servicing The TELEFUNKEN 711 CHASSIS

PART 1 P. C. MURCHISON

THE Telefunken 711 chassis is used in a series of solid-state 110° colour sets. Receiver model numbers are 623, 733, 743, 753, 763, 773, 783 and 793. It has a transistor line output stage (BU108/BU208) and employs a number of i.c.s. The i.f. strip consists of a TBA440 or TDA440 i.c., the sound channel comprises a TBA120S intercarrier sound i.c. followed by a TBA800 audio i.c., while the decoder is of the four-i.c. variety — TBA540/TBA560A/TBA520/TBA530. There is also a later, very slightly modified version called chassis 711A. Models using this are the 624, 734, 743, 753, 7044, 764, 7064, 844, 864, 8064, 874, 884 and 984.

These sets have been around for several years now, during which time various stock faults have become known and standard servicing procedures established. The purpose of this article is to describe these and also the operation of the more unusual circuitry found in the receiver — such as the bridge field output stage!

Receiver Assembly

The basic receiver consists of a touch-sensitive tuning arrangement, a signal board which incorporates the four-i.c. decoder, the tuner, the i.f. strip and the RGB output stages, a main chassis which houses the timebases, raster correction and power supply circuitry, and an auxiliary con-

vergence panel. All basic units are unpluggable and the complete chassis can be easily removed from the cabinet to facilitate servicing. This is perhaps just as well since some rather nasty faults can develop and it is often easier to remove an entire subassembly in the field and take it to the workshop for more detailed examination.

Convergence

Both the static and dynamic convergence can be adjusted from the front of the receiver since the convergence board is situated in the base of the cabinet, beneath the c.r.t. The convergence housing can be slid out by inserting a screwdriver into the slots at the left- and right-hand ends of the housing. By pressing the plastic clips inwards and downwards the housing can be slid out of the front of the set, revealing 28 clearly marked controls which are to be adjusted in numerical order. Convergence is easily adjusted and needs no more mention save just to point out that static convergence is achieved by passing d.c. through the coils.

Power Supplies

The heart of the set is the power supply unit, where many of the faults occur. There are four basic power supply lines in the receiver, designated U1, U2, U3 and U4.
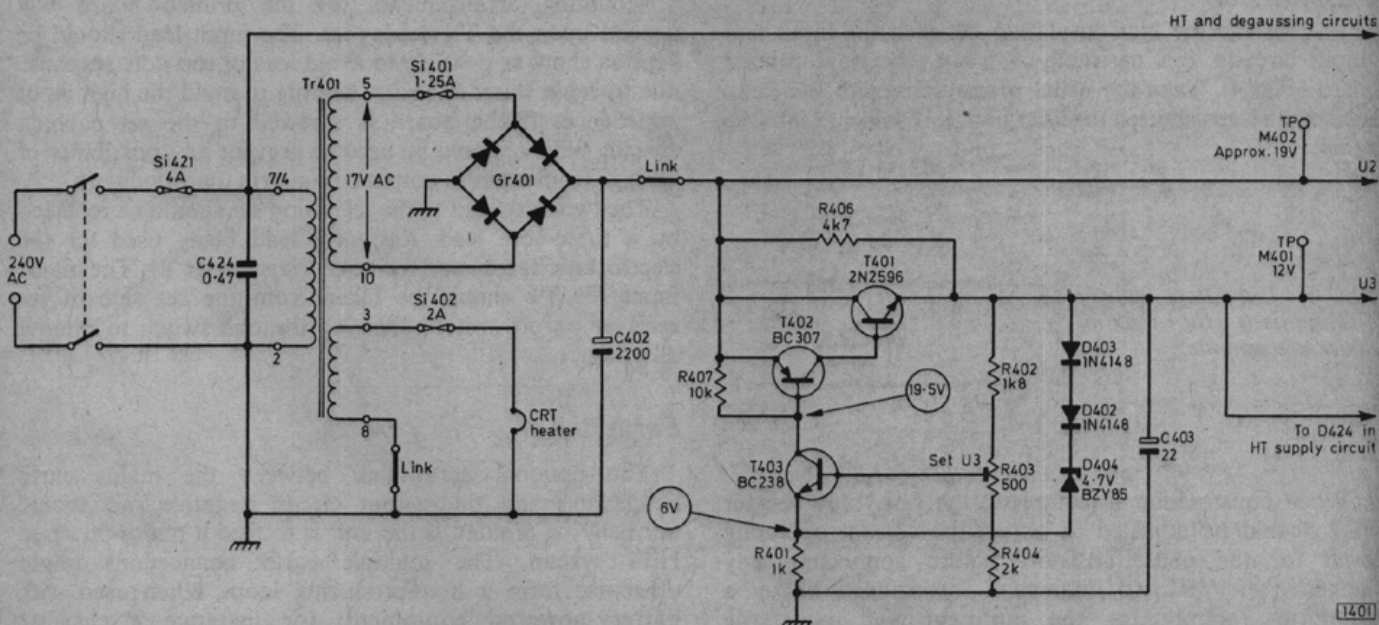

