servicing

THE DECCA 10/30 CHASSIS

PART 1

SERVICING THE DECCA 'BRADFORD' CHASSIS SERIES 10 & 30

PART 1. by R.W. THOMSON

THE Decca Bradford colour chassis first appeared as the single-standard successor to the well-known CTV25. It was a complete departure from the previous design, using a vertical modular layout with easily removable panels. The most laudable change was in the e.h.t. department, where a tripler replaced the e.h.t. rectifier and triode stabiliser which caused so many headaches, not to mention snaps, crackles and very expensive pops, in the earlier set. When it first appeared the Bradford chassis had a fully transistorised decoder panel and was fitted with a mechanical tuner. This is known as the Series 10 chassis. Sets fitted with it can be recognised by the fact that the penultimate figure in the model number is "1", e.g. CS1910, CS2211, CS2213 and CS2610. There were 19, 22 and 26in. versions as these model numbers suggest. The later version of the chassis, the Series 30 chassis, has been released with a wide range of tube sizes from 17 to 26in. It's fitted with either a mechanical or a varicap tuner. The most notable modification is in the decoder section, where a Motorola MC1327P integrated circuit (alternative Texas SN76227) has taken over the functions of quite a few of the transistors and has lead to the RGB circuits being greatly simplified. The penultimate figure in the model numbers is 3, e.g. CS1730, CS1830, CS2230, CS2631 etc.

Spares for these chassis are readily available and they do not suffer from having a profusion of transistors with unknown names and even more obscure sources of supply. All the semiconductors, with the exception of two i.c.s, are Mullard types or equivalents, and as valves are used where drive power is required servicing in those sections most likely to give trouble, i.e. the timebases, is relatively simple. Though all-transistor designs have much in their favour, it is a fact of life that valves are easier to replace than output transistors – not only because less technical knowhow is required but also because of the astronomical cost of large, high-voltage transistors. To get back to the Decca Bradford chassis however let's start at the logical place, the tuner.

Mechanical Tuner

The Telefunken mechanical tuner is probably one of the finest of its type and is very reliable. It has few of the wear and internal breakage problems that seem to beset so many of its competitors.

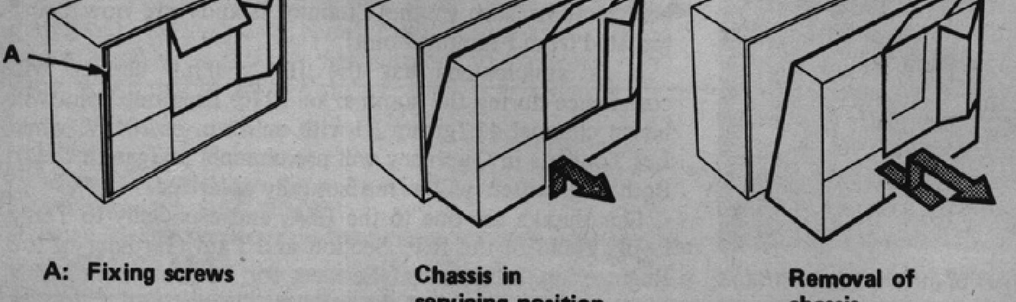
In my experience drift or low gain complaints have been few and have always responded to cleaning and lubricating with Servisol or, depending on the nature of the fault, r.f. amplifier transistor replacement. Drift is a common fault with most mechanical tuners, and in some designs little can be done to effect a cure – the trouble is inherent and unavoidable. Such is not the case with the Telefunken tuner.

Three main causes of "failure to reset to tuned positions" or "drift after station selection" have been found, only one of which can be blamed on the tuner itself. The main cause of this annoying fault is dust and grit on the sliding or rotating surfaces. A good clean up and lubrication seldom fails to restore normal working, provided the tuner is repositioned carefully so that all the buttons are clear of the holes provided for them on the cabinet front. Friction here brings on the same symptoms! The other point to watch is the tightness of the screws on the rotor clamps in the tuner. If these slacken off, failure to reset to the selected positions will occur.

Whilst on the subject of cleaning, a word of warning on the type of cleaner used. Not all the "handy aerosols" available are really suitable for the job, i.e. they don't all clean *and* lubricate, while some are positively destructive! There are few things more frustrating than a beautifully clean and shiny tuner that sticks because of lack of lubrication and has to be retuned every time a station change is made. Some of today's cleaners are really meant for the motor trade, and can damage components in a u.h.f. tuner.

Low Gain

When low gain is encountered, check the earth bond between the tuner body and the small printed circuit board carrying the external components. If this is o.k., the r.f. gain preset may be dirty or faulty through misuse – the latter condition occurs when a keen but heavy hand turns the control too far, bending the pip on the preset away from proper contact with the track. A new preset is the only real cure here. The setting of the control is simple but most important. With the control set approximately half-way, select a station and tune it in. Then turn the control anti-



A: Fixing screws

Chassis in servicing position

Removal of chassis

Fig. 1 (left): Method of lowering and removing the chassis. The bottom of the chassis is supported on nylon rollers: make sure that they are in their runners before withdrawing the chassis too far – otherwise you could end up with a cracked c.r.t. neck.

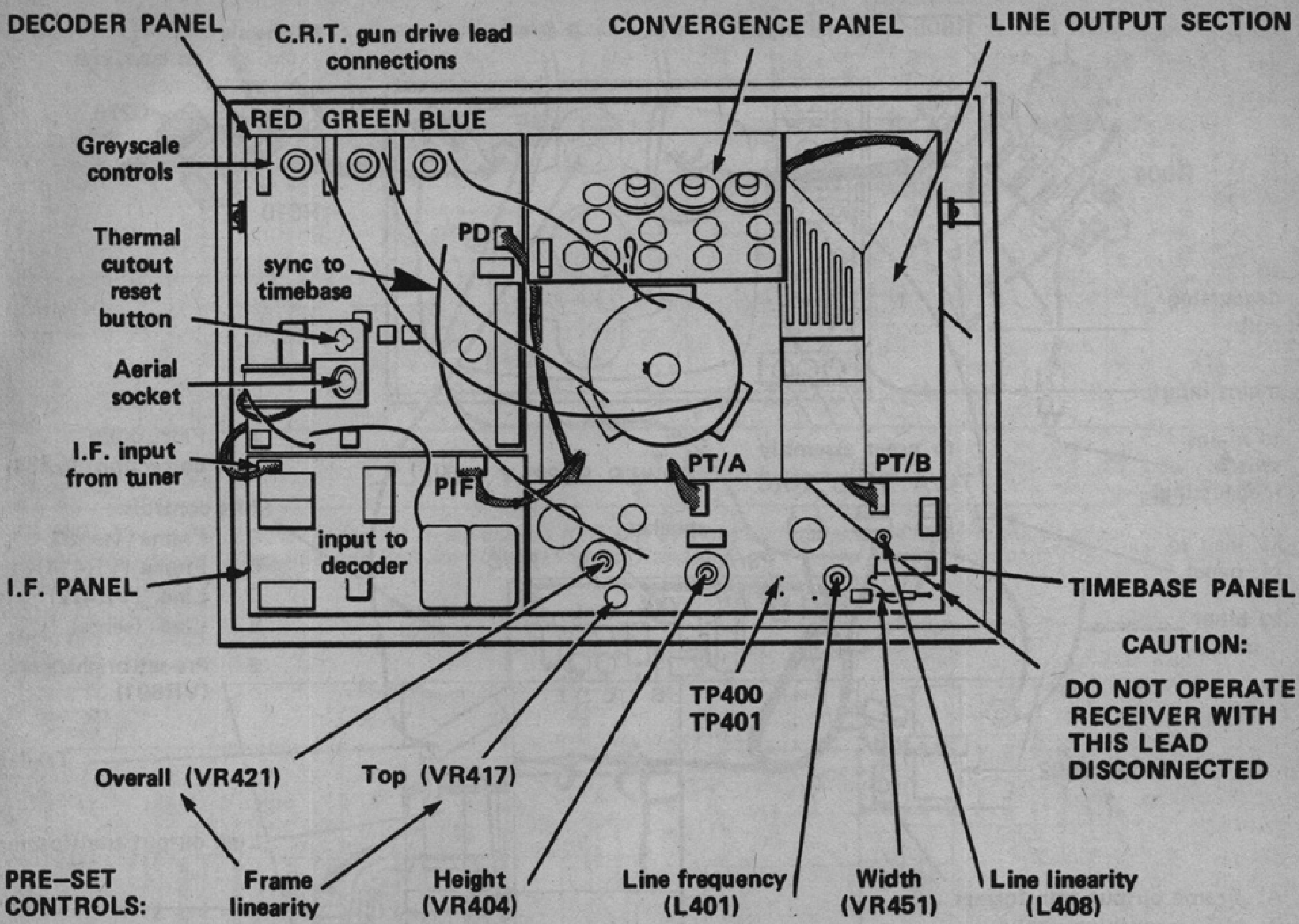


Fig. 2: Rear view of the series 10 chassis, showing panel and control layout. The series 30 chassis is basically similar.

clockwise until noise appears on the screen. Finally, gently rotate the control in the opposite direction until a clean picture *just* appears.

In the case of very low gain not attributable to the foregoing or to an obvious aerial or aerial socket fault, check the voltage appearing on R37 on the i.f. panel. If this exceeds 2·5V or so the fault lies elsewhere – we'll return to this later. If the voltage is approximately correct however the tuner's r.f. amplifier transistor is not operating normally, the transistor itself being the most likely culprit and fairly easy to check.

Transistor Replacement

Though manufacturers throw up their hands in horror at the mere idea of removing a tuner cover, or even worse an actual tuner repair being carried out by a non-boffin, nevertheless transistor replacement is not beyond the capabilities of a careful operator, given a steady hand, good eyesight and slim fingers. Provided the transistor leads are cut to the same lengths as those of the original, and that the transistor is positioned as nearly as possible in the same place as the original, any misalignment will be unnoticeable – particularly as few tuners are called upon to track all the way from the bottom of Band IV to the top of Band V.

The same remarks apply to the mixer/oscillator transistor, failure of this being very uncommon though not unknown. The symptoms are a blank raster and no sound, with some sound hiss because the i.f. stages are operating at full gain. With this symptom however the writer would again first advise a check of the voltage on R37, as the unusual beam limiting/a.g.c. system can cause similar symptoms – but more of that later.

Apart from the two transistors there is just one other semiconductor device in the Telefunken tuner, the varicap diode which provides a degree of a.f.c. This seldom fails but is hardly noticeable even when it does, because of the tuner's inherent stability.

Electronic Tuner

With the electronic tuner fitted to most 30 Series models there are no mechanical troubles because there are no mechanical parts – apart from the button latching device itself, which is small and not usually repairable if damaged. Fortunately the unit is quite cheap to replace in the unlikely event of it being broken. If trouble is experienced with it a clean with Servisol or a similar product is all that is necessary.

The remarks previously made about transistor replacement also apply to this tuner. The smaller physical size of the tuner and the presence of the varicap diodes and their associated presets make the job even more tricky however. Under no circumstances should the adjustment of the control-voltage presets be disturbed – unless very serious misalignment is evident. Even then, never disturb those not controlling the transistor you've just changed. Otherwise spurious bursts of uncontrolled oscillation can be triggered off, bringing you back to the no signal condition your careful work was intended to cure.

