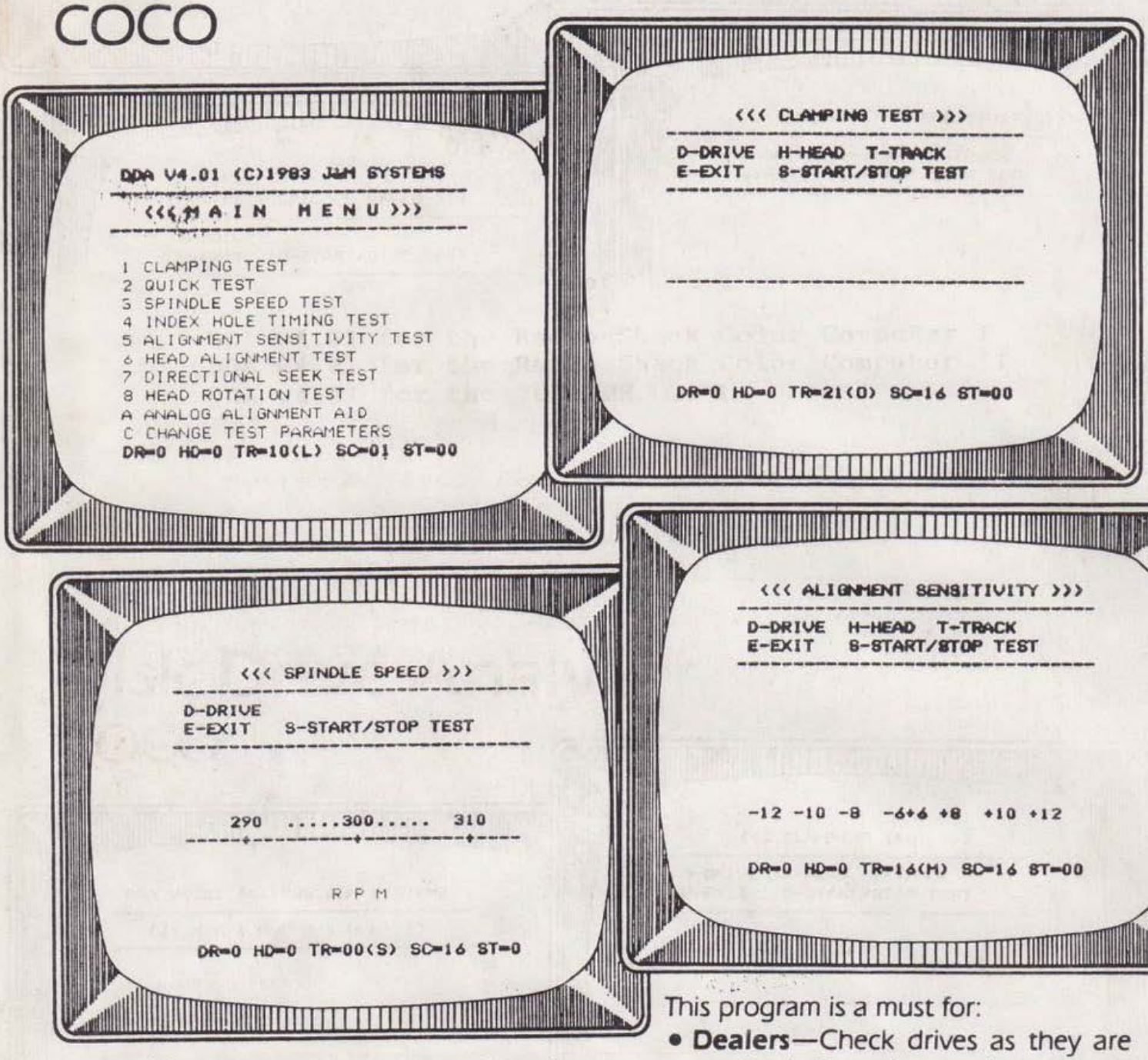
Disk Drive Analyzer

COCO



In 30 seconds this program will make the following tests while drives are in your computer.

- Head Alignment
- Motor Speed
- Index Hole Timing
- Azimuth
- Hysteresis

This program may be used to help align your drives without costly test equipment.

This program is a must for:

- **Dealers**—Check drives as they are received. Save time and money on service contracts by quickly isolating drive problems.
- **End Users**—Check drive performance without costly service calls. Isolate faulty or misaligned drives. Monitor long term drift.

$79—Single Sided
$99—Double Sided

DISK DRIVE ANALYSIS SYSTEM

OPERATOR'S GUIDE

for

DDA v4.01 for the Radio Shack Color Computer I
DDA v4.01 for the Radio Shack Color Computer II
DDA v4.01 for the TDP-100

January 1984

137 Utah N.E.
Albuquerque, NM 87108

DISCLAIMER

J & M Systems, Ltd. does not assume any responsibility or liability for loss or damages caused or alleged to be caused, directly or indirectly, from the use or misuse of this program or from the interpretation of the results of this program, including, but not limited to : any interruption of service, loss of business, anticipatory profits, or consequential damages. While every reasonable effort has been made to provide an accurate and useful diagnostic aid, J & M Systems assumes no responsibility for the interpretation of the indications of this or any other diagnostic program or associated documentation. The user is the sole judge of his or her skill and ability to interpret the results of these and all tests, and to make any and all adjustments of or modifications to any equipment.

Revision A

1st printing Ø1/84

Disk Drive Analysis System

Operator's Guide

January 1984

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INTRODUCTION

The Disk Drive Analysis System (DDA) from J & M Systems is the most comprehensive floppy disk drive diagnostic available for your microcomputer. Until now, comprehensive testing of floppy disk drives was a tedious procedure involving the use of an oscilloscope and other expensive test equipment. But now, thanks to a major technological breakthrough by Dysan Corporation and J & M Systems, anyone can perform comprehensive floppy disk drive testing on their own computer!

With DDA, you can periodically check head alignment, index hole timing, spindle speed, and other performance parameters. Early detection and correction of disk drive problems can be your best protection against costly data loss and down-time! Use DDA to monitor the condition of your drives, or use it as a tool when performing maintenance or repair! DDA will test the most critical performance parameters of your floppy disk drives in seconds.

CHAPTER ONE: DDA OPERATION

DDA COMPONENTS

The DDA System consists of three major components: The DDA Program disk, the Digital Diagnostic Disk (DDD), and the Operator's Manual. The DDA Program disk contains only the DDA Program. Once the DDA Program is loaded into memory and executed, the DDA Program disk is no longer required. The DDD Disk is used by the DDA Program to perform the actual testing of the disk drives. The DDD Disk must be in the drive under test during testing.

The DDA Operator's manual is provided to help you understand test results. Although DDA can be operated without reading the manual, we recommend that you read the manual, and refer to it often to help you interpret the results of the DDA tests!

STARTING DDA

The DDA Program is stored in a file named "DDA/BIN" on the DDA Program Disk. To start DDA, insert the program disk into a working drive, then enter the following commands:

Using Radio Shack DOS:

```
          "MM"
LOADM "DDA"
EXEC &H4000
```

Using J & M Systems' JDOS:

```
. .   MM
RUNM "DDA"
```

The DDA Program will load and begin execution by displaying the Main Menu. After DDA execution has begun, the DDA Disk may be removed from the drive. DDA is completely memory-resident, leaving all of your disk drives free for testing.

THE MAIN MENU

The Main Menu screen (as illustrated below) provides for the selection of eight test screens (1-8) and two auxiliary screens (A and C). To select a test, simply press the key corresponding to the desired test on the menu. When testing a drive, the recommended order of testing is as shown on the menu. That is, start with Test 1 and proceed in order through Test 8.

