RENOVATING the RENTALS

11 BRC 2000 CHASSIS

CALEB BRADLEY B Sc

PART 1

THE BRC 2000 chassis represented an important milestone in television receiver development, being the first ever all-transistor colour chassis. It is found in dual-standard colour models by Ferguson ("Colourstar"), Ultra ("Bermuda"—a long-used name), HMV ("Colourmaster"), Marconiphone and DER and is probably the most complex domestic device ever sold, since it came before such simplifications as single-standard (u.h.f. only) operation and the use of integrated circuits. It has nevertheless proved itself over about 7 years to be a most reliable design. If you know the stock faults it is easy to recondition an ex-rental 2000 set—if you can get one!

General Features

The chassis is a rectangular girder frame carrying eight detachable printed boards which are labelled with component references. If you happen to have spare boards servicing is easy: exchange boards are not too readily available now however. The general layout of a 25in. tube model is shown in Fig. 1. The 19in. chassis is similar except that the power supply regulator board is mounted piggyback fashion over the chrominance board, obstructing access to it. To overcome this, loosen four Phillips screws to allow the heatsink sheet to be detached from the supporting brackets: the assembly can then be parked vertically in slots provided in the left-hand bracket.

For general access loosen four large nuts on the outside corners of the frame to allow it to be slid out on rails. Retighten the nuts in this position. Access to the convergence board is obtained by sliding it out and propping it upright rather crudely on two metal tabs screwed to the top rear of the cabinet. Wires tend to tangle when this is done and for safety the set should be switched off while handling the board.

Board Removal

Before attempting to remove a board check that the set is switched off and that any flying leads are disconnected from the board. Remove or loosen the retaining pieces screwed to the frame. The board can then be pulled out of its socket. If necessary pass a screwdriver through the extractor tab and lever gently against the frame. Similar forceful means may be needed to return the board to its socket but be sure the board does not jam against one edge of the socket and avoid shear force which can crack the board. It is permissible to switch on the set with a board unplugged but switch off before replacing the board.

The board sockets themselves are a source of intermittent faults. Note that any individual pin of the socket can be driven out by means of a narrow screwdriver inserted at the far side from the connecting wire—never pull it out by the wire. If necessary retension the arms of the pin or remake the wire connection. This must be neatly crimped and soldered so that the pin slides back into the socket body.

Tuner

The tuner is an integrated u.h.f./v.h.f. six-button unit. Most of its troubles are minor mechanical ones although occasionally the BF180 r.f. amplifier or the BF115 (VT4, mixer on v.h.f., i.f. preamp on u.h.f.) transistor fails. Either will still let a snowy 625 picture through; the BF180 is definitely at fault if the 625 picture improves vastly when the aerial centre conductor is brought near the second tuned line. The circuit was published in our October 1970 issue (page 34).

Sometimes the tuning capacitor vanes touch: to avoid upsetting the alignment make the readjustment minimal. Often a pushbutton breaks internally so that it cannot be tuned by the user (although the channel can be tuned from behind with a screwdriver): it can be re-welded with a soldering iron. When pulling off a button grip the spindle with pliers to avoid straining a nylon part in the tuner mechanism.

System Switch

There is a spring-loaded strip visible inside the tuner. This operates the u.h.f./v.h.f. Band III/v.h.f. Band I switch. A screw associated with each button allows a 'pip' to be located in one of three holes in the bar for one of these three bands, reading from top to bottom. Intermittent tuner action or poor station reset accuracy can be due to the return spring weakening or the gang rotator bar coming adrift. It is possible to remove turns from the return spring to increase its tension. It is only rarely necessary to remove the band switch slider itself for contact cleaning.

In most areas every button should be set for u.h.f.-625 operation. Thus the 'pip' for each button should be set to the top hole in the bandswitch strip for u.h.f. There should be a spring (0085-084) and washer (00L6-014/131) behind the circlip on each pushbutton spindle for 625 use; ordering numbers are given in brackets in case you need to convert buttons from 405.

Single-Standard Use

It is tempting to cut off the wires to the system

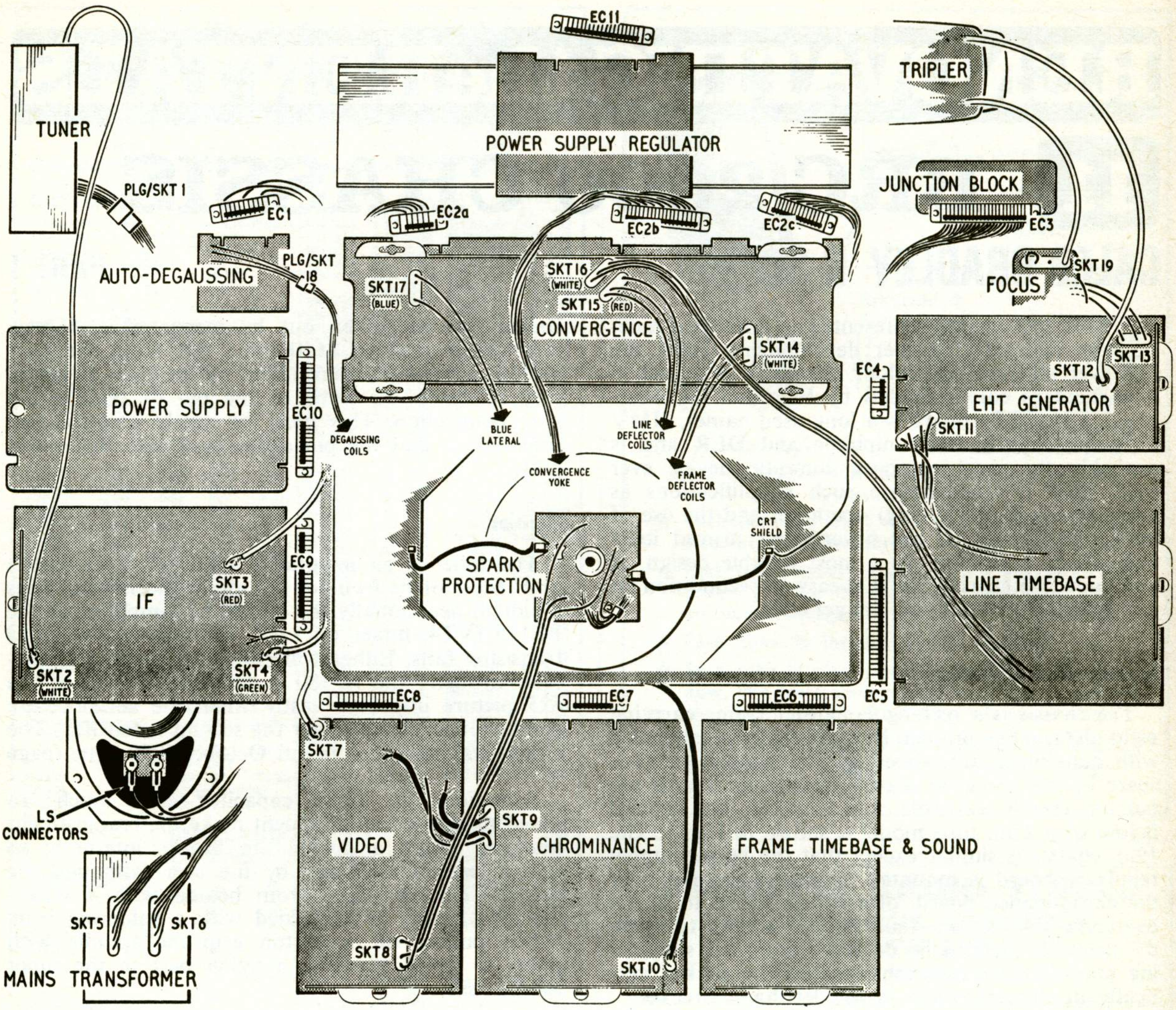


Fig. 1: Arrangement of the eight detachable printed boards. In 19in. models the power supply regulator board is mounted above the chrominance board on two brackets.

microswitch on top of the tuner for single-standard (u.h.f.-625) use and one often finds this done. It will cause viewer complaints about colour purity after weeks or months however because doing this also disables the automatic degaussing. The best way of disconnecting the system solenoids on the i.f., line timebase and convergence boards is by opening the fusible resistors R16, R17 and R18 on the power supply board. For utmost reliability the system switch contacts can be soldered in the 625 position: when servicing however it is helpful to be able to operate a switch by hand to check whether a fault exists on the 405 side as well.

