BBC Model B Computer Fault Notes

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We'll start with some general notes then provide a list of faults we've encountered, many of them stock faults.

General Notes

Random long-term problems, especially with early machines, are mainly caused by degradation of socket connections. Faults of this type cannot be diagnosed. If the following procedure is adopted however many of these intermittent faults can be dealt with, thus saving hours of fault-finding time.

All mechanical connections should be cleaned and disturbed, i.e. clean i.c. pins with a fibre-tipped tool and check i.c. sockets for broken pins etc.

The wires to the push-on connectors between the switch-mode power supply and the main PCB were presoldered prior to being crimped on to the connectors. This has caused all sorts of problems due to high-resistance joints. The problems appear over a period of time as a result of the voltage at the PCB dropping, sometimes to less than 4·7V. In this condition random problems appear as the unit warms up, because the address multiplexers begin to lose their drive power. The solution to this problem is to solder all these crimped connectors. You can do this by pushing the insulation on the leads back to reveal the crimping, then soldering.

Acorn Computers, manufacturer of the BBC B, doesn't encourage people to repair the switch-mode power supply. Only a circuit diagram is provided in the service manual and spare parts are not available. It's worth checking a dead unit for dry-joints however, especially around the mains input filter T1. Also check the bridge rectifier and the 0·6W, 4·7Ω metal-film resistor R12 which provides the feed to the collector of Q2. This TO3 device, which is mounted on a vertical piece of metal, is unmarked. We understand that it's an Hitachi 2SC1942: the Telefunken BU225 seems to be a suitable equivalent (TVT lists the BU500 as an equivalent).

Faults List

The following faults relate to Issue 2 to 7 versions of the BBC Model B.

(1) Won't start up. Read/write pin 34 of the 6502A microprocessor chip IC1 was shorted to earth due to a fault in IC33 (74LS04).

(2) Won't start up, reset line (RST) incorrect. IC33 (74LS04) faulty.

(3) Machine apparently dead. Port B (in/out) of IC3 (6522) faulty.

(4) Large white blocks on the screen. Dry-joints on the power supply leads – crimping is not always reliable. Solder the leads – see above.

(5) Program crashes. Cause was hash on the supply lines due to a faulty power supply.

(6) No data loading on tape. LM324 chip IC35 faulty.

(7) No data loading on tape. Serial interface chip IC7 faulty.

(8) Machine apparently dead, but corrupted BBC logo occasionally appeared. The clue was that random teletext colours came up. A check on the 16MHz clock waveform showed that it was badly distorted though the frequency was more or less correct. IC43 (74S04) was faulty. Note that this chip must be a 74S04, not 74LS04, as the latter won't work. Interesting that with the fault present the waveform could be reshaped, and the machine would start up, by damping pin 2 of the chip with the scope probe.

(9) Continuous beep and no input from the keyboard. IC3 (6522) faulty.

(10) No RGB monitor sync. IC48 (74LS86) faulty.

(11) Keyboard generates incorrect characters, e.g. T instead of 9. Fault was caused by the 74LS30 chip on the keyboard.

(12) Corrupt data in Mode 7 after warm-up, e.g. characters wobble. A finger on the 16MHz crystal X1 made matters worse. IC37 (74LS04) was defective – it had become heat sensitive.

(13) Monitor displays multiple characters. IC3 (6522) faulty.

(14) Intermittent loss of reset. The 555 chip IC16's socket faulty: mount the chip on the board directly.

(15) Intermittent loss of reset. Another cause is a dry-joint on R21 (1MΩ), which is connected to pin 6 of the 555 chip IC16, due to poor flow soldering.

(16) Poor quality i.c. sockets with thin pins were used with Issue 4 boards. The pins snap off inside the socket housing – thus when resoldered the broken pins drop out of the PCB.

(17) DFS (disc filing system) faulty – machine comes on with logo and a continuous tone. Defective 8271 chip is generating a continuous IRQ. Fault can be found by removing the DFS ROM. Note that the old 0·90 DFS ROM looks for an 8271. If it doesn't find one it starts to loop and generates a continuous tone. This can be used for fault finding. Later types of DFS ROM move away if they don't find an 8271.

(18) Won't start up, continuous tone present. No 8MHz output at pin 7 of the video processor chip IC6. Replace this i.c.

(19) No loading from the cassette port. The 820pF capacitors C31 and C35 open-circuit.

(20) Incorrect writing from keyboard. 74LS251 chip on keyboard faulty.

(21) Loss of the display when the machine has warmed

up. Faulty 6845 CRTC chip – the sync pulses read incorrectly.

(22) Shift or control keys on keyboard not working. Key F4 permanently on. Replace F4 keyswitch.

(23) IRQ line incorrect after a few hours. Cause was a heat-sensitive 6502A microprocessor chip (IC1).

(24) Noisy display with u.h.f. output. Scope at emitter of Q8 showed that very little luminance was present. Q8 (BC309) was faulty. Its emitter is normally at 1V, its base at 0·2V.

(25) Machine slowed down to about 700kHz instead of 2MHz. A faulty 6502A chip (IC1) was dragging the clock pulses down at pin 37. Replacing the i.c. cured the fault.

(26) Intermittent lock-up from keyboard. OS ROM chip IC51 had a faulty socket.

