Servicing the Thorn 3000/3500 Colour Chassis

Andy Denham

THORN was the only UK setmaker that never produced a hybrid colour chassis. Their initial dual-standard colour chassis was the 2000, which was superseded by the single-standard 3000 in 1969. The 3500 has modified convergence circuitry and pincushion distortion correction and is used in sets fitted with the larger c.r.t. sizes. A feature of all these chassis is the use of high-current, low-voltage line output transistors – two in the 2000 chassis and early versions of the 3000, a single R2008B in the 3500 and later versions of the 3000. As a result, a relatively low-voltage, stabilised h.t. supply is required. In the 3000/3500 chassis it's 58-65V, and the problem is how to obtain this without a lot of wasteful dissipation. The solution adopted in the 3000/3500 chassis is the use of a switch-mode power supply, of which more later. In addition, there's a 240V rail for the RGB output stages, and stabilised 30V and 12V rails. The switch-mode power supply incorporates overvoltage and excess current protection.

The entire line scan and e.h.t. current pass through a wirewound 1·5Ω resistor (R907) on the beam limiter board, the voltage across this component being used as the limiting reference voltage. The field timebase is unconventional for its year, the output stage consisting of a single BD116 transistor operating under class A conditions with an autotransformer as its collector load. It's driven by a BC116A emitter-follower stage. Both the field and sound output stages are powered from the 58-65V rail. The sound output stage consists of a class B pair of transistors (BC142/BC143) which drive an 80Ω loudspeaker.

Signal Circuits

The decoder in general follows normal practice for discrete circuitry. The set pulse width control R354 sets and shapes the burst gating pulse. There's a conventional BF194 4·43MHz crystal oscillator, with a BC183LB d.c. amplifier in the control loop, and the usual four-diode bridge synchronous demodulators for the chrominance signals. The only unusual feature is the absence of a bistable circuit in the PAL switch. Instead, the ident signal is squared and used to drive the two-diode PAL switch. The latter also produces the colour turn-on bias.

The video panel houses the RGB circuits. It's fed with luminance from the i.f. board, the demodulated B – Y and R – Y signals from the decoder, and power and clamp pulses from the wiring harness. The sync separator is situated on this board. The i.f. panel also carries the degaussing circuit. There are separate luminance and chrominance/sound detectors, and the first, gain-controlled chrominance amplifier is also on this board. The circuitry is quite straightforward. Which brings us round to the power supply again (Fig. 1).

Power Supply

The stabilised 58-65V rail is produced by a series chopper circuit. The chopper transistor is VT604, its load consisting of the inductive reservoir L603 which is in series with the circuits supplied. VT604 is switched on and off at line frequency by a squarewave generated by a monostable multivibrator (VT603/VT606). When VT604 is switched on, energy is stored in L603. When VT604 is switched off, the efficiency diode W616 switches on and the current flow in the load is maintained. Stabilisation is achieved by varying the on/off time of the chopper transistor, i.e. by varying the mark-space ratio of the waveform produced by the monostable. The output voltage is sensed by the feedback amplifier VT608, whose collector voltage is used to adjust the time-constant of the monostable circuit.

Why go to such lengths to obtain a 60V supply? Well first a chopper is pretty efficient. When the transistor is switched on its collector-emitter voltage is low, so even with a high current the dissipation is low. Likewise when it's off the leakage current flowing through it is (hopefully) only a few microamperes, so even with a collector-emitter voltage of 300V or so the dissipation is again low. Hence the only time when energy is wasted is when the chopper transistor is being switched on and off, and the squarewave drive should ensure that this takes place very rapidly. Secondly the output impedance is low, improving the regulation. That, we believe, is why the circuit is used. Imagine the size and wattage that would be required to obtain a 70V, 2·5A supply: according to my reckoning, about 47·5Ω at 475W!! A mains transformer in a colour TV set's cabinet would cause problems due to the magnetic fields, while its weight and cost would be appreciable. And both these alternatives have source impedance and regulation problems. Of course, Thorn could have bought BU105s to start with . . .