Misleading Fault Condition

A misleading situation can arise if the line timebase system solenoid is "chopped" and the set transported much. The system switch delights in settling into an intermediate position: this causes one of the two 30V rails to be pulled down (see line timebase later)—a deliberate arrangement to prevent the c.r.t. being damaged by video drive with no line scan—presenting a misleadingly "dead" set with the symptoms of a 30V rail short. Shove the offending switch and everything comes alive.

Video Board

The circuit of the video board marked "235" is shown in Fig. 3; this is a slightly modified version of the earlier board type 135. In particular type 135 has the following component differences: R38, R58 and R75 are 50Ω presets; R39, R59 and R76 are 82Ω; R40, R60 and R77 are 33kΩ; R42, R61 and R79 are 25kΩ presets; R46, R47, R65, R66, R83 and R84 are 68kΩ; R48, R67 and R85 are 6kΩ 9W wirewound. In addition the following were omitted on the earlier board: clamp diode shunt resistors R86, R87, R88; optional bias reducer resistors R89, R90, R91; luminance delay line terminating resistor R93 and pre-delay-line choke L10. Instead of the latter a choke L5 was fitted immediately after the delay line.

A niggling incompatibility arises if a 235 video board is operated with a line timebase below serial

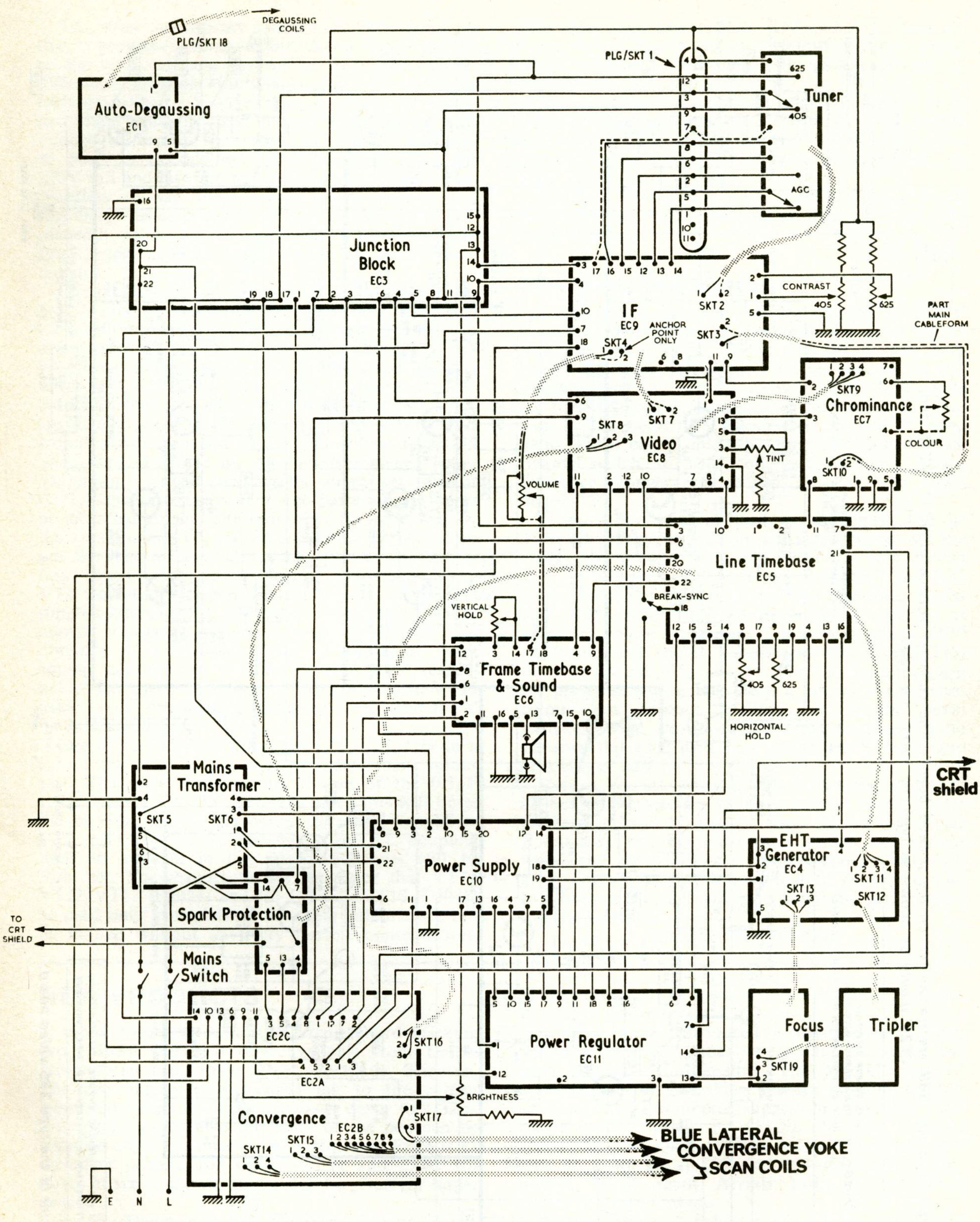
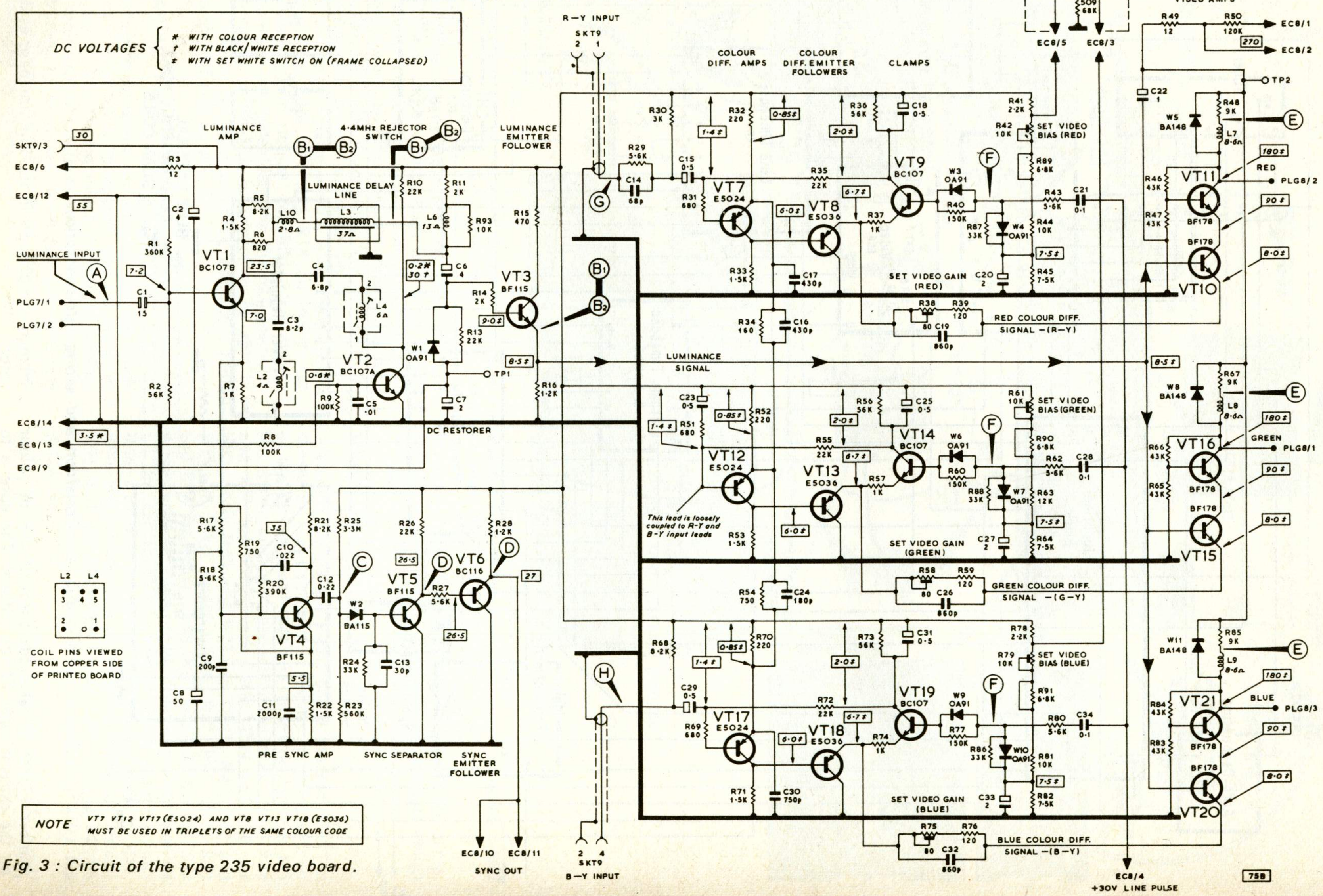


