THE MICRO CLINIC

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MODEL I TRS-80* FLOPPY DISK DIAGNOSTIC / MEMORY DIAGNOSTIC

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Computer "professionals" have long known the importance of regular use of diagnostic software in verifying the integrity of computer hardware. The TRS-80* is no exception; good diagnostics are a must in any situation where valuable data files are maintained. The new double-density recording techniques available for the Model I stretch the hardware to its limits and make it even more important than ever to thoroughly check out the system prior to "trusting" your valuable data to it. THE MICRO CLINIC offers two programs designed to thoroughly check out the two most trouble-prone sections of the Model I -- the disk system (controller and drives) and the memory arrays. Both programs are written in Z-80 machine code and are supplied together on diskette for a minimum 16K single disk system.

While every attempt has been made to make these diagnostics as complete and as thorough as possible, there is always the possibility that certain hardware problems in your system may escape detection. In particular, MOS memory problems can be especially difficult to find due to "pattern sensitivity" in some devices. In any case, these two diagnostics will provide you with a high degree of confidence in the integrity of your system. If you have any questions or suggestions, contact the author, Dave Stambaugh, at THE MICRO CLINIC.

LOADING THE PROGRAMS

The master diskette contains its own loader and CANNOT be read by any DOS software; there is no "system" or directory on it. To boot the loader, power up the entire system, put the master disk in drive 0 and press the "RESET" button at the left rear of the keyboard. After a few seconds, the screen will clear and you will be asked:

LOAD WHICH PROGRAM? (1=DISK, 2=MEMORY)

Select the test you want to run by pressing either "1" or "2". The selected test will begin loading and in a few seconds will announce itself. The master diskette should be removed from the drive after the program finishes loading.

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MODEL I TRS-80* FLOPPY DISK DIAGNOSTIC

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FLOPPY DISK DIAGNOSTIC is the most complete diagnostic program available for the Model I TRS-80* disk system, and could be the most important program in your software library. This program provides a positive means for thoroughly checking out the disk controller circuits and disk drives of just about any Model I system configuration, including standard single-density as well as the more demanding double-density format used in systems equipped with the Percom Doubler**. Problems in the disk system can "hide" from the user since system DOS software performs retries whenever errors occur; these problems can surface later as data which cannot be accessed or diskettes which can only be read in the same drive they were originally written on.

From one to four drives can be tested at the same time, 35, 40, 77 or 80 tracks, single density or double density with the Percom Doubler** installed. Any stepping rate available from the controller chip may be specified, read/write compatibility between drives can be checked, and tests can be run continuously if desired to check long-term reliability. Complete and detailed error messages will be reported when errors are detected, and error totals for each drive will be displayed at the end of each pass of the diagnostic. Floppy Disk Diagnostic is a stand-alone program, not using or depending in any way on your DOS software.

There are nine separate tests which may be selected. The purpose of each test is summarized below; a more detailed description is given in the "Test Descriptions" section of the manual.

TEST A - Tests the basic controller functions and status bits and checks function of mechanical components (track zero detector, write protect switch, and index pulse sensor).

TEST B - Verifies that data is being transferred from drive to controller and forces certain error conditions to see that they are correctly reported.

TEST C - Performs a comprehensive test of the drive's ability to seek to all tracks without error.

TEST D - Performs a single-sector write/read. Data is verified byte-by-byte to insure correct data transfer to and from CPU.

TEST E - Tests the write/read function across the entire diskette; checks cross-track interference.

TEST F - Tests the write/read function across the entire diskette using all possible data patterns.

TEST G - Builds a table of 100 random tracks and sectors, writes random data and reads back in reverse order.
TEST S - Tests the accuracy of the drive motor speed.
TEST T - Tech test; useful for performing alignment of drives or monitoring a write or read operation.