The Analog Alignment Aid is provided for assistance in more exhaustive testing with an oscilloscope, if desired. Refer to Chapter 10 for a description of this screen. The Change Test Parameters Screen (C) allows various DDA test parameters to be changed. Refer to Chapter 11 for a description of this screen.

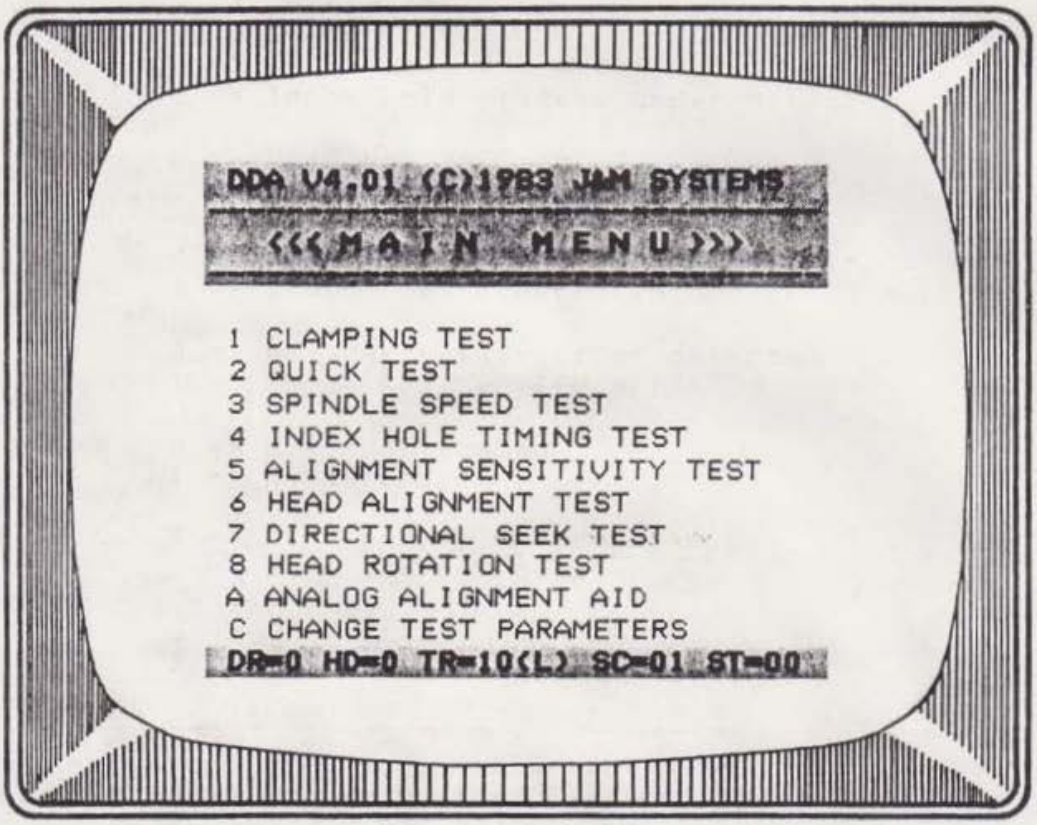

Figure 1: The Main Menu

THE STATUS LINE

The Status Line is displayed at the bottom of the screen at all times. The Status Line indicates the currently selected test drive (DR), head (HD), track (TR), and sector (SC), as well as the current floppy disk controller status code (ST). When a test screen is first activated, you may wish to check the status line to ensure that the current drive and head selections are as desired before starting the test.

The Floppy Disk Controller (FDC) Status Code (ST) displayed on the Status Line is a bit-mapped code supplied by the FDC at the completion of each FDC Command. The Status Code is displayed in Hexadecimal format. The display is updated after the completion of each command to indicate the latest FDC completion code.

The interpretation of the Status Code depends on the command which was just executed. Upon the completion of all commands except read commands (eg, after seek and home), the code has the following interpretation:

BIT	MEANING
0	0 => Controller not busy 1 => Controller busy
1	0 => Index hole not present 1 => Index hole present under detector
2	0 => Head not at Track 0 1 => Head at Track 0 (Track 0 switch active)
3	0 => No CRC Error detected in Sector ID Mark 1 => CRC Error detected in Sector ID Mark
4	0 => No seek verify error detected 1 => Track seek verify error
5	0 => Head not loaded 1 => Head loaded
6	0 => Disk not write-protected 1 => Disk write-protected
7	0 => Drive ready 1 => Drive not ready

After the completion of a read command, the bits within the FDC Status Code have the following interpretation:

BIT	MEANING
Ø	Ø => Controller not busy 1 => Controller busy
1	Ø => Data not ready 1 => Data ready
2	Ø => Data not lost 1 => Data lost
3	Ø => No CRC Error detected in Data Field 1 => CRC Error detected in Data Field
4	Ø => Record found 1 => Record not found
5	Ø => Record type (read), No write fault (write) 1 => Record type (read), Write fault (write)
6	Ø => Disk not write-protected 1 => Disk write-protected
7	Ø => Drive ready 1 => Drive not ready

Examples:

ST=ØØ

This status code indicates no errors.

ST=Ø8

This status code indicates that a CRC Error was encountered during a sector read operation.

ST=CØ

This status code indicates that the drive is not ready and that the disk is write-protected.

DDA TEST SCREEN COMMANDS

The DDA Program provides eight test screens. A test screen may be activated only from the Main Menu. To activate a test screen, just press the key that corresponds to the desired test any time the Main Menu is displayed.

Each test screen provides its own local command menu. Only those commands required for a given test are listed in the command menu for that test. Commands not listed in a test command menu will not operate with that test.

NOTE: When a test is in progress, and the test drive is ON, DDA will be a little slow in responding to commands. So, if the test drive is on, hold the command key depresssed until DDA responds. All commands provide some form of user feedback so that you will know when the command has been executed.

D - Select test drive

The "D" Command is used to select a disk drive for testing. DDA allows testing on any one of four drives, numbered Ø-3. The drive selected for test is referred to as the "test drive" throughout this manual.

Each time the "D" Key is pressed, the test drive number will change on the Status Line at the bottom of the screen ("DR=Ø", "DR=1", etc.). To select a drive for test, just press the "D" Key as many times as required until the desired drive number appears on the Status Line.

Note that the "D" Command is affected by the number of test drives specified on the Program Parameters Screen (see Chapter 11). If the number of drives specified is 1, then the "D" Command will have no affect. If 2 drives are specified, the "D" Command will toggle between Ø and 1, and so on. The highest drive number is always one less than the number of drives specified on the Parameter screen.

E - Exit to Main Menu

The "E" Command will terminate the current test and return to the Main Menu. If the test drive is ON, it will be turned off. You may use the "E" Command at any time during a test. Or, you may use the "S" Command to stop the test, then use the "E" Command to return to the main menu.

When the Main Menu is activated, the test drive head will be moved to the Landing Zone Track. This is indicated on the Status Line by "TR=1Ø(L)". This track is unrecorded, so it is used any time there is no test in progress, thereby extending the life of the DDD Disk.

H - Select head

The "H" Command is used to select the head (side) of the current test drive. Pressing the "H" Key will cause the head selection to toggle between "Ø" and "1". The head selection is displayed at all times on the Status Line at the bottom of the screen ("HD=Ø" or "HD=1").

The "H" Command is useful only when testing double-sided drives. However, the "H" Command will change the head number on the Status Line whether the test drive is double-sided or not. If the test drive is single-sided, the head selection will have no affect on the testing since the head select line is not used by single-sided drives. If you have single-sided drives, you don't need to use the "H" Command.

S - Start/stop test

When a test screen is first activated, the test drive will be turned off and there will be no test results displayed on the screen. When the test drive is started, the test will begin, and the test results will be continuously updated until the drive is stopped.

