ferent cameras/camcorders. For precise setting up instructions for a particular model refer to the relevant manual.

Before making any of these adjustments the correction waveforms must be reduced to zero (flat) irrespective of the picture. It all takes a long time to do and may not produce better results if the tube's emission is low. Beware – an aged tube will have inconsistent sensitivity over the target area, producing shading and a poor grey scale. You cannot get rid of this by using the adjustments, particularly if the tube has a poor lag characteristic or a tendency to green at low light levels.

Failure of the R−Y signal will produce a picture that's mostly green and yellow, with no reds at all. Failure of the B−Y signal will product a picture that's all reds and purples with no green. It's also possible to get just chroma, i.e. a dark picture with only red and blue highlights. This indicates a failure in the luminance signal (YH) path.

If the vertical scanning is incorrect the Y signal circuits can clamp on video, reducing the Y signal and turning the picture magenta. This can often be verified by aiming the camera below a window or other bright light source and then tilting it upwards. If the picture turns magenta when the bright light hits the top of the picture, adjust the vertical centring and/or height until the picture is linear without the effect being present.

In the next part we'll deal with the CCD (solid-state) image sensor.

The B & O L/LX2500/2800 Chassis

Nick Beer

The Beovision L2500, L2800, LX2500 and LX2800 chassis are used in models with type numbers in a series 37XX, e.g. 3701, 3702, 3712, 3720, 3741, 3752, 3760 and many others. As the chassis numbers suggest, there are 25 and 28in. models. LX sets come complete with teletext while the L sets can have a teletext panel fitted if required. The cabinets are teak, rosewood or "White Line". Fig. 1 shows the panel layout.

The sets are typically B and O, with high-quality finish, an excellent picture and superb sound, also flexibility of use/presentation. For example, a set can be used as the central item in the B and O Link System, in which compatible hi-fi, TV or video equipment can be controlled and operated via a remote control unit and a Beolink terminal or Master Control Panel. So you could say watch TV or video then select a track on your compact disc player and listen to its output via the stereo speakers of an LX type set. There's an LX-sat satellite TV decoder which, installed in the main receiver, can provide the display on a remote set in another room while the main set continues to provide terrestrial TV reception or VCR playback. We shall have more to say about the Link System in a later article.

As you might expect, with provision for so many features and B and O's reputation for fitting twenty per cent more components than are basically necessary, the circuit is rather daunting. Once you understand the workings of the set however you should have little difficulty in tackling faults. The few troubles we've experienced to date have been fairly simple ones.

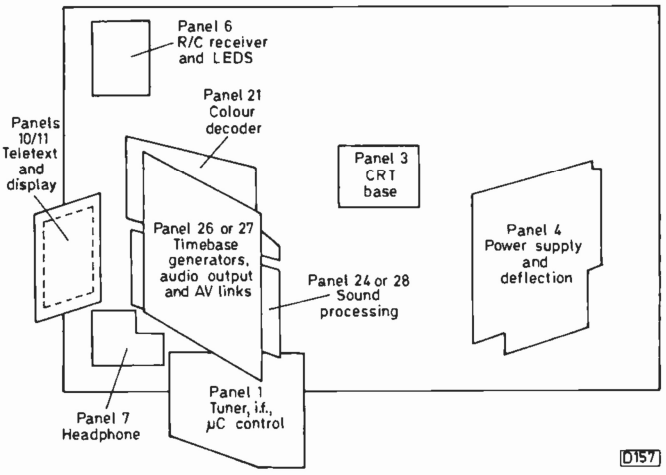

Fig. 1: L/LX2500/2800 chassis panel layout.

The most common fault so far has been failure of the mains switch. It's one of only two controls on the set, the other being a channel-step button. The mains switch brings the set into operation in the standby mode. Full operation is obtained when channel selection (or step) is used. What often happens is that the mains switch fails to latch. Fitting a replacement can be tricky. In view of this when we instal a set we usually advise against frequent use of the mains switch, suggesting instead operation via the remote control unit.