RUNNING THE DIAGNOSTIC

===> NOTE <=== RUNNING THIS PROGRAM REQUIRES THAT A FORMATTED DATA DISK BE INSTALLED IN EACH DRIVE TO BE TESTED. *DO NOT* USE DISKETTES WHICH CONTAIN PROGRAMS OR DATA YOU WANT TO SAVE -- **EVERYTHING** (DIRECTORY, DOS, DATA, PROGRAMS) ON THE DISKETTES WILL BE DESTROYED DURING THE TEST. DISKETTES MUST BE RE-FORMATTED WHEN YOU FINISH RUNNING THE TEST TO MAKE THEM READABLE AGAIN BY YOUR DOS. *DO NOT* LEAVE THE MASTER PROGRAM DISK IN A DRIVE YOU ARE GOING TO TEST, AND *DO NOT* REMOVE THE WRITE PROTECT TAB FROM THE MASTER DISK!!!

After you have selected the Floppy Disk Diagnostic, the program will load and you will be reminded to remove the master disk from the system; press "ENTER" when ready. You will now be asked to specify the desired operating parameters. When entering information, if you accidentally make an incorrect response, enter "↑" (up-arrow) to restart the questions. In the following descriptions, "(CR)" denotes a question which may require the "ENTER" key to be pressed as the last character entered. All drives to be tested at one time must be capable of running under the parameters you specify; in other words, if you specify 80 track operation, ALL drives to be tested must have 80 tracks. If you have a mix of drives, you can test them separately.

ENTER THE DRIVES TO BE TESTED? (0-3) - Enter up to four digits corresponding to which drives you want to test. These drive designations correspond to the standard TRS-80* designations, drive 0 being positioned closest to the expansion interface on the connecting cable. For example, to test drives 0 and 1, you would enter "01"(CR). To test all four drives you would enter "0123" (no CR necessary after the 4th character in this case). Drives may be tested in any order (EX: "3102" is legal).

HOW MANY TRACKS? (1=35, 2=40, 3=77, 4=80) - Enter the number of tracks for the drives under test. Shugart and early Radio Shack drives have 35 tracks; you would enter "1" in this case. Most other drives have 40 or more tracks; enter the appropriate value. Please note that the diskettes you are using MUST be formatted for the number of tracks you have specified here; trying to run the program on a 40-track drive with a diskette

formatted for only 35 tracks would result in unrecoverable Seek Errors during the test.

SINGLE OR DOUBLE DENSITY? (1=SINGLE, 2=PERCOM DOUBLER) - If you have a standard Model I, enter "1"; your system is capable of running in single density mode only. If you have a Percom Doubler** installed in your expansion interface, you may run the test in either single or double density mode. Please note that the diskettes you use must be formatted appropriately; if you select single density operation, they must be formatted in single density -- if you select double density operation, they must be formatted in double density, such as with Percom's DOUBLE FORMAT utility.

TK-TO-TK ACCESS TIME? - If you specified single density operation, you will have these options: (1=40 MS, 2=20 MS, 3=12 MS). In double density mode, the options are (1=30 MS, 2=20 MS, 3=12 MS, 4=6 MS). This option sets the controller chip's delay (in milliseconds) between stepping pulses during seek operations. Most Shugart and early Radio Shack drives are specified for operation at 40 MS track-to-track although they most likely will run without problems as fast as 20 MS. Many other drives are rated faster than this. Use the value closest to but not less than the manufacturer's spec for your drive. If you don't know what this value is, start with the slow values (40 or 30 MS) and work up; when you have exceeded your drive's capabilities, you will get constant seek errors, especially in Test C.

TESTS? (ABCDEFG,ST) - This allows you to select the tests you want to run. Tests may be specified in any order, as many times as you want, up to a maximum of 50 total characters entered. For example, to run Tests A and C, you would enter "AC"(CR). If you were to enter "FFFEEE"(CR), Tests F and E would each be run three times on each drive being tested. One pass of the diagnostic consists of running all specified tests, in the order you gave them, on each drive. Please note that the tests (going from A to G) are in ascending order of difficulty and that the diagnostic makes the assumption that if you select Test C that A & B will pass; D assumes that A, B, and C will all pass, etc.

Test S is the Speed check; entering "S" at any point in this question will cause immediate execution of the drive motor speed test on the 1st drive you requested.

Test T is the Tech Test; its main purpose is in aligning and troubleshooting the disk system. Entering "T" at any time will cause immediate transfer to the Tech Test, exercising the 1st

drive you requested.