(27) Various weird RAM faults – strange displays, garbage on screen etc. Can be caused by IC14 (74LS245). This chip is provided with a socket on later issue boards.

(28) Mode 7 o.k., all other modes faulty. Input from keyboard prints twice, with two cursors. IC39 (74LS283) faulty – pin 4 low. See also (31).

(29) Faulty display with higher definition modes. IC39 (74LS283) faulty – pin 1 incorrect.

(30) Flickering display in 0 mode. Fault in the video processor chip's palette (IC6). Chip is earlier ULA type and is overheating. Replace with MkIII version.

(31) Mode 7 o.k., all other modes faulty. The disenable input at the video processor chip IC6 was incorrect. Cause of the fault was traced to an open-circuit track between pin 3 of IC38 (74LS86) and pin 9 of IC41 (74LS02). See also (28).

(32) Printer won't work. Pin 40 of IC69's socket open-circuit. Replace socket. See also (38).

(33) Printer won't function. Machine was a Model A with issue 2 board that had been upgraded to Model B specification. Pin 26 of the IDC connector on the old issue 2 board is shorted to earth – printer won't work in this condition. Cut print.

(34) Modes 0, 1 and 2 faulty – top half of display flashing. R10 (3·3kΩ) open-circuit. This resistor is connected to pin 11 of IC27.

(35) Incorrect data being sent and received via RS423. A comparison with a good machine showed that the mark/space ratio of the waveform at the baud rate generator was wrong. IC42 (74LS163) faulty.

(36) Interrupt request (IRQ) line down. Reading at pin 20 (CS) of the basic ROM IC52 was very low. The 74LS139 ROM select chip IC20 was faulty.

(37) Will not upgrade to DFS. Pin 12 in IC78's socket open-circuit. Replace socket.

(38) Printer not working. Pin 6 of IC27 (7438) low. Replace IC27. See also (32) and (33).

(39) DFS faulty: machine loads corrupted data from disc. IC87 (74LS123) faulty.

(40) DFS faulty: data is corrupted when saved on disc. IC80 (7438) faulty.

(41) DFS faulty: index header only is displayed, with corrupted figures. IC27 (7438) faulty. See also (49).

(42) DFS faulty: read/write incorrect. IC77 (74LS00) faulty.

(43) 80-column display at switch on. There are various causes for this fault. Usually the IRQ line goes low because the 8271 chip is faulty. Other possible causes are IC3 (6522) port A (keyboard) and the 6845 CRTC (c.r.t. controller) chip IC2.

(44) The machine ran but gave error messages when programs were loaded into memory, e.g. "error at line 251.4532234". Also the RAM test gave a "no room" message and the disassembler, when loaded, gave access to only one address at a time. Cause of the fault was the 68B54 Econet chip IC89.

(45) RAM fault. CAS 0 disappeared and the machine became a Model A. IC45 (74S139) was the cause.

(46) Poor field sync on monitor. Cause of the fault was IC41 (74LS02) which provides composite sync from the CRTC chip's separate field and line sync outputs.

(47) Loading problems with cassettes on issue 3 and 4 boards. Change the value of R75 from 82kΩ to 47kΩ.

(48) Caps lock wouldn't work, i.e. LED didn't light. Cause of the fault was IC32 (74LS259).

(49) DFS fault on issue 4 boards onwards: reads index header only, with corrupted titles. Link S9 not cut with factory fitted DFS.

(50) RS423 fault: the port refused to work properly when a simple acoustic coupler type modem was used. The modem supplies only data out and data in signals but the Model B requires a CTS signal as well. The operator had used the ?89 procedure in the Comunitel software to override this requirement. The Model B does however require a physical signal: to operate with a "dumb" modem, link together the CTS and RTS pins on the DIN connector.

(51) No writing from keyboard. IC4 (74LS30) faulty.

(52) Modes 3 and 6 faulty. The effect on the screen was ghost printing under the required text etc. IC36 (74LS10) faulty, with waveform at pin 8 when it shouldn't be present.

(53) Continuous multi-tone from speaker. IC18 (76489) was going unstable. This is a four-channel tone generator.

(54) Hangs up for no apparent reason. This may be a production fault – the clock pulse too narrow. Can be cured by adding a 100pF capacitor from pin 37 of the 6502A microprocessor chip IC1 to chassis. With issue 3 and 4 boards there are, near this chip, two plated holes that can be used.

(55) Hangs up with continuous tone. IRQ line and clock

pulse at pin 37 of IC1 incorrect. Pin 15 of IC24 (74LS138) was short-circuit to chassis.

(56) Intermittent crashing. Replace IC51's socket.

(57) Cursor only displayed, flashing at top left-hand side of the screen. The IRQ line was low with incorrect waveforms around IC32 (74LS259) which was defective.

(58) Screen filled with approximately half-inch thick horizontal red bars interspersed with blobs of yellow. Poor chip select signal from IC26 to the video processor chip IC6. IC26 (74LS139) was faulty.

(59) Loud buzz on sound with screen flashing (no data displayed). IRQ line to the 6502A microprocessor incorrect. Pin 20 of basic ROM IC52 read 50Ω to chassis. The ROM decoder chip IC20 (74LS139) was faulty with a leak between pins 8 (chassis) and 12.