IF Strip

Trouble in the next section of the receiver, the i.f. panel, is most unusual. Being a low-level, low-voltage area this part of the set can be relied upon to give long and completely

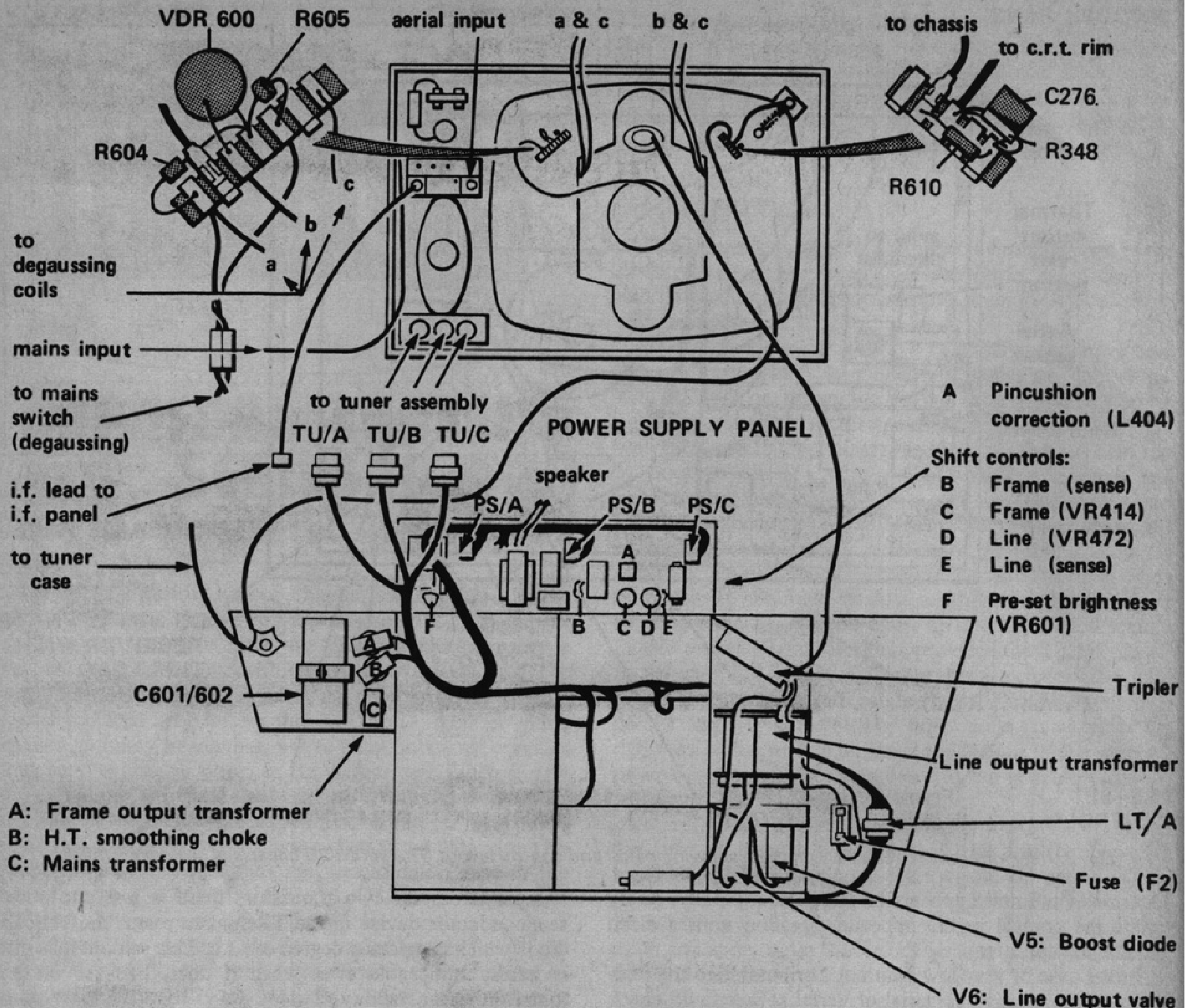


Fig. 3: Internal view, with the chassis folded flat.

drift-free service. Like the decoder and timebase panels, it is mounted vertically and held in place by spring clips, all external connections being via plugs and sockets and plugged flying leads.

Dismantly

The chassis itself is very easy to remove, being attached to the cabinet by only two screws in the top corners. The bottom of the chassis is supported on nylon rollers, permitting the chassis to slide out to a hinged down position that just allows valve and fuse replacement. All connections to the tuner, speaker, front controls and deflection coils are via plugs and are reasonably accessible. Above all, the plugs are foolproof: it just isn't possible, with the exception of the audio wiring from the volume control, to connect the wrong plugs to the various sockets.

A little care is called for when removing and replacing the chassis, if only to avoid a few choice words being uttered. No attempt has been made by the manufacturer to round off the edges of the pressed steel supports and chassis members, so that nicked fingers and scratched hands are something of a hazard. Care should be taken to see that the nylon rollers are actually in their runners. It's quite on the cards that they won't be, or that one of them has come adrift from the chassis itself. If this happens and the chassis is moved too far out, a broken c.r.t. neck and the possibility of a lethal dose of flying glass can be expected when the chassis clears its supports. You've been warned then of this dangerous and expensive possibility!

When lifting the chassis fractionally to clear the top supports, be sure to take the weight of the left-hand corner by the chassis itself, keeping the fingers clear of the decoder components. Otherwise a cracked panel may be added to your problems. The same can be said of panel removal and replacement. It's essential to move the fixing clips away from the panels and not to bend the panels clear of the clips. The latter is easy to do but flexing a printed circuit board often results in minute cracks and hairline fractures that are difficult to find. A careful approach to this is well worth-while therefore.

Above all, never slide the chassis in or out when the power is on, or switch the set on after sliding the chassis out to its hinged position, without looking at the plugs connecting the control panel to the receiver proper. On some models it is quite possible for the large black plug and socket to hook itself on to the field output transformer or the h.t. choke, with the result of blown fuses, fault currents, open- or short-circuit transistors and damage to the plug/socket itself. Having spent hours tracing faults in

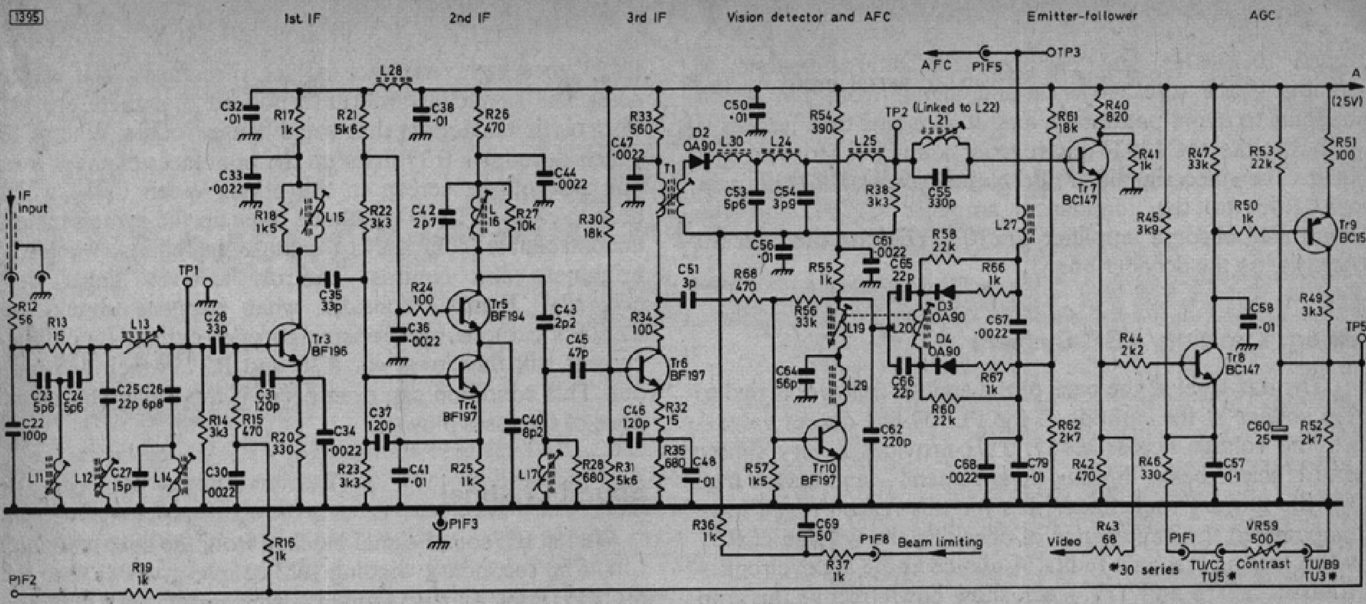


Fig. 4: Circuit of the i.f. strip. In the 30 series chassis R68 and C79 are omitted and a 41·5MHz trap is added in the detector circuit. With varicap tuners R58 and R60 are 100kΩ, R61, R62 and C68 are omitted and the junction of R60-C67 is connected to chassis.

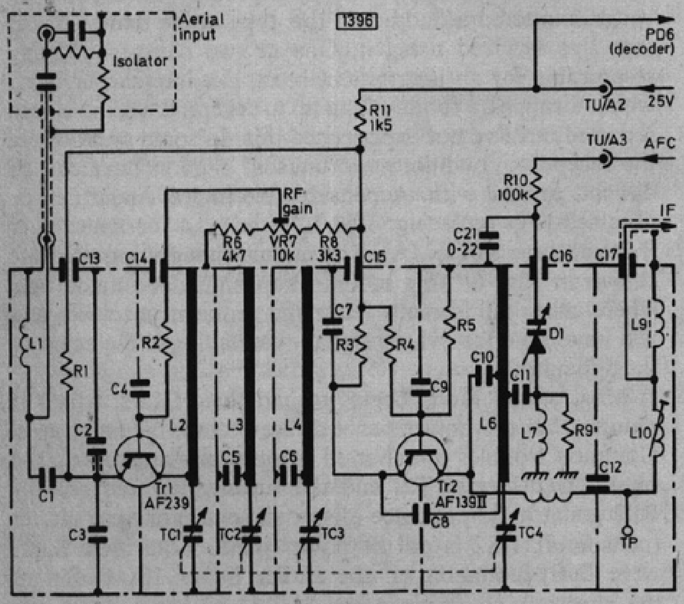


Fig. 5: Circuit of the Telefunken mechanical tuner.

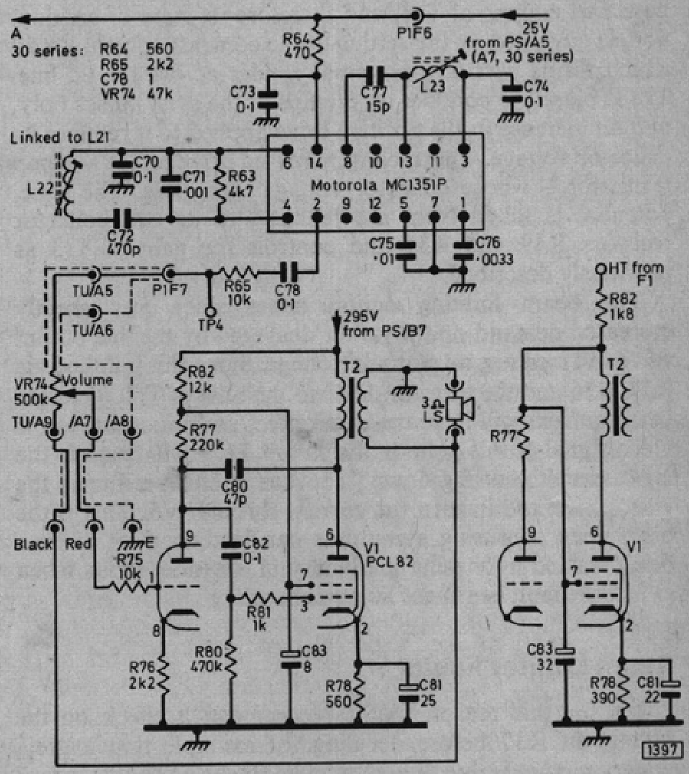


Fig. 7: The sound circuits. Modifications to the audio output stage in the 30 series chassis are shown on the right.

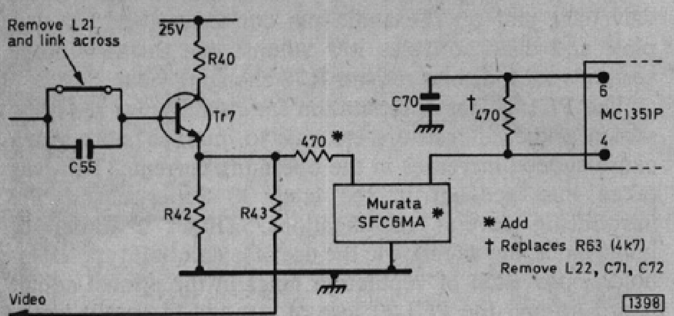


Fig. 6: Modification to remove caption buzz under difficult reception conditions. This should be tried only where normal adjustments fail to produce any improvement, and will not remove buzz due to signal overloading.

almost every section of the receiver after committing this error I can assure you that I am now very wary indeed of this built-in trap.

