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SEPTEMBER 1976

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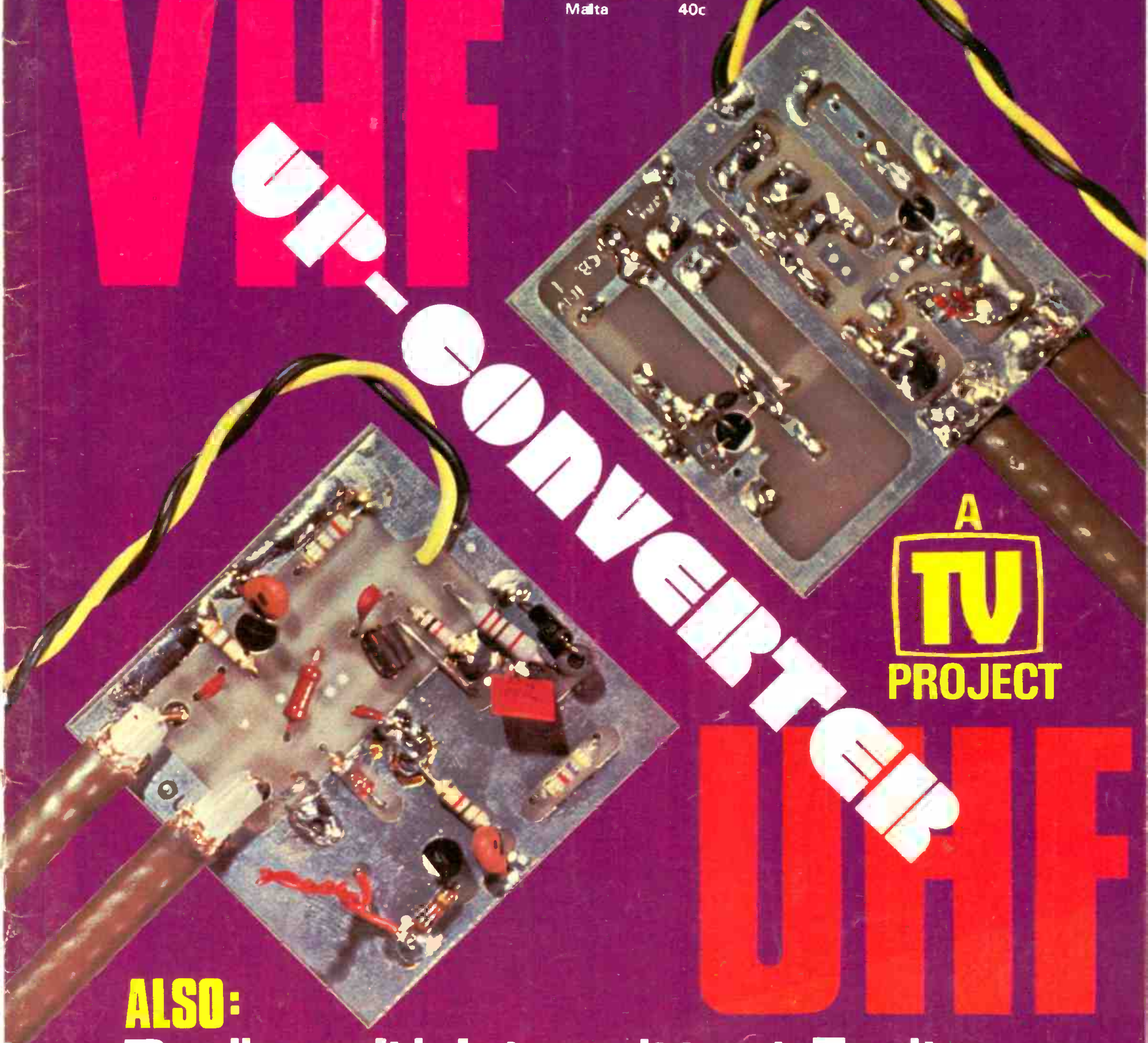

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Television

SERVICING
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1976

CORRESPONDENCE

All correspondence regarding advertisements should be addressed to the Advertisement Manager, "Television", Kings Reach Tower, Stamford Street, London SE1 9LS. All other correspondence should be addressed to the Editor, "Television", Fleetway House, Farringdon Street, London EC4A 4AD.

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QUERIES

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

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613 Test Case 165
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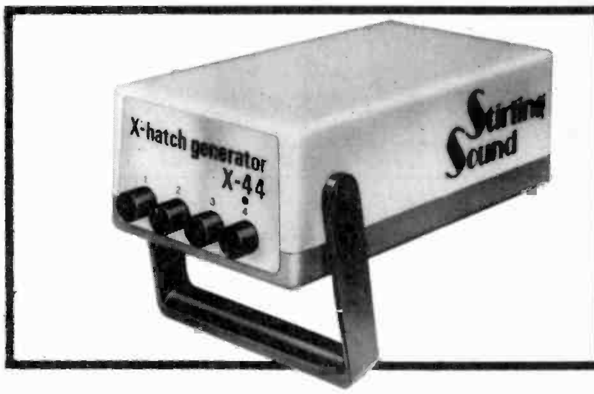
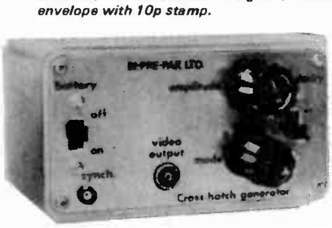
OUR NEXT ISSUE DATED OCTOBER WILL BE PUBLISHED ON SEPTEMBER 20



X-hatch generator
X-44
Stirling Sound



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video output
Cross hatch generator

Television

PUBLIC RELATIONS

E. Trundle's extremely interesting account of dealing with intermittent faults on TV sets (see page 578) raises many intriguing questions. We'll leave the technical ones to E. Trundle, who speaks with many years' experience of supervising a busy workshop. What we'd like to comment on here is the customer liaison aspects. Just how *do* you get across to the owner/renter what's involved in servicing his set?

The basic problem often goes something like this. "It's only a minor fault, about once a fortnight the colour takes ten minutes or so to appear after switching the set on." Not a major fault like Mrs Smith's set next door. "Her picture *and* sound disappeared completely last night and the man took only ten minutes to put it right this morning." Mrs Smith may even have had a whiff of smoke or a loud crack to confirm that the fault was a "major" one. Well of course it is major in the sense that more damage may have been done and more expensive replacements may be required. But the set that sits there and says "look, I've no power supplies" is a simple matter to put right (we're not talking about those sets with switch-mode power supplies or Syclops however!). The one that sits there with an obscure fault it'll reveal only once a week – and then maybe give it's owner a dose of it all evening ("it's got worse, picture kept jumping, on and off, all evening") – is a different matter entirely, even though minor in the sense that the offending item – or connection – is generally, to quote the famous Victorian domestic, "only a little one". The point is that if the customer sees say a nice big line output transformer going into his set he can understand a reasonable bill, but if he's told "I spent three days on it and it seems to be all right now, but let us know if the fault shows up again" he'll think you're probably the local bodger, and will in all likelihood tell his neighbours of the conclusion he's come to into the bargain. The fact is that those customers whose sets have the most time consuming troubles probably seldom get billed for the full economic cost. They should be happy, but probably aren't. "He's been looking after peoples' sets around here for the last ten years, and can't even ensure my colour stays on all evening".

Quite how one gets around this perennial problem is largely a matter for the individual, but we sometimes feel it might be a help if the RETRA produced a leaflet for counter display pointing out that there are easy and awkward faults and that, while most people will be lucky and entirely satisfied with their sets, in a complex piece of electronic equipment such as a TV receiver there will inevitably be occasional troubles that for a time defy even the most skilled engineer. We seem to recall that the motor trade from time to time points out how many thousands of individual bits and pieces go to make a complete car. Maybe BREMA would contribute a word or two.

So what do you say to Mrs Smith's neighbour? It's rather staggering to think that such disparate expertise as that of the skilled diplomat and that of the experienced engineer should often be expected of the same person – they are not, to our mind at least, qualifications one would naturally expect to find going together. Pause for reflection; come to think of it, skilled diplomats don't always seem to do all that well, do they? Be that as it may however, it is surprising how often the engineer does manage to rise to the occasion. Possibly the patience that dealing with awkward faults requires often goes with patience in dealing with awkward owners. And some of them can be awkward indeed. "Got the picture back last night, now the sound's gone: I'll clout him when he calls tomorrow". Yes, that's another point a publicity leaflet could make clear: that different faults generally have different causes – once one could say usually, but a colleague on another magazine reported the puzzled reaction of several shops to the fact that the sound on his Thorn 1580 hybrid portable had disappeared when the field collapsed. But we digress.

Whether you work primarily in the field, or at the workshop where you can be got at on the 'phone ("you've had my set for ten days because the brightness varies and now the substitute set's gone on the blink"), you're likely to find yourself involved in the problem of public relations. The aggro for some is so great that they leave the trade, despite their capability and interest in dealing with domestic electronic equipment. A large number of engineers manage extremely well however in dealing with the owner as well as the set. All we can add is that the public should be very grateful when they are dealt with by such understanding souls.

teletopics

TV FIGURES UP AT LAST

The downward trend of colour TV deliveries appears to have been halted according to the latest figures released by BREMA. May deliveries reached 109,000, an increase of 33% on last year. This figure includes imported sets. However, the total delivery figure for the year up to May was only 501,000, compared to 736,000 for the same period last year. This represents a fall of 32%. Monochrome deliveries, again up to May this year, were 84,000, bringing the year's total to 413,000 compared with 367,000 last year – an increase of 11%.

FIRST BRITISH VIDEO EXHIBITION

Britain's first major exhibition of video equipment, Video 76, is to be held at London's Heathrow Hotel between November 10 and 13. The exhibition will be combined with a three-day conference in the hotel's York Video Suite. The event was conceived in conjunction with Akai, Hitachi-Denshi, JVC, National Panasonic, Philips, Sanyo and Sony. Participation is expected from a wide range of companies handling video hardware, software and production services. Exhibition attendance will be free but restricted to trade ticket holders on the first three days. Tickets are available from the organisers, Emberworth Ltd, 8 Furlong Road, Bourne End, Bucks. As conference seating is limited, a delegate fee of £2 per afternoon session or £5 for the three sessions will be charged. On Saturday, November 13, Video 76 will be open on a no-tickets basis to members of the public.

GRUNDIG'S SELF-SEEKING TUNING SYSTEM

It would appear as though TV set designers have resolved to eliminate all mechanical controls and there is much feverish activity evident to support this view, especially amongst continental manufacturers. Grundig now offers on some models a self-seeking tuning system which goes a long way towards achieving this aim. All the electronics are housed on a single p.c.b. and the system tunes itself, protects itself against drift, and gives a visual display of channel selection on the screen during the tuning process.

Referring to Fig. 1, a 1MHz oscillator contained in the SN16966N i.c. provides a pulsed input to another section of the i.c. known as a "question counter", whose inputs are activated in turn and sweep the inputs of a comparator. Simultaneously, an information counter sweeps separate inputs of the comparator, but at a different frequency. Where the pulses coincide, an output pulse is obtained. These pulses are integrated to produce an ascending staircase signal in 7·3mV steps covering the range 0 to +30V. When this is fed to the tuner varicap diodes it will automatically tune over an entire band of frequencies. In order to slow down the scanning frequency and also stop the sweep when a programme is reached, a special i.f. discriminator circuit has been devised. Fig. 2 shows the response curve of the circuit when the i.f. frequency of 38·9MHz is approached. This waveform is applied to another i.c., type SN16965N. When this i.c. senses the negative excursion of the S-curve as it sinks to about –2V, it switches off the 1MHz oscillator and an internal slow-running oscillator takes over, whose running frequency gradually decreases until the i.f. frequency is reached. Should the i.f. frequency change due to drift in the tuner or associated circuitry, the oscillator will once again start up to compensate. A "clarity" control is provided which in conjunction with a varicap diode, can produce a "sharp" or "soft" picture.

A memory facility is also provided through the action of the shift registers in the three TP4398N i.c.s. These receive information from the comparator and store the digit train responsible for a particular channel. This information is retrieved and integrated to produce the tuning voltage. The memory circuits are activated by a push-button on the front panel which is depressed when the desired channel has been reached.

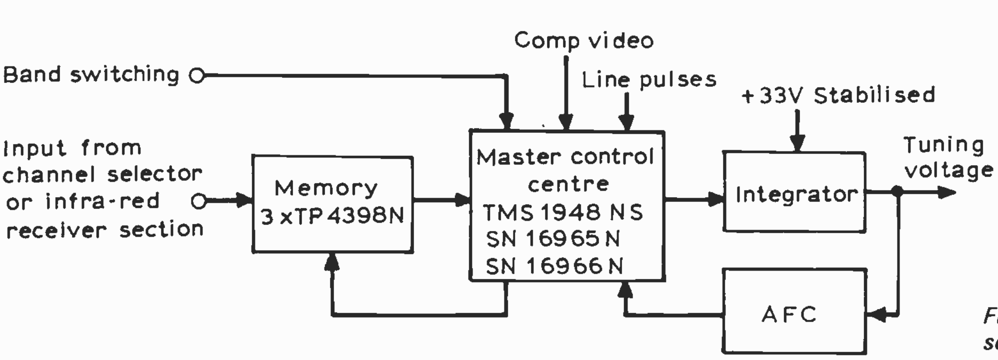


Fig. 1: Block diagram of the Grundig self-seeking tuning system.

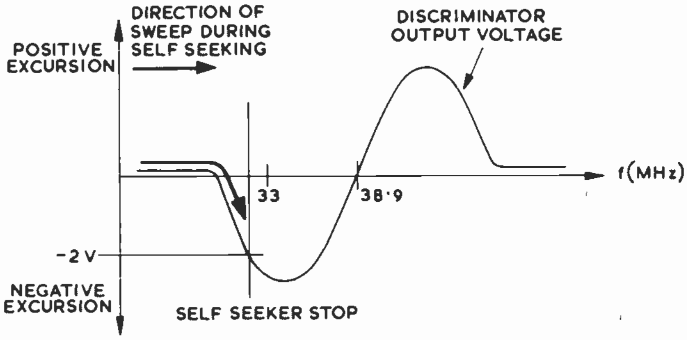


Fig. 2: Response curve of the a.f.c. circuit in the self-seeking tuning system devised by Grundig. The self-seeking action stops as soon as the discriminator voltage sinks to −2V.

KEEPING AN EYE ON THE JAPS

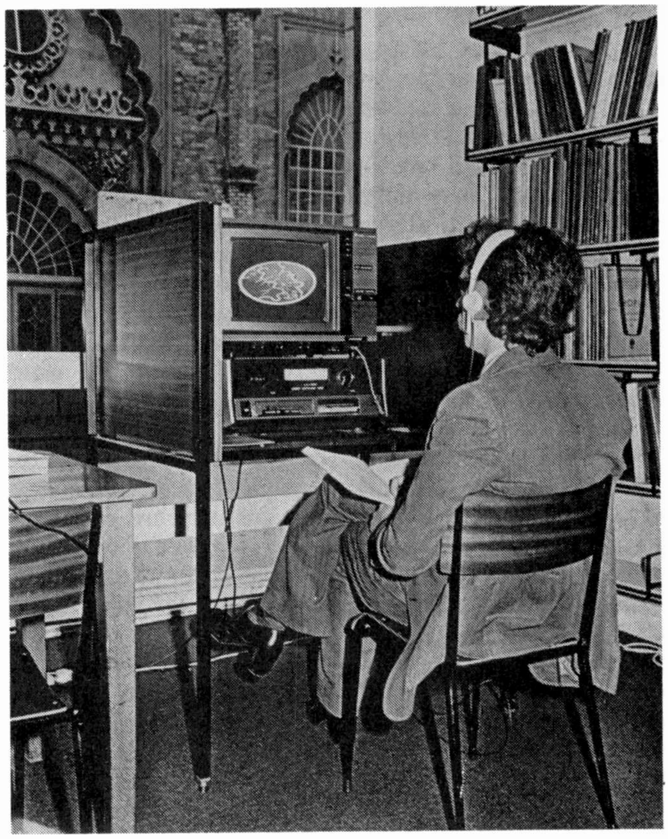
Edward Lyons, MP for Bradford West, was surely right to raise the subject of the effect of Japanese TV imports on the UK TV industry in the House of Commons recently. In reply, Alan Williams, Minister of State, Department of Industry, pointed out that imports have decreased. True, but the Japanese have maintained their share of the market, and have brought to an end their agreement to restrict exports to the UK when demand is low, while the comparisons made with 1973 when the colour TV boom was at its peak and importers were struggling to get whatever they could from wherever possible are hardly relevant. As Mr. Lyons said, Japanese colour tube prices were held steady during 1974-5, but rose very substantially once Thorn's Skelmersdale plant was closed. Japanese colour set prices have not risen to the extent that devaluation and cost increases would have led one to expect. It's all very well for the Government to say that action will follow proof of dumping (which isn't what's being alleged), but when an attempt was made to investigate colour c.r.t. prices it was found that the structure of Japanese industry made it impossible to assess what a "market price" was. The situation needs to be watched carefully, and the Government should not be slow to act if necessary. The Japanese expect a free market everywhere – except in Japan! There is also a far greater degree of government/industry co-operation in Japan than in other capitalist economies: they know what they're doing even if we don't.

TV LICENCE FEE TO RISE IN 1977

There is now no doubt that the TV licence fee will go up – "the increase will need to be substantial" according to the BBC's director general, Sir Charles Curran – when the licence comes up for consideration next year. Sir Charles pointed out, fairly enough, that the BBC was no more immune to the effects of inflation than any other organisation, and that a deterioration in the quality of programmes due to severely inadequate finances would adversely affect new sales and rental agreements. The trouble is, there is something of a chicken and egg situation here. Many dealers feel that the present fee has had a damaging effect on sales/rentals, while the lower than anticipated colour set disposals have adversely affected the BBC's finances. Would a "substantial increase" bring out viewers' cheque books on the expectation of better programmes, or would it simply put them off even more than at present? The Government, anxious to hold back consumer demand at home, is probably not too concerned. Meanwhile the ITV programme companies are wearing a happy look as the economy picks up and advertising revenues grow sharply.

FREE FOR ALL!

An experimental TV installation in Brighton's central public library may be the forerunner of a video library service for the local community. The service is based on work done at Brighton Polytechnic in building up a library of information on video cartridges; students at the Poly simply plug the cartridge of their choice into a National Panasonic playback machine (like that pictured above) and sit back for up to 30 minutes' instruction. The soundtrack is heard through earphones to avoid disturbing other users of the library.



Public use of this system in East Sussex has so far been confined to the unit pictured (installed in the Music Library of Brighton Central Library) and short-term installations in libraries at Hove, Eastbourne and Hastings. A short film about the local rates was produced, and reactions are now being evaluated.

If the idea catches on in Brighton Library, the day may not be too far away when local groups have access to video film-making equipment and can make short programmes on issues of public concern; members of the public could then drop in at their local library, borrow the appropriate video cartridge, and pop it into a playback machine to get information and views on the local topic under discussion.

TRANSMITTER OPENINGS

Beaminster (Dorset) BBC-1 channel 55, ITV (Westward Television) channel 59, BBC-2 channel 62. Receiving aerial group C/D. Vertical polarisation.
Callander (Stirling) BBC-1 (Scotland) channel 22, ITV (Scottish Television) channel 25, BBC-2 channel 28. Receiving aerial group A. Vertical polarisation.
Fremont Point (Jersey) ITV (Channel Television) channel 41. Receiving aerial group B. Horizontal polarisation.
Les Touillets (Guernsey) ITV (Channel Television) channel 54. Receiving aerial group C/D. Horizontal polarisation.

Service Notebook

G.R.WILDING

TV Integrated Circuits

Though television integrated circuits have proved to be quite reliable in service, breakdowns do from time to time occur. It's fortunate that when they do there is usually clear evidence of failure in the form of marked changes in the pin voltages. We have recently come across two faulty i.c.s which, though quite different internally and performing different operations, produced comparable symptoms. The first was a TBA550Q i.c. providing video preamplification, flyback blanking, a.g.c. detection and sync separation in the Philips 320 solid-state monochrome chassis; the second was a TBA530Q providing RGB signal matrixing and preamplification in the GEC C2110 series of colour receivers.

The circuit of the video output stage used in the Philips 320 chassis is shown in Fig. 1, along with its links with the TBA550Q i.c. A conventional diode detector provides a negative-going composite output signal which is fed to pin 10 of the i.c. The output from pin 12 is applied to one end of the d.c. connected contrast control, whose slider applies both drive and forward bias to the base of the video output transistor T2248. Both ends of the contrast control are at the same potential – about 5·9V – so that varying the contrast setting does not alter the brightness level. To stabilise the d.c. conditions in the output stage the zener diode stabilised 12V line is applied via R2239/2231/2240 to the emitter resistor R2249. Flyback blanking pulses are fed to pin 11 of the i.c. When they appear – negative-going – at the output they cut off the output transistor T2248 and thus blank the c.r.t.

In this particular receiver the problem was that whilst a near normal picture was obtained following switch on, within a few minutes the brilliance level rose so that there was only a suggestion of modulation on a peak white raster. Tracing back from the c.r.t. we found as expected that its cathode voltage was low, the output transistor's collector voltage was low, while its base voltage was high. The slight delay in the appearance of the symptom suggested that the fault was due to a semiconductor failure as its temperature increased, i.e. either the output transistor or the i.c. was defective. The simplest way of finding out which one was responsible was to cut through the print from pin 12 of the i.c. to the contrast control, thus leaving the output transistor biased by its base circuit resistor/diode network. On doing this we discovered that the brilliance level remained constant, so clearly the i.c. was at fault. A replacement restored normal operation.

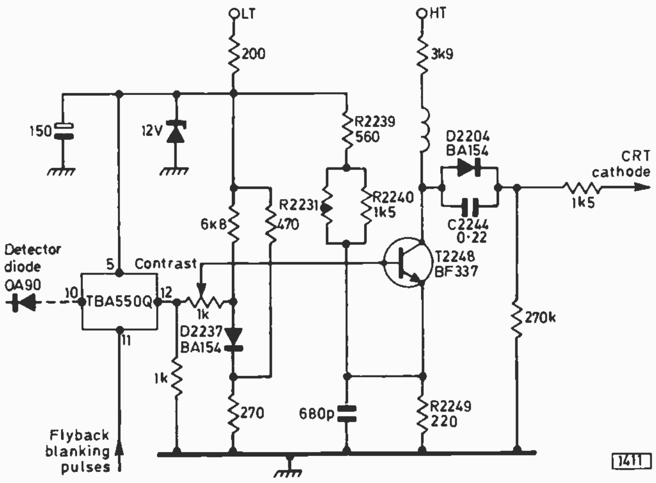


Fig. 1: Circuit of the video channel in the Philips 320 monochrome chassis. A faulty TBA550Q i.c. caused excessive brightness with hardly any picture shortly after switch on.

In the GEC colour receiver the picture was almost completely red from switch-on. Even before making any voltage checks it was apparent that the red output transistor was passing excessive current since its 5·1kΩ collector load resistor was much hotter than those in the green and blue output transistor circuits. Again, either the output transistor or the TBA530 i.c. which drives it could have been defective, but on isolating the R feed from pin 10 of the i.c. to the base of the red output transistor the voltage at pin 10 was found to be very much higher than the correct figure. A replacement TBA530 restored a perfect picture.

Greenish Picture

A "greenish picture" was the complaint with a Pye colour receiver fitted with the 691 hybrid chassis. This was rectified by readjusting the c.r.t. green gun first anode preset control RV38 and replacing the green channel PCL84 valve, but after several days the dominant green hue had returned. This time we replaced the G – Y clamp triode's 8·2MΩ anode load resistor, since these resistors give quite a lot of trouble. Readjusting the controls produced a first class picture, but after about ten days the fault again reappeared. Tests showed that while adjustment of the red and blue c.r.t. first anode preset controls produced similar voltage changes adjustment of the green first anode preset now had only a marginal effect. The control is returned to chassis via a 1·5MΩ resistor, and on checking this its resistance was found to have increased to nearly 3·5MΩ, thus preventing normal reduction of the first anode voltage. On changing this resistor and checking the others no further accentuation of the green content of the picture has been reported.

Many of the faults we have to deal with are caused by high-resistance current carrying resistors increasing in value. Common examples are the resistors in width stabilising circuits, field oscillator anode feed circuits and valve a.g.c. circuits. One wonders just how many service calls would be eliminated by doubling or trebling the wattage rating of such resistors. Paper calculations may well show that the wattage used is sufficient, but in practice, probably because the effect of ambient temperature is not taken fully into account, this is not so. Whatever the reasons however there seems to be a lack of feedback to the design departments of the setmakers about the incidence of high-value resistor failures.

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UP~CONVERTER

W. S. J. BRICE

COMMERCIAL v.h.f./u.h.f. converters are widely employed to enable single-standard u.h.f. TV sets to be used with relay systems which distribute the 625-line signals at v.h.f. The design described gives results comparable or even better than many commercial converters, and is fairly inexpensive to build. It could also be used, with suitable preamplifiers, to receive continental v.h.f. 625-line transmissions using an ordinary u.h.f. receiver, though the results would not be as good as if a proper v.h.f. tuner was used.

Circuit Description

The complete circuit diagram is shown in Fig. 1. Tr1 is a broadband amplifier stage to overcome the losses in the simple mixer circuit and to give the signal some advantage over local oscillator and mixer noise. The low value of C2 (100pF) compensates to some extent for a drop in gain on Band III as compared to Band I.

D3 is a simple diode mixer amplitude modulating the u.h.f. carrier from the oscillator with the mixture of v.h.f. signals fed into the converter. The u.h.f. receiver is tuned to the upper sidebands which correspond to the original v.h.f. signal translated to u.h.f.

The v.h.f. signal is coupled to the mixer diode through L3 which is a length of printed circuit conductor running close to the local oscillator tuned circuit. The small inductor L2 acts as a high-pass filter attenuating any v.h.f. signal remaining at this point and providing an earth return for the d.c. through the diode. The printed circuit strip-line inductor L4 and its associated tuning capacitors C5 and C6 provide a stable high Q circuit resonant in the u.h.f. band.

To further stabilise the local oscillator frequency, the supply rail for the oscillator is regulated by a simple zener diode circuit. The ferrite bead on one of the leads of this zener diode is necessary to prevent frequency modulation of the oscillator by variations of impedance of the zener in sympathy with hum or any other variation of the supply rail.

The converter may be powered from a supply rail of approximately 12V if it is built into a television, or from a simple mains power supply, as shown in the circuit diagram, if built as a separate unit.

Construction

The converter is built on a double sided printed circuit board so that conductor can be left on the top of the board over the oscillator section to provide an earthplane for the tuned line and some screening for the oscillator. The printed circuit layouts for the top and bottom are shown in Fig. 2.

The board can either be placed inside the set's cabinet and powered by a supply rail of 12V to 14V, or built into a small box, preferably metal to screen oscillator radiation, with the simple mains power supply shown in the circuit diagram.

Construction should not pose any problems if the usual precautions necessary with u.h.f. equipment are taken. Component leads, especially decoupling capacitors and transistors should be kept as short as possible. Where a component lead goes through conductor on both the top and the bottom of the board, the wire should be soldered on both sides. The input protection diodes D1 and D2 and also C5 are mounted on the bottom of the board as in the layout diagram.

TR1 and TR2 are mounted with all the leads going through one $\frac{3}{16}$in. diameter hole, instead of the usual separate small holes for each lead. These transistors should not be subjected to excess heat or voltage overloads when

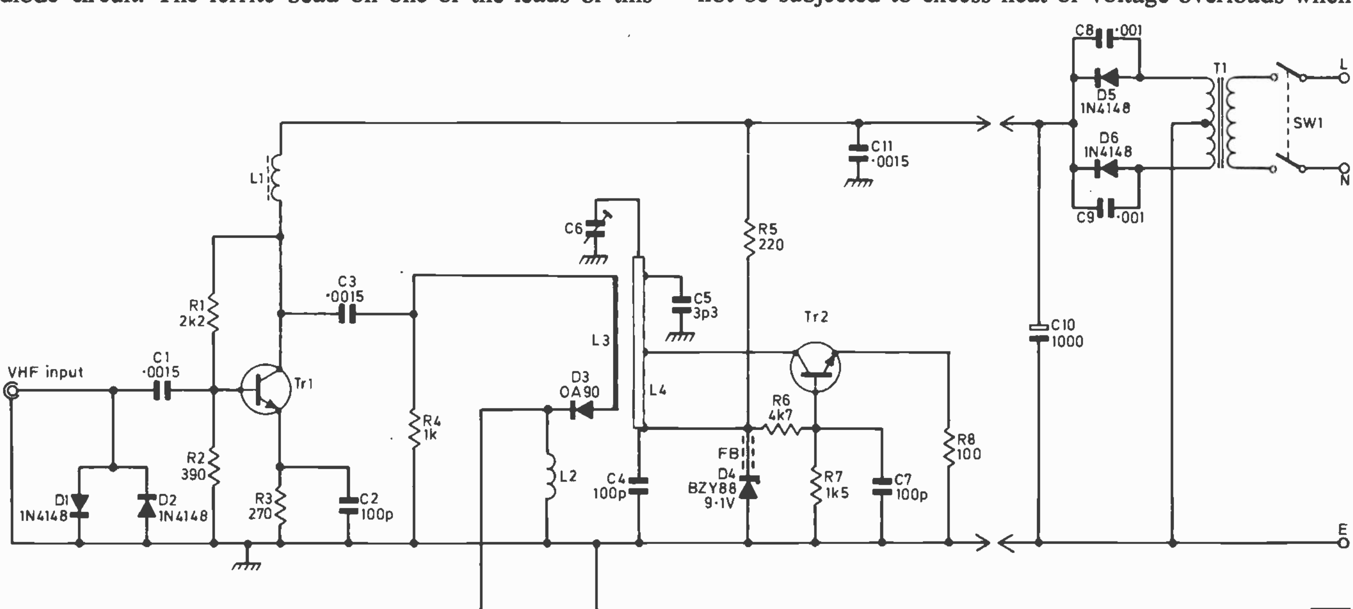

Fig. 1. Complete circuit diagram of the unit. The power supply section is not required if the converter is built into a TV set.