Fig. 1: The mains input and low-voltage power supply arrangements. The U2 voltage should be within the limits 18-20V, depending on the sound level. The U3 (12V) supply is set up by connecting a voltmeter from test point M401 to chassis and adjusting R403 for 12V.
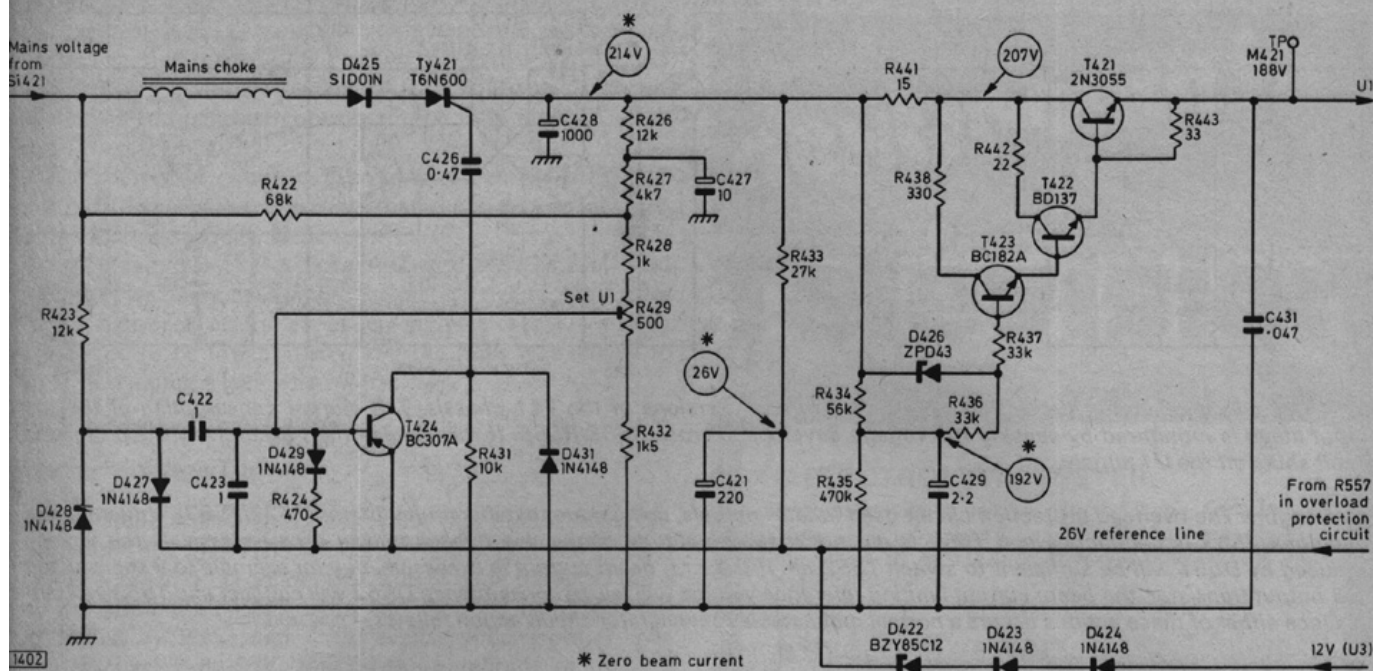
Fig. 2: Circuit of the U1 188V stabilised power unit and the electronic smoothing circuitry, which feed the line output stage and the RGB output stages. In later production D425 was replaced by a shorting link. The 26V reference line is provided by R433/C421 and is stabilised by returning it to the stabilised 12V line via the 12V zener diode D422 and the temperature compensating diodes D423/D424. The control transistor T424 is protected by diodes D429 and D431.

The U4 stabilised 28V line is derived from the line output stage and feeds the field timebase and the convergence circuits. The EW diode modulator acts as the rectifier for this supply.

The U2 supply is an unstabilised 19V line obtained from a bridge rectifier fed from the secondary of the mains transformer (see Fig. 1). The voltage is smoothed by a single 2,200µF electrolytic (C402) before being fed to the audio output stage which has an average current consumption of 150mA.

The U3 supply is a stabilised 12V line obtained by applying the U2 supply to a conventional series regulator circuit (Fig. 1). It feeds mainly the decoder and i.f. circuits.

HT Line

The basic stabilised h.t. line is designated U1. It's a 188V supply produced by a stabilisation circuit which is followed by an electronic smoothing circuit. The arrangement is shown in Fig. 2. The electronic smoothing circuit — transistors T421/2/3 and associated components — consumes less power and is more efficient than a conventional smoothing circuit.

Regulator

It will be seen from Fig. 2 that the gate of thyristor Ty421 is fed from the collector of the pnp transistor T424, via C426. A reference voltage is applied to the base of this transistor from the potential divider network R426-9 and R432 which is connected between the 214V appearing at the thyristor's cathode and chassis. The reference voltage at T424's base is approximately 30V.

Also fed to the base of T424 is a clipped, sinusoidal 50Hz waveform sitting just below the 0V level (see Fig. 3) and of
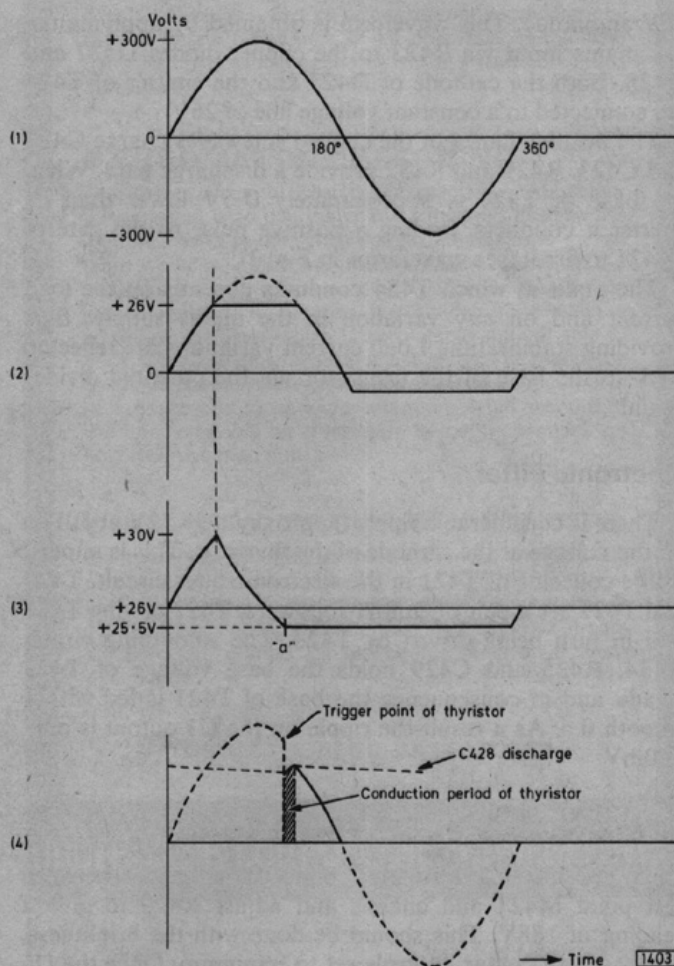