The "S" Command is used to alternately start and stop the test drive. When the test drive is OFF, press the "S" Key to start the drive. When you wish to stop the test, hold the "S" Key depressed until the drive stops. The final test results will remain on the screen until another command is executed. Note that the LED on the test drive will be lighted when the drive is on, and extinguished when it is off.

T - Select Test Track

Multiple test tracks are provided on the DDD Disk for some tests. For example, three test tracks are provided for the Alignment Sensitivity Test. In such cases, the "T" Command is used to select the desired test track.

When the "T" Command appears in a command menu, there is more than one test track provided for that test. Each time the "T" Key is pressed, the Track display on the Status Line will change ("TR=ØØ(O)", "TR=16(M)", etc.). Although the track number may vary from test to test, the letter in the parentheses represents the test track function as described in the table below:

SYMBOL	TEST TRACK SYMBOLIZED
"(A)"	Azimuth (head) Rotation Test Track
"(I)"	Inner test track (nearest spindle)
"(L)"	Landing Zone track (Main Menu only)
"(M)"	Middletest track (between "(I)" and "(O)")
"(O)"	Outer test track (furthest from spindle)
"(S)"	Spindle Speed test track

The following test tracks are provided:

TEST	TEST TRACKS PROVIDED
1 - Clamping Test	"(O)", "(M)", and "(I)"
2 - Quick Test	N/A
3 - Spindle Speed Test	"(S)"
4 - Index Hole Timing Test	"(O)" and "(I)"
5 - Alignment Sensitivity Test	"(O)", "(M)", and "(I)"
6 - Head Alignment Test	"(O)", "(M)", and "(I)"
7 - Directional Seek Test	"(M)"
8 - Head Rotation Test	"(A)"

NOTE: It is not necessary to select a test track every time a test is run. Each test which makes use of multiple test tracks will default to some test track when the test is started. The default test track will be the outer-most test track "(O)" until you select another track with the "T" Command. Once you have selected a test track, that track will become the new default until (and unless) you select another test track.

THE WARNING SCREENS

There are two warning message screens which may appear during operation of DDA. One is referred to as the "NOT DDD" Warning Screen (see Figure 2), and the other is referred to as the "DRIVE NOT READY" Warning Screen (see Figure 3).

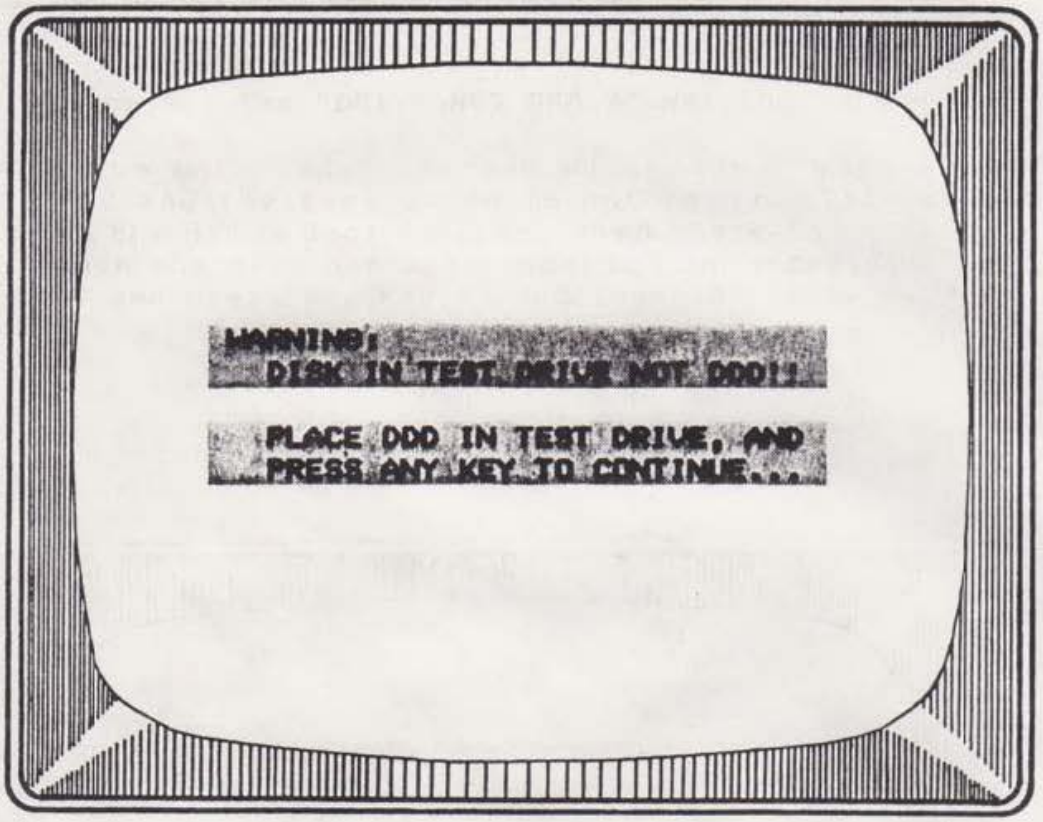

Figure 2: The "NOT DDD" Warning Screen

This screen will appear whenever you attempt to start a test and the disk in the test drive is not a DDD Disk. When this screen appears, insert the DDD Disk into the test drive, then press any key to continue. Of course, you may leave any disk in the test drive and the test will display some result. However, the results will be meaningless unless the disk in the test drive is a DDD Disk.

NOTE: In some cases, the test drive may be misadjusted to the extent that the DDA Program cannot read the DDD Disk properly, and this warning message will appear even though there is a DDD Disk in the test drive. In such a case, ignore the message and press any key to continue the test.

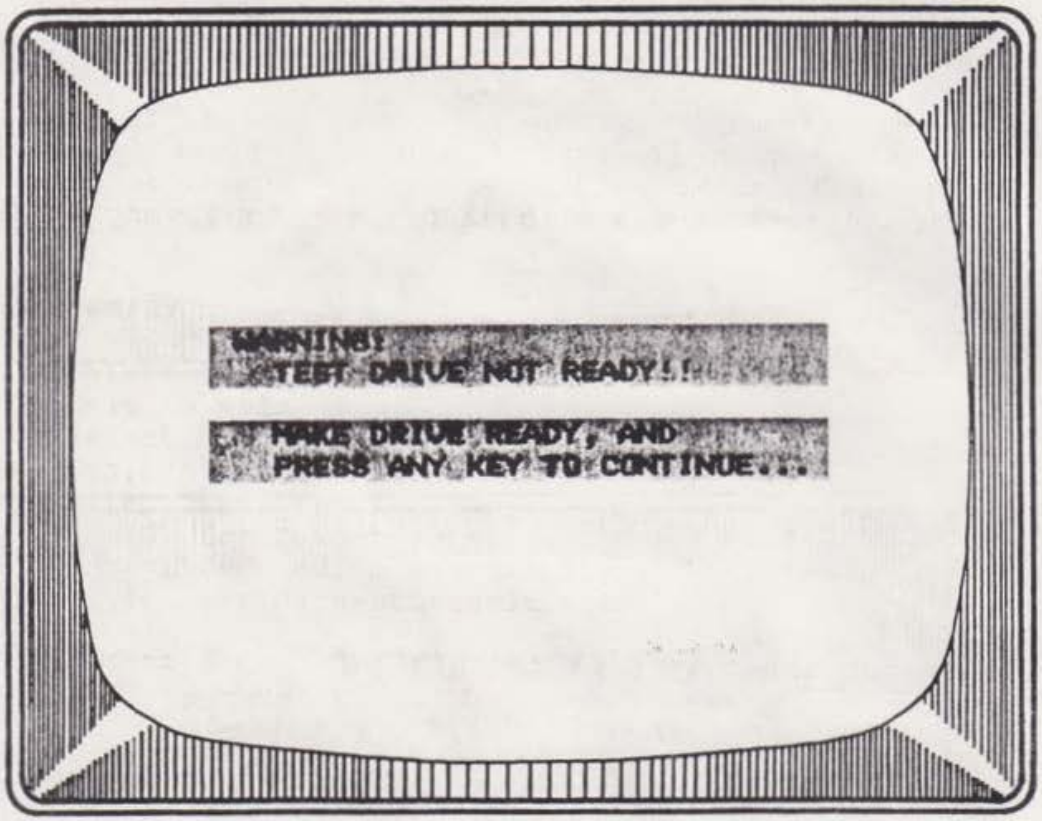

Figure 3: The "DRIVE NOT READY" Warning Screen

The "Drive Not Ready" Screen will appear when a test is first started and the test drive is not ready. This condition results when the drive door is open, when there is no disk in the drive, or when the disk has been inserted incorrectly. Correct the problem, and press any key to continue the test.