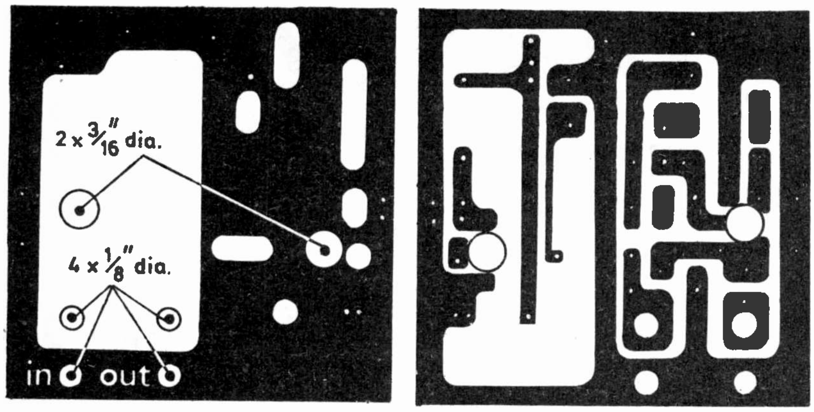

Fig. 2. Printed circuit board details. It is imperative to follow the artwork given very closely, as this will determine the characteristics of the tuning line. For those wishing to buy a ready made board, these are available from Clearline (Bampton), Brook Street, Bampton, Devon, at £1.30 including VAT and postage and packing.

Shown full scale.

constructing or testing the unit as their very narrow junctions, necessary to give a 1·0 GHz cut-off frequency, make them more fragile than, say, a BC109. C6 is simply two ½in. lengths of thin p.v.c. insulated wire twisted together. One wire is connected to the end of L4 and the other soldered to the earth plane.

Setting Up and Operation

When the converter is constructed and operating only one adjustment is needed, that is of the local oscillator frequency. This may be done by twisting or untwisting C6 for fine adjustment or by bending C4 towards or away from the circuit board for coarse adjustment.

The local oscillator frequency is in the lower half of the u.h.f. band and should be adjusted so that it will not cause any interference to receivers using the local u.h.f. channels and so that the local u.h.f. channels do not fall near the required up-converted signals and cause patterning. A useful check to see if the u.h.f. oscillator is working is to put a test meter probe on the link next to R4. Normal operation of the oscillator gives approximately —0·1V at this point.

The optimum input signal for the converter is approximately 1mV. If the signal rises much above this, as is possible with some relay systems, it should be attenuated to a suitable level, as converters tend to suffer severe cross-modulation effects if the input rises above a critical level. Signal levels much below 500μV tend to produce noisy pictures. When tuning a receiver to the converted signal the upper sideband signal (i.e. the signal above the oscillator frequency) must be selected as the lower sideband signals have their frequency components inverted and give smeary pictures with poor colour and sound.

There is a slight drift in frequency of the converted signals during an initial warm-up period but this is within the range of the a.f.c. on most receivers. If the set does not have a.f.c. it is best to leave the converter running continuously.

Safety

If the converter is used as a separate unit it should be properly earthed or if used on a non-earthed mains supply, aerial isolation similar to that on TV receivers should be built in, to prevent any possibility of shock from the leads to the converter. Similarly, if it is built into a receiver, the normal aerial isolation must not be bypassed. Some receivers have an aerial isolation unit with high pass characteristics and thus high attenuation at v.h.f. Others have the safety isolation in the tuner itself. In these cases the aerial socket should be replaced with a proper v.h.f. isolator. ■

★ Components list

Capacitors:

C1, C3, C11	1500pF ceramic
C2, C4, C7	100pF ceramic
C5	3.3pF ceramic
C6	(See text)
C8, C9	1000pF ceramic
C10	1000μF, 16V

Coils and transformers:

L1	3 turns enamelled wire on a ferrite bead
L2	1½ turns 20 s.w.g. x ¼in. diameter
L3, L4	part of p.c.b.
T1	Primary: 240V Secondary: 12-0-12V 6VA

Resistors: (all ±5%)

R1	2.2kΩ
R2	390Ω
R3	270Ω
R4	1kΩ
R5	220Ω ½W
R6	4.7kΩ
R7	1.5kΩ
R8	100Ω

Unspecified ratings ¼W

Semiconductors:

D1, D2, D5, D6	1N4148 or 1N914
D3	OA90
D4	BZY88 C9V1
Tr1, Tr2	BF357K, BFX89 or BFY90

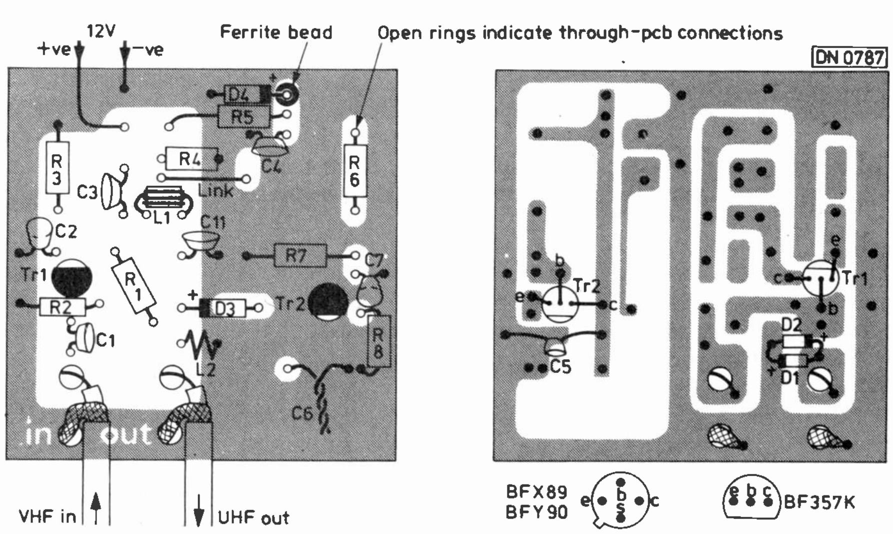

Fig. 3. Component location diagram. Note that some components are mounted on the reverse side of the board. Although other transistors may be used, the preferred type is BF357K.

FAULTS IN RANK 90° COLOUR SETS

A. Denham

THE Rank 90° solid-state chassis has been with us for some years now and there are a number of versions with different panels. The earliest version of the chassis was the A823. Later came the A823A and A823AV. The latest version is the BEABed one, the A823B. Our fault experiences on these sets over the last few years are summarised below.

Quick Checks

Dead set, c.r.t. heater not alight, 5A mains fuse 8F2 black: Normally due to the h.t. supply thyristor BT106 going short-circuit. Can be the mains filter capacitor 8C5 however and this can be responsible for intermittent fuse blowing.
Set dead, c.r.t. heater alight, 2A l.t. supply fuse 8F1 blown: L.T. bridge rectifier BY164 (replace with four BY126 rectifiers) short-circuit or BD131 line driver transistor short-circuit.
No h.t., mains (8F2) and h.t. (8F3) fuses o.k.: Surge limiting thermistor 8TH2 (VA1104) or h.t. thyristor BT106 open-circuit.
No e.h.t., with rushing noise on sound on sets with varicap tuners, 600mA h.t. fuse open-circuit: Line output transistors 6VT1/6VT2 faulty; e.h.t. tripler defective (always chars its 470Ω earth return resistor 6R9 in the line can above the tripler); c.r.t. first anode supply rectifier 6D2 (1N4007, later type SHG1·5) and/or reservoir capacitor 6C13 (0·01μF) short-circuit (check the 2·7kΩ feed resistor 6R7 when this fault is present); 0·47μF S-correction capacitor 6C3 short-circuit; line shift rectifier 6D3 (BA148) or reservoir capacitor 6C11 (200μF) short-circuit; line output stage tuning capacitors 6C5 and 6C6 (both 4,700pF) going short-circuit in early models. 6C3, 6D2, 6C13, 6R7, 6D3 and 6C11 are mounted on the raster correction (scan control) panel.
Hum bar: Check the power supply unit earth screws for cleanliness, and the l.t. reservoir/smoothing electrolytics 8C1-8C4 (2,500μF).
Low h.t.: Check the BC147 transistor 8VT1 and the two 390kΩ resistors 8R6 and 8R9 in the thyristor regulated power supply.
Excessive h.t.: This gives the symptom sound but no raster since the over-voltage protection circuit comes into operation, stopping the line oscillator and thus removing the e.h.t. The most common causes of high h.t. are the BT106 thyristor, or the feedback resistor 8R9 (390kΩ) in the regulator circuit going high-resistance or open-circuit.

The over-voltage circuit itself can be faulty. If the neon in the early circuit keeps striking despite the circuit being set up correctly, check the BC108 protection transistor 5VT3 and 5R11 (43kΩ) which links the neon to the h.t. rail. Trouble in the later over-voltage protection circuit is generally due to the 4EX581 (more recently changed to type XK3100) four-layer diode in the circuit or diode 5D14 (1N4148) which provides it with a supply by rectifying line flyback pulses.
Fluttering on mains, but not when operated from an isolating transformer: Check the h.t. reservoir/smoothing electrolytics 8C9/8C10 (600μF), the thyristor (BT106) and the trigger diac 8D3 (BR100, later 4EX581).
Picture jitter: Check thyristor BT106, trigger diac 8D3 (change to type 4EX581 and alter its series resistor 8R12 to 47Ω), change the associated resistor 8R13 to 1kΩ if of the earlier value (22kΩ).
Flyback lines, dull picture: Check the flyback blanking transistors 4VT1 (BC117) and 4VT2 (BC171) on the c.r.t. base panel.
No luminance: Luminance delay line open-circuit or dry-jointed.
Loss of one colour, poor grey scale: Check the electrolytic coupling capacitors between the SL901B demodulator/matrix i.c. and the RGB channels.

Power Supplies

If you have to replace one of the smoothing resistors it is usually necessary to replace the associated electrolytic capacitor – to avoid a repeat call in a few days' time. The faulty resistor is often caused by the capacitor going low in value, thus increasing the ripple current and the r.m.s. current through the resistor so that it eventually goes open-circuit. It's always worth the few extra minutes required to check this.

Another thing which will save many future calls is always to check the e.h.t. adjustment and the setting of the over-voltage protection preset when working on one of these sets.

Field Timebase

Total loss of field scan occurs when one of the two BA148 40V supply rectifiers, which are fed from a winding on the line output transformer, goes open-circuit (a single BY207 is used in the latest models), or when one or other of the BD131 field output transistors goes open-circuit. When replacing the earlier BD131 transistors with the RCA 16040/16041 pair, note that the emitter and base connections are reversed.

On later chassis – AV type onwards – intermittent field collapse is often due to a dry-joint on the pincushion amplitude control 6RV4 (50Ω, c.t., w.w.) or the pincushion phase coil 6L20. These are on the scan correction panel.

Field bounce can be caused by the 250μF bootstrap capacitor in the output stage or the mid-point voltage or field linearity potentiometers.

Weak field sync in earlier models (with A809 signal panel) is often due to 2C37 (125μF) in the a.g.c. circuit.

Line Timebase

If the BD131 line driver transistor keeps going short-circuit, check the 0·22μF capacitor and 22Ω (5W) resistor in its collector circuit. In later models also check the BC158 transistor which drives the BD131.

A narrow picture accompanied by smoke from the convergence board is frequently due to 7RV3 (7Ω w.w. RRI special), the R/G horizontal tilt control, burning out.

One or two sets we have had have intermittently given typical symptoms of low e.h.t. – ballooning etc. – due to the resistor in the e.h.t. cap burning up. This produces a bulge in the plastic connector.

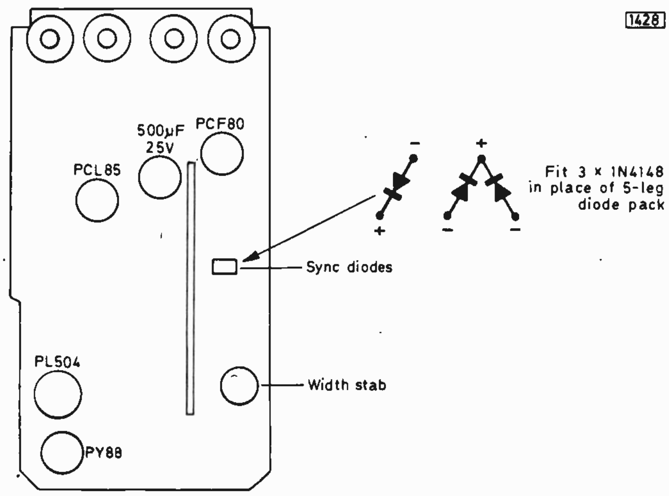

Fig. 1: Rear view of the timebase panel used in the TV141 and later sets.

Decoder

Intermittent loss of colour or excess colour on the two-i.c. decoder is often due to the a.c.c. amplifier transistor 3VT1 (BC148) immediately above the burst gate timing coil.

If the line oscillator is off tune, some sets tend to display red/green changeover because the burst gate timing is incorrect – remember that these sets do not have a reference oscillator stage, the bursts being used to ring a 4·43MHz crystal direct. The phase of the reference signal is thus determined by the phase of the signal applied to the crystal, particularly at switch on, so that burst gate timing faults give some very peculiar colour changes.

On more than one occasion we have encountered an internally open-circuit chrominance delay line and have been able to cure this by resoldering the print inside the case, using a small (Antex 15W) iron.

Noisy Chroma and Sound

On early sets – those with germanium audio output transistors – noisy chrominance and sound can usually be cured by a slight (half turn) adjustment of the *large* core in the *bottom* i.f. can.

Tuner

Tuners of the mechanical type frequently wear the buttons, and also the small nylon screws which tune each button. These can be replaced – time and patience are required.

Low gain, especially after a thunderstorm, is usually due to the r.f. amplifier transistor going short-circuit. Care is needed when fitting a replacement. A defective oscillator transistor gives no sound or picture, with background noise.

Poor Focusing

If the picture is defocused check 6R10 (4·7MΩ) which is in series with the focus control. It tends to go high value.

OTHER RRI MODELS

While on the subject of Rank receivers, the following notes on faults we've commonly encountered may be of help to other engineers.

Model CTV25

Intermittent line oscillation in these sets is frequently due to the coupling electrolytic 3C11 (1·6µF 63V or similar) between the cathodes of the PCF802 line oscillator valve going open-circuit.

TV125 Series

Weak line sync and/or line drift/judder: Replace the original flywheel line sync discriminator diodes 3MR1/2 with 1N4148 diodes or similar ones.

Weak light picture with tendency to sync crushing: PCF80 video amplifier load resistor 2R33 (10kΩ, 2W) low value, or burnt out resistors in the i.f. stages.

Boost diode glowing red hot: One or both boost capacitors 3C23/4 (0·1µF) short-circuit.

This latter fault applies to all Bush/Murphy valve/hybrid monochrome sets after this model.

TV141 Series

Poor field lock: Check 2C43 (8µF) which decouples the screen grid of the sync separator.

TV161 Series

Small dark picture: This is usually the line output transformer.

Poor line sync: As TV125 series. Wire in as shown in Fig. 1.

Poor field linearity plus tendency to roll: PCL805 field timebase valve cathode decoupling electrolytic 3C35 (500µF).

Poor field lock plus line tearing: Usually 2C48 (8µF) which decouples the screen grid of the sync separator, or an a.g.c. fault.

TV181S (A774 Chassis)

Line judder, a.g.c. hunting, even a dead set can be due to earth connection faults where the printed board meets the chassis.

The line output transformer is prone to failure, giving a dark picture with a 4in. gap at either side. The e.h.t. rectifier heater winding tends to short to the frame, giving no e.h.t. – this can be replaced with patience.

No picture or raster with foreign interference usually indicates shorted turns on the scan coils – the l.t. rail drops to around 8V.

If soldering the earth joints fails to cure line jitter, change the following capacitors in the line oscillator circuit: 3C32 (4,700pF), 3C34 (470pF) and 3C36 (0·01µF) – see Fig. 2. If 3C34 is leaky or short-circuit, 3R48 (390Ω) and 3R52 (3·9kΩ) may be burnt. The EF184 oscillator valve may also be damaged. In cases of line drift or frequency variations, check the stage's 10µF h.t. decoupling electrolytic 3C31. ■

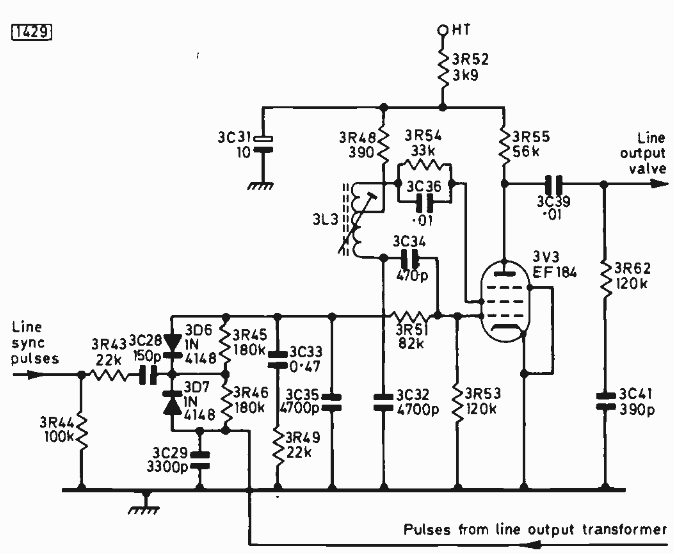

Fig. 2: Line oscillator circuit used in the A774 chassis.

talking about COLOUR CRTs

H. PETERS

THE aerobatic RAF Red Arrows end their display with a "Bomb Burst": the bunch of Folland Gnats suddenly disperses in all directions. I.C.s are doing a bomb burst right now, and colour tubes are poised to follow suit. Before they do so there are a few tips and wrinkles which readers' enquiries lead us to believe are worth passing on, beginning with the topic that worries colour set owners most – is my tube going?

Colour Tube Faults

Although colour tubes are afflicted by the same basic faults as their monochrome counterparts it must be remembered that they have three separate gun assemblies, the heaters of which are wired in parallel. So if you get the symptoms of a blank screen or a dim picture the odds are that you can rule out the tube straight away. Partial loss of vacuum can give these symptoms but you usually get fireworks in the tube neck as well. If the heaters are not lighting at all, yet everything else seems o.k., the connecting leads are the most likely cause. With three 0·3A heaters in parallel the mean current is just under an ampere, quite considerable for the sort of contacts to be found on the average printed circuit board. Some smaller tubes, as well as the quickheat types, take less (around 650mA) and there is no objection to using the latter as substitutes provided the difference in current is allowed for. This is important when the tube heaters are fed from a winding on the line output transformer. An extra ohm in the feed lead is usually required.

Low emission symptoms invariably affect one gun first and the writer's experience is that as well as the usual "glistening" effect the reds begin to look muddy and dull. Emission life is good however compared with monochrome tubes of a decade or so ago. The most common first sign of trouble on ageing colour tubes is an inability to track the grey scale properly due to the change in characteristics of one of the guns. It can happen to any colour, but before blaming the tube check the first anode preset potentiometers. These are often under rated and may change value in use due to a combination of heat and the applied boost potential – check any series resistors as well. The tracking usually deteriorates towards pink high lights and green low lights, possibly due to the red gun phosphors being derived from rare earths and in consequence having a different persistence.

Another annoying fault is a missing dot on the screen, and a microscopic examination of the tube face (× 50 lens) should indicate whether it is missing entirely or just obscured by a particle of foreign matter. If a whole triad of dots is missing the latter is certainly the case, and the particle may possibly be dislodged by tilting the tube face upwards and vibrating the shadowmask with the workshop degaussing coil.

Degaussing

There must be thousands who wonder whether the inbuilt degaussing coils are working efficiently, and others who wonder what the cone shield is for – modern sets don't seem to have them. The cone shield is an anachronism. If you remember the very first 70° round faced colour tubes, you will recall that the metal cone was itself the final anode, exposing over 3 sq. ft. of metal at 25kV. The cone shield was there to keep the fingers away. Today it is something to hang the degaussing coils on and to complete their magnetic circuit. The latest tubes have the steel plate built in, so the degaussing coils are hung on with clips and springs. For maximum effect the pair of coils should be wired so as to magnetically assist each other at the tube face, even though they may appear to be electrically in opposition.

The simplest way to check the coils is to interpose a switch in the mains feed to the degaussing circuit (see Fig. 1). Do not put the switch on the coils alone, or unplug them, as this will surely burn up the resistor (e.g. R907 in Fig. 1) fitted in the thermistor shunt circuit to keep it hot during the running of the set. With the switch open, run the set with the red gun only and really impurify the screen with the workshop degausser – by switching it off whilst held against the screen. Then observe what happens when you close the switch you fitted in the mains feed to the coils. For about two seconds multicolour bands of horizontal lines will roll up or down the screen, leaving it a pure red. Not more than three attempts should be needed to really purify it. If it takes longer, or the rainbows confine themselves to the corners, try reversing the sense of one winding of the pair.

Focusing

Most tubes have a high-potential type of focus electrode, set from a variable 7kV supply derived from the e.h.t. tripler. The supply lead is not usually as well protected as the 25kV line to the final anode and can bite very sharply, favouring innocents with 'scope probes looking at (or for) the blue drive. A number of smaller tubes (such as the 18 in. 470DUB22 or A47/342X) have a low-potential focusing arrangement, the supply being tapped from one of the various potentials present at the tube base. These tubes are known as *unipotential* tubes, as opposed to the 7kV variety which are called *bipotential*, had you not already guessed.

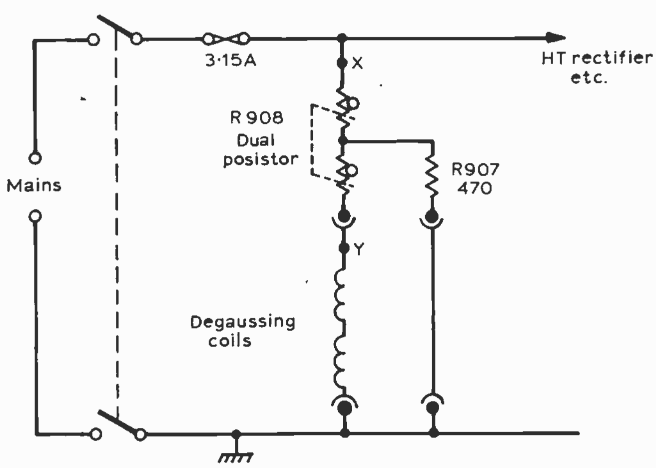

Fig. 1: To check the degaussing circuits, fit a switch at point X (never at Y), display a pure red raster, then impurify it by switching off the bench degausser while held against the tube face. Closing the switch at X will then repurify the displayed raster in a second or two if the circuit is efficient.

specifically for tube protection and will take the sparkgaps and "dag" return. The other is for general earthing. Make a note of what goes where before dismantling.

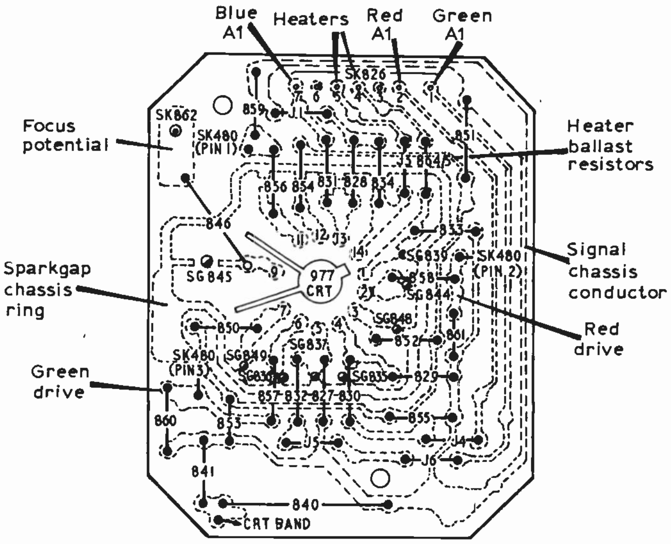

Fig. 2. A typical tube base layout. Ensure that the sparkgaps are uncarbonised. On this layout (Pye 731 chassis) a separate chassis ring is provided for the sparkgaps.

The unipotential type has a soft focus which is never very good but never very bad overall, and may be replaced by the bipotential equivalent if you can obtain 7kV from somewhere – this usually lowers the e.h.t. a little but gives sharp definition at screen centre, if a little fuzzy at the edges.

Flashovers

Sparkgaps are provided around the tube base (see Fig. 2) to protect the set from excessive charges being developed between any electrode and chassis. They often flash over if the e.h.t. is marginally high or the set is being run in a humid or sooty environment. It pays to keep the gaps clean and dry to minimise spurious flashovers as these can set up high current surges in the rest of the set and pop off some of the more sensitive transistors or i.c.s. Make equally sure that the tube "dag" is returned directly to the tube base chassis point (don't pass GO, or collect – etc.) and that the connection is tight. A service warning: there are sometimes two chassis points on the tube base. One is reserved

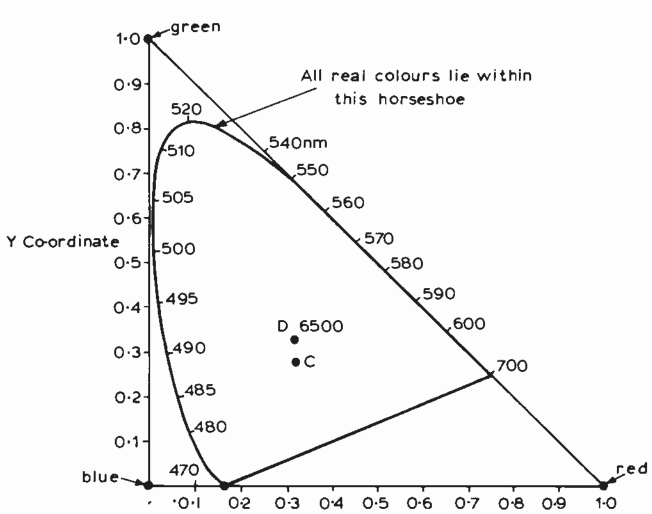

Fig. 3. The C.I.E. chromaticity diagram. The accepted definition of any colour is its X and Y coordinates on this diagram. X relates to the amount of red, Y to the amount of green. Blue (the Z coordinate) is derived from the other two by subtracting their sum from 1 (i.e. X + Y + Z = 1). The two common whites, illuminants C and D, are shown in the centre of the diagram.

Purity

I always used to think of purity as "red gun only, pull back the scan coils, move the red ball to mid-screen, push the coils forward and lock". Then a friend told me about hairline fractures. It so happens that when the coils are pulled back the electrical stress between them and the guns is at its greatest and has been known to crack the neck if left that way too long. Another tip is to position the red ball down towards the red gun – about an inch from centre towards 8 o'clock on a conventional 22 in. set with the c.r.t. mounted with its blue gun up – for easier purity.

The wider deflection angle of the 110° set makes purity harder to obtain, and for the workshop a × 50 magnifying periscope is a good investment. Not only can you set the purity by observing beam landings at screen centre, but you do it with the scan coils in their optimum position. It is essential that the set is well warmed up and evenly illuminated before purifying. Anyone who has soak tested a 110° set on a colour bar will have noticed how the white bar tints pink after a while due to local shadowmask expansion (a white raster dissipates about 20W in heat on the shadowmask).

What is White?

The next bit isn't strictly a tip or a wrinkle but a simple explanation of what constitutes white for those who missed it on the way up. The eye is a rotten judge of white, continually adjusting itself to accept what is conventional under the circumstances in which it finds itself. Monochrome sets give a bluish white, but you don't notice this when you sit and watch the set. Look at it out of the corner of your eye as you pass outside on your way back from an evening stroll, or see a monitor come into shot in a colour studio scene, and it is definitely blue.

As far as colour TV is concerned there are four whites: Illuminant C which is a cold white – natural north light. Illuminant D which is a warmer white, the studio standard. Monochrome tube white which is bluish, as we have just remarked. And a compromise white to which many colour receivers are set and which is somewhere between monochrome white and illuminant D. In the c.r.t. specifications these illuminants are referred to by their x and y coordinates on the CIE chromacity diagram, and in case you have ever wondered what this is all about let us indulge in a little gentle theory.

Chromaticity Coordinates

Most of us have imprinted on the back of our mind the old formula:

1 lumen of white light = 0·3 lumens of red, 0·59 of green and 0·11 of blue.

Each of these amounts of red, blue and green is called a trichomatric unit – TR, TG and TB respectively – and since colour mixing is an algebraic process it is a lot easier to add and subtract the T units than to do complicated sums with 0·3, 0·59 and 0·11. Thus using T units 1 lumen of white = TR + TG + TB = 3 T units, or 1 T unit of white = 1/3TR + 1/3TG + 1/3TB.

If you think about it, this means that any colour can be expressed in terms of R and G only, as B can be derived by

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MILLER'S MISCELLANY

CHAS. E. MILLER

A Quiet Saturday

Cup final day this year was one of the quietest I have ever known – as regards service calls. Recalling past years when the phone was busy all day with calls from frantic football fans, I couldn't help wondering: are sets becoming more reliable, or is football's appeal waning? Or, depressingly, is it my popularity that is suffering, with everyone else doing a roaring trade?

At twenty past six however the phone rang. I answered it reluctantly, guessing (correctly) that it would be someone with a little job that would take but five minutes of my time – like tracing an intermittent fault in the line output stage of a transistor colour TV. I decided for the umpteenth time that I must get a telephone answering machine!

False Lock

I had a rather odd fault recently on a GEC Model 2032 – the one with the integrated v.h.f./u.h.f. tuner. The field lock was good, but on the line side the picture was neatly divided by an inch wide black bar – the classic false lock. The line hold control – the set was used on 625 only – had no effect from one end of its travel to the other. Nor to any great extent did adjustment of the oscillator coil tuning slug. Replacing the discriminator diodes did nothing to help – in fact I later discovered that they could be left out of circuit without disturbing the false lock. Even removing all traces of line sync (as I thought) by removing the line sync pulse coupling capacitors C213 and C214 had no effect.

It became obvious that the sync pulses were getting to the PCF802 by an alternative route. A careful study of the circuit diagram finally gave me the answer. The sync separator and the line oscillator share a common h.t. supply, derived from the main HT3 rail via a $4{\cdot}7\text{k}\Omega$ resistor which is decoupled by a $4\mu\text{F}$ capacitor (C240). This latter had gone open-circuit, effectively coupling the two stages together. A new fault as far as I am concerned, and one I've noted in the book!

Word of Warning

Engineers are advised to take care when purchasing replacement line output transformers. I have recently tried some so called equivalents and found them rather disappointing. The construction was not so substantial as the originals, and the mounting brackets did not match up. Neither was there provision for mounting the e.h.t. tripler as before. Certain components had to be salvaged from the old transformer and fitted on the new one: carrying out this job with the necessary care took me nearly an hour. With all this the price compared unfavourably with the type supplied by the setmaker. So if you need to use non-maker's spares you may need to revise your estimate of the cost accordingly!

