **PHILIPS** VHF Varicap tuners for band I & 3 **£2·85**. Varicap tuners salvaged **£1·50** p.p. 25p.

**UHF** 625 kits and tuners. Lists available at reduced prices. UHF tuners, transistd, **£3·10**, incl. s/m drive, indicator **£3·85**; 6 position or 4 position pushbutton **£4·95**. UHF/VHF transistd. tuner, latest type, incl. circuit **£3·25**. Cyldon valve type **£1·50** p.p. 30p.

**MURPHY** 600/700 series UHF conversion kits in cabinet plinth assembly, can be used as separate UHF receiver **£7·50** p.p. 50p.

**SOBELL/GEC** Dual 405/625 I.F. amp and o/p chassis incl. circuit **£1·50** p.p. 30p. **PHILIPS** 625 I.F. panel incl. cct **£1** p.p. 30p.

**FIREBALL TUNERS** Ferg., HMV, Marconi. New **£1·90** p.p. 25p.

**TURRET TUNERS.** KB "Featherlight" VC11, Philips 170 series, GEC 2010 **£2·50**. AB Dual Stand, suitable Ferguson, Baird, KB etc. 75p, Cyldon C 75p, Pye 110/510-Pam, Invicta, Miniature, increm. **£1·95**, Peto Scott 960, Decca 95/606 **£1·50** p.p. 30p.

**LINE OUTPUT TRANSFORMERS.** Popular types available, brand new replacements, fully guar. A selection which can be supplied p.p. 30p. C.O.D. 28p.

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| **MURPHY** 849, 939, 153 2417S | **£4·90** |
| **PHILIPS** 1768/2168, 1796/2196 | **£4·90** |
| **PHILIPS** 17TG/100 Range | |
| **STELLA** 1011/1029 ... ... | **£4·30** |
| **PHILIPS** 19TG111/12 ... | **£4·40** |
| **PHILIPS** 19TG121 to 156 ... | **£4·90** |
| **PHILIPS** 19TG170, 210 series | **£4·90** |
| **BUSH** TV92, 93, 105 to 186SS | **£4·90** |
| **EKCO** 221 to 394, **FERRANTI** 1001 to 1065 ... ... ... | **£4·30** |
| **EKCO, FERR.** 418, 1093 etc. | **£4·30** |
| **DECCA** DR95, 101/606, DR1, 2, 3, 121/123, 20/24, 2000 ... | **£4·70** |
| FERG 305 to 436, 606 to 727... | **£4·30** |
| **FERG, HMV, MARCONI** | |
| **ULTRA, PHILCO** 3600, 2600, 4600, 6600, 1100 series, Jell pot | **£4·70** |
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| **MARCONI** VT157 to 172 ... | **£4·30** |
| GEC 302 to 456, 2000 series ... | **£4·90** |
| HMV 1865/9, 1870/6, 1910/1924 | **£4·30** |
| PYE 17/21, 17/S, 110 to 510, 700, 830, 1, 2, 3, 11U to 64 ... | **£4·30** |
| **PAM, INVICTA** equiv. LOPTS to above PYE ... ... ... | **£4·30** |
| **SOBELL** 195/282/1000 series... | **£4·90** |

**SPECIAL OFFERS**

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| EKCO 380 to 390 ... | **£2·50** |
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| FERG. 506 to 546 ... | **£1·50** |
| HMV 1890 to 1896... | **£1·50** |
| P/SCOTT 1419 to 1725, 733 to 738 ... | **£1·75** |
| REG 10-6, 10-17 ... | **£2·50** |
| REG 191/2, 17-18 ... | **£2·50** |
| RGD 519, 606, 610, 612, 619, 620, 711 ... | **£2·50** |
| PHILCO 1010/21 ... | **£2·25** |

**COLOUR LOPTS**

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|---|---|
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| DECCA (Windings) CTV 19/25 ... ... | **£6·25** |
| GEC 2040, SOBELL 1040 ... ... ... | **£7·45** |
| LOPT Inserts p.p. ... | 17p |
| KB/RGD VCH, VC11 Featherlight ... | **£2·75** |
| KB/RGD VC1-9 ... | **£1·95** |
| PHILIPS 17TG100... | **£1·95** |

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| Transistorised I.F. panel (salvaged) ... ... | **£2·50** | p.p. 25p |
| 850 field output transformer ... ... ... | **£1·80** | p.p. 20p |
| 850 scan coils ... ... ... ... ... | **£4·40** | p.p. 30p |

**THORN** 850 Time Base Panel. Dual Standard **£1** p.p. 30p.
**THORN** 850 Mains Droppers 30p p.p. 15p (state approx values)

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# TELEVISION

SERVICING·CONSTRUCTION·COLOUR·DEVELOPMENTS

VOL 23 No 10
ISSUE 274

AUGUST 1973


## FOR SALE—WITH CARE

THE new Supply of Goods (Implied Terms) Act which came into force on May 18 raises issues that many constructors and buyers will want clarified. In general the Act goes a long way to tidy up uncertainties in guarantees and warrantees by making exclusion clauses in contracts of sale invalid. There are situations that can still leave a sour taste in the mouth of the customer and retailer however insofar as equipment and component purchase are concerned.

If an item is purchased on the prior understanding that it is expected to perform according to the manufacturer's specification then it is the retailer or salesman who is responsible to the customer for ensuring that the item supplied complies at the time of purchase with this performance specification. There is also that clause in force that goods must be of merchantable quality and reasonably suitable for the purpose supplied. The onus is squarely on the shoulders of the retailer to ensure that goods are reasonably suitable for the purpose supplied. If the retailer states that the goods he sells are suitable for a specific purpose then he also carries this responsibility whether or not they comply with manufacturers' or any other published specifications.

If the customer finds that the goods are sub-standard according to the specification or trade description from either manufacturer or retailer he can no longer, unless he was made aware of this at the time of sale, claim direct from the manufacturer. If the retailer agrees that the claim is justified then he can similarly claim compensation and legal costs against the manufacturer if faulty manufacture is proved.

In the event of a claim for faulty goods, including any component parts, the customer can seek redress if the goods have not been subjected to abnormal operating conditions after the sale. This is one aspect of trading which could still involve dispute unless authoritative technical arbitration is employed by a court of law. It is seldom in television and radio circles that such cases are taken to court because of the costs, so either the customer may choose to say nothing, or the retailer may dismiss the claim on grounds of alleged negligence, or the parties may agree to settle in some other way out of court.

Goods supplied with forms of guarantee must also comply with the Supply of Goods (Implied Terms) Act; other conditions that are written into the terms of the transaction will be void if they exclude any parts of the goods or if they appear to reduce the liability of the retailer or manufacturer to compensation.

We would however expect all parties to exercise common sense. The retailer should fully understand all the technical aspects of the goods he supplies and be cautious about claims for specific purposes. The customer should make quite sure that he is satisfied with the items offered for sale and if in doubt seek a second opinion. By doing so a great deal of heartache can be avoided.

M. A. COLWELL, *Editor*

## THIS MONTH



**THE NEXT ISSUE DATED SEPTEMBER WILL BE PUBLISHED AUGUST 20**

# TELETOPICS

## TRADE SHOWS

So far as television receivers are concerned this year's Radio and Television Trade Shows marked the first though somewhat tentative appearance of 110° colour chassis from UK setmakers. The **Philips** and **Pye/Ekco** groups, **Rank Radio International** and **Thorn Consumer Electronics** all showed 110° colour models though most were prototypes with no sales model numbers or prices. The Thorn 110° chassis is known as their 4000 series chassis and one model fitted with it was announced. This is the **HMV** 26in. console Model 2726 which has been given an approximate recommended price of £435. Other features of this luxury model are touch tuning and cordless remote control. The only other 110° models on show were the **Ekco** CT262 (22in. tube) and CT266 (26in. tube): these are fitted with the Pye/Ekco group's new 731 chassis which uses 11 i.c.s.

Setmakers are clearly in no hurry to switch to 110 colour chassis. Apart from the engineering problems involved there is the disruption of production schedules that would result from an early changeover—and the limited production at present of 110° tubes. Since it seems that a couple of inches in cabinet depth is all that is likely to be gained from the use of 110° colour tubes the longer the setmakers stick to 90° tubes in well-tried chassis the better so far as we can see.

Integrated circuits are being used in increasing numbers, some recent colour chassis having ten or so. But here again setmakers are taking their time. In fact adoption of particular i.c.s by setmakers seems to occur only after lengthy and detailed technical liaison—over a year or more—between i.c. manufacturers and the design departments of the setmakers. Many of the first generation of i.c.s designed by i.c. manufacturers for television receivers never got into sets at all, and it seems that setmakers have to be well convinced of the advantages before designing around a particular i.c. These advantages are mainly cost reduction—either in components, labour or both—, increased reliability and ease of servicing and, rather incidentally, improved receiver performance. Our impression is that the i.c. manufacturers and setmakers are still investigating the most useful and reliable way of designing television sets around i.c.s—a representative of one leading i.c. manufacturer recently commented that optimising television receiver circuitry for use with i.c.s is not likely before 1976/7.

The alternative approach in many areas is as we mentioned in June the use of thick-film modules. These give improved reliability and performance through improved operating stability, and also probably cut labour costs. They are however comparatively expensive unless very large runs are possible, which could be why our largest setmaker TCE seems to be showing the most interest in them at present—the convergence circuits of the 4000 series chassis for example feature thick-film assemblies.

Colour videocassette recorders were shown by **National Panasonic** and **Loewe Opta**, but no prices or expected delivery dates were given. The Loewe Opta machine gives 60 minutes playing time and resolves up to 2.7MHz. **National Panasonic** were among several Japanese setmakers showing PAL specification sets. Their Model TC85G (with 18in. tube) features a black matrix shadow-mask tube (the area between the phosphor dots is covered with a non-reflecting black coating to reduce light reflection from the front of the screen), instant-on operation and "magic green line" tuning. On operating a push-button a green line appears down the centre of the screen: the fine tuner is then adjusted for minimum green line width which coincides with correct tuning. This ingenious technique uses a detector to produce an output depending on the degree of mistuning: this output together with a line-frequency pulse is applied to an i.c. which produces a signal to increase the G – Y output and reduce the R – Y output. Once the tuning is at optimum the push-button is operated again to remove the green line. A.F.C. does not appear to be incorporated in this set and would seem to us a simpler solution to the problem of correct tuning. The recommended price of this receiver is £259.95.

Apart from the 110° chassis mentioned above the only new chassis shown was the Pye group's 173 monochrome chassis. The **Invicta** Models 7320 and 7324 and **Ekco** Models T550 and T551 are fitted with this chassis. Several new monochrome models were shown by **Rank Radio International** including two under the **Dansette** brand name (DM6901 and DM7104, 20 and 24in. models respectively). A modified G8 chassis is used in the latest **Philips** colour models (550/551/552/553) while the Philips 320 series chassis is used in four new monochrome models (328/329/330/331). This chassis features four i.c.s, a TAA550 varicap tuner supply stabiliser, TBA750Q intercarrier sound channel, TBA550Q sync/a.g.c./video preamplifier combination and TBA720Q line oscillator i.c.

**ASA** were showing their first 110 colour model, the 6000, and a 12in. monochrome mains/battery portable, the 3662. This model is interesting in featuring a rechargeable battery pack giving five hours operation and an optional video unit for use with CCTV cameras.

## COMPONENTS SHOW

The Thorn P1 tube mentioned in our last two issues could be seen in operation at the RECMF Component Show. We understand that several manufacturers are working on new chassis using this tube and models are expected to be ready for release in time for next years's Radio Trade Shows. Mullard are also said to be developing an in-line gun colour tube but have made no announcement to date.

Mullard were showing their solid-state 110° chassis which demonstrated several thick-film circuit applications; it uses a single-transistor line output stage and compact line output transformer. Also shown on the Mullard stand were a solid-state monochrome chassis which has a low-voltage stabiliser associated with the line output transformer to minimise picture breathing over a wide range of mains supply voltage changes, and a new quick-heat 12in. monochrome c.r.t. (type A31-410W) which can present a clear picture within five seconds of being connected to a heater supply. It requires an 11V heater supply at 140mA.

AB Electronic Components Ltd. showed a varicap diode tuner unit using thick-film techniques. It uses no discrete resistors and has tuned lines screened into the thick-film layer. The unit is robust and compact and we would expect to find it in use in new models before long. The gain figure quoted is 18dB and the noise figure 10dB. AB have also introduced a six-section varicap tuner control unit (which is in quantity production) with a.f.c. defeat capability—the a.f.c. line is automatically disconnected when the push-button is operated so that stations can be accurately tuned. Another new component shown by AB was their 800 series focus control unit for colour receivers.

## TRANSMITTER NEWS

Main u.h.f. transmitters now in operation:

**Selkirk:** BBC-1 channel 55, BBC-2 channel 62. Receiving aerial group C horizontally polarised.

**Carmel (Carmarthenshire):** IBA channel 60, carrying HTV Wales programmes. Receiving aerial group C horizontally polarised.

**Moel-Y-Parc (North Wales):** IBA channel 49 carrying HTV Wales programmes. Receiving aerial group E horizontally polarised.

U.H.F. relay stations now in operation:

**Bacup:** BBC-1 channel 40, BBC-2 channel 46. Receiving aerial group E.

**Bargoed:** IBA channel 24 carrying HTV Wales programmes. Receiving aerial group A.

**Carnmoney Hill (Co. Antrim):** BBC-1 channel 40. Receiving aerial group B.

**Hebden Bridge (Yorkshire):** BBC-1 channel 22, BBC-2 channel 28. Receiving aerial group A.

**Lethanhill (Ayrshire):** BBC-1 channel 57, BBC-2 channel 63. Receiving aerial group C.

**Maesteg (Glam.):** IBA channel 25 carrying HTV Wales programmes. Receiving aerial group A.

**Pontypool (Monmouthshire):** BBC-Wales channel 21, BBC-2 channel 27, IBA channel 24 carrying HTV Wales programmes. Receiving aerial group A.

**Whitby (Yorkshire):** IBA channel 59 carrying Tyne Tees Television programmes. Receiving aerial group C.

The transmissions from all these relay stations are vertically polarised.

## 3-D TV

Speaking at the recent RTRA Conference at Bournemouth C. B. B. Wood, head of the BBC's Engineering Information Department, mentioned the possibility of three-dimensional television displays as a future item on the mass-production domestic entertainment market. The system would use laser beams to produce the image through holographic techniques, and a working model to give an idea of the system was on show. Mr. Wood commented that "3-D isn't just around the corner but I suppose it will come one day". We have always thought of this as a development for the rather distant future but the fact that the BBC is willing to talk of it as a practical possibility suggests that it may not be as far off as once seemed.

## SONY EXPANSION

We have commented recently on the Sony plants in San Diego (USA) and South Wales (under development). The latest information is that Sony will be establishing a television factory in Bordeaux, France, and is planning to start a joint venture in Australia. Sony plan to produce 1½ million colour sets this year and have now reached agreement with Telefunken to produce sets to the PAL specification. Under the terms of this agreement Sony will make PAL sets in tube sizes up to 18in. only and there will be a quota arrangement.

## CABLE TV

There are signs that cable TV could well become a growth industry. At present 12–15 per cent of viewers in the UK receive their signals in this way while in Germany the figure is 30 per cent and it is estimated that the figure in the USA will reach 50 per cent by 1980. Cable TV is said to be developing fast in the US—it is only just over a year now since the FCC finally made up its mind about the conditions for cable TV operations, ending a long period during which it was impossible to develop new networks. One of the advantages of cable is of course the variety of material that can be provided. RCA have now announced plans to provide for the "rapidly expanding US cable TV market" with the industry's first range of colour sets featuring built-in capacity to receive 24 cable channels in addition to off-air v.h.f. and u.h.f. transmissions—the sets eliminate the need for a separate converter or selector device to provide cable TV reception. In launching these receivers RCA comment that "the consumer can now buy a solid-state TV set with full knowledge that it will be ready when cable TV comes to his area".

## MULLARD PUBLICATIONS

The latest (1973/4) edition of the Mullard Data Book is now available. This new edition follows the lines of previous ones but has a considerably expanded section on capacitors and resistors. Trade customers can obtain copies (cash with order) for 15p from Technical Press Ltd., 122 Westbourne Grove, London W2 5RY (retail price is 30p).

Mullard's Educational Service has published a 52-page booklet which fully describes and illustrates their closed-circuit television camera—this is the unit we reviewed on page 310 last May (Crofton CCTV Camera Kit). Copies of the book can be obtained (60p, cash with order) from the Mullard Educational Service, Mullard Ltd., New Road, Mitcham, Surrey CR4 4XY. Mullard do not supply kits or components—kits can be obtained from Crofton Electronics, 15–17 Cambridge Road, Kingston-upon-Thames, Surrey.

## TRADE NOTES

The extraordinary extent to which US electronics concerns are getting equipment assembled abroad is reflected in the US electronics trade figures for 1972. For the first time ever the US import/export figures showed a deficit—of nearly $500 million. Most of this was due to heavy imports from Japan, Hong Kong, Singapore and Taiwan.

(The US was in surplus in its trading with the UK of course!) One wonders where all this will end: a recent report has it that rising wage scales in Hong Kong have resulted in electronics firms there farming out less complicated items to subsidiaries in Taiwan, Korea and Singapore.

The UK electronics industry made a bad start to the year with an adverse trade balance of £42.4 million in the first quarter—more than 80 per cent the size of the deficit for the whole of last year. In large part this seems to reflect the colour TV boom—colour TV set deliveries reached an all time monthly peak of 233,000 in March of which almost 32 per cent were imported. Total imports from Europe—mainly from the EFTA countries—have been comfortably exceeding those from Japan. On the colour TV component side over 30 per cent of the colour scanning yokes at present used by UK setmakers come from Portugal.

There has been talk recently that colour set deliveries are at last matching demand, but trading distortions following the introduction of VAT make it particularly difficult to draw conclusions at the present time. Throughout the whole of last year colour receiver stocks held by UK setmakers never once rose above the equivalent of one week's production, an indication of the hectic pace in the industry. According to BREMA colour set production in the UK rose last year from 24,000 a week in January to 40,000 a week by December.

## PAL TOLERANCES

A joint statement has been released by the BBC and IBA on the use of non-PAL specification colour receivers. As we have mentioned in this column before several Japanese setmakers have produced sets able to receive PAL transmissions although they do not incorporate the circuitry necessary to take full advantage of the PAL system. The BBC and IBA point out that their transmissions are kept within tolerances which suppose the use of PAL specification receivers and are unable therefore to accept responsibility for the results obtained using non-PAL receivers. It is understood that very few complaints have been received to date but that this warning was felt necessary in view of the possibility of non-PAL sets being used in difficult reception areas.

## TV LIQUID CRYSTAL APPLICATION

The first system in which a liquid crystal device is used for television purposes has been announced by scientists from the Hughes Research Laboratories in the USA. Liquid crystals consist of thin liquid layers which have the property of changing opacity as the potential across them is varied—they are already used for alphanumeric display purposes. The technique developed by the Hughes scientists uses a liquid crystal device as a light valve in a projection TV system. As readers of our November 1972 issue in which we covered large-screen TV techniques will recall, in many projection systems a light valve is used to modulate the light projected on to the screen. The Hughes scientists have backed a liquid crystal with a photoconductive layer. This can be scanned to produce an electric charge pattern which modulates the liquid crystal. A picture is thus produced in the liquid crystal and the light focused on to it from the projection light source is either reflected from the lighter areas or absorbed by the darker areas. A resolution of 50 lines per millimetre in the liquid crystal device has been achieved by the Hughes scientists.

5Z4 434p GT 38p | 6AM6 EF91 17p | 6K7G 12p EB91 | 6V6 9 17p GT 27p | EF80 23p EL84 | EZ80 19p EZ81 20p | EF80 EL84 6K7 6V6 46p 12p 17p

75p 9 3 3 99p EF184 27p

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| OA2 | 0·33 |
| OB2 | 0·33 |
| OZ4 | 0·44 |
| 1A3 | 0·49 |
| 1A5GT | 0·49 |
| 1A7GT | 0·33 |
| 1B3GT | 0·49 |
| 1D5 | 0·55 |
| 1D6 | 0·75 |
| 1G6 | 0·75 |
| 1H5GT | 0·55 |
| 1L4 | 0·14 |
| 1LD5 | 0·66 |
| 1LN5 | 0·66 |
| 1N5GT | 0·60 |
| 1R5 | 0·28 |
| 1S4 | 0·33 |
| 1S5 | 0·22 |
| 1U4 | 0·44 |
| 1U5 | 0·80 |
| 2D21 | 0·44 |
| 2GK5 | 0·55 |
| 3A4 | 0·36 |
| 3B7 | 1·00 |
| 3D6 | 0·19 |
| 3Q4 | 0·49 |
| 3Q5GT | 0·55 |
| 3S4 | 0·26 |
| 4CB6 | 0·55 |
| 5CG8 | 0·55 |
| 5R4GY | 0·70 |
| 5T4 | 0·30 |
| 5U4G | 0·30 |
| 5V4G | 0·35 |
| 5Y3GT | 0·30 |
| [illegible] | 0·53 |
| 5Z4G | 0·34 |
| 5Z4GT | 0·38 |
| [illegible]/30L2 | 0·55 |
| 6A8G | 0·44 |
| 6AC7 | 0·15 |
| 6AG5 | 0·27 |
| 6AH6 | 0·50 |
| 6AJ5 | 0·75 |
| 6AK5 | 0·27 |
| [illegible] | 0·60 |
| 6AM6 | 0·17 |
| 6AM8A | 0·55 |
| 6AN8 | 0·49 |

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|---|---|
| 6AQ5 | 0·22 |
| 6AR5 | 0·55 |
| 6AR6 | 1·00 |
| 6AT6 | 0·30 |
| 6AU6 | 0·28 |
| 6AV6 | 0·33 |
| 6AW8A | 0·65 |
| 6AX4 | 0·55 |
| 6B8G | 0·25 |
| 6BA6 | 0·19 |
| 6BC8 | 0·60 |
| 6BE6 | 0·20 |
| 6BG6G | 1·05 |
| 6BH6 | 0·70 |
| 6BJ6 | 0·39 |
| 6BK7A | 0·60 |
| 6BQ5 | 0·23 |
| 6BQ7A | 0·50 |
| 6BR7 | 0·90 |
| 6BR8 | 0·75 |
| 6BS7 | 1·40 |
| 6BW6 | 0·72 |
| 6BW7 | 0·50 |
| 6BZ6 | 0·49 |
| 6C4 | 0·28 |
| 6C6 | 0·22 |
| 6C9 | 1·00 |
| 6C12 | 0·28 |
| 6C17 | 1·00 |
| 6CB6A | 0·40 |
| 6CD6G | 0·80 |
| 6CG8A | 0·75 |
| 6CH6 | 0·55 |
| 6CL6 | 0·46 |
| 6CL8A | 0·80 |
| 6CM7 | 0·75 |
| 6CU5 | 0·75 |
| 6CW4 | 0·70 |
| 6D3 | 0·60 |
| 6DE7 | 0·75 |
| 6DT6A | 0·75 |
| 6EW6 | 0·75 |
| 6E5 | 0·75 |
| 6F1 | 0·70 |
| 6F6G | 0·35 |
| 6F13 | 0·45 |
| 6F14 | 0·40 |
| 6F15 | 0·65 |
| 6F18 | 0·55 |

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| 6F23 | 0·65 |
| 6F24 | 0·60 |
| 6F25 | 0·51 |
| 6F28 | 0·60 |
| 6F32 | 0·30 |
| 6GH8A | 0·75 |
| 6GK5 | 0·65 |
| 6GU7 | 0·75 |
| 6H6GT | 0·18 |
| 6J5GT | 0·29 |
| 6J6 | 0·20 |
| 6J7G | 0·24 |
| 6J7(M) | 0·38 |
| [illegible] | [illegible] |
| 6K7G | 0·12 |
| [illegible] | [illegible] |
| 6L1 | 2·00 |
| 6L6GT | 0·55 |
| 6L7 | 0·50 |
| 6L12 | 0·34 |
| 6L18 | 0·49 |
| 6L19 | 2·00 |
| 6LD12 | 0·30 |
| 6LD20 | 0·55 |
| 6N7GT | 0·60 |
| 6P15 | 0·23 |
| 6P28 | 0·70 |
| 6Q7G | 0·44 |
| 6Q7(M) | 0·43 |
| 6Q7GT | 0·47 |
| 6R7 | 0·75 |
| 6R7G | 0·60 |
| 6SA7 | 0·35 |
| 6SC7GT | ·33 |
| 6SG7 | 0·39 |
| 6SH7 | 0·44 |
| 6SJ7 | 0·35 |
| 6SK7GT | ·44 |
| 6SQ7GT | ·38 |
| 6U4GT | 0·70 |
| [illegible] | 0·70 |
| 6V6G | 0·17 |
| 6V6GT | 0·27 |
| [illegible] | [illegible] |
| 6X5GT | 0·28 |
| 6Y6G | 0·65 |
| 6Y7G | 1·00 |
| 7AN7 | 0·29 |
| 7B6 | 0·75 |