RUN CONTINUOUSLY? (Y OR N) - To run the tests you specified continuously, enter "Y". If you only want to run through them once, enter "N".

IF YOU ELECT TO RUN THE DIAGNOSTIC CONTINUOUSLY, IT IS STRONGLY RECOMMENDED THAT YOU PROVIDE SOME MEANS OF EXTRA COOLING FOR THE DRIVES, SUCH AS A MUFFIN FAN (AVAILABLE FROM RADIO SHACK), TO PREVENT OVERHEATING OF THE POWER SUPPLIES!!

TERMINATE TEST ON EXCESSIVE ERRORS? (Y OR N) - This option provides for recovery from endless error looping. If answered "Y", all testing would be terminated after 10 errors of any type have accumulated. For example, the test would terminate after 10 seek errors or 10 CRC errors. If this option is answered "N", testing would continue regardless of the number of errors accumulated. This option does not affect any part of Test A and B or portions of Tests D where error conditions are forced or where drive components are tested; errors in these areas may be considered "fatal" and cause testing to be suspended.

OPERATOR INTERVENTION? (Y OR N) - Portions of Test A and the diskette interchangeability test require that this option be answered "Y". If this option is answered "N" the Write Protect and Index Detect functions are not completely tested. This option will always be disabled after the completion of the 1st pass of the diagnostic. See next option for more....

TEST DISKETTE INTERCHANGEABILITY? (Y OR N) - If the previous option was answered NO, this question is skipped. If operator intervention was specified, answering this option "Y" will allow the opportunity to test diskette compatibility between drives in a system when running Tests E, F, or G. In these tests, the diagnostic will write data on a diskette and prompt the operator to put the diskette in another drive where it then will be read for accuracy. If this option is answered "N", the read will be accomplished on the same drive as the write. Again, this option will be disabled after completion of the 1st pass of the diagnostic.

After a diskette has been read-verified in a different drive, the program will prompt the user to put it back in its original drive; at this time, be sure to put ALL diskettes back in their original drives before continuing!

If you have only one double-sided drive, you cannot test interchangeability. If you have two double-sided drives, you can

test compatibility between drives 0-2 and 1-3.

TEST DESCRIPTIONS

The following descriptions are somewhat technical by necessity. For more information on how the Model I disk system works, you may want to acquire the Western Digital 1771/1791 data sheets from Western Digital Corp., 3128 Red Hill Ave., Box 2180, Newport Beach, CA 92663.

TEST A - This test checks the most basic disk controller functions and for proper operation of components within the drive. Assuming that operator intervention was selected, the operator is prompted to open the door of the current drive and to pull the diskette out slightly. This trips the write-protect switch and prevents detection of an index pulse. The drive should also be sensed NOT READY at this time. The drive is then selected; READY should be sensed, as should WRITE PROTECT, while no index pulse should be detected. If no errors so far, the operator is prompted to put the diskette back and close the door. The drive is selected and a RESTORE command (bring head to track zero) is issued. After executing a timing loop, INDEX should be detected, WRITE PROTECT should not be sensed, and the controller should not be sensed BUSY. TRACK 0 should also be sensed, and the controller's track register should indicate that we actually are on Track 0. The drive will be told to step in one track; TRACK 0 should not be sensed, and the controller track register should indicate that we are now on Track 1. The drive is now told to step out one track; TRACK 0 should again be sensed and the controller track register should have been correctly updated. This completes Test A.

Please note that if operator intervention was not selected, write protect and index pulse detect are not completely checked. Also, the Restore/Step-In/Step-Out sequence is important in checking for proper adjustment of the Track 0 switch; if it is misaligned or defective, it can drive your DOS crazy!

TEST B - This test will first perform a RESTORE operation w/o verification, and then attempt a READ-TRACK-ADDRESS operation. This checks that the drive is in fact transferring data to the controller chip; if DRQ is not detected within specified time limits, it means no data is coming back or the diskette is not properly formatted. This should also have forced a LOST DATA error to occur. The controller track register is then loaded with a "dummy" value and a READ is attempted; this should force a RECORD NOT FOUND error to occur.