Beaten to the Post

Speaking of ordering spares, the cost of postage, plus one's time spent writing, is so high now that I try to use the phone for orders when this can be done out of peak hours. The most economical way is when the firm you wish to contact has an answering machine. By having your little speech well rehearsed you can place your order in a matter of seconds. In the evening this is at minimum cost, and at least you know it will be on the books the following morning.

Where are they now?

The present shortcomings of our postal service will be viewed with an especially jaundiced eye by engineers who sat through countless showings of the GPO publicity film "One Jump Ahead" when it was in the repertoire of BBC-2 colour test films. It's a long time since these were discontinued. I wonder if they lie mouldering in cans in the vaults beneath the television centre, the "Home-made Car" alongside "Story in the Rocks"? And what about "Evoluon" and "Birth of a Rainbow" and all the rest? My favourite was the mildly erotic "Atlantic Parks", while my most detested was "Crown of Glass". Not all the films can be entombed though, because quite recently "Beauty in Trust" was to be seen at a National Trust property not far from where I live. I did not bother to go and see it again.

A Not-so-golden Oldie

Looking back a lot farther, does anyone recall the old original test film of the early 1950s? Filmed in richly grained black-and-white, it featured gems from prewar TV productions plus snippets from contemporary programmes. It was interspersed with 15-minute sessions of test card C, and judging by the "rain" still visible on the screen it was a moving picture of a stationary object – years before Andy Warhol cottoned on to the idea! In those days this hour-long treat was more often than not the sole programme transmitted in the day time. If you missed the morning's showing it was impossible to install a set before Children's Hour at 5 o'clock! So before you complain about lack of BBC-2 during the day, consider what we had to put up with then!

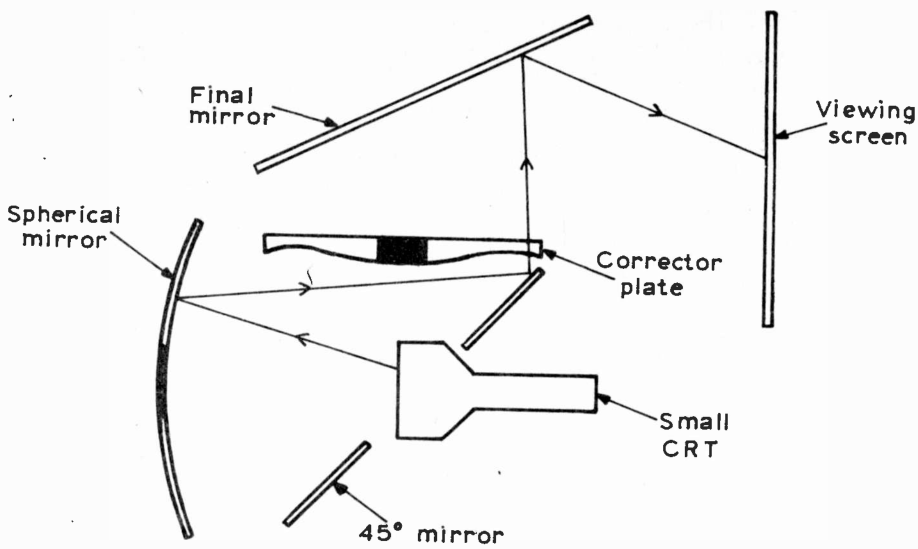
Check Your Memory

Old hands should have the test film engraved on their memories. For them, here is a little quiz: (1) What was the name of the first full length play, by Pirandello, produced on the 30-line system? (2) What popular dance was featured in an early outside broadcast from a London theatre? (3) Was the Powder Monkey speaking truthfully? Answers on postcards only please! The sender of the first correct solution will receive a red EF50, a liquid paraffin-filled magnifier for a nine-inch tube, and a signed photograph of Muffin the Mule. And a copy of my birth certificate to prove that you are much older than I!

By Appointment

Last Saturday lunch time a gentleman called to arrange

Fig. 1: The Schmidt folded optical TV projection system. With the 55° deflection angle tubes current in the early 1950s, this was the only convenient way of obtaining a large picture – without need for a cabinet of massive depth. The small (2½in.) tube and associated hardware were produced by Mullard and used by a number of setmakers including Decca, Ferranti, Philips and White-Ibbotson. The system went out of favour with the introduction of wider deflection angle c.r.t.s. A truly flat picture was obtained, but the brightness level was such that semi-darkness was required for comfortable viewing.



to have a car radio installed. "Name your own day and time, I'm completely at your disposal!" were his very words. Feeling gratified, I suggested the following Monday morning at nine o'clock. His face fell. "A snag there . . . I'm at work all day during the week!" It's true, it's true . . . !

Vintage Spot: Projection TV

The subject for this month's peep into the past was suggested by an advertisement in *Television* by an Australian gentleman seeking a Schmidt optical lens and corrector plate. This device was the heart of the projection TV set-up.

The basic idea was to obtain a large picture without having to use a huge c.r.t. by optically enlarging the very bright image that could be produced on a small tube operating at high anode voltage. It was demonstrated successfully before World War 2, and contemporary descriptions tally very closely with those of the projection sets produced in the 50s. All television broadcasting was suspended in the UK during the war and projection TV disappeared into limbo for over a decade. Conventional receivers offered 15 inch pictures when television returned after the war, but the tubes had a deflection angle of only 55°, which entailed having cabinets of immense depth. So the time was ripe for the projection system to make its reappearance.

Projecting a picture from a c.r.t. image is not as simple as may at first be thought. Putting a lens in front of the tube and trying to enlarge the image on to a screen – as with a slide projector – would be a dismal failure. Only a tiny percentage of the light from the tube would be transmitted to the viewing screen. To increase the light transmission a variation of a system already much used in astronomical telescopes was employed. The projection c.r.t. was mounted with its screen protruding through a hole in a mirror set at 45° to the axis of the tube (see Fig. 1). Light from the tube was gathered by a spherical mirror directly facing it. The magnified image was reflected back to the mirror surrounding the c.r.t., then through the corrector plate on to a third mirror and thence to the viewing screen. The job of the corrector plate was to rectify the "spherical abberation" inherent in the design, by ensuring that all the rays from the mirror came into focus at a common distance from it.

Another feature could be incorporated into the plate, that of modifying the "throw" of the picture to suit various cabinet sizes and viewing screens. The screen could be up to 18 × 15in. when mounted in the TV set's cabinet, or 3 × 4ft when wall-mounted. The c.r.t. used was the Mullard MW6-2, with a face diameter of 2½in. and a deflection angle of only 38°. The final anode voltage, 25kV, was obtained from a proprietary unit using an oscillator operating at about 1kHz and a voltage tripler. The latter consisted of three EY51 rectifiers in a sealed and oil-filled transformer can.

Servicing Problems

Some of the problems associated with projection tubes foreshadowed those encountered years later in colour television. For instance, because of the high e.h.t. the c.r.t. emitted X-rays when working and could not be viewed outside the optical unit without lead-glass shielding. Regulation had to be provided for the e.h.t. voltage and for the c.r.t. beam current. In addition in order to protect the tube face from burns a safety circuit which "cut-off" the grid should either timebase fail had to be incorporated. Focusing was by electromagnet as regards the image on the tube face. But it also had to register correctly on the viewing screen. The procedure for achieving this was long and tedious. When everything was working properly the viewer had what was for the time a large and also a completely flat picture, but the brightness level was so low that semi-darkness was required for comfortable viewing. Interestingly, an account of the system printed in 1952 stated that it was more than adequately capable of resolving 625-line pictures!

Several firms – for example Decca, Ferranti, Philips and White-Ibbotson – produced projection receivers. Since they all used the Mullard units there was little to choose between them as regards performance. Few survived after the introduction of wide-angle picture tubes.

It was long my intention to experiment with three projection units of the 3 × 4ft type and colour filters, with the aim of projecting a colour picture on to a screen mounted above the living room fireplace, but somehow I've never had the time! I wonder if that is what the Australian advertiser had in mind?

For Disposal

Alan J. Gamble of 20, Douglas Drive, Ormskirk, Lancs has a Bush Model TV22 of 1950 or 51 vintage which he feels may be of interest to an enthusiast. Would interested parties please contact him directly.

Dealing with intermittent FAULTS

E. TRUNDLE

ARTICLES on fault diagnosis and repair methods, along with readers' queries, have always formed a large part of the contents of *Television* – and rightly so. The author has for some time however felt that possibly the biggest headache in modern TV servicing, the intermittent fault, has not received the coverage it warrants. It is hoped that the present article will go some way towards remedying this.

It's probably true to say that almost any fault can be diagnosed by fair means or foul provided it stays put – even if this means (heaven forbid!) trial-and-error replacement of components until the fault disappears. Intermittent faults however can be very difficult to deal with, and although the "hardcore" cases represent only a small percentage of the total repair jobs they always take up a disproportionately large amount of time. Possibly a better description of the type of fault we are concerned with here is the defect which the field engineer will not necessarily see when he calls. This takes in reception and propagation faults, interference and thermal effects ("it goes into lines when it's been running two hours" or, worse, "it's been going all right all afternoon but twitches sideways when we first switch on!"). Some of these are not intermittent faults in the true sense of the word, though they present as much difficulty in their diagnosis. Many of our readers' queries are concerned with intermittent faults of one kind or another, and on the occasions when the fault is not a common or a "stock" one diagnosis from afar is almost impossible.

Servicing Philosophy

We have always found that the only certain way to deal with intermittent faults is to adopt a positive diagnosis system rather than a negative one. To be more specific, this means aiming for a situation which signifies that the fault has in fact been cleared, rather than the "negative" approach where a handful of components have been changed, or a solder up done, and the set has come through a soak test without the fault recurring. The proof that the fault has been eliminated may be the appearance of the fault on another receiver to which the faulty component has been transplanted, the ability to make the fault come or go at will with a switched substitute component, or the incontestible evidence of one or more pieces of test equipment hooked into the circuit. The outcome of this approach, which is admittedly more painstaking than the "negative" one, is that the receiver can be returned with confidence following the repair, with very little risk of a recall (bounce) and its attendant financial and customer-relation embarrassments.

Types of Intermittent Fault

Intermittent faults fall into three main categories: thermal, mechanical and random. In our experience thermal faults are most commonly due to semiconductor devices or electrolytic and ceramic capacitors. Mechanical faults are usually traceable to dry-joints or solder blobs on printed-circuit boards, poor connections in plugs and sockets, and defective skeleton preset resistors. There can be a thermal influence here where expansion of materials due to heat provokes a "mechanical" fault. The classic example of this is the hair-line crack in a printed-circuit track.

Random faults are probably the most difficult to trace: they follow no pattern, and are difficult or impossible to provoke. Such effects as intermittent defocusing due to occasional corona discharge at the focus spark gap, and mains input filter capacitors which go bump in the night, are examples: semiconductor devices and electrolytic capacitors (particularly tantalum types!) add their quota. Corrosion due to old batteries, weeping electrolyte from capacitors, and foreign liquids – we have had everything from champagne to dirty flower water and gravy through our sets – also cause random effects, depending on such obscure factors as air humidity.

Sherlock Holmes in a Morris Van

Much can be done on a field service call, even if the fault is not present when the call is made. First, an attempt should be made to establish whether the fault is in the receiver or is due to interference, reception conditions or mains supply problems. It's tempting to install a loan receiver sometimes, so that the above causes can be identified. This is fair enough, but the characteristics of different receivers give different display effects under adverse conditions. This can be confusing – especially to the suspicious viewer. Many cases of interference are traceable to mains arcing within the set (especially on VA1104 thermistors where the lead is loose on the disc surface) or at the mains wall socket. This type of interference gives rise to horizontal bands of dots moving asynchronously over the screen, the edges of the bands being quite well defined. Where interference is suspected and no obvious cause can be found, the GPO will usually be found helpful and courteous; these wizards are busy men however and should not be called in until every attempt has been made to trace the source of interference.

Careful questioning of the viewer to get as much information as possible will help to narrow the field, but experience suggests that too much reliance should not be placed on some viewers' descriptions of their sets' maladies.

A common complaint is "lines all over the screen", which can mean almost anything. In such cases, it is a good idea to try to simulate the fault by off-setting the line hold control ("no dear, it's not like that when it goes") or unlocking the subcarrier oscillator in the decoder ("that's it, just like that!"). This approach can be used in cases of intermittent snowy pictures, lack of one colour-difference drive (football field all pink and green) and in fact most faults. We find that while a viewer, not surprisingly, has great difficulty in describing a fault, he will recognise it easily when it is produced for him. Once the area of the fault is known, careful thought and the usual methods of provocation (see later) may well turn something up.

To quote one or two examples. First a modern fully transistorised receiver with the complaint that the picture gradually darkened and blurred away, with peak white limiting. This can only be the c.r.t. heaters going out. In the particular case, the tube heater was disconnected while the owner watched, and he confirmed that this was the same effect he had been troubled with (about once a fortnight!). Although there were no obvious poor joints in the c.r.t. heater wiring, pins, sockets, edge connectors and soldered joints were run over, after which no more was heard of the trouble.

Colour Drop-out

One of the most common intermittent faults, on past form, is colour drop-out. Having established with the viewer that it happens on all channels, and whether it is a random fault or one which occurs when the set is thoroughly hot, it is necessary to tie the fault down to the reference or signal sections of the decoder. Now virtually all receivers have a slight lag in the colour-killer operation. Thus if the sub-carrier oscillator is drifting out of lock, the familiar rainbow of horizontal coloured lines will be briefly displayed as the colour disappears. If the viewer has seen this effect, the engineer need look no further than the burst processing circuitry and a.p.c. loop. If on the other hand the viewer reports colour fading down to monochrome, or suddenly disappearing, it is likely that the chroma amplifier or colour-killer stages are responsible.

The viewer, knowingly or otherwise, can often be made to be his own diagnostician. Again, intermittent colour symptoms spring to mind, where the colour-killer can be left over-ridden so that the effects can be described to the engineer on his next visit. The complaint on an ITT/KB receiver fitted with the CVC8 chassis was a very occasional intermittent saturated red raster. In spite of efforts to provoke the fault nothing came to light on our call, so we interchanged the red and green driver transistors (T11d and T25d) and the red and blue output transistors (T12d and T33d). A week later, the mystified viewer rang up to say that her picture was now intermittently going blue. A quick visit to fit the necessary BD115 cured the fault with certainty even though we had never seen it. This is positive diagnosis with a vengeance, and though it could be argued that replacement of both transistors together with possibly a few more components would have achieved the same result there would have been no certainty that the fault had been cleared.

Studying Symptoms

Whether in the field or workshop, we cannot over emphasise the importance of getting the maximum information while the fault is present, by observation and deduction, and by instruments if possible. The convergence jumps out for a few seconds at a time: manipulate the controls to ascertain whether one or more rasters are involved, and whether the parabola and tilt adjustments are affected. After careful analysis the information thus gained will usually pinpoint the fault to a very small area of the convergence network. A soak testing Decca set fitted with the 30 series chassis was seen to have a saturated blue raster: a meter connected to the collector of the blue output transistor TR215 was indicating virtually zero voltage. We knew that if the set was so much as breathed on the fault would disappear for a long period. We tiptoed up, laid one finger on the collector load resistor – R296, 10kΩ – and found it was cold. Now a cold 10kΩ resistor with 295V at one end and zero voltage at the other just has to be open-circuit! Thus the blue output transistor and its drive circuitry were eliminated and the diagnosis proved. Incidentally, we have since had several cases of these resistors going intermittently open-circuit in the Decca Bradford chassis: the suspect type is rectangular, encased in a ceramic trough, and sealed with green cement.

We have often seen equipment cruelly provoked in a "disturbance test" (a technical term for using a screwdriver to knock seven bells out of a hapless printed circuit board) and, having made the fault appear, the technician immediately starts hitting the panel again in an attempt to restore normal operation! If a fault appears, even momentarily, it is worthy of careful study – even if only so that it can be simulated afterwards in an attempt to isolate the fault area. One of many examples of this is intermittent hum effects on the vision or the raster, due to a faulty electrolytic capacitor. If the nature of the display is carefully noted when the symptom is present, disconnecting each smoothing/decoupling capacitor in turn is likely to reveal one which gives exactly identical symptoms. This is a good bet if the culprit cannot be traced by other means.

Servicing Techniques

Once the set is in the workshop, simulation of site conditions – poor mains regulation or weak signal reception – can where relevant be tried, using a variac in the former case and an attenuator in the latter. A surprising degree of variance has been noticed between different makes and models in their tolerance of these conditions, and many cases of intermittent loss of colour, field foldover and so on can be resolved in this way. The decision then has to be made as to whether this is a characteristic of the design or a fault in the receiver – usually it's the latter!

Thermal Effects

Many faults occur only when the set has thoroughly warmed up, or alternatively for a short time after switch on from cold. Our most valuable assets here are a hair-drier for warming small areas and specific components, and a proprietary freezer aerosol for rapid cooling. Thus armed, sound distortion when the set is warm for instance may be quickly traced, usually to leaky transistors or a warping cone/speech coil in the loudspeaker. A Pye Model CT72 (691 chassis) came our way recently with the complaint that the blue raster drifted upwards after two hours' running. We found that we could position the blue static convergence wherever we chose by warming and cooling the blue static clamp diode VT32 (AC128, base-emitter strapped). When a specific component has been earmarked by this method it is prudent to temperature-cycle it in isolation, in case an adjacent component is responsible. This can often be done by refitting the component on the print side of the panel, or by fitting a piece of suitable gauge sleeving over it before applying heat-and-freeze. After replacement, the new component can be subjected to the same treatment to ensure that the fault does not recur.

Some words of warning are necessary here. Rapid temperature cycling of components is not good for them, and it is not unknown for good components – especially semiconductors – to be damaged by too rapid cycling. Excessive temperature is the worst offender, and if possible the normal maximum working temperature of the component should not be greatly exceeded. Some circuits are inherently temperature-dependant, and where thermal compensation is built in misleading results may be encountered. In the Thorn 3000 family of colour receivers for instance a thermistor (X501) is provided to counteract frequency drift of the line oscillator due to temperature effects on the reactance transistor VT501. Unless these two components are equally treated in the heat-and-freeze stakes, much time can be wasted in changing good components. Finally, the effect of freezer on a hot valve envelope is quite shattering (pardon!). Once you have done this, you will never forget it . . .

A thermal fault which cannot be found with the hair-drier is the so called hot bulge. The effect is most noticeable with 110° colour tubes, and takes the form of raster impurity due to distortion of the expanded shadowmask under high beam current conditions. This usually manifests itself as a pink patch on the raster, and can be cured by reducing the brightness and contrast settings and if necessary checking the beam current limiter.

Mechanical Faults

Mechanical faults, often known as flag-wavers, e.g. intermittent connections of one sort or another, are probably most often to blame for intermittent faults. The problem may be inside a component rather than outside and visible, some species of polyester and mylar capacitors being notorious for this.

The first step should always be a close scrutiny of the print side of the panel for obvious dry-joints, blobs or cracks. If nothing is revealed, slight manipulation of the components in the area suspected should be tried: very often, pushing or pulling gently on component wires will reveal that a joint which looks perfect is not actually soldered. Gentle flexing of the whole panel will often help to locate cracks in printed tracks – see Vivian Capel's article in the December 1975 issue.

Print and Wiring Defects

A notorious example of intermittent printed-circuit faults is provided by the CDA (colour-difference amplifier) panel in hybrid Pye group receivers, where cracks radiate from hot-spots such as high-wattage resistor legs and valveholder pins. These cracks in the panel are often more obvious from the component side of the board than the print side, and can give rise to various intermittent faults. It often happens that due to stresses in the panel caused by excessive heat and the method of mounting, the crack extends in hairline form across the full width of the panel, resulting in erratic loss of a colour-difference signal. The same CDA panel commonly develops a hairline crack in the h.t. feed track en route to the luminance output stage, thus reducing the c.r.t. cathode voltages to virtually zero. This turns the c.r.t. hard on, much to its detriment, resulting in violent internal arcing and an exceptionally heavy load on the line output stage and particularly the e.h.t. tripler. Apart from the risk of damage, diagnosis is confusing because the fully-conductive c.r.t. usually loads down the e.h.t. generator to the point where the raster disappears, leading the sorely tried serviceman into the line output department – a red herring if ever there was one.

Print faults can be surprisingly difficult to trace where the connection is so sensitive that pressure or tapping over a wide area will provoke the fault. In these circumstances we try to resist the temptation to do a general solder-up, instead using the 'scope and meter in the normal way while the fault is present so that the exact location of the trouble can be found – it is very satisfying to prove with a continuity meter that a perfectly acceptable looking run of print is open-circuit! This again represents the positive approach.

In the few wired chassis which are still encountered, mainly of ITT origin, intermittent effects can often be traced to the bottom-most wire on a tag or chassis lug to which many wires are connected – the one at the bottom of the pile often misses out on solder. No trouble may be encountered for months or years, but eventually the wire and tag become slightly oxidised and that's when the troubles start.

Random Faults

Random faults present the greatest challenge and the widest scope for ingenuity if the cure is to be irrefutably proved! There are no hard and fast rules here, as every case is different.

Tuning Drift

Tuner drift is a common ailment, and if anything is more prevalent since the advent of varicap tuning than ever it was in the era of mechanical tuners. Poor reset on mechanical tuners is often due to loose shafts, the Decca type being particularly prone to loose clamping screws on the capacitor spindle while ITT tuners tend to suffer from loose grub screws on the external cog wheel. Where tuning drift occurs with a varicap system several components may be to blame. The weak spot in ITT and Decca sets seems to be the tuner control unit, i.e. the switch/potentiometer bank, although the tuner may well be responsible – Grundig varicap tuners for instance have the unfortunate habit of developing leakage in the feedthrough capacitor by which the tuning voltage enters the tuner.

A digital voltmeter is a useful tool when seeking the cause of drift. Hook it across the 32V line from the stabilizing i.c. If the voltage remains constant during the drift the i.c. is exonerated and the probe can be transferred to the tuning voltage line to the tuner. If the voltage rises when drift occurs the control unit may be safely condemned. If on the other hand this voltage falls when the drift occurs, the fault may be in the control unit or due to leakage in the tuner; a microammeter in series will soon show which. If there is no change on the tuning line, the drift is most certainly due to the tuner unit. Most sets incorporate a.f.c., which will be seen to move in a direction to restore correct tuning; this is the normal reaction to drift from within the tuner – see "closed loops" later.

Other Examples

Where possible, random faults should be tied down to one stage of the receiver by running the set with a dual-beam oscilloscope monitoring the input to and the output from the suspected stage, after which individual components can be tested. One way of doing this is to transplant the suspect component to another receiver (not necessarily the same make or model). As soon as the fault appears on the other set, the original receiver can be cleared with confidence.

The field jitter and picture flutter effects of a faulty trigger diac or thyristor are by now well known. Philips and

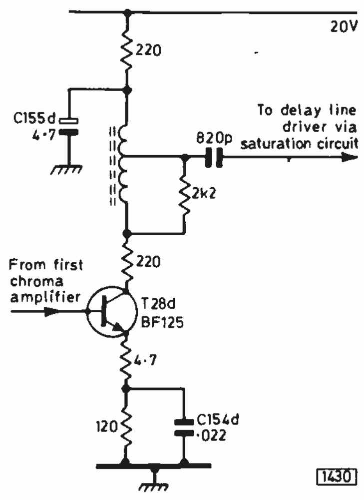


Fig. 1: The second chrominance amplifier stage in the ITT CVC5 and related chassis.

Rank colour sets seem to suffer most from this, and a modification to the Rank circuit was given on page 563 of the October 1975 issue.

Random focus drift is fairly common, and after investigation of the v.d.r. or potentiometer and associated components, leakage or corona at the c.r.t. spark-gap should be suspected. Slight enlargement of the gap with a file and a good clean-up in the area is usually effective, but in stubborn cases we use a nylon bolt as a stand-off insulator from the c.r.t. spark base and fit a separate spark gap.

Some more subtle random faults are line twitch due to intermittent earthing of the line output transformer frame, and corona discharge from the harmonic tuning capacitor C435 to the line output transformer frame in the Decca Bradford chassis – this gives rise to horizontal black lines over the picture, looking for all the world like a tuner or i.f. fault, and led us a merry dance for many weeks when it was first encountered. It has cropped up several times since in these models. The easiest way to detect these discharges is to closely examine the set in a blacked out room.

Some components break down only when under stress of high voltage. A 500V Megger will winkle out most of these. Leakage over the surface of printed panels can also be detected in this way, but beware of injecting high voltages into transistors and low-voltage capacitors!

Use of Test Equipment

At the outset we spoke of irrefutable evidence given by test equipment. Take the case of a transistor chrominance amplifier stage with intermittent low gain. A typical example is shown in Fig. 1, as used in the ITT CVC8

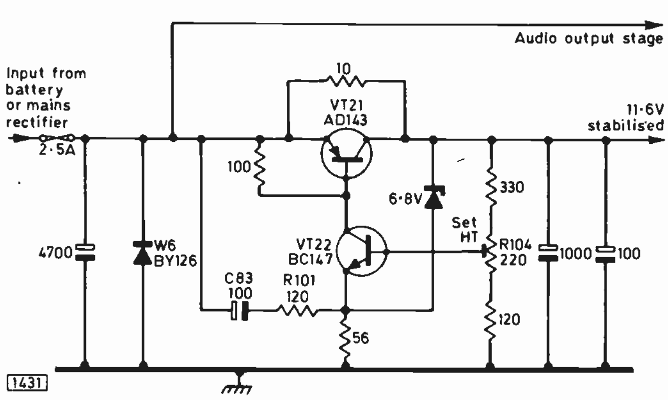


Fig. 2: L.T. stabiliser circuit used in the Thorn 1590, 1591 and 1593 chassis. W6 provides protection against reverse battery connection. C83/R101 provide hum cancellation.

chassis. The first step would be to connect a 'scope across each of the decoupling capacitors C155d and C154d and run the set. If the chrominance signal appears across either of these capacitors when the fault appears, the capacitor is undoubtedly faulty.

If an h.t. smoothing capacitor is suspected of intermittently going open-circuit, connect an a.c. milliammeter in series with it. If the ripple current increases when hum symptoms appear, the capacitor is doing its job and the fault lies elsewhere – probably a heavily loaded h.t. line. If the current decreases, replace the capacitor.

The same sort of test can be used to sort out chicken-and-egg problems in cases where incorrect voltages appear during a momentary fault. Fig. 2 shows the l.t. regulator circuit in the Thorn 1590-1591 series of receivers. We met one of these sets which suffered from an occasional momentary shrinkage of the entire picture, the fault lying dormant for long periods between bouts. A meter connected to the 11·6V line recorded a drop to about 9V when the fault was present, and the problem was to decide whether a fault in the set was increasing the load on the power supply and thus pulling down the l.t. line, or alternatively the supply voltage was dropping, directly reducing the scan amplitudes. An ammeter was placed in series with the receiver l.t. line and the set soak tested. When the picture shrinkage next occurred the receiver l.t. current was seen to drop, thus implicating the regulator.

This voltage versus current idea has applications in many circuits – by checking the current through the collector load of a common-emitter transistor amplifier for example, intermittent collapse of collector voltage may be traced to either an open-circuit load or a bottomed transistor. Admittedly a load resistor is unlikely to be intermittently open-circuit, but they do become dry-jointed, while where a transformer forms part of the collector load an intermittent open-circuit is a strong possibility.

Other examples of definite diagnosis by meter are the reading of direct current through a capacitor and the presence of more than about 800mV across the junction of a semiconductor in the forward direction. Our most recent case of this was in a Pye colour receiver fitted with the 693 chassis. Momentary loss of colour had been traced to the chrominance amplifier stage VT20. During the brief no-colour periods chroma was present at the input to the transistor but not at its collector. A high-impedance meter was left connected across the base-emitter junction of the transistor (BF194) and after a lengthy run the colour faded away. At this point we were rewarded with a meter reading of 3V – base positive with respect to the emitter. The transistor was thus condemned, but the mere action of removing the test-probe restored colour for a further lengthy period.

What's Required

Many of the tests suggested here do not call for sophisticated test equipment – often quantity is more important than quality. We have a selection of old meters such as Avo model 7s and ailing Japanese cheapies, together with the outdated 'scope and so on, all of which are quite adequate for this purpose.

Substitution Checks

Where a fault is particularly elusive several substitution techniques can be resorted to without departing from the positive approach. One method we often use is to wire in a two-way switch, with as many poles as required (not usually more than two!), so that a substitute component may be switched in *during the fault*. If the fault can be made to go *and return* by operating the switch, the component involved may be safely condemned.

This may appear to be unnecessarily painstaking, but if a DPDT switch with flying leads is kept handy, perhaps with one or two common TO3 transistors ready-mounted on heatsinks, it is the work of moments to rig them up, and it's certainly less trouble than a ten-mile round trip to pick up a bounce job for a further (free of charge) fault-tracing session. The idea will not work in r.f. or i.f. circuits of course, due to lead capacitance and stray radiation.

Series Regulator Transistors

Transistors used as l.t. series regulators often develop nasty habits, such as the picture flutter or line twitch effect in Thorn 3000 series colour receivers due to a palpitating 30V line stabiliser VT601 (SP8385 or 2N5296), or intermittent hum and shading in the Bang and Olufsen 2600/3200 series colour sets when the 2N3055 (OTR8) 32V stabiliser lapses. Philips VCRs also fall prey to the latter trouble. The switched substitute idea works well here, only two electrodes requiring to be switched.

Intersubstitution

Intersubstitution is another foolproof method of tracing obscure intermittent faults. The idea is that a faulty stage or component is interchanged with a known good one and both are soak tested, so that the fault still appears to betray its location. Colour sets have three identical video amplifiers feeding three identical c.r.t. guns, so many faults can be brought to light by interchanging individual amplifier stages, components or c.r.t. guns. It is less confusing to remove the colour, reset the grey scale and watch in monochrome while this test is in progress – unless the fault specifically concerns colour-difference signals, in which case a colour-bar signal should be used during the test. Where one colour occasionally flashes on or disappears, the c.r.t. itself, the first anode feeds or the RGB drive circuitry could be responsible: when the fault occurs momentarily and at rare intervals, this method is invaluable.