Fig. 3: Waveforms associated with the U1 188V regulated supply. (1) Mains input, 680V peak-to-peak approximately at 50Hz. (2) Waveform produced by the action of the clipper diodes D427 and D428. This is applied to capacitors C422 and C423 which are charged by the positive-going edge. (3) The waveform at T424 base, showing the initial charging of capacitors C422/C423 followed by their discharge via R429 and R432. At point "a" T424 conducts and the thyristor is triggered. (4) Conduction period of the thyristor — its reservoir capacitor C428 charges to the peak value shown when Ty421 conducts, then discharges until the thyristor is again triggered.
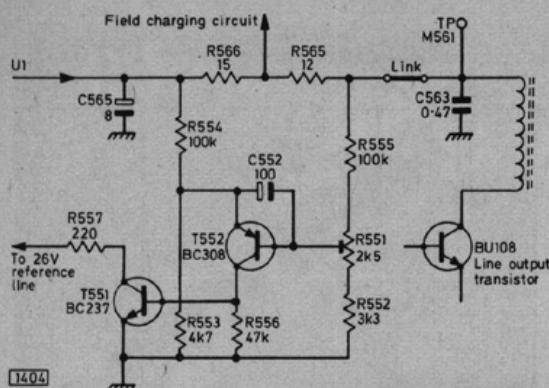
Fig. 4 (left): Excess current protection circuit used in early versions of the 711 chassis. The current consumption of the line output stage is monitored by sensing the voltage developed across R566/R565. If this voltage rises excessively the protection circuit shuts off the U1 supply.
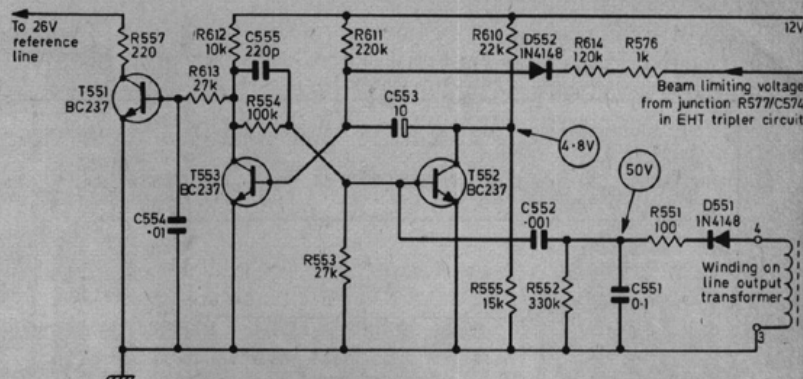
Fig. 5 (right): The overload protection circuit used in later models, using a monostable multivibrator (T522/T553). Under normal conditions T553 is conductive and T552 is cut off. If the amplitude of the line flyback pulses rises excessively the voltage produced by D551 will be sufficient to switch T552 on. If the c.r.t. beam current is excessive, due for example to a short-circuit RGB output transistor, the beam current limiting reference voltage will fall. In consequence D552 will conduct and T553 will cut-off. Once either of these actions occurs a normal monostable multivibrator circuit action follows — see text.

26V amplitude. This waveform is obtained by applying the a.c. mains input via R423 to the clipper diodes D427 and D428. Both the cathode of D427 and the emitter of T424 are connected to a constant voltage line of 26V.

The positive flanks of the clipped sinewaves charge C422 and C423. R429 and R432 provide a discharge path. When the base of T424 is approximately 0·5V lower than its emitter it conducts, feeding a positive pulse to the gate of Ty421 to fire it (see waveforms in Fig. 3).

The point at which T424 conducts depends on the load current and on any variation in the mains supply, thus providing stabilisation. Load current variations are reflected back to the base of the transistor via the potential divider chain.

Electronic Filter

There is considerable ripple (approximately 12V at 50Hz) on the voltage at the cathode of the thyristor. This is applied to the collector of T421 in the electronic filter circuit. T423 and T422 are a pair of emitter-followers, T422 driving T421 and in turn being driven by T423. The smoothing circuit R434, R435 and C429 holds the base voltage of T423 steady and in consequence the base of T421 is fed with a smooth d.c. As a result the ripple on the U1 output is only 300mV.

Setting Up

To set up the U1 supply, connect a voltmeter between test point M421 and chassis and adjust R429 to give a reading of 188V. This should be done with the brightness, contrast and colour controls set to minimum. Once the U1 supply has been correctly set up both the e.h.t. voltage and the picture width should be satisfactory.

Faults

The main faults are as follows.

If the mains fuse Si421 has blown, either the thyristor Ty421 or the mains filter capacitor C424 is short-circuit or there is a short-circuit in the line output stage — generally the line output transistor going short-circuit.

A hum bar on the picture occurs when T421 goes short-circuit, T422 is low in gain (gives normal resistance readings) or R442 goes open-circuit.

If there is no 214V reading at the cathode of the thyristor the most likely causes are that either zener diode D422 or transistor T424 has failed.

Another cause of no 214V reading at the cathode of the thyristor however is when the protection circuit comes into operation and cuts off the power supply. When the protection circuit comes into operation the 26V reference voltage at the emitter of T424 drops, shutting down the U1 supply. This will occur should the c.r.t. pass excessive beam current, due for example to failure of one of the RGB output transistors. The protection circuit itself can be the cause of no U1 supply however and we must next look into this.

Protection Circuits

Two overload protection circuits have been used. The first (see Fig. 4) is a simple two transistor circuit which provides a safeguard against excessive current being drawn and causing damage to the line output transistor, the c.r.t., the power supply, etc. The protection circuit (Fig. 5) used in later versions of the chassis employs three transistors and gives excess voltage protection. We will deal with these in turn.

Excess Current Circuit

The reference voltage for the operation of the first circuit is obtained from the line output stage breather resistors R566-R565. Should the voltage across these rise to an unacceptable level, due to excess current in the line output stage, the base of the pnp transistor T552 will move negatively and it will turn on. In consequence the 26V line to the power supply is reduced via T551 and R557.

Fault Finding

Common failures in this circuit usually cause the U1 supply to shut off and are as follows. The transistors T551 and T552 going short-circuit. R554 or R555 going open-circuit. R551 being incorrectly adjusted.

To adjust R551, connect a voltmeter from the base of T552 (negative lead) to its emitter (positive lead) and set R551 to give a voltage reading of 0·35V. Do this with the brightness and contrast controls turned fully up (maximum beam current).

The protection circuit can be over-ridden by lifting one end of R557 — after checking that there are no obvious faults in other sections of the set.

As an example of the more awkward type of fault that can arise, we had a case where the picture size reduced after the set had been on for about ten minutes. The U1 supply was found to be low at 160V and the fault was traced to T551 developing a leak when warm.

Excess Voltage Circuit

The later circuit (Fig. 5) makes use of a monostable consisting of T552 and T553. Under normal conditions T552 is cut off while T553 is conductive. The flyback pulses as tag 4 on the line output transformer are rectified by D551 and smoothed by R551 and C551 which under normal conditions charges to 50V. Should the amplitude of the line output pulse suddenly increase, C551 will receive a sudden positive voltage increase. The voltage pulse is differentiated by C552-R553, the voltage peak thus produced being fed to the base of T552 which switches on.

T552's collector voltage drops, cutting off T553, and we then get the normal monostable circuit action. When T553 cuts off, its collector voltage rises and T551 is driven on. This pulls down the 26V reference voltage line, via R557, and the power supply unit shuts down.