The Microcomputer Control System

To understand these sets it's important to know a bit about the microcomputer control and data bus system, which is outlined in Fig. 2. Operation of the set is controlled by three microcomputer chips which act via three bus lines. These buses are of the I2C type, i.e. each has two lines, one for serial data and the other for the clock signal. Arbitration is used to sequence/organise communication between the various devices in the control circuitry, to ensure that the correct overriding etc. takes place.

Two of the microcomputer control chips, 1IC6 (type MAB8461) and 1IC5 (MAB8441), are on panel 1 along with the tuner and i.f. circuitry. The set's main control line is Bus 1 which is controlled by 1IC6. Its serial data output is at pin 2 and its clock output at pin 3. This bus provides the control link to the tuning interface and memory, to 1IC5 which controls Bus 2 and to 24IC10 (on panel 24) which controls Bus 3. Bus 1 also controls the brightness, contrast and colour, via the SAB3037 DA converter/decoder chip 21IC3 on panel 21. 1IC6 receives data from the remote control receiver at pin 12, which also receives Link System information from the Aux 1 socket. Remote control information from the VCR is fed into and out of the set via pin 8 of the scart socket, entering 1IC6 at pin 27. The AV remote control information from the Aux 3 socket enters at pin 26.

Power failure detection is also carried out by 1IC6, sensing being at pin 1. Fig. 3 shows the arrangement. The two transistors 1TR22 and 1TR15 provide a high input at pin 1 in the event of a fault being sensed on one of the lines they monitor. 1TR15 senses a number of supplies in

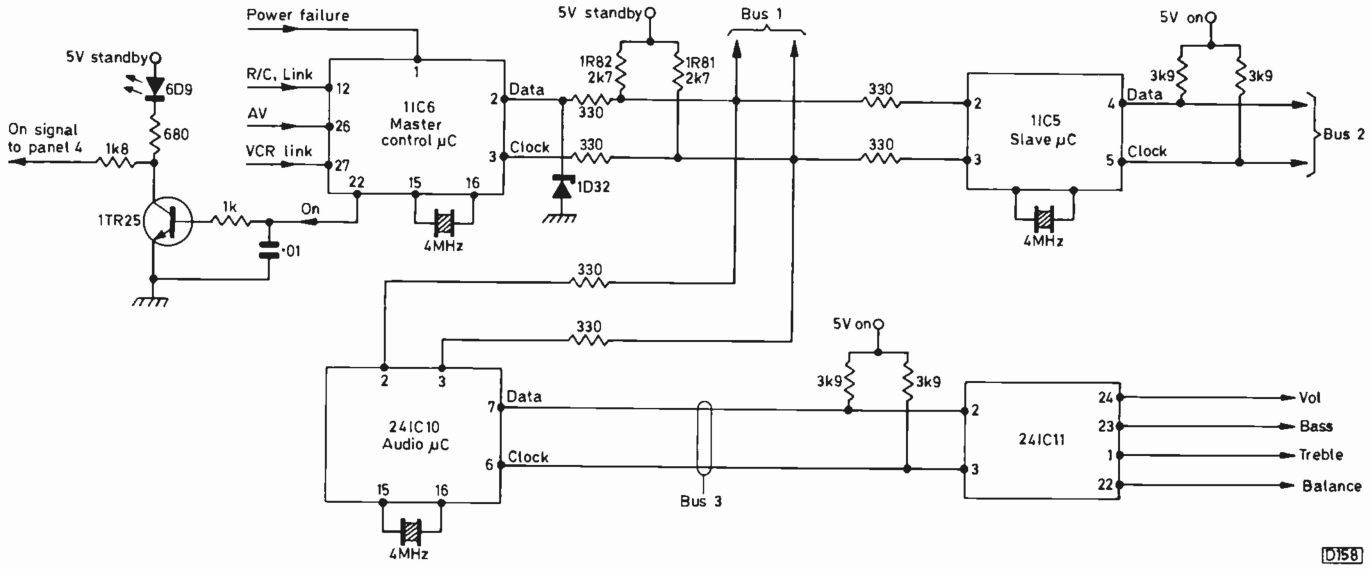

Fig. 2: Outline of the microcomputer control system.

the set, also the beam current, via a diode gate arrangement. 1TR22 monitors the supplies derived from the 17V line. When pin 1 of 1IC6 goes high the set goes into the standby mode.