The other intersubstitution method concerns the use of two receivers, usually but not necessarily identical models. With care, almost any circuit or stage can be interchanged between the two receivers, and a definite indication will appear on one screen or the other when the fault appears. It is easy to get confused by cause and effect with this method, and closed loops, such as flywheel line sync, field linearity feedback, a.g.c. and a.f.c. must be maintained. Complete timebases and, with care, i.f. strips can be checked. This is quite practicable in a large workshop where several sets are available. Things can get very hairy however unless the technician knows exactly what he is doing, and the following suggestions should be adhered to.

(a) Both receivers must be tuned to the same channel.

(b) The signal exchange points should be at low impedance if possible, to minimise stray capacitance and impedance problems. This is particularly important where i.f. strips and video circuits are involved.

(c) Both chassis should be firmly bonded together, and at no higher potential than mains neutral. With conventional power supplies, we run one set from an isolating transformer and one from mains, ensuring that the second chassis is connected to neutral. With the increasing use of full-wave mains rectification and "half-live" chassis, two separate isolating transformers are necessary for complete safety. The foregoing assumes that test gear and tools such as soldering irons are not earthed.

Intermittent Effects of Parametric Faults

Probably a quarter of apparently elusive intermittent faults are due to a permanent malfunction in the receiver. This is not a contradiction in terms, since the reason for the intermittency may be varying reception, mains voltage, temperature or picture conditions.

Decoder Troubles

Consider the case where the ident (7·8kHz) amplifier stage is faulty, with low output: this will reduce the drive to the colour-killer stage, and if it is near the borderline of switch-over the killer will tend to switch on and off at random during a colour transmission. The net result is a nasty case of random colour drop-out, which the thorough technician will immediately (!) trace with an oscilloscope to the ident amplifier.

Staying in the decoder, if the a.c.c. fails, the saturation will vary with time and temperature and magnify any tendency of the tuner to drift.

A common complaint with colour receivers is occasional streaking of incorrect colours depending on the chroma content of the picture. The effect always changes with a different camera shot, and sometimes doesn't appear at all. At first sight the stage is set for a frustrating session with lashings of test equipment – or an exchange decoder panel! In such circumstances, it will almost invariably be found that the burst gating pulse is mis-shapen or badly timed – usually late, so that the first few microseconds of picture chroma are competing with the colour burst to synchronise the decoder reference oscillator. 'Scoping the gated burst stage will reveal all, often with the burst straggling down the left-hand flank of the gating pulse and picture chroma climbing up the right-hand flank. We should add that the normal colour-bar signal, be it off-air or from a generator, will not produce the fault because the first bar is colourless. Assuming that the line frequency and phase are correctly set, the cure depends on circuit design. Where the gating pulse is derived from a ringing transformer (Pye hybrid colour sets for example) realignment of the coil (L28 in Pye/Ekco receivers) may be attempted as a starting point. If, as is more usual, the pulse is obtained from the line output transformer it is usually delayed by an *RC* network and clipped by a diode or transistor. Our most recent case of this trouble was in a Bang and Olufsen 3200 chassis, in which diode 578 (BA148) had gone open-circuit to give a triangular instead of rectangular gating pulse.

Incorrect timing of the burst blanking pulse, or its total absence, will again lead to random effects depending on picture content. The effect is not so obtrusive as burst gating defects, and depends largely on the efficiency of the clamping circuits further downstream.

Random and intermittent drift of the crystal oscillator can also be due to a parametric fault in that any problems in the gated burst amplifier, the phase detector or d.c. amplifier can impair a.p.c. efficiency to the point where it is unable to cope with the normal frequency drift of the crystal – a complete rebuild of the crystal oscillator will not cure this one!

All these are cases where the effect is intermittent but the cause is not. Clearly, the moral is to 'scope appropriate waveforms and check the alignment of the decoder whenever an intermittent fault is encountered. The decoder fitted to the Rank range of single-standard colour receivers is very prone to intermittent faults due to maladjustment of the presets.

Sync Faults

Moving on to other sections of the receiver, the same type of situation can arise in timebases where the synchronisation is weak causing horizontal or vertical lock to be lost, either at switch-on from cold or when the set has been running for a while and has warmed up.

Some sets can develop a fault in the line sync department whereby the flywheel line sync circuit becomes unbalanced, leading to an asymmetrical pull-in/hold-in range. Symptoms here are loss of line sync when the set has warmed up, or on changing channels. The presence of the fault is usually betrayed when setting up the line oscillator – if it is found that synchronisation is quickly lost when the line frequency is moved in one direction but that lock can be maintained for some distance in the other. Leakage in one of the phase discriminator diodes is a common cause, e.g. D402/403 in the Decca 10 and 30 series chassis, or imbalance of the antiphase feedback reference sawtooth waveforms, as when one of R388h or R392h (see Fig. 3) changes value in the ITT CVC5/7/8/9 chassis. When this fault is encountered, it is sometimes possible to overcome the problem by offsetting the line frequency so that the thermal drift can be accommodated. This is rarely satisfactory for long however, and it is much more professional to trace and rectify the fault. While on the subject of line oscillator drift and misleading symptoms we should point out that line drift can delete the colour completely on some receivers – our old friend the Thorn 3000/3500 chassis is guilty of this.

The sync separator circuits used in modern sets give very little trouble. When they do let video through however the disturbance to the synchronisation depends on the video content of the picture. Hard cases are sometimes very elusive, and well within our definition of intermittent faults. The author's current receiver, of RRI origin, takes violent exception to Southern ITV's "Star" caption but nothing else! This means that the engineer has about two seconds (at thirty-minute intervals) to diagnose the fault, unless he is wise to the situation and simulates a peak white raster with a reputable pattern generator. This will often set the field rolling merrily, and an oscilloscope hooked to the sync separator output will reveal great jagged holes in the sync pulse train immediately after the start of the field sync pulse train. If the hold control is used to make the field hover, the top of the picture will often be seen to be bent or wavering, indicating disturbance to the line sync as well. The answer to this one usually lies in the sync separator's bias circuit, examples of common offenders being R33 (4·7MΩ) in the Pye hybrid colour chassis and C196 (3·3μF) in the Thorn 8000 family.

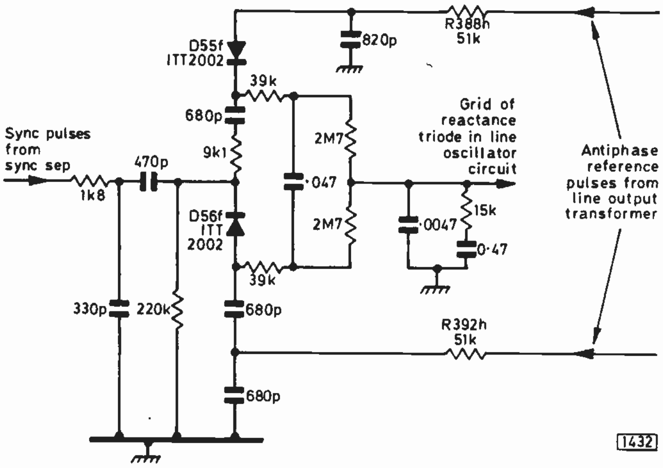


Fig. 3: Flywheel line sync circuit used in the ITT CVC5 and related chassis.

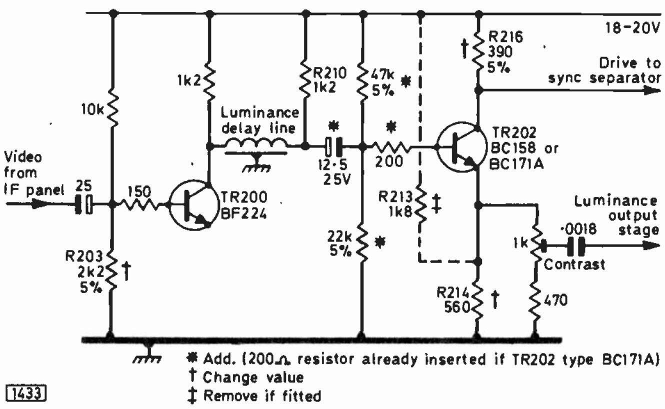


Fig. 4: Modifications in the luminance channel of the Decca CTV25 and related models to deal with field jitter. Applies to models using the following luminance or combined decoder/luminance panels: 550862, 550928 and 550982.

Signal Crushing

A rather less common parametric fault leading to intermittent loss of field sync is signal crushing. This can occur as early as the i.f. strip, but more commonly happens in the video stages before the sync separator stage. The effect produces a flattening or compression of the sync pulse, due to non-linear operation of a stage which is overloaded or incorrectly biased. The field jitter which results is due to the sync separator having little or nothing to bite on. If this trouble is suspected, an oscilloscope check should be made to see whether the 7:3 (approximately) picture/sync ratio is correct. This effect was very common on what is now called the Decca "Battersea" chassis, i.e. Models CTV19, CTV25, and types derived from them including the single-standard models before the "Bradford" chassis came along. The problem was due to incorrect biasing of TR202, and the modifications shown in Fig. 4 will eliminate field jitter due to this cause.

Short Component Life

Failure of components after a short life can be a frustrating by-product of a fault elsewhere in the set. The situation is that the defunct part is replaced, restoring perfect operation for a limited time until the component dies again, and so on. Line output valves come top of this list, and their early demise can often be traced to one of the following:

(a) Incorrect bias conditions due to an incorrectly set stab/width control, changed value resistors in the width circuit, or a leaky coupling capacitor.

(b) Core saturation of the line output transformer due to a cracked core or gapping spacers missing after replacement of windings.

(c) Shorting turns in the line output transformer or the d.c. feed/desaturation choke.

(d) Failure of third/fifth harmonic tuning components.

(e) Leakage in the e.h.t. tripler.

(f) Flashover or leakage in the boost diode.

(g) Badly shaped line drive pulses – in the Decca Bradford colour chassis this fault often develops due to a change in the value of the 33kΩ line oscillator anode load resistor R444.

Line output transistors are even more expensive than valves, and can fall prey to most of the above problems, especially (c), (d) and (g). Intermittent opening of the parallel tuning capacitor spells certain death, and intermittent line drive, also c.r.t. flashover, can result in premature failure.

Semiconductor Troubles

The subject of flashover brings us to the question of random failure of semiconductors generally. E.H.T. voltage and c.r.t. flashover precautions should be carefully checked (see the November 1970 and February 1971 issues for more details) where a high mortality among semiconductors is occurring. The energy from a flashover finds its way into receiver circuitry by some very devious means. Decca researched this in connection with their Bradford chassis, and recommend fitting a spark gap (1-2kV, 0·75pF) across tags 8 and 9 of the line output transformer whenever flashover is suspected of being the cause of failure of semiconductors (the well known Mullard transformer is used in most of these sets).

Line driver transistors can suffer random failure for a different reason. A representative circuit is shown in Fig. 5, that used in the Rank A823 chassis. The damping components 5R35 and 5C25 are there to absorb the high voltage pulse which appears across the primary winding of the driver transformer 6T1 when 5VT7 switches off. Failure of one of these damping components exposes the line driver transistor to excessively high voltage spikes, to which it will eventually succumb; its replacement is not likely to fail immediately however.

Tripler Failure

Premature e.h.t tripler failure is often caused by excessive c.r.t. beam current (check the beam limiting) or, in Thorn monochrome sets, fitting the wrong type of tripler – understandable in view of the diversity of types and the early obsolescence of certain Brand X replacements.

Using the Correct Capacitor

Early failure is only to be expected when components of the wrong type are fitted, but in the case of capacitors it is easy to fit inadvertently a component which conforms to voltage and value requirements but has an inadequate ripple current rating. This is particularly relevant to power supply and line scan circuits, where an ordinary component will soon succumb to overheating – physical size is a useful rule-of-thumb guide in these cases.

HT Rectifiers

H.T. rectifiers such as the ubiquitous BY127 (the author once heard this beautifully described by a Danish engineer as the Volks-diode!) sometimes fail at random. This can

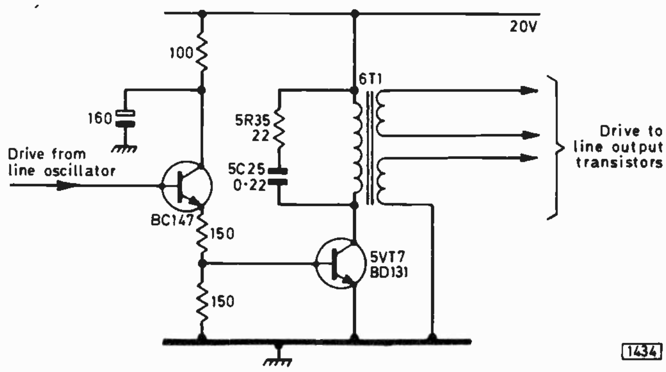


Fig. 5: Typical transistor line driver stage – as used in the Rank A823 chassis.

usually be traced to excessive inverse voltage, and the parallel protection capacitor often fitted should be checked. Excessive surge current is a more remote possibility, and can result from too large a value of reservoir capacitance, or too low a value of surge limiter resistor. These remarks apply equally to diodes used as rectifiers at line rate (e.g. the 20V rectifier D9 in the ITT VC200 monochrome chassis, see Fig. 6) and the supply rectifiers in the increasingly popular switch-mode power units.

Fuse Failure

In the last few years unexplained fuse failure has come to the fore, especially since BEAB requirements have made the setmakers specify fuses rated only slightly in excess of their normal current. This tendency to sail close to the wind combines with the unreliability of modern anti-surge fuses to produce the all-too-familiar situation where replacement of a blown fuse restores normal operation and leaves a great question-mark hanging over the set, the viewer and the engineer! In some cases we unashamedly up-rate the fuse. In the line timebase of the Bang and Olufsen 3400 chassis for instance, where the manufacturers apparently expect a 400mA fuse to pass a constant 430mA at high beam current. This practice should not be taken lightly however, due to fire risk.

Soft and Hard Blowing

Examination of the fuse will reveal much about its ordeal. A blackened or shattered fuse in the mains feed circuit, where no obvious fault can be found, is usually the victim of an intermittently short-circuit mains filter capacitor, or arcing on a tagstrip which has become carbonised. More often the device will be seen to have failed gently as a result of ambient temperature or metal fatigue within the fuse. A more subtle cause of this "soft" failure, where the fuse protects a valve line output stage, is a lazy line oscillator

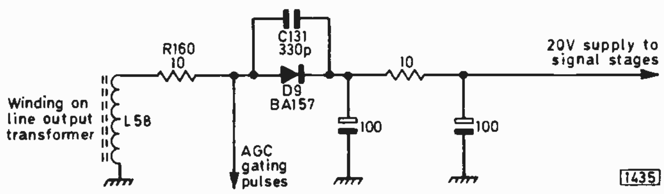


Fig. 6: Method of obtaining an l.t. supply used in the ITT VC200 chassis. D9 rectifies the waveform appearing across L58 during the forward line scan. The negative-going flyback pulses are differentiated, the positive-going spike thus obtained being used to gate the a.g.c. circuit during the sync pulse back porch period.

failing to strike up. Our old friends polystyrene capacitors are regular offenders where they form part of the line oscillator circuit. Examples of this are C427 in the Decca Bradford chassis, and C294, C295, and C291 in the ITT CVC5-9 colour chassis. As with lazy oscillator faults in tuners and decoders, even if the oscillator can be caught napping the mere application of a test prod will usually restore oscillation, after which the circuit will perform perfectly – until a week later!

Faults in Closed Loops

Modern receivers incorporate many closed loops in addition to the traditional a.g.c. and flywheel line sync circuits. Looking at the cover of a recent Sony service manual we noticed that the receiver boasts ACC, ACK, ABL, ANC, AFC, AFT, AGC, AVR and AZC: it is surprising that the set does not wash the dishes! Each of these automatic functions represents a closed loop, and there are several others (a.p.c., flywheel line sync and so on) all of which are forms of either negative feedback or servo circuits.

When an intermittent fault arises in any closed loop we are landed with a chicken-and-egg situation: i.f. gain varies at random, is the problem due to gain variation in the i.f. amplifier or is the a.g.c. system playing up? The line scan twitches momentarily at random intervals: is the line oscillator changing phase or can the d.c. control voltage from the flywheel line sync system be wagging the dog?

Correction Voltage Change

The answer is very easily found by seeing which way the correction voltage goes. In most closed loop systems, the control potential takes the form of a d.c. voltage which may swing above and below zero, as in flywheel line sync systems and some tuner a.f.c. designs, or takes the form of a varying unidirectional potential for gain-control purposes, such as i.f/tuner a.g.c. and width stabilisation in valve line output stages. The correction voltage should be monitored (preferably with a d.c.-coupled 'scope, which is faster than a multimeter). When the fault occurs, if the loop feedback moves in a direction to correct the error the fault must lie in the controlled circuit, whereas if the correction voltage moves in the wrong direction the error voltage generator is faulty, i.e. the tail is wagging the dog. Let us take two common examples of this to illustrate the technique.

Line Twitch

In a Decca 30 series colour chassis the symptom was a type of line twitch in which the picture momentarily moved to the right on odd occasions, often running for hours or days without the fault occurring. We hooked a d.c.-coupled 'scope to TP400 (PCF802 triode grid) to monitor the error voltage (nominally zero) and moved the picture to the right with the horizontal hold control L401. This resulted in a positive swing at TP400 and thus armed we left the setup running until the fault occurred, whereupon the upward (positive) deflection of the 'scope beam revealed that the correction was in the right sense so that the fault was in the oscillator proper. It was soon traced to the feedback capacitor C427. Had the voltage at TP400 gone in the negative direction it would have indicated that the problem was in the phase comparator, e.g. leakage in the discriminator diodes D402/D403 or the pulse feedback capacitor C418. If the voltage had not moved at all attention would have been focused on the line shift circuit, probably culminating in the replacement of the 100Ω line shift control!

Contrast Variations

A Körting hybrid receiver, Model 51765, was brought into the workshop with a varying contrast symptom. After a prolonged soak test the picture suddenly became markedly paler, only to return to normal as soon as the back was removed. It was found that the fault was very shy, appearing at rare intervals and clearing if a test prod was touched on any part of the vision i.f. circuits. As the picture exhibited no grain or noise during the fault the tuner was declared innocent, the likelihood being that one of the i.f. stages was defective. The a.g.c. voltage was monitored at the junction of R145/R146, and during the presence of the fault was found to move momentarily in a positive direction. This immediately exonerated the i.f. strip, so the a.g.c. amplifier/gating stage was monitored. Next time the fault came along it was proved that the gating transistor T106 (BC147B) was the culprit. Just to be sure, we interchanged this with the ident amplifier (T748, BC147B) in the set's decoder and sure enough next day were rewarded with loss of colour after three hours' running. Switching the set off and on restored the colour, and the offending transistor was committed to the dustbin with due ceremony!

Mousetraps

One of the most difficult types of fault to trace is the random fault which appears for a second or two, only to disappear for hours or days on end. Several of the techniques described above can be used in these circumstances, or a trap can be set, where circuit conditions allow, to permanently record any change of conditions. The simplest of these is a fuse, wired in series with the feed to a suspect circuit, so that the fuse blows during a momentary overload, thus helping to isolate the faulty section of the receiver.

In common with many receivers, the Grundig Model 5010 colour TV uses a thermal overload cut-out. We were asked to attend to one of these receivers, the complaint being that the cut-out tripped at irregular intervals – it might happen twice in an evening, then behave for ten days. This was confirmed in the workshop, the problem being that the set would operate normally again once the trip was reset, rendering diagnosis very difficult, especially as provocation by tapping and temperature cycling had no effect. It was a reasonable assumption that either the power supply section or the line output stage was involved, so a 2A fuse was fitted in series with a 282V h.t. feed to the line output stage. The set ran for about six hours, after which the cut-out operated and our fuse was found to have ruptured violently. With the fault thus confined to the line output stage, it was surmised that one of the thyristors TY511/TY518 was failing to turn off, and the problem was finally traced to faulty connections within the input/commutating transformer.

Gate Controlled Switch

While on this subject, a recent innovation by Sony is their GCS (gate controlled switch) devices. These are a cross between a transistor and a thyristor in that the device turns on when the gate-cathode junction is forward-biased (normal thyristor action) but can also be made to turn off if the same junction is reversed biased sufficiently. This means that if the turn-off pulse fails to arrive for any reason, or if the drive is intermittent, the device remains hard on. In the KV1810UB receiver this spells instant destruction for both line output GCS and the power supply chopper, both type SG608.

Use of Relays

To return to our mousetrap theme, where momentary failure of a supply line is suspected, a standard PO type 3000 relay can be pressed into service, the idea being that it is energised via one of its normally-open contacts, and furnished with a suitable series resistor for the supply line being checked. After wiring in, the device is primed by pressing the armature, when it will latch in. The set is now left running on soak, whereupon if and when the h.t. voltage fails, the relay will drop out, thus permanently recording the event. This technique can be developed further with a single transistor amplifier to provide current gain.

The latched-relay idea is very useful in receivers employing several different supply lines any one of which can, if it fails, shut down the receiver. Such a chassis is the Thorn 3000 family, in which failure of the 236V, 60V or 30V lines has the same effect.

The relay can also be used in the other mode, to record a momentary current surge. For this application the relay is wired in series with the suspect component and the relay coil is shunted by a suitable resistor. A normally-open contact switches a holding voltage on to the relay coil from an external source, keeping the relay closed after the surge has passed. This is an alternative to the fuse-trap technique, useful where the overload is too small or too short-lived to blow a fuse.

Strip-chart Recorders

From time to time strip-chart recorders are offered on the surplus market. If one of these can be acquired it is ideal, the more pens the merrier. Several voltages and currents can be simultaneously monitored. A slow chart speed is quite satisfactory, and diagnosis of transient faults can be carried on while one is drinking lemonade in the pub!

Schmitt Trigger plus Bistable

Before leaving the subject of mousetraps, a Schmitt trigger in conjunction with a bistable can be used as a type of electronic latching relay. We can imagine a few eyebrows being raised here, but three or four transistors and a handful of components have been assembled for more bizarre purposes than this, and like all the odd diagnostic aids we have described, once rigged up the device is ready at hand for use when required.

Exchange Modules and Panels

All manufacturers operate a service-exchange scheme on modules, sometimes at great expense. Many service firms rely heavily on these facilities for one reason or another, but the personal view of the author is one of great suspicion. I suspect that many intermittent faults lurk in these highly mobile modules, and while it is easy to pack up a rogue panel and send it back to the manufacturers one might be worse off when the replacement appears three months later in that it might well have a skeleton in the cupboard. No disrespect to the setmaker's service department or engineering staff is implied here, but it is felt that the setmaker's service department stands even less chance than the dealer's engineer of seeing an intermittent fault, let alone tracing it, especially if it is in the "once a week" category and is not graphically described in a firmly attached epistle.

For this reason, and also the very valid one that a nearly new panel can be exchanged for a scruffy five year old one, we steer completely clear of exchange modules wherever possible, operating an "in-house" exchange service with a couple of old receivers in the workshop. Faulty panels are dealt with by a bench engineer as and when the field technicians bring them in. In this situation no modules of unknown parentage are introduced, and latent faults can be kept track of.

Nil Desperandum

The sort of faults we have been discussing represent a challenge to the enthusiastic engineer, and where job satisfaction counts for anything at all it is good for the soul to track down and put right an elusive intermittent fault rather than tread in a replacement panel or mutter obscenities while fitting large numbers of replacement components on a "spec" basis. It is surprising how many elusive intermittent faults can be ferreted out with careful thought and patience. If the fault puts in only very rare appearances much time will obviously be needed to trace it, but many of the suggestions we have made do not require the engineer to sit and watch the set constantly. They are ideal therefore for application in the workshop, where routine work can continue while tabs are kept on the brood of soak testing intermittent sets. We have a regular (but constantly changing) row of about four receivers simmering in one corner of the workshop, usually with odd pieces of diagnostic equipment hooked in: at the click of a relay or the collapse of the field scan a thunder of feet across the workshop usually results in a positive diagnosis and another acquisition for our rogue's gallery of components.

Blanket Component Replacement

In spite of all the foregoing it does on occasion happen that the fault cannot be narrowed down to less than one stage of the receiver. A "blanket" job then becomes necessary, with several of the most likely components being replaced in the hope that one of them is the culprit.

This situation arises more often in the field than in the workshop, and in such cases it is worth bearing in mind the types of component that are most prone to intermittent and thermal problems. As we said earlier these, in order of likelihood, are semiconductor devices, electrolytic capacitors both tantalum and aluminium, polystyrene capacitors, skeleton preset resistors – especially high value ones – low-voltage ceramic capacitors (these are endemic in the transistorised i.f. strips of certain Thorn monochrome receivers) and capacitors subject to high pulse voltages.

Suspect Components

Certain makes of components are suspect in any position in the receiver, veiled references to these having been made many times before in these pages – see, for instance, Les Lawry-John's anniversary gripe about capacitors, page 528 of the September 1975 issue. Thorn are very fond of a certain make of evil little electrolytic capacitor, usually orange and yellow in colour. These should be changed on sight where they form part of a stage suffering from intermittent problems. ■

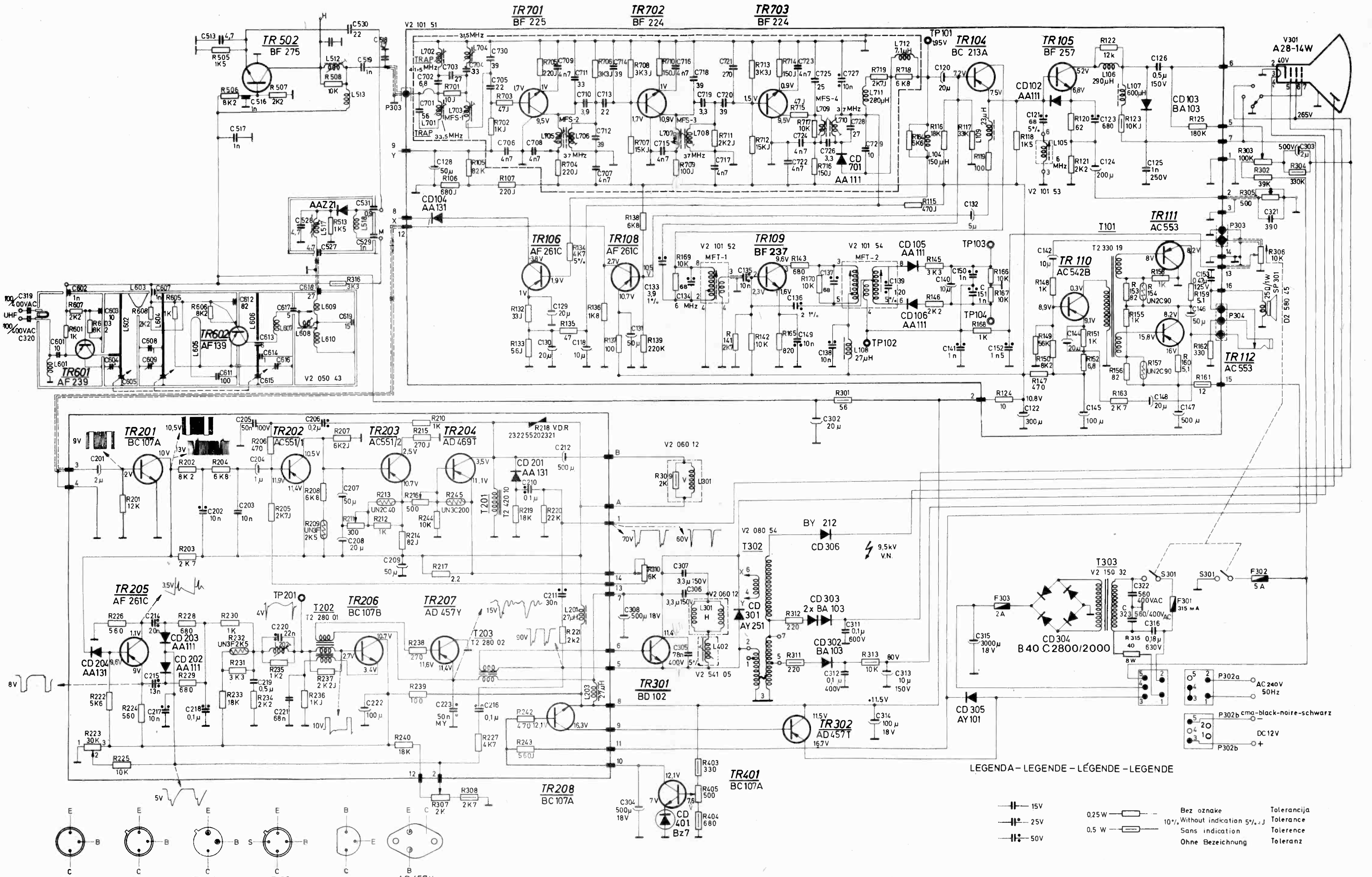


Fig. 1: Circuit diagram of the Minivox 11in. portable Model TV8735/10. The AC553 audio output transistors TR111/TR112 were later changed to type AC180K.

and fitting a single-transistor i.f. preamplifier on a small panel below the u.h.f. tuner to restore the gain. Low-gain i.f. faults are generally due to failure of the transistor (TR502) on the preamplifier panel.

Video

A washed-out picture with no or weak sound is normally traced to a leaky C125 which decouples the 80V supply for the video amplifier. Excessive white highlights at normal brightness and contrast settings can be due to R313 having risen in value: replace it with a 1W resistor.

Flyback lines visible over the whole screen – this often occurs when carrying out repairs – is due to tag 1 of the timebase panel being shorted to ground by the screening braid of the connecting cable. Just move the wires apart: perfectionists may fit an insulating sleeve over the braid. Flyback lines visible only at the top of the screen are due to a leaky C211 (0.03μF).

Intermittent loss of contrast due to a corroded contrast control (R305) can generally be cured by liberal application of switch cleaner. If the fault is due to poor contacts between the carbon track and the connection rivets however the whole control unit, which consists of the brightness and contrast potentiometers and the on/off switch, must be changed.

Field Timebase Faults

The usual cause of field collapse is a defective field hold control (R310). If the potentiometer has failed because the rivets which clamp the connecting tags to the track have become oxidised, it can sometimes be cured by soldering the rivets directly to the track's silvered tips. Other components that have been found to cause field collapse are the field output transistor TR204 and the coupling electrolytic C212. Poor field linearity has rarely occurred, but C208 has been found responsible for this condition.

Poor field sync is due to either of the integrating capacitors C202 or C203 becoming leaky. If they are light brown in colour, change them both as the good capacitor is likely to fail.

Line Timebase Faults

Poor line sync, or the line frequency requiring constant readjustment, should direct attention to C218 and C217 in the flywheel line sync circuit, also the two antiphase line sync pulse coupling capacitors C214 and C215. I recommend that all four capacitors are changed, for the cost of the parts is minor while the reliability is improved and time is saved.