IF Circuits

Returning to the i.f. strip itself however we have to report that there are few bugs here. The three vision i.f. stages – with a cascode pair in the middle – follow the well-known Mullard circuit. The first stage is the only one to which a.g.c. is applied, the gain of the tuner being set by the r.f. gain preset previously mentioned. The a.g.c. is of the forward type, biasing Tr3 on further as the signal strength rises but producing a decrease in stage gain. This technique is not only more predictable and precise than reverse bias, but has less detuning effect on the circuit as a whole. The final transistor Tr6 drives the single luminance/chroma/sound detector D2 and also the a.f.c. circuit. Faults are rare in this area. Transistors have been known to fail, but voltage checks will soon reveal anything amiss in this respect.

Video Signal

The detected video signals are passed to the base of the video emitter-follower Tr7. The transformer L21/22 is tuned to 6MHz and performs the dual functions of removing the intercarrier sound signal from the vision channel to avoid patterning, and at the same time feeds this signal to the MC1351P intercarrier sound i.c. More on that later. The video signals are developed across R42 and pass via R43 to the luminance amplifier Tr201 and the controlled chroma amplifier Tr210 (Tr205 on the later 30 chassis) on the decoder board.

Beam Limiting/AGC System

The d.c. level at the base of the emitter-follower is tied to the voltage at the cathode of the PL509 line output valve – i.e. the voltage across R467. This provides a very simple and efficient beam limiting arrangement – and also a trap for the unwary fault finder. It's for this reason that I have emphasised the importance of checking the voltage at R37 when tracing low gain faults. A glance at the a.g.c. circuit – transistors Tr8 and Tr9 – will show how effective this trap can be! The composite video signal is d.c. coupled to the base of Tr8, hence Tr8's base is always at the same voltage as the emitter of Tr7. The voltage difference between the base and emitter of Tr8, and therefore its state of conduction, is governed by the setting of the contrast control VR59 which forms part of a potential divider across the l.t. line. Tr8 is biased to conduct on the tips of the sync pulses only, and an increase in the positive drive applied to it reduces its collector voltage. This means increased drive to Tr9 – a pnp transistor – whose collector voltage then rises. The a.g.c. potential is taken from the junction of its two collector resistors R49 and R52 and controls the gain of Tr3 as previously described.

The beam limiting action arises since any greatly increased demand on the power delivered by the line output valve will increase its cathode voltage. Since this is linked via R37, R36 and the detector diode to the base of Tr7, increased beam current will have the same effect as an increase in the video signal at this point in the circuit, i.e. it will result in the a.g.c. circuit shutting down Tr3, thus in effect reducing the video drive and in turn the current through V6. This is the trap, since confusing symptoms can lead to a lot of time being wasted in chasing imaginary i.f. or tuner faults when in fact the fault lies in the line timebase!

Beam Limiter Faults

It's for this reason that I recommend a check on the voltage at R37 before deciding for example that a grey, watery picture is due to a gain fault. Under normal test card conditions, with the contrast and brightness controls adjusted for a good, clean picture, the voltage at R37 should read 2·2V on the 10V scale of an Avo Model 8 or similar 20kΩ/V meter. Any notable increase in this voltage should lead to an investigation of the line timebase, a "notable increase" meaning one outside the normal 10% tolerance allowed on this type of equipment. Under no signal conditions a reading of 2·4V should be obtained at the positive end of C60, rising to approximately 5·5V when a good signal is being received, thus biasing Tr3 into a lower gain condition. It is vital then to check that the low-gain condition is not caused by a.g.c. action through excess line output stage current. The PL509's cathode voltage is the key, and the most convenient point to measure it is at R37 on the i.f. strip.

One cause of beam limiter action resulting in confusing symptoms is changed value resistors in the line output stage – R453 for example. We shall have more to say about this when we come to the line timebase. The symptom when R453 goes high resistance is lack of contrast and brightness. The suspicious will have noticed that there are two electrolytic capacitors that could cause trouble. When C69 which decouples R37 dries up the brightness changes from one side of the screen to the other. When C434 which decouples the PL509's cathode dries up the symptoms are uncontrollable contrast, or picture instability when the brightness and contrast controls are set higher than normally. Finally, consider what happens should the PL509's cathode bias resistor go open-circuit. Its cathode current will then pass via R36 and R37, which will burn out. This condition can even occur if the tripler shorts and none of the fuses blow.

Sound Channel

We left the sound signal blocked from the base of Tr7 by L21. The secondary winding L22 couples it via C72 to the MC1351P intercarrier sound i.c. which provides a low-level audio signal sufficient to drive the triode section of the PCL82 audio valve. The i.c. operates at very low signal levels so few problems should be expected – in fact I've not yet encountered a dud i.c. of this type in the many chassis that I've serviced using it. One or two cases of it being responsible for an intermittent buzz, like intercarrier buzz, which disappears for anything up to several days, have been reported but I've not experienced this. In some areas where the reception conditions are unusual caption buzz can be difficult to deal with. A considerable improvement can be obtained by replacing L21/L22 with a ceramic filter (Murata type SFC6MA). The circuit changes required are shown in Fig. 6. This modification should be made only where other adjustments leave the problem unsolved, and will have no effect where signal overloading is the cause of the difficulty.

Most sound faults occur around the PCL82, which is mounted on the power panel at the bottom of the chassis. Common troubles are shorted or open-circuit turns on the output transformer T2, and the screen grid feed resistor R82 going high resistance (distorted sound) or open-circuit (no sound). R82 is on the power panel. Both these faults were fairly common on the earlier Series 10 version of the chassis, and result in the PCL82 having a short life. Other common faults are dry-joints around the PCL82 valvebase and on the audio pin connectors and speaker pins, and distortion plus low volume due to the pentode section's cathode bias resistor R78 changing value.

The PCL82 has a reputation for ruining bias resistors, screen grid feed resistors etc. due to internal faults which cause sudden increases in the operating currents. This was taken into account in the later 30 Series chassis by introducing several modifications. These, in order of importance, are as follows: the use of a stand-off type valve-holder, provision of ventilation holes in the printed circuit board around the PCL82, use of a modified output transformer, and the uprating of some of the more vulnerable resistors in the circuit.

Intermittent sound on either panel can usually be traced to cracks in the print around the heavy and totally unsupported output transformer, particularly if the panel has been removed and replaced a few times. In cases of distortion try a new PCL82, check its pentode cathode components R78 and the decoupler C81 and also its screen grid feed resistor R82, and if necessary check the anode and cathode resistors R77 and R76 in the triode circuit – these also tend to change value.

CONTINUED NEXT MONTH

SERVICING THE DECCA

'BRADFORD' CHASSIS SERIES 10 & 30

PART 2. by R.W. THOMSON

THE main difference between the earlier 10 and the later 30 chassis lies in the decoder. The earlier decoder is all-transistor while the later one features an MC1327 i.c. which carries out chrominance demodulation and matrixing to provide RGB outputs and also contains the PAL switch.

RGB Channels

Both decoders are highly reliable. The most common colour faults occur in the RGB output stages. A bright red, green or blue picture usually indicates a short-circuit BF337 (BF179 in the 10 chassis) while a cyan, magenta or yellow picture is normally due to an open-circuit BF337/BF179. A less common cause of a bright blue/red/green picture is an open-circuit output stage collector load resistor. In all these cases diagnosis is easily confirmed by checking the voltage to chassis from each collector heatsink in turn – the odd voltage is the wrong 'un!

Care should be exercised when replacing these transistors, particularly on the older type of decoder. On both panels it is very easy to break the print around the soldered joints. The earlier panel is worse however because the more complex output stages run with a bit more heat, with the result that the panel becomes very brittle and easily broken. Replacing a BF179 with the later BF337 creates no problems – the Texas BF258 or ITT BD115 can also be used.

The RGB output transistors in the 30 chassis are d.c. coupled to the preceding MC1327 i.c. – which can also be responsible for the predominance of one colour. In the earlier 10 chassis the signals are a.c. coupled to the RGB channels and the electrolytic coupling capacitors used can be responsible for colour tinting and a smeary picture, particularly C214 in the blue channel since it's mounted rather close to R325 which tends to run hot – position a replacement capacitor well clear. As the electrolytic(s) dry up, so there is loss of the appropriate primary colour(s).

Clamp Circuits

The a.c. coupling used in the 10 chassis means that the RGB channels must be clamped in order to maintain the correct drive conditions. Clamping faults are not common but when they do occur can give rise to weird colour effects. Erratic brightness variations can usually be attributed to C265 which to a very large extent plays a part in picture brightness level (there are other causes of brightness faults however – we will come to them when we deal with the appropriate sections of the chassis). The bias on the RGB stages produced by the clamp action consists of the voltages established across C215, C244 and C267: leakage in these capacitors results in background colour faults in the blue, green and red drives respectively. If the pulse clipper diode D215 is faulty there will be complete loss of control over all three drive circuits. The circuit may look a bit complicated but isn't as bad as it seems All three clamps act in the same way so a description of one will suffice.

Consider the red channel. A 660V pulse from the line output stage is fed via R253 to the pulse shaper transistor TR211 and via R325 (that's why it gets hot) to the anode of D215 and then via R335/R295/R240 to the RGB clamps. Since the cathode of D215 is tied to a voltage dependent upon the setting of the brightness control, the 660V pulse is clipped to a voltage just above this. Sticking to the red channel, the clipped pulse passes via R335 and C268 to the clamp diode D217 which promptly switches on, producing a negative-going voltage on C267. This voltage counters and partly cancels the positive bias applied to the base of TR225 via R330 from the 20V line – this bias would otherwise turn both TR225 and TR226 hard on. The two voltages result in a steady "correct" bias however, D217 conducting just sufficiently during the line flyback blanking period to maintain this steady state. This ensures that during the blanking interval the voltage difference between the output stage collector and the base of the driver stage is more or less equal to the difference between the mean and the peak levels of the line clamping pulse as clipped by the action of D215/C265 and the brightness control. As all three channels are identical and controlled by the same clamp pulse input the three output stage collectors are brought back sharply to approximately the same voltage at the end of each line, thus maintaining a reasonably constant grey-scale performance. As mentioned earlier, clamp faults don't occur often and when they do the trouble is usually due to a leaky or open-circuit capacitor – diode failures are almost unknown in these chassis.

In earlier versions of the 30 chassis uncontrollable blue can occur after the set has been on for some time – the picture background becoming predominantly blue. The cause of this is that the metal ends of R214 and R293 touch as a result of expansion. Careful separation cures the fault – in later versions the type of resistor used in the R293 position was changed to overcome the problem.

Decoder Faults

In the case of no colour, with no 'scope, no colour-bar generator, no nothing in fact except a good meter and a stout heart, the writer freely admits that his biggest task is to drag his aforementioned stout heart up out of his boots. Such situations do arise however, and as in all decoders the first step to take is to defeat the colour-killer stage – by shorting the collector and emitter of TR214. In the 30 decoder, pins marked TP205 and TP206 are provided for this purpose (while the colour-killer transistor in this case is TR208) but there are no such shorting pins in the earlier version. This would be a good point to add to the general difficulties by mentioning that all the 10 series decoders serviced by the writer have had two test points marked TP205! The pin nearest R273 on the right-hand side of the panel is the one that should be marked TP205: the other should be marked TP203. But to get back to the task in hand, should shorting out TR214/TR208 restore colour it's a fair bet that the transistor is open-circuit.

Should the colour-killer transistor prove to be o.k. even though shorting it out restores colour, check the following components in its base circuit, C236/D208 (10 chassis) or C232/D203 (30 chassis) – both are essential to the switch-on of the colour-killer transistor in the presence of the colour bursts.

No PAL Switching

If over-riding the colour-killer produces a colour picture containing very low or no red, i.e. a cyan picture, this indicates loss of PAL switching and in the 10 chassis points to failure of TR215/D206/D207/TR216 or an associated component, or in the 30 chassis TR209, an associated component or the MC1327 i.c.