The slave microcomputer 1IC5 controls the display panel (11) in L models and the teletext panel (10) in LX models, via Bus 2. Its serial data and clock pins for this bus are 4 and 5 respectively.

The third microcomputer chip 24IC10 (MAB8410) on panel 24 controls the SAB3037 chip 24IC11 via Bus 3. 24IC10 receives Bus 1 information on pins 2 (data) and 3 (clock), its outputs to Bus 3 being at pins 6 and 7. The SAB3037 acts in the same way as 21IC3 but this time provides d.c. outputs to control the volume, bass, treble and stereo balance.

For the serial data and clock signals to be transmitted along the relevant lines a d.c. level is required. The Bus 1 lines are pulled up to the 5V standby potential via 1R82 (data) and 1R81 (clock). In addition the data line is protected by the 5·6V zener diode 1D32. These items are suspect if there's no pull-up voltage and thus no data transmission along Bus 1. 1IC5's Bus 2 lines are pulled up to the 5V on rail as this chip does not need to be active in the standby mode. The Bus 3 lines are likewise pulled up to 5V on.

Circuit Features

We will now take a brief look at some of the main circuitry used in these sets, starting with the chopper power supply – see Fig. 4.

When going from standby to on the voltage at pin 22 of 1IC6 (see Fig. 2) goes low. Thus transistor 1TR25 switches off and pin 3 of the operational amplifier chip 4IC1 (Fig. 4) is positively biased from the 5V standby supply. The other input, pin 2, of this section of 4IC1 is held at 2·5V by a zener diode stabilised feed. The output voltage at pin 1 of this chip therefore rises to 15V. As a result, 4C23 charges via 4D26 and 4R32, producing a positive-going ramp which is fed via 4R31 to the emitter of 4TR4. This transistor with 4TR5 form a regenerative switch. When 4TR4's emitter becomes positive with respect to its base it switches on, in turn switching 4TR5 on. 4C23 is then discharged via 4R34 and 4D23. The low voltage at the collector of 4TR5 when it switches on is fed back to the base of 4TR4 via 4C21 and 4R23. Thus 4TR4/5 are held on. As 4C21 discharges via 4R30 4TR4/5 unlatch. The sawtooth voltage thus developed drives 4TR6, the chopper driver transistor, which in turn drives the BU508 chopper transistor 4TR1 via 4T3. Note that 4T1/2/3 provide mains isolation. For timing and regulation, a negative-going pulse derived from winding 17-18 of the chopper transformer 4T1 is fed to the base of 4TR5 to control its switch-off time. The pulse obtained from 4T1 is an exact replica of 4TR1's collector waveform. It's clipped by 4R36, 4D28 and 4TR16 to produce a squarewave which is then differentiated by 4C22 and 4R27 to obtain the negative-going pulse that switches 4TR5 off. With 4TR4/5 off, 4C23 can once more begin to charge. The circuit is thus self-oscillating.

In the TV mode, regulation is based on monitoring the 150V h.t. supply produced by 4D6/4C10. A tap on the potential divider 4R8/37/90/38 feeds pin 6 of 4IC1. The other input pin of this section of 4IC1 is held at 5·1V by the action of zener diode 4D24. The error output at pin 7 of 4IC1 sets the bias at the base of 4TR4 and in consequence the point at which this transistor switches on. This regulation loop is kept stable by the action of 4C19 and 4R28.

In the audio only mode the 150V rail is not loaded and cannot be used as the basis for regulation. In this mode the 17V supply is used as the basis for regulation, via 4D47 and 4D48.