No line output is normally due to a defective line output transistor (TR301) but the line oscillator (TR206) is also a frequent culprit.

If the line hold control R307 is locking at the extreme end of its travel it can be corrected by setting the control to the centre of its range and then adjusting the line preset potentiometer R223 for correct synchronization. If this cannot be achieved using this control, adjust the line stabilizer coil L202.

The line output transformer has additional windings whose outputs are rectified to provide the video h.t. line and the c.r.t. first anode and focus supplies as well as the e.h.t. supply. A misleading fault which may cause some head-scratching is R311 and R312 burning out, a ragged raster being present but with no picture. This fault is due to the line timebase running very slow. Capacitor C220 which tunes the stabilizer coil is often the offender. Do not run the set in this condition for more than a minute or TR301 will blow.

A narrow width picture with a vertical line visible at low contrast level is due to the line output stage tuning capacitor C305 being open circuit. As 0·078μF is a non-standard value it can be replaced by two 0·04μF capacitors in parallel.

Corona

Interference on the left-hand side of the raster due to corona discharge will occur if points or spikes of solder are made when replacing the wire-ended e.h.t. rectifier (BY212). Solder the connections with a very hot iron, making sure that when the iron is removed the joints are rounded and free from spikes.

Sound Buzz

If the level of vision buzz is fairly high try adjusting the discriminator coil MFT2 for minimum noise. The vision buzz is quite noticeable even when the set is functioning normally, and a complete cure is not possible.

Audio Output Transistors

Early versions of the set used a pair of AC553 transistors in the sound output stage. These were prone to thermal runaway, which caused the sound to fade and distort as the transistors began to overheat. Eventually the high current causes R161 (12Ω) in the l.t. supply to burn out. In later production a pair of AC180K transistors were substituted and these have proved very reliable. ■

servicing the MINIVOX 11" Portable MODEL TV8735/10

A. MASSING

THE Minivox portable television receiver was manufactured in Yugoslavia and imported into the United Kingdom in great numbers in the early 1970s. Due to its compact size it makes an ideal second or portable set and it's well worth while restoring.

Access

The cabinet is removed by releasing the two self-tapping screws at the top of the rear of the cabinet and the three screws at the front of the cabinet base. Do not try to undo the screws that hold the rubber feet in place.

The set has two main printed circuit panels. The panel mounted horizontally at the base of the chassis contains the timebase components. The other one is mounted vertically and holds the sound i.f., vision i.f., video and sound output circuits.

After removing the four chassis retaining screws the vertical chassis hinges open to give easy access for servicing. The power transistors are bolted on to the chassis, which acts as a heat sink.

Transistor Types

Many of the transistors used have unfamiliar type numbers, but many equivalent types are available: a few of the types I have tried are listed in Table 1.

Stabilized Power Supply

The power supply consists of a fairly conventional series regulator circuit using three transistors, fed on mains operation by a bridge rectifier and a low-voltage mains transformer. It is a little difficult to service however because the various parts that comprise the supply regulator are dispersed all over the chassis.

The rectifier is at the top left of the chassis; the error sensing transistor TR401 is hidden at the bottom right, on a small tag panel; the regulator driver transistor TR208 is on the timebase panel; the series regulator transistor TR302 is on the left hand side of the chassis, under the tuner; while the reservoir capacitor C315 is top centre.

The mains transformer T303 is wound for 220V, which is the continental norm, a 40Ω (R315) ballast resistor being wired in series with the primary winding to enable it to operate on a 240V supply. The chief fault with the transformer is shorted turns, which leads to the primary winding burning out – this can be readily confirmed by the tell-tale black ring around the defective winding. Incidentally, it is quite normal for the transformer to run very hot indeed.

Complete failure of the bridge rectifier CD304 is rare, but one arm of the bridge becoming high resistance is common. This results in two dark bands moving slowly up or down the screen. Take care when fitting a replacement rectifier, as the connections are non-standard.

Another frequent fault experienced in the power supply is the regulator transistor TR302 becoming short-circuit between the collector and base. This gives the effect of enlarged picture size, with poor sync and a hum bar. *Do not run the set* with this fault present as the line output transistor TR301 may fail. The fault is often caused by the customer inserting the 12V lead into the mains supply, in which case TR301, TR208 and the zener diode CD401 will probably have failed as well.

When tracing the cause of a hum bar, first check that the regulated l.t. supply is 11.5V. It can be adjusted by R405, which is fitted on the tagstrip behind the field hold control. If all is in order, check C315 (3,000μF) and C314 (100μF). If C314 is defective replace it with a 500μF 15V working type to improve the filtering. Do not splash a substitute capacitor across C315 – this will temporarily heal the faulty part and the defect will not reappear for days.

Tuner

The u.h.f. tuner is fairly reliable and any defects are easily repaired. Intermittent faults are generally due to poor contacts between the gang stator and the earthing forks which clean up well with a spray of jungle juice. A second fault is when the tuning control rotates round and round due to the end stop plate, which is only pressed into place, becoming detached. The end stop plate is of approximately the same shape as the tuning vanes: it should be lined up so that its flat top is parallel with the vanes, then soldered into place using a large iron.

IF Amplifier

When the Mini TV was originally designed for the European market where v.h.f./u.h.f. reception is required it was fitted with a separate v.h.f. tuner which gave additional i.f. amplification when used in the u.h.f. mode. For the UK market the set was modified by removing the v.h.f. tuner

Table 1: Transistor Equivalents Table

Type	*Suitable Equivalent*
AC542	AC128, AC153
AC551	AC128, AC153
AC553	AC142K, AC180K, AC188K
AD457	AD142, AD149
AD469	AD142, AD149
AF139	AF139 (SGS brand)
AF239	AF126, AF127
AF261	AF106, AF127
AF275	AF127
BC213	BC205, BC478
BD102	2SC555, BD103
BD103	2SC555
BF224	BF115
BF225	BF115

in next months issue

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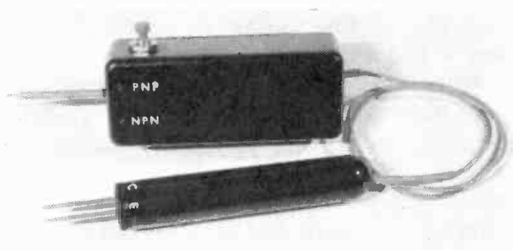
● TRANSISTOR TESTER

In-situ transistor tester. It's much more convenient for an engineer to be able to check whether a transistor is OK or not without having to unsolder it and check it on a conventional tester. Our project next month is an in-situ go/no-go transistor tester which can be built easily and inexpensively. Two LEDs are used for indicating the state of the device under test.

The unit is particularly easy to use and can save a great deal of time and trouble.



● ASSESSING OLDER SETS

The problem of whether or not to spend money on repairing an old set can be difficult. Vivian Capel outlines what to look for in assessing the overall condition of older receivers.

● REPLACING LINE OUTPUT TRANSISTORS SAFELY

One of the major hazards of servicing modern solid-state TV receivers is the vulnerability of line output transistors under certain fault conditions. Care and knowledge are required if the replacement is not to suffer instant destruction. E. Trundle explains the problems and the precautions required.

● SURFACE WAVE FILTERS

These devices, when used in the i.f. strip of a television receiver, obviate the need for the numerous coils which carry out the bandpass shaping.

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SPECIAL PRODUCT REPORT

HEATHKIT IT 1121 Semiconductor Curve Tracer

Geoff ARNOLD

CURVE-TRACERS, instruments which can reproduce on a cathode ray tube screen textbook-style characteristic curves of a semiconductor device, have hitherto been confined, by reason of their cost, to research labs and the like. Certainly they would have been regarded by the average service engineer as a rather expensive "toy", of no practical use to him. Indeed, when so much information about the health of a transistor can be gleaned by the intelligent application of a few multimeter checks, he could hardly be blamed for taking the view that almost any purpose-built transistor testing equipment was superfluous.

Sometimes, however, there is a need to know more about some device – how it will behave under varying supply or bias conditions, or to find pairs of diodes or transistors with matching characteristics. Here, a curve tracer really scores, for just as it is far easier and quicker to check and adjust the passband of an i.f. amplifier using a wobbulator and oscilloscope than it is doing it point by point with a signal generator and output meter, so it is easier to look at a complete characteristic curve, or even a whole family of them, rather than to record and plot many readings of collector current for various values of collector voltage and base current. Also, by sweeping collector voltage repeatedly from zero to a chosen maximum and back again, instead of holding it at a given value, it is possible to check a device up to and past its breakdown point without destroying it.

Now, for about £70 plus a few hours assembly work, you can have in your workshop a unit which can be used with practically any oscilloscope to form a versatile semiconductor curve tracer. The specification table shows the various checks which can be carried out and the test voltages and currents available.

Circuit Description

A simplified block diagram of the IT-1121 is shown in Fig. 1. The sweep supply transforms and full-wave rectifies the a.c. mains supply to produce a pulsating d.c. of up to 40V or 200V peak, either positive or negative-going as required. This pulsating d.c. is applied via a sweep limiting resistor to the collector (or drain) of the transistor under test. The voltage at the collector is sampled and applied to the horizontal (X) deflection circuits of the associated oscilloscope.

A step generator, triggered from the mains supply, is used to apply a current (or voltage) staircase of up to nine steps to the base (or gate) of the transistor under test, and the resulting emitter (or source) current is sampled and applied to the vertical (Y) deflection circuits of the oscilloscope. The resulting display shows the transistor's I_C/V_C characteristic curves for various values of base current. When testing diodes, the step generator is not used.

Abridged specification

Sweep voltage ranges: 0-40V at 1A maximum
0-200V at 200mA maximum
Sweep voltage sampling: 0·1, 0·2, 0·5, 1, 2, 5, 10, 20 and 50V/division ±3%
Sweep current sampling: 0·5, 1, 2, 5, 10, 20, 50, 100 and 200mA/division ±3%
Sweep dissipation resistors: 0, 10, 50, 100, 500, 1k, 5k, 10k, 50k, 100k, 500k and 1MΩ ±10%
Step currents: 0·002, 0·005, 0·01, 0·02, 0·05, 0·1, 0·2, 0·5, 1, 2, 5 and 10mA/step ±3%. Up to 9 steps
Step voltages: 0·05, 0·1, 0·2, 0·5 and 1V/step ±3%. Up to 9 steps
Polarity: PNP and NPN (p-channel and n-channel)
Calibration source: Up to 9V ±2% in 1V steps
Oscilloscope requirements: Vertical sensitivity of 1V/cm. Horizontal sensitivity of 0·5V/cm. Bandwidth to 20kHz or greater
(d.c.-coupled oscilloscope recommended)
Power supply: A.C. mains 110-130 or 220-260V, 50/60Hz
Size: 114 x 286 x 254mm (4·5 x 11·25 x 10in)
Weight: 3·9kg (8·5lb) approximately
Price: £68.52 (plus VAT).
Further details are available from Heath (Gloucester) Ltd., Bristol Road, Gloucester GL2 6EE, telephone Gloucester (0452) 29451, or from the London Heathkit Centre, 233 Tottenham Court Road, London W1P 9AE, telephone 01-636 7349.

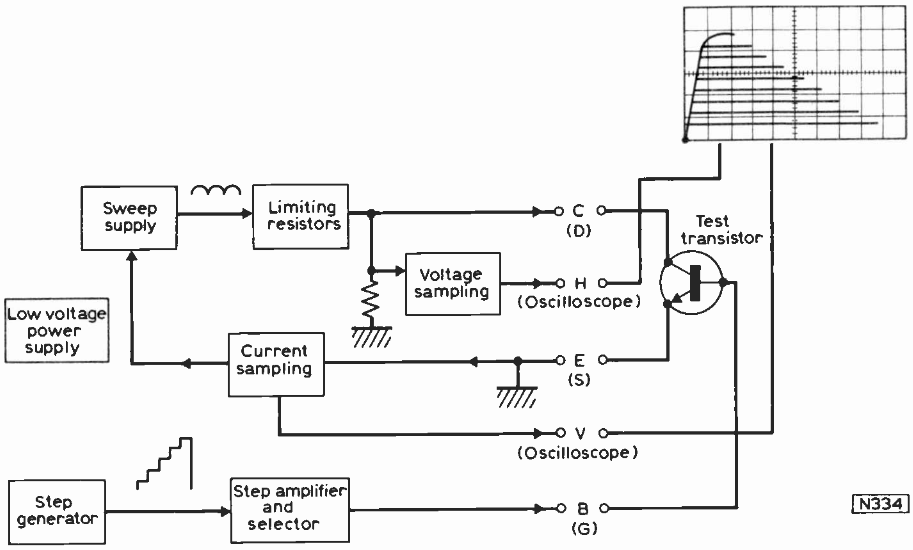


Fig. 1: Simplified block diagram of the Heathkit IT-1121 Semiconductor Curve Tracer. For a pnp transistor, all test signal polarities are reversed, and the display origin moves to the top right-hand corner of the c.r.t.

Tests performed

Bipolar transistors:
Saturation voltage V_{CE} (sat)
Leakage current I_{CEO} & I_{CES}
Breakdown voltage
Output admittance h_{oe}
D.C. Beta h_{FE}
A.C. Beta h_{fe}
Linearity
Reverse C to E breakdown
Thermal heating
Thermal runaway

Diodes:
Forward voltage drop
Forward slope resistance
Reverse breakdown voltage
Reverse leakage

Zener diodes:
Leakage
Operating voltage
Dynamic impedance

F.E.T.s:
Transconductance
Pinch-off
Breakdown voltage

Tunnel diodes:
Peak current and voltage
Valley current and voltage

Thyristors (SCRs):
Forward blocking voltage and holding current
Reverse blocking voltage and leakage current
Gate trigger current
Forward voltage drop

Triacs:
Forward blocking voltage
Gate trigger current
Forward voltage drop

Unijunctions:
Interbase resistance R_{BB}

The use of the unsmoothed rectified mains waveform for the collector sweep supply has two advantages. The most important of these is that the oscilloscope displays both the rising and falling parts of the sweep. Any change in characteristics due to device heating at peak collector voltage and current will show up as "looping" – a difference between the collector current during the rising sweep and the falling sweep. This warns of the onset of thermal runaway.

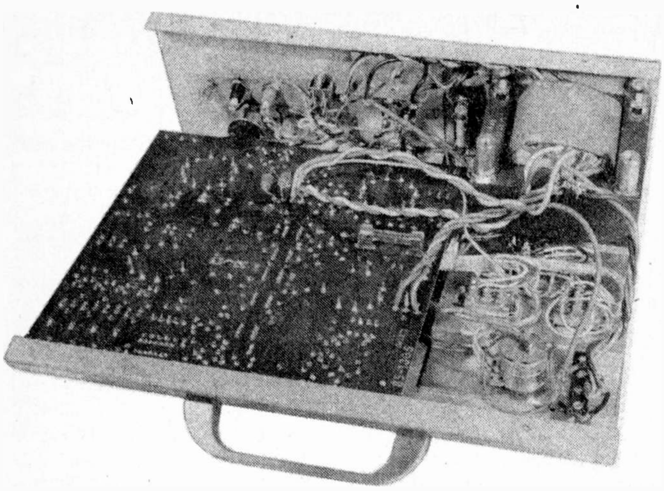
The second advantage is that a transformer plus rectifier is a lot simpler than a sawtooth or triangle generator which would otherwise be required. Unfortunately, as so often happens, simplicity brings with it certain limitations. For a "clean" display, the mains supply (though it need not be a pure sinewave) must have a symmetrical waveform. If it does not, alternate pulses of the collector sweep supply will not be identical in shape or amplitude. If an odd number of steps of base current is then selected, the display will become virtually unusable due to horizontal jitter.

Whether this is much of a problem depends on your local mains waveform. The average industrial or business-generated noise doesn't seem to cause any trouble. In a residential area or a TV service workshop where there are lots of colour receivers with thyristor-stabilised power supplies taking huge bites out of the second quadrant of each mains cycle it's a different story. If you haven't recently looked at your mains waveform on an oscilloscope you may get a nasty shock when you do so. Amplitude differences of 20V between positive and negative peaks are not unknown, together with flattening of that second quadrant. Mains filters using R/C or L/C networks are completely ineffective against this sort of distortion. A tuned constant-voltage transformer might provide an answer but has not been tried.

Incidentally, all but the most exotic curve tracers use the same mains-derived horizontal sweep waveform. Presumably they all suffer from the same difficulties when working from a distorted supply.

Construction

The assembly instructions are to Heathkit's usual impeccable standard, though I did find one minor error



Interior view of the IT-1121. The single large printed board carries the majority of the components, including 6 i.c.s, 17 transistors, 18 diodes and 4 rotary switches.

where they have miscounted the number of wires fitted to a switch tag. This shouldn't cause any headaches among constructors. Total assembly time for the review instrument from unpacking to completion of testing was just 12¼ hours.

The only item to give any difficulty was the power transformer. As supplied, the fixing feet were not quite square and level, so that the instrument case became distorted when the transformer fixing screws were tightened up. The distortion only became apparent after construction had been completed, at which stage it is not easy to get at all the transformer fixings.

Operation

Comprehensive operating instructions for all the tests listed in the specification table are included in the assembly manual. The oscilloscope used should be d.c. coupled on both inputs, otherwise "looping" of the display will occur due to the phase shift caused by the coupling capacitor. Most modern 'scopes have d.c. coupling available on the vertical input, but quite a few have only a.c. coupling on the horizontal input. If yours is one of these, it may be possible to short out the isolating capacitor, though you might also find it necessary to put a voltage-shifting network in series with the lead from the curve tracer to bring the trace back on screen.

Using an oscilloscope with a normal medium persistence c.r.t., flicker becomes quite objectionable if more than six steps of base current are used. With six steps the display is refreshed at intervals of approximately one sixteenth of a second (6 × 10ms = 60ms).

Conclusions

Providing these limitations are accepted (and, after all, they are not too severe) the display is clean and steady. The instrument has proved to be a useful addition to the workshop over the test period. Those bargain packs of unmarked, untested devices can be quickly sorted out! Especially useful is the ability to switch instantly between two sets of test sockets, an absolute blessing when trying to find matched pairs of transistors or diodes. ■

TALKING ABOUT COLOUR CRTs

– continued from page 575

taking their sum away from 1 – which is precisely what happens on the CIE chromaticity diagram (see Fig. 3). Taking illuminant D as an example, the x coordinate corresponding to red is 0·313 and the y coordinate corresponding to green is 0·329: so if you needed it the z coordinate corresponding to blue is 1 – (0·313 + 0·329) = 0·358. It is for this reason that textbooks, specifications and so on evaluate any colour in terms of its x and y coordinates.

The instrument for measuring these coordinates is a colorimeter, and in its crudest form consists of three photocells, each with a primary-colour filter over it, connected to three meters. Practical colorimeters have a box of electronics interposed and produce direct readouts of x and y. It won't help you to set your screen to the correct white point however. Larger organisations use a grey scale box in which a special fluorescent tube is mounted behind an optically neutral stepped filter. This gives accurate rendering of the shades of illuminant D. This is fine for studio and professional work but is not so good for sets that may be used to display a fair number of monochrome programmes and which in consequence need a cooler white. A compromise is as always the best answer, and is a matter of personal taste, north light or a cloudy sky being a good handy reference.

There is a snag however. Tubes vary according to their origin. American tubes have a different red, and Japanese tubes have a different green because the use of cadmium-free phosphors has become mandatory there. This is bound to affect their colour rendition, but it's the effect on the drive required for white that is the most noticeable point.

The video stages of the set (be they RGB or CDA) are all carefully designed to track equally with respect to gain and frequency response, so if you have to set them up individually at vastly different settings to obtain the white of your choice you will sooner or later run into a tracking problem, which prompts a useful tip. Turn down the colour, set up the first anode presets for good low lights as per the book, and join all three cathodes of the tube together. This makes all three drives identical and if you now apply a test card the white tint you will see is the "natural white" of that particular tube: the nearer you set your grey scale to that tint the less trouble you will have in tracking.

Another useful tip. To check on colour matrixing without the need to switch off the guns, mount three Wratten gelatin filters (Kodak Ltd.), numbers 47B blue, 99 green and 29 red, in standard 2 × 2in. slide glasses and look at the colour bars through each in turn. Faulty matrixing shows up immediately.

The Bomb Burst

The colour tube Bomb Burst is now almost upon us. The advent of self-converging wide-angle tubes has brought with it the slotted type of shadowmask with three in-line guns. The small Sony portables began it (the Trinitron), Thorn have started to use the Precision-in-Line (PIL) tube with its permanently fixed scan coils, and Mullard have their 20AX in all tube sizes about to enter the showrooms. There are many others in different parts of the world. Some have middle gun green, some middle gun red. None of them are plug-in replacements for the others, or for each other. So the future looks interesting. Somebody is bound to come up with some hints and tips. Watch this space! ■

FAULT GUIDE: GEC C2110 SERIES

John Coombes

THE GEC solid-state colour chassis uses conventional circuitry, with a BU108/BU208 line output transistor from whose emitter circuit the low-voltage supplies (40V, 24V and 12V) are obtained, a thyristor regulated power supply, a varicap tuner and a four i.c. decoder (TBA560A/TBA540/TBA990/TBA530). Model numbers include the C2110, C2111, C2112, C2113, C2118, C2119, C2121, C2136 and C2137.

Fuse Blowing

No results on earlier models was often simply the 3A mains fuse FS1 blown: it was subsequently up-rated to 5A since when this trouble has been cleared.

If FS1 is found open-circuit the likely cause is that the power supply thyristor SCR701 (BT106) is short-circuit. It is important to ensure that on early models a small modification to protect the thyristor against peak voltages is carried out. This consists of fitting an 0·22μF capacitor (C58, 350V a.c.) and a 270Ω resistor (R69, ¼W) in series between the set side of the mains filter choke L57 and chassis (see Fig. 1). C58 can go short-circuit, blowing FS1. It must be replaced since if it's left out and the BT106 goes short-circuit the contacts on the mains switch SW1 can be ruined. There is a separate fuse (FS2, 5A) in the feed to the degaussing circuit. Note that the mains filter capacitor C751 (0·22μF) is on the other side of it.

HT Voltage Adjustment

As with all solid-state chassis it is important that the h.t. voltage is correct. This is set by P701: adjust for 190V ±5V between R60 and chassis. The e.h.t. should then be 25kV. Excessive h.t. occurs when R709 (270kΩ), part of the a.c. potential divider in the base circuit of the control transistor TR701, changes value. Low h.t. is very often due to the reference zener D702 being leaky.

No HT

No h.t. can be due to several causes. The thyristor triggering diac D701 (BR100) may be open-circuit; the charging capacitor C704 (0·22μF) may be short-circuit; the reservoir electrolytic C702 may be short-circuit; or R68 (41Ω) may be open-circuit.

Excessive Scan

Excessive scan is often due to the regulator feedback resistor R706 (470kΩ) being faulty.

Picture Jitter

H.T. fluctuations cause the picture to bounce up and down. The most common cause of this is the diac D701 – the recommended replacement type is an RCA 17000 or ITT V413M. The thyristor itself can also be the cause. The problem is due to slight forward resistance in these components. The control transistor TR701 can also be responsible for the fault.

Sound Buzz

Buzz on sound at different levels of brightness and contrast is the result of the c.r.t. leads being draped across the sound output board. On later models the problem was overcome by re-routing the leads via the chassis gantry.

Intermittent Sound

Intermittent sound is often due to the preset volume

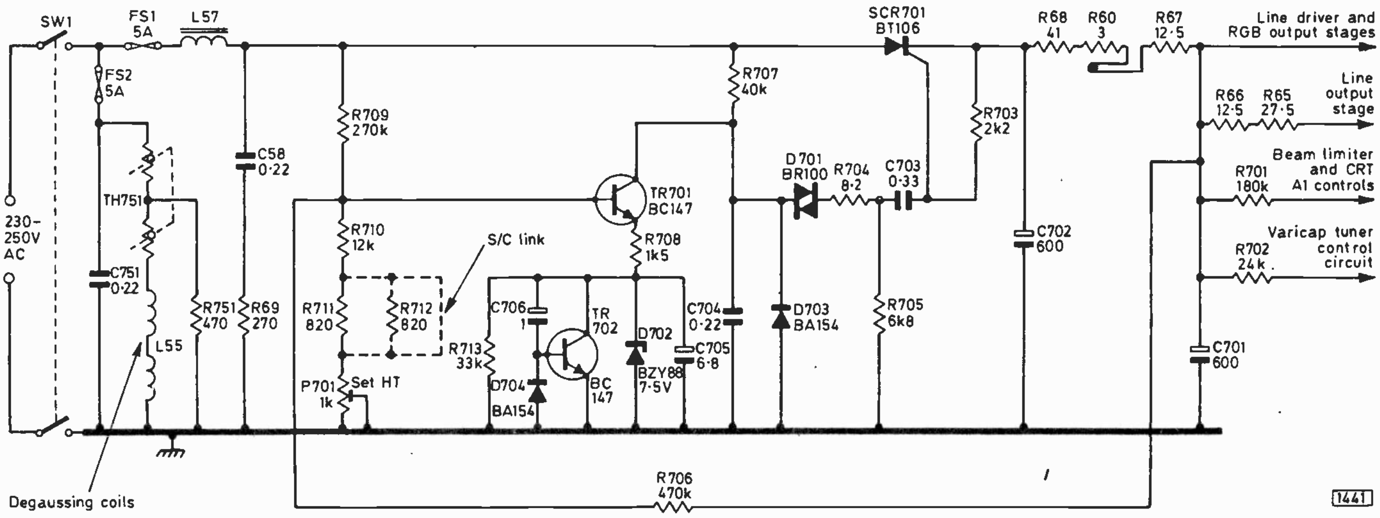


Fig. 1: Circuit of the thyristor regulated h.t. supply. Minor variations will be found in early chassis. The l.t. supplies are derived from the line output stage. TR702 and its associated components form a slow-start circuit to limit the set's initial switch-on current surge. At switch-on C706 is discharged and as a result TR702 conducts heavily, shorting out D702 and thus ensuring that TR701 passes a higher current than during normal operation, delaying the triggering of the thyristor (SCR701). As C706 is charged via TR702's base current, so TR702 cuts off and the circuit operates normally. At switch off C706 discharges via R713.

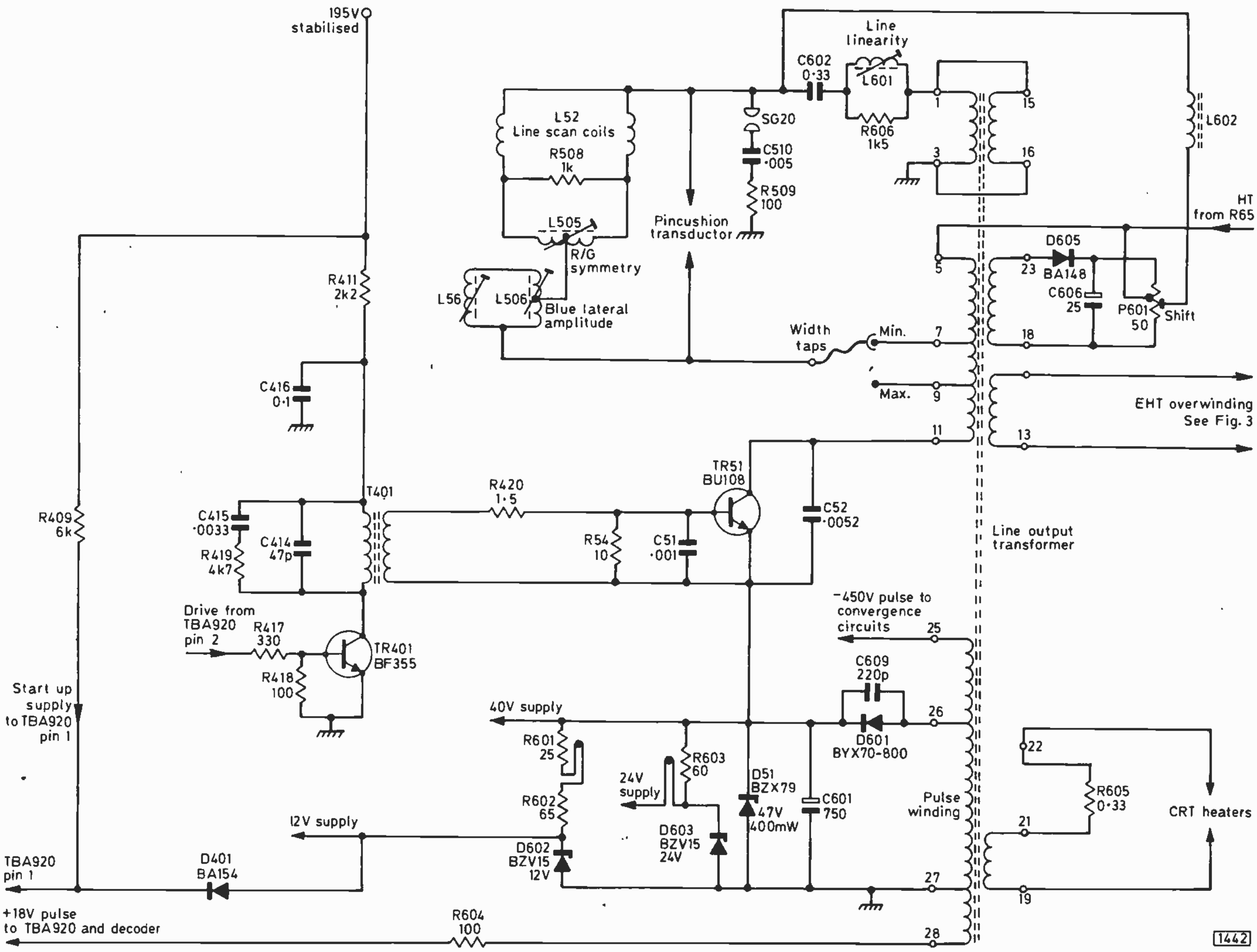


Fig. 2: Circuit of the line output stage. The 47V zener diode D51, a 400mW type, provides circuit protection. Should the 40V line, which is obtained by scan rectification (D601), rise above 47V the zener will go short-circuit, thus removing the l.t. supplies and shutting down the line output stage since there is no line drive.

control P199. It also tends to get jammed and must then be replaced.

Hum

The usual cause of hum on sound is C121 (150μF) which either goes open-circuit or changes value. It smooths the supply to the intercarrier sound i.c. (pin 11 of the TBA120S or pins 6/9/11 of the TBA480). Another cause is C195 (100μF) going open-circuit. This smooths the supply to the SN76013 audio output i.c. (pin 10).

