

SECTION 4

FAULT DIAGNOSIS AND REPAIR

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1. INTRODUCTION

1.1 Test Equipment

1.1.1 Section 4 is intended as a guide to fault diagnosis and repair. It is written for repair staff who are familiar with standard fault-finding procedures and who have the requisite test equipment available. The table below lists the minimum required test equipment and materials.

EQUIPMENT	SPECIFICATION/ MANUFACTURER
Frequency Meter Oscilloscope Digital Multimeter Known good LED display unit Known good keyboard unit Mains Adaptor Superglue	General Purpose Rise time 100 nanosec General purpose Cambridge Computer Cambridge Computer Cambridge Computer Open market

1.2 Modification History

1.2.1 Two types of board only are in circulation, viz Issue 3 and Issue 4. Only a small number of Issue 3 boards are in existence. They differ from Issue 4 boards in that certain components have been manually wired in. In Issue 4 boards, the printed circuit has been amended to accommodate these components. The relevant components are listed below:

Resistors : R80, R81, R82. In addition R23 (100k) has been relocated in parallel with D9.

Capacitors : C31, C32.

Transistors : T25.

Diodes : D28, D29, D30.

Preset potentiometers : RV2.

1.2.2 On Issue 3 boards, resistors R52 and R75 have been removed from the circuit and leave gaps. There is also a gap where R23 has been removed in order to be relocated in parallel with D9.

2. FAULT DIAGNOSIS

2.1 Techniques

2.1.1 In a highly complex electronic device such as the Z88, it is not possible to fully categorise the fault-finding procedure. It is anticipated that practical experience of machine faults, perhaps comparing measurements on a known good unit, will build up the knowledge to pinpoint most faults.

2.1.2 Due to the proven reliability of the electronic components, particularly the integrated circuits, it is expected that most faults will be of a mechanical type, eg faulty connectors, broken RS232 wires, faulty switch operation.

2.1.3 It is believed that as yet few service centres will have the facilities to change surface mounted components - in particular the gate array IC4. To check on a suspect gate array that all legs have been soldered correctly, run a small screwdriver over each leg array. Any poorly connected leg will distort. When a fault has been definitely narrowed down and assigned to this component, the complete unit should be returned to the manufacturers for repair. Faulty memory cards containing surface mounted components should also be returned to the manufacturer.

2.1.4 An initial physical examination of the board can sometimes indicate an obvious fault such as a burnt-out component or over-heated track. If it is suspected that an amateur has been at work on the board, it should be remembered that short circuits caused by hairline solder 'splatter' can cause some very misleading effects.

- 2.1.5 Customer notes on the nature of the fault should in general be ignored. It is often better that the repair task is approached with an open mind and with no pre-conceived idea of the fault.
- 2.1.6 In the case where the customer has returned peripheral equipment (eg memory cards) with his faulty unit, the unit must first be tested with the plug-in modules disconnected. The unit under repair should have the bezel removed and the keyboard detached from the bottom cover assembly. Batteries should also be removed and power applied from a serviceable adaptor.
- 2.1.7 Where the substitution method is used to check a suspect component, the suspect component should be connected into the known serviceable unit rather than the other way round. The faulty component is less likely to damage the working unit, thus safeguarding the unit and the known serviceable component.
- 2.1.8 In order to prevent the Z88 from switching itself off after its 5 minute time-out period, which on a critical fault could be frustrating, change the time-out period as follows:
- (a) Select the Index display and the Panel option.
 - (b) Select the required field indicated by the flashing digit 5.
 - (c) Key in the digit 0 and press ENTER.
- The Z88 will now stay on permanently. In order to revert to the 5 minute time-out period, press the Reset switch.
- 2.1.9 Typical waveforms and voltages taken from a serviceable unit with the Index displayed are set out in Tables 4.1, 4.2 and 4.3 below. Voltages present when the Z88 is in the coma state are listed in Table 4.4

2.2 Power Up

- 2.2.1 If, when the two SHIFT keys are depressed, the Index is displayed it can be assumed that most of the system is working. If it is possible to select Pipedream and generate and store a file, then it can be assumed that the basic system is healthy.
- 2.2.2 If, when the two SHIFT keys are depressed, the unit does not display the Index and the screen remains blank, carry out the following procedure.
- (a) Check that the ribbon connector to the LCD is aligned and connected correctly. It is possible for this connector to be misaligned causing a blank screen.
 - (b) Press both SHIFT keys to power up the unit.
 - (c) If the unit does not power up, disconnect the two keyboard ribbon connectors. This action should switch on the unit. If the unit does not switch on, reconnect the two keyboard connectors.