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| 7B7 | 0·50 |
| 7F8 | 1·00 |
| 7H7 | 0·55 |
| 7R7 | 1·50 |
| 7V7 | 1·00 |
| 7Y4 | 0·65 |
| 7Z4 | 0·80 |
| 9BW6 | 0·65 |
| 9D7 | 0·40 |
| 10C2 | 0·65 |
| 10DE7 | 0·55 |
| 10F1 | 0·50 |
| 10F9 | 0·65 |
| 10F18 | 0·55 |
| 10LD11 | ·70 |
| 10P13 | 0·54 |
| 10P14 | 2·00 |
| 12A6 | 1·00 |
| 12AC6 | 0·55 |
| 12AD6 | 0·60 |
| 12AE6 | 0·60 |
| 12AT6 | 0·28 |
| 12AT7 | 0·20 |
| 12AU6 | 0·38 |
| 12AU7 | 0·21 |
| 12AV6 | 0·28 |
| 12AX7 | 0·22 |
| 12BA6 | 0·30 |
| 12BE6 | 0·30 |
| 12BH7 | 0·27 |
| 12J5GT | ·33 |
| 12J7GT | ·55 |
| 12K5 | 0·53 |
| 12K7GT | ·38 |
| 12Q7GT | ·45 |
| 12SA7GT | ·55 |
| 12SC7 | 0·50 |
| 12SG7 | 0·38 |
| 12SH7 | 0·35 |
| 12SJ7 | 0·44 |
| 12SK7 | 0·55 |
| 12SQ7GT | ·55 |
| 14H7 | 0·55 |
| 14S7 | 0·75 |
| 19AQ5 | 0·42 |
| 19BG6G | ·80 |
| 19G6 | 1·40 |
| 19H1 | 2·00 |
| 20D1 | 0·55 |

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|---|---|
| 20D4 | 2·00 |
| 20F2 | 0·67 |
| 20L1 | 0·80 |
| 20P1 | 0·55 |
| 20P3 | 0·75 |
| 20P4 | 0·80 |
| 20P5 | 0·95 |
| 25A6G | 0·38 |
| 25L6G | 0·20 |
| 25Y5 | 0·38 |
| 25Y5G | 0·70 |
| 25Z4G | 0·33 |
| 25Z5 | 0·60 |
| 25Z6GT | ·70 |
| 28D7 | 1·00 |
| 30A5 | 0·65 |
| 30C1 | 0·26 |
| 30C15 | 0·58 |
| 30C17 | 0·76 |
| 30C18 | 0·55 |
| 30F5 | 0·61 |
| 30FL1 | 0·58 |
| 30FL2 | 0·60 |
| 30FL12 | ·69 |
| 30FL13 | ·50 |
| 30FL14 | ·66 |
| 30L1 | 0·29 |
| 30L15 | 0·55 |
| 30L17 | 0·65 |
| 30P4MR | ·95 |
| 30P12 | 0·69 |
| 30P16 | 0·31 |
| 30P19/30P4 | 0·65 |
| 30PL1 | 0·57 |
| 30PL12 | ·29 |
| 30PL13 | ·75 |
| 30PL14 | ·75 |
| 30PL15 | ·87 |
| 35/51 | 0·63 |
| 35A3 | 0·48 |
| 35A5 | 0·75 |
| 35D5 | 0·70 |
| 35L6GT | ·42 |
| 35W4 | 0·23 |
| 35Z3 | 0·50 |
| 35Z4GT | ·24 |
| 35Z5GT | ·30 |
| 50B5 | 0·35 |

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|---|---|
| 50C5 | 0·32 |
| 50CD6G | 2·17 |
| 50EH5 | 0·55 |
| 50L6GT | ·45 |
| 72 | 0·33 |
| 85A2 | 0·43 |
| 85A3 | 0·40 |
| 90AG | 3·38 |
| 90AV | 3·38 |
| 90CG | 1·70 |
| 90CV | 1·68 |
| 90C1 | 0·59 |
| 150B2 | 0·58 |
| 301 | 1·00 |
| 302 | 0·83 |
| 303 | 0·75 |
| 305 | 0·83 |
| 306 | 0·65 |
| 807 | 0·59 |
| 1821 | 0·53 |
| 4033X | 1·25 |
| 5702 | 0·80 |
| 6060 | 0·30 |
| 7193 | 0·53 |
| 7475 | 0·70 |
| A1834 | 1·00 |
| A2134 | 0·98 |
| A3042 | 0·75 |
| AC2/PEN | 0·98 |
| AC6PEN | ·38 |
| AC2/PEN/DD | 0·98 |
| AC/PEN(7) | 0·98 |
| AC/TH1 | ·50 |
| AC/TP | 0·98 |
| AL60 | 0·78 |
| ARP3 | 0·35 |
| ATP4 | 0·40 |
| AZ1 | 0·40 |
| AZ31 | 0·46 |
| AZ41 | 0·53 |
| B36 | 0·60 |
| B319 | 0·29 |
| CL33 | 0·90 |
| CV6 | 0·53 |
| CV63 | 0·53 |
| CY1C | 0·55 |

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|---|---|
| CY31 | 0·29 |
| D63 | 0·25 |
| DAC32 | 0·55 |
| DAF91 | 0·22 |
| DAF96 | 0·36 |
| DC90 | 0·60 |
| DD4 | 1·00 |
| DF33 | 0·60 |
| DF91 | 0·16 |
| DF96 | 0·36 |
| DH63 | 0·44 |
| DH76 | 0·45 |
| DH77 | 0·30 |
| DH81 | 0·75 |
| DK32 | 0·32 |
| DK40 | 0·55 |
| DK91 | 0·28 |
| DK92 | 0·50 |
| DK96 | 0·45 |
| DL33 | 0·55 |
| DL92 | 0·26 |
| DL96 | 0·38 |
| DM70 | 0·30 |
| DM71 | 0·50 |
| DW4/500 | ·38 |
| DY87/6 | 0·22 |
| DY802 | 0·30 |
| E80CC | 1·65 |
| E80F | 1·20 |
| E83F | 1·20 |
| E88CC | 0·60 |
| E92CC | 0·40 |
| E180F | 0·90 |
| E182CC | 1·00 |
| E1148 | 0·53 |
| EA50 | 0·27 |
| EA76 | 0·88 |
| EABC80 | ·30 |
| EAC91 | 0·38 |
| EAF42 | 0·48 |
| EAF801 | ·50 |
| EB34 | 0·25 |

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| EB91 | 0·12 |
| [illegible] | 0·48 |
| EBC81 | 0·29 |
| EBC90 | 0·30 |
| EBC91 | 0·33 |
| EBF80 | 0·30 |
| EBF83 | 0·38 |
| EBF89 | 0·2[illegible] |
| EBL21 | 0·6[illegible] |
| EC54 | 0·50 |
| EC86 | 0·59 |
| EC88 | 0·59 |
| EC92 | 0·34 |
| ECC32 | 1·50 |
| ECC33 | 1·50 |
| ECC35 | 0·95 |
| ECC40 | 0·68 |
| ECC81 | 0·20 |
| ECC82 | 0·21 |
| ECC83 | 0·2[illegible] |
| ECC84 | 0·28 |
| ECC85 | 0·34 |
| ECC86 | 0·40 |
| ECC88 | 0·35 |
| ECC189 | ·48 |
| ECC804 | ·55 |
| ECC807 | 1·00 |
| ECF80 | 0·27 |
| ECF82 | 0·25 |
| ECF86 | 0·64 |
| ECF804 | 2·10 |
| ECH21 | 0·63 |
| ECH35 | 0·50 |
| ECH42 | 0·59 |
| ECH81 | 0·28 |
| ECH83 | 0·38 |
| ECH84 | 0·34 |
| ECL80 | 0·28 |
| ECL82 | 0·28 |
| ECL83 | 0·52 |
| ECL84 | 0·54 |
| ECL85 | 0·54 |
| ECL86 | 0·3[illegible] |
| EE80 | 0·6[illegible] |
| EF22 | 0·6[illegible] |
| EF40 | 0·49 |
| EF41 | 0·58 |
| EF42 | 0·33 |
| [illegible] | [illegible] |
| EF80 | 0·23 |
| [illegible] | 0·28 |

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| EF85 | 0·28 |
| EF86 | 0·27 |
| EF89 | 0·23 |
| EF91 | 0·17 |
| [illegible] | [illegible] |
| EF97 | 0·55 |
| [illegible] | [illegible] |
| EF183 | 0·25 |
| EF184 | 0·27 |
| [illegible] | 1·20 |
| EFP60 | 0·50 |
| EH90 | 0·34 |
| EL32 | 0·18 |
| EL34 | 0·48 |
| EL35 | 1·00 |
| EL37 | 0·74 |
| EL41 | 0·53 |
| EL81 | 0·50 |
| [illegible] | [illegible] |
| EL84 | 0·23 |
| [illegible] | 0·40 |
| EL86 | 0·38 |
| EL91 | 0·38 |
| EL95 | 0·32 |
| EL360 | 0·49 |
| ELL80 | 0·75 |
| EM80 | 0·37 |
| EM81 | 0·37 |
| EM83 | 0·75 |
| EM84 | 0·31 |
| EM85 | 1·00 |
| EM87 | 0·49 |
| EY51 | 0·35 |
| EY81 | 0·35 |
| EY83 | 0·54 |
| EY84 | 0·50 |
| EY87/6 | ·27 |
| EY88 | 0·40 |
| EY91 | 0·53 |
| EZ35 | 0·28 |
| EZ40 | 0·40 |
| [illegible] | 0·42 |
| EZ80 | 0·19 |
| EZ81 | [illegible] |
| [illegible] | 0·75 |
| FW4/800 | 0·75 |
| GY501 | 0·75 |
| GZ30 | 0·33 |
| GZ32 | 0·39 |

| | |
|---|---|
| GZ33 | 0·70 |
| GZ34 | 0·57 |
| GZ37 | 0·67 |
| HABC80 | ·44 |
| HL23DD | ·40 |
| HL41DD | ·98 |
| HL42DD | ·50 |
| HN309 | 1·40 |
| HVR2 | 0·53 |
| HVR2A | ·53 |
| IW3 | 0·38 |
| IW4/350 | ·38 |
| IW4/500 | ·38 |
| KT2 | 0·25 |
| KT8 | 1·75 |
| KT41 | 0·98 |
| KT44 | 1·00 |
| KT63 | 0·35 |
| KT66 | 0·80 |
| KT74 | 0·63 |
| KT76 | 0·63 |
| KT81 | 2·00 |
| KTW61 | ·63 |
| KTW62 | ·63 |
| KTW63 | ·50 |
| LZ339 | 0·58 |
| M8162 | 0·63 |
| MHL4 | 0·75 |
| MHLD6 | ·75 |
| MX40 | 0·50 |
| N308 | 0·95 |
| N339 | 0·44 |
| N359 | 0·43 |
| P61 | 0·40 |
| PABC80 | ·32 |
| PC86 | 0·44 |
| PC88 | 0·44 |
| PC95 | 0·53 |
| PC97 | 0·36 |
| PC900 | 0·29 |
| PCC84 | 0·29 |
| PCC85 | 0·24 |
| PCC88 | 0·39 |
| PCC89 | 0·42 |
| PCC189 | 0·46 |
| PCC805 | 0·55 |
| PCC806 | 0·65 |
| PCF80 | 0·26 |
| PCF82 | 0·30 |
| PCF84 | 0·40 |
| PCF86 | 0·44 |

| | |
|---|---|
| PCF200 | ·67 |
| PCF801 | ·28 |
| PCF802 | ·37 |
| PCF805 | ·69 |
| PCF806 | ·55 |
| PCF808 | ·66 |
| PCH200 | ·62 |
| PCL82 | 0·29 |
| PCL83 | 0·54 |
| PCL84 | 0·32 |
| PCL805/85 | 0·37 |
| PCL86 | 0·36 |
| PCL88 | 0·75 |
| PCL800 | ·75 |
| PCL801 | ·57 |
| PD500 | 1·44 |
| PEN4DD | 1·38 |
| PEN45 | 0·80 |
| PEN45DD | 0·75 |
| PEN46 | 0·20 |
| PEN453DD | 0·98 |
| PENA4 | ·98 |
| PEN/DD/4020 | 0·88 |
| PFL200 | ·50 |
| PL33 | 0·38 |
| PL36 | 0·46 |
| PL81 | 0·43 |
| PL81A | 0·48 |
| PL82 | 0·28 |
| PL83 | 0·30 |
| PL84 | 0·28 |
| PL504/500 | 0·60 |
| PL508 | 0·90 |
| PL509 | 1·00 |
| PL820 | 0·75 |
| PM84 | 0·31 |
| PY33/2 | ·50 |
| PY80 | 0·33 |
| PY81 | 0·25 |
| PY82 | 0·25 |
| PY83 | 0·26 |
| PY88 | 0·31 |
| PY301 | 0·65 |
| PY500 | 0·80 |

| | |
|---|---|
| PY500A | 0·80 |
| PY800 | 0·31 |
| PY801 | 0·31 |
| PZ30 | 0·48 |
| QQV03/10 | 1·20 |
| QS75/20 | ·63 |
| QS95/10 | ·49 |
| QS150/15 | 0·63 |
| QV04/7 | ·63 |
| R11 | 0·98 |
| R16 | 1·75 |
| R17 | 0·88 |
| R18 | 0·50 |
| R19 | 0·28 |
| R20 | 0·60 |
| R52 | 0·33 |
| RK34 | 0·38 |
| SP61 | 0·75 |
| TH4B | 0·50 |
| TH233 | 0·98 |
| TP2620 | ·98 |
| UABC80 | ·30 |
| UAF42 | 0·49 |
| UBC41 | 0·45 |
| UBC81 | 0·40 |
| UBF80 | 0·33 |
| UBF89 | 0·33 |
| UBL21 | 0·55 |
| UC92 | 0·35 |
| UCC84 | 0·33 |
| UCC85 | 0·33 |
| UCF80 | 0·31 |
| UCH21 | 0·60 |
| UCH42 | 0·57 |
| UCH81 | 0·29 |
| UCL82 | 0·30 |
| UCL83 | 0·54 |
| UF41 | 0·50 |
| UF42 | 0·60 |
| UF80 | 0·35 |
| UF85 | 0·34 |
| UF86 | 0·63 |
| UF89 | 0·27 |
| UL41 | 0·54 |
| UL84 | 0·28 |
| UM80 | 0·33 |
| UR1C | 0·55 |
| UU5 | 0·38 |
| UU9 | 0·40 |

| | |
|---|---|
| UU12 | 0·20 |
| UY41 | 0·38 |
| UY85 | 0·23 |
| U10 | 0·45 |
| U12/14 | 0·38 |
| U16 | 0·75 |
| U17 | 0·35 |
| U18/20 | 0·75 |
| U19 | 1·73 |
| U22 | 0·39 |
| U25 | 0·65 |
| U26 | 0·60 |
| U31 | 0·31 |
| U33 | 1·50 |
| U35 | 0·83 |
| U37 | 1·75 |
| U45 | 0·78 |
| U47 | 0·65 |
| U49 | 0·60 |
| U50 | 0·30 |
| U52 | 0·30 |
| U76 | 0·24 |
| U78 | 0·20 |
| U191 | 0·65 |
| U193 | 0·31 |
| U251 | 0·62 |
| U281 | 0·40 |
| U282 | 0·40 |
| U301 | 0·40 |
| U403 | 0·33 |
| U404 | 0·38 |
| U801 | 0·76 |
| U4020 | 0·55 |
| VP13C | 0·35 |
| VP23 | 0·40 |
| VP41 | 0·38 |
| VT61A | 0·35 |
| VU111 | 0·44 |
| VU120 | 0·60 |
| VU120A | ·60 |
| VU133 | 0·35 |
| W76 | 0·38 |
| W107 | 0·50 |
| W729 | 0·60 |
| X41 | 0·50 |
| X63 | 0·44 |
| X66 | 0·50 |
| XE3 | 5·00 |
| XH/1·5 | ·48 |
| Z329 | 0·61 |
| Z749 | 0·65 |

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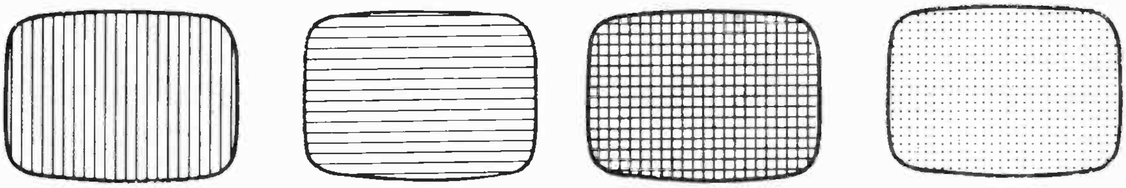

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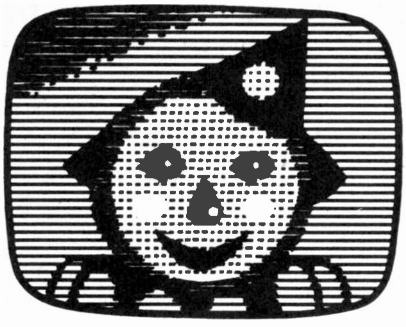


# UHF FAULTS

G. R. WILDING

U.H.F. reception, particularly with dual-standard receivers, gives rise to more complaints than v.h.f. reception. Many owners of dual-standard models find that when they instal a u.h.f. aerial and switch over unsuspected faults are present. These faults range from simple lack of contrast, impaired sync, rolling hum bars, distorted sound and vision buzz on sound to all sorts of unusual conditions. Taking the main faults in turn, let's start with the most common one, **inadequate gain**.

In many cases the aerial used is just not good enough for local conditions, a set-top aerial being used where a loft aerial at least should be installed or a loft one where an outside aerial is necessary. As a result of the much higher carrier frequencies used on 625 lines the field strength falls away far more rapidly than on 405 lines as the distance from the transmitter is increased; line-of-sight obstructions cause greater signal attenuation and there are increased problems with ghosts and reflections. When a u.h.f. aerial is being installed therefore greater care with its siting and direction must be exercised and in hilly or fringe areas attention taken to find the optimum degree of tilt. Good quality low-loss cable is essential, particularly in fringe areas and for long runs, and sharp bends must be avoided.

When a valve u.h.f. tuner is used both valves may be in need of replacement even in cases where the set has not previously been used on u.h.f., and there may be an internal preset sensitivity control which needs advancing.

Assuming that a good signal is available from the aerial and that any preset control is correctly adjusted this still does not imply that inferior results are due to a tuner fault.

If v.h.f. is good but u.h.f. fades away within a short while for example the odds are that the video amplifier section of the PFL200—so commonly found in dual-standard models—is slightly soft. This may produce little effect on v.h.f. because the signal is usually d.c. coupled from the detector on this system. On 625 however a.c. coupling is generally employed and the considerable grid current results in signal fade. This fault is now widely known but still crops up frequently amongst readers' problems.

Some receivers use a printed circuit type coaxial aerial socket and cracks often develop in the connection between the centre pin and the aerial isolating capacitor: this fault is usually shown up by a large variation in gain as the aerial plug is wobbled about in the socket.

Then although v.h.f. reception may seem to be all right nevertheless the overall i.f. gain may be down due to a low-emission i.f. pentode etc. This may only be apparent on u.h.f. because for the reasons previously mentioned of much lower aerial input on this sytem.

If low gain persists after these points have been cleared the h.t. or l.t. and a.g.c. voltages applied to the tuner should be checked—the feed resistors are generally mounted on the main chassis.

With valve tuners there should be only a very small negative a.g.c. voltage on weak signals but a considerable negative potential on strong signals. If it is suspected that a delay diode is failing to hold off the a.g.c. potential it is only necessary as a check to short the supply tag to chassis: this should not produce any significant increase in contrast in a weak signal area but with a strong signal will usually produce cross-modulation.

With a transistor tuner the a.g.c. bias must closely conform to the figure given by the makers: even a small deviation will radically affect the gain. It is most important not to inadvertently short the supply point to chassis. If the emitter of the r.f. amplifier is fed from the l.t. rail and not chassis this could result in a possibly damaging collector current as the base-emitter junction would be connected across the supply via one or two low-value resistors.

The opposite fault, **excessive contrast**, is most commonly seen in transistorised receivers and is very often due simply to an over-advanced contrast control. This fault is almost always accompanied by cross-modulation while due to the excessive signal being applied to the video stage which provides the input to the sync separator the sync pulses may be clipped resulting in poor line or field timebase locking.

A typical example of this was provided recently by a dual-standard Bush model. The owner's sole complaint was field jumping, especially on BBC-2, but inspection immediately showed that the u.h.f. contrast was excessive and on readjusting the internal preset contrast control to obtain a picture of normal tone the field jumping immediately disappeared. The fault had been particularly bad on BBC-2 because this was locally much the stronger signal.

Excessive contrast may also be caused by an a.g.c. circuit fault which results in failure to reduce the i.f. and/or tuner sensitivity on strong signals. If this is the case it will be found that the collector and emitter voltages of the controlled transistors are about the same as they should be under no-signal conditions. Transistor a.g.c. systems appear to be more complicated than valve systems and are more difficult to follow through. The basic arrangement is usually straightforward however, consisting of an a.g.c. amplifier which is either bottomed or cut-off under no-signal conditions and is progressively taken away from this condition as signal strength rises (the usual technique adopted on 625 is to use a peak detector to measure the amplitude of the sync pulse tips, the output being smoothed and used to drive the a.g.c. amplifier). The base circuits of the controlled stage(s) are d.c. linked to the a.g.c. amplifier which thus controls the forward bias applied to them. With forward a.g.c. there is a considerable drop in

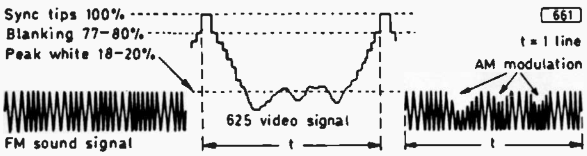



*Fig. 1: The 6MHz intercarrier sound signal produced by the beat between the f.m. sound i.f. at 33.5MHz and the a.m. vision i.f. at 39.5MHz becomes amplitude modulated by the latter when its minimum amplitude (peak white) falls below the amplitude of the f.m. sound signal.*

the collector voltage of the controlled stage(s) as signal strength rises, due to the increased voltage developed across the feed and decoupling resistors.

Once correct a.g.c. amplifier voltages have been obtained—and this means that any presets have been correctly adjusted and that the voltage at the take-off point to the a.g.c. circuit, generally the emitter or collector of the first video stage or the cathode of the video output pentode, is correct—normal conditions will return in the controlled stages giving normal contrast. A.G.C. circuits don't generally give much trouble but when a fault is present the main suspects are the various diodes employed, dry-joints and the high-value, low-voltage electrolytics present.

Many complaints relate to **impaired sync** on 625 although the synchronisation is good on 405 lines. The basic reason for this relates to the difference between the two systems. On 405 the sync pulses represent a reduction from 30% modulation level (black level) to zero whereas on 625 they consist of an increase from 77–80% modulation (625 black level) to 100% modulation. Thus any signal handling stage which is overdriven by the peak-value excursions will clip the pulses and impair sync separator action. (On 405 peak white equals 100% modulation so that signal overdrive results in highlight clipping.) When investigating cases of poor 625 synchronisation therefore this possibility must be borne in mind, particularly where the picture appears to be over contrasty and if the sync locking improves when the aerial input is reduced. The first suspect must be an over-advanced 625 preset sensitivity control in dual-standard models or a wrongly adjusted a.g.c./gain control in single-standard receivers.

If adjusting the preset(s) fails to improve matters and appears to have less than the normal effect on overall receiver gain check the voltages in all signal stages in case changed d.c. operating conditions are resulting in sync pulse clipping.

**Hum bars** quite frequently develop due to impaired h.t. and/or l.t. smoothing, being mainly evident on 625 lines in dual-standard sets since these transmissions are not locked to the mains, discrepancy between the mains and field frequencies appearing as a slowly moving hum bar. In some cases they may even produce slight variation in picture width, showing that the line output is being slightly modulated at mains frequency.

If defective heater-cathode insulation in a valve is not the cause the fault can in most cases be cured by connecting a medium-value electrolytic across each smoothing or reservoir capacitor in turn and noting the effect—with transistor circuits the set should be switched off while connection is being made. If the extra capacitance improves matters or completely clears the fault it can be taken that the original component has partially dried up and is in need of replacement. It is not necessary to shunt each suspect capacitor with one of the same value—if the suspect was completely open-circuit there would be other symptoms such as speaker hum, distorted raster or weak field sync.

When the v.h.f. sound is OK, thus ruling out any trouble in the audio circuits, **distorted sound** is sometimes the result of drift in one or more of the 6MHz sound i.f. tuned circuits. Although we don't generally advise slug adjustment on signal, in this case as the intercarrier sound signal is always at the correct frequency it is often possible to make minor adjustments for optimum results.

When the distortion is accompanied by vision buzz, especially if the a.m. balance control appears to have little effect, the ratio detector diodes should be checked to ensure that they have a low and equal forward resistance and high reverse resistance. Due to the negligible working voltages in this type of circuit the other components rarely give trouble although the load shunting electrolytic can sometimes be faulty.

A.F. distortion is most often caused in the output stage of course, by a slightly soft pentode or incorrect bias. A common cause of trouble in GEC group models fitted with an EH90 amplifier/detector valve however is the resistors in the screen grid circuit of this valve: these often reduce in value resulting in bad distortion. There is an 18kΩ resistor from h.t. to pin 6, a 5.6kΩ resistor from pin 6 to cathode and a 180Ω cathode resistor. If any of these resistors is discoloured change all three. (See Fig. 2, page 305, May issue for typical circuit.)