Fig. 2: Cableform and wiring interconnections.

number 12,000. It takes the form of loss of colour on the extreme right of the picture. The cure is to change components in the line timebase as described later.

Corrections : *R42 and R89 are transposed on the printed board. The collector voltage of VT11, VT16 and VT21 should be shown as typically 190V, not 180V.*

DC VOLTAGES
- * WITH COLOUR RECEPTION
- † WITH BLACK/WHITE RECEPTION
- ‡ WITH SET WHITE SWITCH ON (FRAME COLLAPSED)



NOTE VT7 VT12 VT17 (E5024) AND VT8 VT13 VT18 (E5036) MUST BE USED IN TRIPLETS OF THE SAME COLOUR CODE

Fig. 3 : Circuit of the type 235 video board.

The most noteworthy feature of this circuit is that it provides primary-colour drives (R, G and B) to the c.r.t. cathodes instead of using the colour-difference principle (luminance "Y" to all three cathodes with R−Y, G−Y and B−Y to the respective grids) generally used in early colour sets. High-voltage transistors were then less readily available so pairs in cascode were used to work from the 270V rail and give the required signal voltage swing. Needless to say these output pairs usually fail together, causing one gun of the c.r.t. to switch permanently on or off. But note that a turned-on gun may simply be due to L7, L8 or L9 going open-circuit.

Circuit operation is as follows. Luminance from the i.f. board is fed via VT1 to the usual delay line L3 which compensates for the different delay times experienced by the luminance and chrominance signals. Intermittent luminance troubles can be the result of L3 breaking away from the printed track. Note also that it is convenient to connect our video crosshatch generator (TELEVISION September 1972) output across one end of L3. On colour reception only, VT2 is turned on by the chrominance board colour killer circuit, making the subcarrier rejector C4/L4 operative to prevent fine patterning in areas of saturated colour. The luminance d.c. level lost by the a.c. couplings C1 and C6 is restored by W1 which sets the sync tip level at a voltage set by the brightness control (see power supply). Emitter-follower VT3 (sometimes responsible for smeary luminance) supplies luminance to the bases of the lower cascode output transistors. The red and blue drives are obtained in VT10 and VT20 by means of base-emitter addition of Y to R−Y and B−Y respectively. The green drive is similarly obtained in VT15 using G−Y obtained by summing R−Y and B−Y by R34 and R54.

One of the 0.5μF electrolytics C15, C23, C29 in a colour channel can fail, causing a permanent colour cast. The same result occurs if one of the 0.5μF electrolytics C18, C25, C31 fails since this will upset the bias on one of the colour-difference amplifiers VT7, VT12 or VT17: because of the d.c. coupling used all voltages in the affected channel will be incorrect. The manufacturer's insistance that VT7/VT12/VT17 (E5024) and VT8/VT13/VT18 (E5036) be used only in triplets of matching colour code can be flouted without any very terrible consequences.

The video gain presets R38, R58 and R75 often get noisy which shows as an intermittent tint change while viewing. Treatment with switch cleaner is usually only partially successful.

There are two components which fail with nasty repercussions elsewhere. C22 shorts, opening fusible resistor R20 (it may also destroy VT2-BFY50) in the power supply. Also R50 changes value causing an a.g.c. circuit burnup (see i.f. board).

The sync separator is VT5; a component to watch here is C8 which fails causing no field lock and only weak line lock.

Grey-Scale Adjustment

Grey-scale adjustment, which ensures a neutral monochrome picture and is essential for good colour reproduction, is more critical with RGB than with colour-difference drive sets. First set controls as follows: Viewer tint control midway; CRT first anode (A1) presets (convergence board) clockwise; R video gain (video board) 45° clockwise; G and B video gains (video board) midway; Set white (convergence board) switch to field collapsed position; Video reference (convergence board) for 9.5V at video board TP1.

Connect the positive lead of the meter (on its 250V d.c. range) to TP2 on the video board. Set the video bias presets R42, R61, R79 for 80V (board 235) or 90V (board 135) across R48, R67 and R85 respectively. On board 235 the shorting links across R89, R90 or R91 may be removed or replaced as necessary. Now set the c.r.t. grid bias preset (R30 on frame and sound board) for 40V (board 235) or 30V (board 135) at c.r.t. pin 12. Advance each A1 preset slowly in turn until a line of the relevant colour just appears, making use of the beam switches. With worn tubes it may be necessary to advance the c.r.t. grid bias preset for a maximum grid bias of 60V.

Return the set white switch to normal and with all beams switched on set up a normal monochrome picture, ideally of colour bars (i.e. a grey-scale staircase). Trim the video gain presets for neutral white and the video bias presets for neutral dark grey. The viewer tint control merely varies the relative bias in the red and blue channels, giving quite a pleasing effect.

TO BE CONTINUED

NEW PRODUCTS

A useful nylon-tipped printed-circuit board marking pen (Model 33PL) is now available from Decon Laboratories Ltd., Ellen Street, Portslade, Brighton. The pen applies etch-resistant ink to the copper laminated board in line thicknesses down to 1/32in. —a spare nylon tip in the body of the pen can be trimmed down for finer work if required. Price is £1 including postage for single orders and £3.85 for boxes of six—separate quotes will be given for larger orders.

R. W. Dixon and Co. (Winton, Beacon Road, Crowborough, Sussex) have introduced a TV listening aid, the Soundmaster, for the hard of hearing. The device operates on the loop induction principle and is not connected to the set therefore: a loop from the set's loudspeaker is taken round the room so that units can be used in any position. A volume control is incorporated.

