Servicing the Ferguson TX100 Chassis

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The Ferguson TX100 chassis, following in the footsteps of its predecessors the TX9 and TX10, exploited the advanced techniques of its day. The asynchronous chopper power supply provides full mains isolation and for the first time in a Ferguson chassis auto-greyscale correction was featured. Now, in its turn, the TX100 has been superseded.

Sets fitted with the TX100 chassis started to be introduced in the autumn of 1984. There were great expectations of the chassis and these were not misplaced. It's good tempered and reasonably reliable, apart from an early spate of power supply and line output transistor failures – I'll deal with this subject in full. One fact to bear in mind is that the chassis was designed to be able to drive a very wide range of tubes – 90° and 110° types, both "standard" and FST versions, with three neck sizes and several scan coil configurations. This involves a number of subtle but important component value differences in the timebases. When component replacements are required in these areas, make sure that yout fit the correct type.

In common with most other chassis, the more basic the model the less troublesome it is. Many of the troubles with the TX100 stem from the high sensitivity of its remote control system. Minor irritations with the mechanical programme selector switches and the occasional field timebase fault tended to make those not committed to Ferguson products suspicious. There is however little to dislike about the TX100.

Power Supply Faults

We'll begin with the power supply. There are several common faults here. Fortunately they can be recognised and eliminated easily. The faults all result in the no results symptom and begin with the mains on/off switch.

In models with remote control the mains switch has a third pair of contacts that make momentarily when the switch is operated. These contacts provide a system reset for the remote-control circuits so that the receiver comes on with all the analogue controls normalised and the programme selector at No. 1. If the contacts fail to close momentarily the receiver will immediately go into standby and the remote-control unit will have to be used to switch it on. If the switch fails with the contacts permanently closed the receiver will power up but the channel-stepping buttons on the front panel won't change upwards and the remote-control system will operate only partially. Changing the switch is the obvious cure. The replacement will restore normal working though some switches, because of their mechanical tolerances, won't respond to on/off "stabbers": the switch should always be operated deliberately and pushed fully home.

Further problems occur in the chopper control circuit – they are commonly found in other manufacturers' models that use the TDA4600 series chip (a TDA4600-2 here, IC7). Fig. 1 shows the relevant circuitry. The chopper transistor TR6 is current limited by the action of the components connected to pin 4 of IC7. C118 charges from the rectified mains supply via R115. While TR6 is conducting, pin 4 of IC7 is open-circuit, allowing C118 to charge. When the control circuit switches TR6 off, pin 4 of IC7 goes low and C118 is discharged. Thus a sawtooth waveform is developed at pin 4. The amplitude of this sawtooth waveform depends on the length of time during which TR6 is conductive. To prevent TR6 passing excessive current the control circuit checks on when the amplitude rises to 4V. The time C118 takes to charge depends on the value of R115, and in early TX100 sets this resistor gave trouble – as it did in the TX9 chassis (PC1044 board). R115 has to withstand the 350V or so produced by the mains rectifier, so a standard 250V working type will not do as a replacement. A 500V, metal-glaze type is required and is available from Ferguson.

Another critical resistor is R114, whose value was standardised at 0·39Ω for all models. We've had earlier models in the workshop with this resistor having gone high in value. This reduces TR6's base drive, the result being destruction of TR6. A word should be said on the trail of destruction that accompanies failure of TR6. It usually goes short-circuit collector-to-base. D13 then has 350V at its cathode and disintegrates. R121 burns up, and current flows via C117 into pins 7 and 8 of IC7. C117 frequently survives this treatment, but IC7 rarely does.

The recommended replacement for TR6 is a T9063V, which is a selected BU508A. It's wise to replace the spring retaining clip and the grey thermopad at the same time. A kit for the job is available from Ferguson. These comments apply equally to the line output transistor TR10, which we'll come to in a moment. In 110° sets D28, which is connected in series with the 119V h.t. supply to the line output stage, is a common offender, either going very leaky or short-circuit. In the leaky condition the diode exhibits an excellent leakage resistance/temperature characteristic!