- (d) Check the following signals to find out if the pseudo-static RAM is being refreshed:

<u>Signal</u>	<u>Level</u>	<u>Test Point</u>
IRCE	High	IC2, pin 22
SE1	High	SK1, pin 30
SE2	High	SK2, pin 30
SE3	High	SK3, pin 30
POE	Low	IC2, pin 1

- (e) If the signals in (d) above are not present, a serious fault exists. Check for 5.5V at R74 and trouble-shoot for a power supply fault if not present.
- (f) Check for the 25.6 KHz clock at the collector of T24. If this signal is not present, the computer does not come out of the coma state.
- (g) Check at C21 if the 40 μ S reset pulses are reaching the gate array. The level is normally high and goes low for the duration of the pulse. Allow 1 second between pressings of the Reset switch.

CAUTION: DO NOT ATTEMPT TO MEASURE THE 9 MHz CLOCK WITH AN UNPROTECTED PROBE. USE A 1 nf CAPACITOR IN SERIES WITH THE PROBE OR ATTEMPT TO 'PICK UP' THE OSCILLATOR SIGNAL WITH THE PROBE CLOSE TO BUT NOT TOUCHING THE CIRCUIT.

- (h) If the reset is present, use the frequency meter to check at R43 for the 9.83040 MHz clock signal. If the clock is not present, check at R42 for the switched 5.5V rail. If 5.5V is not present, check at R39 for a low LP signal from the gate array.
- (j) Check at IC1 pin 26 that reset pulses from the gate array are getting through to the Z80. If reset pulses are present, check at IC1 pin 6 that 5.5V 3.2768 MHz pulses are present.
- (k) If the Z80 is not being reset, check at the collector of R25 for a high level (+5.5V). If this is not present, the computer cannot leave the coma state.
- (l) If no progress is being made check for correct operation of the Flap switch - normally open.

TABLE 4.1 POWER SUPPLY VOLTAGES

TEST POINT	VOLTAGE
SK8, pin 12	+5.5V
R9	+16.3V
R38	-6.0V
T8 emitter	-18.0V

TABLE 4.2 TYPICAL VOLTAGES

TRANSISTOR	EMITTER	BASE	COLLECTOR
T1	+0.4V	0.0V	-0.4V
T2	-0.3V	-0.4V	-5.6V
T3	0.0V	0.0V	-0.3V
T4	0.0V	-0.3V	-6.1V
T5	0.0V	-6.2V	-5.6V
T6	+5.5V	+4.9V	+5.4V
T7	+0.4V	0.0V	-18.0V
T8	-18.0V	-18.0V	+5.5V
T9	0.0V	0.0V	+5.0V
T10	0.0V	-0.4V	+5.0V
T11	+5.5V	+5.5V	-5.8V
T12	+5.5V	+4.9V	+5.5V
T13	+0.5V	0.0V	-5.3V
T14	-5.4V	-5.6V	-6.0V
T15	+5.5V	+5.5V	-6.0V
T16	-5.9V	-5.3V	-6.0V
T17	+5.5V	+4.8V	+5.5V
T18	+2.7V	+2.3V	+5.5V
T19	0.0V	-0.5V	+2.7V
T20	+14.0V	+14.0V	+5.3V
T21	0.0V	0.0V	+14.0V
T22	0.0V	+0.2V	+2.8V
T23	+5.5V	+5.1V	+2.8V
T24	+5.5V	+6.0V	+2.8V
T25	-0.9V	0.0V	+5.0V