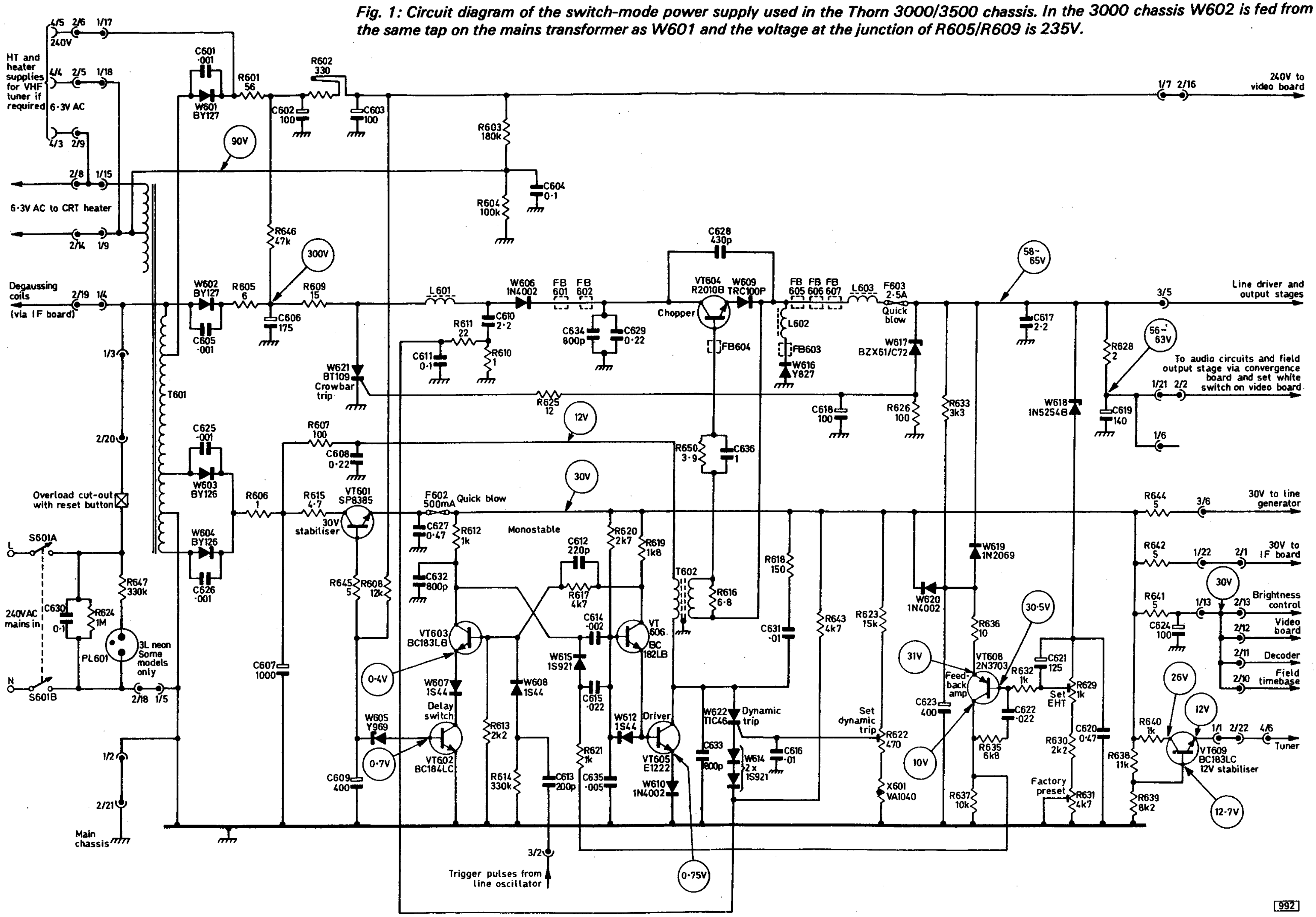
Start-up Sequence

What happens when we switch on? The half-wave rectifier W601 produces the 240V rail. As a result, the 30V zener diode W605 comes into operation, biased via R608. The 30V series regulator transistor VT601 can then come into operation. Once the 30V rail has been established, the line oscillator will start up, supplying trigger pulses to drive the monostable circuit. So the last supply to appear is the chopper-regulated rail. No 30V rail means no chopper drive therefore. The delay switch transistor VT602 makes this doubly certain: unless W605 conducts, VT602 remains cut off and the monostable cannot operate since VT603's emitter is virtually open-circuit. Thus if the 30V zener or VT602 or VT601 is open-circuit, or C609 is short-circuit, there's no chopper drive and no e.h.t., field scan or sound!

Protection Circuits

Since the chopper transistor's collector is at around 300V, produced by the half-wave rectifier W602, protection must be provided in case it goes short-circuit. This is done by the 72V zener diode W617 and the crowbar trip

Fig. 1: Circuit diagram of the switch-mode power supply used in the Thorn 3000/3500 chassis. In the 3000 chassis W602 is fed from the same tap on the mains transformer as W601 and the voltage at the junction of R605/R609 is 235V.



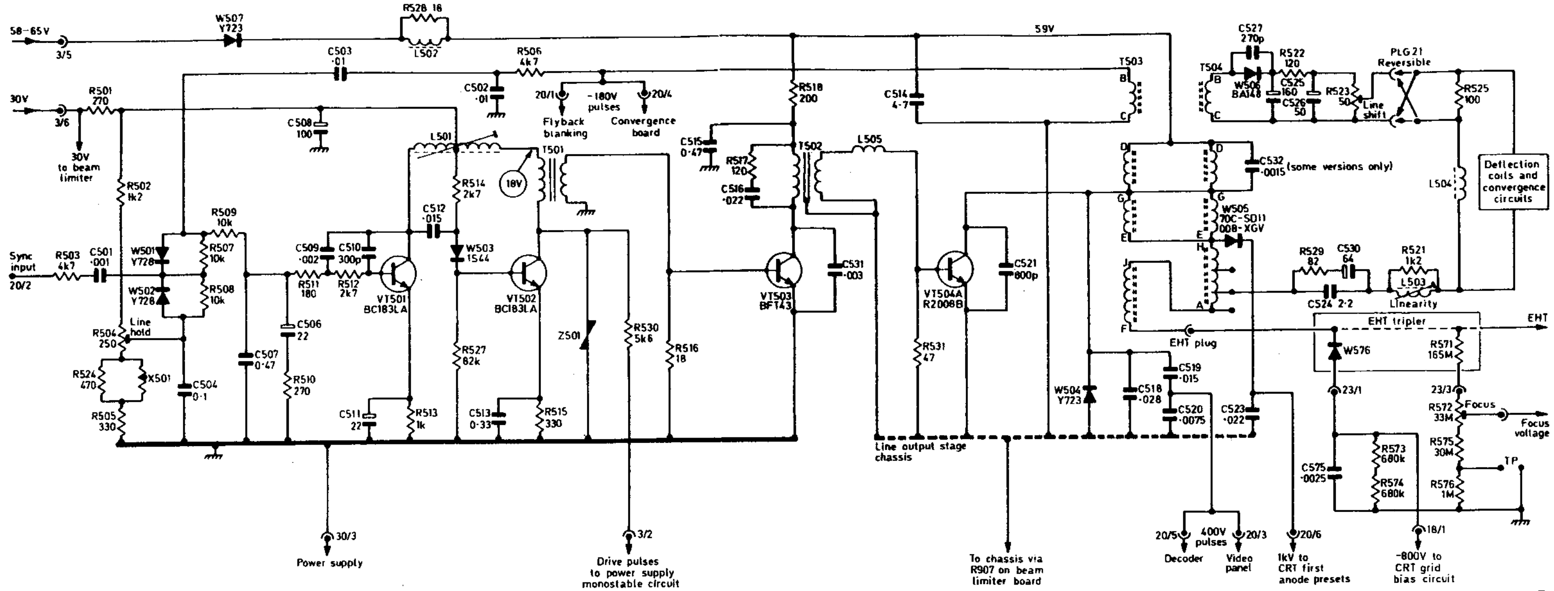


Fig. 2: Line timebase circuit. In the 3000 chassis L505/R531 are omitted, R572 and R575 are 25MΩ, and the wiring between the line output and e.h.t. transformers differs, J of T503 being linked to tags E instead of tag A of T504. In later production 3500 chassis tag J of T503 is connected to tag H of T504 instead. The transformers are coded to indicate the correct connections.

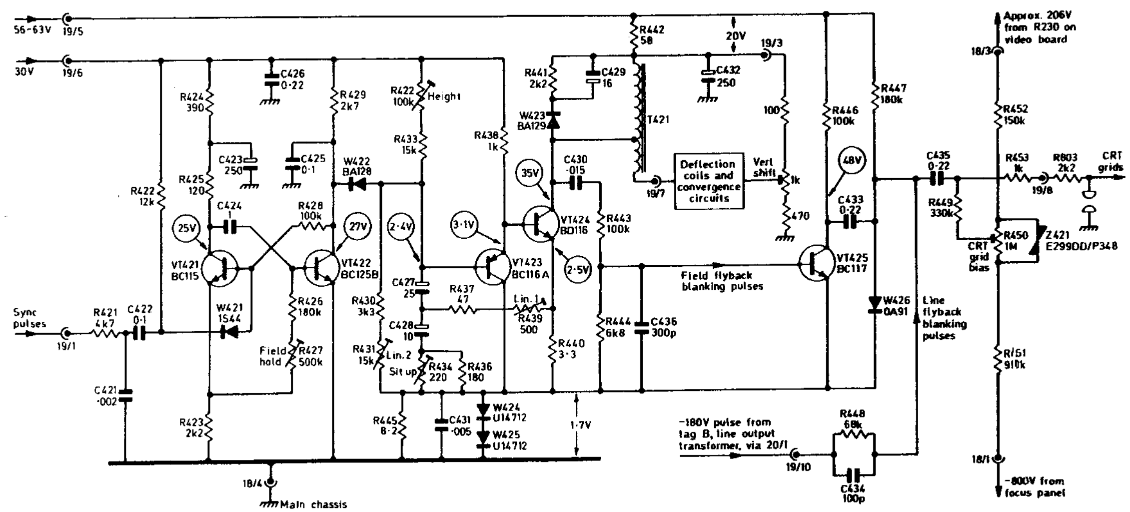


Fig. 3: Field timebase circuit. The voltage shown at the collector of VT424 applies at 60V h.t.