CHAPTER TWO: THE CLAMPING TEST

PURPOSE

The Clamping Test provides a qualitative measure of diskette clamping. The quality of diskette clamping is normally a function of the condition of the diskette hub, but may also be affected by the condition of the drive spindle bearing. Improper clamping may cause the diskette to rotate eccentrically about the spindle which, in turn, may cause excessive read errors.

Use the Clamping Test to ensure that the DDD Disk is clamped as concentrically as possible prior to performing any other DDA tests. Improper clamping can lead to misleading test results.

NOTE: If the test drive is out of alignment, the results of the clamping test may be meaningless. If proper clamping cannot be achieved even on the least-sensitive track (Track 0), then an initial alignment may be required (see Test 5 or 6).

COMMAND SUMMARY

D - Select test drive
E - Exit to main menu
H - Select head
S - Start/stop test
T - Select test track:
    (O) for lowest sensitivity
    (M) for medium sensitivity
    (I) for highest sensitivity

For a detailed explanation of each of these commands, refer to Chapter 1.

TEST OPERATION

The Clamping Test is activated from the Main Menu by selecting Test 1. When first activated, the Clamping Test screen consists of the command menu, a bar in the center of the screen, and the status line at the bottom of the screen.

Insert the DDD Disk into the test drive and press the "S" Key to start the test. After a short delay, the display should show a group of square blocks attached to the center bar. If the DDD disk is properly clamped, there will be 8 blocks above the bar and 8 blocks under the bar (see Figure 4).

The "T" Command may be used to select one of three clamping test tracks on the DDD Disk. Each Clamping Test Track provides a different sensitivity to eccentricity. The Outer test track (O) is the least sensitive, the Middle test track (M) provides medium sensitivity, and the Inner test track (I) is the most sensitive.