TABLE 4.3 TYPICAL WAVEFORMS AND VOLTAGES

TEST POINT	WAVEFORM
<u>General</u>	
R44	5.5V sinewave 9.8304 MHz (MCK) NOTE: Before attempting to measure this signal, refer to the CAUTION on page 4.4
C18	5.2V sinewave 25.6 KHz
T24 Collector	5.2V squarwave 25.6 KHz (SCK)
C21	40 μ S reset pulse, negative going (press Reset switch)
T25 Collector	+5.0V sense line (SNS)
C14	+2.4V (LP)
<u>IC1</u>	
Pin 6	Squarewave 5.5V 3.2768 MHz (Z80 clock)
Pin 11	+5.5V
Pin 16	Negative going 5.5V pulses, 100 Hz (<u>INT</u>)
Pin 17	Negative going 5.5V pulses, 100 Hz (<u>NMI</u>)
Pin 18	Negative going 5.5V pulses, 100 Hz (<u>HALT</u>)
Pin 20	Negative going 5.5V pulses, 100 Hz (<u>IORQ</u>)
Pin 26	Negative going reset pulse, (<u>RST</u> , press Reset switch)
<u>Display SK5</u>	
Pin 1	+5.5V
Pin 3	-6.6V to -10.5V variable by RV1
Pin 4	+5.5V pulses, 300 nS pulse width, period 156 μ S
Pin 5	5.5V squarewave 50 Hz (FR)
Pin 6	+5.5V
Pins 8,11,12,13,14	Data
Pin 9	5.5V squarewave 3 MHz (display shift clock, XSCL)

TABLE 4.4 COMA VOLTAGES

TEST POINT	VOLTAGE
IC2, pin 20	+5.5V (IRCE)
SK1, pin 30	+5.5V (SE1)
SK2, pin 30	+5.5V (SE2)
SK3, pin 30	+5.5V (SE2)
IC2, pin 22	0.0V (POE/ <u>OE</u>)

2.3 Keyboard

- 2.3.1 The keyboard interconnection diagram is shown in Figure 4.1. the configuration is a straightforward 8 by 8 matrix. The main objective is to establish whether the fault is on the keyboard or the main board. From a comparison between the keys pressed and the characters displayed it should be possible to isolate a faulty membrane. It should be remembered that it is possible, although a very rare occurrence, that the silicon mat itself is faulty. The keyboard is moisture susceptible.
- 2.3.2 With any apparent major problem with the keyboard, it is recommended that a known serviceable assembly be substituted in order to isolate the fault.
- 2.3.3 Faults are most likely to occur on the membrane or the connectors and are likely to fall into one of three categories:
- key on all the time
 - wrong character selected
 - no selection.
- 2.3.4 If a given row or column does not respond, the connector is suspect. If a short circuit exists between two keys, the system will not leave the coma state since it will be unable to recognise any key depressions. If a short is suspected, substitute the keyboard for a known good component. Ensure that ribbon connectors are correctly aligned in their sockets.
- 2.3.5 If a break in a ribbon cable line occurs close to a connector, it may be possible to remove the connector and slice off a short section above the break. The insulation may then be peeled off to expose the connector pins and the cable re-connected.
- 2.3.6 In order to see what is going on on the keyboard, trigger the oscilloscope from TORQ (SK8, pin 21) and monitor sockets SK6 and SK7.

2.4 128k RAM Packs

- 2.4.1 Some difficulty was encountered in early 128k RAM packs with the pack drawing more current than it should. If this problem is encountered failures can be reduced by reinforcing the joints on pins 9 and 10 of IC6 by bridging them together with solder. Pins 12 and 13 of IC6 can also be bridged. Since the RAM pack uses surface mounting techniques in its manufacture, the item is not repairable.
- 2.4.2 Testing the supply current drawn using a 128k RAM pack test jig is the only way to properly test the packs. In order to convert a Z88 into a 128k RAM pack test jig, remove resistor R48. The test rig must have the batteries removed and be powered by a Z88 adaptor with an ammeter connected in series. The batteries must be removed because unloaded batteries can have a higher voltage than an adaptor and would thus provide some or all of the standby current via the adaptor failure protection diode D24. Carry out the test as follows:

Test 1

- (a) Plug in the 128k RAM pack to the RAM pack test jig.
- (b) Switch on the modified Z88 test jig.
- (c) Check that the current being drawn by the system is 100 mA \pm 20 mA.