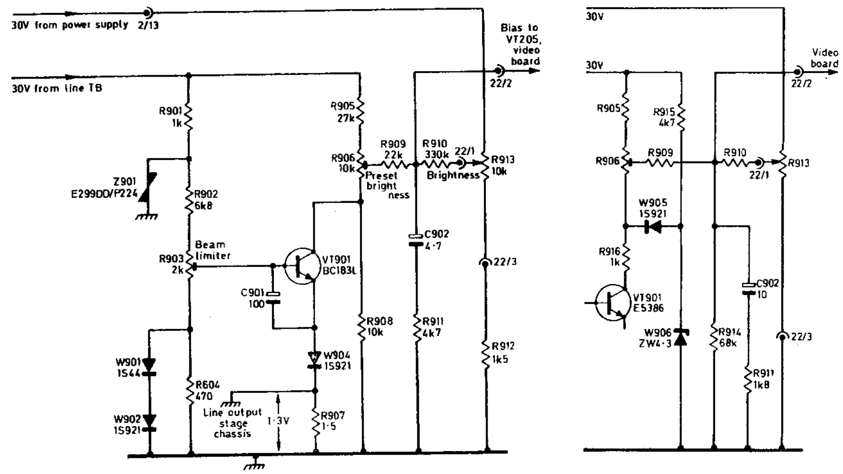


Fig. 4: The beam limiter circuit. 3500 chassis changes on the right.

thyristor W621. Should the chopper output rise to 72V, W617 conducts and the voltage developed across R626 fires W621. This short-circuit across the 300V supply in turn trips the cutout.

With such a low-impedance supply, excessive current could be drawn in the event of a fault. So excess current protection is required. In the event of excess current demand the ripple at the collector of the chopper will increase. This is bypassed by C610 and R610, and if the ripple is excessive the negative-going excursion of the waveform appearing across R610 will be sufficient to fire the dynamic trip thyristor W622. This virtually short-circuits the collector of the chopper driver transistor VT605, removing the chopper drive. The circuit continues to trip, at line frequency, so long as the excessive current demand is present.

Power Supply Faults

Such a complicated power supply means that a careful approach to servicing is required. Let's take the various possible symptoms.

Dead set, cutout tripping: Check the rectifiers on the top of the power supply unit. If R609 smokes as the cutout trips, the crowbar thyristor could be firing. Check W617 and W621. If these are not short-circuit, the chopper transistor may be. Alternatives are W616, C610, C629 and C634. If these are all o.k., the monostable may be holding the chopper on too long. Disconnecting one end of W615, the bias on which controls the mark-space ratio of the monostable's output, should reduce the chopper rail to about 30V. If W615 is not faulty, check the feedback amplifier circuit. The mains transformer can be responsible for the cutout tripping, while the cutout itself is sometimes faulty.

Intermittent cutting out is often caused by C618 being faulty. This capacitor is present to prevent short-term spikes at the output operating the crowbar.

There are also mechanical possibilities. The lead from W609 to the reservoir inductor L603 can short to chassis where it passes through the chassis, the chopper transistor's isolating washer can break down, and leakage from the electrolytics, e.g. C607, can be present on the print around W621.

Dead set, c.r.t. heaters alight: Check the voltage at each end of the 30V zener W605. If both sides read about 40V the zener is short-circuit and VT602 will be damaged. The 30V rail will be high. If the cathode is at around 10V, suspect C607 of being open-circuit – the 30V rail will be low. If there's no voltage at the cathode, check at R602 to make sure that the 240V supply is present, then check R608 for being open-circuit or C609 for being short-circuit. Correct voltages are 30·7V at the cathode and 0·7V at the anode of W605.

If these voltages are correct, check for 30V at F602. If missing check VT601. If the 30V rail is in order check whether the line oscillator is operating, by monitoring approximately 18V at the anode of W608. If lacking, check the line oscillator circuit. If present, check the voltage at the collector of the chopper driver transistor VT605. If the voltage is around 3V either the monostable is not running or the dynamic trip is faulty, holding the monostable off.