TEST C - Proper operation of the drive seek function is tested. Two counters are used to determine the track to be reached -- counter A starts at 0 and increments, while counter B starts at the highest track number and decrements. The seeks are performed using read-verification to insure correct head positioning. This series of seeks will result in a damped oscillation across the disk, settling at midpoint; all possible length seeks in each direction will be performed. Next, a series of seeks is performed in the following manner: from track 0 to 2, 2 to 1, 1 to 3, 3 to 2, 2 to 4, etc. This is further insurance that the head will position correctly under any condition.

TEST D - This test will check the write and read commands by writing an alternating AA/55 pattern to sector 0 of track 0. The sector will then be read back and verified byte-by-byte to insure correct data transfer between the expansion interface and the CPU. Errors caused either by controller status flags or by unexpected data returned during the read will be listed, showing the expected and actual data in hexadecimal form.

TEST E - This test will perform a write/read across the entire disk. Cross-track interference (writing on one track causing data interference on an adjacent track) is checked by writing alternating tracks of ones and zeroes. This is especially critical in 77 and 80 track systems since the track-to-track spacing is much closer. Diskette interchangeability may be checked as described under that test option. Data transfer is done a single sector at a time with complete error checking after each transfer.

TEST F - This test performs a write/read operation across the entire disk using an incrementing pattern (00 to FF). Diskette interchangeability may be checked as described under that test option. Data transfer is done a single sector at a time with complete error checking after each transfer.

TEST G - This test will fill a buffer with 256 bytes of random data and build a table of 100 random tracks and sectors. The random data will be written on these tracks/sectors, then read back in reverse track/sector order to insure that approaching the tracks from either direction will not cause data recovery problems. Interchangeability may be tested, and complete error checking is done after each data transfer.

TEST S - This checks the accuracy of the drive motor speed of the first requested drive. The results are continuously monitored and displayed on the screen. The allowable error is +/- 0.33% (1 RPM) from the nominal value of 300 RPM. Adjustments

may be made while the test is running. To exit this test, hold down the "ENTER" key.

Inaccurate motor speed is a common cause of errors during tests E, F, and G, especially on the higher (inner) tracks. The speed adjustment control is usually located on a small circuit board at the rear of the drive; UNDER NO CIRCUMSTANCES SHOULD YOU ADJUST ANY CONTROLS ON THE LARGE CIRCUIT BOARD ON THE SIDE OF THE DRIVE!!!!

TEST T - This is the Tech Test; it can be used for aligning and/or troubleshooting disk systems. It essentially allows you to use your TRS-80* as an "intelligent" disk exerciser. Three functions are available: Write, Read, and Seek. You will be asked to specify the track and sector for the operation; these are 2 hexadecimal digits. Please note that NO error checking is done on these values; if you specify a non-existant or undefined track/sector, the program will probably bomb out. Also, leading zeroes MUST be entered -- track 9 must be entered "09". If the Write function is selected, you will also be asked to specify a 2-digit hex value to be written to disk; the value specified will be used to fill the specified sector.

The write and read operations will be done with complete error checking and a status display will be shown on the screen similar to this:

STATUS: 00WXYZ00

This is a mask of the controller chip's Type II status byte and is read from left to right going from bit 7 to bit 0. The bits shown above as zeroes are always zero. The four meaningful bits are:

W=1 -- WRITE PROTECT (during write oper. only)
X=1 -- RECORD NOT FOUND error
Y=1 -- CRC error
Z=1 -- LOST DATA error

Bits equal to 0 mean no error occurred. During a write operation, "W"=1 means WRITE PROTECT is sensed and the write is not actually taking place. This status display is continuously updated, possibly making the test useful in troubleshooting intermittent problems. As an example of a status display, "00001000" indicates there is a CRC error.

When running the Tech Test, pressing "T" while the test is in progress will return you to the start of the test; entering "↑"

(up-arrow) as the function code will return you to the main menu. In addition, during the Seek operation, the following functions are available:

"R" - Restore and re-seek to last track
"I" - Step head in one track
"O" - Step head out one track

During the seek operation, the current track will be displayed on the screen and will be updated as you step in or out. Note that if you step past the limits of the drive (for example, beyond track 0) this display will no longer be valid.