Test 2

- (a) Plug in the 128k RAM pack to the RAM pack test jig.
- (b) Using the two SHIFT keys, switch the test rig OFF.
- (c) Monitor the supply current for a period of two minutes and check that the current at no time exceeds 0.8 mA.

3. REPAIR

3.1 General

3.1.1 Renewal of components should be carried out using recognised desoldering/heatsinking techniques to prevent damage to the component or to the printed circuit board. Note the following points:

- (a) When handling ICs take normal anti-static precautions. It is recommended that only a suitably earthed, low power soldering iron be used.
- (b) When renewing/replacing the plug-in IC (IC3) it is advisable to use the correct removal and insertion tools. Avoid contaminating the connection pins by handling them.
- (c) When replacing a keyboard assembly, ensure that the ribbon connectors are correctly aligned, fully inserted into the board connectors and are not kinked during insertion.
- (d) After repairing a 32k RAM pack, the cover should be swaged using a centre punch and a ?? lb hammer.
- (e) After any component has been renewed, the circuit board should be examined carefully to ensure that there are no solder splatters which may cause short circuits between tracks or connector pins.
- (f) LCD Display Handling Precautions
 - (1) The display modules consist of two thin glass plates with polarizers (with UV cut filters) which are easily damaged. Extreme care should be used when handling the display panel.

- (2) When cleaning the display surface use a soft cloth (eg gauze) with a solvent (recommended below) and wipe lightly:
 - isopropyl alcohol
 - ethyl alcohol
 - trichlorotrifluoroethane
- (3) Do not wipe the display surface with dry or hard materials that will damage the polarizer surface.
- (4) Do not use the following solvents:
 - water
 - ketone
 - aromatics
- (5) The LCD modules use CMOS LSI drivers and it is recommended that the body, work/assembly areas, and assembly equipment is grounded to protect against static electricity.
- (6) Avoid intense shock and falls from a height which would damage LCD elements.
- (7) To prevent modules from degradation, do not operate or store them exposed to direct sunshine or high temperature/humidity.

3.2 EPROM Substitution

- 3.2.1 It is possible that some service centres may wish to replace the 1 Mbit ROM compatible EPROM with EPROMs conforming to the JEDEC pinout. This requires a small modification to the board involving the interchange of pins 2 and 24. This applies to both the Z88 and the EPROM PACK. In order to modify the Z88, proceed as follows:
 - (a) Cut the track in one place and add three wire links as shown in Figure 4.1(a).
 - (b) Cut two tracks as shown in Figure 4.1(b).
- 3.2.2 In the case of the EPROM card, add external wiring to transpose pins 2 and 24.

3.2.3 A summary of the action required for the various manufacturers' products is set out in the table below.

EPROM MAKE/TYPE	SWAP PINS 2 AND 24 ON 128k EPROM CARD?	MODIFY Z88 or OKAY AS IS?	ROM or JEDEC?
<u>Toshiba</u> TC571000D-20 TC571001D-20	YES NO	MODIFY OK	JEDEC ROM
<u>NEC</u> uPD27C1000D-20 uPD27C1001D-20	NO YES	OK MODIFY	ROM JEDEC
<u>Hitachi</u> HN27C101G-20 HN27C301G-20	YES NO	MODIFY OK	JEDEC ROM

NOTE: The NEC and Toshiba parts are opposite types
but with similar part numbers

AWAITING MASTER ARTWORK FROM CAMBRIDGE COMPUTERS

FIGURE 4.1 JEDEC MODIFICATION SOLDER SIDE OF BOARD

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FIGURE 4.2 JEDEC MODIFICATION COMPONENT SIDE OF BOARD