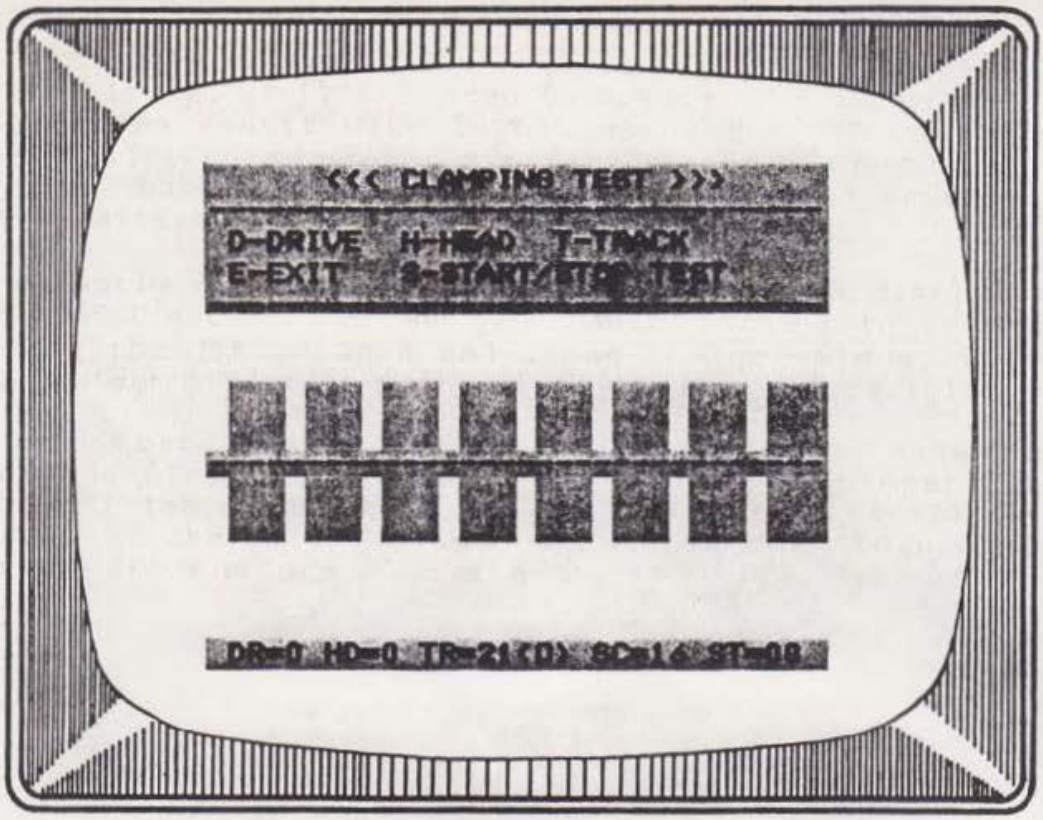

Figure 4: Proper Clamping

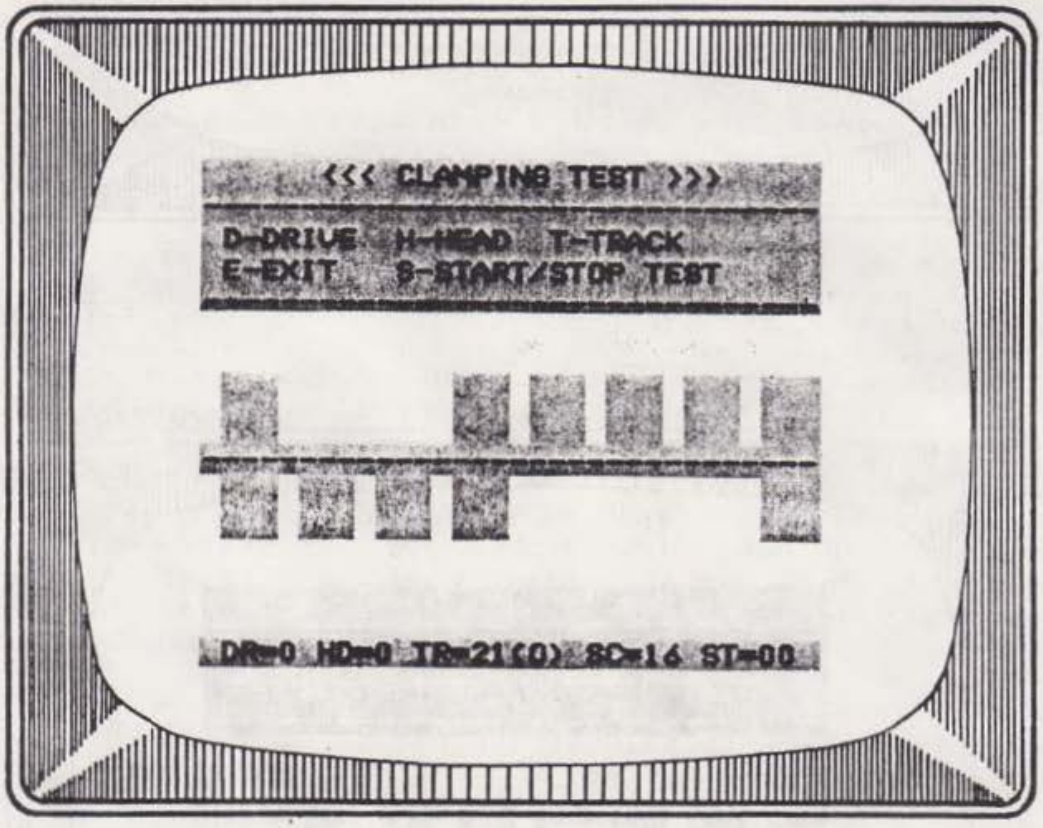

Figure 5: Improper Clamping

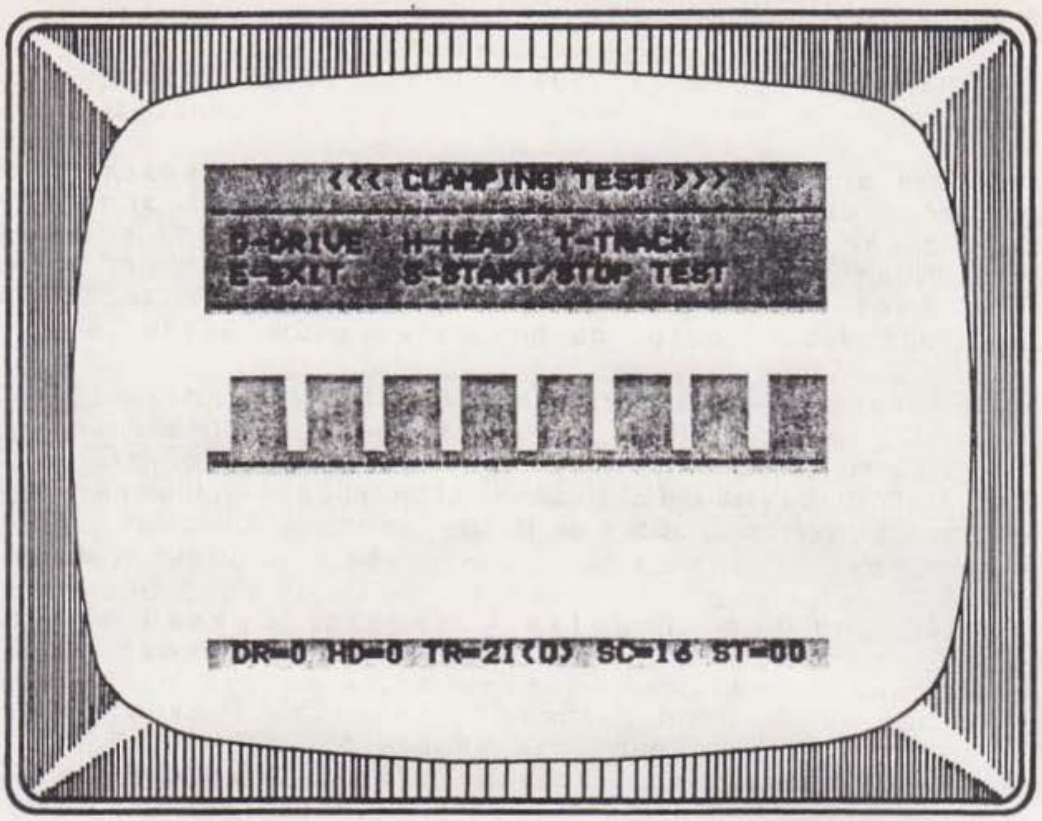

Figure 6: Head Alignment Error

TEST INDICATIONS

A properly clamped diskette will result in a display with no missing blocks, as illustrated in Figure 4. Check the clamping at all three sensitivity levels using the "T" Command. Few drives will display proper clamping at the highest sensitivity level (I), but most drives should exhibit good results at the least sensitive level (O).

A poorly clamped diskette will result in a display similar to that of Figure 5. If you get results similar to this, try re-clamping the disk. Open and close the drive door repeatedly until you get a pattern with as many blocks as possible.

As illustrated in Figure 6, improper head alignment may cause a display which appears to indicate improper clamping. This condition usually results in the absence of all blocks on one side of the bar. In such a case, it may be necessary to align the drive before you can get good results from the Clamping Test.

HOW THE TEST WORKS

The Clamping Test makes use of three specially recorded tracks on the DDD Disk, referred to as "Alternate Offset Tracks". On each of these tracks, the sectors are recorded slightly off of track center-line. Odd-numbered sectors are displaced toward the center of the disk, while even-numbered sectors are displaced away from the center of the disk.

On the Outer test track (0), the sectors are displaced 7 mils from the track center-line. On the middle test track, the sectors are displaced 8 mils from the track center-line. And, on the Inner test track, the sectors are displaced 9 mils from the track center-line.

The basis of the test is that the further the data is from the head, the harder it is for the head to sense. If the head is properly aligned, it should be able to read data at least 9 mils in either direction from the track center-line. If the disk is clamped perfectly, all of the sectors will be displaced from the head by exactly the distance that they are displaced from the track center-line.

But, if the disk is clamped eccentrically, the track center-line will not always be directly under the head. As the disk rotates, the track center-line will drift back and forth under the head. Thus, some of the sectors will come closer to the head than the distance by which they are displaced form the track center-line, while others will end up further from the head.

The Clamping test displays a block above the center bar for each odd-numbered sector that can be read. A block is displayed below the bar for each even-numbered sector that can be read. If a sector cannot be read, no block is displayed. Thus, missing blocks may indicate sectors which are too far away from the head to be read properly.

If the head is properly aligned, and the DDD Disk is perfectly clamped, there will be no missing blocks (as illustrated in Figure 4). Improper clamping is indicated when there are blocks consistently missing both above and below the bar (as in Figure 5). If blocks are consistently missing only on one side of the bar (as in Figure 6), then an alignment problem is more likely indicated.

ADJUSTMENTS

Most drives have no adjustments for eccentricity. As stated above, improper clamping is most often caused by a worn center hole in the diskette. If the diskette is not the problem, then the drive may have a bent spindle or very worn bearings. If the drive is excessively worn, it should be returned to the manufacturer for refurbishment.

CHAPTER THREE: THE QUICK TEST

PURPOSE

The Quick Test is designed to provide a quick, yet comprehensive summary indication of the condition of your disk drives. The Quick Test quickly and automatically checks all of the most critical drive performance parameters:

- Spindle speed
- Index hole timing
- Clamping
- Head alignment
- Alignment sensitivity
- Head rotation
- Directional seek

COMMAND SUMMARY

D - Select test drive
E - Exit to main menu
H - Select head
S - Start/stop test

Refer to Chapter 1 for a complete description of the operation of each of these commands.

NOTE: Unlike the other DDA tests, none of the commands may be executed during testing. So, before beginning the test, make sure that the Drive and Head indicated on the Status Line are the drive and head that you wish to test. Once the test is started, it will run to completion!