Pressing any other keys during the Tech Test will return you to the main program menu. Remember that all values you specify must be in hexadecimal, and don't forget the leading zeroes!

ERROR HANDLING

Error messages are printed out any time the diagnostic detects error or abnormal conditions. Errors in Test A and B and portions of Test D are considered fatal and will cause termination of testing. Other errors will be reported by type, with track and sector information printed out in hexadecimal. During normal read/write operations, the errors you are likely to see are CRC ERROR, LOST DATA, RECORD NOT FOUND, and SEEK ERROR; the error summaries will tell you the accumulated number of these four types.

CRC ERROR - During a disk write operation, the controller will calculate a CRC byte (cyclic redundancy checkword - a sort of checksum) for the 256-byte record and write it to disk. When this sector is read back in, the controller will again calculate the CRC byte and compare it to the one it recorded on the disk; if they don't match, a CRC error occurs. These errors are most common on the inner (higher-numbered) tracks and usually indicate a data separation problem with the controller. Percom Data Co. makes a board called "The Separator"** which plugs into the expansion interface and should help with these problems. The Doubler** has its own data separator built in. Incorrect motor speed or flawed diskettes are other common causes of this error.

LOST DATA ERROR - This indicates that the CPU is not keeping up with the disk controller/drive as it transfers data. A common cause of this problem is incorrect motor speed.

RECORD NOT FOUND - Whenever the controller is told to write or read a sector, it must first locate this sector on the disk

using track and sector information written on the diskette during formatting. If the controller is unable to find the specified track and sector within four revolutions of the disk, a Record Not Found error will be reported.

SEEK ERROR - Indicates that the track information read from the disk at the completion of a seek function did not match what the controller expected to find.

What do you do if your system is giving you these errors but seems to work OK with your other software? Most likely, your DOS is going into error-recovery without telling you. Most of the above errors are "soft" and can be corrected by attempting the operation again. If an error occurs repeatedly on the same track/sector, you may have a flawed diskette; the offending track should be locked out or the diskette discarded. CRC errors are especially troublesome in double density operation on the innermost tracks on some drives during Tests F and G; you may find it necessary to restrict operation to fewer tracks than are actually available in especially severe cases. We have particularly had this problem on head 1 of double-sided drives. If installation of a data separator does not cure the problems, there is not much you can do except avoid using the problem tracks.

Other error messages:

```
DRIVE SENSED READY WHEN NOT SELECTED
DRIVE NOT READY
DRIVE SENSED READY WHEN NOT EXPECTED
WRITE PROTECT NOT SENSED
WRITE PROTECT SENSED
BUSY NOT SENSED
INDEX MARK NOT SENSED
INDEX SENSED WHEN NOT EXPECTED
TRACK 0 NOT SENSED CORRECTLY
DRIVE EXCEEDED TIME LIMIT TO COMPLETE SEEK
TRACK REGISTER IS NOT BEING UPDATED
FORCED LOST DATA ERROR DID NOT OCCUR WHEN EXPECTED
DATA IS NOT BEING TRANSFERRED FROM DRIVE TO CONTROLLER
FORCED RECORD-NOT-FOUND ERROR DID NOT OCCUR
```

These errors can be caused by a number of expansion interface and/or disk drive problems (as well as operator error!). Some items to look for are dirty or corroded edge connector pins, broken or intermittent cables, worn or missing head load pads, misaligned heads (usually shows up when testing drive-to-drive compatibility), dirty heads (clean only with a clean Q-Tip and

91% alcohol), or a dirty or excessively worn head carriage. If you are unable to correct the problem, note what error is being reported and take your system to a COMPETENT technician for service (even The Shack has a few of these!).

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** DOUBLER is a registered trademark of Percom Data Co.

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MODEL I TRS-80* MEMORY DIAGNOSTIC

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The Memory Diagnostic is a comprehensive test of the memory arrays in the keyboard and expansion interface. After the program loads, the user will be asked to enter test parameters as follows (be sure to remove the master disk from the system):

ENTER THE SYSTEM MEMORY SIZE? (1=16K, 2=32K, 3=48K) -- Enter the appropriate total memory size for your system, including the expansion interface. For example, if you have 16K in the expansion interface, your total memory size is 32K and you would enter "2" (16K in keyboard + 16K in the interface).