The monostable action continues however, with C553 discharging via R611, until a point is reached when the monostable circuit returns to its original condition — with T552 cut off and T553 conducting. This occurs after about 1·5 seconds, and if the flyback voltage pulse is still excessive the whole cycle recommences. The resultant effect is usually seen as a rapidly pulsating picture varying in height and width. If the U1 line is monitored with a voltmeter the needle will be seen to flicker back and forth between 100V and 150V, a most perplexing state of affairs for the uninitiated!

Excessive Beam Current

The same conditions arise when there is excessive beam current, since there is also a feed to the circuit from the beam limiter via D552 and R614. This again brings the circuit into action when the beam current is excessive.

Servicing

If the picture seems normal but the protection circuit is operating it can be over-ridden as with the earlier circuit — by lifting one end of R557 — to see whether a normal, stable U1 line and picture are then produced. If all is well, check transistors T552 and T553 for shorts and leakage and replace as necessary.

Next Month

So much then for the workings of the power supply unit and the protection circuits. The second article in this series will deal with the signal circuits, the touch-sensitive channel selection system and the beam limiter and list the faults encountered in these parts of the set.

Servicing The TELEFUNKEN 711 CHASSIS

PART 2   P. C. MURCHISON

LAST month we covered the power supply section of the chassis. This time we shall take a look at the front end and the signal circuits.

Tuners

Earlier sets came fitted with a multiband v.h.f./u.h.f. tuner unit. This had a balanced feeder (300Ω) aerial input circuit which often led to mismatching, causing loss of gain and ghosting problems. Fortunately there are not many sets around with this type of tuner, later ones being fitted with a tuner designed specially for the UK market. This has an unbalanced 75Ω aerial input circuit of course, and operates on u.h.f. only. Basically, the tuner consists of an r.f. amplifier stage and a mixer/oscillator stage, followed by an i.f. amplifier. Varicap diodes are used for frequency selection, the tuning voltage being obtained from the "programme storage" unit. A simplified circuit of the latter is shown in Fig. 2.

Channel Selection

There are eight sensor contacts on the touch-sensitive switch contact board, seven for ordinary channel selection and the eighth for use with a videotape recorder – when this selection is made 12V is applied to pin 8 of the TBA950 sync separator/line generator i.c. in order to alter the time-constant of the flywheel sync phase comparator circuit during the replay of a videotape recording.

The programme storage function is carried out by two integrated circuits, types SAS560 and SAS570. These are almost identical internally, the only difference being that the SAS560 has an additional internal transistor (T14, see Fig. 1) which ensures that the set is always tuned to channel selection number one when it's initially switched on.

Internal Circuitry

The internal circuitry of one of the four switching stages (E1-E4 in Fig. 2) is shown in Fig. 1, for i.c. type SAS560. When the base of T1 is earthed via the high-value resistor chain and the sensor contacts it switches on and in turn switches T2 on. T5 which had previously been conducting because of the bias via its base resistors R2, R3 and diode D3 turns off suddenly when T2's collector voltage drops to around half a volt. T5's collector voltage rises to a value set by the zener diode D4, switching T6 on. As a result, a voltage of about 4·5V is developed across R1124, which is the common emitter resistor for all the switching stages.

T6 enables T8 and T11 to switch on, in turn switching on transistor T9 to select the tuning voltage and T13 to illuminate the appropriate channel indication lamp.

Transistor T8 also supplies T7 with base voltage, via zener diode D10 and R8. After the finger is removed from the sensor plate T6 switches off but T7 remains on, taking over and holding the stage in the operating state. When, as a result of a further channel selection, the voltage across R1124 rises to 4·5V T7 will switch off, removing the hold action of the initial channel selection, and the newly switched on stage will take over.

When the set is first switched on there is no voltage across the common emitter resistor R1124 and the base of T14 is negative with respect to its emitter. T14 conducts therefore, turning off T5 to give selection of channel 1 via the action just described.

External Circuitry

The complete external circuit of one of the two programme selection i.c.s is shown in Fig. 2. S1-S4 are the sensor contact plates which must be bridged with a finger to initiate programme change. High-value resistors are
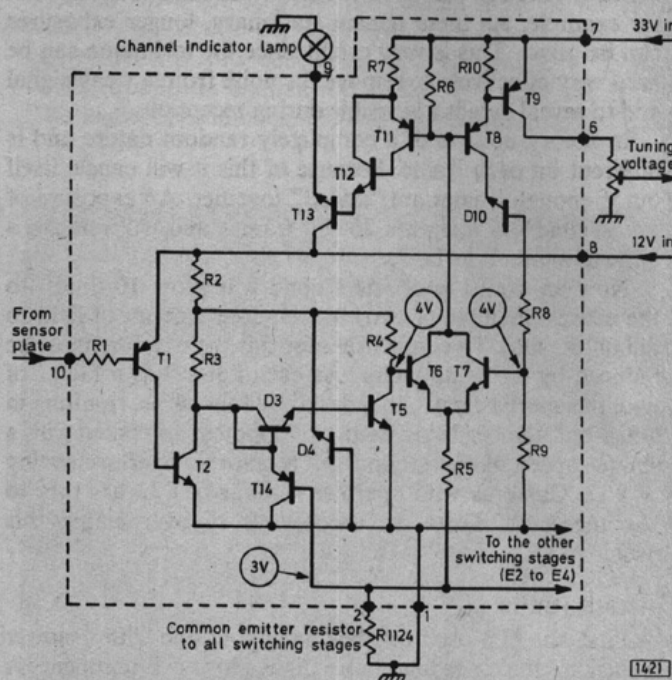