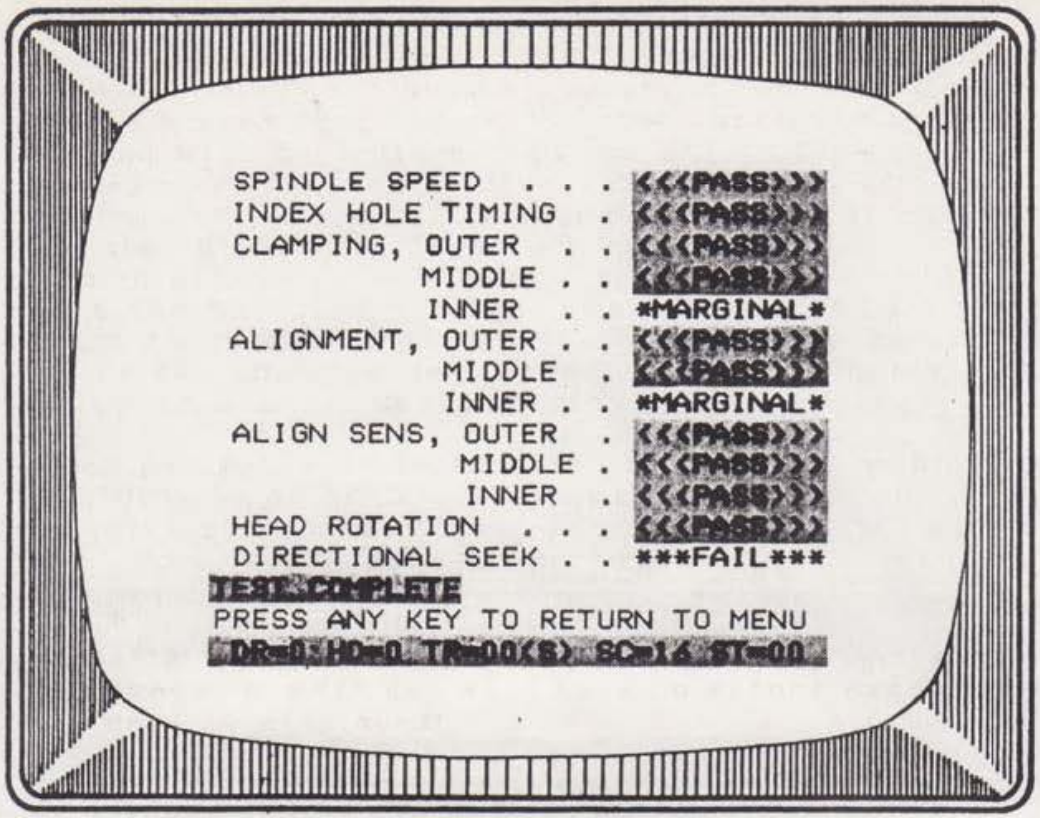

Figure 7: The Quick Test Menu

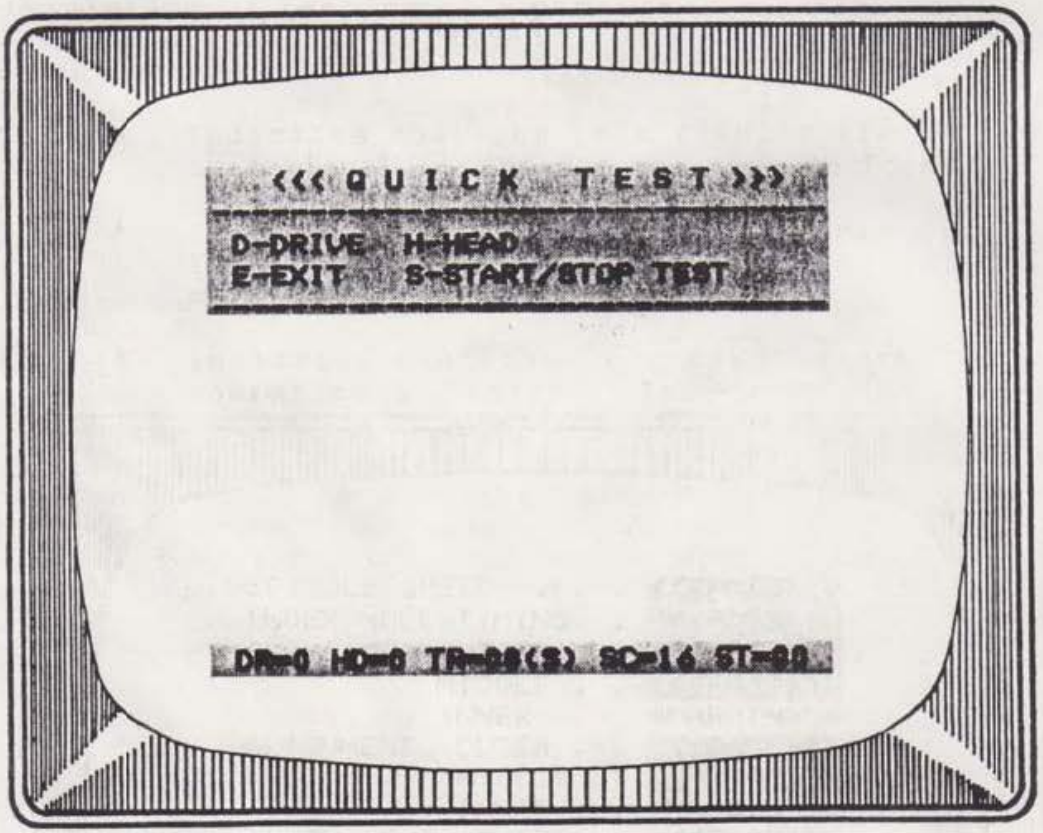

Figure 8: The Quick Test Display

TEST OPERATION

The Quick Test is activated from the Main Menu by selecting Test 2. When first activated, the Quick Test screen consists only of the command menu at the top and the Status Line at the bottom of the screen (see Figure 7). The currently selected test drive and head will be indicated on the Status Line. If you wish to change either the test drive or the head, do so before beginning the test. Use the "D" Command to select another test drive, and the "H" Command to select another head.

Insert the DDD Disk into the test drive, and press the "S" Key to start the test. When the test starts, the results screen will replace the command menu (see Figure 8). Once the test is started, it cannot be stopped from the keyboard.

As each parameter is tested, the result will be displayed as "PASS", "MARGINAL", or "FAIL". When all testing is complete, the Test Drive will stop, and the message "TEST COMPLETE" will appear near the bottom of the screen. Press any key to return to the Quick Test menu.

Use the "E" Key to return to the Main Menu. As with any of the command keys, the "E" Key will have no affect except when the Quick Test Menu is displayed!

TEST INDICATIONS

The Quick Test will test each of the indicated parameters in turn, starting at the top of the list, and working down the list. Upon completion of testing of a parameter, a pass, marginal, or fail condition will be indicated to the right of the parameter name on the screen:

<<< PASS >>>	Indicates that the test results are well within operational limits for the test performed.
* MARGINAL *	Indicates that the drive is within operational limits, but only marginally. The drive should probably be tested further.
*** FAIL ***	Indicates that the test results are not within operational limits. The drive is in need of further testing and/or adjustment.

If the drive does not pass all tests, re-run the Quick Test several times. Occasionally, a transient noise condition or other anomaly may cause erroneous results. If a non-pass condition persists, further testing is indicated. The table below summarizes which DDA test or tests pertain to each of the Quick Test tests:

Quick Test parameter	**Related DDA Test(s)**
Spindle speed	Spindle speed test (3)
Index hole timing	Index hole timing test (4)
Clamping	Clamping test (1)
Alignment	Head Alignment (6)
Alignment sensitivity	Alignment sensitivity (5)
Head rotation	Head Rotation (8)
Directional seek	Directional Seek (7)

Note that the "OUTER", "MIDDLE", and "INNER" parameters of the Clamping, Alignment, and Alignment Sensitivity tests refers to the Outer (O), Middle (M), and Inner (I) test tracks, respectively.

CHAPTER FOUR: THE SPINDLE SPEED TEST

PURPOSE

The Spindle Speed Test measures the rotational speed of the disk in the test drive. For best results, the spindle speed should be 300 RPM plus or minus 2% (294-306 RPM).

COMMAND SUMMARY

D - Select test drive
E - Exit to main menu
S - Start/stop test

Refer to Chapter 1 for a complete description of the operation of each of these commands.