Crackle on Sound

The slider of the 4·7kΩ volume control P51 can cause crackle on sound – due to dirt on the track.

No Sound

No sound is usually due to a defective intercarrier sound i.c. – check the voltages around the i.c.s (IC180 and IC181). A dry-joint on any of the pins around these i.c.s can cause intermittent sound.

Distortion

Distorted sound can be due to the zener diode D603 on the line output panel – it stabilises the 24V supply to the SN76013 audio i.c. Distorted sound with excessive sibilants

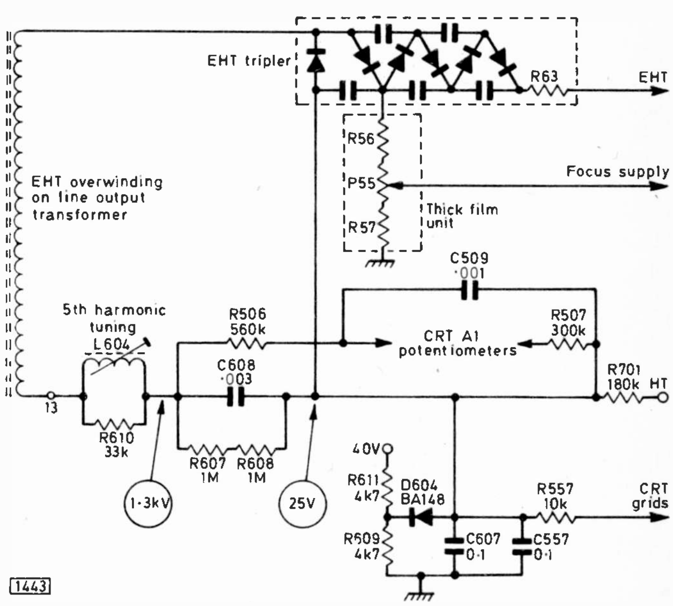


Fig. 3: The e.h.t. and c.r.t. supply circuitry. C608 charges to 1·3kV to provide the first anode supply. D604 monitors the e.h.t. beam current. If the beam current exceeds the bleed current flowing via R609, D604 and R701, D604 will cut off and the voltage at the junction D604/C607 will move negatively, the reduced c.r.t. grid voltage pulling back the beam current. Under normal conditions D604 acts as a clamp diode, clamping the c.r.t. grids at 25V.

should be clearable by resetting the quadrature coil L199. If there is a high-frequency whistle on all channels, attenuate the signal and adjust the intercarrier sound input coil L198 for minimum noise.

Grain

In the case of grainy pictures check the second and third i.f. transistors. These are TR101 (BF196) and TR102 (BF197). They go open-circuit base-to-emitter, or sometimes short-circuit.

Tuning Faults

The tuner gives little trouble. The usual fault is the tuning voltage stabiliser IC101 (TAA550) causing drift. On the models with touch tuning the neons can cause trouble – they may not light, or may stick on one channel so that you cannot change channels. The easiest way of rectifying this fault is simply to change all the neons.

No Line Drive

No line oscillation means no picture of course. A common cause is a short-circuit driver transistor (TR401, BF355). Another cause is D401 going open-circuit. This diode is in series with the 12V supply from the line output stage to the TBA920 line oscillator/sync separator i.c. At switch-on the line output stage will be inoperative so there will be no 12V supply: to start the TBA920, current is fed to it via R409 (6kΩ). D401 is then reverse biased and prevents the 12V source loading the start-up supply. When the line output stage comes into operation, the 12V supply appears and D401 is forward biased. If the line output stage doesn't come into operation D401 doesn't receive its 12V supply of course.

Line Output Stage Faults

The line output stage tuning capacitor C52 (0·0052μF) has a tendency to go open-circuit. The line output transistor TR51 then passes excessive current and the 400mW, 47V protection zener diode D51 goes short-circuit, shutting down the line timebase since there is then no supply to the TBA920 i.c. In practice the line output transistor may also go short-circuit, and the excessive current may result in R60 springing open. TR51 can also short, killing D51, without C52 being involved.

If the link on R601 is open the line output transistor is faulty. You may find that the transistor reads all right when checked for resistance with a meter, but when current flows through it the defect appears. The only cure is to replace the transistor.

Lack of width with poor e.h.t. stabilisation – picture balloons when the brightness is turned up – can also be caused by a defective line output transistor.

Tube not Lighting

The tube may not light up due to lack of heater voltage, which is obtained from a winding on the line output transformer. The c.r.t. heater pins are 1 and 14, which are fed from plug and sockets PL22-1 and -2 on the line output transformer panel PC475. PL22-1 goes to tag 19 on the line output transformer, PL22-2 to tag 22. Between tags 22 and 21 there is an 0·33Ω resistor (R605) – a piece of resistance wire. This can go open-circuit due to a faulty line output transistor. It may also go open due to incorrect plug/socket connections.

Faulty Tripler

The e.h.t. tripler can pack up, giving no raster though there is plenty of e.h.t. at the line output transformer. Some triplers split, causing arcing to chassis.

Brightness Troubles

Brightness troubles are generally due to changed value resistors in the supplies to the first anode potentiometers. If R507 (300kΩ) goes high, the brightness is excessive with flyback lines showing prominently on the screen. Low brightness can be caused by R506 (560kΩ) on convergence panel PC470 (replaced by R616 on panel PC481 in some models) or R701 (180kΩ) on the power supply panel changing value.

Striations

Striations on the left-hand side of the screen are often caused by C414 (47pF), which is connected across the primary winding of the line driver transformer, being defective. If changing this does not remove the trouble, check whether PL35 is in the open-circuit position and if so adjust the blue lateral amplitude coil L506 for minimum inductance. Also check the linearity coil damping resistor R606.

Field Timebase

The field timebase has proved reliable. In cases of poor linearity, ensure that the mid-point adjustment is correctly set (for 23V at the junction R466/R467). If the linearity gets worse as the set warms up, check the thermistor TH451. Other causes of poor linearity/foldover are the charging capacitors C457 and C458, the boostrap capacitor C462, and R471 (220Ω) changing value. Also make sure that the 40V supply is not low: if it's down slightly, check C601 and try replacing rectifier D601.

Colour Faults

On earlier models there was trouble with the corrugated heatsink on the red output transistor TR303 (BF336) – it shorted to the preset red drive control P305 to give an uncontrollable red raster.

No red, green or blue is most commonly due to the appropriate output transistor going open-circuit. The green output transistor is TR302 and the blue output transistor TR301.

No colour is very often due to a faulty reference oscillator i.c. (IC251, TBA540).

Picture Fade

Picture fading away to nothing after the set has been on for a short period is usually due to a faulty preset contrast control (P202, 22kΩ).

No Luminance

The luminance delay line L202 can go open-circuit, removing the luminance signal. The result is just visible colour only on the test card. ■

The SAMPLEDOT TV SYSTEM

PAT HAWKER

TELEVISION engineers have for many years been seeking ways of reducing the enormous bandwidth required for television transmission compared with other communications services. Whereas, for example, m.f. sound broadcasting is contained within channels only 9kHz wide, the 625-line u.h.f. vision and sound channel is 8,000kHz wide: television thus gobbles up almost 900 times as much of the frequency spectrum, which is one reason why (the other being money) the number of different television programme channels is so restricted. And if, as seems likely, the broadcasters of the future distribute their programmes – at least over the inter-city networks – in digital form, then they could need over 100MHz of microwave bandwidth for a single vision channel. While this may be available in the future, using long-distance waveguides or fibre-optics, nevertheless bandwidth costs money and many engineers are looking into ways of reducing the bandwidth needed for digital television.

Even for analogue systems it would be very useful, particularly for many specialised applications, if the present 8MHz channel (representing video frequencies up to about 4MHz) could be reduced.

Various techniques have in fact been developed over the years for narrow-band television. These include slow-scan systems for transmission over speech channels; video telephone systems which provide a reasonable picture if the subject is seen in close-up, without much movement; and some narrow-band systems used "on-air" by a few German amateur stations in channels not much more than 1MHz wide – including systems where the sound is transmitted by frequency-modulation of the vision carrier.

But despite the amount of unnecessary information contained in the conventional video signal few of the many systems so far developed are suitable for transmission of virtually broadcast quality, due to noticeable flicker or excessive smearing on movement.

Sampledot (Fig. 1)

However a new system, "Sampledot", developed by the American General Electric Company, appears to have overcome many of the problems. It provides a practical narrow-band system with up to a 10:1 compression on the standard American 525-line, 60-field system without unduly costly additional electronics (at least when in quantity production), giving a "utility" picture which when viewed from the correct distance closely approaches the quality of standard pictures.

For some applications, the system might also bring about the introduction of narrow-band frequency-modulation for vision transmission in place of conventional amplitude-modulation. This is not to suggest that even the originators seem to see "Sampledot" as superseding conventional systems for public broadcasting, but rather regard it as a technique suitable for educational and military applications. A monochrome version has been widely demonstrated in the United States, and a colour system has reached the planning stage.

The system stems from the work of Dr. S. Deutsch in the late 1960s. It is based on the known characteristic of the human eye to disregard flicker at field rate in small areas of the picture. Even in real life an observer does not see movement in clear detail; he perceives a reconstruction in his mind, based on the detailed images seen before rapid movement starts and when it ceases.

Segments

Instead of transmitting the whole picture in each frame (or half the picture in each field with interlaced systems), Deutsch suggested dividing the picture into a number of segments consisting of say 16 × 16 picture elements. In each segment (see Fig. 2) a random pattern of sample dots, one per line, is transmitted, the pattern changing with each frame. This considerably reduces the amount of information transmitted per frame. With a 16 × 16 segment it will take 16 times longer than with conventional transmission to transmit an entire picture: in other words, the frame rate has been effectively slowed down by 16 times. By using 8 line segments an 8 times reduction of frame rate is achieved. For the American 60-field standard this would slow the TV video frame rate to 1·875 or 3·75 frames per second.

With conventional scanning this would result in pronounced flicker. It is the claim of the designers of "Sampledot" that no such flicker is apparent because of the small-area effects when the picture is viewed at the normal "optimum" viewing distance – about four times picture

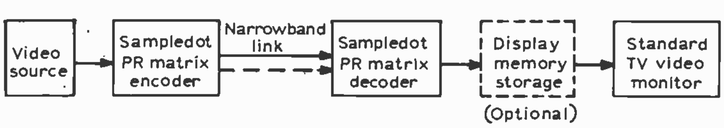
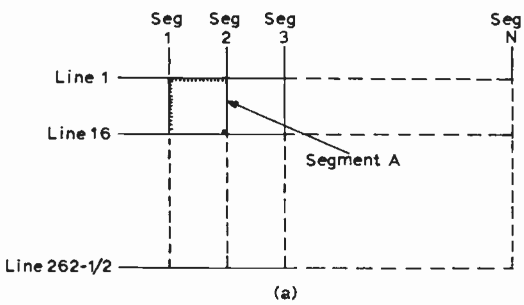


Fig. 1: Concept of the basic Sampledot system.



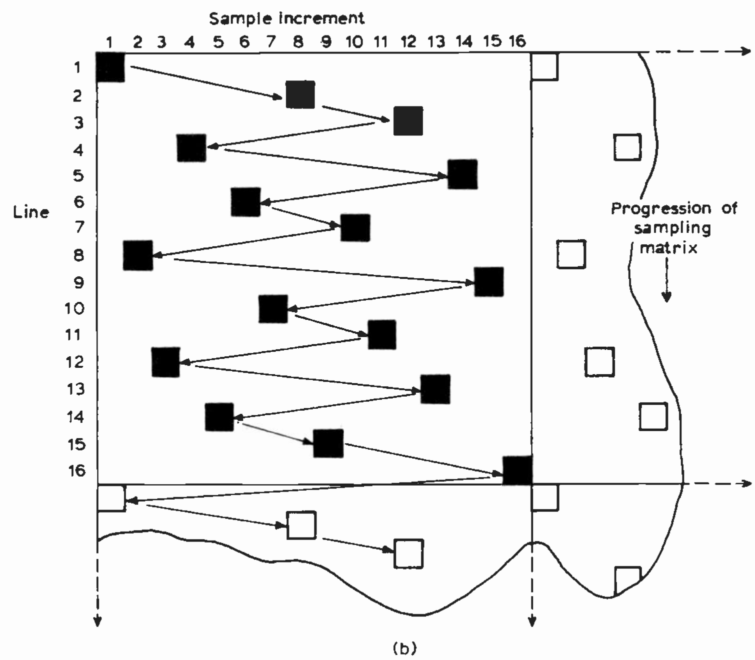


Fig. 2: (a) The Sampledot pseudo-random sampling matrix. (b) An expanded view of segment A, showing a typical pseudo-random sampling code sequence.

height. When viewed on long-persistence phosphor tubes the picture is reported to have slight smear (judged "negligible"), but even this is not seen on a standard fast-phosphor tube. A slightly longer-persistence phosphor allows the picture to be viewed more closely before the small-area flicker effects become noticeable however.

Claims made by R. F. Stone on behalf of "Sampledot" in a recent issue of the *IEEE Transactions on Broadcasting* include:

(1) Real-time live motion television with no perceptible flicker, closely resembling conventional 525-line, 60-field reproduction.

(2) Up to 10:1 bandwidth compression. Even higher compression is possible with display processing and electronic memory (a useful picture with lower resolution and limited motion can be sent in as little as 15kHz of information bandwidth).

(3) Compatibility with standard video processing equipment and video monitors, though longer-persistence phosphors may be desirable.

(4) Several channels of "Sampledot" pictures can be easily multiplexed together for transmission along a normal wideband TV link.

The American company has developed and demonstrated several systems using different "Sampledot" standards. The latest generation of equipment uses clocked digital shift registers to achieve the pseudo-random gating required. No work seems to have been reported on any use of this system with European 50-field systems, where presumably slightly less compression would be desirable.

Typical applications envisaged by the Americans include: conference closed-circuit television; two-way educational and consultation systems; surveillance and control; and specialised broadcasting. Tests in the United States have included transmission over domestic space satellite systems.

Many attempts at bandwidth compression have been abandoned in the past, often because of their additional complexity. The "Sampledot" concept seems more practical and more promising, but final judgement must still be reserved. ■

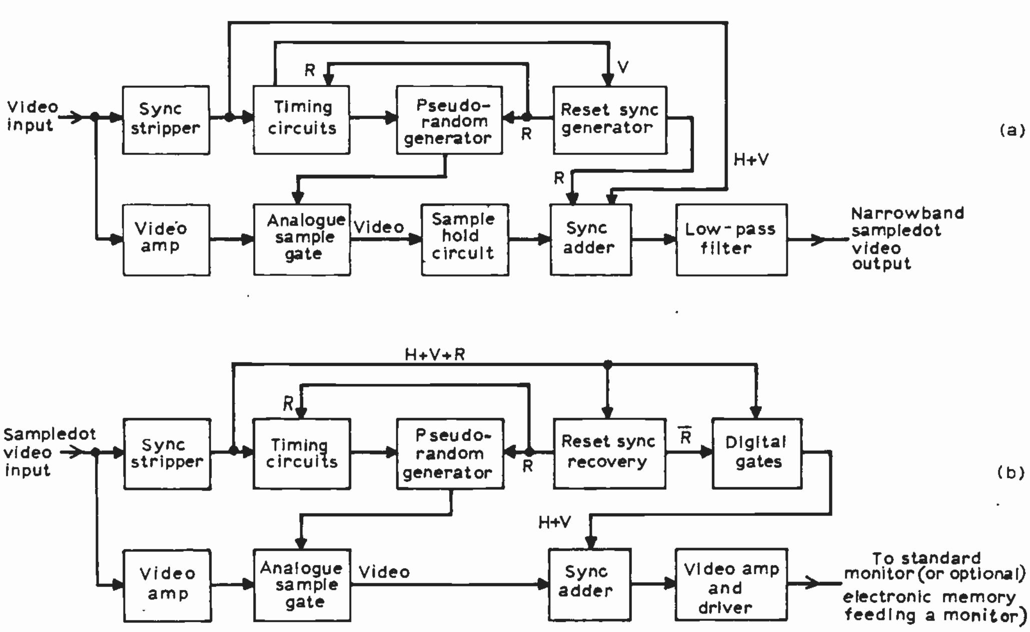
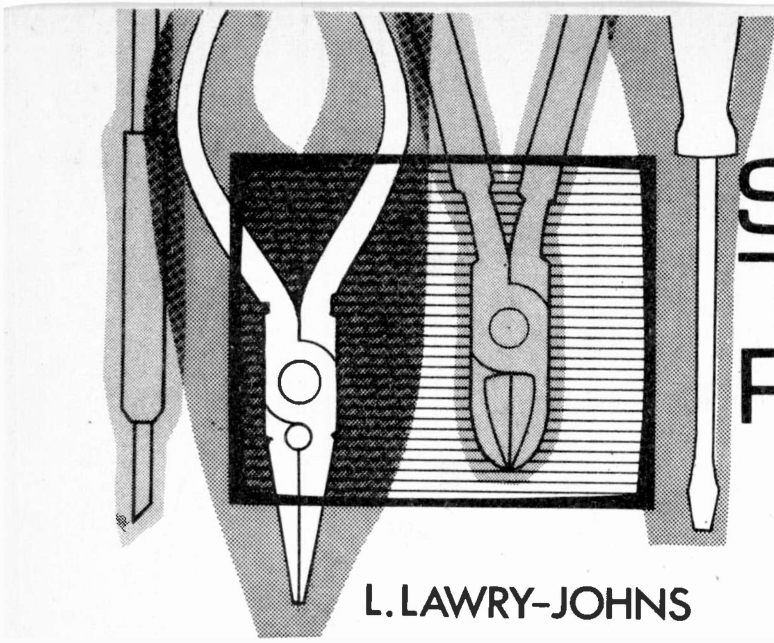


Fig. 3: A simplified block diagram of the Sampledot TV system. (a) Transmitting encoder. (b) Receiving decoder.



SERVICING TELEVISION RECEIVERS

THORN 1400 CHASSIS

– continued –

L. LAWRY-JOHNS

Field Timebase Faults

The field timebase consists of the familiar PCL85 (PCL805) in a not so familiar circuit. There is no cathode bias, no cathode resistor to change value, no cathode capacitor to dry up.

Instead, the bias is applied to the grid of the output pentode and is derived from the heater circuit at the junction of V9 and V10, the potential being negative (due to W10) and at this point unsmoothed. It's smoothed by the high-value resistors R105/R110/R108 and capacitors C94 and C95, and divided by these resistors and the linearity network.

Now this is quite nice and the basic idea is to call attention to the heater circuit if W10 should short (we could say when W10 shorts, as this is a common occurrence). When W10 shorts, the heater current increases dramatically and the valves and tube would have a very gay (albeit short) life if left in this state. With the field output stage bias derived from the heater line however attention is called to this condition as the field scan then acts in a most peculiar way, the bottom of the picture folding up and there being no proper hold. Thus a normal picture cannot be restored until the heater circuit diode is replaced, thereby saving the tube and valves. After all nobody wants to watch a crazy picture like that, do they? Well the sad fact is that they do! We have often been called to attend to a set with this fault only to find it still operating even with no one watching it. You see they must have their favourite serial(s) on to keep up with what is happening to this or that character. They may not be able to watch properly, but to listen is apparently enough.

One look at the valve (and tube) heaters is sufficient to confirm the diagnosis, and it is only minutes' work to cut out the faulty diode and fit another and hope that the overload hasn't proved too much for the valves and the perhaps already ailing tube.

The fault was much more common before W10 was changed to a BY126. It may also be present in less exaggerated form due to the diode being leaky.

Insufficient height can be due to a failing PCL85 but is more often due to the height control itself or its 330kΩ series resistor (R103). If the height control has a dud spot it should be replaced, not merely reset to a different part of the track. The condition of R133 (boost feed) should also be checked.

We are going to couple field collapse with field hold troubles since the latter are often the forerunner of a horizontal white line. For example resistors R113 and R114 often change value. Depending upon the severity of the change, the result could be loss of field hold or complete field collapse. C92 can do the same, depending upon whether it leaks slightly or fails completely. This capacitor must be of high voltage rating. C87 is a similar instance and can cause hold troubles as well as collapse but here the voltage rating is not critical.

Other causes of field collapse are C104 and R135.

C93 has a tendency to leak. This reduces the bias on the output stage with the result of fold up at the bottom.

Video Output Stage

The video output stage consists of a 6F28. If the picture lacks contrast it is often because this valve is losing emission. Since this is not the most widely used of valves, one may not be to hand for a quick swop and it pays therefore to check associated components. The suspects are R40 and R41 in the anode circuit and the 39kΩ bias stabilising resistor R38 between the screen grid and cathode. As this goes low it loads up the cathode bias to cause a weak picture with loss of sync. It may also result in R39 changing value.

If R36 is changed to 8·2kΩ (as it should be) an EF184 can be fitted to see what the difference is. This will not give the same performance as the 6F28 but is all right for a check or as a stopgap until the proper valve can be fitted.

Other Contrast Faults

Lack of contrast is often due not to the video stage but to loss of emission in either the 30FL14 (PCF808), which is the vision i.f. amplifier and line oscillator, or the 6F29 (EF183) first i.f. amplifier. When one has to replace V4 because of a line hold fault it is often surprising what a difference this makes to the contrast. A voltage check at pin 6 can save time. If this is about 2V the valve is probably not at fault and it is better to concentrate on the EF183, its screen grid feed resistor R14 and the a.g.c. components. The common troubles here are the contrast controls and the high-value resistors R4 and R7 in series with the sliders.

Poor Sync

We have mentioned the tendency for R38 to change

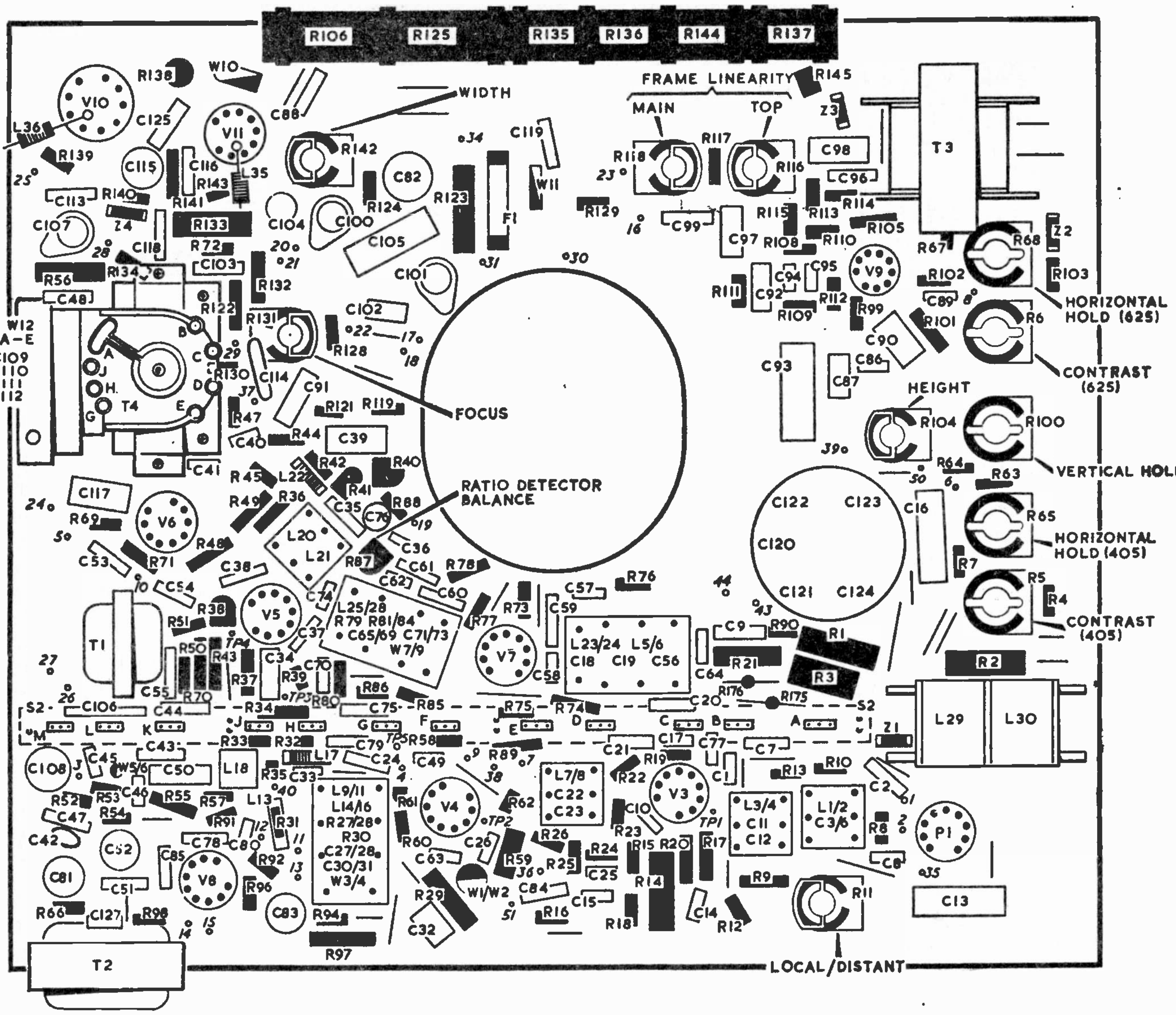


Fig. 2: Main chassis component layout.

value and upset the sync performance. Other suspects are C34, R45 and C40.

Tuner Units

In the majority of cases the v.h.f. tuner is not used for v.h.f. reception but where it is the tendency for R206 to change value should be kept in mind. This puts paid to v.h.f. reception as it is the oscillator load resistor. Its position up in the side wall makes the job of replacement a little tedious and precludes the possibility of using a larger and more reliable resistor.

The PCF805 mixer/oscillator often requires replacement and this affects u.h.f. reception as well since it is also used as an i.f. amplifier on 625-lines. The coil biscuit studs may also require cleaning from time to time and perhaps the switch bank carrier eased down with a screwdriver blade to improve the contact surface. The PC97 hardly ever needs replacement.

One of several types of u.h.f. tuner may be encountered so we can't go on too much about this. Probably the most common trouble is variation of the tuning setting due to poor contact between the spindle earthing springs and the tuner body. Cleaning out the grease with a solvent (not switch cleaner-lubricant) such as meths will often clear the fault, but it's sometimes necessary to remove the oscillator section springs with a large iron in order to clean and retension thoroughly. Other troubles are mainly of a mechanical nature and can be immediately spotted and rectified.

Aerial Input Panel

The aerial input panel itself is a prime source of weak signals. Resoldering the tracks etc. can produce a marked improvement.

Sound Circuits

The sound output stage uses a 30PL1 (nearest equivalent PCL83) which is fairly reliable but can give rise to trouble. When it has to be replaced it is essential to check not only its cathode bias resistor (R96) but also the h.t. feed resistor R97 (which should be 1kΩ). Other causes of weak output can be C81 and C83, both of which can dry up. R92 may go high but this doesn't happen very often.

We have already outlined the main sound trouble which is background buzz. If L27-L28 are set correctly, together with R87, the other remedies must be tried.

Distortion can be due to C80 leaking or R91 going high.

LONG-DISTANCE TELEVISION

ROGER BUNNEY

LATE May and early June are generally regarded as the peak period for really enhanced Sporadic E propagation over extreme distances, but the 1976 season seems to be proving an exception. After a "good" May period conditions seemed to die down somewhat – at least in the intensity of the openings – but since about June 18th Sporadic E has taken on a new lease of life. This reversal of the slow decline has been most welcome, particularly since doublehop signals from the Middle East have been received over much of the UK and in Western Europe. The most notable signal has been the ch. E3 outlet at Amman, Jordan, which has been received at high levels by many DX enthusiasts with even the simplest of aerial systems. Clive Athowe of Norwich has seen this signal three times this season! The tendency for signals to come mainly from the south and south east is well marked, with RTVE (Spain), RTP (Portugal), RAI (Italy) and JRT/RTV (Yugoslavia) providing the bulk of CCIR channel reception, along with MTV (Hungary) and TSS (USSR). Scandinavia has provided very few chances for north easterly openings, and YLE (Finland) has been completely missing!

Tropospheric Conditions

The latter part of June brought an unprecedented spell of near heat-wave conditions for almost two weeks (still continuing as I write on June 30th), with local temperatures reaching 96°F on several successive days. Not surprisingly, Tropospheric propagation has been providing some interesting catches, mainly in the short to medium distances. I feel that when the current hot spell ends we may be in for a really good Tropospheric opening.

Results at Romsey

To transcribe my full log would take up the major part of the column this month, so I will highlight only the important reception here at Romsey!

5/6/76 Improved Trop signals at u.h.f. from TDF (France).

6/6/76 A southerly Sporadic E (SpE) opening gave Canary Islands ch. E3 at 1805 with identification and a map of islands. One hour later a strong line sawtooth test pattern on ch. E4 caused headscratching – Azores?

10/6/76 RAI was noted at 0800 carrying colour bars with a small insert at the bottom right hand with the identification "RAI".

14/6/76 Another good u.h.f. Trop opening into France.

19/6/76 An intense and prolonged SpE opening from 0644 to after 2000 and embracing all Europe!

20-23/6/76 Good SpE openings daily.

24/6/76 Another good Trop opening across the Channel into N. France, with several new stations including a 160W relay on ch. E34 with TF-1.

Tropospherics have remained good – though not fantastic – until the time of writing, just allowing East Germany (Band III) and West Germany at u.h.f. Sporadic E openings have continued daily and at long last Jordan has apparently been received here – on June 28th from 1800-1900 floating over JRT ch. E3. At least the programme content was of Arabs sitting. Script followed with subtitled cartoons. Albania ch. IC was received for over two hours the same evening.

Aerial Change

Hugh Cocks visited me on the weekend of June 12th/13th and was put to work assisting in the erection of an Antiference XG21W u.h.f. array – replacing the Telerection backfire aerial. There was nothing wrong with the latter but the opportunity arose to test the XG21W and this was too good to miss! My findings will be given in due course – the initial results have been encouraging.