Fig. 1: Internal circuitry of one of the switching stages (E1) in the SAS560 i.c. The E1 stage incorporates the additional transistor T14 to ensure that the set automatically tunes to "channel 1" when initially switched on.
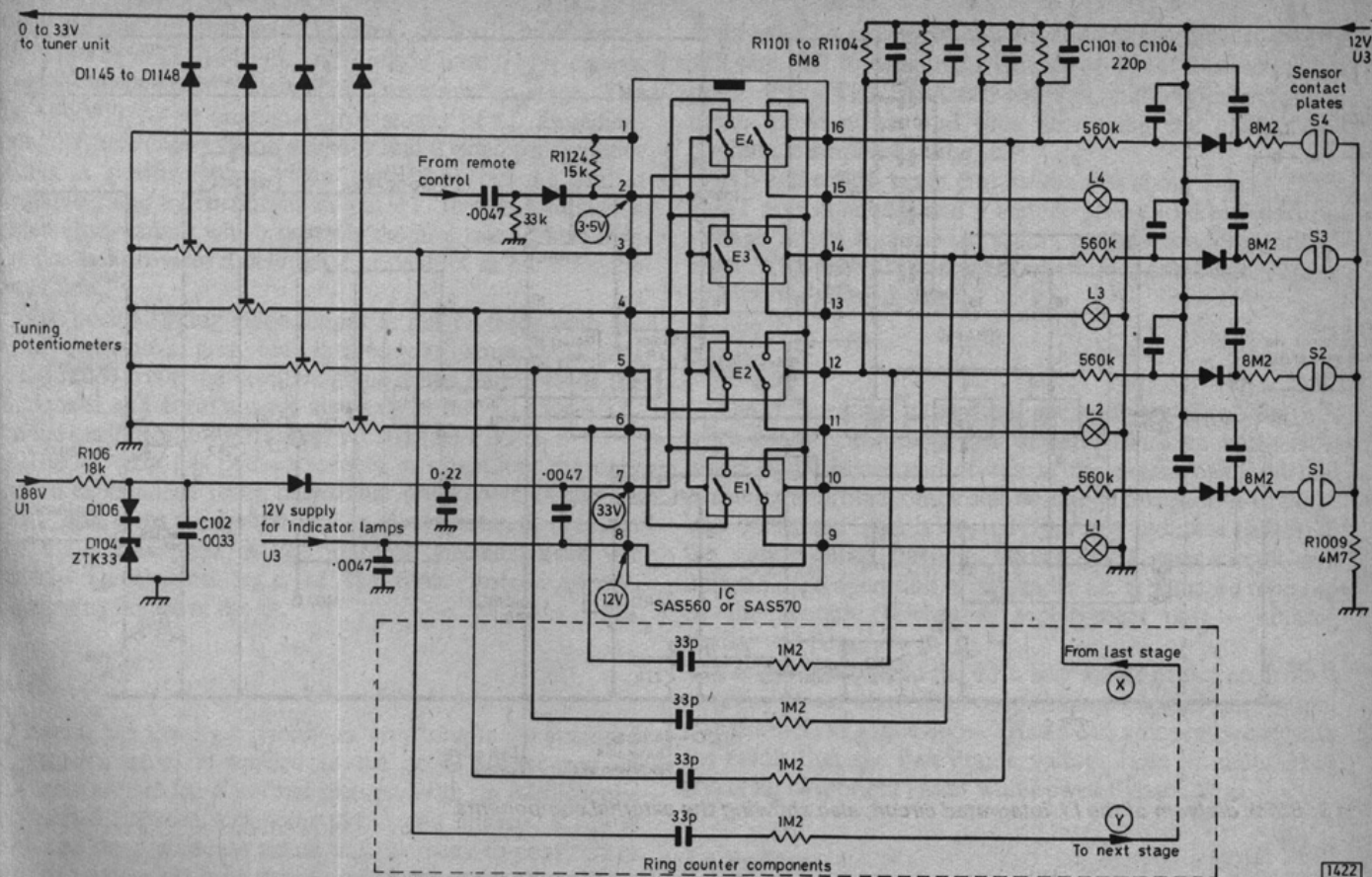
Fig. 2: Circuitry of the touch-sensitive tuning selection unit, showing in simplified form the i.c. which provides the switching action. Only one of the two i.c.s used in the unit is shown: two are used in order to provide choice of eight channel selections.

connected in series with the sensor plates to safeguard against high current flow in the sensing circuit. Diodes D1145-D1148 connected in series with the sliders of the tuning potentiometers minimise the risk of interaction between the potentiometers. As can be seen, the electronic switches E1-E4 switch both the tuning voltage to the tuning potentiometers and the 12V required to light the appropriate channel indicator lamp.

R1101-R1104 and C1101-C1104 are present to make the unit insensitive to interference pulses. Isolating diodes are present in the sense input circuits to prevent interaction here.

Remote Control

Programmes can be remotely selected by plugging a remote control unit into the rear of the set. This control unit has a channel change switch which supplies a 12V positive pulse to pin 2 of the i.c. every time the switch is operated. For this control unit to work with the storage circuit the two i.c.s are connected as a ring counter, the output from the first stage being connected to the input of the next stage via a capacitor-resistor network (33pF plus 1·2MΩ) and so on until a complete ring counter circuit is formed. Every time a positive pulse is applied to pin 2 of the i.c. the channel will change upwards one place, the channels changing in sequence until number eight is reached when after a further pulse the selection returns to channel 1.

Drift

Unfortunately there is no a.f.c. applied to the Telefunken tuner. This inevitably leads to a common problem, tuning drift. The tuning voltage stabiliser diode D104 (ZTK33) is often a very small glass type which seems to have a very

poor temperature coefficient. The result is that as the temperature in the set rises so the tuning voltage changes, putting the set off tune. Diode D106 does not seem to provide sufficient compensation for this temperature drift. The common type TAA550 stabiliser is far more stable, consisting of several zener diodes in series, and is a much more satisfactory replacement.

Another problem is when the "contacts" of the electronic switches in either i.c. vary in resistance, again causing tuning drift. The answer in this case is to replace the i.c.

Channel Change Faults

Erratic channel changing, or sticking on one channel, is usually caused by one of the i.c.s (the SAS560 in the case of channels 1-4 and the SAS570 in the case of channels 5-8). The appropriate i.c. must be replaced. The SAS560 often sticks permanently on channel 1, presumably due to failure of the internal transistor T14. The diodes and 560kΩ resistors in series with the sensor plates often go open-circuit, causing failure to select the relevant channel. It's a fairly easy job to check these components and replace as necessary.

Snowstorm

The tuners have an earthed brading to bond them to the main chassis of the set. This is often left off by service engineers, causing a "snowstorm" on the screen. It's always advisable to check that this brading is well soldered, using a high-wattage soldering iron.