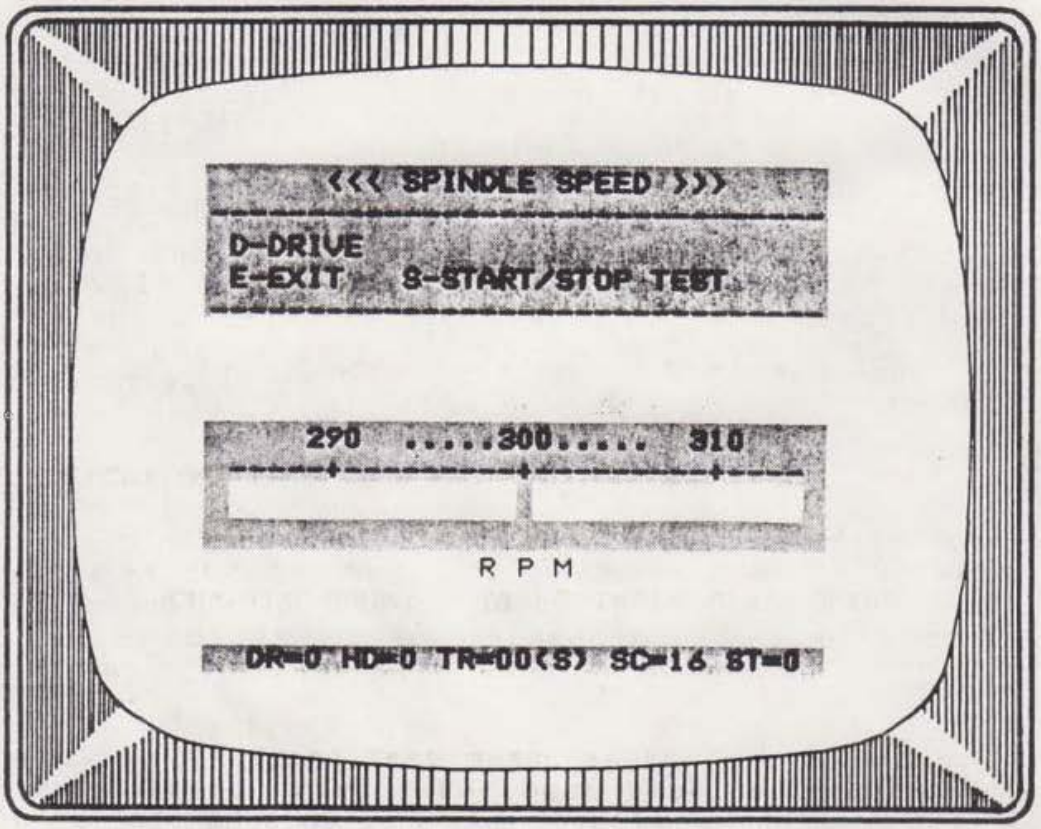

Figure 9: The Speed Test Display

TEST OPERATION

The Spindle Speed Test is activated from the Main Menu by selecting Test 3. The test screen consists of a command menu at the top, a speed "meter" in the middle of the screen, and the Status Line at the bottom.

The speed "meter" in the center of the screen is calibrated in Revolutions Per Minute (RPM). The scale spans from 285 RPM on the extreme left to 314 RPM on the extreme right. The resolution of the "meter" is 1 RPM. The desired meter reading range of 294-306 RPM is indicated on the scale by dots surrounding the 300 RPM center point.

To start the test, insert a disk into the test drive and press the "S" Key. This test does not require the DDD Disk, but it may be used if desired. Once the test is started, a "meter needle" will appear in the "meter", indicating the real-time spindle speed of the test drive. Since the needle is displayed real-time, the drive speed may be adjusted while watching the meter display.

TEST INDICATIONS

The spindle speed of a 5-1/4" floppy disk drive should be in the range of 294-306 RPM. If the meter needle appears in this range, as indicated by dots on the scale, then the spindle speed is properly adjusted. If the needle is not within this range, then the spindle speed is in need of adjustment.

HOW THE TEST WORKS

The Spindle Speed Test derives the spindle speed by measuring the elapsed time between consecutive occurances of the index hole. The measured time is converted to RPM and displayed in meter needle form.

ADJUSTMENT

On most drives, the spindle speed may be adjusted by means of a variable resistor on the servo board. To identify the servo board, look for a board that connects to the spindle drive motor. Unfortunately, some drives do not have a speed adjustment. If the speed cannot be adjusted, then the servo board must be replaced or the drive must be returned to the manufacturer for repair.

CHAPTER FIVE: THE INDEX HOLE TIMING TEST

PURPOSE

The Index Hole Timing Test measures the elapsed time from the leading edge of the index hole to the beginning of the Sector ID Mark. For purposes of interchangeability, this time is required to be 200 microseconds, plus or minus 50% (100-300 us).

COMMAND SUMMARY

D - Select test drive
E - Exit to main menu
H - Select head
S - Start/stop test
T - Select test track

Refer to Chapter 1 for a complete description of the operation of each of these commands.

TEST OPERATION

The Index Hole Timing Test is activated from the Main Menu by selecting Test 4. The test screen consists of a command menu at the top, a timing "meter" in the middle of the screen, and the Status Line at the bottom.

The timing "meter" in the center of the screen is calibrated in microseconds (us). The scale spans from 0 us on the extreme left to 580 us on the extreme right. The resolution of the meter is 20 us. The desired meter reading range of 100-300 us is indicated on the meter scale by dots on either side of the 200 us point.

To start the test, insert the DDD Disk in the test drive, and press the "S" Key. A meter needle will appear in the meter, indicating the real-time index hole timing. Since the meter needle is displayed real-time, the index hole photodetector may be adjusted while watching the meter display.

NOTE: If DDA cannot detect the index hole, the meter needle will be erased from the screen. So, if the meter needle does not appear after the test is started, or if it disappears during testing, DDA cannot detect the index hole. This may be caused by the drive door being open, no disk in the test drive, or an improperly inserted disk. If none of these problems exists, then it may be that the index hole photodetector is loose or drastically misaligned.