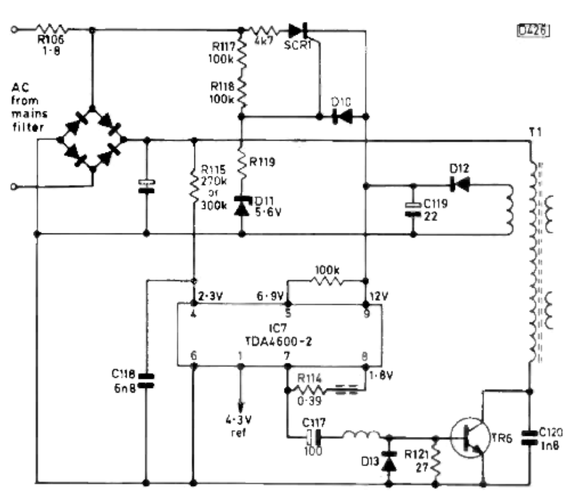

Fig. 1: Part of the chopper circuit, showing the items that can give trouble.

Before leaving the power supply it's useful to consider what happens should the line output transistor TR10 for example fail, placing a short-circuit across the 119V h.t. line. The contacts of relay RL1, which is controlled by TR9, switch the 119V supply on/off. When there's a short-circuit across the h.t. line the protection system within IC7 automatically shuts the power supply down. As TR9 is then no longer powered, the relay's contacts open, thus removing the short-circuit. The power supply senses that the short-circuit has been removed and starts up again. The cycle is repeated and with a non-remote control set you can hear the relay's contacts chattering. With remote-control sets the power supply drops into the standby mode at switch-on. Disconnecting PL18 will get the relay chattering if there's a short-circuit across the 119V rail.

Failure of the power supply to start up should direct attention to R117 and R118 in thyristor SCR1's gate circuit. These are both 100kΩ, but occasionally one of them may go high-resistance as a result of which there's insufficient current for SCR1 to switch on. SCR1 provides a start-up supply for IC7.

Line Scan Troubles

Failure of the line output transistor TR10 was a common occurrence in early TX100 sets. A couple of modifications ensure that it doesn't recur. Fig. 2 shows the relevant circuitry. Note the change in the suply to the timebase generator chip IC4, at pin 16: C75 is changed to 22μF while R78 becomes 1kΩ and is connected to pin 3 of the 15V regulator IC9. TR10 should preferably be type T6071V with 90° tubes and type T9063V with 110° tubes. These transistors are both selections from the BU508A family.

The line driver transistor TR8 occasionally fails, though this isn't an everyday happening. In this event it's worth checking C127, C141, D34 and the output from IC9. If a scope is to hand check TR8's base and collector waveforms to see if the transistor is operating with full drive. TR8 should be replaced using another BC372 or a recommended equivalent.

Field Scan Failures

Failure of the field driver/output chip IC6 is fairly rare. Two types are in use. The TDA3652 is usually found but in sets with an A51-590X or A51-427X conventional 20in. tube a TDA3651 is fitted. They are not interchangeable and the rule is to replace with the same type.

Field cramp at the bottom, foldover and sometimes loss of height occur when C99 (100μF) has gone low in value or D4 is leaky. Go for the capacitor first – sometimes you can see that electrolyte has leaked on to the PCB.

Low-level Stages

The tuner, i.f., luminance/chrominance processing, low-level sound and sync/timebase generator (pin 10 of IC4) circuitry is fed from a nominal 12V line. This is derived from a 17V supply via a three-terminal regulator (IC8) which is rated at 1A. Failure of this regulator has been encountered occasionally, generally after a thunderstorm which has done further damage to the chassis though the device can fail for no apparent reason.

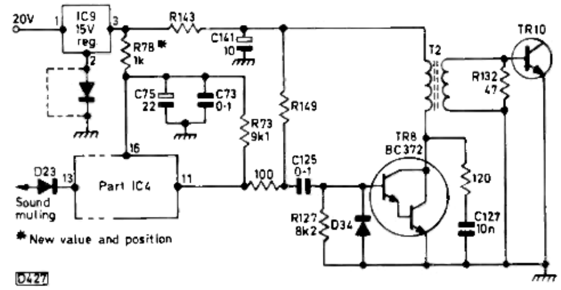

Fig. 2: The line driver circuit, showing modifications to IC4's supply at pin 16. The value of R143 depends on the tube type. R149 is 1kΩ or omitted depending on tube. D34 is omitted when R149 is not present.

Some models display heavy chroma patterning on areas of saturated colour. This is due to subcarrier leakage and can be traced to L6. If adjustment doesn't cure the problem you can get a replacement type – with this C27 must also be changed, from 22pF to 27pF.