PAUSE ON ERRORS? (Y OR N) -- If you want the diagnostic to pause whenever an error occurs, enter "Y". This would be useful whenever a great number of errors are occurring since they will scroll off the screen faster than you can read them. If no errors occur, or they are infrequent, you may want to specify "N". Whenever the test pauses after an error, you may resume testing by pressing "Y" to retain the pause-on-error mode of operation. Pressing any other key would disable this mode.

RUN M-1 WORM TEST? (Y OR N) -- It is recommended that you delay running this test until you are sure your system passes the normal write/read test without error. Because this test actually executes machine code from the memory being tested, results can be unpredictable sometimes. For details on this test, see the description which follows. Enter "Y" to run the test or "N" to suppress it.

The diagnostic will keep you informed at all times of what it is doing. During the write/read portion, it will alternately display "WRITE/READ" and "RE-VERIFY" as it moves through these two sections. The "LOOP" count displayed will increment from 00 to FF. During the M-1 Worm Test, it will print out the execution address of a six-byte block of code and this address will increment to the top of memory in your system. The larger the memory, the longer the diagnostic will take to run. One complete pass on a 48K machine will take about 30 minutes. At the end of each complete pass, the total pass count and the cumulative error count will be displayed. The most desirable way to test your system for long-term reliability is to allow the diagnostic to run overnight as a minimum, and longer if possible. Many manufacturers of computer equipment "burn in" system for 72 hours or more, sometimes at elevated temperatures.

TEST DESCRIPTIONS

The Memory Diagnostic is broken down into two basic tests, the conventional write/read test and the M-1 Worm test.

WRITE/READ TEST -- This portion of the diagnostic performs a comprehensive check on the ability of each memory location to store and retain data. The test is broken down into 5 basic pattern tests. Each of these tests executes as follows: the address under test is written into and immediately read back to insure accuracy. This continues on through to the end of memory. Then each address is re-checked to insure 1) data integrity is maintained over a period of time (refresh) and 2) accessing any particular address did not alter data in any other address. One pass of the diagnostic will have tested each address 520 times using every possible data pattern.

M-1 WORM TEST -- This test is named for the Z-80 M-1 machine state (opcode fetch) which is the most critical in regard to memory timing and for the fact that the test "worms" its way through memory. This test attempts to execute a short block of machine code from the memory under test. First the entire test area is filled with "FF". Then a special 6-byte block of code is written into the first 6 locations and is executed. If this works, the 6-byte block will be moved up one address, the byte immediately preceding the block is changed to "FF", and the block is executed again. This continues, moving the block up one address each time, until it has moved throughout memory. Some Z-80 machines have problems running a test such as this due to timing problems since this is a worst-case situation for the CPU and memory.

ERROR HANDLING

Errors are handled differently depending on whether the write/read test failed or the M-1 Worm test failed.

ERRORS IN WRITE/READ TEST -- An error in this portion of the test will cause an error message to print out with the following information (all hexadecimal): the error address, the expected (correct) data, the actual (error) data, and the location of the failing IC. A typical error printout might be as follows:

```
ERROR: ADDRESS=A045  EXPECTED DATA=B5  ACTUAL DATA=BD
       DATA BIT(S):  7    6    5    4    3    2    1    0
       ---------------------------------------------------
       IN EXP INTF:                     Z13
```

See the section on Troubleshooting Hints for help in interpreting error messages.