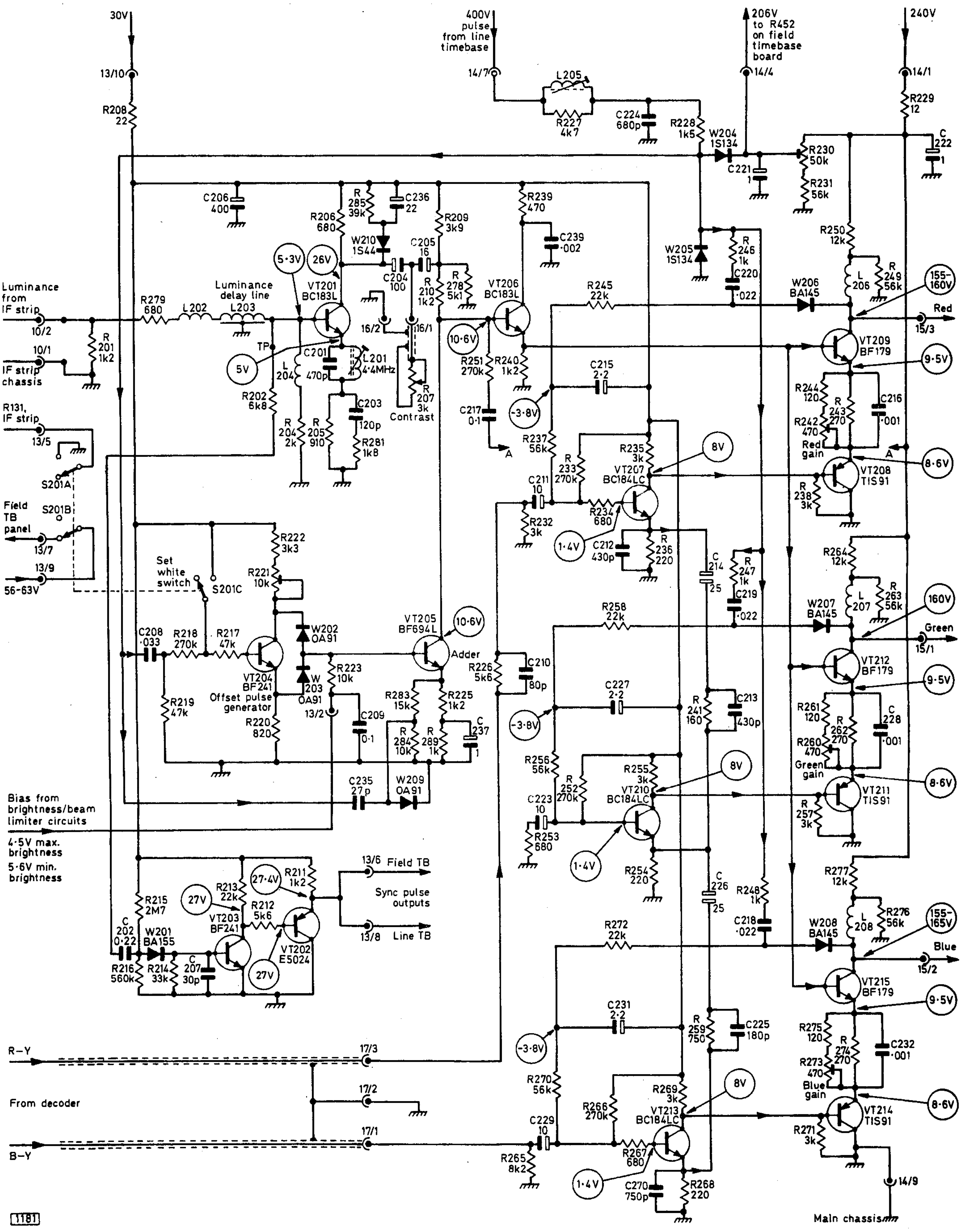


Fig. 5: Circuit of the video panel.

If all is well here check the chopper drive with a scope. W616 is also suspect. Don't overlook the possibility of a burnt 60V fuse holder, but of course you've checked the fuse, haven't you?

Ringing: Distorted verticals, a sort of cog-wheeling effect, can be due to C619 being leaky. Use a 220μF type as a replacement, rated at 75V or above. There are alternative causes on the line timebase panel however. The feed coil

L502 may be dry-jointed or may have lost its core, or its parallel resistor R528 may have burnt out. Similar trouble can be caused by C631.

Low h.t.: This can be a confusing fault, as effects similar to the dynamic trip operating are displayed on the screen. The 60V line drops to around 40V, the field folds up, the edges of the reduced line scan are curved, there's hum on sound and the voltage at VT604's collector will be around 120V instead of 260V. C606 is the usual culprit and, being part of a can, the whole lot needs to be replaced.

Blown h.t. fuse: The cause of F603 being open-circuit is usually in the line timebase, where favourites are a defective driver transistor VT503 or the c.r.t. first anode supply's reservoir capacitor C523 being short-circuit. In the latter case the associated rectifier W505 will probably have to be replaced.

Miscellaneous faults: C609 drying up causes ragged verticals. C624 drying up causes loss of colour with a hum bar.

The Line Output Stage

The line output stage (see Fig. 2) is quite straightforward, but note that there are two output transformers: one drives the e.h.t. tripler while the other drives the line scan circuit. If it's not operating and the h.t. supply is present check the voltage across R907 in the beam limiter circuit. If this is more than about 2V the line output stage is probably drawing excessive current. Possible causes are: the line output transistor VT504A leaky; shorting turns on the line output transformer T504 (rare); shorting turns on the e.h.t. transformer T503 (not uncommon); efficiency diode W504 short-circuit (very rare); C514 faulty (will blow the fuse if short circuit – caught fire on early sets); tripler leaky; c.r.t. first anode supply components leaky (W505, C523); shorting turns on the a.c. blocking choke L504. Disconnect these various items while monitoring the voltage across R907. Note that we said the line output stage may probably be drawing excessive current if the voltage across R907 is high. Alternatively, R907 may have risen in value to cause loss of brightness.

C514 is a special type, and can also be responsible for lack of width. C530 going open-circuit is another possible cause of lack of width. A far more common cause however is the core falling out of L504. Also check around L502/R528 for this fault. W507 was omitted on later sets incidentally, and the e.h.t. transformers are spot colour coded for the different c.r.t. sizes.

C523 has been known to go short-circuit with W505 going open-circuit: the symptom then is e.h.t. but no raster.

A common fault in the line output stage is C520 going short-circuit. This removes the pulses to the decoder and video panels. The symptoms are no colour with excessive brightness and the brightness control inoperative.

Poor focus is generally due to the 165MΩ resistor in the e.h.t. tripler. Varying focus means a clean up around the focus electrode's spark gap is required, and possibly widening the gap slightly with a file.

Line Stability

Line jitter seemed to plague these sets from the first. Anything badly soldered on the line timebase board seems to give rise to the jitters. Apart from dry-joints, any of the following components can be responsible: R504, C506, C511, W501/2 (use 1N4148s), W504, C525/6, R523, VT501/2 or T502.

Line drift is generally C506, C511, VT501 or VT502, less often R524. Slow line drift can sometimes be cured by adding a 220Ω resistor in series with X501.

Field Timebase Faults

The field timebase, audio and c.r.t. grid bias/flyback blanking circuits are all on one panel. In the event of field collapse, check whether the output stage h.t. feed resistor R442 is hot or not. If it's cool, the oscillator is usually at fault and either transistor (VT421/2, see Fig. 3) may be the culprit. The driver transistor VT423 can cause field collapse or field foldover, while a short-circuit BD116 output transistor causes R442 to heat up no end. The latter also occurs should C432 go short-circuit of course. A leak in the BD116 will give foldover just as sufficient height is reached, though the field charging capacitors C427/8 can also be responsible for this. C429 or W423 can be responsible for top cramping or foldover, whilst bottom cramping is usually due to the sit-up control R434. The discharge diode W422 can cause false locking and lack of height. Loss of field hold can be due to C423 or to the sync separator's base bias resistor R215 (2·7MΩ) – the latter is to be found on the video panel.

The field scan current is a.c. coupled to the convergence circuits by a 400μF electrolytic which is mounted on the convergence panel. It's C705 on the 3000 chassis and C762 on the 3500 chassis. If it goes short-circuit, the raster is displaced and there's severe misconvergence. It can also be responsible for intermittent field collapse and bottom cramping.