The Sync and TB Generator Chip

Complete loss of sync occurs when C63 (150pF) goes short-circuit, removing the video feed to the sync/timebase generator chip IC4. A one-ended line hold control (RV9) turned out to be due to a damaged track though R70 could also be the cause. IC4 itself rarely seems to cause trouble. Note the previously mentioned modifications to prevent destruction of the line output transistor TR10 at switch-on, particularly in cold weather. When R78 is changed from 18kΩ to 1kΩ it must be connected to the 15V supply, not the 119V line.

Sound Muting

IC4 contains a circuit that detects the presence of the video: its output at pin 13 goes low to mute the sound in the absence of video and sync. In a set with no picture and sound it's sometimes useful to check for the presence of sound before you dismantle half the tuner and i.f. strip. This can be done by unsoldering one end of D23: the mute line then goes high, enabling the sound chip IC5.

The Colour Decoder Chip

A TDA3562A colour decoder chip is used (IC3). It also performs the brightness, contrast and saturation control operations, auto-greyscale correction, and contains the RGB video switches that provide changeover

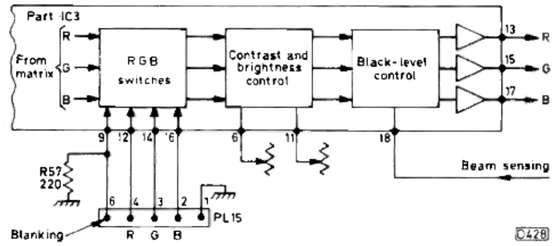

Fig. 3: Inputs to the video switches in IC3. 1·5V at pin 9 of IC3 (pin 6 of PI15) changes the switches over.

from decoded off-air or external (via the scart socket) signals to teletext RGB signals. Switching control is applied to pin 9 of the chip: there is access to this at pin 6 of PL15, see Fig. 3. Application of 1·5V from a torch cell to this point changes the video switches over and could be a useful way of isolating the source of any video disturbance. IC3 is very reliable and provides long service. It can however be destroyed by a c.r.t. flashover.

The CRT Base Panel

The RGB output stages are on the c.r.t. base panel. There are two main problems here. The first relates to the three 1kΩ resistors R604, R608 and R612 which link the RGB channels to the single beam sensing line that provides feedback to the TDA3562A chip. They tend to go high in value. The result is a flood of colour depending on which resistor has changed value. It can give the impression that the c.r.t. has failed.

The other problem occurs mainly with 59cm FS tubes. It shows up as random spurious operation of the remote-control system. The cause is corona discharge in the spark gaps formed in the tube base socket. Homes with coal fires and/or occupants who smoke tend to experience this trouble. The best remedy is to replace the c.r.t. base socket, install central heating and give up smoking!

Versions of the TX100

A problem with the TX100 is that there are eight or nine different versions of the chassis. When remote control and teletext are taken into account as well, the permutations become pretty complex. Some later models incorporate fastext and in this case a microcomputer chip is used to operate the remote-control system – the whole system is on one PCB. Table 1 lists the various models and PCB numbers. Where retrofit teletext is available the kit number is included in the teletext column. Some models incorporate baseband stereo sound for VCR use. There are punchings in the basic chassis for the German Zwei-Ton system, but this is not used in the UK. Some models are equipped with TACS control PCBs, enabling up-down buttons to be used instead of rotary or slider controls. The TACs board is included in the remote-control column.

If you are tempted to try to convert a 90° chassis to 110° or vice versa be warned that this is very difficult. It will take three or four hours and a lot of adrenalin.

Remote Control Problems

Excessive sensitivity of the remote control input circuit to induced interference from the mains lead and from high-voltage corona can be reduced, on non-teletext models that use the PC1564-311 panel, by connecting an underboard bonding strap of heavy-gauge wire, suitably insulated, between pin 1 of the SAA5012 chip IC2001 and the earthy end of the clock oscillator timing components C2007 and C2008. Screening the mains lead where it passes by the remote control PCB is a help. So is removing the mains lead from the bundle of cables from the chassis to the controls and routeing it away from the rest. A "power cleaner", like those used with computers, can also be tried, but watch out for earth-leakage trips in rural areas – they may not like the current in the earth line!

Table 1: Models fitted with the TX100 Chassis.