**Vision buzz on sound** often proves difficult to cure since it can be caused by so many things—the root cause however is the fact that if picture values approaching peak white fall below the amplitude of the f.m. sound signal at the detector (see Fig. 1) this video information is impressed as amplitude modulation on the sound signal. The amplitude of a beat signal produced from other signals can never exceed that of the lowest amplitude frequency applied to the device which produces the beat signal, and for this reason on 625 lines a sound i.f. signal attenuator is placed in the i.f. strip—generally soon after the tuner—to ensure that the amplitude of the sound i.f. signal applied to the vision detector does not exceed that of the vision i.f. signal, even at peak white. This attenuator is often referred to as a trap in service data but is not present to completely filter out the signal, merely to reduce its amplitude. Misadjustment of this attenuator will clearly produce the fault by failing to reduce the sound i.f. signal sufficiently, but so also can misalignment of the i.f. stages generally by over favouring the lower frequency side of the overall response curve. Misalignment does not necessarily imply slug misadjustment—the overall response can be radically altered by open-circuit decoupling capacitors, open-circuit or dry-jointed coil loading resistors or tuning capacitors, left off or unearthed coil screening cans, soft or incorrect type valves, or incorrectly biased transistors. The grid current taken by a soft valve or the base current of a transistor with excessive forward bias will increase the loading on its input tuned circuit, broadening the response and markedly distorting or even removing the step in the response designed to accommodate the ±50kHz f.m. signal deviations.

In many sets the intercarrier signal is taken from the video output stage and if the d.c. operating conditions of the valve or transistor used in this stage are incorrect it can be operating at near saturation point on peak white, causing simultaneous f.m. signal compression, i.e. amplitude modulation.

This particular trouble was prone to occur in models fitted with early versions of the BRC 1400 chassis—mainly when deep white captions on a low-key background were present. The trouble was overcome in later production by increasing the value of the 6F28 video pentode screen grid resistor from 3kΩ to 8.2kΩ. This reduces the screen grid voltage and therefore the anode and screen currents, taking the valve away from saturation. The modification is well worth making to any sets encountered that haven't received it.

While f.m. ratio detector and EH90 valve detector circuits provide considerable a.m. protection most receivers operate with one of the sound i.f. amplifiers as a limiter on 625 lines. When valves are employed the screen grid voltage is considerably reduced to give the valve a short working grid base, i.e. to reduce the voltage required to drive the valve from cut-off to saturation (in the same manner that sync separators are operated). The valve is without a cathode resistor and an automatic self-bias is developed at the grid proportional to the amplitude of the input signal, approaching its peak negative value (without a grid leak resistor the grid capacitor would charge to the full peak value). The result of this bias is that peak positive grid swings are clipped by grid current while peak negative excursions drive the valve to cut-off. This trims the f.m. signal of amplitude modulation and high-value noise pulses.

A typical example of this technique is the sound i.f. amplifier/limiter stage used in the BRC 1400 chassis—see Fig. 2. On 405 lines the screen voltage is 60V and the input tuned circuit is returned to the a.g.c. rail. On 625 lines the screen voltage is reduced to 30V and the input is *RC* coupled via C58 and R75. The *RC* coupling network is essential of course to develop the self-bias.

When a transistor is employed for limiting the amount of forward bias applied and the inclusion of a resistor in series with the l.t. supply will keep the collector current variations substantially constant despite considerable changes in the amplitude of the input signal.

In many Pye/Ekco group dual-standard models f.m. limiting is achieved by means of a miniature diode and 120 Ω resistor (D12 and R48, Fig. 3) shunted across the primary of the final intercarrier sound i.f. transformer. The voltage across R48 normally reverse biases the diode: peak signal excursions which exceed the bias level make the diode conduct, thereby clipping the output and removing a.m. and strong noise pulses.

Thus in cases of vision buzz all valve possibles, the setting of preset contrast controls and of the r.f. gain presets now widely used in single-standard models instead of tuner a.g.c., plus the other possible causes mentioned must be carefully checked before aligment is considered.

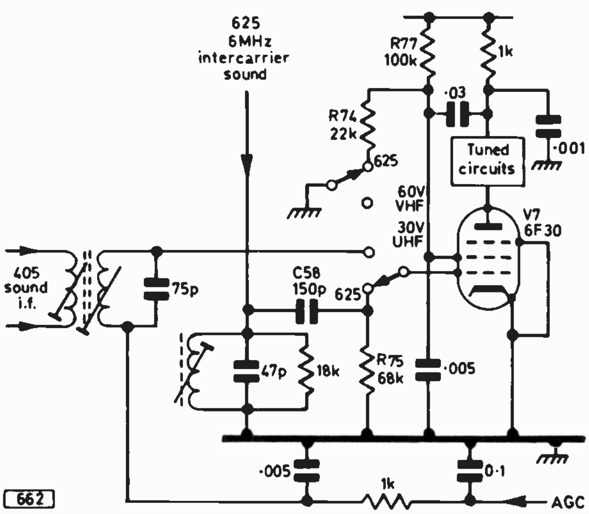



*Fig. 2: Sound i.f. amplifier/limiter stage used in the BRC 1400 chassis.*

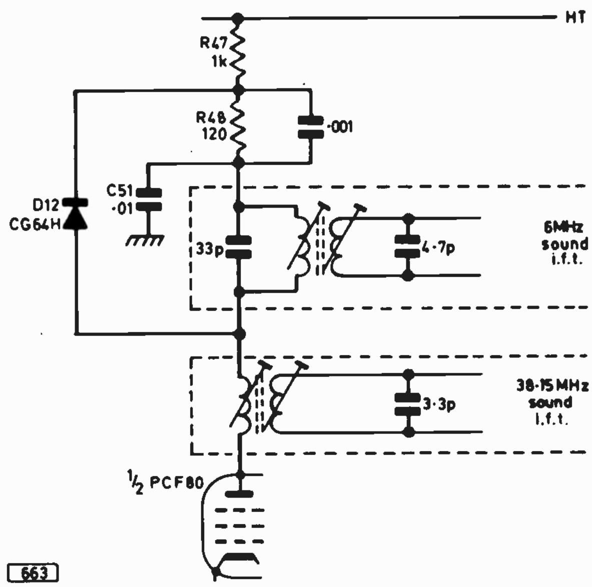



*Fig. 3: Diode f.m. limiter used in many Pye/Ekco group dual-standard models.*

An interesting example of vision buzz produced by a defective valve was provided by a dual-standard Decca set that came our way recently. On 625 the fault was fairly constant from switch on but on 405 there was both sound-on-vision and vision-on-sound which became progressively worse as the set warmed up. The accompanying symptom which gave a clue to the cause of the trouble was that *decreasing* the setting of the contrast control removed the sound-on-vision and reduced the vision-on-sound but slightly though distinctly *increased* the gain. The fault was due to the EF183 first gain-controlled i.f. amplifier valve being soft. Decreasing the contrast increased the negative a.g.c. potential applied, reducing the grid current which was loading the input tuned circuit and thereby restoring the response to something like its correct form.

**Insufficient width** on 625 lines is produced by similar causes to 405-line operation but frequently shows up more on this standard. Valves and preset controls are the first thing to check of course. Occasionally one finds a line oscillator which gives reduced output on 625 though its output on 405 may be quite normal. Since different S-correction components are used on the two systems lack of width on 625 lines only will sometimes be found to originate here.

Cases of **excessive width** on 625 lines in models fitted with the BRC 850 chassis are often due to the sound i.f. amplifier/limiter valve being soft. The line oscillator is fed from the same h.t. line as the screen grid of this valve (V12). What happens is as follows: excessive screen grid current on 405 lines reduces the anode voltage of the line oscillator and the reduced width is compensated by increasing the width control setting; on switching to 625 an additional resistor (R109) is introduced in the screen feed to V12 and the resulting reduced current drain then increases the line oscillator anode voltage thereby producing an excessively wide picture. On replacing V12 and returning the width control to its correct position normal width is obtained on both systems. ■

E. J. HOARE

# receiver debugging

PART 1 CRT DRIVE AND SCANNING

THIS new series follows a previous one (February-May 1973) in which we explored in some detail the procedure for assessing TV receiver picture quality at home without using any test gear. Along with picture quality we also investigated the sound channel and the operation of the various customer and preset controls. In the April issue (page 271) we provided a check list of the more important items to look for.

If you follow this procedure with a newly completed home-built receiver it is reasonable to expect that you will have quite a long list of comments—some good, others not so flattering! A manufactured receiver should be almost free of defects, but even here a sharp pair of eyes will have spotted a number of items that failed to earn full five star rating.

Let us assume you have just completed a new receiver and tested it. What are the most likely items in our check list to have given trouble, and what are the principles on which to base a cure?

Probably the most common nonevent of all is that when you switch on you get no picture or raster. You wait anxiously and still nothing happens. So what do you do? Switch off, switch on again, and listen for the "sigh" as the e.h.t. capacitance of the tube charges up. If you hear it then obviously the line timebase is working. Listen for the line whistle too. Say you check the brightness control again but there is still no picture. Turn the volume control to minimum and put your ear to the speaker. The chances are that you will hear some rasping buzz, so turn the field hold control from end to end and listen for a change of note. If you hear this change you know the field timebase is working too. If a field output transformer is used it will probably be buzzing. The conclusion after these checks is that the timebases are OK but that the c.r.t. electrode voltages are faulty and the tube therefore cut off. What voltages should we expect?

Fig. 1 shows typical conditions for a monochrome receiver, indicating the sort of spreads (differences between individual c.r.t.s of the same type) that are likely to occur in practice. Note that the starting point is to measure the cathode-chassis voltage. This will vary quite widely between different designs. Then measure the first anode (A1)-cathode voltage which in the example shown—Fig. 1(b)—is 400V: i.e. the first anode is 400V above the cathode. From the curve of c.r.t. beam current plotted against grid-cathode voltage you will see that when the c.r.t. is just cut off the grid, with a first anode potential of 400 volts above the cathode, will lie between 30V and 60V *below* the cathode depending upon the individual tube you happen to have. If the grid voltage is made more positive (i.e. the cathode-grid voltage is decreased) beam current will start to flow and the c.r.t. screen will be illuminated. If the cathode-grid voltage on the other hand is greater than the cut off value, say −80V, the c.r.t. will be in the "blacker than black" condition.

Not all designs adopt a first anode-cathode voltage of 400V although this is a fairly common choice in monochrome receivers. Roughly speaking for every 100V above 400V between the first anode and cathode add 10V to the grid cut-off voltage. Thus with a first anode-cathode voltage of 500V—see Fig. 1(c)—the cathode-grid voltage for cut off becomes 40–70V. For lower first anode voltages the grid cut-off voltage is correspondingly smaller.

In colour receivers the cathode to grid voltage at cut off is fixed at about 100–120V and the first anode voltages are adjusted to give this value—usually in the range 300–700V. This is a standard part of the grey-scale tracking procedure to get neutral coloured dark-grey tones.

The focus electrode voltage has very little influence on the brightness of the picture and is simply adjusted to give best focusing.

In most monochrome receivers the brightness control is used to vary the voltage on the grid of the c.r.t. It should have a range of about 25V above and below the voltage that gives a just black raster.

If you get funny answers when you first measure the c.r.t. cathode voltage remember that in many designs this is established by the operating conditions of the video output stage, i.e. designs where the video output stage is d.c. coupled to the c.r.t. Thus if the video output stage is cut off the cathode of the c.r.t. will be at h.t. potential: if on the other hand the video output stage is turned fully on, i.e. bottomed, the c.r.t. cathode will be at almost chassis potential. This point applies to both monochrome and colour receivers, and to luminance, RGB and colour-difference output stages.

## Line Scanning

Having obtained an illuminated raster and sorted out any problems concerned with getting drive to the c.r.t. the next common discovery is that the line scan is non-linear and either too large or too small. The e.h.t. is probably wrong too but you may not be able to measure it.

If the scan is wrong the first thing to do is to check whether the h.t. voltage supplied to line output transformer is correct for the one you are using. Every line output transformer is designed to work with a particular value of h.t. and if this is altered by more than about ±5% there is not much that you can do by way of compensation: the amount of energy supplied to the scanning system is simply not matched to the requirements.

If the h.t. is correct and there is no fault in the components or their connections the line scan should be roughly correct and only a bit of juggling is needed to put things right. A point to bear in mind is that every aspect of line timebase performance interacts with every other aspect. Take e.h.t., scan amplitude, flyback time and third/fifth harmonic tuning. If you do anything which alters one of these parameters you will alter the other three as well! The peak and mean currents through the line output device—whether valve or transistor—will usually vary as well.

Here are two important relationships—assuming you keep the h.t. constant. First if you increase the e.h.t. by say 10% the scan amplitude will be reduced by 5% (in-

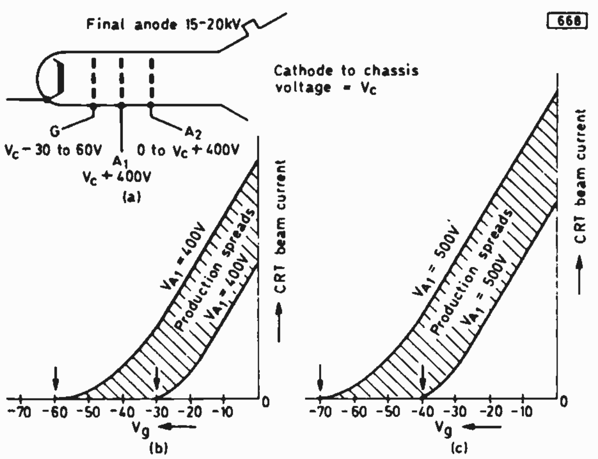



*Fig. 1: Typical monochrome c.r.t. operating conditions and characteristic curves. Note that all voltages are quoted relative to the cathode.*

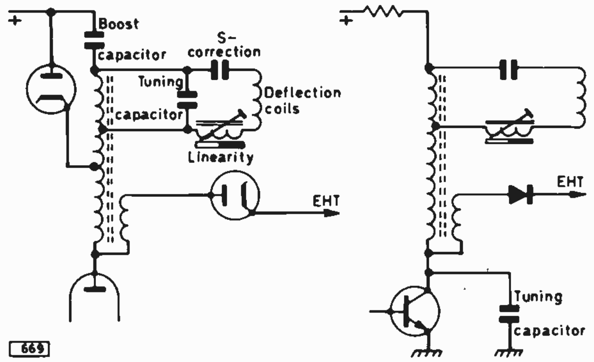
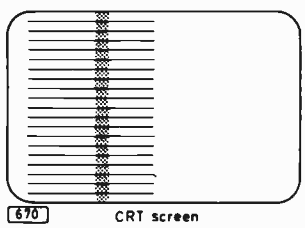



*Fig. 2: Where to find the line output transformer tuning capacitor. Its value determines the e.h.t., the flyback time and the harmonic tuning.*

*Fig. 3: When the line linearity control is working correctly a very small adjustment should cause a narrow vertical band of movement in the picture area as shown here.*




creasing the e.h.t. reduces the deflection sensitivity). Conversely a reduction of e.h.t. increases the scan. Secondly if the flyback time is increased (flyback slowed down) the e.h.t. will fall and the scan will increase. Shortening the flyback time will increase the e.h.t. and reduce the scan.

So here we have a clue about how to alter the scan or e.h.t. (and everything else!) by small amounts.

The flyback time of a line output transformer is governed by its inductance and the associated self and stray capacitances of the system, including any capacitors deliberately connected to the primary winding. The effect of these various capacitances depends upon how many turns of the transformer winding are "seen" by each one. Nearly every line output transformer is operated with an external tuning capacitor to make the total effective capacitance correct and thus achieve the desired flyback time—usually between eleven and thirteen microseconds. Fig. 2 shows where to look for this capacitor. Note that it must be a very high-voltage type.

If this capacitor is reduced in value the e.h.t. will rise and the scan will be smaller. If the e.h.t. is only 16kV and it should be 18kV, increasing it to this value will decrease the scan by (16/18) × (100/2) = 6%. The flyback time will be shorter which does not matter too much, but the harmonic tuning will be changed: after any alteration of line output transformer tuning look for striations on the picture or raster and observe whether there has been any change—for better or worse.

If a change of more than about 2kV is needed to get the scan right with a properly designed line output transformer there must be something else wrong. Changing the value of the tuning capacitor is only intended to correct for minor variations in component tolerances and construction. Make sure for example that the S-correction capacitor shown in Fig. 2 is of the correct value. Then carefully inspect the linearity of the picture and adjust the linearity control if necessary. Sometimes the magnet is not fully magnetised and the control is then ineffective, or the control may be connected the wrong way round.

A line linearity control is intended to expand the picture at the left-hand side. If you move the core a little you will see a small part of the picture start to expand or contract. Check that this action occurs in the area shown in Fig. 3. The S-correction capacitor affects *both* ends of the scan more or less equally.

Some line output transformers have two or more taps to which the deflection coil feed can be connected. This gives small adjustments of scan amplitude but the e.h.t. will tend to vary depending upon which tap is used. Other designs have a series choke which can be shorted out.

In view of the difficulties involved in modifying line output transformers it is best to avoid any substantial changes. Anything you do will alter the c.r.t. and/or e.h.t. diode heater current (if these are fed from the line output transformer) and for reasons of X-ray radiation and flashovers it is important to avoid using higher values of e.h.t. than those specified by the makers of the c.r.t. The amount of line scan is not too critical: what you are aiming at in most cases is just to lose the outer castellations of the standard test card at the beginning and end of the scan. A small error is not too important.

Incidentally if the line output transformer is used to provide an l.t. voltage measure it. If the d.c. load is correct the l.t. voltage will give a useful cross check on the e.h.t. voltage because they are interdependent. Thus if you cannot measure the e.h.t. measure the l.t. instead. Similarly check the boost h.t.: if you have a stabilised valve line timebase adjust this voltage to the correct value before making any other changes.

## Field Scanning

The problem with field scanning is not so much a matter of getting the height of the picture right—this is usually easily adjusted by means of the height control—but of making it linear. Height problems do arise of course and fall into two categories. Either it is a simple matter of adjusting the height potentiometer network to get the right drive to the output stage, or else you find that whatever you do you cannot get enough field scan without it being hopelessly distorted. In the latter case the trouble nearly always lies in the feedback network(s) which are intended to improve the linearity. Any fault here will not only alter the linearity but will also affect the amount of drive to the output stage: too much feedback will reduce the height, too little will produce too much scan.

Before tackling this sort of problem it is helpful to be

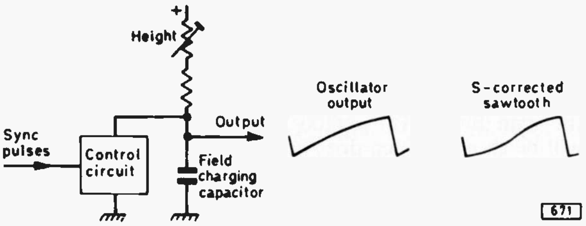



*Fig. 4: The field timebase generator usually produces a curved sawtooth waveform. What we really want is a symmetrical S-corrected sawtooth.*

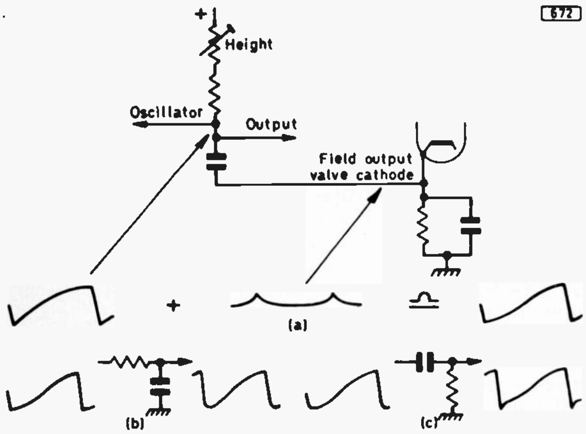



*Fig. 5: Shaping the field drive waveform. (a) Adding a parabola to the curved sawtooth makes it more symmetrical. (b) Integrating the sawtooth gives S correction during the first half of the scan. (c) Differentiating with a short time-constant tidies up the start of the scan.*

quite clear about what you are trying to achieve in terms of drive and output waveforms—and how these differ from the field oscillator output. Nearly all field oscillators consist of a *CR* charge network with an active stage—valve or transistor—to discharge the capacitor at a predetermined instant to provide the flyback stroke. Fig. 4 shows this type of arrangement. The capacitor charges during the scanning stroke from the boost rail (valve timebases) or a suitable l.t. line (transistor designs) via the height control and any series resistors. When the field sync pulse arrives the valve or transistor conducts and discharges the capacitor very quickly, producing the flyback cycle. The resulting waveform is a slightly curved sawtooth therefore. What we need however is the S-corrected waveform also shown in Fig. 4. The purpose of the feedback network between the output stage and the oscillator is to change the curved sawtooth into a completely symmetrical S-shaped sawtooth.

There is a wide variety of circuits used in field timebases, with some marked differences in detail between valve and transistor circuits. When these are analysed however it will often be found that the feedback shaping networks are achieving their objective in three distinct stages. If these processes are understood it becomes a fairly straightforward operation to modify—or fault-find—in any existing circuit.

The first stage consists of turning the gently curving sawtooth waveform into a straight line. This is done by adding a small amount of parabolic waveform to the sawtooth. In transistor circuits the parabola usually has to be manufactured, but in valve circuits a parabola exists at the cathode of the output stage. Adding this to the sawtooth produces a more symmetrical waveform—see Fig. 5(a).

Stage two turns this into an S-shaped curve by simple integration using a long time-constant *CR* network—see Fig. 5(b). Unfortunately although this produces quite a good S curve it also has the effect of rounding off the end of the flyback and the beginning of the scanning stroke. The result on the picture is that the top 10–20% gets compressed quite badly whilst the rest of the scan is linear.

Stage three puts this right. The new waveform is differentiated by a short time-constant *CR* network which affects only the flyback stroke and the beginning of the scan. This has the effect of straightening out the curve at the beginning of the scan and hence stretching the top of the picture.

The art in getting the field linearity correct in a new set lies in first identifying these three elements in the particular circuit, then looking at the picture to identify the type of fault present and finally going to work on the circuit that controls the part of the waveform involved.

There are of course occasions when this is more easily said than done. In some circuits, particularly transistor ones, it is not easy to identify the various shaping circuits until you are fully familiar with every aspect of the field output stage. There is a short cut however if you remember that it is the capacitors which are the key element in this type of circuit. Take each one in turn and add a duplicate component in parallel, thus doubling the capacitance. Dab it on and off and observe what happens on the picture. Try to relate the results with the three basic shaping characteristics we have discussed and illustrated. Adding a parabolic component as in Fig. 5(a) expands the bottom and compresses the top of the picture; integrating the waveform as in Fig. 5(b) compresses the top more than the bottom; differentiating it will expand only the extreme top if the time-constant is short—Fig. 5(c).

## Flyback Blanking

Blanking is a very unobtrusive part of the performance of a TV receiver—or at least it should be—because you are only aware of it when things go wrong. Nevertheless it is important. Without blanking you would see field flyback lines all over the picture and a white blur at the left-hand edge and possibly the right-hand edge as well.

The most common technique is to couple negative-going line and field flyback pulses to the grid of the c.r.t. In principle this is easy: in practice three problems commonly arise.

First, any capacitor used for coupling or shaping the field pulses will provide a low-impedance path to the high-frequency line pulses. Thus it may be difficult to get enough line pulse of the right shape on to the grid. Also line pulses could be fed back to the field timebase and this is always bad from the point of view of getting good interlaced field scanning. The answer is to isolate the field pulse circuit from the line pulses by a series impedance as shown in Fig. 6(a). The d.c. grid voltage feed must have a high impedance to avoid potting down the blanking pulses.

The next problem is to get adequate blanking over the *whole* of the blanking periods, both field and line. The pulses sometimes have to be integrated by means of a small capacitance to chassis in order to make them a bit wider. In other cases—where the height of the pulses at source is barely adequate—it may be better to differentiate them slightly to make the sides steeper.

The third problem lies in the disturbances that the

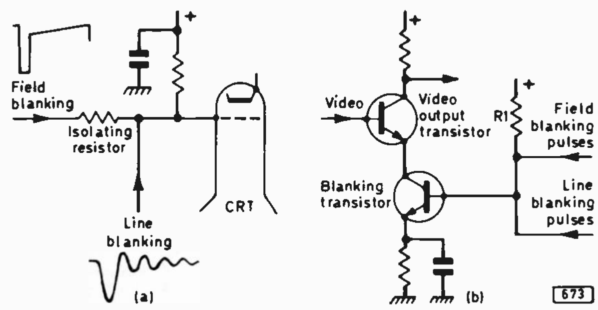



*Fig. 6: (a) Typical flyback blanking network. (b) Blanking pulses may alternatively be injected in the video output circuit.*

blanking waveforms introduce. Fig. 6(a) shows typical pulses at source. The field waveform has a sawtooth component while the line pulse is inevitably followed by some harmonic ringing from the line output transformer. The field sawtooth component will cause shading at the top of the picture while the line rings will appear as curtains across the screen. This difficulty can be overcome either by using larger amplitude blanking pulses a.c. coupled to the grid or by using a diode to clip the pulse train.

Not all designs use blanking at the c.r.t. grid. If an i.c. is used for video and sync processing it may have provision for field and line blanking: the same shaping problems arise but the amplitude of the pulses needed is a few volts only.

Another method which produces the same sort of results is to inject the blanking pulses via a transistor connected in the emitter or cathode circuit of the video output stage —see Fig. 6(b). Here part of the emitter resistance of the output transistor consists of a transistor which is bottomed by the bias supplied by resistor R1. The base of this transistor is also fed with blanking pulses which switch it off during the blanking intervals, causing the collector of the output transistor and hence the cathode of the c.r.t. to go positive towards cut off.

## Striations

Striations are a common problem and cause a very characteristic and unpleasant disturbance on the picture. They are the result of ringing in the line output transformer and there are two distinct mechanisms by which they can cause interference.