The Audio Circuit

The sound circuit was shown last month, where some of the problems that can occur were mentioned. The electrolytics can give trouble, C409 (100μF) and C407 (32μF) sometimes being responsible for low output, C401 (4·7μF) producing distortion when it leaks and C405 (250μF) removing the sound and cooking R405 when it goes short-circuit.

Flyback Blanking

The transistor and diode in the flyback blanking circuit can give trouble. Note that the c.r.t. grid bias potentiometer R450 is connected between a −800V supply which is obtained from the clipper diode in the e.h.t. tripler and a 206V supply which is set by R230 on the video panel. If R452 goes high-resistance or open-circuit (not very likely) or C221 goes short-circuit (not unknown) the c.r.t. grids will be swung negatively and there'll be low or no brightness.

Setting up the Decoder

The decoder is fairly reliable when set up properly. An excellent meter/scope method is given by Thorn. The meter method is simple and can be carried out in the field. Select a colour transmission and set the a.c.c. preset R308 fully anticlockwise. Connect the meter (Avo Model 8) to the anode of the a.c.c. rectifier W301 and adjust the burst discriminator coil L301 for the maximum negative output – alternatively scope the collector of the final burst amplifier transistor VT302 and adjust L301 for maximum burst output. Then adjust R308 for −7V. Next connect the meter to the end of R311 nearest the rear of the receiver. Disconnect the aerial, set the local/distant control on the aerial panel fully anticlockwise, and tune the oscillator coil L302 to the peak obtained near the top of the can. Alternatively scope the collector of VT304, tuning L302 for maximum output (5V peak-to-peak). Reset the gain control on a colour transmission.

Override the colour-killer by connecting an 82kΩ resistor between the anode of W305 and chassis. Open-circuit links A and B and make link D. Adjust the a.p.c. control R315 for near stationary colour. Make links A and C and adjust R309 for near stationary colour, then remove link C and adjust R312 for near stationary colour. Remove link D, restore links A and B and remove the 82kΩ resistor.

Connect the meter to the end of R339 nearest the rear of the set and tune the ident coil L303 for the dip which should occur when the core is nearly flush with the top of the former – the reading should fall from about 26V to 23V. If using a scope, tune for maximum output (20-30V peak-to-peak) at the collector of VT306

PAL Switching

As pointed out earlier, the ident signal drives the PAL switch directly instead of synchronising a bistable. If the switching doesn't occur at the right time, there will be a band of incorrect colour down the right- or left-hand side of the screen. If necessary, L303 should be adjusted to remove this effect – which is sometimes found in sets where the coil has slipped down the former. If there is inadequate output from the ident stage, check the emitter decoupling capacitor C321 (0·22μF). C325 which decouples its collector supply can short, removing the collector voltage.

Decoder Faults

Pulses from the line timebase are fed to a polarity-splitter transistor (VT308) which provides anti-phase pulses to drive the burst blanking diodes and, from its emitter, the pulse used for burst gating. So if this transistor fails there's no burst, no ident, and no colour. Other transistor failures I've had to cause no colour have been the final burst amplifier VT302, the reference oscillator VT304 and the ident amplifier VT306 (the latter was an intermittent fault). Another cause of no colour is C330 (4·7μF) across which the colour turn-on bias is developed going short-circuit or leaky (there should be 17V at TP2).

A problem that's sometimes encountered is intermittent loss of colour sync. This may be due to a delayed or mis-shaped burst gating pulse. The components to suspect are the two OA91 diodes W315 and W323 which clip the pulse, and the two pulse coupling components R351 (220kΩ) and C334 (82pF). The pulse width control R354 in this circuit is normally set fully anticlockwise: turn slightly clockwise if there's loss of colour at the left-hand side of the picture – colour will be lost completely if the control is rotated too far clockwise.

The demodulated B – Y and R – Y signals are fed to the video panel via filters. The coils can go open-circuit to remove one or the other signal (L304 no R – Y, L308 no B – Y).

The Video Panel

The video panel (Fig. 5) tends to be less reliable. Nearly every stage has given me trouble at some time or other. Let's start with the luminance circuit. A close look at the symptoms displayed is invaluable here. If the timebases are synchronised and there's only colour on the screen the fault must lie in the circuitry following the luminance delay line, usually one or other of the BF179 RGB output transistors short-circuit base to emitter, or VT201. If there's no sync, look closely for luminance by trying to lock the timebases. If there's no luminance the chances are that the delay line driver transistor VT105 on the i.f. panel is defective. If luminance is present one or other of the sync transistors VT202/3 is suspect.

If the brilliance control has no effect and the tube looks suspect, either VT204 or VT205 may be defective.

Conventional feedback clamps are used in the RGB circuits, clipped positive-going line frequency pulses switching on W206/7/8 during the line sync pulse back porch. The resultant negative potential stored by C215/227/231 adjusts the bias applied to VT207/210/213. Now obviously if one of these capacitors is leaky there'll be an excess of the colour concerned. This is a not uncommon fault on these sets. The same fault occurs if the clamp diodes go short- or open-circuit.

If you suspect one of the transistors in the RGB channels, monitor the relevant output transistor's collector voltage while short-circuiting the base-emitter of the appropriate preamplifier (VT207/210/213). This action should result in the output transistor's collector voltage rising to nearly 200V. If it doesn't, check the other voltages thus obtained. For example, short-circuiting the base-emitter junction of the B – Y preamplifier VT213 should result in its collector voltage being high, the emitter voltage of VT214 being high, and VT215's collector voltage also being high. This checks the d.c. conditions in the circuit.

Clamping failure I've always traced to the line pulse missing at pin 7 of plug 14. The effect is excessive brightness and the usual cause, as mentioned in dealing with the line timebase, is C520 going short-circuit.

The output transistor load resistors R250/264/277 have a habit of increasing in value to give virtually a red, green or blue raster. Two types have been used, wirewound ones and a combined thick-film unit. Separate wirewound ones are best. The output circuit also contains three chassis-connected resistors R249/263/276 which can fall in value to give an excess of the colour concerned.

Other faults on this panel have already been mentioned – C221 and R215.

IF Strip Faults

The i.f. panel gives little trouble. Instability can usually be cleared by slight adjustment of the 33·5MHz coil L113 in the luminance detector's output circuit. A case of normal sound with little luminance and no colour caused me some worry. The second i.f. amplifier transistor turned out to be at fault, letting sync, chroma and sound through but little else. I've found that the easiest way to test the transistors in the i.f. strip is to monitor the collector voltage while short-circuiting the base-emitter junction: the collector voltage should rise – if it doesn't change the transistor. Intermittent sound or colour is usually due to broken print around the relative plugs.

