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A TANDY CORPORATION COMPANY

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02/13/81 MB

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TO: ALL REPAIR CENTER MANAGERS
CHICAGO REGION
cc BUD MCCLURE

FROM: DICK KOEPKE

SUBJECT: TROUBLE SHOOTING TRS-80 MODEL-1

The following attachment six (6) pages is a synopis of the Repair techniques, procedures, and information developed by Marc Brumlik (0637) over the past year while repairing the TRS-80 Model-1.

Section 1 explains trouble shooting techniques using basic circuits description and theory of operation.

Section 2 trouble shoots the Model-1 based on information shown on the video monitor.

This information will enable you to gain additional information and insite in the repair of computer. It will also enable you to provide additional technical information enabling a new employee to become more productive, at a high level of quality in a minimum length of time.

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ADDRESS LINES

The sixteen Address lines (A0 - A15) are outputs from the Z-80 used to specify one of the 65536 memory locations in the CPU or EI. There should be activity on all of these lines (changing states). If any Address line is inactive there will be 'garbage' on the screen. If a bad address line is suspected, remove the dip shunt at Z-3 and turn on the computer. If the screen fills with @9@9@9... A0 - A9 are good and A10 - A15 must be checked with a scope (note that A15 will not be active unless an EI is being accessed ).

If removing Z-3 produces a pattern of @9@9... on parts of the screen and garbage on other parts, one of the lines A0 - A9 is bad. For example, if there are alternately four characters of @9's and four of garbage, then A2 is inactive ($2^2 = 4$). Similarly, if there are 64 characters (one line) of garbage and 64 of @9's, A5 is bad ($2^5 = 64$).

If an address line is found to be inactive, the cause will usually be the tri-state buffer for that line. If replacing the suspected buffer has no effect, cut the foil trace to each of the gates using that line as an input and check the output of the tri-state after each cut is made. Do not repair the cuts until the defective chip has been isolated (don't forget the keyboard). Note that the ROM satellite board could be responsible for inactivity on A11, A12, or A13 even if the 24 pin cable has been removed from Z33.

ADDRESS DECODER

While the address lines specify a memory location, the address decoder enables a memory area, like ram, rom, or video. Z21 and support chips Z36, Z37, Z73, and Z74 use the higher order address lines to decode the signals ROM A*, ROM B*, RAM*, MEM*, VID*, and KYBD*. The outputs of Z21 break down the 32767 memory locations in the cpu into 4K blocks (dec. 0-4095, 4096-8191, 8192-12207, etc.). If any of these signals is absent, there will be garbage on the screen, @9@9...'s or @S@S...'s on the crt with both dip shunts in place. (Z21 is a <u>very</u> <u>common</u> cause of garbage on the screen)

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DATA LINES

The data lines are used by the Z-80 to read from or write to any memory location specified by the address lines. An inactive data line will cause garbage or changing patterns on the crt. removing Z3 may show a pattern on the screen other than @9's. If so, subtract the ascii code of the wrong character from the code of what it should be to find the bad line (for example, if the pattern seen is D9D9... then D2 is bad because ascii of @ is 64, ascii of D is 68 the difference is 4 and $2^2 = 4$).

The data lines are used in conjunction with the control lines from Z23. These lines specify what is to be done with the data on the data lines (read write in-port or out-port). If RD* or WR* are not active, there will be garbage on the screen. If IN* or OUT* are inactive, cassette I/O, 32 char./line mode and other ported I/O will not operate.

(note that all Ram inputs are tied directly to the data bus. A shorted Ram will look like a bad data line.)

VIDEO DIVIDER CHAIN

When VID* is inactive (the Z-80 is not accessing video ram) the video ram is being addressed by the divider chain. The chain reads the contents of video ram sequentially so that its contents can be displayed. Z65 and Z50 output the signals C1 - C32, specifying the 64 character positions in one line on the crt. Z12 outputs the signals L1 -L8 specifying one of the 12 scan lines of a character to be printed. Z32 outputs R1 - R8 to select one of the 16 lines of characters on the screen.

L1 L2 and L4 are used by the character generator Z29 as signals RS1, RS2, and RS3 to select one of seven lines of an alpha-numeric character. L4 and L8 are used by Z8 to specify the top- middle- or bottom-thirs of a graphics cell. L8 is also used in the character mode to keep the scan lines beneath the characters blank. Shorted video address lines v0 - V9 will cause multiple images on the crt. Missing signals L1 - L8 will cause illegible characters. Shorted or inactive video address lines can be diagnosed similarly to the system address bus (remove Z3 and look for a pattern of alternating @9@9's and garbage).

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VIDEO RAM

Ram errors are the most common video problem. The symptom is generally the exchange of one character for another. To isolate the defective chip, first determine the ascii codes of the character which should have printed and of the character appearing instead. For example, a blank screen (after pressing 'clear') is ascii code 32 (the code for a 'space'), in every ram location. If some location(s) show a '$' (ascii code 36), subtract 36-32=4. The ascii code for the location(s) in error is 4 greater than it should be. since $2^2 = 4$, bit 2 is held high. Replace Z46. Similarly , if pressing a 'B' on the keyboard produces a 'J' on the crt, B=66 and J=74. 74-66=8 and $2^3 = 8$, so bit 3 is held high. Replace Z45. If replacing the suspected video ram does not correct the error, the data line may be held high (or low) by a video ram tri-state buffer, or Z27 or Z28.