If you turn the brightness down until the screen is nearly black you may see dark vertical bars marching all the way across. If so you have line rings superimposed on the signal being fed to the cathode of the c.r.t. or present on the d.c. voltage applied to one of the other electrodes. You can check which electrode is involved by decoupling each one to chassis in turn with a capacitor of about a 0.1$\mu$F rated at 400V. Usually it's the grid or the cathode. If it's the grid you can probably decouple it permanently, but be careful of the blanking pulses if grid blanking is used.

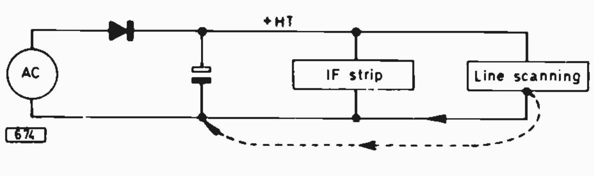



*Fig. 7: If line scanning currents flow through the i.f. strip earth all sorts of troubles can arise, including striations.*

Line rings sometimes appear on the signal itself. This is usually caused by line timebase scanning currents flowing in an earth path shared with high-gain signal circuits—see Fig. 7. It is almost always important to ensure that all line timebase currents have their own earth path directly back to the common mains input earthing point.

Now turn the brightness up high. If you see any striations the trouble is caused by rings present on the line scanning current. These result in the c.r.t. spot speeding up and slowing down, producing velocity modulation of the picture. The only cure is to reduce the rings at source by improving the transformer tuning or damping rings such as those caused by the linearity control. Harmonic rings tend to spread right across the picture: other sources of ringing are usually excited during the first quarter of the line scan only. With a well designed line output transformer you will see hardly any rings except possibly at the extreme start of the scan.

Good tuning of the harmonic ring component is designed into a line output transformer. For a given value of h.t., method of construction, number of turns in each winding and a particular winding technique there is only one value of scan current and e.h.t. which is compatible with minimum ringing. If your transformer is being operated correctly and the e.h.t. and scan are also correct there is not much that can be done to improve matters. Any change in the value of the tuning capacitor will alter the ringing but will also effect the e.h.t. and scan as we discussed earlier.

The only case where you have any scope for change is when the line output transformer has an adjustable coupling winding. This is not common practice but a few older designs used the technique. The degree of coupling between the main winding and the overwind can then be adjusted for minimum ringing. The e.h.t. will vary a little but probably not enough to need correction.

## User Controls

There isn't much that needs to be said about user controls. The basic principle is to make sure that they operate as smoothly as possible, both electrically and mechanically, and that their range of control is well suited to their purpose. It is rather irritating for example if tuning controls are so stiff that they hurt your fingers, or if the brightness control cannot be turned up or down quite enough to get a good picture. These are obvious points but quite important ones.

A contrast control needs a range of action of about 6:1 to cater for viewing conditions which may be anything from bright sunlight to complete darkness. A c.r.t. with a cut off of say 60V will need a maximum drive of 60–70V to allow for ageing and a minimum drive of 10–15V for comfortable viewing in conditions of near darkness. For a tube with a 30V cut off the figures become 30–35V and 5–10V.

Most tuners have reasonably good frequency stability but it really does pay to keep them cool. Avoid mounting them at the top of the cabinet in the middle of a blast of hot air from a mains dropper. Best of all place them at the bottom of the cabinet over some ventilation holes so that they stay close to ordinary room temperature.

Some mechanical push-button tuning gear leaves a bit to be desired in terms of reset accuracy. The tuning varies every time you reselect a channel because the oscillator has been tuned to a slightly different frequency. This is a purely mechanical problem and a little oil and attention to sliding fits can make a useful improvement.

**CONTINUED NEXT MONTH**

# VALVE AND TRANSISTOR Substitution Guide

M.A.HARRIS, B.Sc.

THE purpose of this article is to lay down guide lines for selecting suitable transistors and valves for replacement purposes in domestic equipment. We will deal with transistors first. Unlike valves transistors tend to have *near* rather than *direct* equivalents. When using a substitute type as a replacement it is essential to ensure that the device will be working within its ratings—this is especially important with output stages.

The first thing to do is to find out whether the device to be replaced is a germanium or silicon one and whether it is a pnp or npn type. In the case of audio output circuits if there is a transformer present the pair of transistors will be the same type (either two pnp or less commonly two npn). A negative supply rail (i.e. a positive earth) points to pnp devices and a positive rail to npn types but there are many exceptions. Alternatively a meter switched to "Ω" can be used to settle any doubts. Most meters (the author uses an Avo) when switched to "Ω" have their internal battery so connected that a negative voltage appears at the red, positive lead and a positive voltage at the black, negative lead. This is rather confusing but a second meter can easily be used to check that it is so. This requires doing only once and the meter can then be marked—to save remembering!

A resistance check will also weed out the more obviously duff transistors. The sort of readings to expect are shown in Table 1 (an AC127 and an AC128 were used to obtain these—with larger power transistors the "low" reading would be a lot lower, perhaps only a few ohms). High-power transistors can give spurious readings—in some cases one can never be sure whether a low reading is normal or a short-circuit. The transistor test circuit shown in Fig. 1 (with acknowledgements to *BRC Bulletin*) is useful in this respect. With switch S open lamp B2 should be out—if it is on there is a collector-emitter short-circuit in the transistor under test. With switch S closed both bulbs should glow—if B1 only glows the base-emitter junction of the transistor is short-circuit while if neither bulb glows the transistor is open-circuit.

Table 2 shows the sort of readings to expect when making resistance tests on diodes—both h.t. and signal types (h.t. ones read higher than one might expect because the readings are being made with a low test voltage).

## Semiconductor Devices

Now to deal with transistors type by type. We will start with audio types.

**AC126:** Germanium pnp transistor used mainly as an audio driver. Can be used to replace the following: NKT202, NKT204, NKT205, NKT206, OC75, XB102, XB104, XB112. Not the OC81D, see AC128.

**AC127:** Germanium npn transistor used mainly in low-power output stages (up to 750mW or so) with the complementary AC128. Will replace among others the AC157, AC160, AC168, AC172, AC175, AC181, and AC185. Also the NKT73 and NKT713 but not the higher power NKT773 (see later).

**AC128:** General purpose germanium pnp output transistor. Is used either in pairs or with an AC127 (up to 750mW) or an AC176 (up to 2W). Will replace a whole host of earlier, obsolete types, e.g. NKT203, NKT208, NKT211, NKT212, NKT216, NKT273, NKT275, OC71, OC72, OC81D, OC81M, OC81DM, OC82, OC76, and OC79, also all the AC types higher than AC105 with the exception of those listed for the AC127 and AC176 and the AC107, AC139, AC187, AC188. A lot of Japanese 2SB series are pnp transistors and can be replaced almost without exception with the AC128.

Note that if a transistor is noisy or if distortion is experienced—especially crossover distortion (recognised by the fact that the distortion is a lot worse at low volume

**Table 1: Typical transistor resistances.**

**PNP transistor (AC128 used)**

| *Red meter lead to:* | *Black meter lead to:* | *Resistance* |
|---|---|---|
| Base | Emitter | Low—about 200 Ω |
| | Collector | Low—about 200 Ω |
| Emitter | Base | Very High |
| | Collector | High (35k Ω) |
| Collector | Base | Very High |
| | Emitter | Medium (1.2k Ω) |

**NPN transistor (AC127 used)**

| *Red meter lead to:* | *Black meter lead to:* | *Resistance* |
|---|---|---|
| Base | Emitter | Very High |
| | Collector | Very High |
| Emitter | Base | Low (200 Ω) |
| | Collector | Medium (1.2k Ω) |
| Collector | Base | Low (200 Ω) |
| | Emitter | High (35k Ω) |

**Table 2: Diode resistance checks.**

| *Red meter lead to:* | *Black meter lead to:* | *Resistance* |
|---|---|---|
| Cathode (red dot or band) | Anode | Low (500 Ω) |
| Anode | Cathode (red dot or band) | Very High (greater than 1 M Ω) |

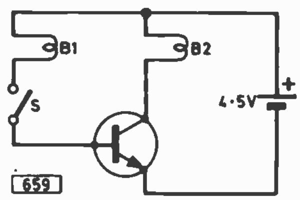



*Fig. 1: Simple test circuit for checking power transistors. B1, B2 3.5V 0.3A bulbs. For pnp transistors reverse the battery polarity.*

levels and gets appreciably less as the volume is turned up)—a good way of locating the troublesome transistor is to use one of those aerosol freezer sprays on the suspect one(s) whereupon the noise or distortion should decrease as the device cools.

**AC176:** A higher power version of the AC127. Usually used as a complement to the AC128. Can replace the AC 141 and NKT773.

**AC187, AC188:** Used for outputs up to 3W in complementary circuits. The AC187 is the npn one and the AC188 the pnp one. There are no equivalents and must be replaced therefore with the same sort. Can be used to replace lower output types such as the AC127, AC128 and AC176 though more expensive.

**AD149:** A much higher power type than the foregoing ones. Can replace the AC138, AC139, OC16, OC19, OC22–OC30 inclusive, OC35 and OC36, also the NKT 452. Can replace a single AD162, but not if the AD162 is in circuit with the complementary AD161.

**AD161, AD162:** An npn/pnp pair. There are no equivalents.

One word of caution with audio output transistors. A lot of earlier equipment used a pair of output devices with no emitter resistors—the emitters going direct to earth. When making a substitution it is always a good idea to include a low-value resistor (of the order 2.2Ω to 4.7Ω) in the emitter lead. This helps prevent thermal runaway.

Now to r.f. and i.f. types. With the following substitutions it will be found that little or no tweaking of coils or trimmers associated with the particular transistor to be changed is required.

**AF114:** An r.f. amplifier type for use in a.m./f.m. receivers. Replaces AF111, AF112, AF113 and AF125. Can also be used to replace the AF115, AF116, AF117, AF124, AF126, AF127, AF132 and AF133.

**AF115:** Oscillator/mixer for a.m./f.m. receivers. Can replace AF114 in this application, also the OC170 and OC171. Will replace the AF116, AF117, AF125, AF126, AF127, AF132 and AF133.

**AF116:** An i.f. amplifier transistor for f.m. receivers. Can replace the OC170 and OC171 in this position, also the AF117, AF132 and AF133.

**AF117:** Used in the mixer/oscillator and i.f. amplifier stages of a.m. only receivers. Replaces the obsolete OC44 and OC45. Can also be used instead of the AF127 and AF133.

**AF124/5/6/7:** Can be used as direct equivalents to the AF114–AF117 respectively.

**AF139:** This can be used as an equivalent to the AF186 which is obsolete. A lot of earlier integrated v.h.f./u.h.f. tuners used the AF186.

**AF178, AF179, AF180, AF181:** These have no real substitutes and should be replaced by the same type.

The foregoing types are all germanium transistors and with the exception of the AC127, AC176, AC187 and AD161 and equivalents are pnp types. Next we come to silicon transistors.

**BC107:** An npn audio driver, also used for signal processing in TV sets. A higher-power version really of the BC108 which it can replace if necessary though this is not usually worthwhile since it is dearer. If one is desperate it can also replace the BC109 but will be a lot noisier. Like the BC108 and BC109 the BC107 has a "Lockfit" equivalent. Lockfit transistors have connections in the form of three self-locking rigid strips and are designed to fit into printed circuit boards with standard grids. These equivalents are direct, i.e. they are the same devices in different encapsulations. BC107 = BC147, BC108 = BC148, BC 109 = BC149. The remarks given for the BC107, BC108 and BC109 apply to the BC147, BC148 and BC149. Thus the BC107 can also replace the BC108, BC109, BC147, BC148 and BC149.

**BC108:** A general purpose audio and driver transistor also used in TV circuits. Will replace the BC148 and BC149 (noisier). Will not usually replace the BC107 and BC147.

**BC109:** A low-noise device designed for the input stages of high-fidelity and high-power amplifiers. Equivalent to the BC149. The BC109 will replace the BC108 and BC148 but is a dearer component.

**BC147/8/9:** Lockfit versions of the BC107, BC108 and BC109. Same remarks apply.

**BC157/8/9:** Lockfit devices. Same specification virtually as the BC147, BC148 and BC149 but these three are pnp types. Remarks about replacements for each other are the same as for the BC107, BC108, BC109, BC147, BC148 and BC149.

**BC186:** A pnp device. Can replace the BC158 and BC159. It can also replace the BC157 provided the voltage rating is not exceeded (the BC186 has a $V_{cbo}$ of 40V and a $V_{ceo}$ of 25V while the BC157 has a $V_{cbo}$ of 50V and a $V_{ceo}$ of 45V). When used as a replacement for the BC159 expect an increase in noise. It is not a lockfit type, but an ordinary sort.

**BD series:** These are higher power devices. Replacement with other than the same type is not recommended.

**BF115:** An npn transistor which can be used as an r.f. or i.f. amplifier, or a mixer/oscillator, in a.m./f.m. sets. Some foreign sets use npn transistors and this makes a useful replacement. Can replace the Lockfit BF194 and BF195.

**BF167:** An npn device usually used as an a.g.c. controlled transistor—the first i.f. stage for instance. It replaces the BF158 and BF164. Has a Lockfit near equivalent, the BF196, and can replace or be replaced by this.

**BF173:** An npn i.f. transistor. Can replace the BF158 and BF159. Has a Lockfit equivalent, the BF197.

**BF180:** An r.f. amplifier for integrated u.h.f./v.h.f. tuners. Can replace the BF200 if necessary, but this is not recommended.

**BF181/2/3/4/5:** These do not have equivalents and replacement by the same type as the original is preferred.

**BF194:** Lockfit a.m./f.m. i.f. amplifier. Can be replaced by the BF195 (Lockfit) or BF115.

**BF195:** Lockfit a.m./f.m. r.f. amplifier and mixer/oscillator. Can replace the BF194 or be replaced by the BF115.

So much for transistors. The 2N series has not been mentioned because there are far too many to be listed in any completeness and also because they are not often found in domestic equipment.

Now to diodes. With the exception of those used in colour circuitry and varicap diodes which must be replaced by the correct type there are really only two sorts to deal with, signal and power diodes.

**Signal diodes:** Whatever the original, whether a detector, discriminator, etc., in practice an OA81 or OA91 can be used. For discriminator use it is of course essential that the two diodes are balanced. This is done by means of a resistance check. See Table 2 for the readings to be expected. A lot of sets use a pair of diodes in a single encapsulation for the flywheel line sync discriminator (a field interlace diode may be incorporated as well). These must be replaced in pairs—and preferably balanced for the same forward resistance using a meter. These multi-encapsulated diodes have a habit of going very high in both directions.

**Power diodes for h.t. rectification:** These include the BY100, BY127, OA211 and OA214, among others. The current one (no pun intended!) is the BY127. Into this category can be included finned rectifiers and the contact-cooled types which can also be replaced with a BY127—

when doing so a series resistor of 10Ω and 10W or 15W rating should be fitted as silicon rectifiers have a lower forward resistance than their older counterparts. The series resistor will keep the h.t. voltage to its correct figure and also limit the surge current into the reservoir capacitor.

## Valves

**U.H.F. r.f. amplifiers:** This is the PC88 and its less known brother the EC88. There are no equivalents so replacements must be the same type.
**V.H.F. r.f. amplifiers:** There are a number of these valves, the ECC84, ECC88, ECC89 and ECC189 and the series heater equivalents PCC84, PCC88, PCC89 and PCC189 respectively. There are also the Mazda types 30L15 and 30L17. The E/PCC84, E/PCC89, 30L15 (≡PCC805) and 30L17 (≡PCC806) all have the same pin connections but have different mutual conductances as follows:

| | | | |
|---|---|---|---|
| E/PCC84 | 6mA/V | 30L15 | 9mA/V |
| E/PCC89 | 12mA/V | 30L17 | 15mA/V |

If the original is a PCC84 a 30L15 can be tried. Although the other two valves will fit and possibly work they are not recommended because the r.f. stage is adjusted to suit a particular valve and problems of instability may arise—especially at the bottom of Band I. Another point to bear in mind is that the 30L15 and 30L17 are quite considerably more expensive than certain counterparts. The PCC84 for example retails at approximately half the cost of a 30L15. Thus if one is to hand fair enough, otherwise it is not worth the change. This variation in prices will be found several times later.

The E/PCC88 and E/PCC189 are not often encountered but to all intents and purposes can be interchanged. The E/PCC88 is a straight valve whereas the E/PCC189 is a vari-mu valve. In cases of cross-modulation due to too high a signal it may be an advantage to fit an E/PCC189.

The later v.h.f. tuner r.f. amplifier valves are the triodes PC97 and PC900: these have no equivalents.
**Radio r.f. amplifiers:** F.M. sets generally use an ECC85. This can be replaced with an ECC88 or ECC189. There is no advantage—it depends what is in the spares box. An EF80 is sometimes encountered—this will be dealt with in the section on i.f. valves.
**U.H.F. frequency changers:** The PC86 (and its parallel heater equivalent the EC86) has no equivalent.
**V.H.F. frequency changers:** Here there are one or two equivalents that can be used. The original PCF80 and PCF82 are sometimes encountered—the PCF82 can usually be replaced with the PCF80 but the converse does not always work. This is an advantage since a PCF82 is more than twice the price of a PCF80.

The PCF84 is not often found these days. It is interchangeable with the more common PCF86. The later PCF801 and PCF806 are interchangeable.

The next three valves are Mazda ones and although there are equivalents there are no savings to be made. 30C15 ≡ PCF800, 30C17 ≡ PCF87, 30C18 ≡ PCF805.
**Radio frequency changers:** The usual one encountered is the ECH81. Its series counterpart is the UCH81. The ECH81 has the same pin connections as the ECH83. The ECH83 can be used to replace the ECH81 but as the ECH83 was designed for a 12V supply—e.g. in car radios—the ECH81 will not replace the ECH83. It may sound a bit drastic using a 12V type valve on around 200V, but the valve seems quite happy to do this. The earlier types—the UCH42 and ECH42—do not have equivalents.
**I.F. valves:** These seem to be similar whether used for radio or TV sets. There are a lot of them, all with the same pin connections. If really necessary all can be interchanged although performance may (and in some cases will) suffer. They are the EF80, EF85, EF183, EF184, 6BW7, 6BX6, 6F19, 6F23, 6F26, 6F29, 6F30 and 30F5.

To start with the best known i.f. valve, the EF80. This is an early post-war type developed from the B9G based EF50. It says a lot for the design that it is still occasionally used in current designs. It is a straight pentode, directly equivalent to the 6BX6, and without any loss of performance can replace the 6BW7. The higher gain versions are the EF184, 6F23, 6F30 and 30F5. Strictly speaking the mutual conductance of the frame-grid types EF184 and 6F30 is higher than that of the 6F23 and the 30F5. These valves are generally used in i.f. stages to which a.g.c. is not applied.

The vari-mu i.f. valves—for stages to which a.g.c. is applied—are the EF85, 6F19 and 6F26. Frame-grid higher gain versions are the EF183 and 6F29.

As a guide, generally replace a low gain valve with a low gain one and a high gain valve with a high gain one. Occasionally one comes in TV sets across triode pentodes with the pentode section used as an i.f. amplifier. The PCF80 and 30FL1 for example. No real equivalents here.

In radio sets the EF89 may be encountered. An EF80 can be used (or an EF85) provided the cathode is connected to earth or to the screening and the suppressor grid: the reason for this is that while on an EF80 pin 1 is connected to the cathode on the EF89 pin 1 is connected to the valve screening.

Other valves encountered are the EBF80 and EBF89 which incorporate two diodes. These two have the same pinning, the only difference being that the EBF80 is a straight valve and the EBF89 a vari-mu type. Some difference in a.g.c. can be expected if these two are interchanged but this is not usually enough to be troublesome.
**Detector:** If not a semiconductor type or incorporated in the last i.f. valve (e.g. in the EBF80/89) this is invariably an EB91 double diode or its equivalent the 6AL5. The only way of replacing these is with two diodes such as the OA81. These can either be wired across the valve base or wired on to a B7G plug—one diode going from pin 1 (cathode) to pin 7 (anode) and the other from pin 5 (cathode) to pin 2 (anode). In a series heater chain (as in most TV sets) a 22Ω 2W resistor must be included, either across pins 3 and 4 or somewhere convenient—e.g. at the end of the dropper.
**Video amplifier:** Usually one of the following: EF80 (rare nowadays), PL83, PL84, PCF80, PCL84, PFL200, 6F28, 30FL1. The PL84 has the same pinning as the PL82 but the exchange is not recommended. The others do not have equivalents.
**Sync separator:** Generally chosen from the following: EF80, ECH84, PCF80, PCL84, PFL200, ECC83. In place of the EF80 any of the straight pentodes could be used as discussed in the i.f. section. The ECH84 could be replaced by the ECH81 or ECH83 provided the connections to pins 1 and 7 are interchanged. The PCF80, PCL84 and PFL200 have no equivalents. The ECC83 (12AX7) has a few plug-in replacements which could be used, possibly with some degradation of performance. They are the ECC81 and ECC82 but the change is not recommended.
**Timebase oscillators:** A number of valves can be used here. Very often the triode of a triode-pentode is used, the pentode section being employed elsewhere e.g. as sync separator, flywheel d.c. amplifier, even sound output or sound i.f. amplifier. Manufacturers tend to use whatever is available. The field oscillator is generally part of the same valve as the field output, e.g. PCL82, PCL83, PCL85, PCL805. More about these valves in the appropriate

section. Double triodes are often used, for example the ECC81, ECC82, ECC83 and 6/30L2. The first three have the same pinning and ECC81s and ECC83s can be interchanged easily. An ECC82 is generally allowed to draw more anode current than the other two so a replacement here would have to be on the basis of "suck it and see". The 6/30L2 is a very similar valve to the ECC82 and can be interchanged with it provided the connections to pin 9 are removed: on the ECC82 (and ECC81 and ECC83 for that matter) pin 9 is a tapping on the heater. For series operation pins 4 and 5 are strapped together and the heaters taken from 4, 5 and 9. On the 6/30L2 the heater pins are 4 and 5 and pin 9 is an internal screen. A small wiring modification is thus necessary. The 6/30L2 is twice as expensive as the ECC82 so using an ECC82 to replace it is quite an attractive proposition. The Thorn 850 series (a chassis used in a number of Ferguson, HMV, Marconiphone, Ultra, etc. models) used a 6/30L2 and this small modification is well worthwhile. The opposite swop is not recommended, primarily from a cost point of view.

There is no equivalent to the PCF802 used in sinewave line oscillator circuits.

**Field output:** The earlier types were the PL82, PL83, PL84, 30P12, 30PL1, PCL82 and PCL83. The later types are the PCL85, PCL805, 30PL13 and 30PL14. The PL82 and PL84 have the same pin connections and can be exchanged if necessary. The 30P12 can also be included here and as this is something like twice the price of the other two the change is well worthwhile. The PCL83 was not often used as the field output valve—perhaps as well since it used to draw grid current very easily—but the 30PL1 was. These two have the same pinning so an exchange could be made. The PCL82 and 30PL13 can be interchanged but the 30PL13 seems to have more "urge" than the PCL82—it is also twice the cost. The 30PL13 will replace the PCL82 but the opposite swop does not always work. It is a case of try it and see.

The current field output valves are the PCL805 and 30PL14. The PCL805 started life as the PCL85 but this was a bad valve generally and was replaced by the PCL805. It has no equivalents. The 30PL14 has the same pinning as the 30PL13 and the PCL82 but the substitution is not worth it—there is not usually enough height available.

With all these alternatives to try the height and linearity usually suffer and whether the controls have sufficient range to correct matters can only be found out by adjustment. It can be well worth trying however because it might work out and can mean the difference between a blank screen over the weekend or a picture of sorts.

**Sound output:** In some older sets several "non-audio" valve types were used—for example the EF80 and the F sections of the PCF80 or 30FL1. These never gave a large output and needed frequent replacement. The more usual types encountered are the PCL82, PCL83, PCL86 and 30PL1. The PCL82 can be exchanged with the 30PL13 but as mentioned in the last section the swop is not worth while. The PCL83 and the 30PL1 have the same pinning and so can be interchanged. The PCL86 has no equivalent. Many sets used the same type of valve for field and sound output. If a replacement is necessary it is a good idea to put the new valve in the field output position as a lack of emission here will give rise to lack of height and especially cramping at the bottom of the picture. The ex-field output valve could be put in the sound output place as a lack of emission here simply causes the maximum output to be less—and the volume control is very rarely used flat out anyway.

**Line output:** The line output valve is generally worked very hard, as is the boost or efficiency diode. The older sorts are the 20P4 (which has no equivalent), the 50CD6 (again no equivalent) and the 6CD6—a parallel heater version of the 50CD6—which can be replaced by a 6BG6 although the width is invariably less. The later types are the PL81, PL36, PL302, PL500, PL504, 30P4 and 30P19. The PL81 has no equivalent. The PL36, PL302, 30P4 and 30P19 all have the same pin connections and can be interchanged—usually by the PL36. The 30P4 seems to have a little more "urge" than the PL36. There was a Murphy chassis which used a single valve to double as both line output and line oscillator: the valve was coded 30P4MR (the MR standing for Murphy Radio) and a replacement should be the same sort or the line timebase might not operate at the right speed. The 50CD6 can be replaced by a PL36 provided (a) the valve base is rewired to the appropriate pins—pin 8 to pin 4, pin 3 to pin 8, and all connections (if any) to pins 1, 3 and 6 removed—and (b) a resistor of 83Ω 10W is inserted somewhere in the heater chain. This resistor can be made up from convenient values. The PL500 has been superseded by the PL504 which has no equivalent.