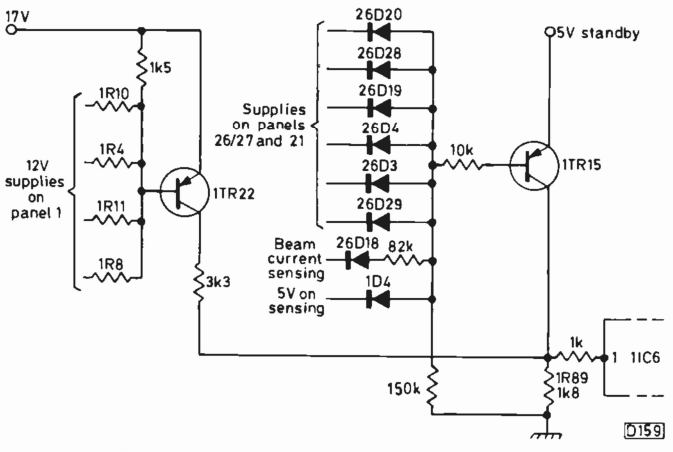

Fig. 3: The power failure detection circuit.

During start-up 4C23 charges via 4D26 from the 17V standby supply. When running 4C23 charges via 4D25 from winding 17-18 of 4T1. Since the voltage here depends on the mains input, the charging of 4C23 will vary as the mains supply varies, thus providing stabilisation against changes in the mains input.

The regulation provided by this circuit is certainly impressive. The set will run on 60V (and that's with a 28in. c.r.t.!) and will start up with a 150V input.

The line output stage is conventional, using a BU508 (4TR11) line output transistor, a diode-split line output transformer, and a diode modulator for EW correction. The line output transformer provides the e.h.t., first anode, focus and c.r.t. heater voltages and also the +12V and −12V supplies used by the TDA2170 field output chip. The line drive signal is generated by a TDA1940 chip on panel 26/27 and is fed via 26/27TR3 to panel 4 where four transistors (4TR8/9/10/15) are used in the driver stage (no driver transformer). The purpose of 26/27TR3 is to act as a switch to remove the line drive in the audio only mode – this prevents e.h.t. generation.

The field sync pulse output from the TDA1940 chip on panel 26/27 is passed to the colour decoder panel 21 and then back to 26/27TR21. This transistor's output is used to control the field oscillator, which consists of an LF353 dual operational amplifier chip (26/27IC6). Half of another dual operational amplifier chip, 26/27IC7 (LF358), acts as the field preamplifier which drives the TDA2170 on panel 4. The other half of 26/27IC7 provides EW drive. The TDA2170 drives the field scan coils directly – this is made possible by the energy efficient c.r.t. deflection system.

The field oscillator runs at 47Hz to allow for graphics injection (e.g. tuning information) with no signal and thus no sync. The sync provides the extra three for 50Hz.

Two TDA2040 chips on panel 26/27 provide 15W of audio output per channel at 8Ω. Each channel has a 4in. woofer and 2in. tweeter, with external speaker options.

Table 1: Tuning Display Frequencies

Channel	*On-screen display-MHz*	*Channel*	*On-screen display-MHz*
21	471	46	671
22	479	47	679
23	487	48	687
24	495	49	695
25	503	50	703
26	511	51	711
27	519	52	719
28	527	53	727
29	535	54	735
30	543	55	743
31	551	56	751
32	559	57	759
33	567	58	767
34	575	59	775
35	583	60	783
36	591	61	791
37	599	62	799
38	607	63	807
39	615	64	815
40	623	65	823
41	631	66	831
42	639	67	839
43	647	68	847
44	655	69	855
45	663		

The output from the audio detector is mono of course. It's split and fed via switching i.c.s 28IC1/2 then through 28IC7 to the dual volume/tone control circuits in 28IC8.