IF Strip

The i.f. signal from the tuner leaves at pin one and then

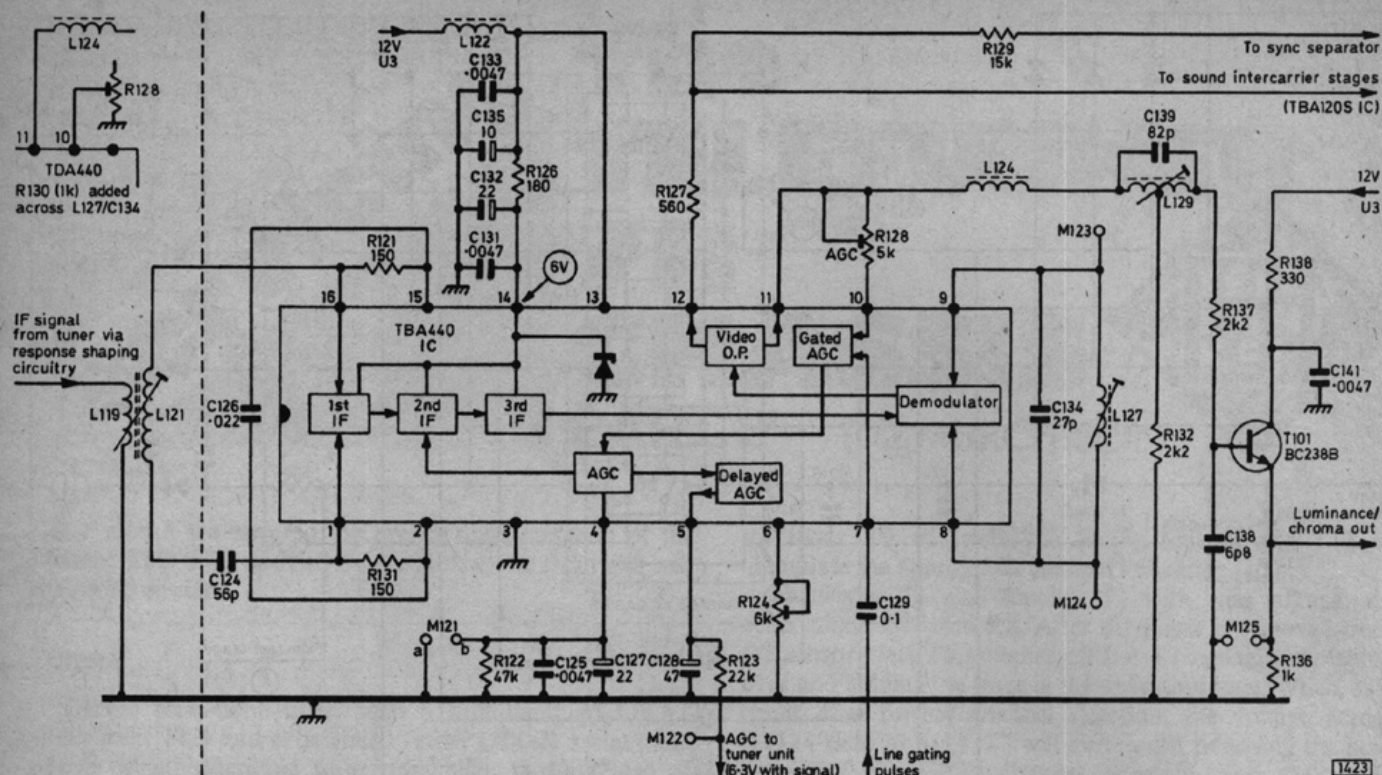**Fig.3: Block diagram of the i.f. integrated circuit, also showing the external components.**
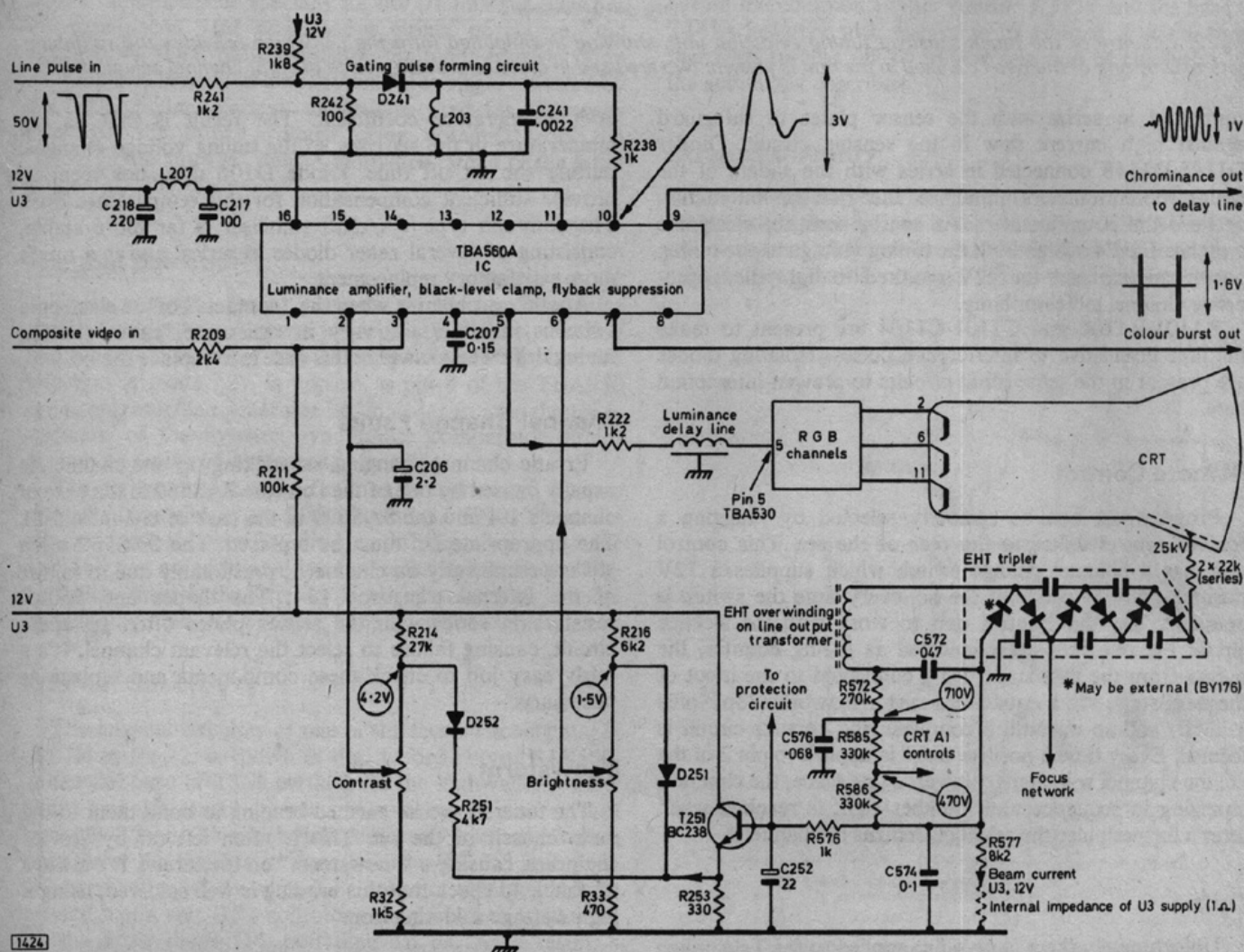

Fig. 4: Simplified diagram of the circuitry around the TBA560A luminance i.c., also showing the e.h.t. and the beam limiting arrangements. The gate pulse forming circuit is shown at the top: the overswing pulse produced when L203 rings is used to gate the bursts and operate the clamp circuit in the i.c.

goes via the i.f. bandpass shaping network to either a TBA440 or a TDA440 i.f. i.c. – in the later 711A chassis there is a separate transistor i.f. preamplifier stage. The TBA440/TDA440 contains three stages of i.f. amplification, a synchronous vision detector and a video preamplifier giving a positive-going video output at pin 12 and a negative-going video output at pin 11. It also contains a gated a.g.c. circuit which controls the first two i.f. stages in the i.c. and provides a delayed a.g.c. output at pin 5 for the tuner unit.