Model	*Chassis*	*RC PCB*	*Teletext*
20A1	PC1150-014	–	–
20A2	PC1150-014	PC1863-303	–
20A3	PC1150-014	PC1515-357	PC1539-304
20C3	PC1150-014	PC1564-311	PC1539-304
20G1	PC1150-014	PC1564-321*	–
20G2	PC1150-014	PC1564-311	–
20G3	PC1150-014	PC1564-311	PC1539-304
20H1	PC1150-014	PC1223-001*	–
20H2	PC1150-014	PC1223-002	–
20H3	PC1150-014	PC1223-002	PC1228-001
22B1	PC1150-111	–	–
22B2	PC1150-111	PC1548-302	–
22B3	PC1150-111	PC1515-357	PC1539-304
22B4	PC1150-111	PC1536-307	PC1539-304
22D1	PC1150-111 (30AX)	–	–
	PC1150-121 (Bonded-yoke CRT)	–	–
22D2	PC1150-111 or -121	PC1564-311	–
22D3	PC1150-111 or -121	PC1564-311	PC1539-304
22G1	PC1150-111 or -121	PC1564-321*	–
22G2	PC1150-111 or -121	PC1564-311	–
22G3	PC1150-111 or -121	PC1564-311	PC1539-304
22H1	PC1150-111 or -121	PC1223-001*	–
22H2	PC1150-111 or -121	PC1223-002	–
22H3	PC1150-111 or -121	PC1223-002	PC1228-001
26D1	PC1150-111	–	–
26D2	PC1150-111	PC1564-311	–
26D3	PC1150-111	PC1564-311	PC1539-304
26G2	PC1150-111	PC1564-311	–
26G3	PC1150-111	PC1564-311	PC1539-304
51A0	PC1150-731 (A51JAR)	PC1564-311	–
	PC1150-751 (A51EAL)	PC1564-311	–
51A2	PC1150-731 or -751	PC1544-311	–
51A3	PC1150-731 or -751	PC1544-311	PC1539-304
51A4	PC1150-731 or -751	PC1544-311	PC1539-304
51A5	PC1150-731	PC1544-331	PC1539-304
51A8	PC1150-731	PC1564-311	TA171 kit
51G2	PC1150-731 or -751	PC1637-003	–
51G3	PC1150-731 or -751	PC1637-001	–
51H4	PC1150-731 or -751	PC1637-001	–
51H5	PC1150-731 or -751	PC1637-001	–
59B2	PC1150-841	PC1544-311	TA174 kit
59B3	PC1150-841	PC1544-311	PC1539-304
59B5	PC1150-831	PC1544-331	PC1539-304
59B8	PC1150-131	PC1564-311	TA171 kit
59D2	PC1150-841	PC1544-311	TA174 kit
59D3	PC1150-841	PC1544-311	PC1539-304
59G2	PC1150-731 or -751	PC1637-003	–
59G3	PC1150-731 or -751	PC1637-001	–
59H4	PC1150-831	PC1637-001	–
59H5	PC1150-831	PC1637-001	–
59J7	PC1150-131	PC1223-102	PC1228-001
66B2	PC1150-861	PC1544-311	TA174 kit
66B3	PC1150-861	PC1544-311	PC1539-304
66B5	PC1150-861	PC1644-331	PC1539-304
66B8	PC1150-161	PC1564-311	TA171 kit
66H4	PC1150-861	PC1637-001	–
66H5	PC1150-861	PC1637-001	–

* Non-remote TACS panel.

Sunlight can decrease the sensitivity of the receiving diodes by swamping them with vast amounts of infra-red radiation. Careful positioning of the receiver may be necessary and a tip here is to slide the infra-red assembly slightly back down the moulding that holds it. This decreases the "window" and can help, but it also narrows the angle from which the receiver can be controlled by the handset.

Remote Control Servicing

There are seven different types of remote-control PCB. Of these the PC1564-311 is the most common. Faults in this area usually involve the SAA5012 chip IC2001 or the M293B1 chip IC2007. The SAA5012 produces a variety of faults that can be logically traced back to it, notably total disability of the remote-control system. An oscilloscope can be used to check this. Apply the probe to pin 22 first to see if there's an output from the IR receiver module. Next check for 5V at pins 23 and 24 and for the clock oscillator waveform at pins 18 and 19. If this waveform is absent and there's nothing obviously wrong with the resonator and its associated components, the chip has probably retired. Other problems with IC2001 include failure to switch in and out of standby due to absence of a flip-flop output at pin 6 and failure to select any even-numbered channels due to the absence of an output at pin 3, which carries the least significant bit of the programme number address.