Teletext subtitles can be recorded on these sets and also printed by a suitable printer (LX versions of course). As mentioned earlier, the L models are teletext adaptable. This calls for removal of the display board – but hang on to this for diagnosis (it can prove a Bus 2 fault or teletext decoder fault). Note also that because of the power fail circuit these sets will not operate unless one or other of these boards is fitted. The on-screen display with text sets is provided by the text panel.

Tuning is not by the well-known channel numbers (21-68) but by frequency. Table 1 shows the equivalents.

Despite the fact that the retail price of the LX2800 was over £1,000 these sets sold well in our area. They have since been replaced by the LX2502/2802 series (38XX type numbers) which have only two buses and built-in Link processing.

Stuck in Standby

Our experience has been that faults are usually supply related or in the Bus 1 system. In either case the set will go into standby, as previously described. If you have a set that's stuck in standby and you don't know where to start, proceed as follows.

(1) Try to start the set in the audio only mode. If the set comes on you can rule out faults in the secondary supplies as these will all be up and running. It's likely that there's a Bus 1 fault. The best policy is to switch off, short out the test link connected to pin 11 of 1IC6 and try the set in the TV mode again. This overrides bus error detection. The set will now more than likely start. If so check for data and clock signals on the appropriate lines. If absent check for d.c. pull-up. As previously mentioned absence of pull-up can be caused by open-circuit pull-up resistors or the protection zener diode being short-circuit. Another possibility is excessive loading due to a faulty i.c. The bus lines should give a resistance reading to chassis of 3·5kΩ. A quick check is to remove the 330Ω series resistors (see Fig. 2) to see if this resistance returns. Also look for tuning. If there's none, suspect a fult in the tuning interface or memory.

(2) If the set won't start in the audio only mode look for loading on the power supply, i.e. 4T1's secondaries, for example a short-circuit line output transistor. Such secondary loading is indicated by a noise in the chopper transformer. If there's no noise, suspect a mains input or control circuit fault. 4R3 could be open-circuit or 4TR1 may have failed. For repeated failure of 4TR1 check whether 4C15 (1μF) is open-circuit.

(3) Check for power failure detection at pin 1 of 1IC6. A high here indicates an overload on one of the l.t. supplies.

Once you've understood the basic operation of the chopper power supply and the bus control arrangements you should have no difficulty in repairing faults in these sets. Develop the correct technique for these areas and the rest is much the same as with anyone else's sets!

Fault Report

Here's a list of some of the faults we've had.

(1) A completely dead set (no standby light) is usually due to a burnt up mains switch. If the subpanel is damaged, as it usually is, the complete assembly (part number 8003605) should be replaced – this is done through the