Note for Beginners

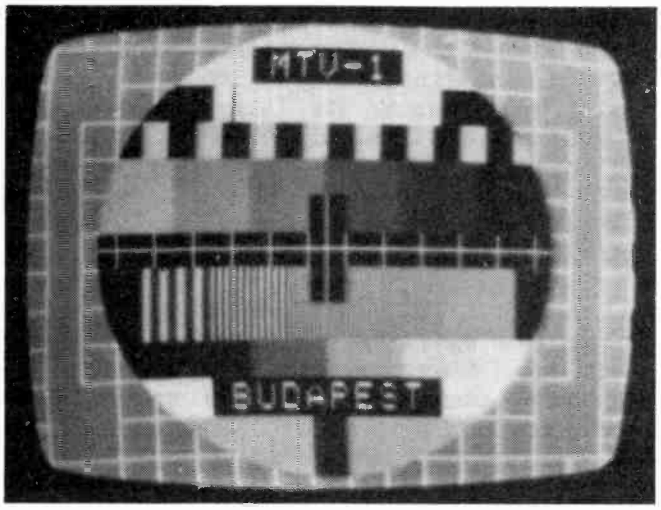
As a final note for those who are thinking of starting TV-DXing but despair of receiving anything due to an unfavourable location or the lack of a large outside aerial, small aerials will work – a wideband Band I dipole will give excellent results on most Sporadic E signals. Witness the opening of June 22nd: RTVE ch. E2 gave a measured reading at the receiver (with a single-stage masthead amplifier) of 5·25mV!

Points from the Post

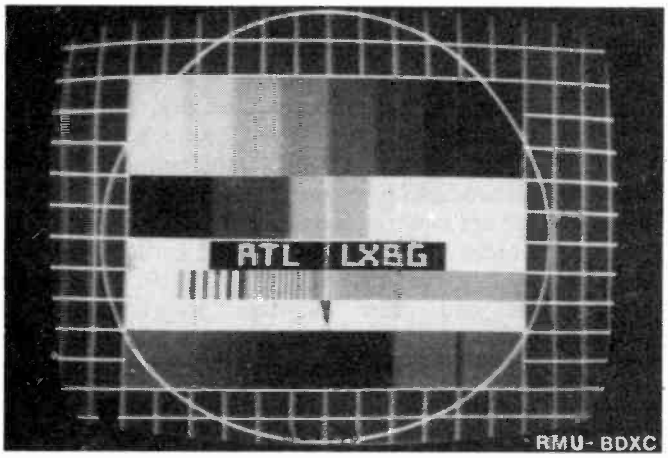
Our Leeds friends Bill Holt, Kevin Jackson and Mike Allmark have been providing us with interesting reading. The RTP (Portugal) test card E has been received on ch. E4, suggesting that the Azores can in fact be received – the signal was seen both via MS (Meteor Shower) in April and later by Bill in early June. There has also been another mystery signal at Leeds – the 0249 card as used by TSS but with the normally grey background completely white. This signal was noted on ch. R2 floating over TVR (Rumania) and suggests that this could be the elusive Bulgaria. Can anyone help?

Clive Athowe (Norwich) tells us that TVR is using a new version of their test card, with the date superimposed at the

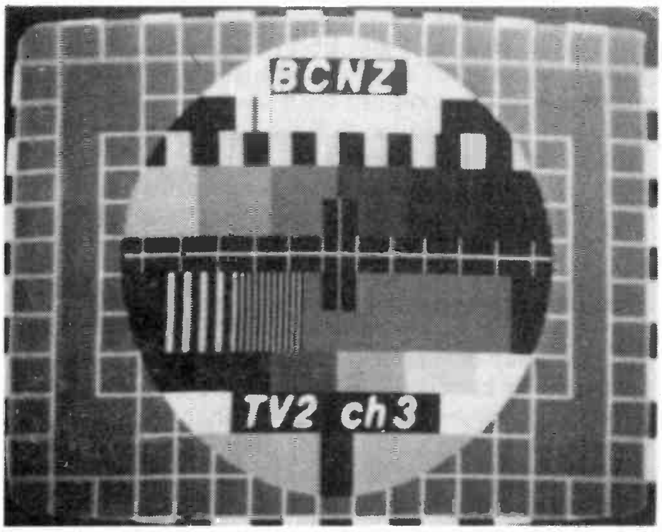
LONG-DISTANCE TELEVISION



The PM5544 pattern as used by MTV-1 (Hungary). This replaces the old MT-1 pattern.



The Fubk card as used by CLT Luxembourg, ch. E21.



The 5544 card as used on TV2, New Zealand Broadcasting Service.

top left hand and a digital clock bottom right hand. Clive has been fortunate, as already mentioned, with several exotic signals.

Kevin Jackson has resurrected an old problem – a French language programme in Band I via Sporadic E. Since this was on ch. E4 I feel it could be CLT (Lebanon) with evening programming – French is often used with programmes, Arabic subtitles being superimposed. Kevin has also confirmed the possibility of lightning scatter reception, by receiving strong bursts of signal, coincident with lighting flashes, from Goes ch. E32 (NOS-Holland) and Egem ch. E43 (BRT-Belgium).

Mystery Signals – and Morocco!

Hugh Cocks (Honiton), active as ever, reports mystery signals – the RMA test card on ch. E4 and a modified version of the PM5540 card with identification at the top and a "picture" at the bottom frame, also ch. E4, both on June 22nd prior to 2000. He suspects these may be Italian pirate stations, but I feel that the RMA card may have originated in Ghana and the PM5540 in Nigeria – the PM5540 being part of new colour tests. Of more immediate excitement, during an opening with RAI and RTVE present and whilst checking the low end of Band III for possible Sporadic E he received two strong signal bursts on ch. M4 – Morocco! This channel lies below the active Band III spectrum, at 163·25MHz, and is the only channel that uses this frequency. The transmitter is Zerhoun, with 180kW e.r.p. This is the first time that a N. African station has been received via MS in Band III in this country and our congratulations to Hugh on this "first". (Details: 25th June, ch. M4 at 1920 BST – two bursts of signal via MS).

News Items

Ghana: Colour television will not be introduced during the next 12 months or until such time as a satisfactory coverage of its monochrome service can be extended to the Northern and the Volta regions of the country.

Nigeria: As from April 1st, 1976 the military government took over all television stations, forming a new national network. The new call sign is "NTV Lagos". The transmitters at Jos and Sokoto are at present transmitting in colour and Lagos is testing with an anticipated start of colour at the end of 1976. The new network will comprise six main zones, in turn made from the 19 states. A production centre is to be formed in each state capital to give programmes to its own particular zone headquarters. The plan is eventually to transmit the six different zonal programmes over the whole country, giving six separate programmes in most parts of the country. The CCIR system B will be used at both v.h.f. and u.h.f., with PAL coding. Plans are progressing for a new 10 storey TV production complex and a central news distribution system for the national network.

USA: WRET-TV, Charlotte, North Carolina is to participate in a satellite relay experiment for CATV systems in the USA. The station will link its programme output to an orbiting equatorial satellite which will in turn reradiate back to the US. The satellite transponder uplink is at 5,925MHz and reradiates in the 3,700-4,200MHz band.

It is anticipated that the FCC will authorise

LONG-DISTANCE TELEVISION

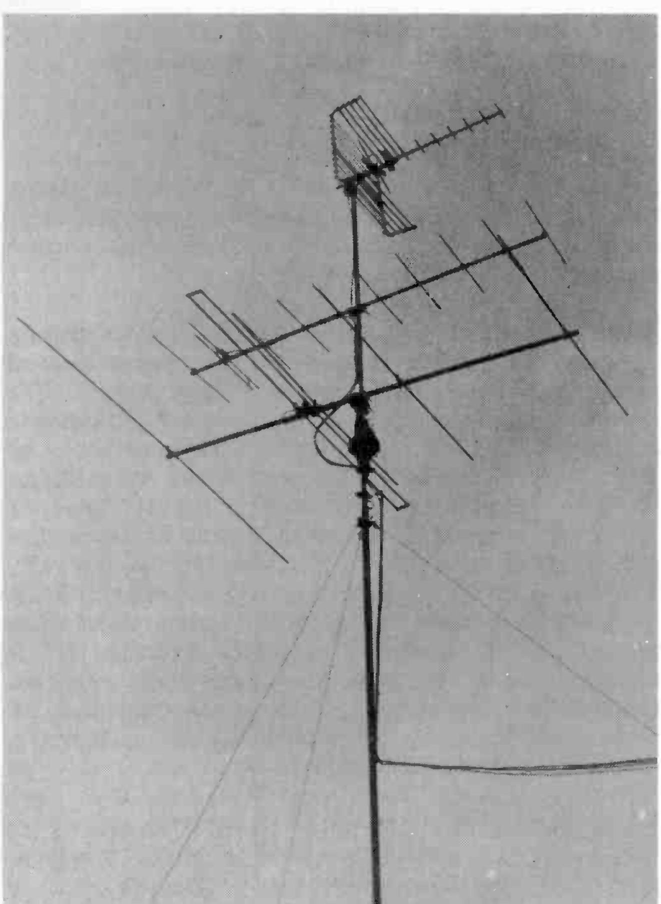
transmissions with circular polarisation. Experiments have been carried out at both v.h.f. and u.h.f. with favourable results, particularly in built up areas which suffer heavy ghosting with plane polarised transmissions. We are preparing a short article on this new system.

Gulf Update

The *Video and Audio-Visual Review* recently published an interesting article by John Fisher describing a visit to the Persian Gulf area. As a result we have been able to update our information on the TV situation there. The situation briefly is as follows:

Bahrain: The TV service, originally provided by RTV International NY, has been taken over by the Government's Ministry of Information. RTV apparently ran into financial problems and went into voluntary liquidation (1975). The ch. E4 transmissions from the Isa Town transmitter at 15kW e.r.p. continue. A new replacement transmitter is planned for Hamala, with 100kW e.r.p. but on the same channel. This is due to come into operation at the end of 1976.

Qatar: A new colour TV centre is now in operation at Doha, with two transmitters at 200kW e.r.p. Future plans include a new transmitter on the West Coast and a second TV channel.



Graham Harrison's aerial mast at St. Leonards. All are wideband arrays: backfire for u.h.f., 10-element for Band III (Telerection), 4-element home constructed unit for Band I.

Oman: The colour TV network in both the Muscat and Dhofar regions is now established, with five transmitters (all Band III). There are no further plans for expansion.

United Arab Emirates: The UAE consists of seven territories including Dubai, Abu Dhabi and Sharjah – the first two are the UAE's joint capital. Abu Dhabi is at present operating in Band III and at u.h.f., with several additional relays planned over the next few years on the completion of an extensive microwave link network. Dubai will shortly supplement its existing v.h.f. output with a new u.h.f. transmitter. The main TV production centre for the Emirates is at the studios in Dubai and Abu Dhabi. At present the TV coverage from the UAE includes the neighbouring countries and states of Bahrain, Qatar, Kuwait, the Oman and parts of the eastern Saudi Arabian land mass – mainly around the coast.

Jordan Television

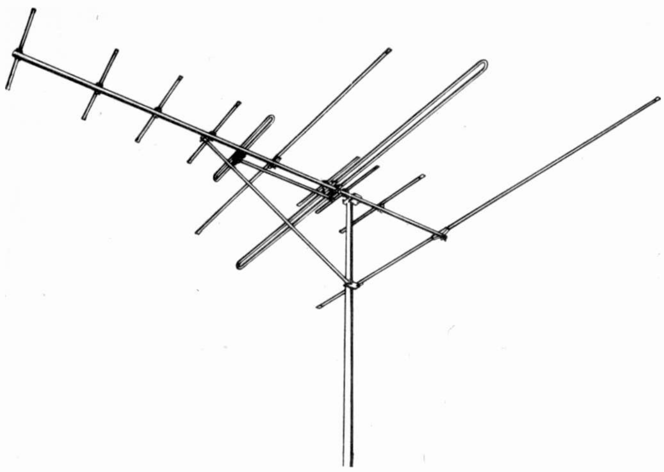
Following the recent reception of JTC in the UK it may be as well briefly to mention the system there. The PM5540 or the Marconi no. 1 card is used – the latter was seen here in May. Programmes commence at approximately 1600 local time and continue until midnight. There is a tendency for cartoons to be shown during the first hour. Other programmes consist of local Arabic productions, English (i.e. English language) films with Arabic subtitles, and at times English production plays on videotape – PAL colour is used. There are two transmitters, both with 100kW e.r.p. The ch. E3 outlet beams its output northwards to Syria in Arabic, while an omnidirectional output on ch. E6 provides both Arabic and other language programmes. The programmes are split for about two hours after which the transmitters join to transmit a common Arabic programme.

The Antiference 'Interceptor' MH308 aerial

Antiference have recently introduced an export aerial, type MH308, primarily intended for Arab areas in the Middle East. It has a wideband response through Bands I and III (i.e. chs. E2-4 and E5-11). Since this array could provide an easy and relatively inexpensive system for DX enthusiasts not too keen to erect separate aerials for each band – or indeed with no facilities for large systems – we felt that it should be investigated. As can be seen from the illustration, the array has three elements for Band I and eight (four directors, a folded dipole, two resonators and a reflector) for Band III, the outputs from the separate arrays being coupled via twin phasing bars into a common downlead. The elements are made of $\frac{3}{8}$in. diameter alloy, a forward support arm being provided to prevent forward sag since the array cannot be mounted at its balance point due to the phasing bars.

One problem encountered was inability to obtain the correct horizontal position for the Band I dipole on assembly – due to slightly misdrilled holes. I am assured that the aerial in question was a hand-made prototype and that production models are correct in this respect. The initial results obtained were disappointing – due in part to yours truly fitting the dipole insulator to the incorrect end of the phasing bars – this can be done if there is no instruction sheet, as with my prototype! The instruction sheet now available does show the box correctly connected at the Band III terminal and once this was rectified the results were more promising.

After a period of operation the array was taken to David Martin at Shaftesbury where further tests were conducted.



The Antiference MH308 wideband Band I/III export aerial.

LONG-DISTANCE TELEVISION

Our results show that the Band III performance is good over most of the band but tends to fall off at the bottom end – at Rennes ch. F5 (this is in fact below the design limit). Progressively higher in Band III, the performance improves. Comparing the results with a wideband eight-element Band III aerial, its output is marginally down but there's not much in it. The Band I performance is more difficult to evaluate, since both our locations have four-element wideband Band I systems with reduced h.f. coverage. Over most of the band however the aerial responded well to all but the weakest signals (with on signal comparison checks). In its basic form, i.e. without an amplifier, the system should not be used for MS work in Band I; for Sporadic E and Tropospheric signals however the aerial works well.

Conclusions Reached

Our conclusion is that for an aerial which is a compromise between separate systems (separate aerials are always more efficient) the unit works well and can be recommended for the enthusiast who wants to be active in the v.h.f. Bands but is unable or unwilling to erect larger arrays. We would however recommend using with the aerial a masthead amplifier covering Bands I and III. The Wolsey Supa Nova v.h.f. single-stage amplifier with a 12dB gain over the 40-250MHz band would be ideal.

Although intended for export, the MH308 can be ordered through Antiference outlets and at the time of writing costs £15·00 + VAT. Gain ranges: in Band I 1·5-3·5dB (E2-E4), in Band III 4-8dB (E5-11). Front-back ratio at E4 15dB, E5 21dB, E7 22dB, E10 18dB.

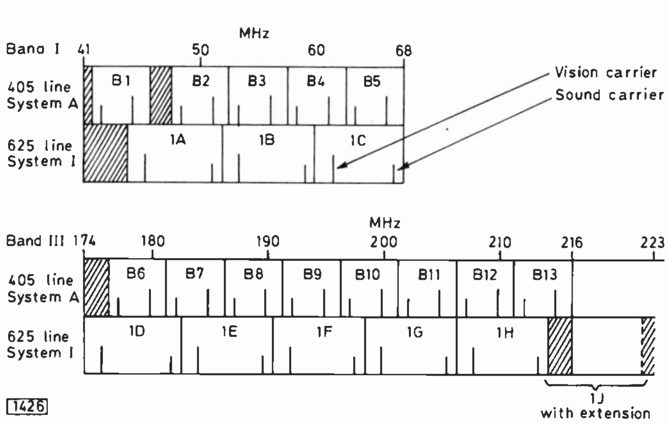


Fig. 1: BBC proposals to the Annan committee for 625-line Band I/III channel allocations. The diagram shows the existing subdivisions of Bands I and III into 5MHz channels for 405-line television and the proposed subdivision into 8MHz channels for 625-line television. The positions of the sound and vision carriers are also shown.

The Future of the VHF Television Spectrum in the UK

The April 1976 *EBU Technical Review* included an article describing the BBC's submission to the Annan Committee on the possible uses for Bands I and III once the existing 405-line transmissions cease after 1980. The alternative uses for this frequency spectrum are listed as:

(1) Further national or local TV services.
(2) Extended radio services – either national, local, or for mobile entertainment and information.
(3) Transmissions of Teletext or other pulse code modulation information.

If the decision is made for further expansion of the TV services, the 625-line system using PAL would be used, adopting the System I channel characteristics as with the present UK u.h.f. system and the Irish v.h.f. service (that of the RTE). This means incompatability with the 7MHz channel allocations used in Western Europe, i.e. the present System B v.h.f. system, but it is not expected that the wider bandwidth would produce any great problems. Three channels are possible in Band I using 8MHz spacing. These could provide a limited national coverage, but an extended Band III – creating a new channel J – would provide comprehensive national coverage and give optimum co-channel and adjacent channel interference protection.

In the event of Band I being used for an extended radio service, the use of f.m. is advocated, with vertical polarisation in the interests of interference protection and portable receiver reception.

Several other possible services are considered for Band I, including pulse code modulation using either single-channel narrowband or multi-channel with bandwidths up to 5MHz. A similar bandwidth would allow Teletext transmissions with greatly increased programme capacity.

At this stage it is impossible to predict what will happen to the v.h.f. spectrum in the UK over the next decade, but it is likely that Band III will be re-engineered for television, with an increased channel bandwidth, and that Band I will be devoted to public entertainment and/or information services. It is unlikely that Band I will be used for other services (e.g. mobile communications etc.) because many European countries will continue to use this spectrum for broadcasting, thus restricting the UK due to the interference problem. Fig. 1 shows the present and proposed future channel allocations for v.h.f. television in the UK.

ELECTROLYTIC TESTER
(August 1976)

Note that SEW meters are now handled by ITT Electronic Services, Edinburgh Way, Harlow, Essex. The RS instruments case number is now 509-737.

Servicing The TELEFUNKEN 711 CHASSIS

PART 3

P. C. MURCHISON

PERHAPS the most awkward section of the Telefunken 711 chassis to service or understand is the field output stage, which consists of a rather unusual bridge circuit. In this final instalment we are going to examine the workings of the field timebase and the fault conditions experienced here. We shall also take a brief look at the line output stage, which is reasonably trouble free – the only common fault is failure of the line output transistor.

The complete field timebase circuit is shown in Fig. 1. It can be broken down into three sections, the oscillator, driver and output stages.

Field Oscillator

The field oscillator is a conventional multivibrator consisting of the two transistors T451 and T452. Sync pulses from the TBA950 sync separator/line oscillator i.c. are fed in via the integrating circuit R451/C451 and the coupling capacitor C452.

The time-constant components which determine the frequency are C453/R453 and C454/R458, the former determining the forward scan time and the latter the flyback.

Field flyback blanking pulses are taken from the collector of T451 and fed to the luminance section of the TBA560A i.c. where blanking is effected. The collector of T451 can also be shorted to chassis via a service switch on the rear of the signal board: this stops the oscillator to enable grey-scale adjustment to be carried out.

The field frequency is varied by adjusting R452: do this by shorting together points X and Y of TP M450 and then adjusting R452 until the field frequency is almost correct.

Charging Circuit

The oscillator output is taken via the switching diode D452 and the linearity control R474 to the field charging capacitor C459 which charges from the junction of R565/R566 (see Fig. 5), in the h.t. feed to the line output stage, via R472/R465/R467 and the height control R468.

Phase-splitter and Feedback Loops

The waveform produced by the charging network appears at the base of the phase-splitter transistor T454 which provides antiphase outputs at its collector and emitter to drive the driver transistors T456 and T457.

Linked to the charging circuit are the linearity networks. There is a negative feedback loop from point A in the output stage to the charging circuit, and a second loop from point B via R494 to the collector of the phase-splitter transistor T454. This latter loop ensures that a deflection voltage component is included in the feedback loop.

Driver and Output Stages

The driver transistors T456 and T457 in turn feed the two arms of the bridge T459/T461 and T458/T462. Since T456 and T457 are phase-splitters, the drives to T459/T462 and T458/T461 are in the same phase. The net result is the production of two antiphase sawtooth voltages at points A and B (see waveforms 4 and 5 in Fig. 2). These two voltages add together to give sufficient voltage gradient across the scan coils (22V peak-to-peak).

Since T458 and T459 are emitter-followers they do not provide any voltage gain. T461 and T462 on the other hand provide some voltage gain and thus require less drive than the emitter-followers. For this reason the collector and emitter load resistors in the driver stages differ in the ratio 8 to 1.

Under d.c. conditions, the bridge is balanced when the d.c. voltage between points A and B is zero, the shift control R487 being set at its mid-point. When the control is moved, the base bias applied to the driver transistors is altered so that when the bias applied to T456 increases that applied to T457 decreases and vice versa. Thus throwing the bridge off balance results in a current flowing through the field scan coils in either a negative or a positive direction – depending on the shift control setting – and the picture moves upwards or downwards.

The output stage operates under class A conditions. This allows a simple drive system to be used, free of mid-point crossover distortion, but the efficiency is in general less and there is greater power dissipation. The reversal of current during the flyback requires a flyback voltage almost as large as the forward sawtooth scan. This implies the need to increase the working voltage of the output stage three-fold, with the power dissipation increased still more.

Impulse Adder Transistor

To overcome this problem, only a portion of the flyback voltage is amplified in the output stage, the remaining portion being provided by the impulse amplifier stage T453. During the forward scan this transistor is cut off, D451 is conducting, linking T459 to the U4 28V supply, and C457 charges to the U4 potential. During the flyback T453 is turned on by a positive pulse from the collector of T452. It acts as an emitter-follower, the positive voltage developed at

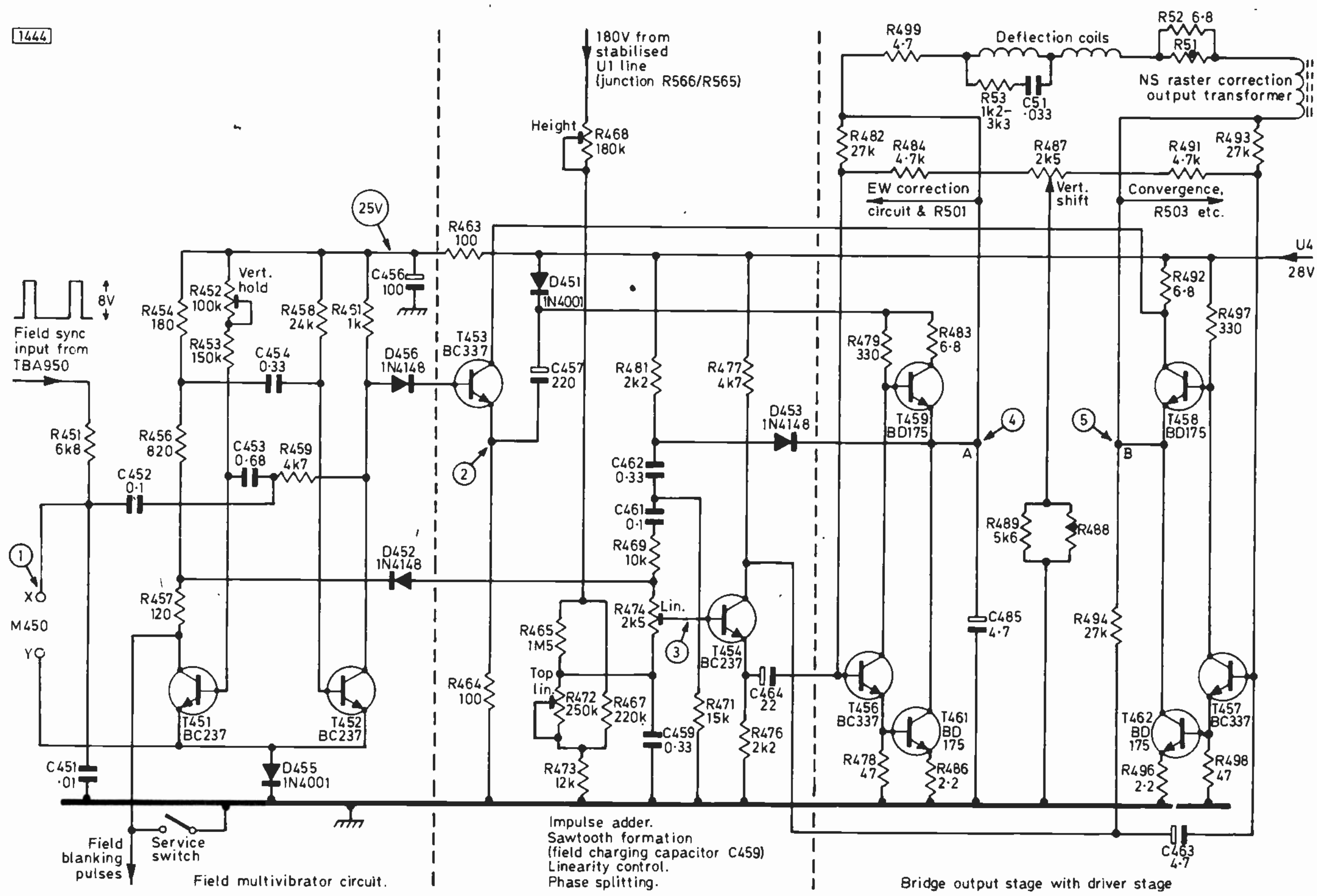


Fig. 1: Complete field timebase circuit. Following the sawtooth waveform charging circuit, the phase-splitter transistor T454 provides antiphase outputs to the driver transistors T456 and T457 which in turn drive, in push-pull, the bridge output transistors T458/T459/T461/T462. To assist with the flyback, a pulse obtained from the collector of T452 is applied via D456 to the impulse adder emitter-follower transistor T453 and is fed via C457 to the output stage.

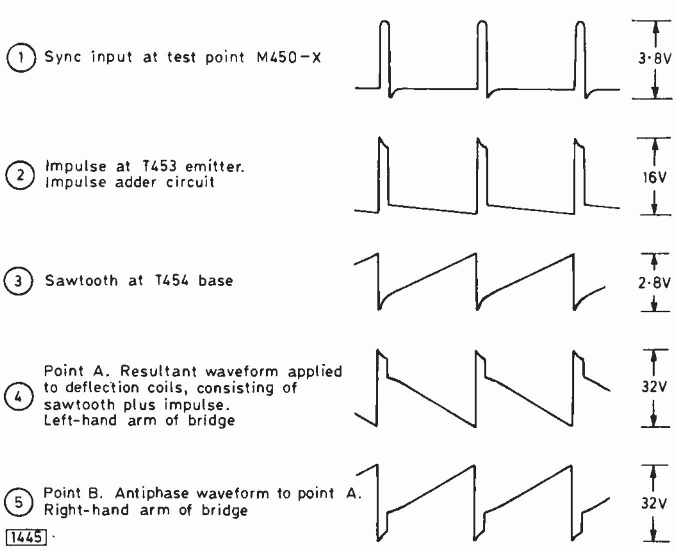


Fig. 2: Field timebase waveforms. The antiphase outputs from the bridge output stage are shown at (4) and (5).

its emitter being added to the charge on C457 with the result that D451 cuts off. The emitter voltage is applied to the scan coils via T459 and T462. This supplies the additional current required in the field scan coils: a rather curious arrangement!

Faulty Impulse Adder

The BC337 impulse adder transistor often fails, causing cramping with flyback lines superimposed at the top of the picture – an effect very similar to a linearity circuit fault, so that many hours could be spent looking in the wrong place for the cause of the trouble!

Partial Loss of Raster

As a result of the bridge configuration, fault conditions can cause loss of either the top half or the bottom half of the picture. D451 can go open-circuit: T459 then receives no supply and the top half of the picture is lost. A fault in T459 can have a similar effect. An even worse effect is when T459 has an intermittent fault, resulting in the picture occasionally coming a few inches down from the top.

Output Transistor Failures

The output transistors occasionally go short-circuit. Usually one half of the bridge (T459 and T461 or T458 and T462) is affected. Such failures are generally accompanied by the overheating and consequent failure of either of the 6·8Ω collector load resistors R483 or R492 – in the left- and right-hand bridge sections respectively. In consequence the field will usually be found compressed to a few inches and displaced either upwards or downwards, depending on which transistors have blown.

Loss of U4 Supply

Complete loss of the U4 line – which is obtained from the line output stage – can be traced back to failure of diodes D562 and D563 in the EW modulator circuit. The BYX55 diodes originally used here have been replaced by a heavier

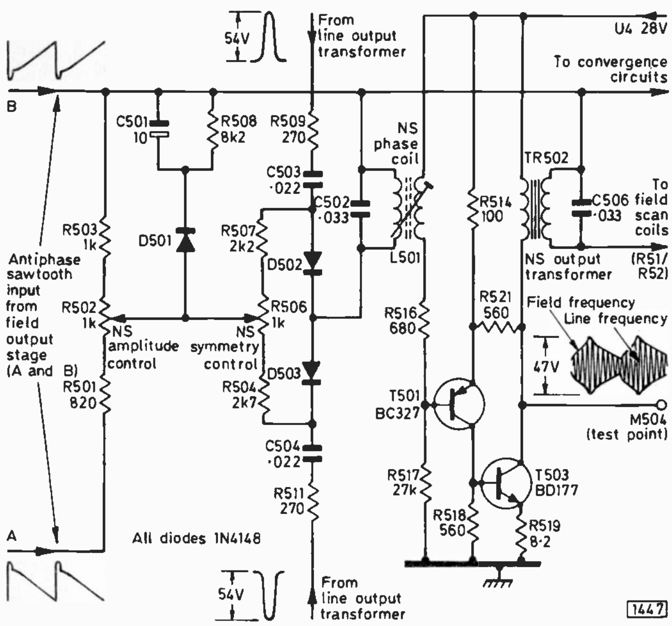


Fig. 3: The north/south raster correction circuit. The diode modulator consists of D502 and D503. The field sawtooth waveforms are modulated at line frequency, the resultant output being applied to the field scan coils. T501 and T503 are the driver and output transistors. A common failure is T503 going short-circuit base to emitter and burning out the emitter resistor R519.

duty type with a much larger heatsink. This has reduced the failure rate. The original diodes had a tiny piece of copper soldered to the cathode lead-out: the heat dissipation from this must have been minimal.