The 10μF a.g.c. decoupling capacitor C179 is a fairly common offender. It usually goes open-circuit, producing lines across the screen – akin to sound-on-vision. In very early sets there's also a 25μF decoupler (C134) which can cause the same fault. If C179 goes short-circuit the first i.f. transistor VT101 is no longer biased on: there's no vision therefore and weak if any sound.

The 180pF capacitors (C158/9) in the ratio detector circuit can be responsible for low, distorted sound. The

THORN 3000/3500 CHASSIS common faults

PAUL E. SOANES

THE Thorn 3000 single-standard colour chassis was introduced in 1969 and is probably the most frequently encountered chassis in colour receivers. It is used in sets in the Ferguson, Ultra, Marconiphone, HMV, DER, Baird, Alba and other ranges. The subsequent 3500 chassis, which differs mainly in its convergence circuitry and the addition of pincushion distortion correction, is used in 26in. and some 22in. models. The unique chopper stabilised power supply was covered in the September 1974 issue, with additional comments in the Letters page in the November 1974 issue. In this article we shall deal with faults we have come across on the other boards.

Line Timebase Panel

Apart from the power supply module, the line timebase (Fig. 1b) is the most troublesome part of the set. Some of the faults here will blow the h.t. fuse F603 on the power supply panel. Early models used a two-transistor (VT504 and VT505) line output stage while later models use a single-transistor (VT504A) line output stage. If the line output transistor(s) go short-circuit the fuse will blow and frequently R907 (1·5 Ω) which forms the line output stage earth return and is mounted on the beam limiter board will go open-circuit. Other components which will blow the fuse are C514 (4·7μF) which decouples the supply to the line output stage going short-circuit, C523 (0·022μF) which is the c.r.t. first anode supply reservoir capacitor going short-circuit, the efficiency diode W504 going short-circuit, or either the driver transistor VT503 or the capacitor (C531) across it shorting. If the e.h.t. transformer (T503) is defective the fuse will sometimes blow. Common causes of no e.h.t. are the driver or output transistors, the efficiency diode, R907 and C514.

No picture but e.h.t. present will be the symptom when C523 is short-circuit. Inevitably the first anode supply rectifier W505 will also be damaged and this will emit an unpleasant smell.

Lack of Width

R528 (18 Ω) will be damaged if L502 goes open-circuit and the result will be lack of width: it will also be damaged if C514 shorts resulting in no e.h.t. Note that C514 is a special type. Disturbances when the set has warmed up can be caused by C514. R528 can be badly discoloured and sometimes open-circuit without any other fault being present.

Lack of width can also be caused by the core falling out of the line shift circuit a.c. blocking coil L504. This is easily overlooked if you are not familiar with the chassis.

Poor Focus

Poor focus with the control at its limit is generally caused by the e.h.t. tripler—the internal 165M Ω resistor which feeds the focus circuit goes high-resistance. The tray can be damaged if C575 (2,500pF) on the focus panel is leaky or the tray's earth return lead is not making proper contact.

Line Hold Troubles

Drift or weak line hold is a fairly common fault, generally due to one or other of the two electrolytics C506 (25μF) in the flywheel filter circuit or C511 (also 25μF) which decouples the emitter of the reactance transistor VT501. As with most line generator circuits the flywheel sync discriminator diodes (W501, W502) should not be overlooked. R524 can also cause these faults and in one case we found that the thermistor X501 was defective, causing line drift and the need to frequently adjust the line hold control. In stubborn cases of line drift try adding a 220 Ω resistor in series with X501, also check VT503.

To adjust the line hold control from cold connect the positive lead of a meter switched to its 10V d.c. range to the slider of R504 and the negative lead to chassis, short the flywheel test point (just below the field output transformer) to chassis, adjust R504 for a reading of 6·2V and then adjust L501 for a stationary picture. Finally remove the short-circuit. Note that the reading 6·2V applies only when the receiver has just been switched on from cold.

If the verticals are bent it is worth checking the two electrolytics C525 (160μF) and C526 (50μF) in the line shift circuit.

Jitter on the line can be caused by the line driver transistor VT503 or by dry-joints on or around the driver transformer T502.

In the two-transistor line output stage the usual flyback pulse equalising network is connected across the transistors. If the lower transistor is faulty the resistor (R526, 47 Ω) connected from the two transistors to the equalising capacitors will be damaged.

No Colour, Excessive Brightness

When C520 (7,500pF) goes short-circuit there will be no 400V pulse feed to the video and decoder boards. The symptoms are no colour and excessive brightness.

Field Timebase

A multivibrator consisting of VT421 and VT422 comprises the field oscillator. C423 (250μF) which