Unlocked Colour

Another symptom which may appear when the killer is shorted out is unlocked colour, i.e. colour bands running through the picture, it being possible to lock or nearly lock the colour by adjusting the set oscillator frequency control VR305(10)/VR269(30). Should this effect appear the fault must lie in the phase detector or d.c. amplifier circuits which control the oscillator frequency. Components to check are D212/D213/TR222/C254/R308 in the 10 chassis, D205/D206/TR212/C246/C247/R272 in the 30 chassis. Less likely causes of these symptoms are D214/C248/C250/R304/R306/R312/R313 on the 10 chassis, D207/C241/C243/C248/R267/R268/R277/R280 on the 30 chassis.

Dead Chroma Circuits

Failure to obtain colour at all when the colour-killer transistor is shorted out is the worst headache of all when test instruments are denied to us. The writer adopts the following approach.

(1) Do not touch any of the presets.

(2) Detune the receiver slightly to see whether the colour subcarrier can be seen as patterning in what are definitely known to be coloured parts of the picture. If so proceed to (3). In the less likely event of no patterning, misalignment or lack of bandwidth in the i.f. strip or tuner must be suspected.

(3) Check that the decoder 25V l.t. supply is present.

(4) At this point we must differentiate between the 10 and 30 decoders. Taking the 10 decoder first, check the voltages on the oscillator transistor TR223 and the following emitter-follower buffer stage TR224. Check TR223 by substitution since slight leakage can stop oscillation (slight leakage in TR224 – TR214 in the 30 decoder – can cause weak, incorrect colours due to the reference signal being attenuated).

(5) Check all transistors in the chroma and burst paths – TR210, TR212, TR213, TR220 and TR221, the d.c. amplifier TR222 in the oscillator control loop, and the pulse shaper TR211. Check the varicap diode D214. Check for dry-joints around the crystal, which itself could be faulty.

(6) Check all the components mentioned earlier when we were discussing the symptom of unlocked colour on over-riding the colour killer.

(7) Check all the small electrolytics and polystyrene capacitors in the circuits around the transistors listed above.

(8) Check the continuity of all inductors in the same circuits.

On the 30 decoder the procedure is similar, the transistors in step (4) being TR213 and TR214. Before proceeding to (5) however check all voltages around the MC1327 i.c. Great care must be taken when doing this not to short any pins together – the i.c. can be destroyed instantly by inadvertent connection of pins. A very sharply pointed meter probe should be used therefore. If these voltages are correct or very nearly correct, proceed to (5).

(5) Check TR205, TR206, TR207, TR210, TR211 and TR212.

(6)–(8) As above.

If the voltages on the i.c. are incorrect at any point it is fair to assume that the i.c. is faulty and that replacement will cure the no colour symptom.

Performance Peaking

Once colour has been restored it remains only to peak the performance of the defective circuit *if* it contains a tuneable inductor or variable preset. If the oscillator was at fault for example – as is usually the case with no colour failures in these sets – it may be necessary to adjust the set oscillator frequency preset (VR305 or VR269) to obtain satisfactory colour lock while adjustment of the oscillator coil (L208 or L207) may be necessary to compensate for slight variation in transistor characteristics. Tune the coil with a small tool for maximum colour consistent with good colour lock.

If the trouble was in the ident circuit, readjustment of the coil (L207 or L205) may be necessary.

Incorrect PAL Switching

The PAL switch on the 10 decoder is driven directly by the ident signal. A low-amplitude ident signal can cause incorrect switch timing, i.e. a vertical band of incorrect colour down one side of the screen or the other. Check the tuning of L207, TR215 for leakage and the switching diodes D206/D207. The alternative possibility is a fault in the colour-killer stage, i.e. C236 dried out leaving a ripple on the base of TR214, D208 leaking or high-resistance, or possibly even C230 dried out to give a similar effect to C236.

In some 30 decoders, where the PAL switch is in the MC1327 i.c., the switching time can be incorrect resulting in wrong colour at both sides of the screen. The cause is a leaky disc ceramic capacitor. Check that the voltage at pin 11 of the i.c. is between 2·2V nd 2·7V. If the voltage is low, check C230 and C231: if it's high, check C235 and C228. If C228 is defective there are likely to be Hanover bars as well. If C244 is of the same type and is defective there will be complete colour reversal. Only a limited number of 30 series decoders were fitted with the type of capacitor that causes these faults however.

Line Flyback Blanking

Another operation carried out in the MC1327 i.c. is line flyback blanking. R286 can go high-resistance or open-circuit with the result that the blanking is not carried out.

Sync

In addition to the chrominance circuitry there are two luminance stages and the first sync separator on the decoder panel.The input to the sync separator transistor (TR206/TR202) is coupled via an electrolytic (C213/C207) which can be responsible for complete loss of sync or for vertical ripple on the picture and possibly bent verticals. The latter symptoms or signal loss can be caused by the

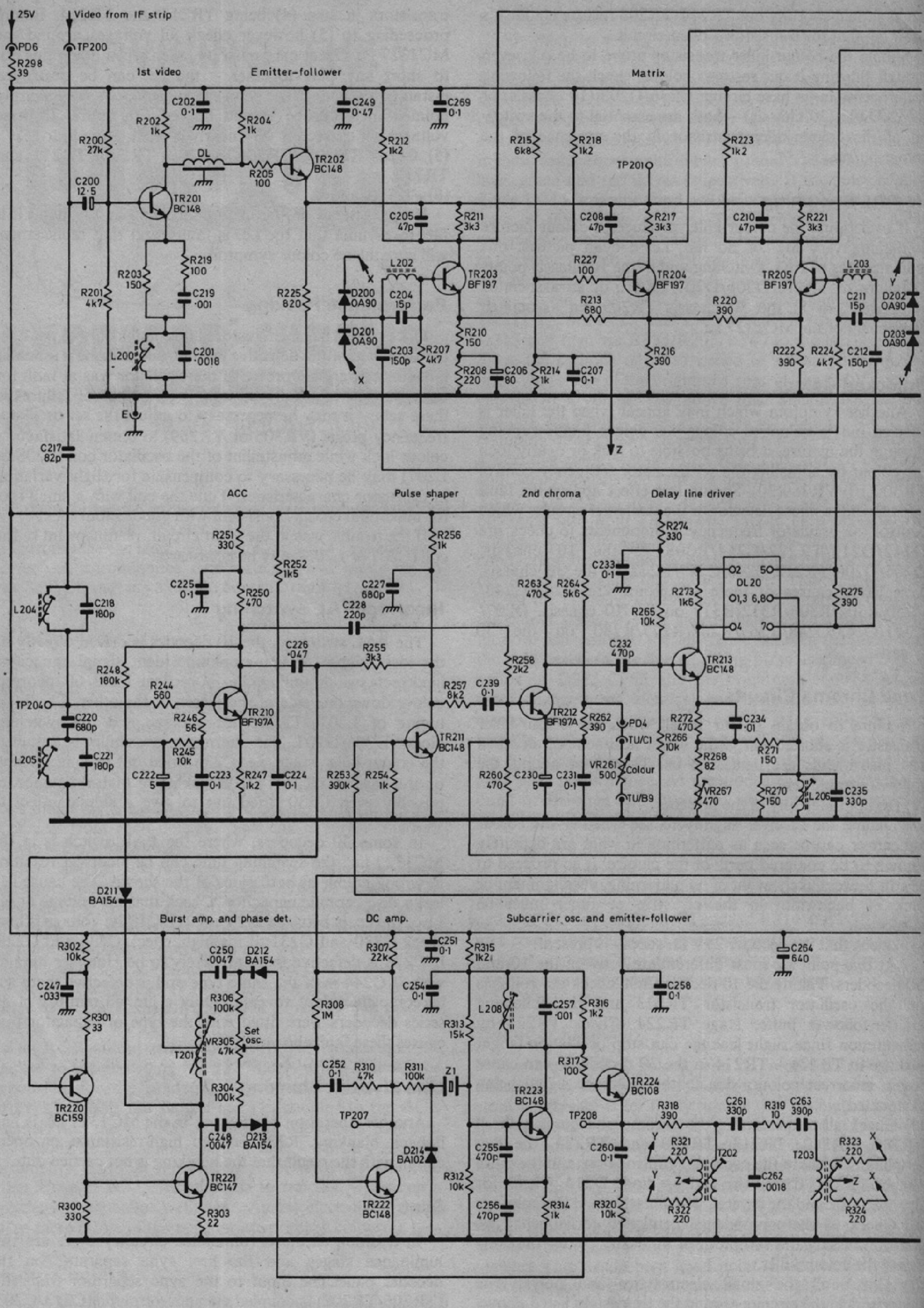
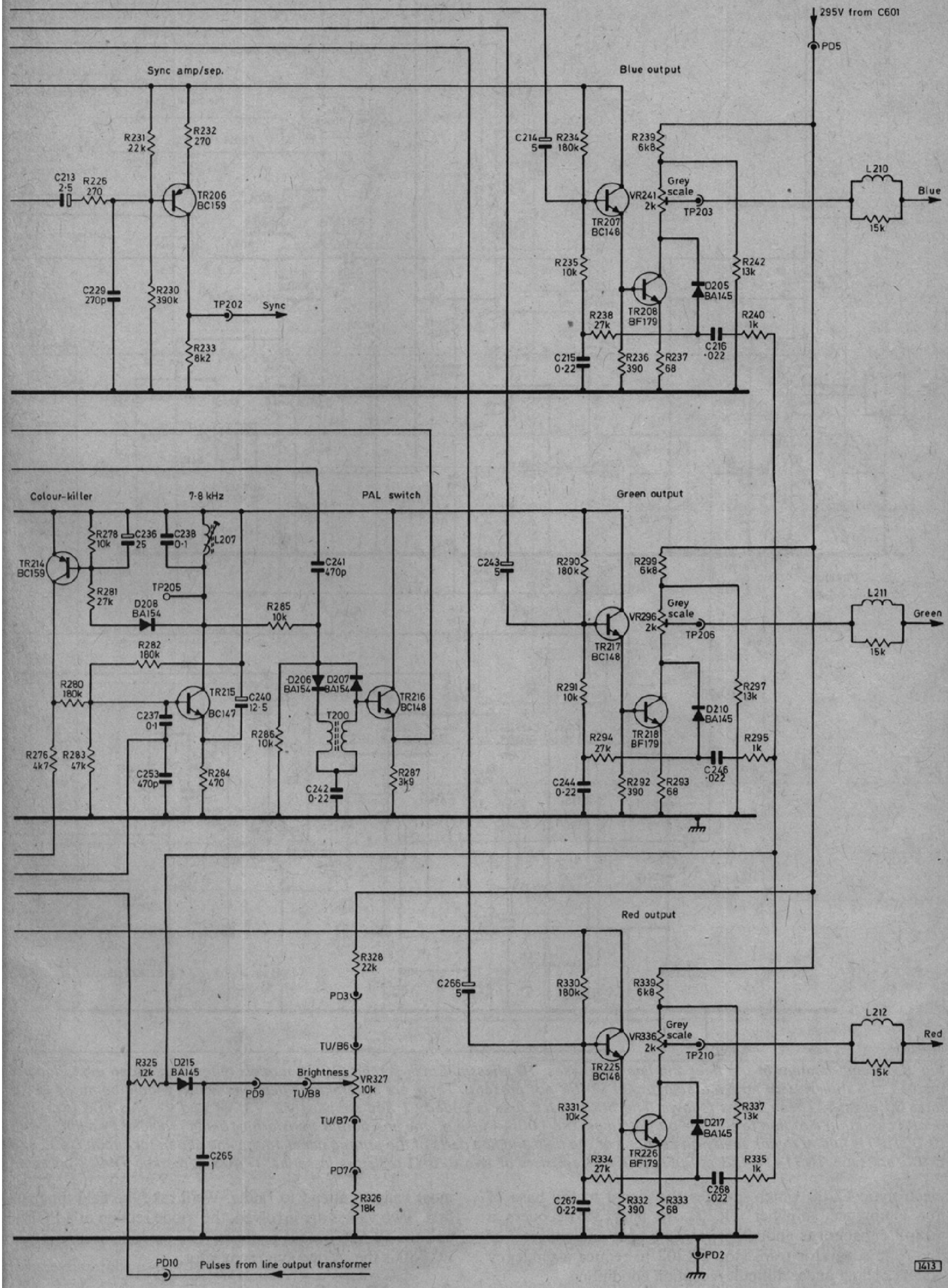


Fig. 8: Decoder circuit used in the 10 version. The circuit used in the later



30 version is almost entirely different and will be included next month.