J Beam have introduced a massive new array intended for use in areas where u.h.f. reception has been difficult or impossible. The MBM70 has 17 multiple director assemblies and for absolute rigidity an extra long trombone support is provided. The recommended price is £11.50. Stacked (Model 2MBM70) and quad (Model 4MBM70) arrays will also be available at £27 and £54 respectively. Enquiries to J Beam Aerials Ltd., Rothersthorpe Crescent, Northampton.

A new low-cost colour-bar generator has been announced by Labgear. The aim is to enable service engineers to do a greater percentage of colour service work in the field. The generator has been jointly developed by Labgear and Granada TV Rentals and is to sell at £80 trade.

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E.H.T. AND POWER SUPPLIES

The basic e.h.t. generator (see Fig. 4) is very simple and consists of VT7 which is switched at line frequency (the drive is obtained from a separate secondary winding on the output transistor driver transformer in the line timebase and is connected via PLG/SKT11, pins 1 and 2) and drives T1 which steps up the flyback pulse to about 8kV to feed the tripler. This supplies 24kV d.c. to the c.r.t. final anode. The tripler is mounted on the c.r.t. itself whose final anode capacitance forms part of its circuit. W3 acts as an efficiency diode while C9 tunes the "flyback" pulse. A common failure here is the tripler itself; this may in turn damage VT7 causing the power supply trip to operate. An unpleasant brushing effect on the picture can be due to corona in T1.

The e.h.t. regulator circuit occupies the rest of Fig. 4. The e.h.t. voltage is divided down by v.d.r.s Z501, Z500 and R506 and compared by the long-tailed pair VT2/3 with a zener stabilised voltage from R14 (set e.h.t.). The c.r.t. focus voltage (4–5kV) is taken from a slider on Z500: on early sets this focus control becomes intermittent but the trouble can be cured by taking it to pieces and rubbing the slider with fine emery paper.

VT2/3 drive VT4 which drives VT5 which in turn drives the series regulator VT6 for the e.h.t. generator supply. Zener diode W2 prevents excessive drive to VT5 and VT6. If the feedback voltage from R506 is absent VT1 turns off and prevents VT3, VT4 etc. passing excessive current. Do not adjust R13 unless 24kV cannot be obtained with R14. R13 is factory set for 26kV maximum e.h.t. Running at higher e.h.t. than 24kV for any length of time is certain to damage the tripler. Tripler life can be prolonged by setting R14 for an e.h.t. of 22-23kV.

Failures in the e.h.t. regulator are generally con-

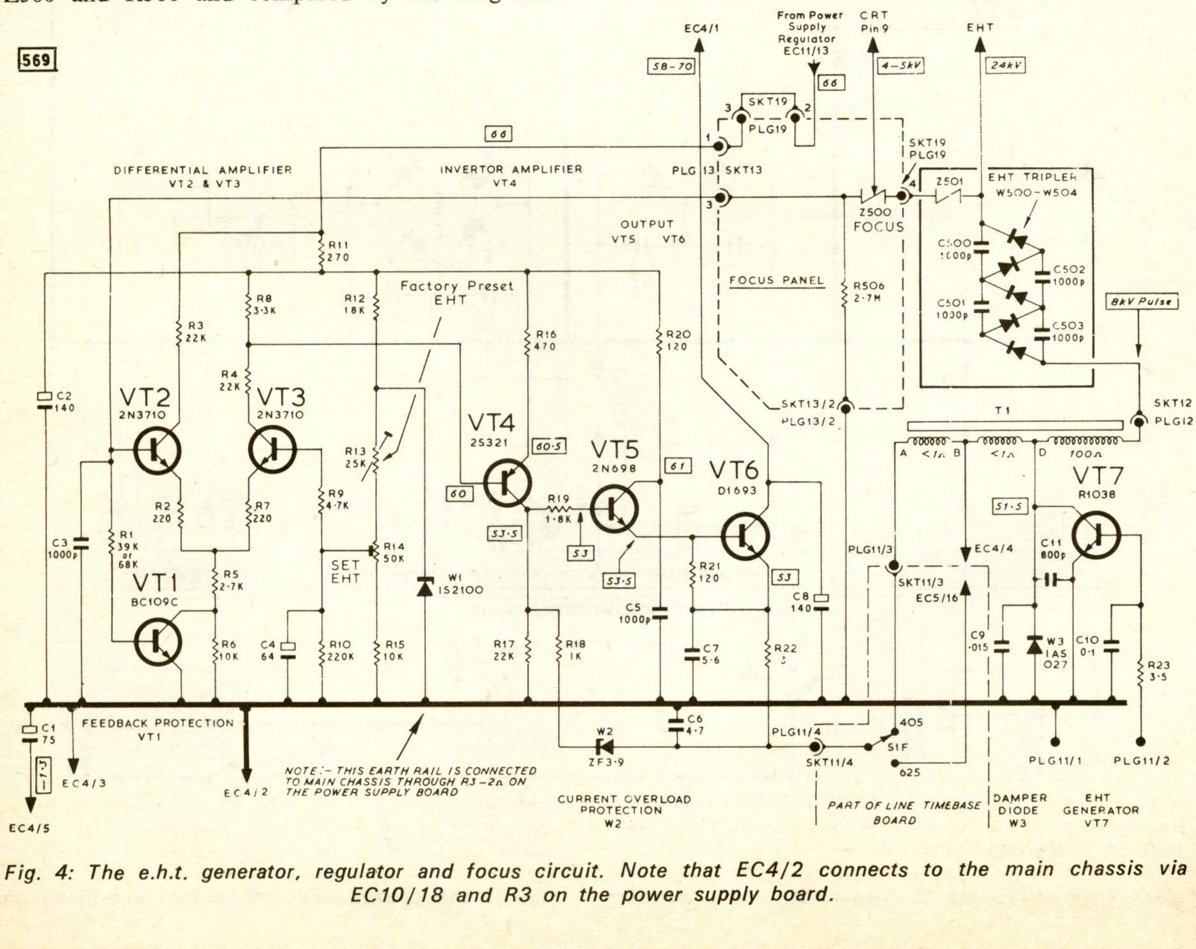

Fig. 4: The e.h.t. generator, regulator and focus circuit. Note that EC4/2 connects to the main chassis via EC10/18 and R3 on the power supply board.