The positive-going video output at pin 12 feeds both the sync separator and the intercarrier sound channel (TBA120S) while the negative-going video output feeds the luminance and chrominance channels in the TBA560A i.c. via the emitter-follower transistor T101 (see Fig. 3).

The i.f. strip has proved reliable in operation, the only failure experienced being occasional breakdown of the i.c. itself. This gives the symptom of a blank raster. A check at the a.g.c. test point M122 in these circumstances will usually reveal zero a.g.c. to the tuner instead of 6V, confirming failure of the i.c.

AGC

Setting up the a.g.c. circuit is very simple. A standard colour-bar signal is applied to the aerial socket and all controls are set for a normal picture. With an oscilloscope connected between test point M125 and chassis, R128 is adjusted for a staircase signal of 2·9V peak-to-peak. Once this procedure has been carried out optimum results will be obtained under all input signal conditions.

Luminance Channel

Luminance amplification is carried out in the multipurpose TBA560A i.c. The signal is fed in at pin 3, at low impedance, after which it undergoes black-level clamping and flyback blanking before emerging at pin 5. Control of both the brilliance and contrast is effected simply by varying the d.c. voltages on pins 6 and 2 (see Fig. 4), these user controls being on the front panel of the receiver.

Beam Limiting

The contrast and brilliance controls are also tied in with the beam limiting circuit, to prevent the beam current reaching the point at which defocusing occurs. The beam limiter circuit is fairly simple in operation but is quite effective and entirely automatic – there is no preset control to set up as in most other types of circuit.

The beam current flows via the c.r.t., the tripler, R577 (see Fig. 4) and the low-impedance of the U3 12V power supply to chassis. In consequence a voltage dependent on the beam current is established across R577. Maximum voltage (negative-going) is developed across this resistor when the beam current is around 1·2mA, the rated maximum beam current for the c.r.t.

The voltage across R577 is applied to the base of T251 via a smoothing network (R576/C252). At zero beam current there will be no voltage drop across R577. In consequence the base of T251 will be at 12V and its emitter will be at 11·5V. Diodes D252 and D251 have 4·2V and 1·5V respectively at their anodes and are thus both cut-off. As the beam current rises so the voltage across R577 increases and the base of T251 moves negatively, its emitter voltage falling in sympathy. At a beam current of around 850μA the emitter voltage will have fallen sufficiently for D252 to

conduct. The voltage at the top end of the contrast control will then fall to that at the emitter of T251. The voltage at pin 2 of the TBA560A will also fall, automatically turning down the contrast and thus decreasing the gain of the luminance amplifier in the i.c.

When the c.r.t. beam current reaches about 1·1mA diode D251 also conducts and a similar process takes place, the voltage at pin 6 of the i.c. falling to turn down the brightness. With these two control operations the beam current cannot rise above 1·2mA.
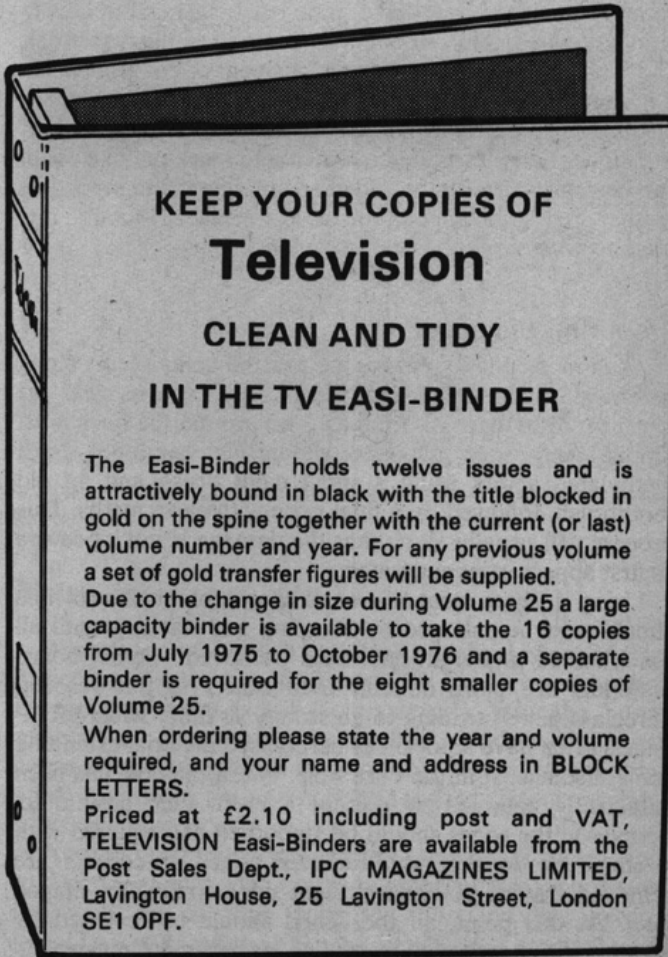
Faults

The only rather nasty fault encountered in this stage is when there is complete loss of video, with an excessively bright white raster and of course the excess beam current causing the protection circuit described last month to come into operation. This is caused by a tiny inductor (L203) in the gating pulse forming circuit going open-circuit and upsetting the operation of the entire i.c. It must be replaced by the genuine Telefunken replacement part – nothing similar will do!

The voltage to feed the c.r.t. first anode preset controls is obtained from the e.h.t. overwinding on the line output transformer, as Fig. 4 shows. R586 can go open-circuit with the result that the first anode voltage rises to about 1kV, giving an overbright raster with bowed flyback lines.

To Follow

Next month we shall be considering mainly the rather unusual field timebase circuit used in this chassis.