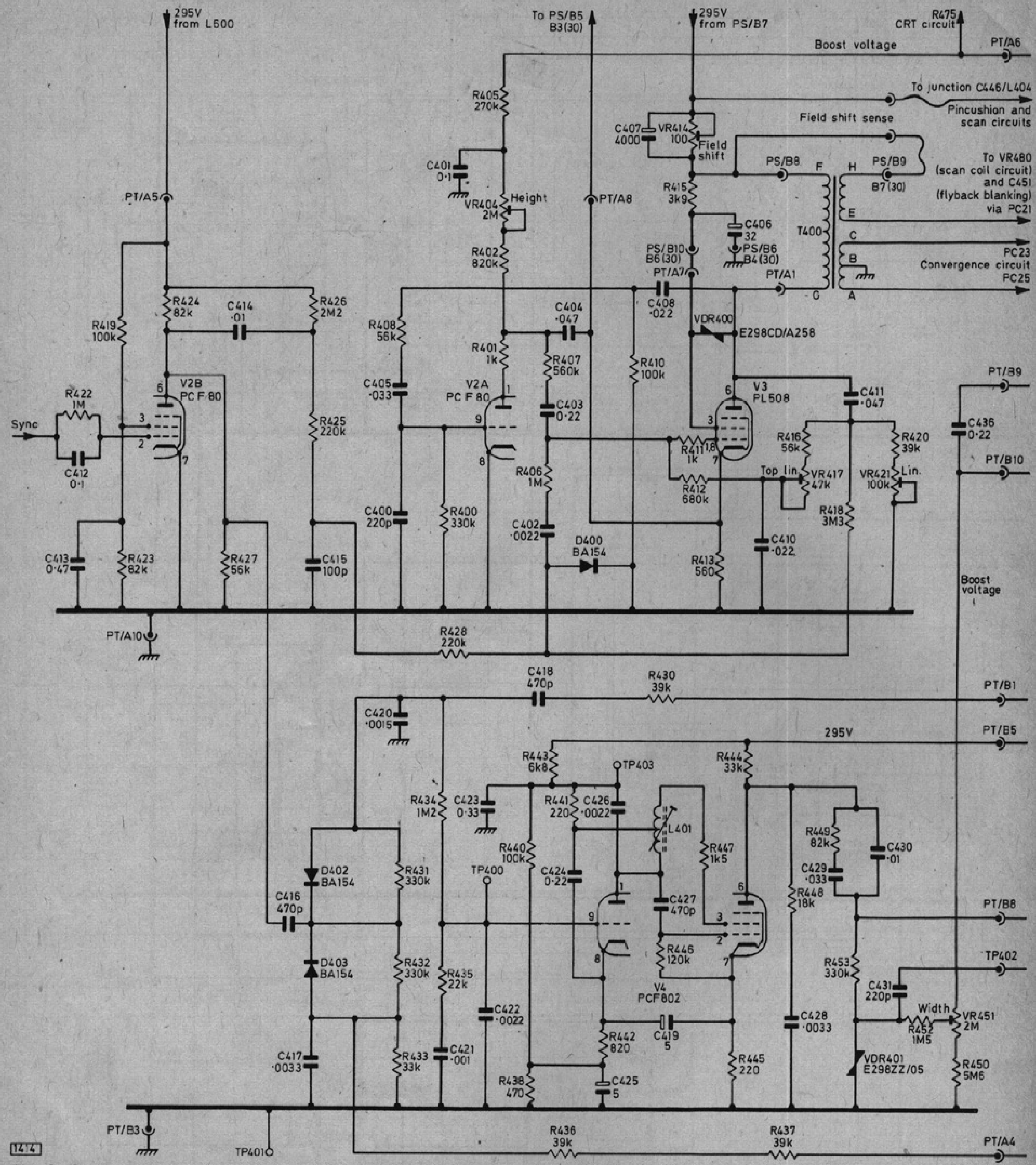


Fig. 9: Circuit diagram of the field and line timebases, 10 chassis. Small-screen (20kV) models differ in using an e.h.t. doubler instead of a tripler, with no e.h.t. adjustment (R458 not present). There are several modifications which should be noted in the later 30 chassis. These are as follows. The 500mA h.t. fuse is coded F1 and supplies V2, V3, V4 and V1 plus PC6 (c.r.t. first anode circuit) in addition to the line output stage, the 100mA fuse on the line output transformer being replaced by a link. C449 (0·001μF) is added to link the earth sections of the field and line parts of the printed panel. In the line generator circuit D402 and D403 are type 1N914, C423 is 8μF and R452 consists of two 820kΩ resistors in series. TP403 is marked TP402 on some

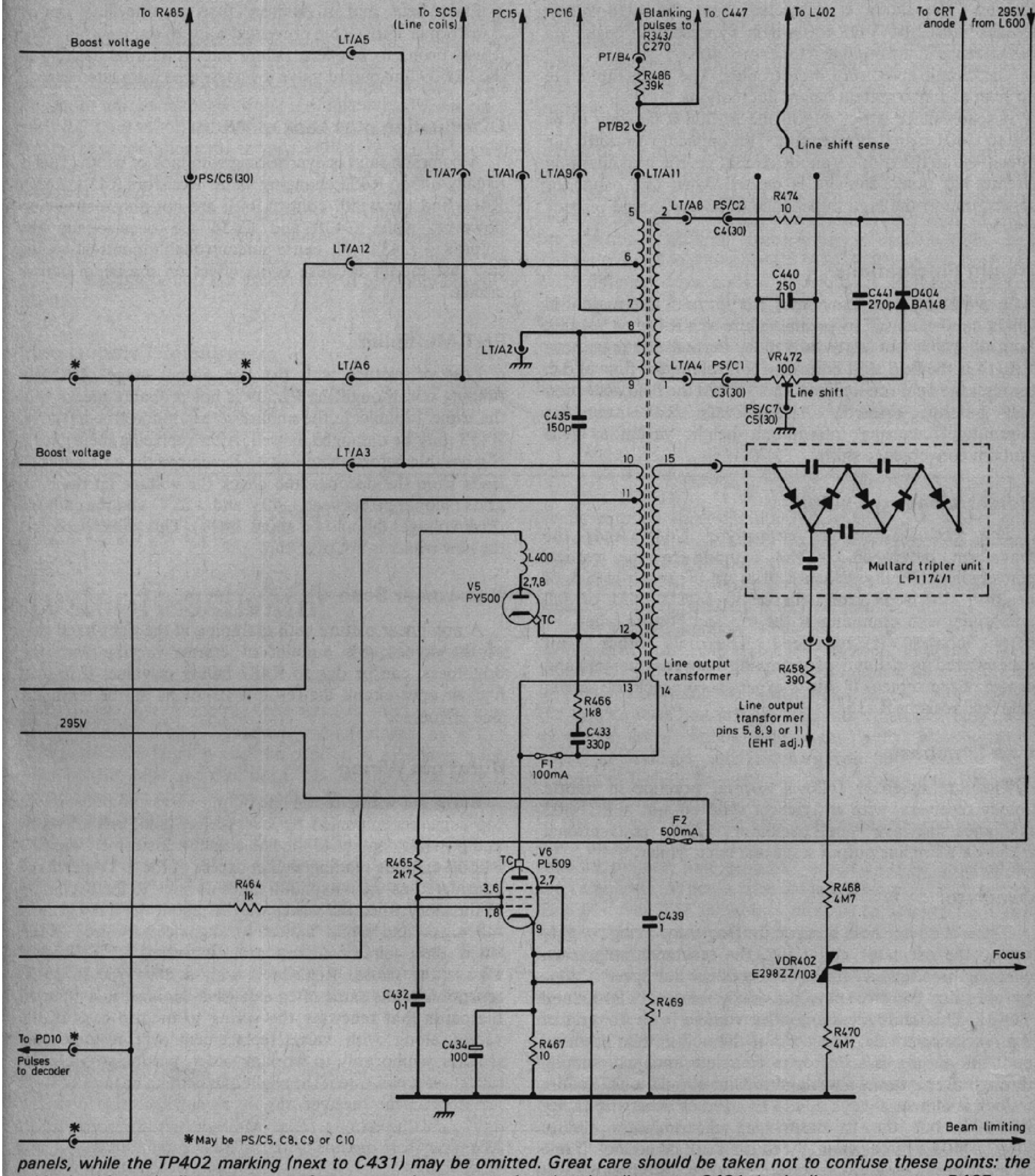
electrolytic C200 which couples the signal to the base of the luminance amplifier TR201. In later 30 decoders a 6·8pF capacitor is added between the base and collector of the sync separator transistor TR202 to reduce a tendency to line pulling under difficult reception conditions.

The Timebases

The timebases are reliable and don't give a lot of trouble, though as you'd expect the line output stage is the cause of most calls to attend to faults. We'll take the field timebase first. Two valves are involved, the triode section of a PCF80 and the PL508 output pentode. The pentode section of the PCF80 is the second sync separator.

Second Sync Separator

The reason for using two sync separators is that there is always a small amount of video present at the collector of the first, transistor sync separator on the decoder panel.



panels, while the TP402 marking (next to C431) may be omitted. Great care should be taken not to confuse these points: the white lead from the line output transformer must be connected to the pin adjacent to C431. In the line output stage R467 may be 6·8Ω, C435 maybe 220pF, C440 is 220μF and C439 is 0·22μF with R469 omitted. There is no "LT" plug and socket. R486 is omitted, the line flyback blanking pulses for pin 6 of the MC1327 i.c. being taken from pin 9 of the line output transformer via PD10. In the field timebase D400 is type 1N914 and C407 is 4,700μF. The field linearity circuit is modified as follows: C411 is 0·1μF, R420 22kΩ, R416 33kΩ and R412 820kΩ.

Under good signal conditions this video is removed by the pentode sync separator. Under weak signal conditions the transistor is unable to carry out any separation and the whole duty falls upon the valve.

Field Timebase

The triode section of the PCF80 acts as a multivibrator with the PL508, the field sync pulses being fed to the grid of the PL508. As there is no field hold control in the circuit it is essential that the multivibrator's natural free-running frequency can be easily locked by the field sync pulses over a much wider range than in more conventional circuits. This need for a wide lock-in range presents the problem of random triggering by spurious pulses. This is overcome by diode D400, which is turned on during the forward scan by the waveform fed back to it from the anode of the pentode and effectively removes any odd pulses which might otherwise appear at the pentode's grid and upset the locking. The diode is protected from the high-voltage flyback pulses by VDR400 which bypasses the peaks via the screen grid decoupling capacitor C406.

The circuit gives very little trouble. The main faults are no scan and intermittent height fluctuations.

If scan failure is not due to the PL508 it is likely to be due to C401 being short-circuit. This capacitor smooths the boost feed to the triode's anode circuit, i.e. the field charging circuit. No other damage is caused when this capacitor shorts, due to the high impedance of its associated resistor R405.

Height Fluctuations

Intermittent and sometimes very rapid fluctuation in height can be caused by partial failure of VR414 or VR480, both of which run fairly hot under normal circumstances. VR414 is the field shift control – controlling the flow of d.c. through the field scan coils – and VR480 the field deflection coil balance control. Alternatively R491 can be intermittent, causing intermittent height variations plus random convergence shifts.

Height/Linearity Faults

The PL508's cathode electrolytic C448 feeds the waveform developed at the cathode to the vertical convergence circuits. When it dries up the result is lack of height – the scan can collapse to say a third of full amplitude, with cramping at the top and bottom when the height control is advanced. The only other fault encountered is a band of cramping between the top and centre of the screen. If this is experienced check the screen grid feed resistor R415.

Line Timebase

The line timebase follows normal practice in hybrid colour receivers, with a flywheel sync circuit, a PCF802 reactance/sinewave line oscillator valve, conventional PL509/PY500 line output stage and e.h.t. tripler.