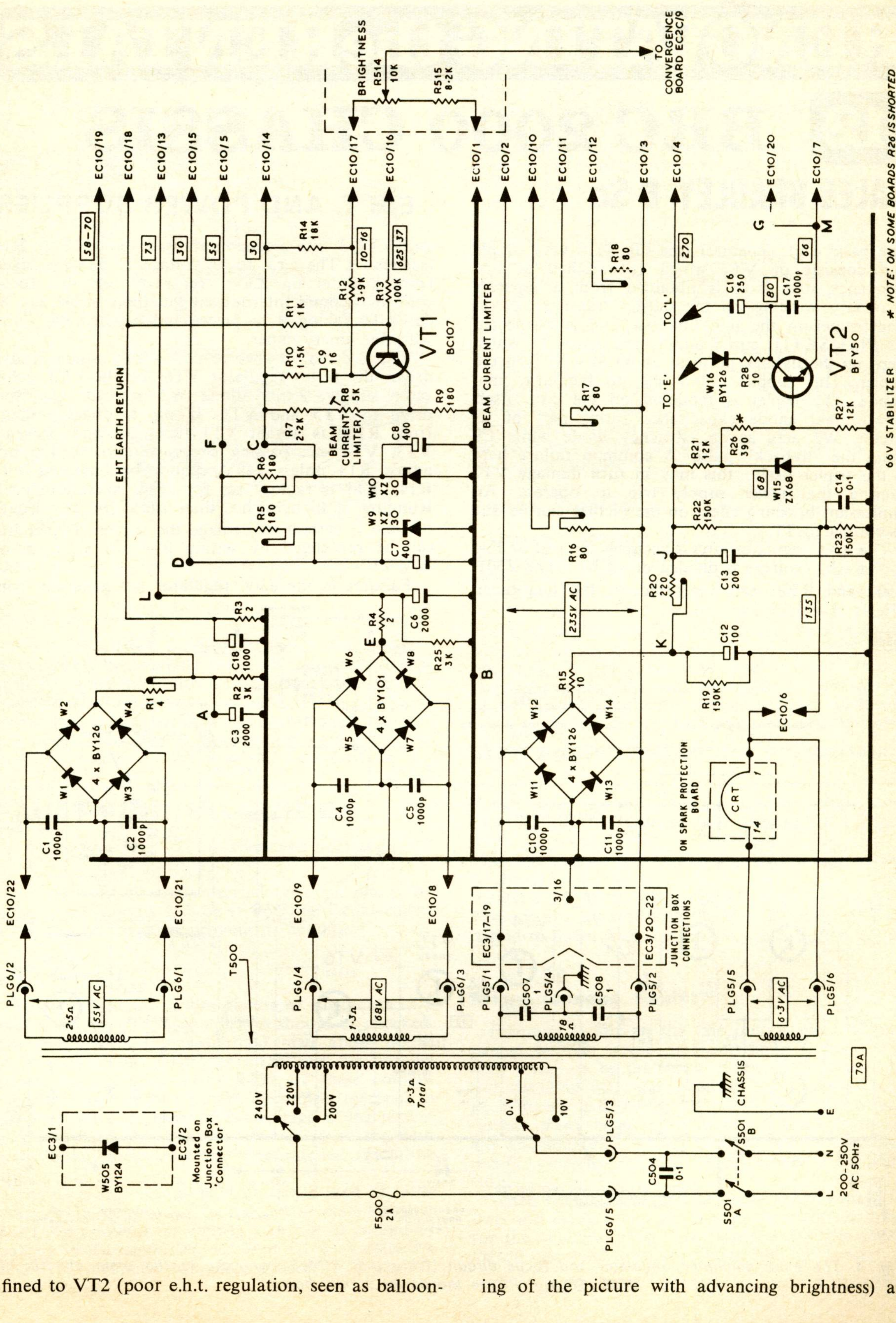

Fig. 5: The power supply circuit.

fined to VT2 (poor e.h.t. regulation, seen as ballooning of the picture with advancing brightness) and

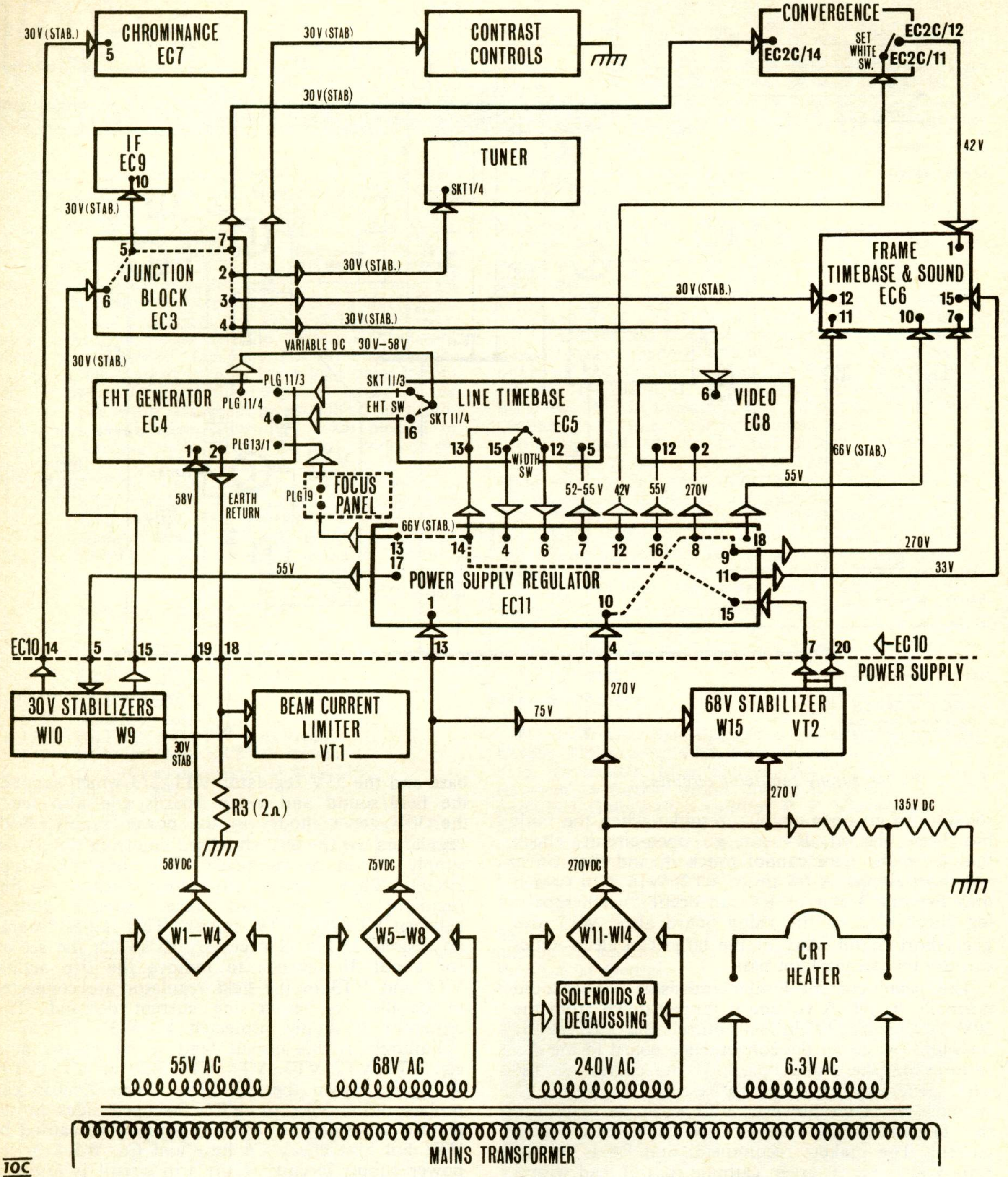

Fig. 6: Power distribution. The voltages shown are nominal.

VT6 going short-circuit. The latter causes a small picture with sky-high e.h.t. Unadjustable e.h.t. can be due to a faulty W1. C2 and C8 can explode with no apparent reason.

An important servicing note is that the e.h.t. board earth, including the extractor tab, is returned to the main chassis via R3 (2Ω, see Fig. 5) in the power supply circuit, decoupled in Fig. 4 by C1. For correct operation there should be less than 1.5V negative across C1; more suggests that VT6 or VT7 is shorted or that the tripler is faulty.

The power supply circuit is shown in Fig. 5 and the power distribution in Fig. 6. Separate bridge rectifiers provide supplies of approximately 58V, 73V and 270V d.c. The only common fault is in bridge W5-8 although mains transformers with shorting primary turns have been encountered.