**Boost diode:** The older types are the PY31, PY80, U152, U309, U281, U282, U191, U301, U339 and PY301. The PY80 (and its equivalents the U152 and U309) can be replaced by the PY81 and its equivalents if the wire from pin 3 is removed from that pin, extended, and connected to the top cap. The U191, U281, U282, U301, U339, PY301: apart from the U191 being equivalent to the U339 and PY301 these valves must be replaced with the same type. Two other older types are the 6U4 (no equivalent) and the 25U4 (again no equivalent). Now we come to the present crop of boost diodes: PY81, PY83, PY88, PY800, PY801, U153, U193, U251 and U349. The PY81 and PY83 are now obsolete, having been superseded by the PY800 or PY801. As the U153 and U349 are the same the PY800 or PY801 will do for them. All these valves have a heater voltage between 17-19V. The next three have higher heater voltages and so the heater chain would strictly speaking need modifying in order to use them as replacements. They are the PY88 (30V), U251 and U329 (25V). In practice replacing a PY88 with a PY800 would cause the heaters to be overrun by some 6%. The mains tapping for the heaters can be moved from the normal 240V tap to the 250V tap to take care of that. For the U251 and the U329 using a PY800 or PY88 for replacement purposes would mean respectively overrunning and underrunning the heaters by approximately 2% which is not worth bothering about.

**EHT rectifiers:** The older types—the EY51, R12 and U25 have wire ends. The R12 and the EY51 are the same valve. These and the U25 have no direct equivalents. They can however be replaced with a later type—one with a B9A base—to make subsequent replacements easier. The EY51 can be replaced by the later EY86/7, assuming of course that there is room to fit it in the line output can. The heaters are connected to pins 2, 5 and 8 strapped, and 1, 4, 6 and 9 strapped. The feed to the c.r.t. final anode is taken from pin 1, 4, 6 or 9. The EY51 anode wire goes to a top cap on the EY86/7. There are no connections at all to pins 3 and 7. The earlier plug-in types were R19 and R20. The R19 can be replaced by a DY86/7 but this puts additional strain on the line output stage as the heater power requirements are more, the R19 taking 0.625W while the DY86/7 takes 0.77W. The line output valve and boost diode must be in good condition to cope with this. The current types are the DY86/7, EY86/7 and U26. The first two have already been discussed. The U26 has no equivalents and must therefore be replaced with the same type.

**HT rectifiers:** The older types are the U801 and PY82. The U801 is a large valve with two full-wave rectifiers inside.

One was generally used as the h.t. rectifier and the other half as the boost diode. It should be replaced with the same sort although the base could be rewired for one of the octal boost diodes (with the 0.2A heater—same as the U801) and the h.t. part replaced with a silicon diode. The PY82 was generally used in pairs—in parallel, with separate surge limiters for each anode. If the emission has dropped (and *not* if the valve has gone soft—signified usually by an attractive purple glow inside the valve) the valves can be left in circuit as far as the heaters are concerned and a silicon diode used for the h.t. rectification. This also applies to the current type—the PY33. The original was called the PY32 but the manufacturers superseded it with the PY33.

The present form of h.t. rectification uses a silicon diode—the BY127. This will replace all the earlier sorts of silicon diodes—the OA211, OA214 and BY100.

A lot of sets have (or had) either a finned metal rectifier or a contact-cooled type. These are usually replaced with a BY127. A surge limiter should always be used as the BY127 has a much lower forward resistance than the metal type. The easiest way is to use a small tagstrip—see Fig. 2. The short length of wire between the resistor and the rectifier is to prevent the heat from the resistor upsetting the diode.

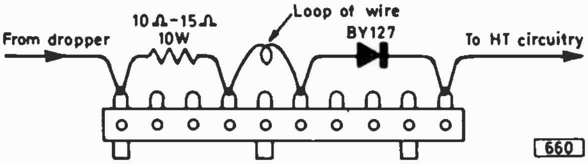



*Fig. 2: Using a BY127 as a substitute h.t. rectifier.*

The above notes are by no means exhaustive and no mention has been made of valves specifically designed for colour sets. These are usually fairly high-power types designed for a specific job and by and large have no equivalents. Direct equivalents—i.e. the same valve made by a different manufacturer but given another number, e.g. ECC83 ≡ 12AX7 ≡ B339 ≡ 6L13—have not usually been mentioned since this sort of information can be obtained from any valve manual.

For devices of foreign origin where little or no information is available this article lays down very general guide lines for substitution with more readily available parts. ■

# MILLER'S Miscellany

Chas. E. MILLER

SEATED one day in the workshop I was weary and ill at ease. This was odd because I had just managed to repair a mind-boggling fault on a colour set. Why was I not elated then? Because I had just realised I was obsolescent. The fault, on a transistorised i.f. strip, had taken me far too long to find to make the exercise commercially viable as they say—a similar fault on a valve chassis would have taken me a fraction of the time to trace.

As the i.c. or "chip" continues on its all-conquering way servicing as we know it at present could disappear. The valves are going out all over Europe, and we shall not see them relit in our time! As the late Lord Nelson might have said, i.c. no ships, only hardships! In future a simple fault like field scan collapse will no longer mean a PCL805, a quick cup of tea, and thank you kindly madam! It will entail changing a panel which naturally will not be in stock and as it will take at least twenty-eight days by return of post to obtain one from the manufacturers more and more loan sets will have to be lugged around. This will inevitably lead to a higher incidence of hernias amongst service engineers, thus causing National Insurance contributions to rise. Where will it all end?

There are two sides to every story however and there will be a few compensations for us panel-jockeys. It should put a stop once and for all to the "my husband thinks it's a valve" routine! And when a puzzled owner tells us his faulty set was perfectly all right the previous evening we shall be able to remark—with a smirk—another case of chips that pass in the night! Erstwhile valve salesmen will blandish us with cries of "i.c.s, come and get your i.c.s, they're lovely!" But the ultimate as far as I'm concerned will come when I can swagger up to the bar—sorry counter—of my local wholesalers and snarl "gimme a stack of chips!"

Have you ever listened to a radio programme and groaned aloud as a piece of test card music has been played? Well, something even more upsetting occurred to me whilst I was patronising our local cinematographic emporium. Immediately following an advertisement for high-speed gas test card C flashed on the screen for a split second! "Did you see that?" I gasped to the better half, who replied by making some unfavourable comments regarding my eyesight. When quizzed, the projectionist seemed inclined to humour me, but honour was vindicated some weeks later when he took the trouble to present me with a strip of 35mm film containing a dozen or so frames of test card C which he had snipped from the reel of adverts. Nobody seems to know how or why they got there however, so could any reader . . .?

The following two tales were told to me by my local friendly aerial supplier who swears they are true.

The first concerns a "fly-by-night" character who rather than erect genuine aerials chose to construct his own with an ingenious mixture of wooden broom-handles, six-inch nails, scrap pieces of tin and broken 5-amp sockets! As these were mainly put up in virtual sight of the local relay transmitter the results were tolerable. Our hero finally tempted fate by using one of his contraptions in a bad spot: furthermore, he was foolish enough to allow it to straddle a chimney pot. As the soot built up so the signal strength dropped! The customer's complaints were deflected by putting the blame on low power, bad weather, etc. until at last reception ceased altogether. Thoroughly irate, the customer phoned up and bellowed "you'll have to do something about that aerial now, the so-and-so thing caught fire last night and fell off the flipping roof!"

The second story tells of an aerial erector who owns a very small van. Apparently he arrives at my friend's factory from time to time and buys a quantity of 18-element u.h.f. arrays. As they are slightly too long to fit in his van he sits down with a hacksaw and busies himself for half an hour. Then off he goes with a load of 17-element aerials neatly packed inside! ■

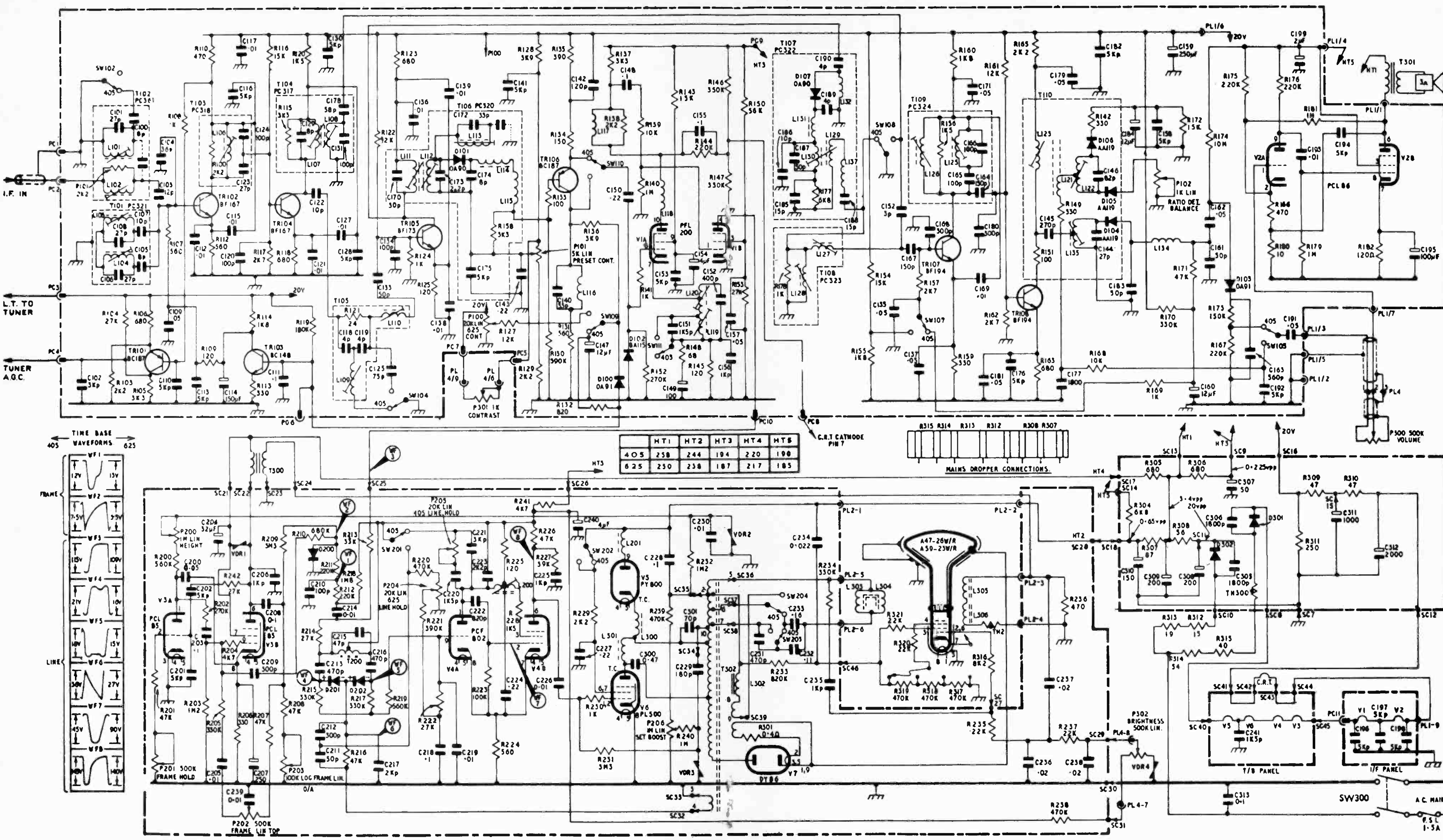



*Fig. 1: Main chassis circuit diagram, GEC 2032 series. R110 is 680Ω in some receivers. In later production V6 is a PL504, TR102 a BF196, TR104 and TR105 are type BF197.*

Vision normal, 405 sound normal, 625 sound distorted with buzz: check the back-to-front resistance of the ratio detector diodes, the alignment of L123 and L122, C184 and trim P102 for minimum buzz. Consult makers alignment data and carry out 6MHz tuning carefully.

If sound distortion is present on both standards check the output stage valve (PCL86) and the associated components, particularly R182 120 Ω which is often damaged by a faulty valve.

Sound normal on both standards, vision signal distorted with very bad resolution: check TR106 collector voltage (7.6V). If this is wrong check the transistor.

Picture lacking in contrast: check PFL200 cathode voltage (2.8V approximately). If correct check the preset contrast control and if the 625 sound is affected check TR105 (1V at emitter).

These are of course normal faults and there are many others which can afflict the less fortunate.

CONTINUED NEXT MONTH

# LONG-DISTANCE TELEVISION

ROGER BUNNEY

As I write these lines the 1973 Sporadic E season is well under way—after a rather belated start. Activity was on the increase at the beginning of May but things didn't "open up" as expected. There were certainly a number of minor openings early in the month and on several days signals of rather weak ch.R1 origin riding just over the receiver noise level were trying to get in. The first main opening occurred on May 19th and since that date things have been humming with daily openings of long, strong signals. It has been difficult so far to determine whether there is any particular direction of main activity as signals have arrived from most countries. Up to now the longer skip signals have come in best—the USSR in particular has dominated most early morning openings. One country that has been lacking is Iceland (RUV) which is normally well received when longer skip signals are favoured. At this location (near Southampton) the nearer countries have been missing, with no sign of West Germany, East Germany, Denmark—a difficult one at the best of time—or Switzerland.

## "Exotic" Reception Confirmed

An important confirmation has been received relating to the "exotic" reception mentioned in last month's column. Hugh Cocks at Mayfield had reported possible reception of the Rhodesian Gwelo transmitter on ch.E2. Immediately following this reception details were sent to Rhodesia Television Ltd. at Salisbury and the Head of Engineering has now replied indicating that the reception noted by Hugh on April 24th did in fact check with the transmission log for the programme at the time coming from the Salisbury studio! It can be taken therefore that the signal originated from the Gwelo transmitter. I am sure all readers of this column will wish to congratulate Hugh on this magnificent reception which I feel can be regarded as something of a record—certainly I have heard of no other reports of this transmitter being received so far North.

## Log and Report

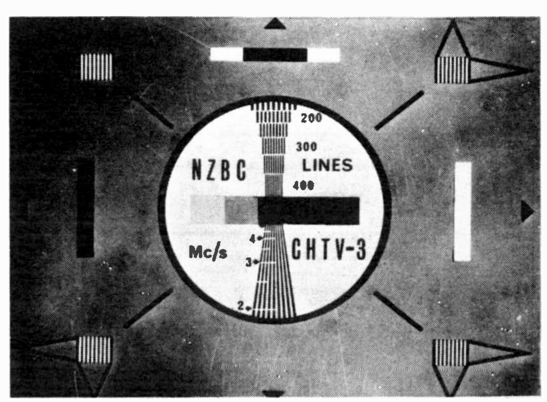
From the exotic to the more run of the mill receptions—in fact my log for the period:

1/5/73 TVP (Poland) ch.R1; CST (Czechoslovakia) R1—both MS (Meteor scatter); various ORTF (France) tropospherics at u.h.f.
2/5/73 ORF (Austria) E2a; SR (Sweden) E2—both MS; NOS (Holland) E4—trops.
3/5/73 SR E2; CST R1—both MS.
4/5/73 TVP R1—MS; NOS E4—trops.
6/5/73 WG (West Germany) E2; SR E2; NRK (Norway) E4—all MS.
7/5/73 DFF (East Germany) E4; CST R1; SR E2—all MS.
9/5/73 TVP R1—MS.
10/5/73 SR E2; TVP R1—both MS.
11/5/73 MT (Hungary) R1; CST R1—both MS.
12/5/73 DFF E4; CST R1—both MS; BRT/RTB (Belgium) E8, 10—both trops.
13/5/73 NOS E4—trops.
14/5/73 WG E2; SR E2; CST R1; ORF E2a—all MS; TSS (USSR) R1; ch.R1, 2 unidentified—all SpE; NOS E4; BRT E8—both trops.
15/5/73 DFF E4—MS; also ORTF u.h.f. trops.
16/5/73 CST R1—MS.
17/5/73 DFF E4—MS; BRT/RTB E8, 10—both trops.
18/5/73 CST R1—MS; TSS (USSR) R1—SpE.
19/5/73 TSS R1; CST R1; MT R1; NRK E2, 3; RAI (Italy) 1A—all SpE (the first good SpE of the season logged here); NOS E4—trops.
20/5/73 NOS E4—trops.
21/5/73 WG E2—MS.
23/5/73 TSS R1; MT R1; TVP R1, 2; CST R1; TVE (Spain) E4; RAI 1A, 1B—all SpE, plus various unidentified signals.
24/5/73 CST R1; TVP R1; TSS R1, 2; MT R1, 2; TVR (Rumania) R2; SR E2; TVE E2, 3, 4; RAI 1A, 1B; also many unidentified signals—all SpE; see later re unusual signal!
25/5/73 TSS R1, 2, 3; MT R1, 4; CST R1; JRT (Yugoslavia) E3, 4; ORF E2a; TVE E2, 4; ORTF F2; plus many unidentified signals—all SpE; various ORTF u.h.f. trops.
26/5/73 TSS R1 twice; TVP R1, 2, 3; CST R1; MT R1; RAI 1A, 1B; JRT E4; SR E2—all SpE.
27/5/73 RAI 1A; TVE E2, 4—all SpE; BRT/RTB E10—trops; various ORTF u.h.f. trops—including a new one here—Chartres E50!
28/5/73 CST R1 twice; TSS R1, 2; RAI 1A, 1B; JRT E3, 4; SR E2, 3, 4; NRK E2, 3; YLE (Finland) E2; plus various unidentified signals—all SpE.
29/5/73 TSS R1; TVE E2, 4; also unidentified signals—all SpE.
30/5/73 CST R1; RAI 1A; JRT E3, 4; TVE-2 E2; TVE-1 E2—all SpE; CST R1-MS.

On May 6th a great number of short bursts of signal were noted—undoubtedly from the May Aquarids meteor shower. On May 19th whilst tuning casually over the u.h.f. spectrum observing the noise and little else a short series of signal fluctuations was noted on ch.E34 from the ORTF-2 transmitter at Metz. This lasted for about 20 seconds and no other u.h.f. signals of any note were received at this time. Since tropospherics were at a low level during this period I can only assume that the signal was some form of aircraft scatter/reflection.

An unusual reception via SpE was noted on May 24th on ch.E2 from 1810 BST onwards. It came from a southerly direction and consisted of what appeared to be a pulse and bar (or 2T pulse and bar) pattern with smeary multiple images running at a line frequency slightly lower than the usual 625-line standard (the line hold control needed resetting for this). At 1813 it changed to a fine grid (graticule/crosshatch) and then back to the original pattern. The signal persisted until after 1930 when it annoyingly faded into the noise still carrying the original pattern. I've no idea of its origin—did anyone else have better luck with it?

It was something of a pleasure to note the close-down of TSS




*New Zealand monochrome test card—Christchurch channel 3. Courtesy M. Dolci.*



# SERVICING television receivers

L. LAWRY-JOHNS

## GEC MODELS 2032 & 2033

THESE receivers and the identical Sobell Models 1032 and 1033 feature a four-band integrated tuner, silicon transistor i.f. stages and seven valves.

### Tuner Unit

Any tuner which has to function at v.h.f. and u.h.f. must necessarily be a bit of a mess and present problems due to the switching and tuning. The fact that they work as well as they do is a never ending source of wonder to the simple mind of the writer. Three transistors are employed: one works some of the time (v.h.f. only) while the other two work all the time. The 12V supply required by the tuner is derived from the main panel 20V line at PC3 via suitable resistors.

Forward a.g.c. is applied to the r.f. transistor TR1 (BF180) from PC4. Some less technical readers who are happy with negative a.g.c. being applied to a valve to reduce its gain are not so happy to find positive voltages being applied to the equivalent of the grid (to make an npn controlled transistor conduct more) in order to reduce the gain. Once it is realised however that increased current reduces the collector voltage available due to the voltage drop across a supply resistor and that this reduction produces a more even reduction of gain the whole thing falls into place without too much explanation.

The transistor which works only some of the time is the v.h.f. oscillator TR3 (BF115). We have already mentioned the r.f. transistor TR1: this leaves us with TR2 (BF181) which operates as an oscillator/mixer on u.h.f. and as a mixer only on v.h.f. (it doesn't like oscillating at low frequency, hence the separate oscillator TR3). The tuning on u.h.f. is by ganged capacitors and on v.h.f. by ganged inductors (slugs moving up and down).

Weak and grainy reception on v.h.f. with little reception at all on u.h.f. would tend to suggest a damaged TR1 (BF180). Normal v.h.f. with nothing on u.h.f. would tend to suggest a BF181 which is reluctant to oscillate. Normal u.h.f. with no v.h.f. should direct attention to TR3 which again could be reluctant to oscillate. At all times the correct operation of the switch sections should be checked. The a.g.c. voltage at PC4 (TR101 collector) should be about 3V according to the signal input.

### IF Strip

The i.f. output signal from the tuner is taken to PC2 (screening to PC1) where it is applied to the first i.f. transistor (TR102) which may be a BF167 or a BF196. It is worthwhile spending a moment to consider the circuit of this stage since its operation determines the amount of a.g.c. applied to the tuner. The conduction of the second a.g.c. amplifier TR101 is controlled by the collector voltage of TR102 (via R108) not by the a.g.c. line as such. The latter operates on the first a.g.c. amplifier TR103 which in turn forward biases TR102 so that as its collector current increases the resultant voltage drop across R110 brings the pnp transistor TR101 into operation to control the a.g.c. applied to the tuner.

The a.g.c. line voltage applied to TR103 from the a.g.c. detector D100 is negative going. This reduces the conduction of TR103 which is normally passing maximum current (saturated). It therefore provides a rising positive voltage at its collector as signal strength rises, forward biasing TR102 and thus the tuner r.f. amplifier via TR101.

The voltage drop across the emitter resistor R112 of TR102 should be 4V or more (more as the signal strength rises). No voltage here indicates that the transistor is not working.

The second i.f. stage TR104 is not controlled and its emitter voltage should be a clear 3.5V if the supply and the transistor are in order. The 405 sound i.f. is picked off in the collector circuit of TR104 while the 625 sound is taken from the collector of TR105, the emitter voltage of which should be 1V if the transistor is functioning normally.

The vision signal is detected by D101 and passed to a phase-splitter transistor TR106: here the 625 signal is extracted from the collector and the 405 signal from the emitter to present the correct signal polarity to the video amplifier V1 (PFL200).

The a.g.c. voltage is derived from TR106 collector. The level of this voltage is determined by the base voltage of TR106 which is set by the contrast and preset contrast controls, acting via D101. Whilst the contrast control is quite reliable in operation the preset tends to develop poor contact either at the point of wiper contact or at one end, producing a profound effect on the picture and sound when the control is disturbed.

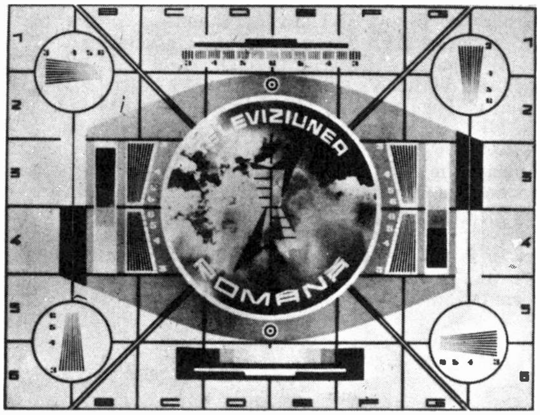
It will have been observed that the 625 sound signal is taken from the i.f. stage prior to the vision detector. A separate diode D107 is used to detect the sound signal and produce the 6MHz intercarrier signal which is amplified by TR107 and TR108 before being presented to the ratio detector D105, D106, etc. and then passed via R149 and R168 to the volume control by way of the system switch SW105.

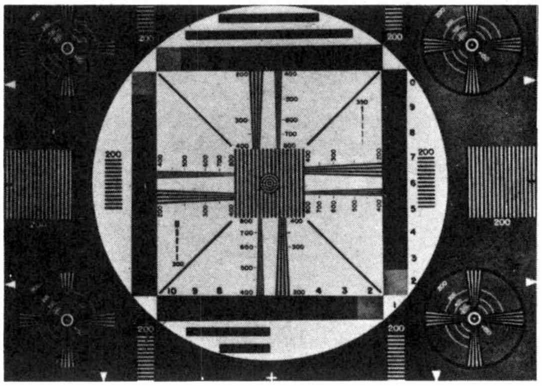
The 405 sound signal follows a different route. It passes from TR104 via a 3pF capacitor to TR107 and then TR108, is detected by D104, passes to the noise limiter diode D103 and then to the system switch SW105.

### Signal Faults

Vision normal, 625 sound normal, 405 sound distorted: check R174.