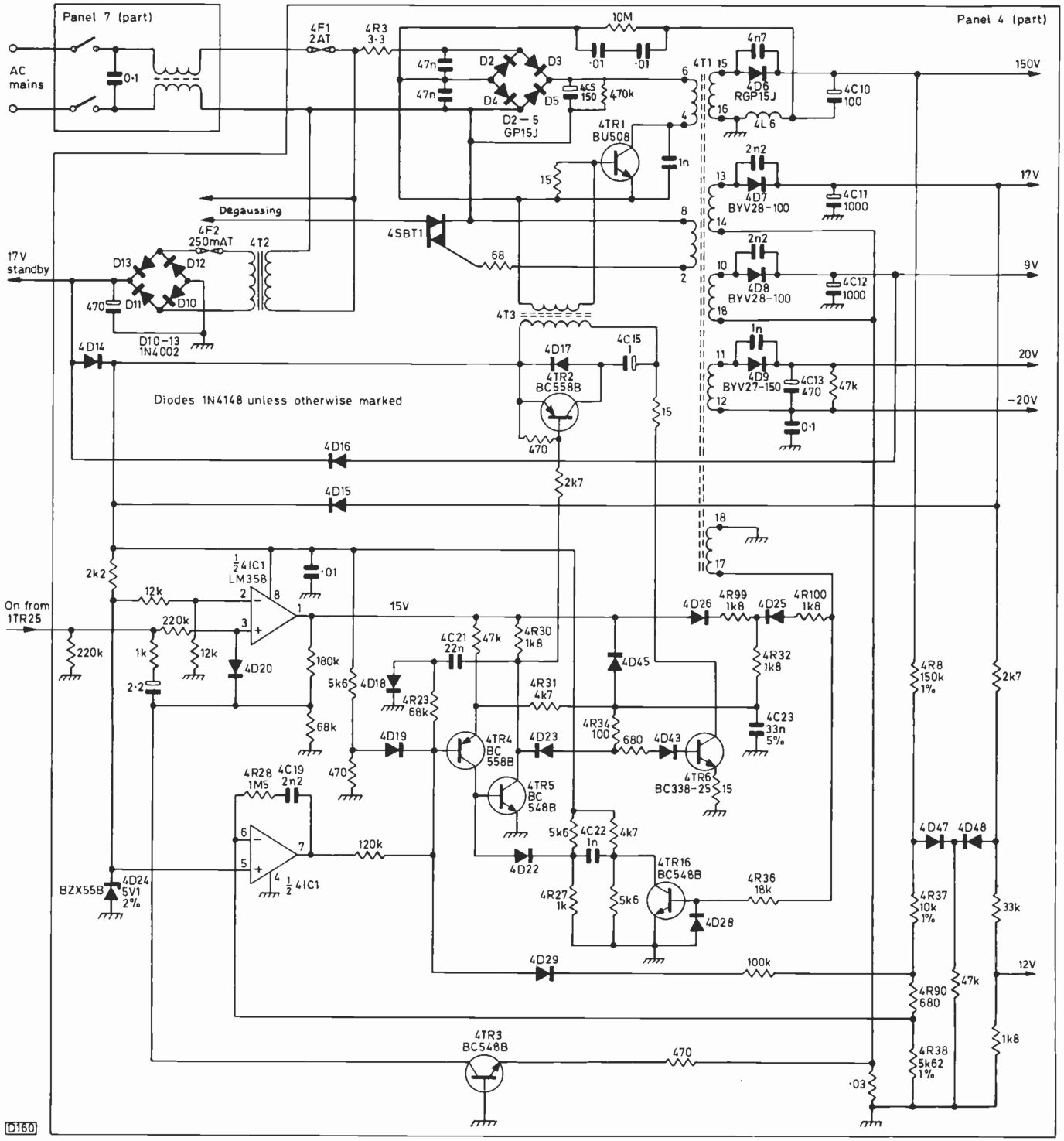

Fig. 4: The chopper power supply circuit. In earlier versions 4R32 was 3·9kΩ with 4R99 and 4R100 omitted. There have been other minor modifications to the circuit.

flap in the bottom of the cabinet.

(2) The most common cause of a set being stuck in standby, again usually preceded by smoke, is an open-circuit surge limiter resistor (4R3, 3·3Ω). A type with improved construction is now supplied.

(3) Reduced width and height has on a number of occasions been traced to the line flyback tuning capacitor 4C32 (1·5nF) being open-circuit.

(4) Stuck on standby, not a Bus 1 fault. The line output transistor 4TR11 short-circuit.

(5) A few lines of field foldover on the picture. Check the 0·1Ω resistors 4R74 and 4R75 in series with the supplies to the TDA2170 field output chip.

(6) No control of a VCR via the Aux 2 socket when used in conjunction with a Beomaster 5500 and Master Control Panel 5500. Data reaching 1IC6 (MAB8461) but no output to the scart socket. Programming of options (datalink) correct but 1IC6 faulty.

(7) No picture when brought on from standby via the MCP 5500 with the above system. 21IC3 (SAB3037) faulty.

(8) No line or field sync after a few seconds. IC5 (TDA1940) on panel 26/27 faulty.

(9) Teletext not running, top line only displayed. Horizontal phase control 26/27R65 slightly off.

As a final note, when removing the back cover it's not necessary to remove the screws completely – this saves losing them.