SYSTEM RAM

A bad ram can cause an occasional system lock-up or DOS reboot, a blank screen, changed line numbers or program text, shorted power supply voltages, garbage on the screen, or randomly changing patterns on the crt. If the system is not operating at all, try substituting a known good set of rams. If that has no effect, check for CAS RAS and MUX, and for activity on the ram address lines (output from Z35 and Z51). Common causes of total ram failure are Z35, Z51, Z67, Z68. If the problem is intermittant, try the ram tests. Since each test checks ram differently, only one may fail. It may take many passes of a test to find a problem.

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TROUBLESHOOTING

GARBAGE ON THE SCREEN

check power supply voltages for +12 and -5 volts

check voltage drop accross R4 (a voltage in excess of .3 suggests excessive current consumption on the 5 volt supply - check for heating components)

check for activity on the outputs of Z23 and Z21 (MEM*, VID*, etc.)

remove Z71 - a screen full of @S@S@S... suggests a ram error. A screen full of some other pattern suggests a data line problem.

remove Z3 - a screen full of @9@9@9... suggests a rom error. Some @9's and some garbage is a bad address line. (don't forget to check A10 - A15).

check for a clock to the Z-80. check for a high signal on the Z-80 pins 16,17,18,24,26. check for a pulse on pin 17 when the reset button is pushed. Try another Z-80.

replace ram with a known good set and downgrade to level I

try replacing Z35 and Z51. try Z67 and Z68. try Z21

VIDEO PROBLEMS

VIDEO JITTER check for intermittant controls R20 and R21, check for outputs from Z66, check each gate of Z5, Z6, and Z57, check each output of the divider chain for a stable signal.

NO VIDEO check 5 volt supply (note that if the 12 volt supply is out the 5 volt will not work), and check voltage drop accross R4. check for activity at Z30, pin 1. If there is a signal, check Z41, Q1 and Q2. If not, check Z9, pin 8 for SHIFT*. check the outputs of Z26, pin 8 and Z10, pin 13. check for output from the character generator and for RS1, RS2, and RS3. check for activity of BLANK, VCLR*, and DLY L8.

MISC. wrong characters printed -- video ram error.
parts of characters missing -- Z29 or Z10 or RS1, RS2, RS3 or Z10.
no blank scan lines under alphanumeric char. -- DLY L8 inactive.
printing outside of border -- BLANK is inactive.
video is a smear of dots -- Z29 or inactive video address lines.
dim video -- Z41, Q1, Q2, shorted cass. relay or shorted CR3
rolling video -- Z5, Z6, Z57 or C20, C21, C26, C27

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CASSETTE I/O

NO CSAVE check for a high signal on Z59, pin 1. check for activiity on Z25, pin 8. If good and cassette motor is running, replace Z59.
NO CLOAD check Z4 pin 10 for output. if present, check Z24, pin 8. if present check Z44, pin 12 (after XRXIII). if present replace Z44.
INTERMITTANT CLOAD if signals on Z24, pin 8 and Z44, pin 10 look good, replace Z44.
TAPE MOTOR STAYS ON if intermittant, replace relay, otherwise check for shorted CR9 or CR10, Z41, or replace Z59.
DIM VIDEO DURING CASS.I/O check K1 or Cr3 for short. if not, replace Z41.

MISC.

PRINTMEM is less than it should be -- ram error-try pokeing and peeking 0 and 255 in high memory and look for a change or replace rams individually until corrected
CHANGES IN LINE #'s OR PROGRAM TEXT -- bad ram or Z-80. check ram and Z-80 for bent pins under chip.
SCREEN FILLS WITH A's or other letters or patterns from lower right -- check for intermittant spectra-strip, pin(s) bent under a ram rom or Z-80, inter rom ribbon cable or other rom wiring
PRINTS CHARACTERS AFTER "MEMORY SIZE" -- if one letter, check for. shorted key on keyboard. if a few letters check for bad keyboard chip Z3 or Z4 (compare letters printed to a row or column in keyboard matrix)
CHARACTERS CHANGE WHEN SCREEN SCROLLS -- there is a short internal to a video ram.

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SUGGESTIONS

If a gate has active input(s) but no output and replacing it has no effect, cut the foil traces from that output to any gate using the signal as an input. check for activity between each cut until the cause is found (if the gate's output was held high by another chip, replace that chip again because it may have been damaged). If no foil cuts correct the problem, use both channels of your scope on the inputs of the suspected chip and check that it's input conditions are being met. If not, check back into the circuit.

The input or output of any gate can be pulled low with a cliplead for testing (to insure input conditions). This is also usefull if in doubt what would happen if a given signal were absent (for experimenting and investigating).

If symptoms suggest a bad gate but that gate has an active output, use the scope to determine that the output is correct for the inputs and that gate's logical function. For example, Z23 gate at pins 4,5,6: put scope CH1 on pin 4, CH2 on pin 5, and EXT trigger on pin 6. Since the output is active LO, use NEG trigger. The scope will show what was on the inputs when the output went LO. (for this example use a 1us timebase 2V per division both channels).
To check a tri-state buffer with the same technique, for example, Z76 gate at pins 4 and 5, connect CH1 to the input(pin 4) and CH2 to the output. With EXT trigger on the enable line (pin 1) the input and output can be compared for missing pulses or time lag.