Oscillator

There is no line hold control, the frequency being roughly set by the oscillator coil L401, the reactance stage then ensuring precise lock. Initial setting of the line speed is done by shorting the two pins provided, marked TP400 and TP401. This removes the control voltage from the grid of the reactance triode. The core of the coil is then adjusted until the picture is seen to be complete and just running through. Remove the short and the line should lock. Failure to lock is almost always due to an aged or otherwise faulty PCF802, but the flywheel sync discriminator diodes D402/D403 can occasionally cause weak or no lock if one of them develops a low reverse resistance. In difficult cases check C427, C424, C419, C425 and C423. Vertical ripple was mentioned when we dealt with the decoder.

Line Output Stage

The line output stage is the weakest point in the receiver, though this does not detract from our previous statements that the set is highly reliable. The fact that the line output valve, boost diode and line output transformer are all crammed very tightly into a comparatively small space means that there is a great deal of heat concentration. Thus faults that give rise to increased current consumption very often result in otherwise trouble free components being damaged.

Early sets had a 100mA fuse on the line output transformer itself. This prevented a lot of damage but since it was prone to frequent failure due to internal flashing in the PL509 line output valve it was deleted from later sets.

Overheating plus Lack of Width

A common fault is overheating with lack of width. This is usually due to R453 changing value. Resistors R450, R452, R467 and the width control itself are not above suspicion however, while C430 and C434 are occasionally the culprits – C434 will cause uncontrollable contrast as we saw last month because of its effect on the beam limiter circuit.

EHT Multiplier

Loss of picture with the line output stage obviously running o.k. though the PL509 is hot probably means that the tripler (doubler in the smaller-screen models) is defective. R458 may be damaged as well. After replacing the tripler it is advisable before switching on to remove the c.r.t. cathode leads from the decoder and check the voltage on the c.r.t. grids (should be between −40V and +25V) and the cathode drive voltages (should be about 140V). This will ensure that the new tripler is not over-run.

Non-Linear Scan

A non-linear picture with cramping at the right-hand side of the screen, the amount of cramp varying with the brightness, can be due to R487 falling in value. If it goes high or open-circuit the result is striations on the left-hand side of course.

Burnt out Wiring

Burnt out wiring to the line output valve and boost diode top caps, accompanied by low receiver gain, lack of width and possible damage to the line output transformer, with the PL509 cathode reading well in excess of the 2·2V normally considered as the maximum, takes us back to the beginning of the story when the writer warned about the link between the a.g.c. and beam limiter arrangements. Check R453 when these circumstances are discovered – it's nearly always the cause. Replace it with a 2W type to avoid repetition of the same often extensive damage. It is quite on the cards that renewing the wiring to the top caps of the valves along with valve replacement will restore the receiver temporarily to working order, particularly in good reception areas, and if the slight overheating of the PL509 is not noticed the receiver may work satisfactorily for a few days until the damage once again occurs. So check R453 whenever there are line drive or receiver gain faults.

No EHT

No e.h.t. can be due to the PL509 or PY500 of course. If the PL509 is cool it probably means that the screen grid feed resistor R465 is open-circuit.

No e.h.t. with the line output valve excessively hot means no line drive and probably the fuse open-circuit. Check the PCF802 and if necessary C427. This capacitor can be responsible for intermittent failure. The fuse may be found blown because the oscillator is slow to start as a result of C427 playing up. A leaky C427 can also be responsible for a symptom akin to e.h.t. brushing when the set is first switched on.

No e.h.t. with the PY500 possibly damaged and the fuse blown point to a short-circuit boost capacitor, C436, since it's returned to chassis via windings on the line output transformer. Alternatively it could be that the harmonic tuning capacitor C435 has gone short-circuit. This capacitor can be damaged if the red/yellow lead from pin 9 of the PL509 is too close to it. Before C435 breaks down under these conditions the trouble will be corona, which will also occur if the glass envelope of the PL509 is too close to the metal shield.

Though we've not come across it ourselves we've seen reports of no e.h.t. due to the oscillator's anode load resistor R444 going low in value. This removes the drive to the PL509 which gets hot, the excess current probably blowing the fuse.

Line Output Transformers

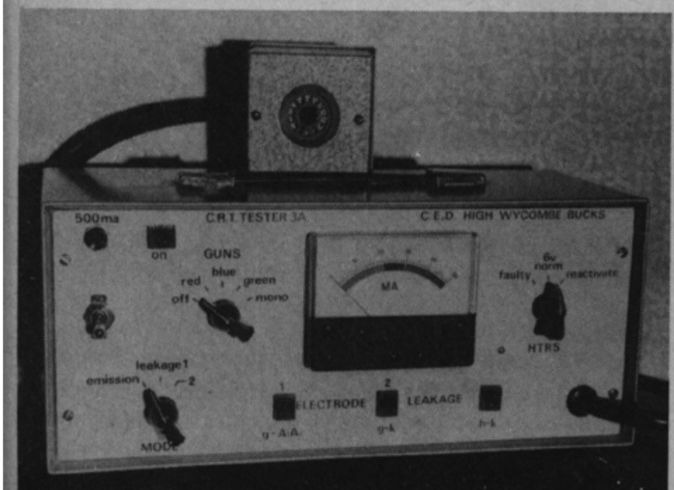
There are several different types of line output transformer in use in these sets. The well-known Mullard transformer is suitable for use in both the larger screen (25kV) and smaller screen (20kV) models. The Weyrad transformers used can be easily recognised by the translucent gold-coloured shrunk-on sleeves around the windings. There are different types for the 25kV and 20kV models. The 25kV transformer has a label marked Weyrad-057 and a blue spot adjacent to the solder tags on the top cheek of the main winding. It can be interchanged with the Mullard transformer. The 20kV Weyrad unit has a label marked Weyrad-093 and a red spot on the top cheek. It is suitable for use only in the 20kV, i.e. 17 and 18in. models. In addition a different transformer is used in 18in. sets carrying the Model number CS1830/A. These sets are fitted with different scan coils – a combined scan-convergence coil assembly bearing the part number 822165/18. The correct transformer is part number 85-0313-3 – early versions carry an identification label marked 093A. Neither the coil assemblies nor the transformers are interchangeable. Model CS1830/A also has the following component value alterations: C435 100pF, R448 27kΩ, R450 2·2MΩ.

Review: The CED CRT Tester-Reactivator

Ian C. Beckett

THE Model 3A cathode-ray tube tester is another addition to the range of test equipment manufactured by CED Instruments of High Wycombe, Bucks. It measures 14in. wide by 5in. high and 5in. deep. The strong metal case is finished in grey, with a carrying handle and a white fascia. The weight, including the c.r.t. base box and leads, is 10lb.

The meter is calibrated from 0 to 50 and measures $3\frac{7}{8}$ by $3\frac{1}{8}$in. It is situated at the top centre of the front control panel. To the left of the meter are the on/off control, a five-position gun selector switch (off, red, blue, green and monochrome), and a three-position mode switch which selects the emission and two electrode leakage tests. There are three indicators along the bottom of the fascia panel for the indication of grid-anode 1 or 2, grid-cathode, and heater-cathode short-circuits and leakage. To the right of the meter is the 6·3V heater supply and reactivate control which is also fitted with an off position.



The CED Model 3A c.r.t. tester.

The instrument operates on 220-240V a.c mains supplies and is fitted with a 500mA fuse. A fourth indicator shows whether the mains supply is "on".

The instrument will test 6·3V monochrome and colour tubes with B8H or B12A bases without the tube having to be removed from the set – just remove the base and connect the tester's base box instead. The red, green and blue guns of colour tubes can be tested individually. Interelectrode shorts or leakage, and emission, can be measured. The reactivate facility enables the life of tubes that are not completely exhausted to be extended.

With colour tubes we have found that the red gun very often appears to lose emission first. Reactivating a colour tube for the first time generally brings all three guns up to the same level. When a tube loses emission for the second time however it is sometimes difficult to balance the three guns evenly – careful adjustments of the first anode controls have to be made.

On testing the emission of a good monochrome c.r.t. a reading of 45 can be expected. On reactivating some nearly exhausted c.r.t.s giving readings of only 15-20 we obtained emission readings of 40-45. Most of the tubes we reactivated a few months ago are still holding up well.

The 3A tester/reactivator performed well on test over a period of several months. It has proved a good companion in the workshop and for field servicing.

A base (B14G) is now available for use with the Sony triniton tube. We understand that an adaptor base for the Thorn PIL tube will soon be available. On the latest version the heater supply voltage has been lowered and the current increased: this improves the reactivation process. The meter is now screen printed, and it is planned to introduce a smaller case.

Including leads and base box the CED Model 3A c.r.t. tester carries the price of £53 plus VAT (8%). It can be supplied by Willow Vale Electronics Ltd., Old Hall Works, Aberfield Road, Shinfield, Reading, Berks; Charles Hyde and Sons Ltd., Canal Head, Pocklington, Yorks; and Eastern Electrical Wholesale Ltd., Demesne Road, Dundalk, Eire. Further details are available from the above suppliers or from CED Instruments, 54 Barons Mead Road, High Wycombe, Bucks HP12 3PG.

SERVICING THE DECCA

'BRADFORD' CHASSIS SERIES 10 & 30

PART 3. by R.W. THOMSON

FAILURES in the power supply sections of radio and TV sets are usually fairly easy to locate and rectify, blown electrolytics and burnt resistors being all too obvious. Sometimes however faults which give misleading symptoms can arise. An example occurs in the smaller screen models in this series, the CS1730 and CS1830, when a dried out electrolytic h.t. reservoir capacitor (C602) causes the h.t. voltage to drop just far enough to limit the width and height of the picture – without any trace of hum being evident. The larger screen models give a more positive indication of low h.t.

Hum

Sources of hum can usually be readily diagnosed if it is remembered that hum on the h.t. line will be apparent on sound and on the raster but will seldom affect the vision. On the other hand hum on the l.t. supplies will nearly always result in hum bars with little or no colour content, and may or may not appear as hum on the sound sections. Note the negative supply in the c.r.t.'s grid circuit – the preset brightness control VR601 is strung between positive and negative rails. The negative supply is provided by D603 and smoothed by C605 which can be responsible for a hum bar on the picture. Another hum possibility is a cathode-heater leak in one of the valves, the culprit usually being easily identified by the appearance of the raster. Our accident prone friend the PCL82 in the sound section can almost certainly be relied upon to destroy its cathode biasing components as well as itself when this happens!

Loss of capacitance in a reservoir capacitor – that's the one nearest the rectifier – always causes low voltages but doesn't always result in hum, whereas an open-circuit or low-capacitance smoother, such as C601 on the h.t. line or C604 on the l.t. line, creates so much ripple on the d.c. supply as to be just too obvious. Where there are separate reservoir and smoothing capacitors, as in the l.t. supply, it is good practice in the writer's view to replace both together – except in the case of failure in a fairly new set where old age isn't the cause of the defect.

Common Power Supply Faults

The more common power supply faults are as follows:

No sound or raster, R603 open-circuit: Check whether the h.t. rectifier D600 is short-circuit. The correct replacement resistor should be fitted since it offers a great deal of protection, fusing a lot faster than the thermal overload trip (10 chassis) or the anti-surge mains fuse (30 chassis).

Mains fuse blown: Check the mains filter capacitor C607 and D600 for being short-circuit.

No sound or raster, fuse o.k., heaters out: Check for an open-circuit heater, a break in the heater line at the PCL82 base, plug/socket connections.

No sound or raster, heaters, R603, and fuse o.k., small screen models: Check whether the h.t. smoothing resistor R606 (100Ω, replaces L600 fitted in the larger sets) or D600 is open-circuit.

No sound or raster, heaters, R603 and fuse o.k., large-screen models: Check D600 for being open-circuit.