ERRORS IN M-1 WORM TEST -- Errors in this test can be much more difficult to handle because it attempts to actually execute machine code from the address under test. The results can be unpredictable if the machine attempts to execute an unexpected or non-valid instruction. This is the reason for filling all addresses with "FF" prior to execution of the test; if the CPU pulls the instruction from one of these address rather than the six we are actually trying to test, it would execute a RST 38H instruction which would turn control over to a ROM-based "trap" routine. If this occurs, or if any other error occurs, an error message will appear such as this:

```
***** ERROR IN M-1 WORM TEST *****
ADDRESS OF 1ST BYTE OF CODE = ZZZZ
EXPECTED CODE AT TEST ADDRESS = 7D 55 AA C3 B6 44
ACTUAL CODE AT TEST ADDRESS   = XX XX XX XX XX XX
```

"ZZZZ" represents the address of the first byte of the six-byte block; "XX" would equal the actual code at the test addresses and may or may not match the expected data. If the system fails this test but will not print out any error messages (for example, it reboots or does something else unexpected) you could try running the write/read test alone for a long period.

TROUBLESHOOTING MEMORY PROBLEMS

It is not possible to document here every possible cause of memory problems in the computer; only the most common of these problems will be discussed. If the system fails the diagnostic, and you do not want to attempt to troubleshoot it yourself, write down the results of the diagnostic and take your system in for repair.

*** NOTE *** IF YOU OPEN THE KEYBOARD OR THE EXPANSION INTERFACE, YOU VOID THE WARRANTY!!!!!

For the purposes of this discussion, the computer contains three 16K memory arrays which will be referred to as "pages". The three pages of memory are addressed and physically located as follows:

```
PAGE 1 - ADDR X'4000' TO X'7FFF' -- located in keyboard
PAGE 2 - ADDR X'8000' TO X'BFFF' -- located in exp intf
PAGE 3 - ADDR X'C000' TO X'FFFF' -- located in exp intf
```

The IC's which make up these pages and the associated data bits are:

	D7	D6	D5	D4	D3	D2	D1	D0	
PAGE 1	Z13	Z14	Z20	Z15	Z19	Z18	Z16	Z17	*** Keyboard
PAGE 2	Z09	Z10	Z11	Z12	Z13	Z14	Z15	Z16	### Exp Intf
PAGE 3	Z01	Z02	Z03	Z04	Z05	Z06	Z07	Z08	### Exp Intf

Using the error example given previously, the error address was X'A045', the expected data was "B5", and the actual data was "BD". In this case, the error occurred in Page 2 of memory; the actual data indicates that we picked up data bit 3.

DATA BITS		7	6	5	4	3	2	1	0
"B5"	=	1	0	1	1	0	1	0	1
"BD"	=	1	0	1	1	1	1	0	1

From the charts, you can see that the memory chip for data bit 3 in Page 2 is Z13 in the expansion interface. These reference designations are silkscreened on the circuit boards next to each chip.

*** NOTE *** THESE MOS MEMORY CHIPS ARE VERY SENSITIVE TO STATIC ELECTRICITY AND ARE VERY EASILY DAMAGED BY IMPROPER HANDLING!!!!

If this were the only bit failing, you could try swapping the suspect IC with another one. If the error moves to the new location, you have probably found the bad memory chip. If the error persists at the same location, or if you have multiple bad bits or cannot otherwise determine any other logical pattern to the errors occurring, you should probably take the unit in for repair.

Keep in mind that your system may fail even though there is nothing technically wrong with it. For example, if you are in an electrically "noisy" environment (such as an office with copying machines or other electrical equipment), the computer can pick up "glitches" from the AC line causing random errors. Another cause of problems is wide swings in the line voltage. For example, if the display on your video monitor is constantly shrinking and expanding, the line voltage may not be stable enough for the computer to handle. In either of the above situations, you may be forced to invest in some kind of power conditioning equipment before your computer will operate reliably. This would hold true for any computer system, not just

the TRS-80*

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OWNER REGISTRATION

Please take the time to send in the following registration form. If something should happen to your master diskette which damages the software, we will re-copy the programs onto the diskette for a $5.00 charge for postage and handling. This offer applies to registered owners only, and may not apply if the diskette has been physically abused. When returning diskettes, provide adequate protection such as putting the diskette between 2 pieces of cardboard and mark the outside of the mailer "DO NOT BEND" in LARGE letters!

Mail to: THE MICRO CLINIC
17375 Brookhurst, Suite 114
Fountain Valley, CA 92708

NAME:_____

ADDRESS:_____

CITY:_____ STATE:____ ZIP:_____

PURCHASED FROM:_____