## DATA PANEL 25—2nd Series



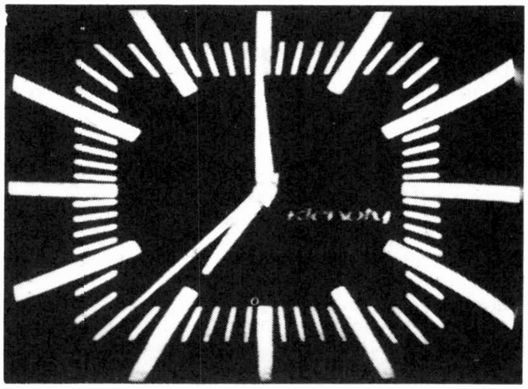
**Rumania (Radioteleviziunea Romana):** *Test cards in use are (1) 0249 type (see Data Panel 23) with identification "Bucuresti Studionel de Televiziune" within the lower half of the central circle and the "0249" omitted and (2) the "new type" test card shown above left.*

**Hungary (Magyar Televizio):** *Test cards used are the RETMA type (shown above right) and the PM5544—with no identification in either case.*

**Poland (Polskie Radio Telewizja):** *The RETMA test card without identification is used.*

*Both Hungary and Poland use the EBU test pattern—Hungary with "MT Budapest" inserted and Poland at times with "TVP Warszawa". It is extremely difficult to detect the source of a RETMA card on an R channel: as a general rule if the small numbers outside the main circle are white the card probably originates from Hungary, if black then probably Poland.*


*Identification slide used by Bulgaria (Boghlarskoi Televidenie), photo courtesy Garry Smith.*



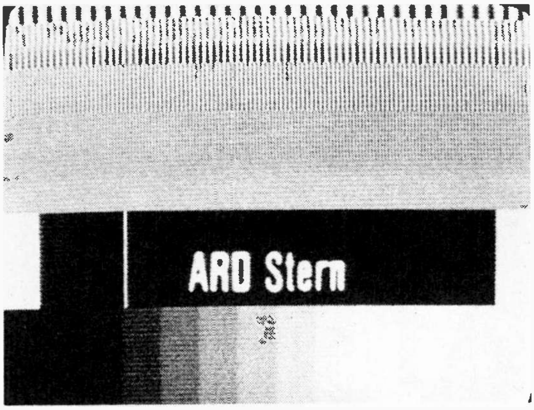
*Czechoslovakian clock, courtesy Ryn Muntjewerff (actually received by Ryn in Holland).*

(USSR) late on the evening of the 25th—2200—with a period of the 0249 test card. With TSS now opening on programme at 0730 BST the 0249 card is becoming something of a rarity! For those not too exhausted by long periods of SpE operation the tropospherics gave a welcome respite on the 27th—the ORTF u.h.f. stations were mainly noted here, with one new station on ch.E50!

In the last column we included a depressing note that the familiar PM5544 card is being used by SR (Sweden). During recent openings problems have been experienced as both NRK and SR use this card. The difficulties are greater of course with weak signals. The PM5544 has been appearing on channels R1, R2 and R4. Due to the vigilance of Graham Deaves early in the season this problem has fortunately been reduced—he identified MT (Hungary) using this card. There is in fact no identification on the card—the only problem that could arise is with a weakish PM5544 card on ch.R1 as it could originate from either ORF (Austria) or MT (Hungary). Another pattern noted on ch.R1 from time to time is of electronic generation and similar to the pattern used by the NDR third chain—see November 1972 Data Panel. At the time of writing this one hasn't been identified but I suspect either MT or CST.

Our colour expert Graham Deaves rang me up today (May 30th) in some excitement. He had successfully logged TSS ch.R1 in colour (SECAM). Although a mostly noisy signal it did at times give clear colour signals of a football match (evening of May 29th). Only a few days earlier Graham had noted the PM5544 from Hungary in colour—again SECAM—on ch.R1.

Our final item in this round up concerns the DFF (East




*ARD (West Germany) network/station linking slide. Courtesy Dieter Scheiba.*

German) TV network. The familiar pattern has a new identification—we are hoping to include a photograph of this shortly from Ralf Erler.

## Listings and News

*Luxembourg:* Increased height of the transmitting mast for the ch.E7/21 transmitters. The ch.E7 aerial has been lifted 40 metres to 240 metres a.g.l.
*Norway:* Halden ch.E11 60kW horizontal—a new transmitter near Oslo. This is a possible for trops.
*USSR:* The Ostankino TV Tower in Moscow is being increased in height from the existing 533 metres, mainly to improve coverage from the existing radius of 130km. Moscow Central TV now has six channels and the capital towns of the 15 republics of the Union and many other major cities two or three channels. Moscow colour programmes are received in 65 towns, with colour programme origination from the following: Kiev, Ukraine; Tbilisi, Georgia; Leningrad; Tashkent, Uzbekistan; Baku, Azerbaijan. It is anticipated that by 1975 colour will be transmitted throughout the Central TV Network. Domestic TV is also transmitted via a satellite system to remote areas of the country—the Molniya 1 satellite operates in conjunction with ground receiving stations. At present some 45 million TV receivers are in use receiving signals from 127 stations.
*Brazil:* RCA have advised us that Brazil is operating in colour—the first country in the Continent to do so—using PAL-M. The suffix M indicates that a 525-line system is used—as with the existing monochrome services.
*South Africa:* Important information has come in about the projected TV service in this country. As mentioned previously both Band III and u.h.f. will be used, the former for sparsely populated areas where it is hoped to cover an extreme area such as the Cape Province, Natal, parts of the Orange Free State and the Transvaal. Each transmitting site has been given a group of four channels—not unlike the UK system of u.h.f. channel grouping. In fact the aerial groupings resemble our Groups A, B and C. The v.h.f. channel spectrum for South Africa covers chs.4-13, i.e. 174-254MHz inclusive (ch.12 is not used). The u.h.f. system uses chs.21-68, i.e. 471-855MHz inclusive (basically similar to ch.E21-68 CCIR). One interesting point is that the sound-vision spacing is +6MHz (similar to the UK u.h.f. standard).
*Rhodesia:* Additional information has come from the Head of Engineering Mr. F. Cluley about the Rhodesian Television Service Ltd. The transmitters at present in operation are Gwelo ch.E2 15kW e.r.p., Bulawayo ch.E3 3kW e.r.p., Salisbury ch.E4 15kW e.r.p. and Umtali ch.E5. The Bulawayo transmitter is fed by an independent studio in the Matabeleland province, the other transmitters being fed via microwave links from the Salisbury studio centre.

## From our Correspondents

David Bunyan of Sittingbourne has been extremely active with improvements to his receiving equipment. Of particular note is his successful construction of a varicap tuned Band I aerial amplifier. This started initially as a single-stage Band I BF180 unit which worked very well. This has progressed and is now a two f.e.t. (2N3823) in cascode unit with input and output tuning. Type BA110 diodes are used for tuning and in view of Dave's success with this project we hope that an article will be forthcoming in the near future! Dave noted Auroral activity on March 23rd and during the later and more active period around end March/April 1st. Fortunately he was able to note some detail during the last Auroral period, including an advertisement for a vacuum cleaner attachment, a programme relating to historical garments (also noted here) and a clock at plus one hour GMT—all on ch.E2.

D. McFadyen of Raurimu, North Island, New Zealand has written a long and interesting letter about conditions and equipment in his part of the world. He has conducted experiments with a rhombic array to improve reception of his local station some 60 miles distant. This apparently gave spectacular performance when three parallel wires were used instead of the single one. Colour television is being introduced in New Zealand—initially in the main centres of population. Test card F is to be used carrying the identification "NZBC Colour" in the lower central frame.

## Correction-Data Panel 24

The bottom left-hand photograph shown in Data Panel 24 last month was not of course the Czechoslovakian clock, which is shown in this month's Panel. It was the GDR (East Germany) DFF-2 only colour test pattern—courtesy R. Erler. We regret this editorial error and apologise to all concerned.

# NEW PRODUCTS

A remote television sound control unit which provides volume adjustment and a speaker on/off switch has been introduced by R. W. Dixon and Co., Winton, Beacon Road, Crowborough, Sussex. The suggested price is £4.75 and there are three versions to suit different loudspeaker impedances.

A new desoldering instrument which does not require air or vacuum lines has been introduced by Adcola: the R500 is designed for easy one-hand operation, featuring an air-bulb connected to the barrel by p.t.f.e. tubing. In use the instrument reaches operating temperature in two minutes: the air bulb is depressed and the nozzle then positioned over the joint in order to melt the solder. Once the solder is molten the air bulb is released and the solder sucked into the barrel to leave a clean joint. The R500 is available in a range of voltages from 6V to 250V and has a 30W element. The price is £6.72 plus VAT.

Broadaker Engineering have made available to the domestic market their range of wall brackets for supporting TV sets and loudspeaker enclosures—prices range from £6.90 to £13.75. Details can be obtained from Piercy's (Electronics) Ltd., 58-62 Lupus Street, Pimlico, London SW1.

A new electronic multimeter, Model EM272, has been introduced by Avo—the trade price is £24.85 plus £2.49 VAT. Features include high input impedance (316k$\Omega$/V) and good frequency response to 20kHz. There are 20 voltage, 14 current and 5 resistance ranges, a.c. and d.c. voltages being from 30mV to 1kV f.s.d., current 3$\mu$A to 3A f.s.d. both a.c. and d.c. and resistance 1k$\Omega$ to 40M$\Omega$. In the interests of reliability printed-circuit shunts and thick-film resistor modules are used.

# SHORT BACK-FIRE AERIAL for Bands IV&V

REG ROPER

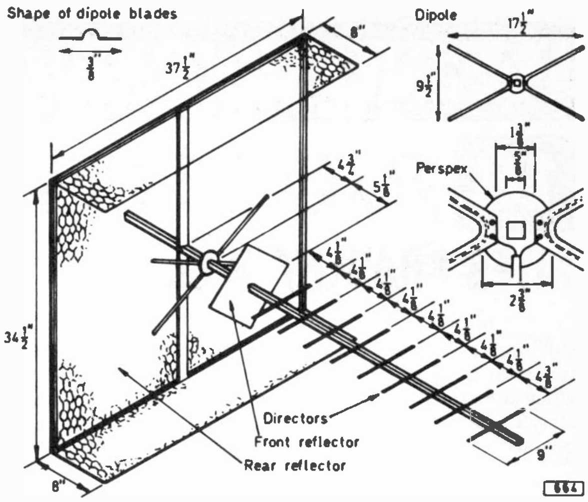



*Fig. 1: Constructional details of the short back-fire aerial for Band IV/V use.*

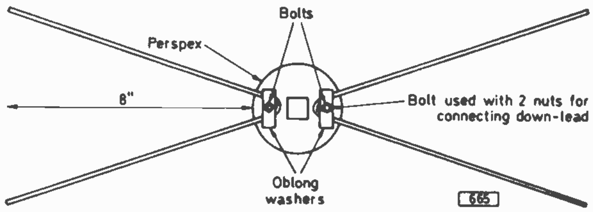



*Fig. 2: This modified dipole arrangement using ¼in. diameter rods makes construction easier.*

The short back-fire aerial I described in the February issue this year was intended for use mainly in Band IV, the gain dropping off drastically above channel 47. Since then a number of readers have tried the aerial and reported successful results and requests have come in for a Band V version.

The design presented this time has a very wide bandwidth so that it covers both Bands IV and V. Nine directors are used—giving what I call the long short back-fire aerial if you will forgive that! The new design is shown in Fig. 1 and has a gain which climbs steadily up to channel 60 where it levels out, at roughly 21dB, to about channel 65. A gain of this sort at these frequencies is not to be sneezed at! As before the basic idea features a rear reflector with parabolic characteristics and a small front reflector, the dipole sitting between these elements.

## Construction

The rear reflector which is made of wire mesh (mesh not larger than ¾in.) is 37½in. wide and 34½in. high, with an 8in. deep edge at the top and bottom. The wooden support down the centre is also used to hold the centre beam which could be fixed to it using the type of mounting device used to fix loft aerials to loft beams. If the aerial is mounted on a metal mast outside the house it should be 8in. from the mast. The dipole is made of aluminium sheet ⅜in. wide and fluted for strength, and is spaced 4¾in. from the rear reflector. The front reflector is spaced 5⅛in. from the dipole and consists of a 10½ × 10½in. square of aluminium fixed diagonally on the centre beam. The centre beam/tube is of ⅝in. diameter and 55½in. long. All nine directors are 9in. long and made of 5 to 8mm. rod or tubing. They are spaced 4⅛in. from each other and the front reflector except for the final one in the chain which is spaced 4⅜in. from the preceding one.

## Modifications

The dipole in this design is difficult to make using fluted aluminium sheet so I suggest the use of ¼in. rod instead. Aluminium or alloy rod used for welding can be obtained from any garage that does a certain amount of welding repairwork—it is usually in 3ft. lengths and the ¼in. diameter rod is ideal not only for the dipole but also for the directors used. If two rods are bent to a V shape about 8in. long (see Fig. 2) the dipole is a simple matter. The V-section dipole halves can be fastened to the circular Perspex insulator using a single bolt and an oblong washer for each, the same bolts being used to connect the down-lead. A further modification which helps construction is to use a square-section centre beam—one can possibly be got from an old aerial. The square-section beam makes it easy to fix the dipole, reflectors and directors.

Finally a couple of corrections to the article published last February. The diameter of the front reflector is 8in. as in the diagram, not 10in. as in the text. The basic 2λ diameter quoted for the rear reflector is a figure given in certain textbooks but would give a rather cumbersome array. ■

## USE OF WOODSCREWS BARRED

An amendment to BS415 bars the use of woodscrews for fitting legs to TV sets when these can be fitted by dealers or customers as an optional extra. A BREMA report points out that this will not of course overcome the problem of legs sold for other purposes being fitted to TV sets. This is an important safety point: fatalities have been caused in the past as a result of metal legs or fixing screws in wooden legs being live through contact with internal metalwork.

# RENOVATING the RENTALS

# 16 PHILIPS G6 CHASSIS

CALEB BRADLEY B Sc

## TIMEBASE PANEL & CRT BASE

THE circuit of the timebase panel is shown in Fig. 3 and its layout in Fig. 6. It has many unusual circuit features which affect setting up and if not appreciated can cause delay in fault finding even though the stock faults in this area are mostly mundane ones such as valve failure.

### Line Oscillator

The line oscillator circuit is basically the same as we have encountered on other colour chassis i.e., a PCF802 valve with the pentode half connected as a Hartley sine-wave oscillator and the triode half providing flywheel reactance control. There are elaborations however! The flywheel sync discriminator is a fully-balanced type in which line sawteeth of opposite polarities, obtained by integrating line pulses in C4008 and C4009, are applied across the discriminator diodes X4140 and X4141. The mean voltage at X4140 cathode depends on the point during the line flyback when the positive-going line sync pulse fed in via C4007 makes X4140 and X4141 conduct. To improve the out-of-sync pull-in performance some direct sync is added to the flywheel control voltage via R4077/C4011.

The circuit requires careful setting up by two controls as follows (there is no viewer line hold control). First short the junction R4075/6 to chassis to disable the flywheel control. Use a slim screwdriver to set L4501/2 (625) for near correct line speed, i.e. picture just drifting sideways. Make appropriate recorrection if using a metal screwdriver since this affects the tuning. Remove the short. With V2002 pin 2 on the i.f. panel shorted to chassis to disable sync adjust R4071 for near correct line speed. The discriminator is now balanced and the picture should lock correctly when the short is removed.

### Field Timebase

The field oscillator is a conventional multivibrator using an ECC81 (V4002). The sawtooth waveform is generated across C4033 which charges via the height control towards boost h.t., stabilised by v.d.r. R4090. S-shape linearity correction is obtained by adding some field parabola to the sawtooth by means of the main linearity control. Failure of V4002 is not uncommon and as will be seen later may disable the line output stage as well as the field oscillator.

The field sawtooth is fed via the cathode-follower V4003A to the control grid of the field output valve V4004, with further shaping by R4106 and C4039. Top linearity is controlled by some field sawtooth which is fed back from an isolated winding L1556 on the field output transformer via R4121 and R4114 and integrated by C4037. Transductor L4511/2/3/4 provides interaction between the line and field scan currents for pincushion correction; it also provides some minor field linearity correction by means of a waveform developed across C4045 in series with the top linearity feedback path.

The picture height is rather unusually stabilised by employing a v.d.r. (R4109) to rectify the field flyback pulses and give a negative grid bias—this arrangement is much more common in line output stages. About −63V is developed across C4041 when the circuit is working normally. Should the field scan fail, absence of this voltage causes a "c.r.t. protector" stage on the decoder panel to disable the line output/e.h.t. circuit in order to prevent an over-bright horizontal line on the c.r.t. This intentional dependence of line scan on field scan can make simple field faults seem very confusing to the uninitiated! It was omitted in later versions of the chassis.

The actual grid bias for V4004 depends on both the negative stabilising supply fed back via R4112 and a preset positive supply via R4105. For the circuit to stabilise correctly against mains fluctuations and output valve ageing it is important to set R4105 for 12.5V at V4004 cathode. This potentiometer is often left mis-set since it has little effect on the picture; it should be checked however after any height, linearity or boost voltage adjustments.

An internal short in the PL508 causes R4117/8 to overheat and possibly drop off and usually damages the cathode decoupler C4043. This capacitor must be of the correct value to provide the field parabola waveform which is used for linearity correction as described though not for convergence as is often the case. Greatly reduced height can be caused by a faulty thermistor (R1721) in the scan coils.

### CRT Drive and Controls

The luminance signal from the i.f. panel is fed to the three c.r.t. cathodes via the circuit on the c.r.t. connector panel shown in Fig. 4. This includes a push on/push off switch to remove the luminance for easier first anode voltage (background colour) adjustment. In the case of apparent "no picture" faults first check that this switch or the beam cut-off switches are not off!

The source of the sharp click heard inside these sets is the operation of a relay on the c.r.t. connector panel. Its function is to provide a pleasant bluish shade of white on monochrome programmes instead of the "true" white used for colour. On colour programmes the relay is energised by a driver stage on the decoder panel and the luminance is fed to the cathodes in the usual way for colour-difference drive, i.e. directly to the least efficient (red) gun and via highlight balance controls to the blue and green guns. On a monochrome transmission however the relay is not energised and two further potentiometers R1076 and R1078 are brought into circuit to reduce the red drive and increase the blue drive respectively.

The setting of these monochrome-white controls is entirely a matter of taste. Note that pressing the "colour

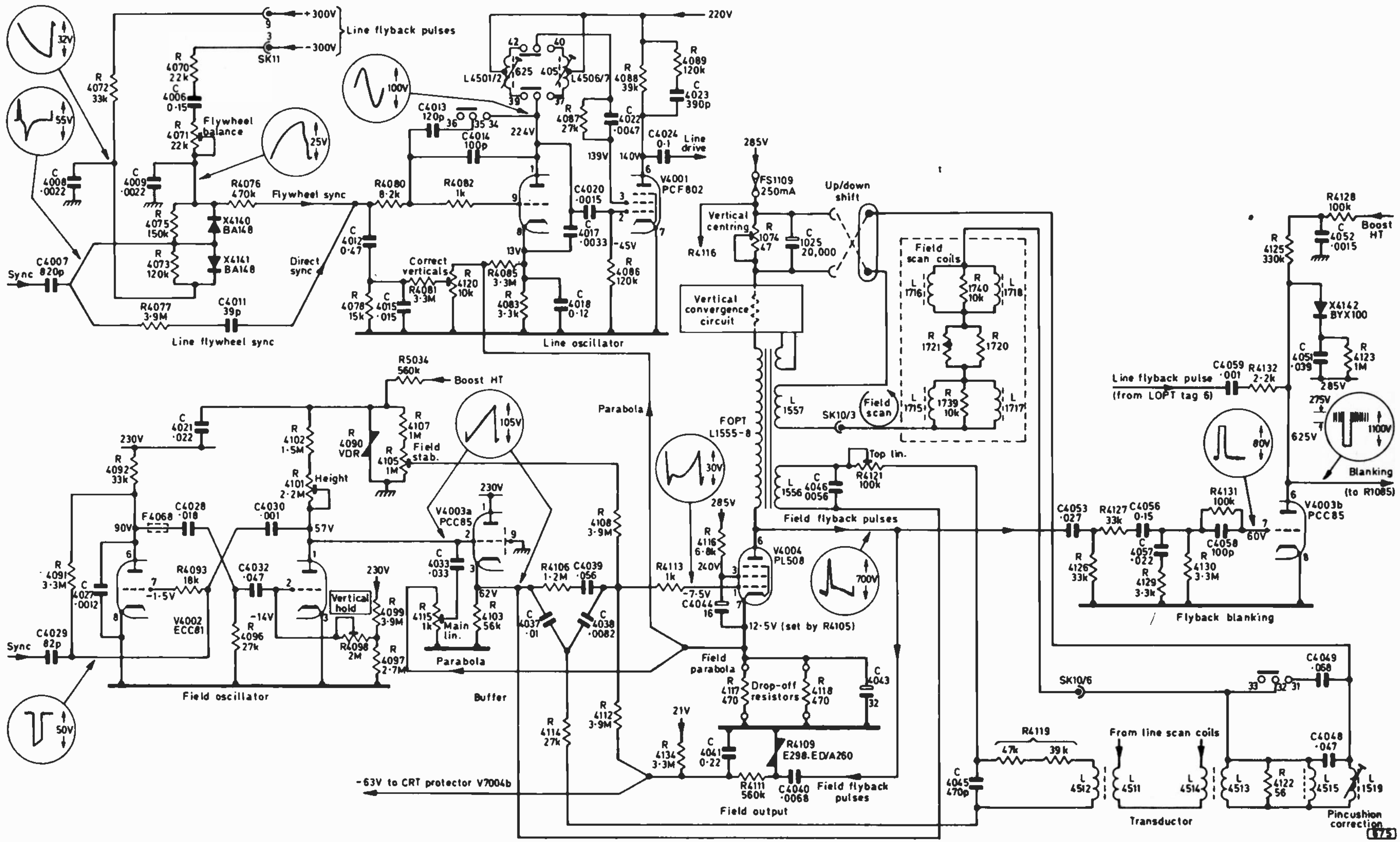



*Fig. 3: Circuit diagram of the timebase printed panel, with the 405/625 system switches shown in the 625-line position. In later versions R4075 is 130KΩ and R4134 and the c.r.t. protection circuit are deleted.*

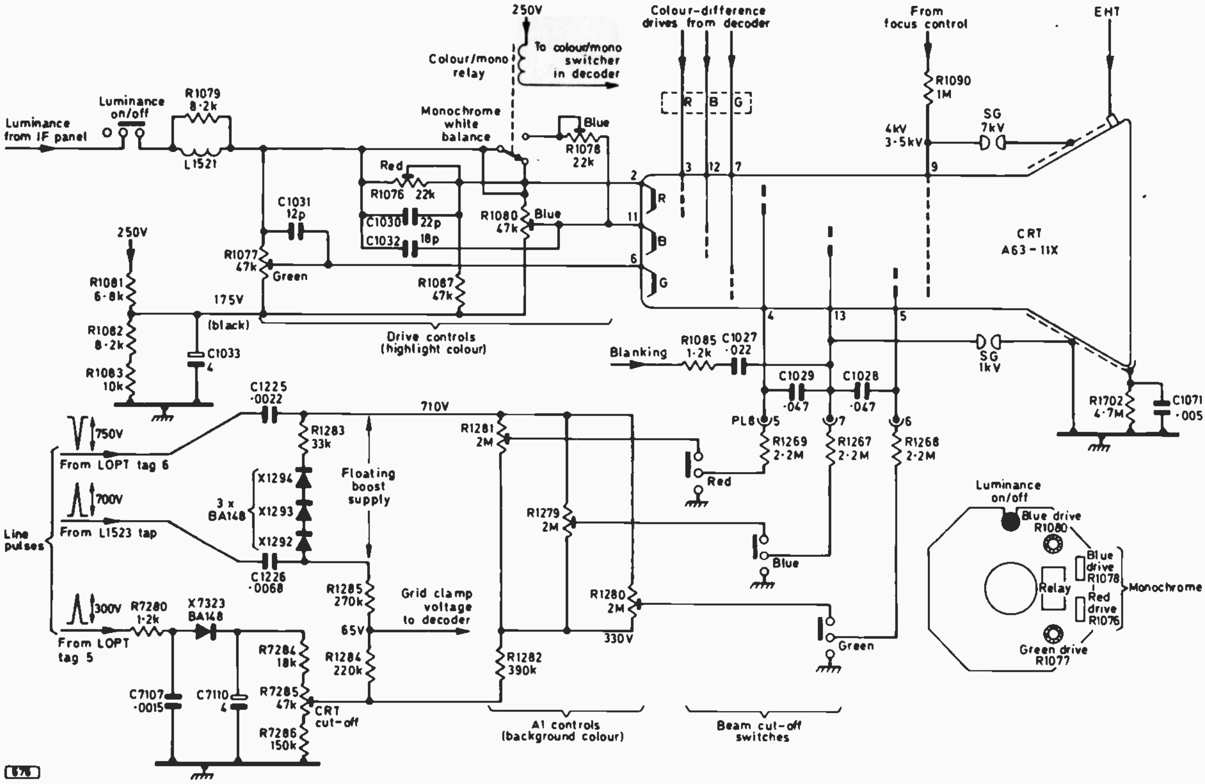



*Fig. 4: C.R.T. connector panel circuit and control layout. The first anode presets and switches are mounted on the convergence box. The colour/monochrome relay switch is shown in the colour (relay energised) state—R1076 is shorted out and R1078 open-circuit in this condition. On monochrome R1076 is brought into circuit to reduce the red drive while R1078 provides increased blue drive. This arrangement is deleted in later versions. Also in later versions R1282 is 220kΩ, R1284 180kΩ and R7284 deleted.*

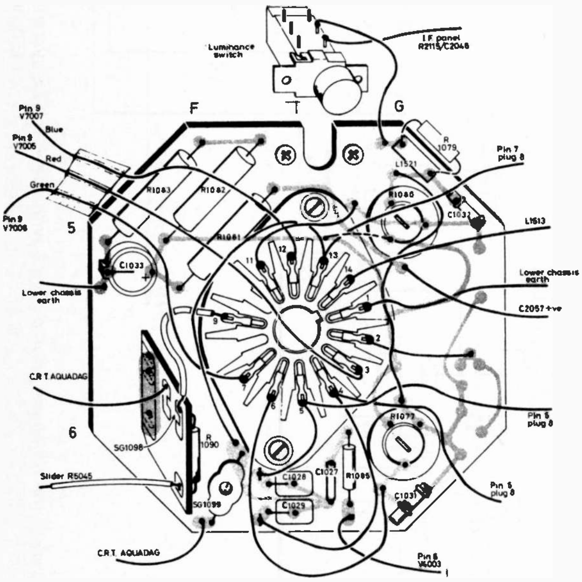



*Fig. 5: Layout of the c.r.t. panel (component side)—later versions with R1076 and R1078 omitted. The lead from c.r.t. base pin 2 should be shown joined to the print immediately below where it is shown connected. This point connects via the lead shown to L1521/R1079.*

off" button on the control panel does just that and no more: the monochrome white is only obtained when a monochrome signal with no reference burst is received (or if a colour signal is detuned sufficiently to lose the 4.43MHz content). The relay driver is the second triode of the PCC85 used in the c.r.t. protection circuit: the whole lot was cleared out in later chassis.