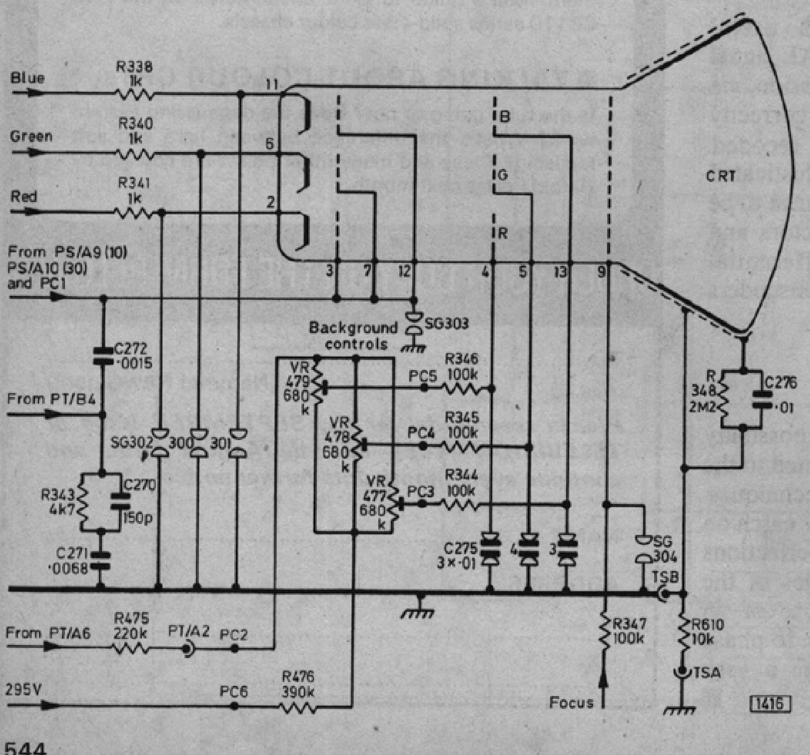


Fig. 1 (left): C.R.T. circuit, 10 series chassis. In the 30 series chassis R610 is omitted, C276 is 0·004μF, VR477-9 are 1MΩ with C409 (0·01μF) shunting R476 and the background controls. C272/R343/C270/C271 are omitted (line flyback blanking is carried out in IC2), the c.r.t. grid bias from R600 and the field flyback blanking pulses from PC1 being fed to pins 3/7/12 via a 10kΩ resistor (R339).

Fig. 2 (right): The power supply circuit used in the 10 series chassis. The circuit used in the 30 chassis is similar, the main differences being as follows. The thermal cutout is replaced by a 2A anti-surge fuse (F3) in the live a.c. lead and a 500mA fuse (F2) from tag F on T600 to chassis; D601, D602 and D603 are type 1N4002, D601 and D602 being protected by parallel 0·01μF capacitors; C604 is 2,500μF and C605 22μF; R606 in the heater line is omitted; R611 is omitted and VR601 is connected directly between C604 and C605 (i.e. there is no R612); the plug and socket connections differ. In the 17 and 18in. models R606 (100Ω) replaces L600. C605 is 47μF in Model CS1830.

No sound or vision, raster present: Check R602 for being open-circuit.
Hum on sound and raster, vision o.k.: Check the h.t. electrolytic can C601/C602.
Hum on vision, raster and sound: Check the l.t. supply electrolytics C604 and C606. Check whether one of the l.t. supply rectifiers D601 and D602 is open-circuit.
Frequent overload cutout tripping (10 chassis) not accompanied by overheating in any other component: Cutout itself faulty, or shorted turns on the mains transformer T600. The latter is uncommon but not unknown.

Power Panel

Some components mounted on the power panel can cause troubles associated with other sections of the set. In particular as mentioned in Part 1 some of the sound components – the PCL82 etc. – are mounted on this board. Attention is again drawn to the damage that can occur in unmodified 10 series receivers, particularly around the PCL82 valve base.

Brightness Faults

Lack of brightness is another fault that can be traced to this part of the set. As mentioned above, the c.r.t.'s bias comes basically from the preset control VR601 which is across the positive l.t. supply from R602/C604 and the negative supply provided by D603 and C605. A change in the value of any of these components, or a faulty slider or track on VR601, will radically change the brightness level. Note that on the 10 chassis there is an h.t. tap via R611 to VR601, but since this resistor carries little current and is not subjected to pulse voltages it seldom gives trouble. What can be more confusing is a screen either too dark or too bright with VR601 having no effect. This is due to the c.r.t. grid spark gap SG303 being leaky or short-circuit.

Quite a common cause of lack of brightness is when R475 increases in value. This resistor provides the feed from the boost rail to the c.r.t. first anode preset controls. As it changes value it eventually leaves the first anode voltages at less than the bare minimum of 450V. In the 10 chassis the other cause of brightness troubles is the brightness/RGB clamp circuit which we dealt with in Part 2.

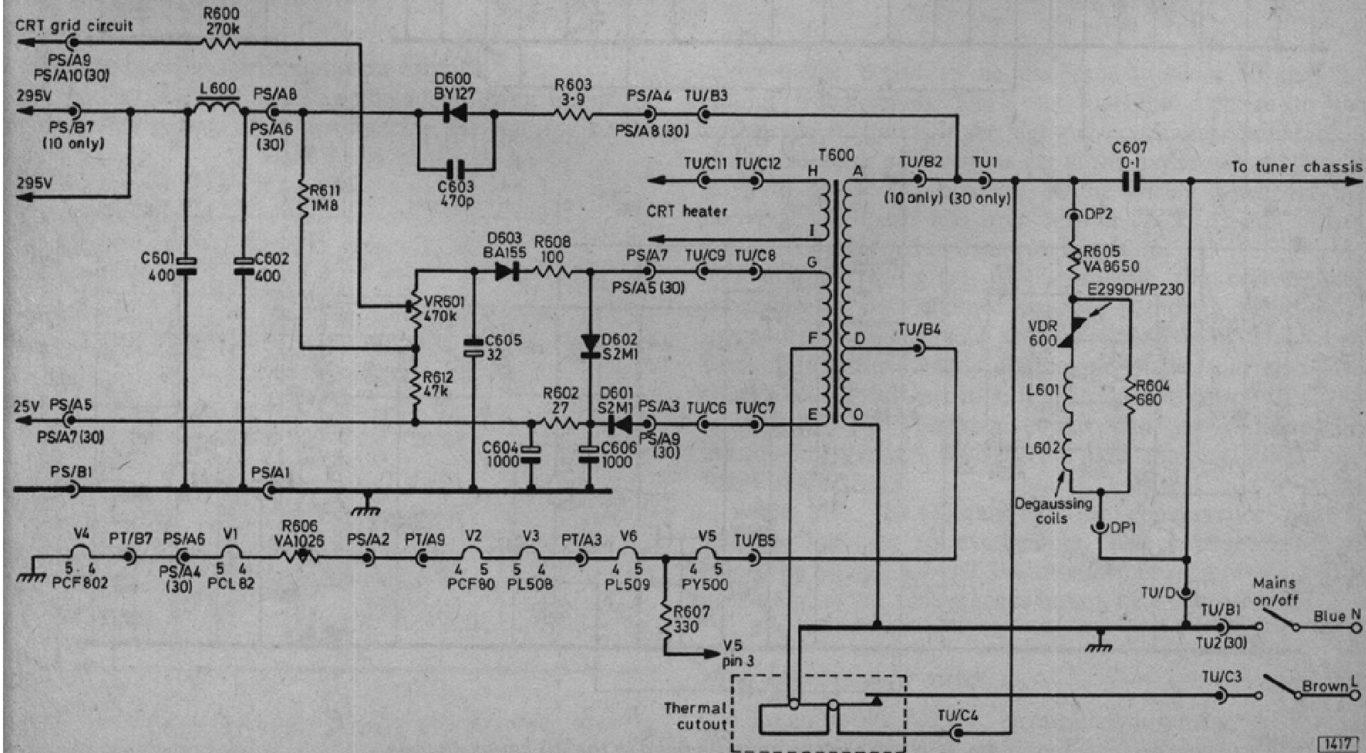
Focus Faults

Loss of focus in the larger-screen sets can usually be traced to R468 which goes high and reduces the focus control voltage range. On the odd occasion R470 can go high, but if it does one has a sure indication that this is the case since the focus voltage goes so far up the scale that the spark gap SG304 has a continuous arc through it – in fact it will melt away if permitted to run like this for long. Replacement of these resistors is a bit fiddly as they are enclosed in the small focus control tube. I prefer to wire them with longer leads, using proper e.h.t. sleeving over the resistors themselves and leaving them outside the box. One watt resistors stand up much better than the original $\frac{1}{2}$W types fitted, and if you carry out this up-rating there is no alternative but to fit them externally – but do insulate them very carefully. This can be done neatly and safely with a little care. No medals are awarded to those who prepare multikilovolt belts up the arm of a future serviceman – who may be you!

Intermittent loss of focus occurs if the lid of the focus control box is not clamped in place properly. It is good practice to clean the v.d.r. with a small piece of sandpaper, roughening off the glaze that forms under the wiper of the focus control. Some people refer to the v.d.r. itself as the focus control: this is incorrect and misleading, the whole gubbins being the focus control. The stick is of necessity a v.d.r. since the voltage source is pulsing and with poor regulation. SG304 can also be responsible for intermittent focus troubles – due to dust.

Convergence

Convergence troubles are sometimes due to failure of the dynamic convergence controls. It is best to use metal-clad controls as replacements as the plastic ones originally fitted



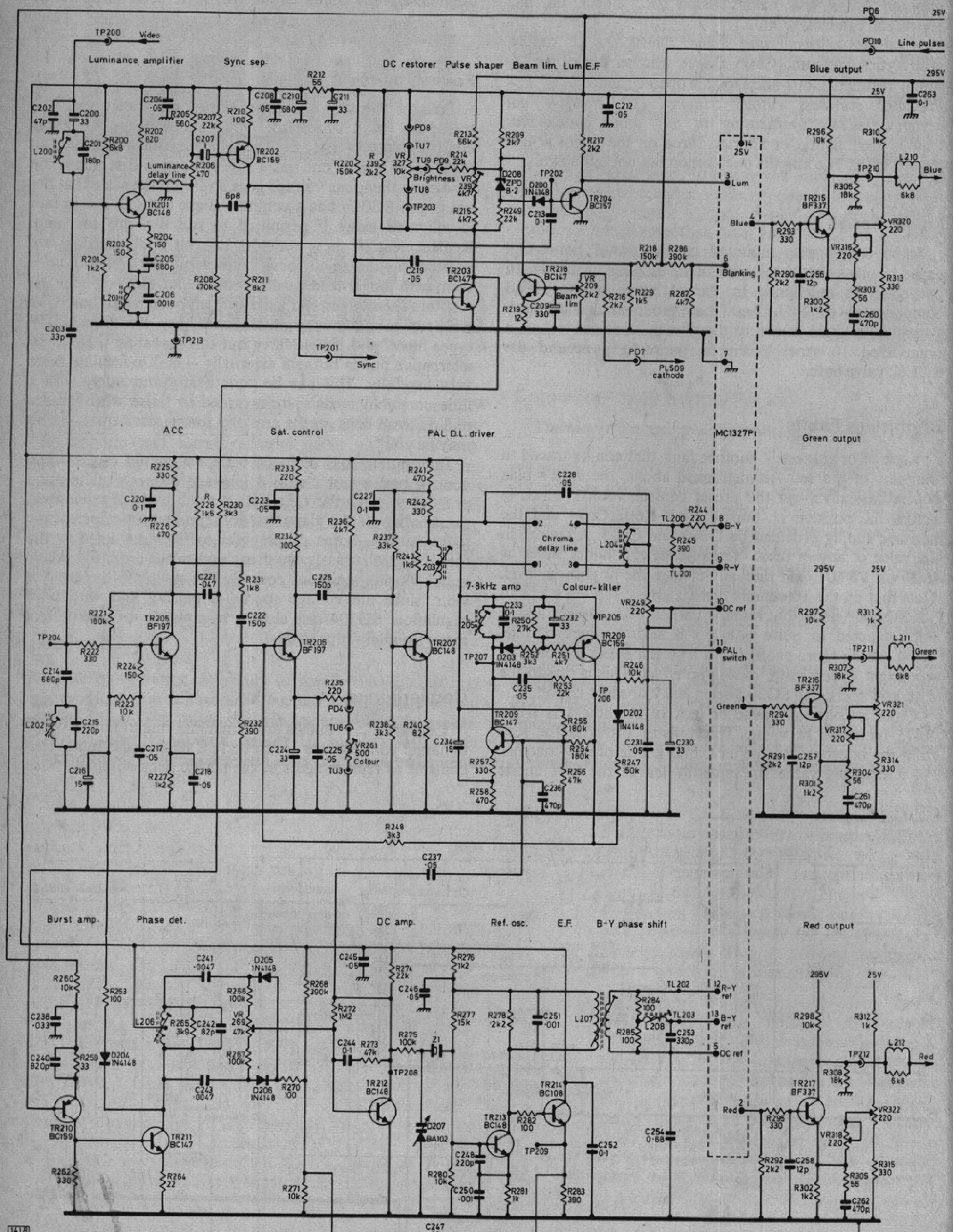


Fig. 3: Circuit of the decoder used in the 30 series chassis.