Oscillator Faults

Failure of the transistors (T451, T452) in the oscillator circuit is not unknown. They tend to go open-circuit base to collector. A quick check with a voltmeter will then reveal one collector high whilst the other is at almost chassis potential, indicating that the oscillator has stopped.

If the oscillator is running, D452 is often suspect. It goes open-circuit so that there is no discharge action in the following stage.

Field Fault Summary

Oscillator and diode failures cause complete field collapse while with output stage troubles there is usually some sort of compressed display on the tube face.

Working on the Deflection Board

Fault finding would not be too bad were it not for the cramped nature of the main deflection board, as it is called.

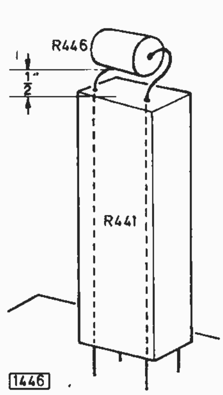


Fig. 4: A single p.t.c. thermistor (R446) is used in the degaussing circuit, mounted on top of the h.t. feed resistor R441 to keep it hot. To prevent it overheating, a half inch gap should be left between its body and the top of R441.

This does not lend itself to ease of servicing. The print is very fine and closely spaced, so that a fatal slip with the meter test prod can result in a really horrifying chain reaction of transistors going short-circuit! Replacement of these components once blown is a very tedious business as the print is prone to lifting at the slightest provocation. Thus care must be taken to use a low-voltage soldering iron and to remove solder from components with a solder sucker prior to their removal. It's all too easy to come unstuck when working under dark and primitive conditions in the corner of a customer's living room! A not very pleasant experience, usually followed by a lot of hard work back at the workshop.

Degaussing Thermistor

One thing we omitted to mention in dealing with the power supply section in Part 1 was the combination of the 15Ω feed resistor R441, an upright "stick" resistor, with the p.t.c. degaussing thermistor R446 which is perched precariously on top, the long leads of R446 passing through R441. The idea is that the heat dissipated by R441 keeps the p.t.c. thermistor nice and hot, so that after the initial surge of current in the degaussing coils there is minimal current flow. Unfortunately the inevitable happens: the thermistor gets too hot and falls to pieces, the body of it falling into the works and shorting out some convenient h.t. line! Telefunken now recommend that replacement thermistors are mounted about half an inch above the top of the resistor – the latest thermistors have longer legs for this purpose. The assembly, with the thermistor correctly fitted, is shown in Fig. 4.

NS Raster Correction

The raster correction circuits used are reasonably trouble free, although the NS output stage sometimes fails, causing a drastic bowing towards the top of the raster. The basic circuit of this stage is shown in Fig. 3. The main culprit is the output transistor T503 which goes short-circuit base to emitter. This results in the emitter resistor R519 burning out. Replacing these two components will restore the stage to normal working order.

The operation of the NS raster correction circuit is fairly simple. Two antiphase sawtooth waveforms from bridge points A and B in the field output stage (Fig. 1) are applied to the diode modulator D502/D503 along with antiphase pulses from the line output transformer. The modulated output is amplified by T501 and T503 and is applied to the field deflection coils via TR502.

Line Timebase

The line driver and output stages are shown in Fig. 5. They are reasonably conventional, the only complication being the addition of a diode modulator circuit to provide EW raster correction. The base of the line output transistor is fed via the driver transistor T561, this in turn being driven by the line oscillator which is in the TBA950 i.c.

Line Output Transistor

The line output transistor T562 was originally a BU108. These are rather prone to emitter-collector breakdown. When this happens the protection circuit will shut off the h.t. and there is loss of picture with no further damage to the circuits. A similar result occurs when the heatsink washer beneath the transistor arcs through – the washers

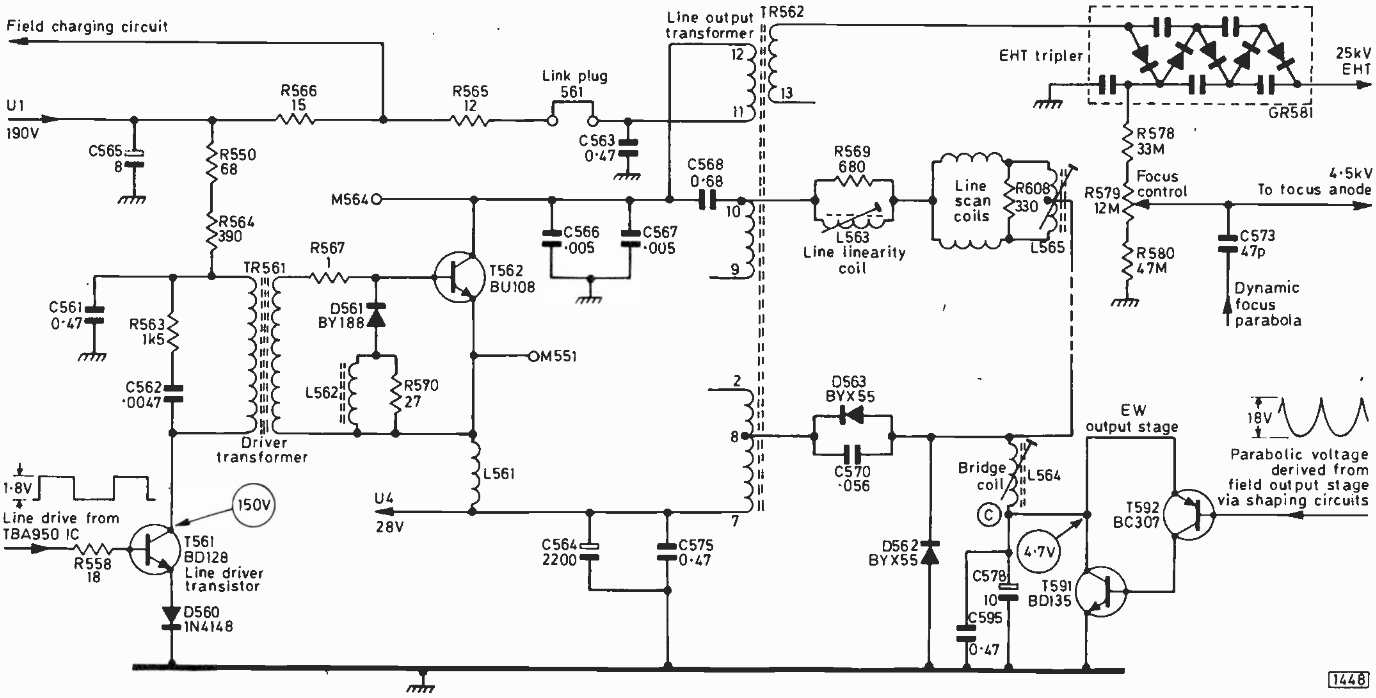


Fig. 5: Simplified circuit of the line driver and output stages, showing the diode modulator (D562/D563) used to provide east-west raster correction. The collector-base junction of the line output transistor acts as the efficiency diode during the first part of the forward scan. Current then flows via the collector and base of T562, diode D561 and L562. Diode D561 is included so that the current does not flow via R567 since this could cause poor linearity. The presence of D561 could impair the switch off waveform applied to the line output transistor at the end of the forward scan. To overcome this problem the special choke L562, which slows down the switch on time of D561, is included.

used are made of an extremely thin type of mica. It is best to be sure to fit a thicker substitute.

The BU108 was superseded by the higher rated BU208. The remedy to line output transistor failure is always to fit a BU208 as a replacement.

EW Raster Correction

The diode modulator D562/D563 is there to stop the raster bowing in at the sides. It does this by parabolic modulation of the line deflection current. The circuit is simple but effective since it manages to carry out its function without impairing the stability of the e.h.t. voltage.

The EW driver circuit produces a varying impedance at point C. This impedance is in parallel with C578 and varies from zero to infinity at field rate. The two extreme conditions are at the beginning and end of the scan when C578 is open-circuit, and the middle of the scan when it is short-circuit.

EW Modulator Faults

An important component in this circuit is the bridge coil L564. This has proved to be unreliable, tending to overheat and melt. This renders the circuit inoperative, and the scan then suffers parabolic distortion at the sides. Before suspecting the coil however the EW driver stages should be checked since it is not unknown for the transistors here to fail.

A by-product of the diode modulator is the 28V U4 supply which as previously mentioned feeds the field timebase circuits. Should the diodes fail, U4 is lost and the result is field collapse.

Focus Troubles

The focus voltage is taken from the centre of the potential divider chain consisting of R578, R579 and R580. This is a straightforward arrangement but is worth mentioning since the resistors often fail, the result being a very out of focus picture with the focus setting changing as the set warms up. The cure is to change R578 (33MΩ) and R580 (47MΩ). This should restore focus stability.

Conclusion

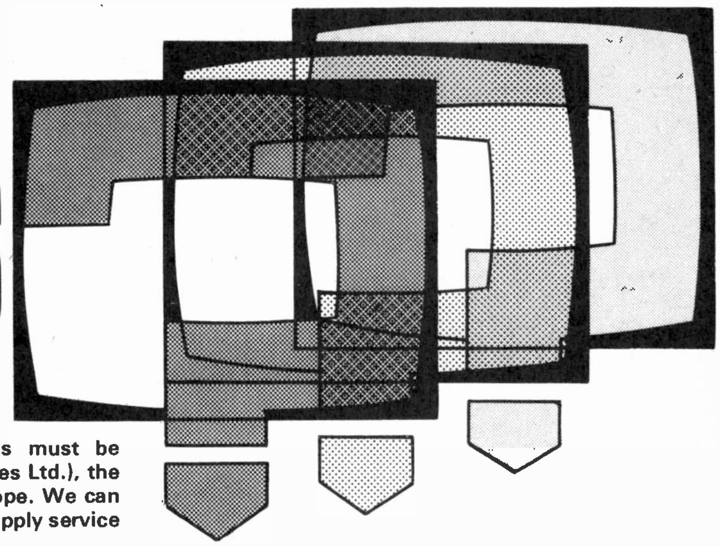
Apart from these failures the line timebase has proved to be reliable in operation. The faults mentioned above have been the only ones we've experienced.

In conclusion, though there are other aspects of the 711 chassis that could be covered it is felt that the present articles have dealt with the most likely trouble spots and have explained the operation of the more unusual and awkward circuits. ■

PRICE INCREASE

We regret that it is once again necessary for us to increase the price of Television. From the next, October, issue the price will be 45p. The costs we have had to bear have continued to increase steadily during the past year, in particular the cost of the paper on which the magazine is printed. The increase has been approved by the Prices Commission.

Your PROBLEMS solved



Requests for advice in dealing with servicing problems must be accompanied by a 50p postal order (made out to IPC Magazines Ltd.), the query coupon from page 613 and a stamped addressed envelope. We can deal with only one query at a time. We regret that we cannot supply service sheets nor answer queries over the telephone.

ULTRA 6713

The fault in this set causes magenta casts on vertical, close-spaced bars. It is independent of the colour control setting and is not due to convergence misadjustment. On a sharp transition from white to black, the green gun seems to be slow to respond – vice versa on black to white – hence a magenta patch for about a quarter of an inch into the white area. The effect seems to vary in magnitude. Do you think the SN76227N demodulator/matrix i.c. could be responsible?

The fault is symptomatic of reduced bandwidth in the green drive channel. While IC3 could be the cause, it is more likely that one of the green output transistor's frequency-response compensating components R234 (56Ω) or C194 (330pF) in its emitter circuit is responsible. More remote possibilities are the green output transistor itself (VT119, BF258), or the peaking coil L130 being open-circuit. (Thorn 8500 chassis.)

SABA T/S6716

In about one out of every two times the set is switched on a whistle, at about 8kHz, comes from the back of the set a minute or so afterwards. The whistle is not from the speaker but appears to come from the scan circuitry. It disappears after a minute or two. The picture and sound are in no way degraded when the whistle, which is not loud, is present. On very rare occasions the whistle starts immediately the set is switched on, is louder and has additional components lower than 8kHz. No picture appears – there is only a very feint horizontal line across the centre of the screen – but the sound is present. Switching the set off and on again immediately clears the fault. When the set was new it tended to switch itself off from time to time, but this stopped after a couple of months.

Excessive line whistle is a common problem with these sets and is usually caused by mechanical resonance of the line output transformer at half line frequency (7·8kHz) due to a loose transformer core. The best way of dealing with this is to unsolder and unbend the four clips holding the transformer into the printed circuit board, unsolder the high-voltage lead to the tripler, and unplug the transformer from its socket on the mother board. This will reveal the heads of the two bolts at the bottom of the transformer. These hold the transformer core together and tightening them should cure the first problem.

The second fault is not connected with the transformer. It's usually due to the TBA920 line oscillator i.c. (IS641) starting at a frequency far removed from normal. Switching the set off and on again sends a voltage transient into the i.c., after which it reverts to normal operation. Under the fault condition no e.h.t. is developed and the field collapse occurs because the 38V supply to the field timebase is obtained from a rectifier (D734, type BYX55/600) which is fed from a winding on the line output transformer. Replacing the i.c. should cure this trouble.

The set has an automatic overload protection circuit which opens the mains switch when the 12V or 280V supplies are overloaded. The circuit can be over sensitive however, causing spurious triggering of the protection circuit thyristor THY601. The voltage at the gate of this thyristor should be 0·35V. If the voltage is too high, reduce the value of its gate/chassis resistor R607 from 5·6kΩ to 4·7kΩ. This reduces the sensitivity of the cut-off circuit, eliminating random switch off. (Also applies to Models T/S6735, CSL2725, T/S6715.)

EKCO T530

Everytime a dark picture with little whiteness is shown – for example white writing on a black background, an advertisement change or a dark film sequence – the picture starts to roll, with slight line pulling. This stops when the picture returns to a brighter scene. The field and line oscillator valves have been replaced and all voltages in these stages seem to be fine.

The trouble is in the sync separator circuit where you are likely to find that the base bias resistor R125 (4·7MΩ) has changed value. If necessary check the sync pulse coupling capacitor C219 (4μF) and the sync separator transistor VT11 (BC147). (Pye 569 chassis.)

GEC 2028

The raster and sound are present but there is no picture, either colour or monochrome.

The video phase splitter stage following the vision detector diode is common to the luminance and chrominance signals and we suggest you check the voltages around this transistor (TR7, BF194). An oscilloscope is invaluable when dealing with this type of fault, so that the vision detector output can be confirmed. If there is no signal at TR7 base the vision i.f. and a.g.c. circuits will have to be investigated.

TELEFUNKEN 742SE

The original trouble with this set was various failures in the power supply circuits. After putting these right there is lack of red – the picture is green where the reds should be. I have checked around the PAL ident stage and the voltages here seem to be correct. Also the voltages on the c.r.t. guns and the small chokes in series with the cathode feeds and the other small components in this area all seem to be in order. There are also flyback lines on dark pictures. The RGB output transistors have been changed without making any difference. I have been all over this area looking for dry-joints, but without success.

The green coloration suggests loss of red drive to the c.r.t. and since you have checked the c.r.t. voltages and found no discrepancy at the red cathode (165V should be recorded here) the output transistor and its preceding two d.c. coupled stages must be operating correctly and the fault must therefore be farther back. One suspect is the R–Y demodulator driver transistor T361 (BC237B) which sometimes goes short-circuit from collector to emitter as a direct result of a voltage transient appearing when the power supply fails. If this transistor is o.k., check the R–Y demodulator diodes GR364 and GR363. All Telefunken sets exhibit flyback lines on the picture if the c.r.t. first anode controls are set too high. Set the service switch to the "service" position in order to collapse the field scan, then adjust the controls – R499 (red), R498 (green) and R497 (blue) – in that order so that the red, green and blue lines are just visible on the screen. On returning the switch to the "operate" position a picture free of flyback lines should be present. (Telefunken 710B chassis.)

FERGUSON 3711

This set frequently blows its h.t. fuse F603. The cause seems to be the line output transistor which has had to be replaced on four occasions.

Check the voltage across the line output stage earth return resistor R907 on the beam limiter panel, with the c.r.t. blacked out. If the voltage is in excess of 1·5V, suspect shorting turns in the line output or e.h.t. transformers or in the shift circuit a.c. blocking choke L504. If the voltage is not above 1·5V, check carefully for dry-joints in the line drive and output stages, then suspect the line output stage tuning capacitor C518, the efficiency diode W504, or c.r.t. flashovers. A faulty e.h.t. tripler is another horrible possibility. (Thorn 3500 chassis.)

PHILIPS G25K511

There are two faults on this set. First the focus is very poor, and no amount of adjustment to the focus control makes any improvement. Secondly the whole picture has shifted to the right, so that sometimes about a quarter of an inch on the left-hand side of the screen is blank. Adjusting the line shift control makes no difference.

Poor focus on this chassis is generally due to failure of one or more of the string of high-value resistors R5043-R5050 of which the focus control forms part. You will have to check them individually, replacing as necessary. First check that there is not an open-circuit on the earthy side of the control. The displaced picture is due to a line oscillator fault. Setting up the oscillator coil L4501/2 and the flywheel balance control R4071 as detailed in the manual may clear it. If not check the flywheel line sync discriminator diodes X4140/X4041 and if necessary their load resistors R4073 and R4075. (Philips G6 single-standard chassis.)

MURPHY V2310U

The problem is weak sync. The picture rolls intermittently, and it's almost impossible to lock the verticals. Often the picture slips sideways. New line and field oscillator valves have been tried, and a new PFL200 video/sync valve only made matters worse.

It could be that the heater supply rectifier 3D6 is short-circuit or leaky – the screen grid of the sync separator is fed from the heater chain in order to draw attention to this situation. Alternatively the screen grid decoupling electrolytic 2C48 could have dried up. If this does not cure the trouble, check the two electrolytics in the video stage (2C44 and 2C45) and the pin voltages around the PFL200 in case any of the resistors have changed value. (Bush TV161U series).

KB SV048

The first fault was no picture or sound. The PCF802 line oscillator valve together with its cathode resistor R149 and the tuning capacitor in the cathode circuit C127 (R149 had gone low resistance and was burnt) were replaced, restoring the picture and sound, and the oscillator coil was then adjusted for a steady picture. The trouble now is line jitter. The other tuning capacitor C126, the coupling capacitor to the output stage (C129) and the sync separator transistor have been replaced without success.

First look for a dry-joint on the printed board, then try replacing the oscillator feedback capacitor C125 and if necessary the flywheel line sync discriminator diodes D7/D8. If this does not clear the fault it is likely that one of the polystyrene capacitors C115-C119 inclusive in the flywheel line sync discriminator circuit is defective. We usually replace the lot in such cases. (ITT VC200 chassis.)

PHILIPS G22K523

There is an intermittent brightness fault on this set. Approximately ten minutes after switching on, the brightness drops for several minutes after which it recovers to normal. The fault may recur over a period of two hours. The raster remains of the correct size and the sound is present all the time. It seems to be a heat induced fault since whenever I remove the rear cover to check voltages the fault immediately clears. It does not occur if the rear cover is left off. When the fault is present the brightness can be brought to its correct level by adjusting the brightness control.

Brightness troubles of this sort on this chassis are generally caused by the 12V zener diode D5582 in the beam limiter circuit. This is on the line scan panel. It's best to up-rate it by fitting a 1·3W type. (Philips G8 chassis.)

PYE V110

The first symptom was two pictures, one upside down, separated by a thin white line which got smaller as the set warmed up. The picture then went completely due to loss of e.h.t. The line output and boost diode valves are glowing but the e.h.t. rectifier heater does not light up. There is line whistle present, varying in pitch as the line hold control is moved, so the line drive must be there.

There is a lack of boost voltage. Check the PL81 and PY81 valves, the boost capacitor C93, the decouplers C89 and C91 and the boost smoothing capacitor C92 before suspecting the line output transformer.

FERGUSON 3712A

When the set is switched off it usually makes an objectionable rasping sound. Turning the volume control to minimum makes no difference. Occasionally the set does not make this sound when switched off, but it resumes the rasping after a couple of days.

Temporarily hook a 50μF capacitor between the supply pin 5 of the intercarrier sound i.c. (IC2) and chassis. If the fault persists, suspect C701 which decouples the h.t. supply to the audio output transistor, the transistor itself (VT701, MJE340) and its collector clamp diode W701. If the temporary capacitor stops the "burp", suspect IC2 (RCA CA3065, Texas SN76666N or Motorola MBRC1358) or its 22μF supply decoupling capacitor C150. (Thorn 8000A chassis.)

PYE CT200

High-brightness objects at the extreme left-hand side of the screen cause bands of lower intensity across the screen. This is particularly noticeable and annoying with white-shirted footballers in Match of the Day! Bright objects away from the edge of the screen do not cause the fault. The test card display is satisfactory.

The burst gate adjustment may be incorrect. The set gating potentiometer is R325 on the chrominance board and the setting is usually correct when the wiper points to the R328 end, giving minimum colour. If this control is misadjusted, the black-level clamping inside the TBA560A luminance/chrominance i.c. will be upset. (Pye 713 chassis.)

BUSH TV148U

When the set is first switched on a thick black band appears in the middle of the screen, from top to bottom. If the channel selector button is pressed the picture will appear normal, except for shimmering from left to right at the top of the picture. After about ten minutes the black band reappears again. This sequence can be repeated several times, then the picture breaks up into four pictures all mixed up. All line timebase valves have been replaced without success. There is also a fault in the sound section. When the set is first switched on the sound is normal, but after ten minutes a loud screeching noise starts. This can be stopped by turning the volume down or fully up.

The black bar and line break up are likely to be due to the flywheel line sync discriminator diodes. These are 3MR1/2 in the five-leg block on the right-hand side of the timebase panel. We suggest you replace them with 1N4148 or similar silicon diodes. For the sound fault, check the PCL82's triode grid leak resistor 2R50 (10MΩ) then suspect that the printed board is conductive around the base of the PCL82. This can be the case without being visibly obvious and can be cured by drilling holes between the pins. We assume that the PCL82 itself has been checked, also the audio screened lead earth bonding at P/S3-2.

HMV 2700

The picture seems to have "water" running downwards over the screen, so that objects appear as in a "hall of mirrors".

The trouble is caused by hum modulation of the h.t. line, probably due to failure of one or more of the 2S034 field h.t. regulator transistors on the power regulator board. A BDY20 or 2N3055 is a useful substitute for these transistors. (Thorn 2000 chassis.)

PYE CT205

The trouble with this set is a green haze in the background, though the other colours are correct. The c.r.t. green first anode potentiometer has been adjusted so that the green horizontal line is at minimum visibility, and the PCL84 G–Y output valve has been changed three times – each time the green haze cleared for a few weeks only. There are also three or four striations down the left-hand side of the screen.

A common cause of this trouble (the green haze) is leakage across the colour-difference amplifier printed panel. It can usually be overcome by linking the input components (C362 and R378) to the grid of the G–Y PCL84 above the panel – and doing the same with the corresponding components in the B–Y and R–Y channels if necessary. For the striations, check the BC147 blanking transistor VT28 in the cathode circuit of the PL802 luminance output pentode, and the line linearity coil damping resistor R228 (1·5kΩ). (Pye 697 chassis.)

EKCO T530

This set, fitted with the 569 chassis, works perfectly for long periods. At other times however there is line tearing and dithering – not line slip. The line hold control has no effect. I have fitted a new PCF802 line oscillator valve and checked the feedback capacitor and the electrolytic in this stage.

First check for dry-joints around the small printed subpanel. The line oscillator coil L14 is suspect – try squeezing it to clear short-circuit turns. If the fault persists, change the polystyrene capacitors in the line oscillator circuit. (Pye 569 chassis.)

ITT CK602

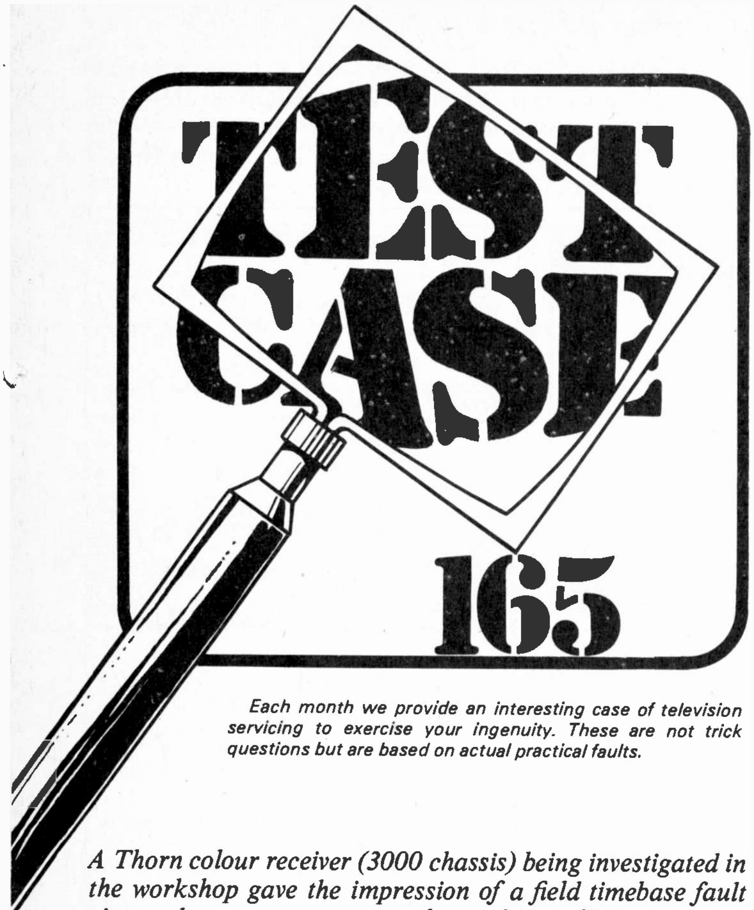
The trouble with this set is that the fusible resistor R380 in the HT1 supply to the line timebase goes open-circuit about once every three weeks. The 630mA delay fuse F7 in this feed blew on one occasion. An orange wire from the convergence panel seems to have been left disconnected. Has this any bearing on the trouble?

The intermittent fuse blowing and fusible resistor popping could be due to flashovers in the PL509 or PY500 valves in the line output stage. Alternatively the line oscillator could be responsible if it is slow to start up – in this case any of the polystyrene capacitors C291, C294 or C295 could be at fault. The orange wire has been left disconnected at the factory during the convergence setting up because the c.r.t. in your receiver does not require dynamic blue lateral convergence correction. (ITT CVC9 chassis.)

BUSH CTV1122

At all times a thin horizontal white line moves up or down the picture at varying speeds – sometimes it's almost stationary. It is most noticeable on a picture with a clear background.

The trouble is in the power supply unit and is usually associated with the double 2,500μF electrolytic 8C1/2. First make sure that the PK screws (fixing to the main frame) are tight, then try to improve the tag contact on the capacitor itself (lead out to the soldering tags). If necessary, replace the capacitor. (Rank A823AV chassis.)



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.

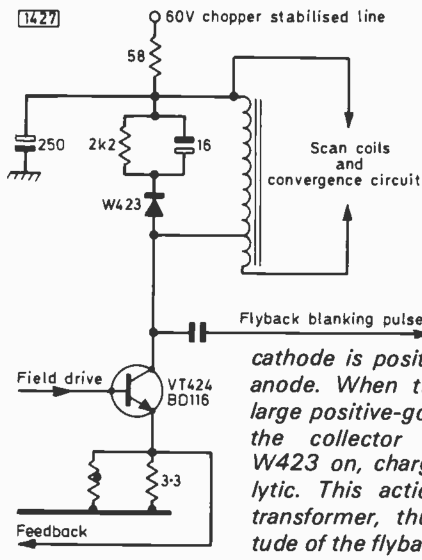


Fig. 1: Field output stage circuit used in the Thorn 3000 and 3500 chassis. W423 and its associated RC network provide flyback pulse limiting to protect the output transistor. During the forward scan W423 is non-conducting since its cathode is positive with respect to its anode. When the flyback occurs the large positive-going pulse appearing at the collector of VT424 switches W423 on, charging the 16μF electrolytic. This action damps the output transformer, thus limiting the amplitude of the flyback pulse.

A Thorn colour receiver (3000 chassis) being investigated in the workshop gave the impression of a field timebase fault since the symptom was that of insufficient height accompanied by top cramping. This was one of the first all solid-state chassis, the timebase consisting of a two-transistor oscillator (multivibrator), driver stage and output stage. The field timebase module features five presets, two for vertical hold and height, two for linearity and a fifth called "sit up". Correct adjustment procedure is first to turn linearity-2 fully clockwise and then set linearity-1 for the best geometry over the full height, next to readjust linearity-2 to remove bottom cramping, and then finally to optimise the form by readjusting linearity-1 in conjunction with the height preset. The "sit up" preset regulates the charging conditions at the start of the field scan.

The adjustments were performed in accordance with the rules but although the top distortion could be modified and turned into a distinct foldover no combination of settings which would completely cure the symptom could be found. All voltages were within the specified tolerance and no trouble could be found with the transistors. The circuit includes several electrolytics and a diode (W423) in the collector circuit of the output transistor (a BD116, VT424). The field output is taken from an auto-transformer whose primary is shunted by W423 in series with a charging circuit consisting of a 2·2kΩ resistor in parallel with a 16μF electrolytic (see Fig. 1). Since the fault appeared to reside in the output stage (the symptom implied inadequate field power), one end of the diode was disconnected and an ohmmeter test proved that the diode was in order. The electrolytics were shunted, all to no avail. In desperation, value tests were made on the resistors, and at this stage (with one side of W423 disconnected) it was found that the 2·2kΩ resistor was reading around 1kΩ. This resistor was changed but the fault persisted.

What had the technician overlooked during his testing and could well have had a bearing on the symptom? See next month's Television for the solution and for a further item in the Test Case series.

SOLUTION TO TEST CASE 164
(Page 557 last month)

The video signal failure accompanied by lack of control over the brightness should have led the technician to investigate first the coupling from the video output stage to the picture tube – certainly before changing the video i.c. He should also have made a closer examination of the video output transistor voltages. It will be recalled that since there was about 3·2V at the emitter the technician assumed that the transistor was conducting.

The emitter potential was that provided by a potential-divider bias stabilising network fed from the stabilised supply line however. A check on the collector voltage revealed that it was at the full supply line potential, proving that the collector load was passing no current and that the transistor was non-conductive.

The technician would have saved himself a good deal of time and effort if he had adopted a more scientific approach to the fault. Replacing the BF257 cleared the fault of course, and with the transistor removed from the board a simple test with the ohmmeter proved that the emitter junction was open-circuit!

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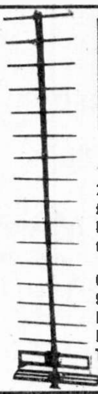

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