Most supply shorts cause one of the seven fusible

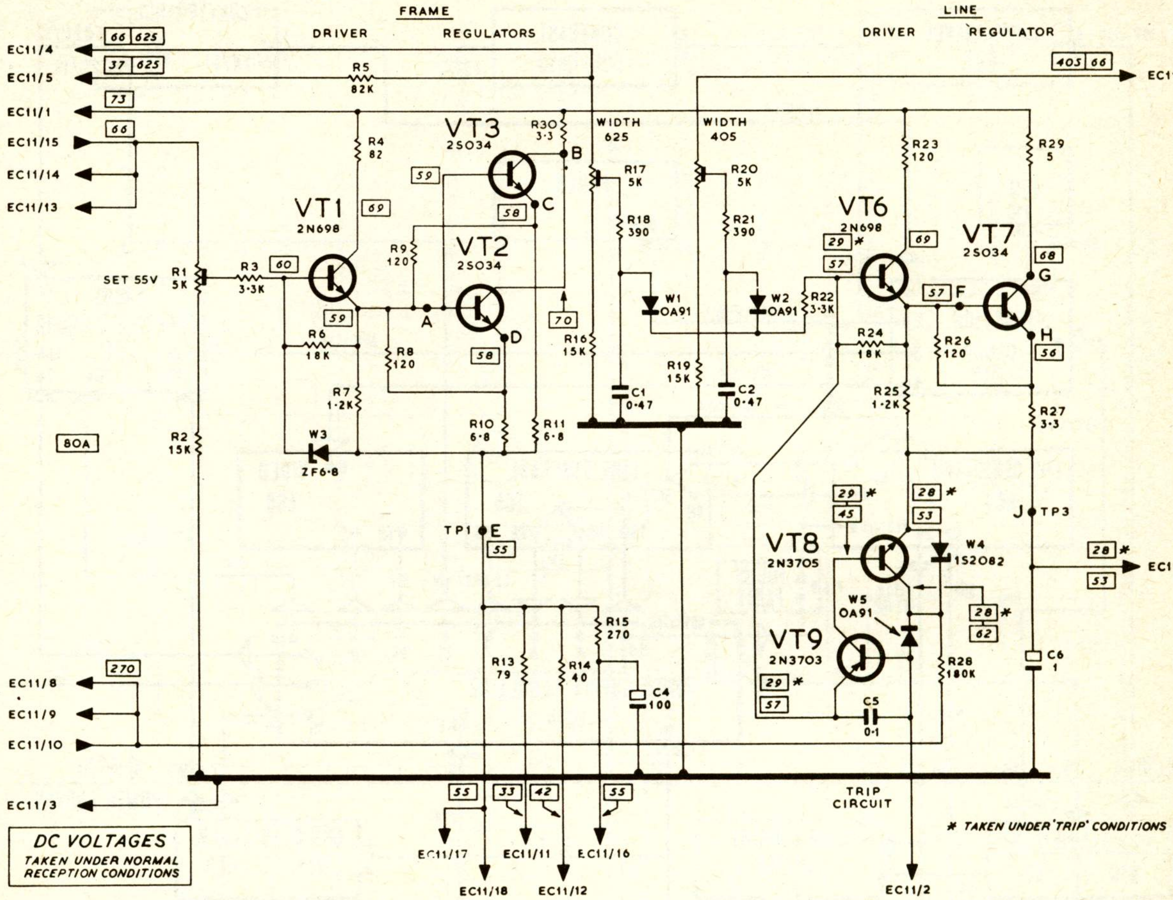

Fig. 7: Power supply regulator circuits.

resistors to go open-circuit: resolder when the fault has been cleared. R4 can go open-circuit—check that a nearby wire cannot touch it, and that C6 is not short-circuit. A fry up of VT2, W16, C16 (which may explode!) and/or R4 can occur: when repairing check C22 on the video board also. W15 also goes short-circuit. Any of the large can electrolytics can dry up causing hum bars.

The beam current limiter transistor VT1 should normally be off. A voltage is tapped down from the 30V rail by the brightness control and fed via the set white switch on the convergence board to the d.c. restorer on the video board. If the current in the e.h.t. generator earth return resistor R3 in Fig. 5 becomes excessive however VT1 turns on to reduce the brightness and prevent excessive c.r.t. beam current. The makers recommend that R8 is set for 850μA at the c.r.t. green cathode (pin 6) lead with a normal contrast picture and the brightness fully clockwise. The lead can be unplugged from the c.r.t. base for this measurement. A faulty VT2 can cause uncontrollable beam limiting.

The c.r.t. heater is kept at approximately 135V by R22/23. This is done to minimise strain on the heater-cathode insulation.

The power supply regulator circuit shown in Fig. 6 receives 75V from the power supply and consists of regulator VT6/7 which supplies 52–55V (depending on the width control setting) to the line timebase and the 55V regulator VT1/2/3 which supplies the field/sound and video boards and also feeds the 30V zener diodes in the power supply. Both regulators use the 66V stabilised line from the power supply circuit as reference. The unijunction-type circuit VT8/9 forms a trip which disables the line regulator if an overload causes excessive voltage between VT8 and VT9 emitters. This causes "sound, no vision" and it is necessary to switch the set off for about 30 seconds to remove the trip action. VT2 and VT3 in the field regulator are connected in parallel to handle the current demand. This regulator is simply protected by W3.

Failures in this circuit tend to be catastrophic, e.g. VT1/VT2/VT3, VT6/VT7/R29 or VT8/VT9/W5 going down together. The cheap 2N3055 can replace VT2, VT3 or VT7. S-shaped sides to the picture and side-to-side line jitter may be caused by VT7 but also check C6 here and C6, W5–8 in the power supply circuit. If the trip circuit is faulty it can of course be cut out to restore the line scan but one should not operate the set this way. Sets have also been seen where VT7 had gone open-circuit and had been simply bridged collector to emitter to restore the line scan (grossly overscanned unless a wirewound resistor is used). This is not good practice! A faulty VT7 or open-circuit width control will cause ripple on picture verticals. With older type e.h.t. boards (square transistors) the trip circuit can be temperamental: reducing R27 (3.3Ω) to 1 or 2Ω cures this.

TO BE CONTINUED

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— TIMEBASES

We shall deal this month with the timebases. The field ("frame") timebase and audio circuits are on the same board, see Fig. 8: also on this board are certain stages relating to the c.r.t. grid circuit, the blanking transistor VT6 and brightness stabiliser stage VT7 (see Fig. 10).

With earlier boards field collapse is often due to W4 (OA5) going open-circuit: the BA148 used on later boards is a much more reliable replacement. Failure of VT3 gives the same symptom. The only other common frame fault is reduced height with bottom cramping in which case leap for the bootstrap