The c.r.t. first anode supplies and the grid clamp voltage for the colour-difference driver stages on the decoder panel are obtained by rectifying line pulses from the line output stage. Pulses of opposite polarity and approximately 700V amplitude are fed by C1225 and C1226 to rectifiers X2192/3/4 to generate a floating boost h.t. supply of nearly 400V which is summed with a separate voltage supply set by the "c.r.t. cutoff" control and fed to the first anode potentiometers. The c.r.t. cutoff control R7285 is located near the top of the decoder panel above the delay line and must be set for 110V grid-cathode bias on the c.r.t. (e.g. between pins 11 and 12) with the luminance and colour switched off. It must not be used in place of the preset brightness control. Tube damage or picture troubles such as bad grey scale and appearance of flyback lines occur if this control is wrongly set.

Common causes of intermittent or permanent strong colour casts due to a faulty first anode supply to one gun are broken tracks on the connector panel due to rough handling, bad contacts at PL8 pins 5, 6, 7, or a burnt out first anode potentiometer or beam switch.

CONTINUED NEXT MONTH

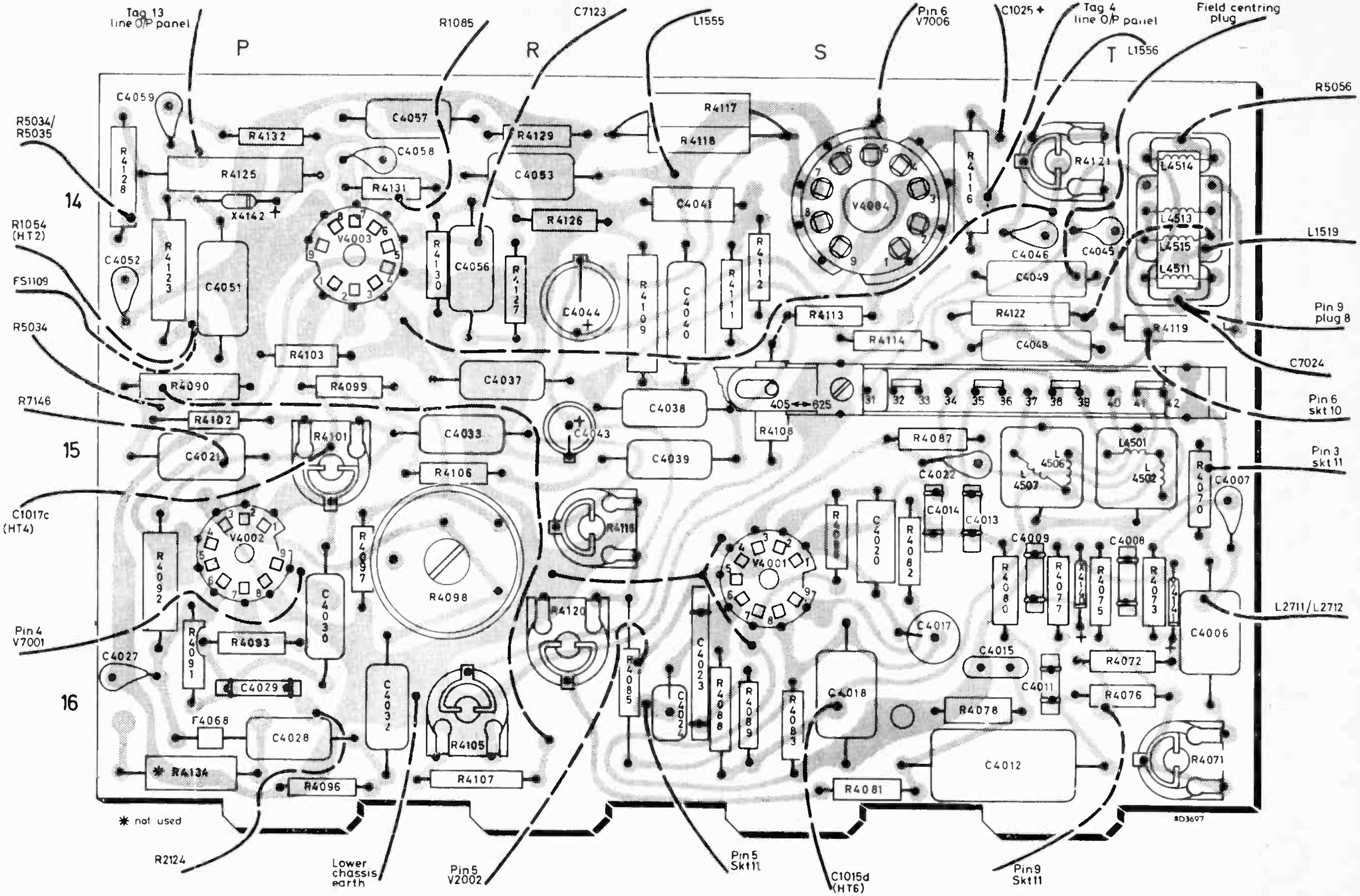



Fig. 6: Layout of the timebase printed panel, viewed from the component side.

# COLOUR RECEIVER PROJECT

At the time of going to press with this issue we understand that a full set of setting-up instructions for the colour receiver is being cross-checked with several sets produced by a group of constructors in the author's part of the country. We had hoped that these instructions would be complete in time for inclusion in this issue but it is not possible to hold up printing any longer. We would emphasise that unless you are extremely familiar with the workings of colour receivers it is most unwise to apply power to the various units until these details are available.

## "TELEVISION" COLOUR RECEIVER FAULT FINDING ADVISORY SERVICE

"This is the most ambitious project we have ever covered in TELEVISION." Having quoted the very first sentence from Part 1 of this series we would like to continue with a quote from later in that article: "Let us be blunt: have you understood the introductory article on the colour receiver project?"

"We will go as far as it is possible for us to go in helping any readers who get into trouble, but we must be cautious about the degree of assistance that we can afford to give—we cannot after all be expected to build, rebuild or complete a receiver that a reader has abandoned."

### Before You Write

Now for the general procedures that should be adopted by those constructors who are in genuine need of assistance. But before you rush pen to paper we must ask you to read the notes below.

We earnestly request constructors to make quite sure that their problems are not already answered by the appropriate parts of the published articles and addenda. There have from time to time been various items that have been corrected or modified; reference should be made to these points in the articles as necessary.

The Alignment Service has experienced a wide variety of i.f. units that range from first-class professional workmanship to those almost beyond redemption. In many cases additional work has been made necessary in order to bring individual units within the operational tolerances required for the receiver, largely due to the effects of component tolerances.

Soldering has mostly been of an acceptable standard but we must stress that because of the use of some very sensitive circuitry and the several hundreds of soldered joints involved the chances of having a dry-joint or other related fault are very high. It is absolutely vital that *all* joints, whether soldered or touch contact, must be perfect and clean; the primary cause of trouble is frequently in this area.

Also due to the use of circuits operating at h.f. and u.h.f. most wires and component lead lengths must be kept to a minimum—some i.f. boards have arrived with component wires uncropped, the components left standing on "legs" more than half an inch long, despite the articles stating that wires should be trimmed.

The testing, setting-up and final "switch-on" procedures must be rigidly followed. For your guidance a voltage measurement table will be supplied but due to component tolerances identical measurements must not be expected. The measurements quoted will be for a particular test meter and the appropriate allowances must be made if other meters are used. The best guide in most parts of the receiver is a good-quality oscilloscope with a sufficiently wide frequency range.

In the event of faults occurring a level head, a logical approach and care with the soldering iron will go a long way to achieving the desired results. Do not attempt alterations or "corrections" until you are quite sure in your own mind that you understand the implications. It is quite possible that one fault condition can cause a chain reaction and damage other components, particularly semiconductors, and you should not ignore this possibility in assessing your receiver's symptoms.

If you are quite sure you have followed and understood the comments here and elsewhere but you still need further assistance the following course of action can be taken. You must bear in mind however that our consultants are remote from your receiver and cannot possibly be expected to give you the fullest advice unless you can give us the fullest description of all symptoms. Neither can they always be expected to offer solutions if the components used are different from those recommended in the articles.

We regret that we cannot undertake to accept any constructor's receiver or part of the receiver and we cannot be

**Component-Pack 24**

| | |
|---|---|
| C332 | 0.01μF 2½% polystyrene |
| C601 | 180pF 8kV disc ceramic (not tubular) |
| C602 | 0.47μF or 0.5μF, 1kV |
| C603 | 330pF 8kV disc ceramic (not tubular) |
| C604 | 1,000μF 25V electrolytic |
| R605 | 470Ω 1W carbon |
| R606 | 1.8kΩ 5W, 10% non-inductive |
| R607 | 68kΩ ½W, 5% |
| D601 | 1N4148 or equivalent |

Also insulated valve top cap connectors for the PL509 and PY500.

**Supplier**

Forgestone Components, Low Street, Ketteringham, Wymondham, Norfolk.
Cost £1.15p including postage, packing and VAT.

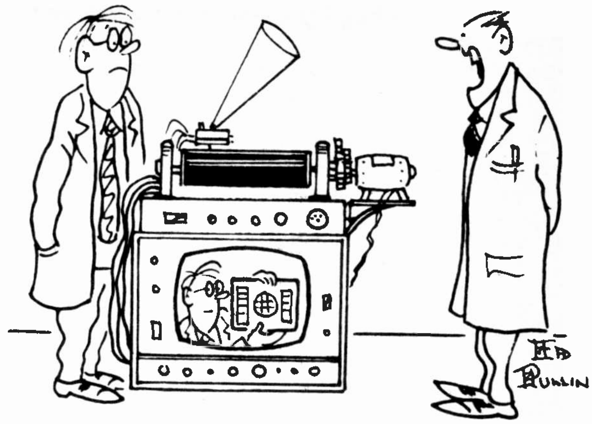
Suitable components are also available from Manor Supplies, 172 West End Lane, London NW6.

held responsible for loss, damage or inconvenience. We cannot entertain queries from personal callers at this office. We are not legally bound to give advice or to solve readers problems but we will try to do our best within the limits of communications at our disposal. We hope you have enjoyed making this receiver and wish you every success in its operation.

## Applying for Advice

There are two ways by which you can obtain advice but whichever method you chose we must ask that you complete the coupon that is given in this issue of TELEVISION and will also be in the next two issues only. WE CANNOT GUARANTEE TO ANSWER PROBLEMS ON THIS COLOUR RECEIVER PROJECT THAT ARE SENT TO US IN ANY OTHER WAY. Any queries on other subjects should be sent separately through the normal 11p Query Service.

Incomplete forms sent to us may be ignored or returned to the sender at our discretion. We do not at this stage envisage a charge for this Fault Finding Advisory Service but it may become necessary if a reader continues correspondence on the same receiver beyond two coupons. In writing to us we would appreciate letters that are typewritten or neatly printed; if we cannot read your writing you cannot expect the fullest reply.



*"I'll grant you it's clever Potter, but we rather had discs in mind!"*

**Adopt the following procedure:**

(1) Complete the coupon, supplying complete fault symptoms and details of test measurements and/or oscilloscope traces that you have made and the results.

(2) Send your coupon and letter and **two** stamped self-addressed envelopes to: Fault Finding Advisory Service, "Television", Fleetway House, Farringdon Street, London EC4A 4AD.

## By Post

Letters will be dealt with in rotation and you should be prepared if there is a delay. If you have followed the instructions here you should receive an acknowledgement bearing a reference number which must be quoted in all further correspondence.

## Telephone

There may be occasions when an answer is best given by telephone, *but please do not ring us, we will ring you.* If you think that communication can be done better by telephone please write your evening/weekend telephone

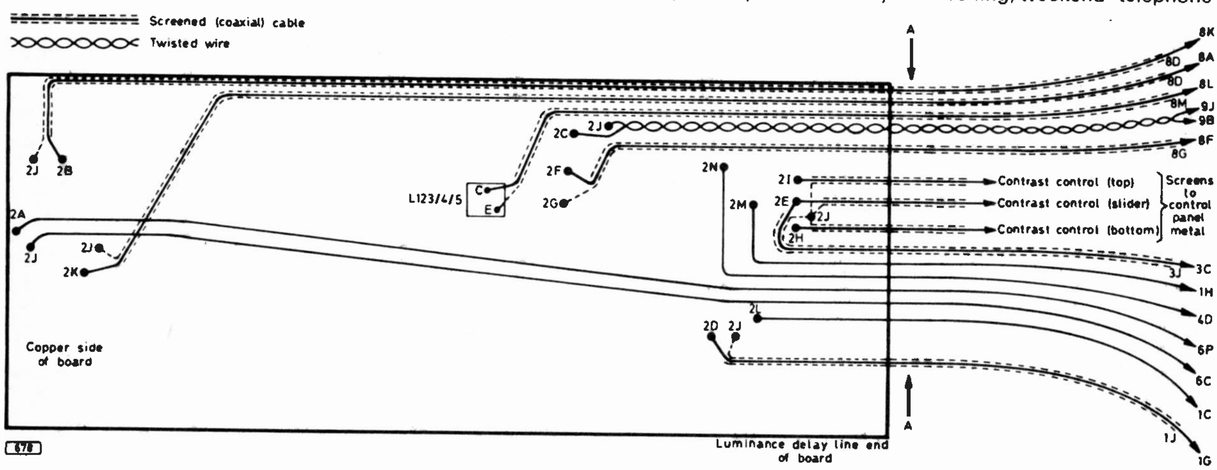



*Fig. 1: Typical module connection format (i.f. module shown). Tie the cables together along A/A, form into a loop of about 6-9in. and tie again before splitting off to the other modules. The i.f. strip is the most critical module and the arrangement shown here should be carefully followed: in particular make the earth connection back to 6C at the 2J point shown and apply power at point 2A.*

number in full on the coupon where stated. **Warning:** If we choose to telephone to help you or to ask for further information we may make a "transfer charges" call, i.e. at your expense. If you are not prepared to accept such a call do not enter your telephone number. It would be helpful if you have access at the time to details of your receiver. WE CANNOT ANSWER QUERIES BY TELEPHONE IN ANY OTHER WAY.

Finally we would like to emphasise that such a service cannot be effective without the fullest co-operation of the constructor: please keep your letters brief and relevant to the fault conditions.

**Note:** This service is being made available in this form until November 30th 1973 only, at which time the situation will be reviewed.

The following corrections should be made: we are awaiting clarification from the author on several other points.

## Important Corrections

—8V **Supply:** The negative side of C604 (Fig. 2 last month) should have been shown connected to the junction of D601 anode and R607.

**Power Supply Circuit:** Add a 16μF 450V electrolytic capacitor (C530) from the junction of R503/R504 to chassis and a 10μF 63V electrolytic capacitor (C531) from the junction of R508/R509 to chassis. It is important that low-leakage types are used, also that higher values are not used. Suitable components are available in the RS range — the wire-ended types can be easily mounted on the power supply printed circuit board. Add a 470Ω ½W 5% carbon film resistor (R534) — e.g. RS Hystab type — between the junction of R509/R510 and output point 6K on the power supply board (break the print connection).

The correct specification for R501 is 260Ω 25W.

**NEXT MONTH: SETTING UP**

## "TELEVISION" COLOUR RECEIVER PROJECT: FAULT FINDING ADVISORY SERVICE

Please complete the whole form in ink in capital letters, attach to your letter describing fault symptoms and send with TWO stamped self-addressed envelopes to: Fault Finding Advisory Service, "TELEVISION", Fleetway House, Farringdon Street, London EC4A 4AD.

FOR OFFICE USE ONLY
1st Ref.
2nd Ref.
3rd Ref.

NAME ..........................................................................

ADDRESS ..........................................................................

..........................................................................

..........................................................................

1st Ref. number ........................................ (if known).

BRIEF FAULT SYMPTOMS (use additional paper if necessary):

TEST PROCEDURES CARRIED OUT:

PLEASE TELEPHONE ME BY TRANSFER CHARGE CALL DURING THE EVENING OR WEEKEND BETWEEN (times)

........................................ ON TELEPHONE NUMBER ........................................

I UNDERSTAND THAT THE PHONE CALL MAY BE CHARGED FROM CORNWALL OR LONDON. I HAVE READ AND UNDERSTOOD THE CONDITIONS OF THE ADVISORY SERVICE AS GIVEN IN THE AUGUST 1973 ISSUE OF "TELEVISION". I ALSO UNDERSTAND THAT THE MAGAZINE PUBLISHERS CANNOT BE HELD RESPONSIBLE FOR ANY LOSS OR DAMAGE TO THE COLOUR RECEIVER.

SIGNATURE ............................................

DATE ............................................

*For Office use only.*

DATE ...............................

NAME ............................................

REF ...............................

Dear Sir,
We acknowledge receipt of your form for the Fault Finding Advisory Service. This is being dealt with. Please quote the above reference number in all communications on the Colour Receiver Project.

Yours faithfully,
FOR TELEVISION MAGAZINE

# A HANDY CRT REJUVENATOR

by R. Verge

IN many workshops there are a number of discarded Veemaster and Metropolitan set-top aerials which have become troublesome through age. This article describes how to adapt one for use as a c.r.t. rejuvenator. The circuit is shown in Fig. 1 and makes use of the well known principle of connecting the grid and cathode of the c.r.t. as a diode in order to achieve cathode reactivation. It is unnecessary to explain the component layout in detail because of the few components required. The main purpose of this article is to explain how to alter the aerial base (using a Veemaster as our example) to accommodate the components.

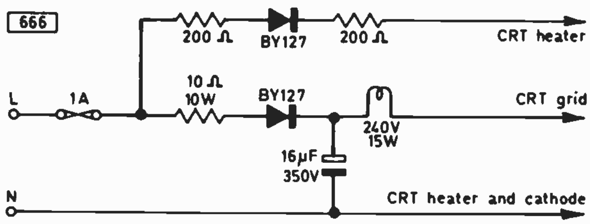


*Fig. 1: Circuit of the c.r.t. rejuvenator.*

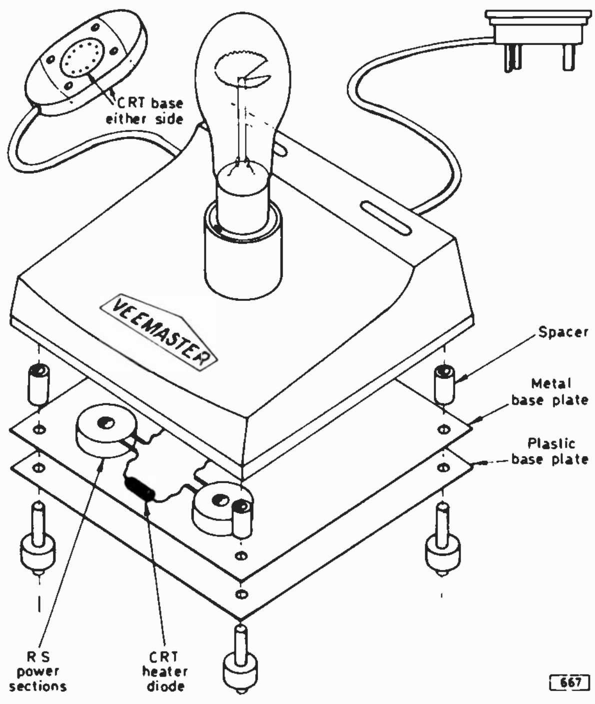


*Fig. 2: Using a discarded Veemaster set-top aerial to house the c.r.t. rejuvenator.*

## Construction

Select an aerial base which has least damage to its case and remove all existing clamps, rods, switches etc., keeping the metal base plate. Drill a centre hole to take the bulbholder (see Fig. 2) where the knob was previously fitted—note that in order to reduce the depth of the bulbholder the terminal cover is not used. Then drill holes for the input and output cables. The exact positions of these depend on the internal layout adopted: this is not critical but the cables should be kept away from the c.r.t. heater power sections (Radiospares 200Ω power resistors). Mount the heater power sections on the metal base plate in such a way as to be clear of the case and all wiring. The heater diode can as shown be mounted between the terminals of the two power sections and although I have never had any trouble with this diode I recommend mounting it on a tagstrip away from the power sections in case the rejuvenator is left on accidentally for some length of time and the diode damaged through heat.

If a standard 13A plug is used the fuse fitted in the plug (change to 1A) will be the only fuse necessary. If any other plug or if crocodile clips are used for the mains input a fuse will have to be included in the case. As Fig. 2 shows the metal base plate is mounted between the case and the bottom plastic base plate, spacers being used between the metal base plate and the case so that the power sections do not touch the top of the case. The housing for the two types of monochrome c.r.t. bases in common use is a simple matter—any small plastic container will do. The two bases should however be bolted together in the plastic container to give extra strength.

## Use

If crocodile clips are used to feed the mains to the unit one clip should be connected to the chassis of the receiver in which the c.r.t. to be rejuvenated is fitted and the other clip to the mains input point on the mains dropper. This is a more convenient method than having to change plugs as necessary *but is very dangerous and should only be adopted by those who have the necessary skill.*

After making the mains connections to the rejuvenator remove the c.r.t. base and fit the appropriate rejuvenator base. Switch on and wait until the bulb stops flashing and becomes bright. Switch off, refit the original c.r.t. base and test the set.

Where the power is taken from the set via crocodile clips the valve heaters in the set will be at mains potential (i.e. 240V) when the heater chain is broken by removing the c.r.t. base. It can be argued that this could cause damage to the valves and this is true. Experience has shown however that this seldom happens and when it does it only proves that the valve's insulation was poor anyway.

The heater of the c.r.t. under rejuvenation runs at a higher voltage than in a normal chain with a diode in circuit, i.e. at 4.5–4.8V. This is because with some very poor tubes extra heater drive is required in order to get rejuvenation.

A c.r.t. rejuvenator of the type described is an invaluable tool. I have found that 60% of tubes rejuvenated lasted for over a year, 20% over six months and the remaining 20% under six months. A note should be made in the receiver that the c.r.t. has been rejuvenated and the date of rejuvenation. This is because you can successfully rejuvenate a c.r.t. only once: the next time it is tried the rejuvenation lasts for only a very short time. A note in the receiver will save time being wasted at a later date. ■

# FAULT FINDING GUIDE

6 John Law

# PYE 11U SERIES LINE TIMEBASE

In early 1963 the Pye/Ekco group produced a dual-standard chassis which appeared in a wide range of television receivers under many brand names. It was reliable and popular and was sold in large numbers over many years. In early versions the u.h.f. tuner was optional. There were standard and fringe versions—with or without a flywheel sync panel—and the models were fitted with either 19 or 23in. c.r.t.s. The chassis was widely used by major rental companies. The Pye group brands fitted with the chassis were Ekco, Ferranti, Dynatron, Invicta, Pam and Pye. Several different v.h.f. tuners were fitted with different valve complements. For example tuner type EA15089 used a PC97 r.f. amplifier and PCF86 mixer, tuner type EB01532 a PCC89 r.f. amplifier and PCF86 mixer, tuner type EB01478 a PCC89 r.f. amplifier and PCF801 mixer and tuner type AF00056 a 30L17 r.f. amplifier and 30C17 mixer. The u.h.f. tuner used was a valved type. Because of their reliability and the large numbers of sets sold the chassis is commonly found in the workshop.

## Chassis Arrangement

On removing the back of the set one sees a vertically mounted chassis containing two large printed panels (the print side faces rearwards). The panel on the left incorporates the i.f. stages and the field timebase while that on the right is the line timebase panel. The system switch assembly on each panel is linked across the centre by a rod. Removal of two screws at the top of the chassis allows it to swing down; on removing two further screws at the bottom corners the chassis falls to bench level enabling service work to be carried out easily. The general arrangement has been illustrated on a number of occasions previously in the magazine—see for example the May 1972 issue, pages 296–7. This article is concerned with the line timebase circuit and the faults commonly encountered in this area: the circuit is shown in Fig. 1. Component positions and reference numbers are indicated on the printed panel: this makes life easy!

## Circuit Description

The line oscillator circuit appears somewhat complicated at first sight but is nevertheless simply a cross-coupled multivibrator arrangement. The triode section of the PCL84 sound output/line oscillator valve V14 forms one section of the multivibrator and the line output pentode V17 (PL36) the other section. The anode load of the triode section of R100 (12kΩ) and the line sync pulses are applied via C85 (12pF) to this electrode. The triode is coupled to the output pentode via C87 (0.01$\mu$F)—which tends to cause troubles in this chassis—and the grid stopper R107 (1kΩ). Coupling from the output stage back to the triode grid is via C90 (150pF) from the line output pentode screen grid and R119 (270kΩ) and C94 (12pF) from the line output pentode anode via a tapping on the line output transformer.

Pulses from the line output transformer are fed via C92 (250pF) to the voltage-dependent resistor R106 which rectifies them to produce a d.c. bias dependent on pulse amplitude. This bias is applied to the grid of the line output pentode via R105 (2.2MΩ) and stabilises the operation of the output stage against mains voltage fluctuations affecting line amplitude and valve ageing. The set width controls R111 and R112 modify the grid bias to achieve correct operation on both standards. The PL36 screen grid is fed via R108 (1.8kΩ) in series with R109 (100Ω), C91 (0.25$\mu$F) being the screen decoupler.