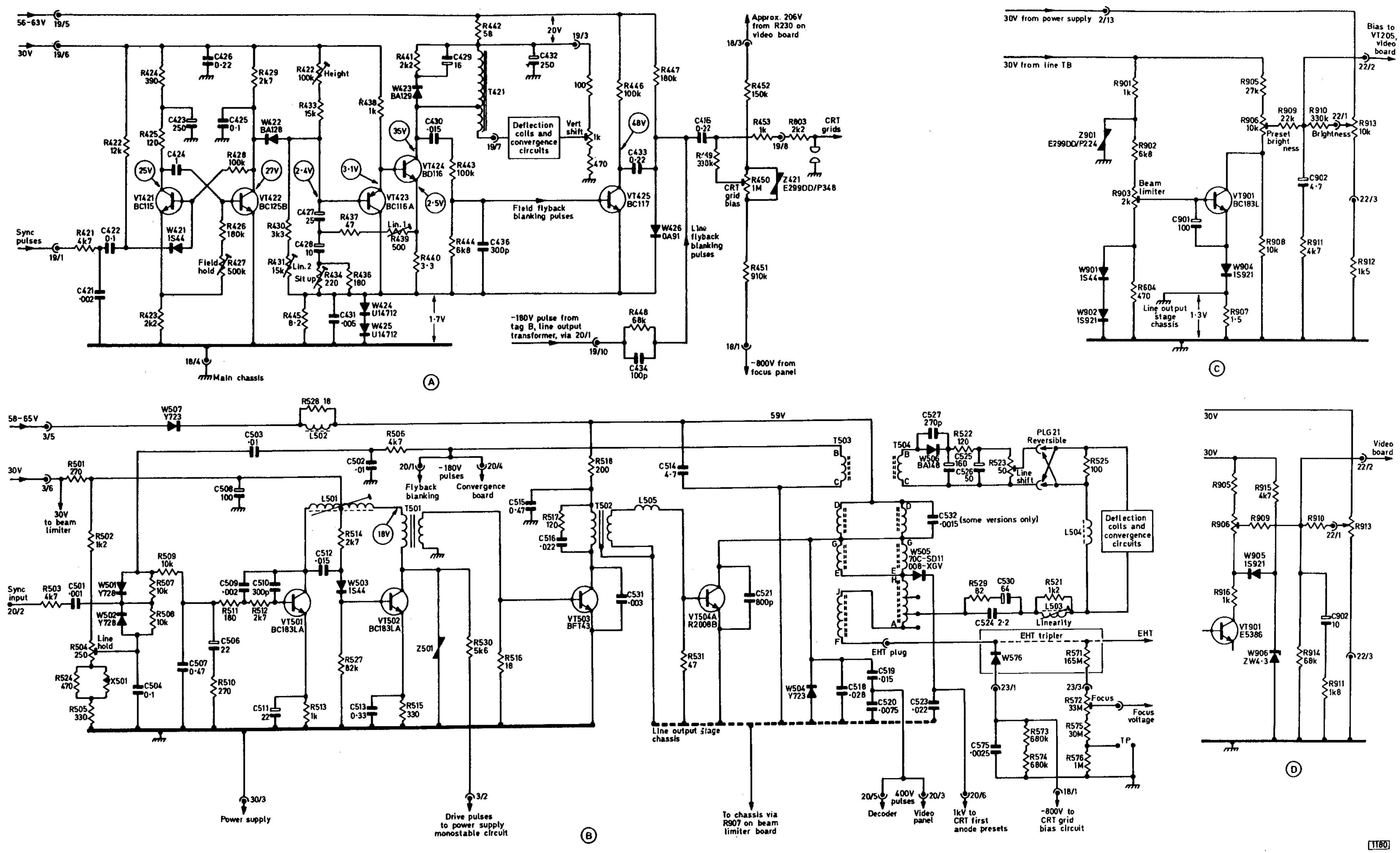


Fig. 1: Timebase, beam limiter and c.r.t. blanking and grid bias circuits. (a) The field timebase. In earlier production R434 is 200Ω with R435 (10Ω) connected from the junction of R434/R436 to the junction R445/C431, C430 is 0.022μF and X421 (VA1034) is connected across R440. Note that the voltage shown at VT424 collector applies at 60V h.t. (b) Line timebase circuit. In earlier production C506 and C511 are 25μF, R510, 120Ω, VT503 type E1222 and L505/R531 are omitted. In the 3000 chassis R572 and R573 are 25MΩ and the e.h.t. is 24kV instead of 25·5kV: in consequence the wiring between T503 and T504 is slightly different, J of T503 being linked to tags E instead of to tag A of T504. In later production 3500 chassis J of T503 is connected to tag H of T504 instead. The transformers are coded to indicate the correct connections. (c) Beam limiter circuit. (d) Modifications to the beam limiter.

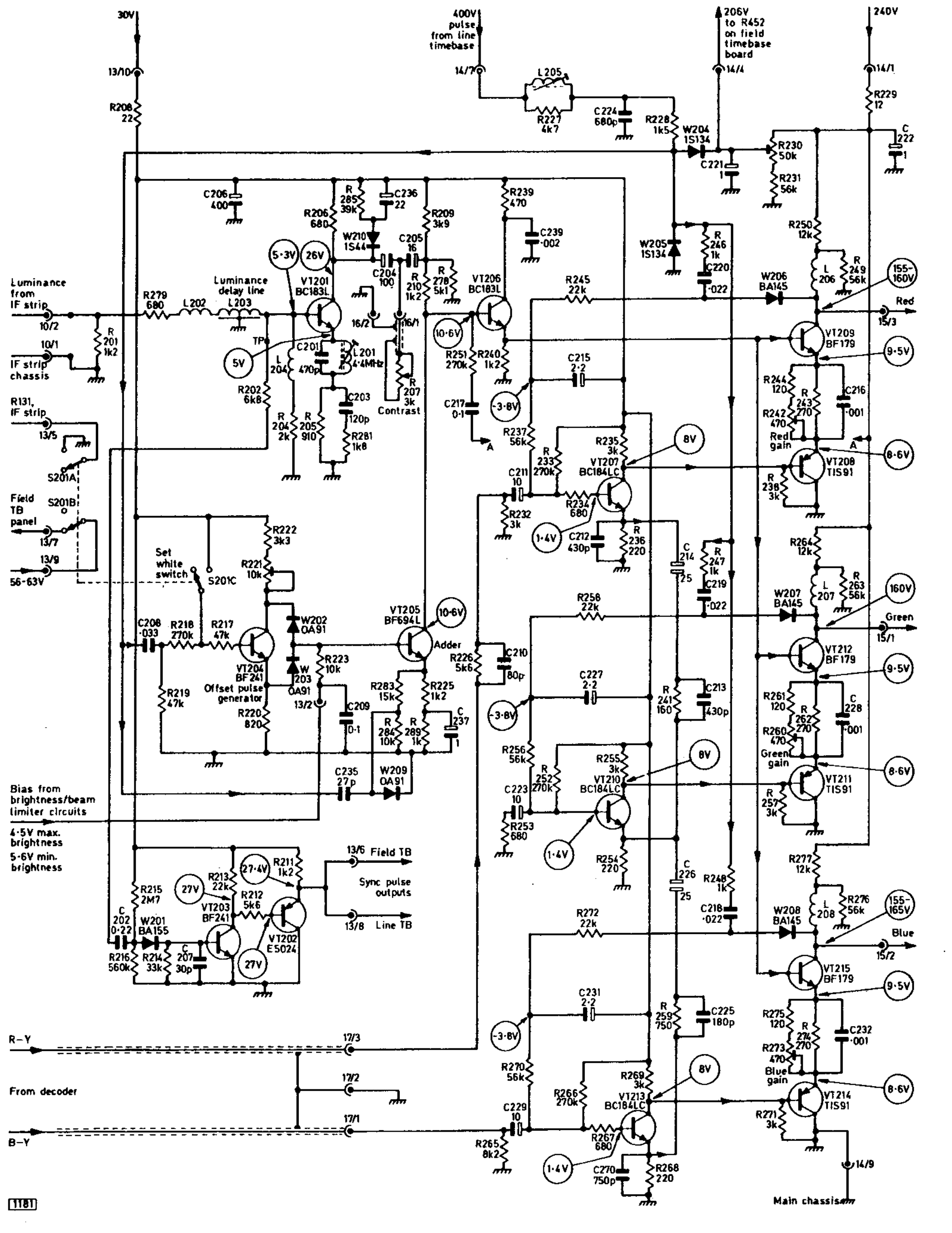


Fig. 2: Circuit of the video board. In earlier production R288 (1kΩ) is connected across L201, C239 omitted, VT203 and VT204 are type BF224 and VT205 type BF224L, C235 is 18pF, R242/R260/R273 500Ω, C215/C227/C231 2μF.

decouples the supply to VT421 has a habit of being intermittent with the result that lock is lost and no amount of hold control adjustment will restore it.