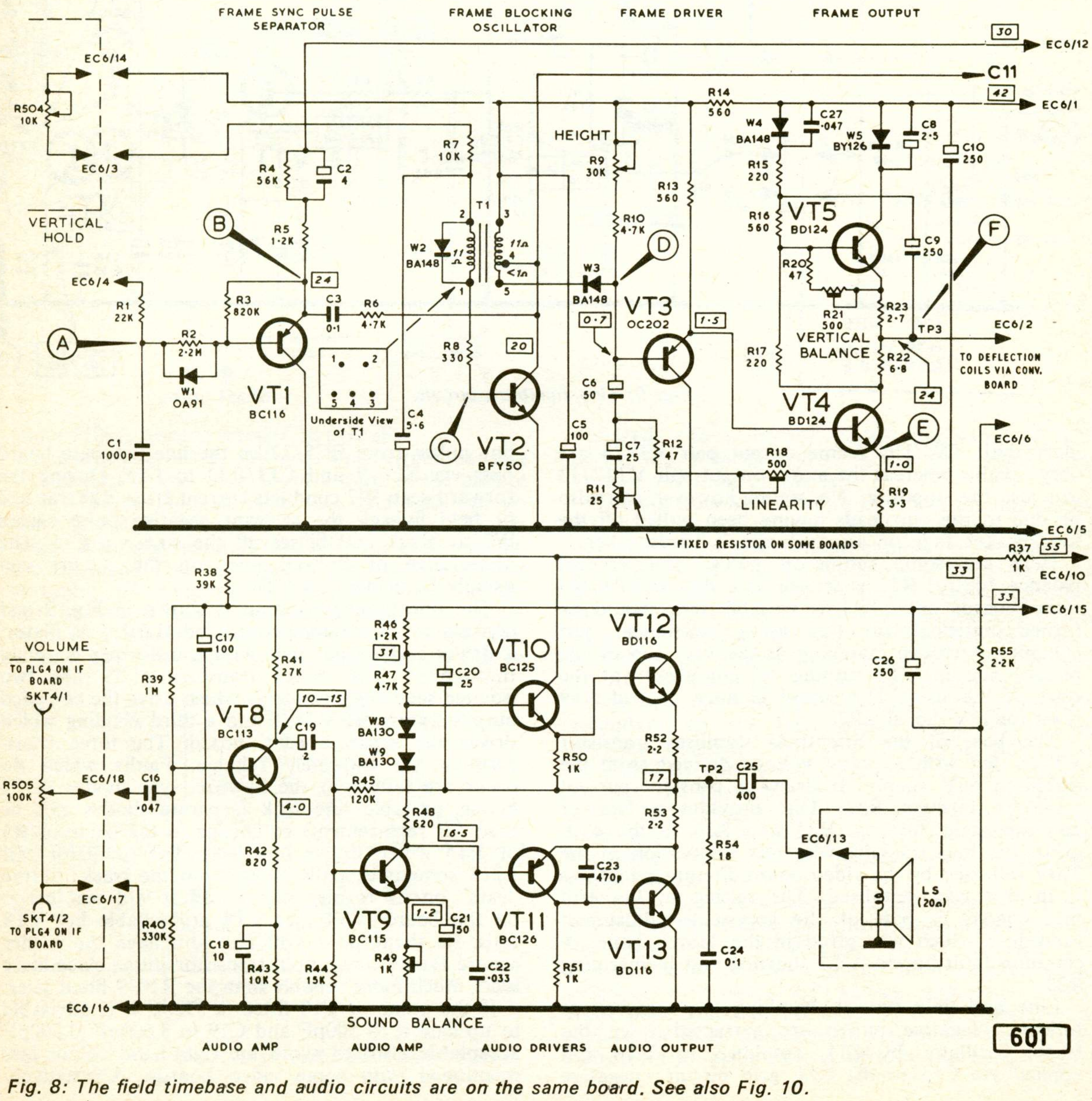


Fig. 8: The field timebase and audio circuits are on the same board. See also Fig. 10.

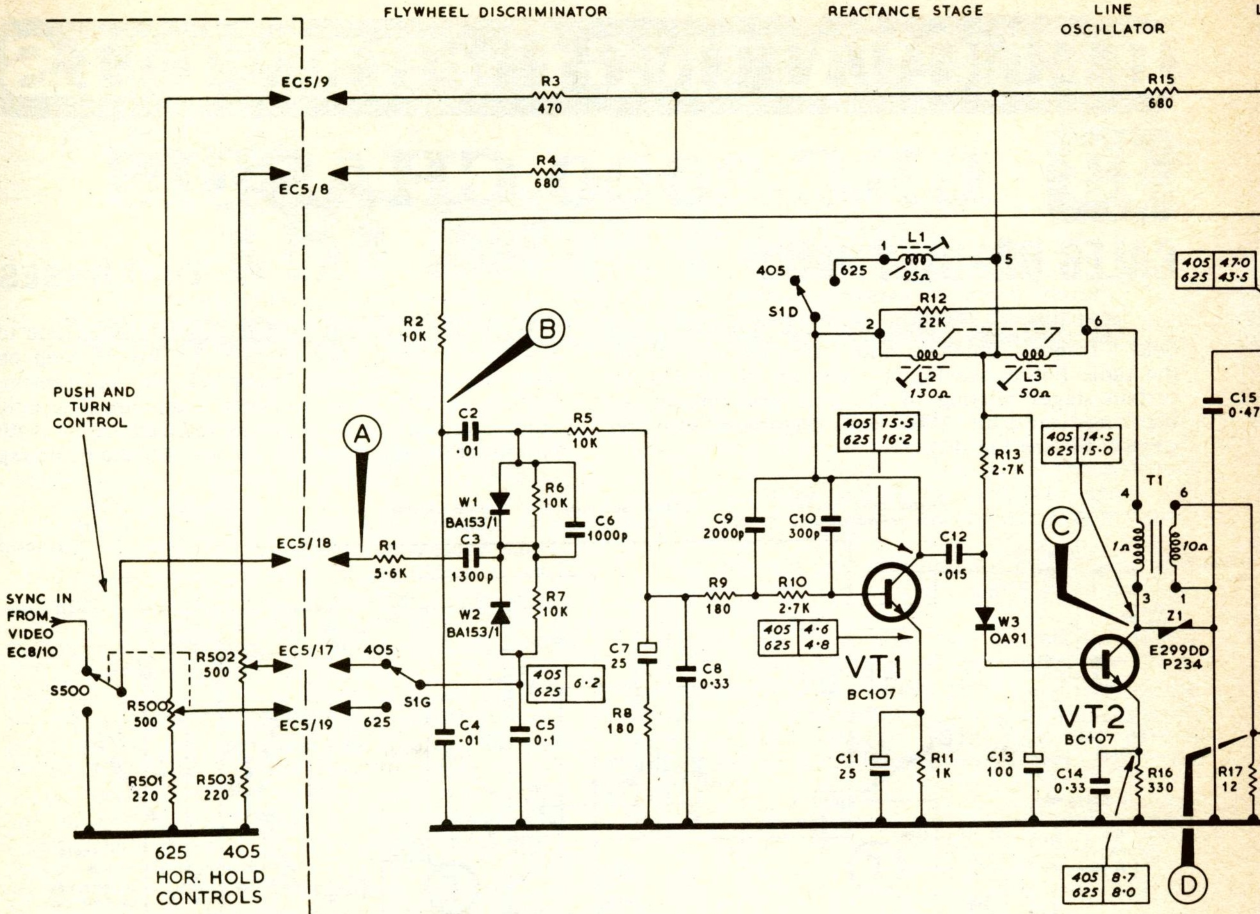


Fig. 9: Line timebase circuit.

electrolytic C9. The frame output pair VT4/5 are very reliable whereas the audio output pair VT12/13 are just the opposite. No sound however can also be due to the clip leads having been pulled off the loudspeaker tags or an open-circuit loudspeaker.