Separate 405 and 625 line hold controls are incorporated in the triode grid resistor chain.

## Common Faults

When trouble is experienced in the line timebase the valves should be the prime suspects. In addition to the PCL84 and PL36 the valves are the PY800 boost diode V18 and the e.h.t. rectifier V19. The latter is usually a DY87 but in some early models it is an EY87: because of the different heater voltages these valves are not interchangeable but it is easy to substitute them by mistake.

The complaint of picture break up after an hour's use is generally due to the line hold control being at the end of its track when the set is switched on: the line only just locks when the set is cold but as it warms up conditions change and line slip gradually appears. A replacement PCL84 will usually enable the hold control to be centralised again but sometimes the PL36 is the culprit.

## Striations

One case where there were a number of vertical lines extending from the left of the screen suggested scan coil trouble: new coils made no difference so we checked around the c.r.t. base and found that with a capacitor from the grid (pin 2) to earth the picture improved. Further checking traced the fault to C64 (0.1$\mu$F) in the field blanking network—this capacitor is at the bottom right of the i.f. panel, just above test point 38.

Striations can be caused by the damping resistor R67 (2.2kΩ) across the line linearity coil changing value: this resistor dissipates some heat in operation so its value can change in time. It is mounted on top of the sound output transformer.

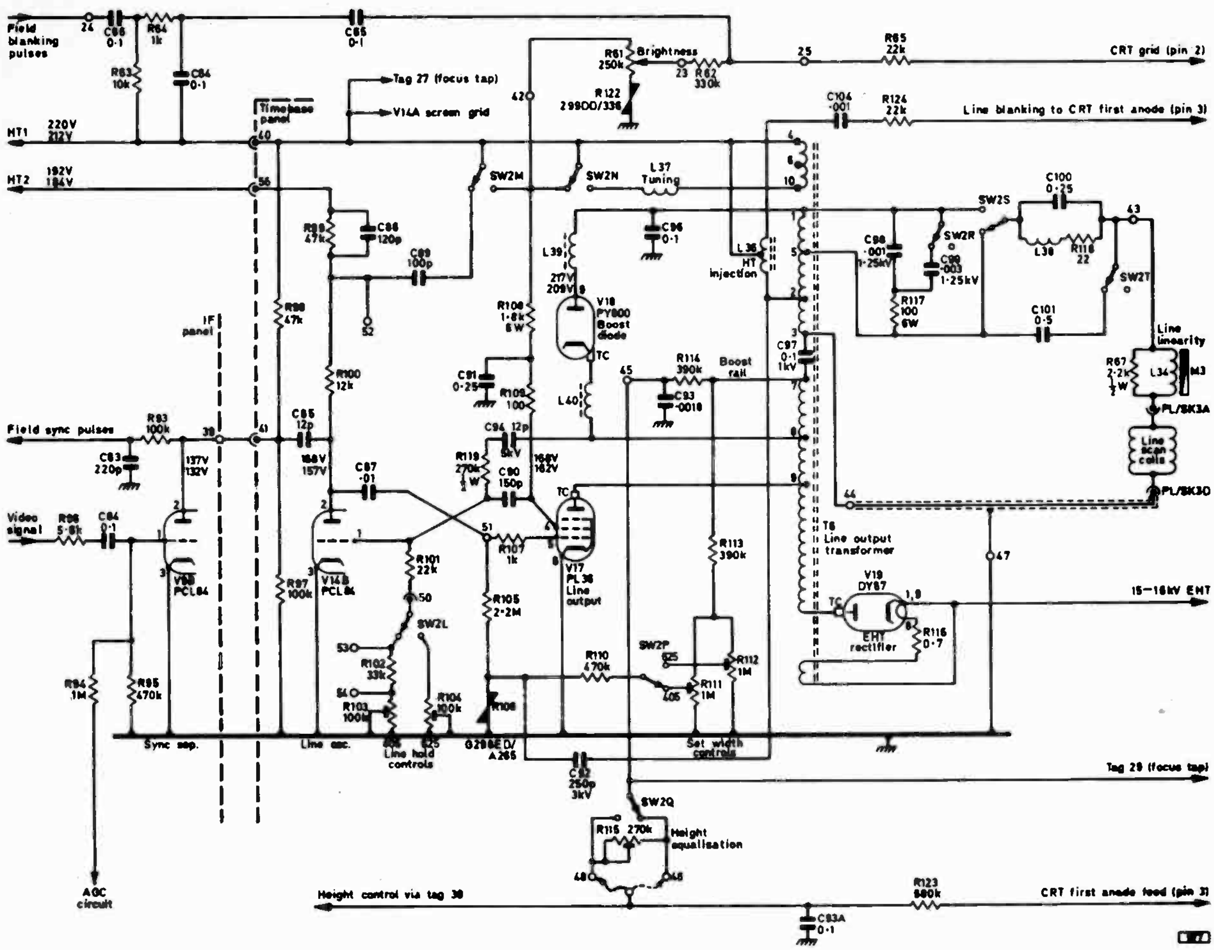



*Fig. 1: Circuit of the line timebase used in the Pye 11U series (Ekco T418/T433 etc. series). In earlier versions the line flyback blanking is omitted and the earthy side of R61 taken to mains neutral.*

Faint striations have been caused by the line output valve screen grid decoupler C91 being open-circuit.

## No Raster

No raster is a common fault condition which if due to lack of line drive requires care in tracing. This situation is indicated by the PL36 anode glowing red hot and absence of line whistle. The line drive provides the negative control grid voltage to hold the PL36 in its normal operating condition: removing it causes a rapid rise in anode current and this if prolonged will damage the valve and possibly the line output transformer.

Failure of the drive coupling capacitor C87 is a common cause of loss of drive. The triode anode load resistor R100 can go open-circuit, leaving no voltage at its anode and thus cessation of the multivibrator action and no drive. The 47kΩ resistor R99 in series with R100 can also go high-resistance or open-circuit with the same result: note that its associated capacitor C86 is returned to h.t. and not to chassis.

## Ballooning

Picture ballooning when the brightness is turned up is usually caused by a faulty DY87. Similar symptoms accompanied by reduced width and height did not however in one instance respond to replacing the DY87. Closer inspection revealed a faint red glow in the PL36. The PCL84 triode anode voltage was then found to be less than half the correct figure, indicating excessive current through it although it was obviously oscillating. The fault proved to be a slight leak in the drive coupler C87. This was loading the triode anode and thus reducing its voltage drastically.

The resistor R116 (0.7Ω) in series with the DY87 heater can deteriorate resulting in ballooning followed in time by failure of the e.h.t. supply. If this fault is suspected prise off the top of the valveholder to gain access to the plastic wafer containing the sockets: the wafer can be removed complete with heater leads. Since the DY87 is a diode one might be excused for suspecting that there are only an anode connection to the top cap and heater leads to pins 4 and 5. In fact the heater pin 4 is internally connected to pins 1, 6 and 9 while the other heater pin 5 is connected internally to pins 2 and 8. This has advantages when as sometimes happens socket connections become intermittent since the unused sockets can be linked together to restore positive connections. Indeed some manufacturers wire each feed to two or more points to ensure good heater connections. When R116 has been found inside the valve socket it can be replaced: in view of its

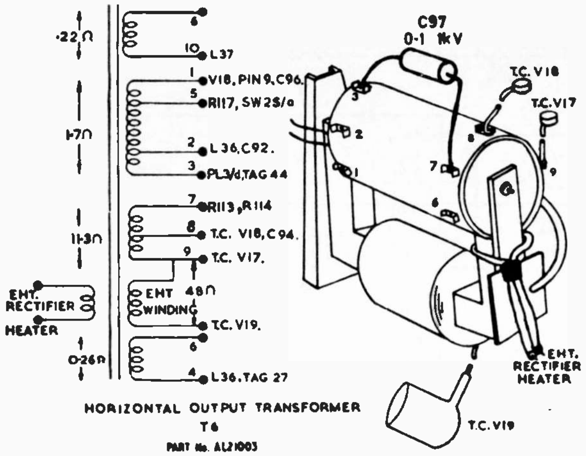



*Fig. 2: Line output transformer connections.*

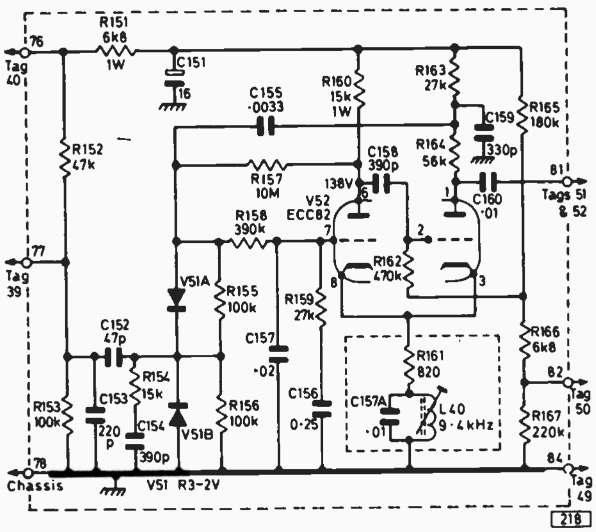



*Fig. 3: The most common of the three flywheel sync units used on these models. R167 is sometimes omitted.*

low value a correct manufacturer's replacement is desirable.

## Lack of Width

Normal width on 405 lines dropping to around two-thirds width on switching to 625 lines followed sometimes by complete collapse of the picture has been traced to a faulty width control. The two controls are mounted at the top right corner of the panel. They are slider type potentiometers which can break contact between rotor and track, sometimes leaving a burnt spot.

## Weak Hold

An unusual fault in a Pye 11U receiver resulted in the need to reset the line hold control once or twice during an evening's viewing. Valve replacements made no difference and there were no discoloured resistors. Resistor values were checked however and eventually one of the 1W resistors tucked behind the line output transformer was found to be changing value as the set warmed up: this was R113 (390kΩ) connected between the transformer and the width controls. In operation as the value of R113 dropped the grid bias voltage developed across the v.d.r. R106 gradually changed altering the oscillator conditions until the set went out of lock. This sort of thing can happen when the line output stage also forms part of the line oscillator circuit.

## Lack of Boost Voltage

After changing valves the usual suspect for lack of boost voltage is the boost capacitor itself. This is C97 (0.1$\mu$F). It is located beside the line output transformer inside the screening can—connected between tags 3 and 7 (see Fig. 2). Note that it is rated at 1kV working.

## Line Output Transformer

The line output transformer is not immune from breakdown and careful setting of the width controls is essential to ensure long life. This is most accurately done using an e.h.t. meter. Adjust R111 on 405 lines and R112 on 625 lines to give an e.h.t. of 14.8–15.8kV.

After replacing components on the line output transformer make sure that there are no whiskers or ragged solder joints: corona can be a problem on this chassis giving, especially on 625 lines, ragged vertical stripes on the screen. If the line output stage screening can has to be removed make sure that it is replaced and that all the self-tapping screws are tightly secured.

## Line Whistle but No EHT

Loss of e.h.t. but with line whistle and no overheating in the PL36 is usually due to the screen grid resistor R108 being open-circuit—note that it is rated at 6W. This resistor sometimes becomes intermittent instead of completely open-circuit.

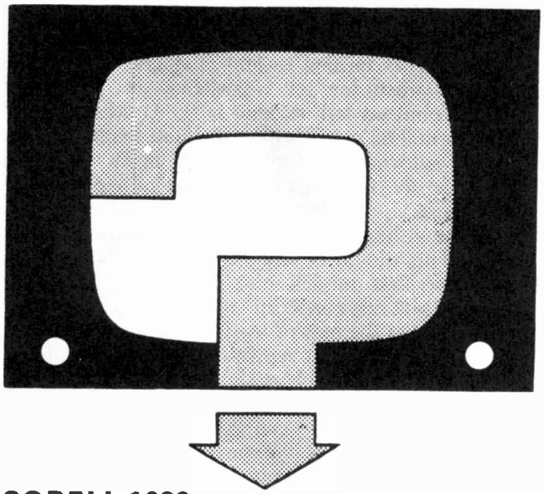
## Flywheel Sync

For use in fringe and difficult reception areas three different flywheel line sync panels were issued in kit form: the panel was bolted to the top of the i.f. panel above the height control, making it easy to identify whether a set is a flywheel sync model or not when it reaches the workshop for repair.

Of the three versions the most common one is shown in Fig. 3. It will be seen to use an ECC82 double triode as a cathode-coupled multivibrator. This takes over from the line oscillator V14B which is then redundant. The panel is reliable but in time the valve develops faults. The two flywheel sync diodes V51A and V51B can change resistance, upsetting the balance of operation—replacement diodes should be chosen to be of equal resistance value. C151 (16$\mu$F) can lose capacitance, resulting in S-shaped verticals.

## System Switching

The system switch is divided between the i.f. and the line timebase panels and cleanliness is essential for good working. The tags tend to discolour and even to corrode in time. A rub with a rag moistened with Servisol will clean them. Ensure that the switch linkage system engages properly when the chassis is swung back into its normal position after servicing and that the switches make firm contact on both 405 and 625 lines.



# YOUR PROBLEMS SOLVED

★ **Requests for advice in dealing with servicing problems must be accompanied by a 11p postal order (made out to IPC Magazines Ltd.), the query coupon from page 475 and a stamped, addressed envelope. We can deal with only one query at a time. We regret that we cannot supply service sheets or answer queries over the telephone.**

## SOBELL 1029

**The set displays a monochrome picture overlaid with groups of horizontal colour bars repeated from the top to the bottom of the screen. On two previous occasions adjusting the colour reference oscillator preset P302 cured the trouble but adjusting it no longer spreads the colour normally.—F. Kirkman (Bristol).**

The trouble is in the reference oscillator or its control circuit and we suggest you check the diodes D307 and D308 in the phase detector circuit—these need to be a balanced pair, so resistance checks should be made on them. The detector transformer L306 may need trimming. If this does not cure the problem check the reference oscillator transistor Tr28 itself—it might be reluctant to operate at the correct frequency—after which you will have if necessary to check the reference oscillator circuit generally.

## KB WV80

**The picture and sound are both weak, the picture being grey with little or no contrast. The trouble is exactly the same on both u.h.f. and v.h.f. The contrast control has little effect—it seems to be inoperative. The h.t. is correct and all likely valves have been checked and found to be OK. Both tuners seem to be working satisfactorily.—G. Hurst (Rayleigh).**

The trouble could well be due to increase in the value of the 4.7MΩ resistor connected to the slider of the contrast control. Another possible resistor value change is in the 33kΩ feed resistor to the screen grid (pin 8) of the first i.f. stage. It would be worth checking the vision detector diode (GD12, OA70 or OA90) which is inside the final i.f. coil can. Check by taking a resistance reading from the control grid of the PCL84 (with the set switched to 405 lines) to chassis: the reading should be about 3kΩ with the leads one way round and low with the leads reversed.

## STELLA ST2133

**The line output transformer was replaced in order to restore the e.h.t. but this was found to be extremely fierce and crackled ominously, even at maximum beam current. Instead of about −50V at the PL504 grid there was −30V: the oscillator voltages were also incorrect. After checking various components in the line output stage the new output transformer finally failed. Before obtaining a new one I would welcome some views on possible component faults.—R. Hollweig (Tadcaster).**

It strikes us that the most likely cause of the trouble is that the two 8.2MΩ resistors above the preset width controls have at some time been replaced with resistors of lower value—they often change value in this chassis. The exact values are not too critical but the total resistance should not be below 10MΩ. Then check the coupling network between the line oscillator and line output valve—the coupling capacitor C413 and the charging network C410 and R450. (Philips Style 70 chassis.)

## INVICTA 7021U

**The set is operated on u.h.f. only and the fault is vision-on-sound buzz which cannot be tuned out. I understand that the coils have been adjusted but that the problem is always present in this chassis (Pye 11U series).—J. Paynter (Walsall).**

If the 6MHz intercarrier channel coil cores L28, T2 and L24 have been accurately aligned it seems to us that the second i.f. amplifier EF184 (V6) is low emission. Check this, also the other common vision and sound valves—the PCL84 and EF183. Make sure that the preset contrast control is correctly set—this may require resetting to obtain best results with freedom from overloading if replacement valves are fitted.

## CRTs

**In the advertisements for television c.r.t.s in your magazine a number of terms are used which I have not seen explained, e.g. standard, Rimguard, twin-panel, etc.—R. Bennett (Rye).**

The important point about the various types of tube is that an exact replacement type—i.e. the original type or a direct equivalent—must be used to avoid fitting difficulties and to maintain safety. A standard tube requires a separate mounting band and a separate front protective screen—these are rather old types now. A Rimguard/Panorama type tube has a built in mounting band with fixing lugs and front protective reinforcement—this is the modern type of tube. Twin panel tubes are standard ones but with a protective panel bonded to the faceplate—they have mounting lugs but no metal band. These were mainly imported but were quite widely used in the early 1960s.

## PHILIPS G22K511

**The picture keeps turning to pink and green. Sometimes this happens when the set is switched on, the picture becoming normal say half an hour later. At other times the picture is normal on switching on, the fault developing later and maybe subsequently turning back again to normal. Now however the fault is present most of the time.—G. Fawson (Thirsk).**

Check the voltage at pin 13 (blue first anode) of the c.r.t. base. This should be roughly equal to the voltage at the other two first anodes, pins 4 and 5. If it is lower, check the 2.2MΩ resistor R1267 to the blue gun switch on the small panel at the rear of the front adjustments. If the voltage at pin 13 is about right turn attention to the blue grid (pin 12). The voltage here should be 62V (the same as at the other grids, pins 3 and 7). If this voltage is low check the B−Y amplifier/clamp valve V7007 (PCF200) and the 10MΩ resistor R7249 in the anode circuit of the clamp section of this valve (pin 9). (Philips G6 chassis.)

## BUSH TV95

**The picture is good but the field keeps slipping. The best field lock that can be obtained is with the control fully anticlockwise but even then the picture jumps at intervals. The field timebase and sync separator valves have been replaced without success. I would also like to use a silicon h.t. rectifier in place of the metal one.—G. Towers (Sevenoaks).**

Changing the 10MΩ anode load resistor of the field sync stage V101B may help the lock but if the control has to be set to one end of its range you should check the values of the 2.2MΩ resistor in parallel with it and the 620kΩ resistor in series with it. The existing h.t. metal rectifier can be left in position and a BY127 or equivalent silicon diode wired in series with a 20Ω (approximately) wire-wound resistor soldered across the two ends—pointed end to h.t. and the flat end to the a.c. input.

## PYE 13U

**The trouble with this set is that there is only a small, square picture, about 5 × 5in., at the centre of the screen. The line timebase whistle seems to be abnormally high. The raster is of normal size when the set is first switched on but after about ten seconds the whistle becomes louder and the picture shrinks. The line timebase valves have been changed without success.—T. Watts (Norwich).**

The symptoms you describe can be caused by a faulty coupling capacitor between the line oscillator and line output valve (C87, 0.01μF) and as this component is a weak spot in this chassis we suggest you replace it.

## BAIRD 701T

**The problem with this set is to get the line timebase to lock—it seems to be running too fast. By adjusting the line multivibrator stabilising coil L432 and the horizontal hold control the timebase can be locked to give a very large, out-of-focus picture. The line oscillator and output stage valves, the flywheel sync discriminator diodes and most of the capacitors in the line oscillator circuit have been replaced.—R. Dunn (Hayes).**

We suggest you check the reference signal feedback components to the discriminator circuit—there are two 39kΩ resistors and a 1,800pF capacitor, connected in series. Also check the two series-connected 2.7MΩ resistors in the width circuit.

## KB KV025

**If v.h.f. is selected when the set is switched on there is sound but no picture. On switching to u.h.f. there is no sound and a blank raster but after several minutes the sound and picture try to resolve themselves and eventually succeed—the picture is then also present on v.h.f. The problem has got worse but can be cured by switching on and off a couple of times after which everything is all right for the rest of the evening.—G. Cullen (Sheffield).**

The trouble is almost certainly due to the PCL84 video amplifier being defective so this should be changed. It is possible but far less likely that the EF184 second i.f. amplifier valve is faulty. (STC/ITT VC51 chassis.)

## PHILIPS 19TG158A

**After the set has been operating for about half an hour the picture pulls over to the left and slips, giving a double image. This occurs either on a change of camera or during darker scenes. The problem is improved by turning the brightness control up.—G. Read (Chelmsford).**

There are two ECC82 valves on the right-hand side. One is the line oscillator and the other the flywheel sync valve. Just to the right of the upper, flywheel sync one there is a 27kΩ resistor—one of the anode loads. This quite often changes value to produce the fault you describe.

## HMV 2627

**There are two problems on this set. First field slip which cannot be cured by adjusting the field hold control. Secondly the brilliance control is at maximum and although the picture is quite good it is too black, whitewashy and the background scenes have pale halo outlines.—R. Allen (Sale).**

The field slip will probably be cured by replacing either the PCL85 field timebase valve or the PFL200 video amplifier/sync separator. The picture trouble is due to the supply to the c.r.t. first anode (pin 3) being low, probably due to the decoupler C93 being short-circuit. To check this remove the lead to pin 3 and connect pins 3 and 4. If the picture is better renew C93 and reconnect as previously. (Thorn 950 chassis.)

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**TELEVISION AUGUST 1973**

# TEST CASE

## 128

*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.*

? *Having a customer located in a low television signal field area, the service technician suggested that significantly improved results might well be obtained by the use of an aerial preamplifier. The aerial in use was a high-gain multi-element model mounted as high as feasible on the chimney stack of a modern bungalow, and the signal was fed to the receiver through good quality low-loss coaxial cable.*

*The signal direct from the aerial averaged about 75µV and while this was sufficient to produce a well-locked picture on the modern receiver in use the definition was marred by background grain, resulting of course from the poor signal-to-noise ratio. The receiver in question was equipped with a capacitance-diode-tuned all-transistor tuner and it was concluded that some extra 10dB gain, stepping up the signal to about 225µV, would clear a good deal of the picture noise—as had been found by the technician previously when using such a preamplifier in the same area with a less modern receiver.*

*Consequently a set-side aerial preamplifier was installed but much to the surprise of the technician there was virtually no change at all in the performance, in spite of the receiver signal now measuring about 250µV. It was thought that a better place for the preamplifier would be at the aerial so its location was changed and the signal fed down through the same coaxial downlead—which was also used to power the preamplifier. But again there was barely any change in performance.*

*What important factor had been overlooked by the technician See next month's* Television *for the solution and for a further item in the Test Case series.*

### SOLUTION TO TEST CASE 127

**(Page 425 last month)**

Since when the colour faded the colour sync also went out of lock while the chrominance signals remained substantially constant at the input to the synchronous detectors the fault obviously had its origin in the reference oscillator circuit somewhere. The burst channel was obviously in order since the chrominance channel turn-on bias is derived from its output.

The final test made by the technician was of the reference signal amplitude. When the colour faded it was seen on the 'scope that the reference signal amplitude also fell, eventually becoming so low that correct synchronisation with the bursts was no longer possible.

Further checks indicated that the 4.43MHz crystal was defective, the fault reducing the reference signal amplitude as the temperature increased. The crystal could be "shock excited" into oscillation by switching the receiver off and then on again, but for a short time only. A replacement crystal completely cured the trouble.

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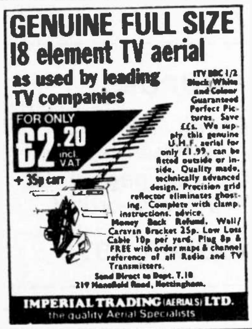


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**IMMEDIATE POSTAL DESPATCH, LISTS S.A.E., DISCOUNT PRICE**
**PRICES FROM 1.4.1973 (INCL. V.A.T.)**

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| DY86/7 | 33p | PC88 | 61p | PCL86 | 53p | 6/30L2 | 80p | 30PL 13 | 95p |
| DY802 | 37p | PCF80 | 43p | PL36 | 70p | 6BW7 | 66p | 30PL 15 | 95p |
| ECC81 | 40p | PCF801 | 53p | PL84 | 53p | 6F23 | 85p | | |
| ECC82 | 37p | PCF802 | 55p | PL500/4 | 70p | 6F28 | 60p | | |
| ECL80 | 43p | PCF805 | 73p | PY81 | 40p | 20L1 | 88p | | |
| EF80 | 37p | PCF808 | 70p | PY800 | 40p | 20P4 | 88p | | |
| EF183 | 49p | PCL82 | 41p | PY801 | 40p | 30C15 | 84p | | |
| EF184 | 49p | PCL83 | 53p | U25 | 80p | 30FL1/2 | 60p | | |
| EH90 | 46p | PCL84 | 49p | U26 | 80p | 30L15 | 84p | | |
| EY51 | 60p | PCL85 } | 53p | U191 | 80p | 30L17 | 84p | | |
| EY86/7 | 33p | PCL805 } | | | | | | | |
| GZ34 | 63p | PCL805 (non BVA) | 44p | U193 | 40p | 30P12 | 84p | | |
| PC86 | 61p | | | U251 | 83p | 30PL1 | 66p | | |

NOTE: PRICES ARE TO NEAREST NEW PENNY QUANTITY PRICES ARE LOWER.

BY100-127 with 10W res. 16p!

*POST FREE OVER £3, BELOW THIS add 3p per valve*

Large PCF80 30p. Sorry, no X78, X79 but EQUIVS, 12AH8 & 10C1
See separate Component, CRT and Transistor Lists. Many obsolete types available.

**(Adjacent to Post Office) 6 POTTERS RD., NEW BARNET HERTS. Tel: 449/1934-5 any time.**

**Local Agents:** MANOR SUPPLIES, 172 WEST END LANE, LONDON NW6 Tel: 794/8751. (Near West Hampstead Tube Station)