A number of faults are common in the field driver stage. Failure of the driver transistor VT423 will give no scan of course. Diode W422 can give satisfactory readings but nevertheless be the cause of false field lock and lack of height. The sit-up control R434 usually has a rough spot somewhere after a period of use and the effect is that the bottom of the picture rises and falls while horizontal lines may appear across the screen. The control must be replaced. Poor linearity is usually due to one or other of the field charging capacitors C427 (25μF) or C428 (10μF) being leaky, or alternatively the output transistor VT424.

If C432 (250μF) which decouples the supply to the output stage goes short-circuit the field will collapse and the associated dropper resistor R422 will probably be damaged and need replacement. The output transistor itself is reliable, though it can cause poor linearity. Cramping or foldover at the top can be caused by W423 or C429. Bottom cramping can be produced by C705 (400μF) on the convergence panel.

Blanking Circuit

We have experienced both the transistor (VT425) and diode (W426) in the blanking circuit go open-circuit and short-circuit. If the c.r.t. grid bias preset R450 requires adjustment this should be done as follows: turn the beam switches off and operate the set-white switch, connect a meter switched to the 100V range between one of the c.r.t. grids (pin 3, 7 or 12) and chassis (positive to chassis, negative to the grid) and adjust R450 for a reading of −20V.

Audio Stages

The audio circuits are d.c. coupled, the only unusual aspect being the loudspeaker impedance which is 80 Ω. Low output can be caused by the output coupling capacitor C409 (100μF) or C407 (32μF) which decouples the emitter of the first stage being faulty. C405 (250μF) which decouples the supply to the audio circuits can go short-circuit so that there is no sound. C401 (4·7μF) which decouples the bias applied to the base of the first stage can leak, producing distorted sound and overheating in the upper output transistor VT403. In the event of intermittent sound check for dry-joints or broken connections around the output transistors. Distorted sound can often be due to the loudspeaker.

IF Panel

The i.f. panel gives little trouble. Probably the most common faults are due to C179 (10μF) which decouples the a.g.c. line. When it goes open-circuit the symptom present is lines across the screen, similar to severe sound-on-vision. This trouble is most frequently experienced on earlier models. When C179 goes short-circuit there is no vision and weak or no sound. Note that when the raster is not synchronised foldover will be seen at the bottom. C177 (30μF) which decouples the supply to the first i.f. stage can be responsible for intermittent vision.

Low and distorted sound are often due to one or other of C158 and C159 (both 180pF) which tune the secondary of the ratio detector transformer. They usually go open-circuit, but sometimes intermittent. The 4·7μF electrolytic (C163) in the ratio detector circuit will produce distortion when open-circuit.

No colour can be due to the first chrominance transistor (VT110) which is on the i.f. board being defective, also to its output coupling capacitor C175 (0·01μF).

Video Panel

Faults on the video panel (see Fig. 2) are frequently due to defective electrolytics.

Favourites are the 2·2μF capacitors C215, C227 and C231 which are in the clamp circuits, developing the bias applied to the colour-difference amplifiers. They either go leaky or short-circuit and the result is the predominance of the colour produced by the channel of which they form part—for example when C215 is leaky there is excessive red. The same fault can be caused by the clamp diodes (W206, W207 or W208) going short-circuit. When C223 (10μF) which decouples the base of the green colour-difference amplifier goes open-circuit the picture is shaded purple and green—at first glance the effect can be mistaken for a purity error.

The clamp pulse amplitude control R230 should be set for 160V at the c.r.t. green cathode. If it is not possible to obtain this reading it is likely that C221 (1μF) is open-circuit.

The set porch bias control R221 sets the bias on the luminance driver transistor VT206: correct setting is when there is 10·7V at the base of VT206—a convenient point to take this reading is on a jumper lead behind VT202. When making this adjustment operate the set white switch and turn the beam switches off. If the correct reading cannot be obtained the two diodes W202 and W203 should be checked, also VT204 and VT205. Brightness troubles can also be caused by C519 and C520 from which the clamping and luminance offset pulses are derived in the line output stage, C902 (beam limiter board) which decouples the brightness and preset brightness controls, and lack of c.r.t. first anode voltage. If R221 is defective the symptom can be no luminance.

If C205 is leaky the base voltage of the luminance emitter-follower will fall: there will still be luminance but no colour due to the action of the clamps being affected.

If there is no luminance and the contrast control does not operate check C204 which can go open-circuit. Failure of the RGB output transistors VT209, VT212 and VT215 is often due to a flashover in the c.r.t. The colour-difference emitter-followers (VT208, VT211 and VT214) may also be damaged by the flashover. The thick-film load resistor arrangement is quite reliable, which is just as well since it would be rather an expensive way of replacing one resistor.

Decoder

As with the i.f. strip, the decoder is very reliable. The diodes around the burst channel fail however. A couple of electrolytics can give the no colour symptom, C330 (4·7μF) which is the reservoir for the chrominance turn-on bias and C325 (1μF) which decouples the supply to the ident amplifier. The arrangement used

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here is worth noting. The 7·8kHz ident signal is squared and used to operate the PAL switch, the switch's earth return current being smoothed to provide the chrominance turn-on voltage. The tuning of the ident coil (L303) is critical: it should be adjusted for maximum output at the collector of the ident amplifier VT306, using an oscilloscope to monitor the 7·8kHz signal. If it is impossible to get adequate output from VT306 check the decoupling electrolytic C321 (0·22μF) in its emitter circuit. If the coil is not correctly tuned there will be colour streaks on the right-hand side of the screen. The coil also tends to move on its former with the result that there is a vertical stripe of incorrect colour on the left- or right-hand side of the screen depending on whether the coil has moved downwards or upwards. It should be 0·45in. from the top of the former.

No colour is often caused by the pulse polarity splitter transistor VT308 going open-circuit. This drives the burst blanking diodes and also provides the burst gating pulse. If C337 (0·47μF) which feeds pulses from the collector of VT308 to the burst blanking circuit is leaky the picture will be tinted blue (becomes more marked as the colour control is advanced). If the diodes which clip the pulse waveform fed to the base of VT308 are faulty the chrominance can disappear from the right-hand edge of the picture.

To over-ride the colour killer connect an 82kΩ resistor from the junction of the ident coil tuning capacitors C323, C324 to chassis.

It must not be overlooked that the line hold control setting is critical for good colour reception.

Convergence Panels

As with most convergence units, noisy potentiometers are a common fault. If the blue line tilt and amplitude controls have insufficient range check the 10μF electrolytic C704 (3000 chassis).

The pincushion distortion correction transductor T751 going short-circuit is a problem on the 3500 chassis. The result is smoke, damage to the associated resistors and fuse blowing. There is also a tendency on this unit for R773 (120Ω) which feeds line frequency pulses to the transductor to burn up. Replacing it with a wirewound type stops this trouble. ■