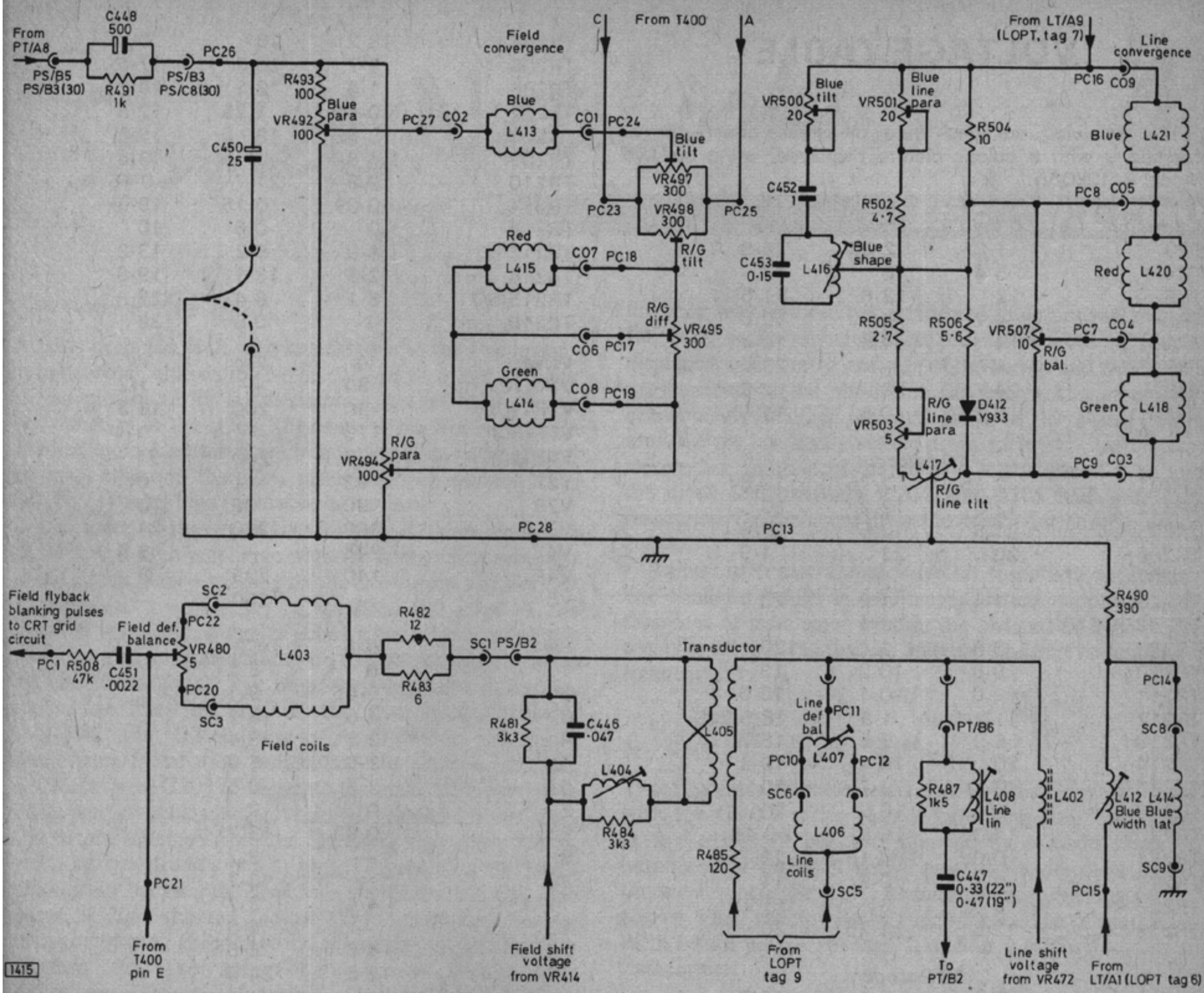


Fig. 4: The convergence circuitry, 10 series chassis. In the 30 series R493 and R508 are omitted, L412 is a tapped coil with the second section replacing R490, R484 is omitted and R481 is changed to 10Ω and is connected across the parallel windings on the transductor. The S-correction capacitor C447 is 1μF in the 17in. model. The small-screen (17, 18 and 19in.) models do not incorporate pincushion distortion correction, transductor L405 and its associated components L404, C446, R481, R484 and R485 being omitted.

seem to be heavily over-run at some settings.

A special word of warning should be given about the convergence wiring. It is possible for the harness to the convergence board to lie dangerously close to the line output transformer. The result can be damage to the convergence circuits if the high pulse voltages appearing at the transformer connections get at the harness insulation. It pays to check the position of the wiring whenever the convergence board has been moved up to its adjustment position or returned to its normal position.

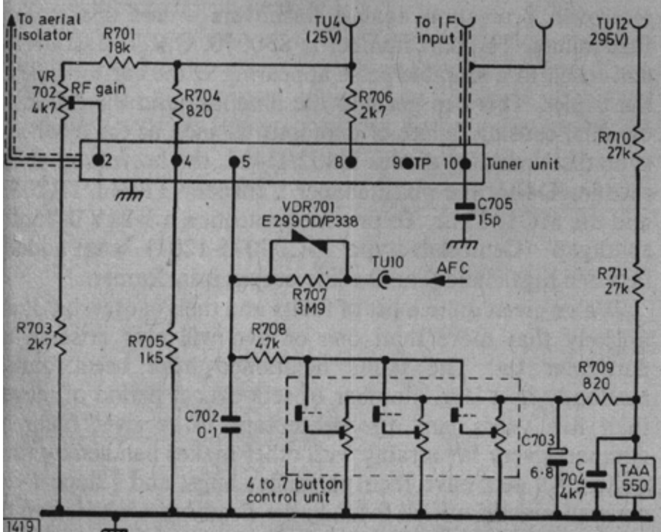


Fig. 5: Circuitry associated with the varicap tuner used in many 30 series models.

There are no great problems with the convergence procedure or with picture centring – though attention is again drawn to the field shift control VR414 which can cause intermittent height fluctations. R491 can also give trouble as we saw last month. The 25μF electrolytic C450 in the field convergence circuit can go short-circuit, introducing vertical R/G errors and making R492 and R494 ineffective.

Some 17in. c.r.t.s can call for convergence control settings that lead to overheating. This can generally be helped by adding a 6·8Ω 3W resistor between tags 8 and 9 at the edge of the convergence board, i.e. across VR507.

Miscellaneous Faults

Like any other piece of electronic equipment, the Decca Bradford chassis can on occasions produce weird and

VOLTAGE TABLE

The following voltages were measured under normal conditions with a colour picture displayed, using an Avo Model 8 (20kΩ/V).

Transistor	*Ve*	*Vb*	*Vc*
TR3	1·65	2·25	16·5
TR4	5·4	6	12
TR5	12	12·6	21·5
TR6	4·7	5·3	19·5
TR7	4	4·6	10·4
TR8	4·6	—	23
TR9	24	23	2·5
TR10	0	0·6	11
		10 Decoder	
TR201	2·15	2·75	12·8
TR202	12·8	12·2	20
TR203/4/5	1·8	2·5	13·8
TR206	20	21	1·9
TR207/TR217/ TR225	1·4	1·9	20
TR208/TR218/ TR226	0·8	1·4	120
TR210	9·6	10·2	19
TR211	0	–0·1	15·5
TR212	1·2-1·64	1·9	18·5-20
TR213	6·9	7·5	15·7
TR214	20	19·4	19·9
TR215	3·4	3·7	20
TR216	9·4	10	20
TR220	14·3	15·5	0·16
TR221	0·08	0·16	20
TR222	0	0·5	11
TR223	5	5·1	13·25
TR224	12·6	13·25	20
		30 Decoder	
TR201	2·3	2·9	12·7
TR202	19·5	19·6	2
TR203	0	–1·5	22
TR204	18·2	10	0
TR205	9·7	10·3	17·6
TR206	1·4	2·1	19·2
TR207	0·65	1·25	12·5
TR208	19·6	19	19·5
TR209	4·8	5	19·6
TR210	19·8	21·7	0·15
TR211	0·09	0·15	19·5
TR212	0	0·5	10
TR213	4·9	5·2	13·2
TR214	12·5	13·1	19·6
TR215/6/7	8·1	8·4	125
TR218	0	0·5	36

Valve	*Va*	*Vsg*	*Vk*
V1T (10)	80	—	1·2
V1P (10)	190	200	16·3
V1T (30)	110	—	1·4
V1P (30)	295	240	21
V2T	93	—	0
V2P	90	96	0
V3	280	260	24
V4T	245	—	3·5
V4P	140	235	2
V6	—	250	—

Pin	*IC1*	*IC2*
1	6	8·1
2	5·65	8·1
3	4·6	18·2
4	2·2	8·4
5	2·3	6·6
6	2·3	–0·5
7	0	0
8	0·03	3·7
9	—	3·7
10	—	3·7
11	4·6	3·7
12	—	6·6
13	4·6	6·6
14	12·5	24·6

C601 295V; C602 308V; C604 24·6V; C605 –40V; C606 31·5V.

wonderful causes of failure. Some of these are avoidable since they arise due to carelessness by servicemen.

Two outstanding examples which come to mind are failure of the valves to heat after valve replacement – particularly where the PCL82 or PL508 is concerned – and damage to the convergence board wiring due to lack of clearance between the harness and the line output transformer (see above). The latter fault can be avoided by tying the harnesses back out of the way as is done by the manufacturers in later models. The former trouble can be avoided only by taking care when changing valves. Both the PCL82 and PL508 valve bases have to endure a fair amount of heat, which makes the surrounding material brittle and introduces the danger of cracks – with the resulting intermittent faults one associates with hair-line breaks in the tracks. The PL508 often unsweats the base connections from the panel, resulting in either no field scan or the mind-boggling type of intermittent fault one learns to live with in time!

Shorting of the boost diode and line output valve top cap leads to chassis is quite often found, especially if they've come off and been resoldered. If this happens, don't just trim the end and resolder. Cut a new length of wire just a bit longer than the original, dressing the wiring away from the valve and the screening cans to avoid the considerable heat in this part of the set (once again, in the case of excessive overheating here remember to check R453 which can go low and R450 which can go high). Refitting the cap to the original lead merely brings it closer both to the valve and the earth screens, increasing the local heating and the danger of flashovers.

In later 25kV sets an insulation ring is added at the underside of the boost diode valve base in order to give improved protection against flashovers – and spasmodic fuse failure. The part number is 850070. C.R.T. flashovers can result in a sizeable pulse appearing at the earthy end of the tripler. This can get into the timebase and the decoder circuits, causing failure of components such as the flywheel sync discriminator diodes D402/D403, the horizontal shift rectifier D404, the pulse shaper transistor TR211/TR203, and the MC1327 i.c. To provide protection a 1-2kV 0·75pF sparkgap (Centralab type GC00075-1201) was added between tags 8 and 9 on the line output transformer.

We've given quite a list of faults and their causes, but it is unlikely that more than one or two will ever arise in a particular set. The faults mentioned have been found randomly in a large number of sets over a period of more than five years, and the percentage of receiver failures compares very favourably with other makes handled by the writer. All sets have their particular bugs, and I hope I've covered most if not all those in the Bradford chassis. Some other set designs I've dealt with would require an article twice the length of the present series in order to cover the faults to which they are prone.