Servicing The TELEFUNKEN 711 CHASSIS

PART 3 P. C. MURCHISON

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

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

Field Oscillator

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

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

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

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

Charging Circuit

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

Phase-splitter and Feedback Loops

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

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

Driver and Output Stages

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

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

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

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

Impulse Adder Transistor

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

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

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

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

Faulty Impulse Adder

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

Partial Loss of Raster

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

Output Transistor Failures

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

Loss of U4 Supply

Complete loss of the U4 line – which is obtained from the line output stage – can be traced back to failure of diodes D562 and D563 in the EW modulator circuit. The BYX55 diodes originally used here have been replaced by a heavier
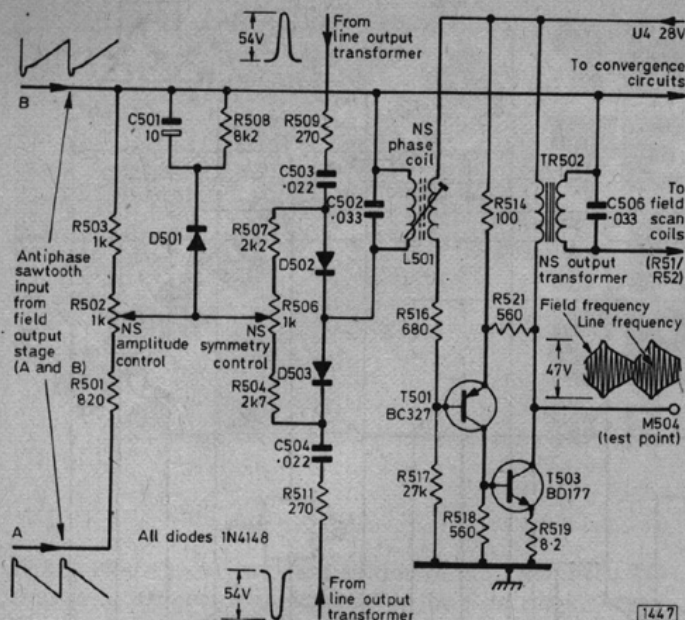
Fig. 3: The north/south raster correction circuit. The diode modulator consists of D502 and D503. The field sawtooth waveforms are modulated at line frequency, the resultant output being applied to the field scan coils. T501 and T503 are the driver and output transistors. A common failure is T503 going short-circuit base to emitter and burning out the emitter resistor R519.

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

Oscillator Faults

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

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

Field Fault Summary

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

Working on the Deflection Board

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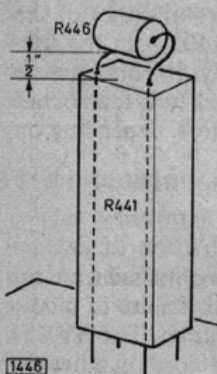

Fig. 4: A single p.t.c. thermistor (R446) is used in the degaussing circuit, mounted on top of the h.t. feed resistor R441 to keep it hot. To prevent it overheating, a half inch gap should be left between its body and the top of R441.

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

Degaussing Thermistor

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

NS Raster Correction

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

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

Line Timebase

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

Line Output Transistor

The line output transistor T562 was originally a BU108. These are rather prone to emitter-collector breakdown. When this happens the protection circuit will shut off the h.t. and there is loss of picture with no further damage to the circuits. A similar result occurs when the heatsink washer beneath the transistor arcs through – the washers
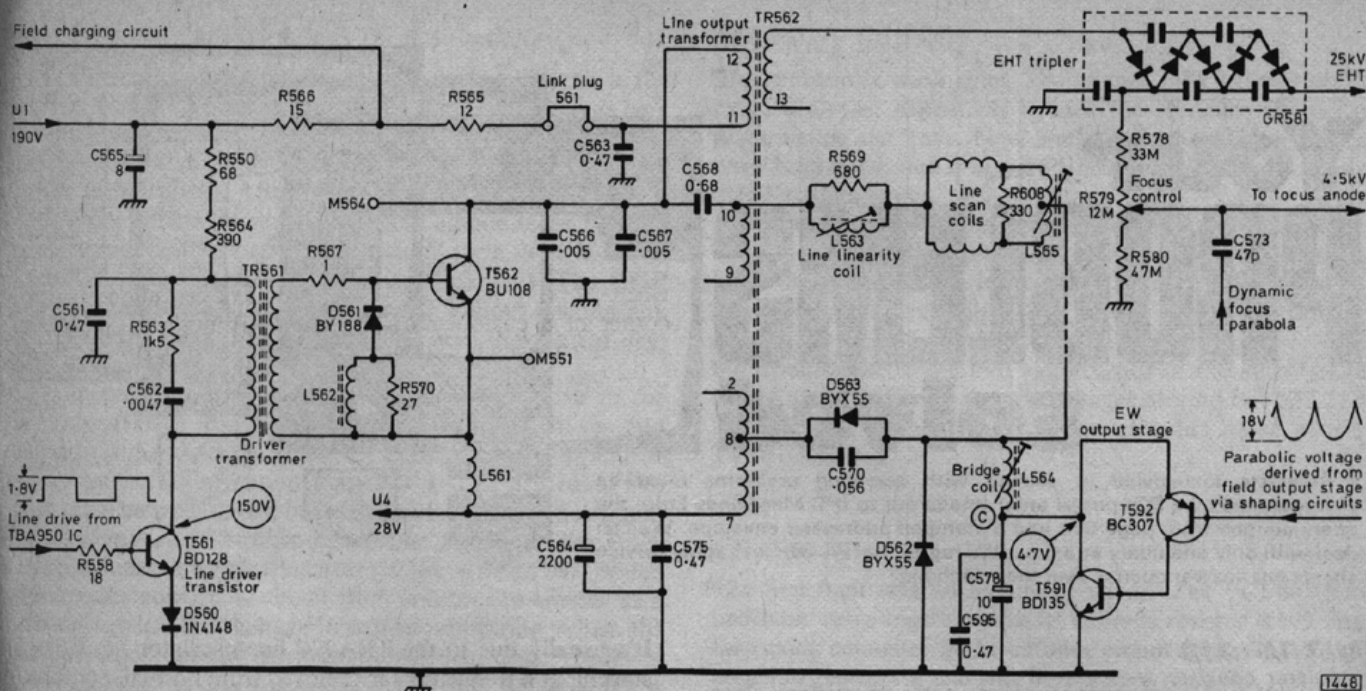
Fig. 5: Simplified circuit of the line driver and output stages, showing the diode modulator (D562/D563) used to provide east-west raster correction. The collector-base junction of the line output transistor acts as the efficiency diode during the first part of the forward scan. Current then flows via the collector and base of T562, diode D561 and L562. Diode D561 is included so that the current does not flow via R567 since this could cause poor linearity. The presence of D561 could impair the switch off waveform applied to the line output transistor at the end of the forward scan. To overcome this problem the special choke L562, which slows down the switch on time of D561, is included.

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

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

EW Raster Correction

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

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

EW Modulator Faults

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

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

Focus Troubles

The focus voltage is taken from the centre of the potential divider chain consisting of R578, R579 and R580.

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

Conclusion

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

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

PRICE INCREASE

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