The M293B1 tuning chip contains a non-volatile memory. Thunderstorms and c.r.t. flashovers very often attack this part of the chip, the result being that memory is lost and programmed-in channels cannot be retrieved. Check for the oscillator waveform at pins 13 and 14, for 5V at pin 12, and the status of the programme-address pins 3, 4, 5 and 6. Pin 3 is the least significant bit, and programme one is binary 0000.

Tuning drift with this module can occur through internal leakage in IC2007, but before you consign this chip to the little heap already on the bench it's worth checking IC2006, TR2018 and C2020. Suspect TR2017 and its associated components if the module won't memorise tuning data – this circuit supplies 25V for the memory during its read and write cycles.

The remote-control receiver is very sensitive and can be affected by corona from high voltages in the c.r.t. system and from mains-borne spikes between either side of the mains and earth. If the symptoms are wild, abandoned channel-changing and variations in volume, colour and brightness, look for these causes. I've known a faulty mains switch on the receiver to be the cause, but more commonly the trouble is due to a loose connection to the tube's external coating or mains-borne spikes. In the latter case try removing the incoming mains lead from the bundle and routeing it well away from the remote-control PCB. In severe cases I've fitted a screened mains cable from the mains plug to the receiver's on/off switch, but this is expensive and difficult to obtain nowadays.

There are two three-terminal regulators on the PC1564-311 panel, IC2002 and IC2003, both type 7805. The former supplies the IR receiver preamplifier and IC2001 while the latter feeds the memory and display areas. They should be checked in the event of malfunctions.

Teletext

In the past setmakers have not encouraged teletext decoder servicing, possibly due to the delicate and expensive semiconductor devices they use and partly due to the assumption that enginneers are unfamiliar with digital technology. Fortunately very little appears to go wrong with teletext decoder modules and, given a little thought, most faults are fairly obvious.

There are some adjustments on the teletext panel and a summary of their functions may be useful – but the temptation to go twiddling must be resisted. Trimmer CV1031 adjusts the resonance of the clock oscillator's 6MHz crystal. The clock oscillator provides the decoder's timing signals, and is set by calling up a mixed picture and text display from the remote-control handset. When CV1031 has been set correctly the text and TV displays should be synchronised. L1031 is part of the resonant circuit used to recover the transmitted clock signal that precedes each row of text data. This clock oscillator is a shock-excited type, similar to the colour subcarrier regenerator circuit used in elderly Rank colour sets. The tuning of L1031 gives either text of gibberish. If you have a frequency counter it can be set for 6·9375MHz.

The setting of RV1031 should not be altered unless there's a field sync problem with "after-hours" text operation. The teletext display normally depends on the transmitted signal for line and field sync. Should the transmitter fail or simply close down at the end of the day's broadcasting text will normally be lost. The decoder used in these sets substitutes its own sync pulses when the transmitted signal ceases, RV1031 being provided to adjust the width of the substitute field sync pulse.

Finally RV1032 is the text contrast adjustment. Set it to give clean areas of saturated colour without colour drift due to overheating of the c.r.t.'s shadowmask. Teletext is notorious for showing up this failure in current c.r.t. technology: judicious adjustment of RV1032 will avoid its appearance.

Further Points

The TX100 has proved to be a very good workhorse for 90° and 110° models. We've covered most of the common problems and some less common ones in the previous notes. One or two further points are perhaps worth making. We've already mentioned failure of the line output transistor. The transformer also fails on occasion. When either of these items has to be replaced the line driver transistor TR8 is not above suspicion. A check is to measure its base voltage over a period of about a quarter of an hour. The reading should remain steady at 0·8V. In the event of no green/blue/red check whether the relevant bias/feedback resistor R601/605/609 (100kΩ) has gone open-circuit.

Retubing

The chassis has a lot of life in it beyond that of its tube. It's worth replacing the tube therefore when this becomes necessary. When fitting a reprocessed tube there's one small pitfall you can encounter. Very often the beam current balance between the three guns leaves much to be desired, and this can result in the auto-greyscale system doing a few somersaults! If this occurs, try to get access to a c.r.t. analyser such as the B-K unit that can balance the emissions of the guns. Also note the effect of the first anode preset: when fitting a fresh tube it will pay to experiment with the setting of this control (part of the line output transformer) slightly.