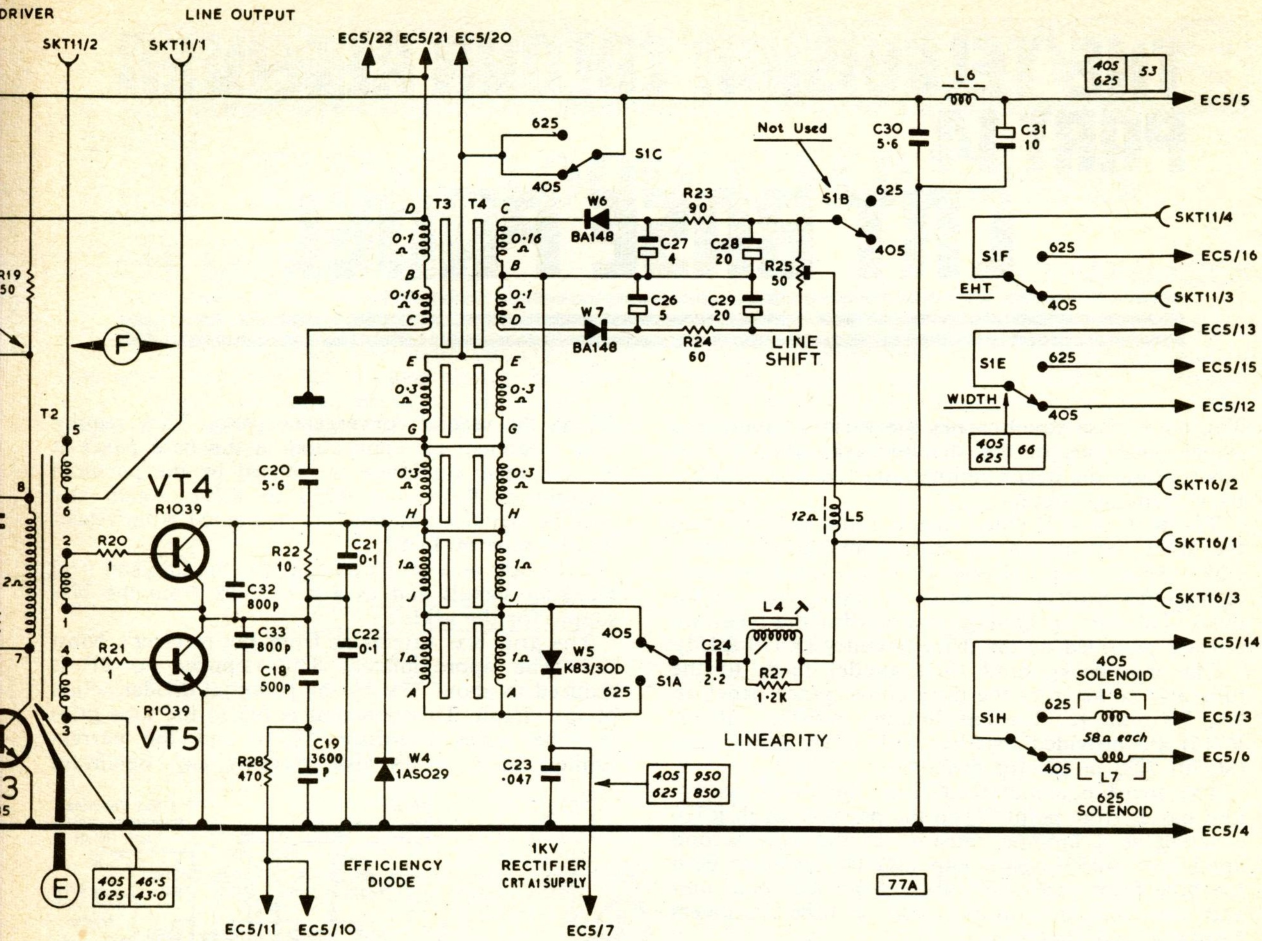
Here are some setting-up notes. The vertical balance control R21 is set for 24V d.c. at TP3. On some boards only, R11 is variable and should be turned anticlockwise (increasing resistance) just enough to remove cramping at the very top of the picture due to VT4 turning off completely at the start of the scan. The sound balance control R49 is set for 17V d.c. at TP2.

The base of the brightness stabiliser transistor VT7 is fed with a preset voltage derived from the stabilised 66V supply. It draws a constant current therefore through R33. This provides a bias of approximately 30V via R35 and R36 to the c.r.t. grids, the bias tracking with any fluctuation in the 270V rail used by the video board. Picture brightness is in this way stabilised. The setting of the grid bias control is part of the grey-scale adjustment procedure which was given in the March issue. A common fault here is VT7 shorting and incinerating R33.

Line and field flyback blanking are achieved as follows. Negative pulses are extracted from the frame oscillator by C11, amplified by VT6 and applied via C15 to the c.r.t. grid circuit; negative line pulses from EC5/22 on the line timebase board pass via EC6/9 and C13/R32 to C15. During the forward scan W7 conducts current from R28: at line or field flyback the relevant negative pulse causes W7 to block and biases off the c.r.t. via C15. The appearance of flyback lines on the picture can usually be blamed on VT6.

The line timebase circuit is shown in Fig. 9 and consists of a reactance controlled Hartley oscillator, a driver and output pair with transformer coupling throughout. The driver transformer T2 has two isolated secondary windings which drive the cascaded output transistors VT4/5 and a third winding which drives the separate e.h.t. board. The three transformers are extremely reliable. Faults which do occur are failure of the flywheel sync diodes W1/2 giving unstable line lock (separate diodes can be used for replacement) or change in the value of R3 or R15 which upsets line lock. The oscillator coil L2/3 sometimes pulls away from the track: if the "ears" on its former are cut off it will seat better on the board. VT1 and VT2 are reliable but VT3 fails. Be thankful if you find you have the earlier square D1418 line output transistors fitted since these seem much more reliable than the R1039 fitted later.

If the value of C18 fitted is 330pF it is advisable to up-date it to 500pF and C19 to 3,600pF (3,000pF acceptable also) to avoid the right-hand colour loss mentioned with some video boards. Alternatively



add a 150kΩ resistor across C18 (330pF).

The efficiency diode W4 goes open-circuit causing a brightness change over about a third of the picture (not foldover though). Also C21 and C22 can go leaky. The c.r.t. first anode supply reservoir C23 can short: this removes all picture since the power supply trip operates. The A1 supplies can also be shorted by faulty 1nF smoothers on the convergence board; this burns up associated resistors and the beam switches. The A1 supply rectifier W5 (which can make a bad smell when it goes short-circuit) can be replaced with a BY127. Check the value of R27 across the linearity coil if the picture suffers from vertical striations on the left.

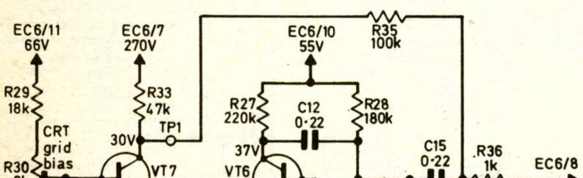


Fig. 10: The brightness stabiliser and flyback blanking circuits are also on the frame board.

The contacts S1C serve to interrupt the h.t. supply during a system change. Note also that the lead out at EC5/20 goes to the cathode of a diode on the junction block EC3; the anode of this goes to the main 30V rail. With S1C in an intermediate position the 30V rail is heavily loaded giving the impression of a short on the rail—see "a misleading fault condition" in the March issue instalment. The contacts of S1C take a heavy current and become pitted.

The line shift voltage is obtained from an isolated secondary on the line output transformer. This supplies rectifiers W6 and W7. The output is smoothed by C26 to C29, tapped off by R25 and fed through the line scan coils via the isolating choke L5. If R25 comes to one end of its travel and you need more shift try swapping R23 and R24. If the horizontal shift control is completely ineffective check W6 and W7.

Finally this month some further notes which got left out of the March instalment when we dealt with the video board. If R50 has to be replaced use a resistor rated at 1W or more. The luminance input coupling electrolytic C1 causes numerous faults from poor video to no sync. If it is necessary to replace the RGB output pairs it is best to use BF179 transistors in place of the BF178s for better reliability.