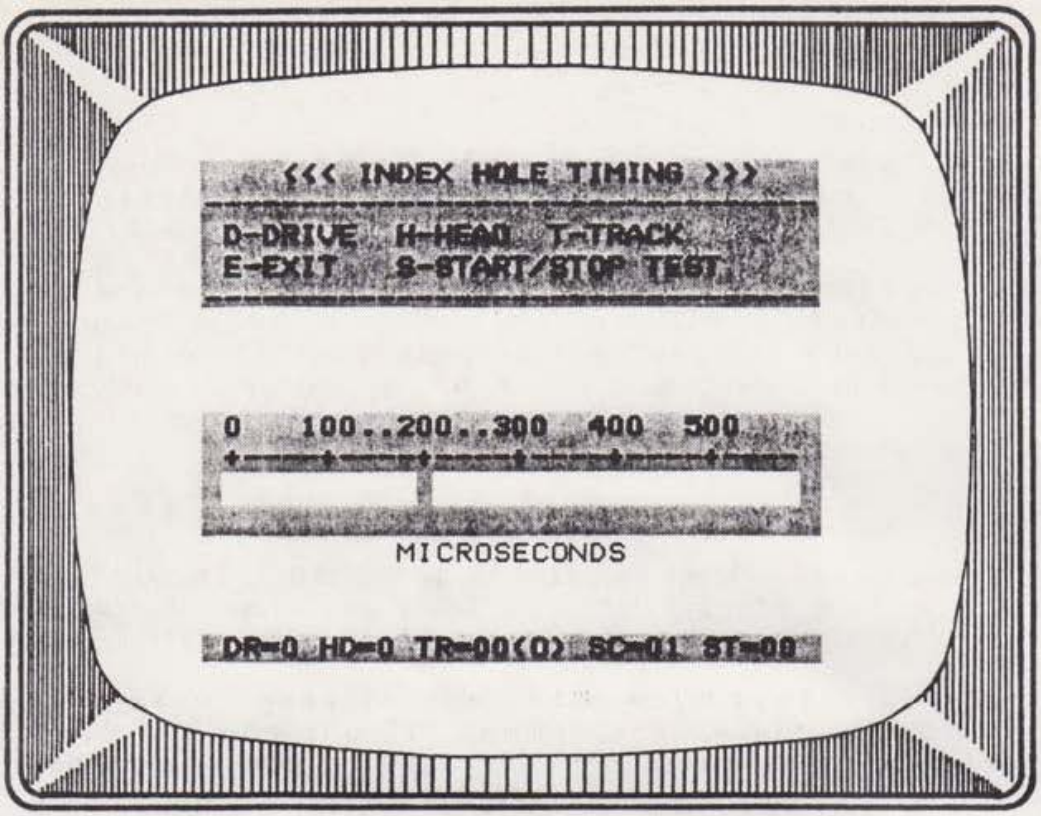

Figure 10: The Index Hole Timing Display

TEST INDICATIONS

The index hole timing should be in the range of 100-300 us. If the meter needle appears within this range, as indicated by dots on the scale, then the index hole photodetector is properly adjusted. If the needle is not within this range, the index hole photodetector is in need of adjustment.

HOW THE TEST WORKS

The DDD Disk provides two test tracks which have the Sector ID Mark recorded at precisely 200 us from the leading edge of the index hole. DDA simply measures the time from the leading edge of the index hole to the Sector ID Mark on either of these test tracks. The resulting time is then displayed as a meter needle.

ADJUSTMENT

Find the photodetector assembly that detects the index hole. It will be aligned with the index hole window in the diskette jacket when the diskette is fully inserted in the drive. The photodetector assembly is normally held in place with a screw. Loosen the screw slightly and move the assembly slightly while watching the display. Continue to move the photodetector until the proper timing is indicated on the "meter", then tighten the screw. Note that tightening the screw may change the results and the adjustment may have to be repeated.

THE SKEW TEST

An additional feature of the Index Hole Timing Test is the Head Skew Test. Head Skew is a function of the perpendicularity of the head positioning mechanism to the disk surface.

To test skew, measure the Index Hole Timing at the Outer test track, then use the "T" Command to select the Inner test track. The difference between the measurements at the two test tracks is an indication of head skew.

Ideally, there should be little or no difference in the index hole timing at the two tracks. However, most drives will exhibit a difference of 20-40 us. If your drive shows a great difference, about 60 us or more, then the head skew is probably unacceptable.

There is no adjustment for head skew. A drive which exhibits unacceptable head skew should probably be returned to the manufacturer for refurbishment.

CHAPTER SIX: THE ALIGNMENT SENSITIVITY TEST

PURPOSE

Alignment Sensitivity is a measure of the drive sensitivity to head alignment. This parameter relates to the sensitivity of the head read electronics, which affects how tolerant the drive is to slight head misalignment. In general, the more sensitive the read electronics, the more tolerant the drive will be to slight head misalignment.

The Alignment Sensitivity test provides a histogram display indicating percentage of good reads on the vertical axis versus sector displacement on the horizontal axis.

COMMAND SUMMARY

D - Select test drive
E - Exit to main menu
H - Select head
S - Start/stop test
T - Select test track

Refer to Chapter 1 for a complete description of the operation of each of these commands.

TEST OPERATION

The Alignment Sensitivity Test is activated from the Main Menu by selecting Test 5. When first activated, the screen consists of a command menu at the top of the screen, a sector displacement scale near the bottom, and the Status Line at the bottom. The sector displacement scale is calibrated in milli-inches (mils) from -13 mils on the extreme left to +13 mils on the extreme right. A negative displacement represents a displacement away from the spindle, while a positive displacement represents a displacement toward the spindle.

Insert the DDD Disk into the test drive and press the "S" Key to start the test. After a few seconds, a histogram (bar chart) will appear above the sector displacement scale. The test will continue indefinitely, updating the histogram approximately every 5 seconds until the test is stopped with the "S" Command, or terminated with the "E" Command.

Use the "T" Command to position the head over the Inner, Middle, and Outer test tracks. A test track may be selected before starting the test, or while the test is in progress. If a new track is selected while the test is in progress, the histogram will be erased, and the test must be re-started with the "S" Command.

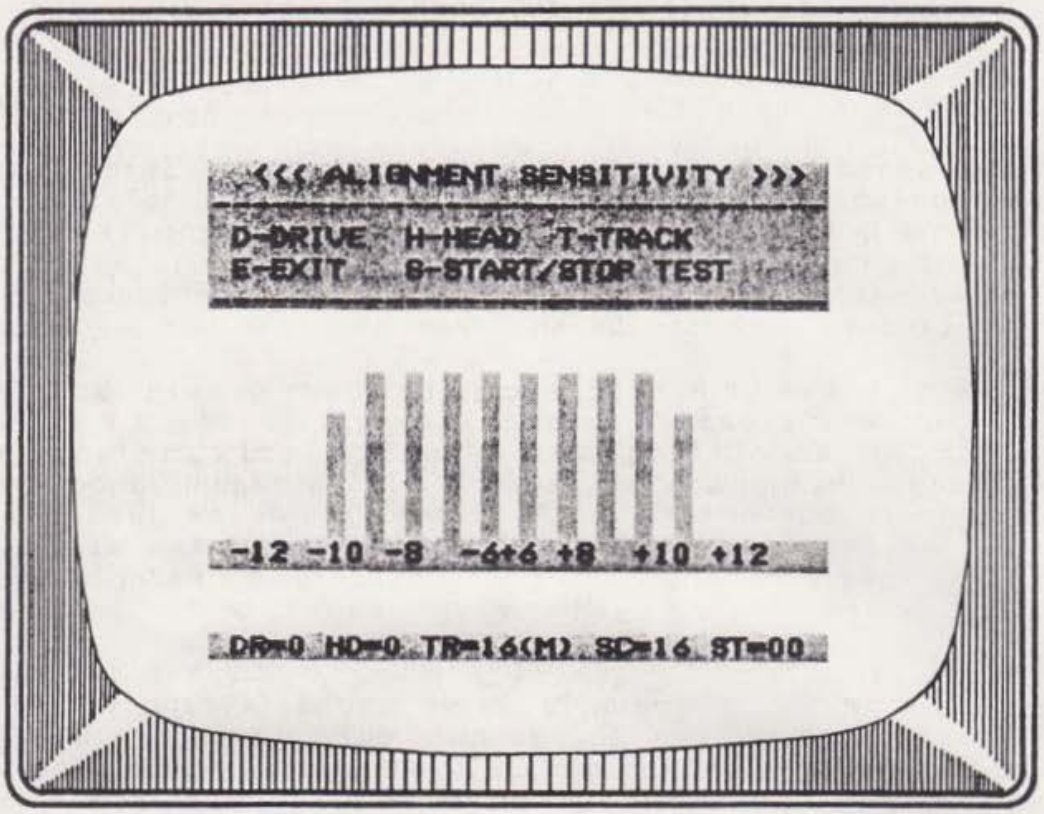

Figure 11: Normal Sensitivity, Proper Alignment

PROPER ALIGNMENT

Figure 11 illustrates results obtained from a properly aligned drive with normal read sensitivity. Each vertical bar indicates the ratio of good reads to bad reads in 5 samples for the corresponding sector. A 100% bar indicates that every attempt to read the corresponding sector was successful. A 20% bar indicates that out of 5 attempts, the sector was read only once without error. Higher error rates on the fringes of the histogram is normal.

Most newer drives will result in a display with 100% bars from at least -10 mils to +10 mils. Older drives usually result in narrower displays. Some factors that can affect the width of the display include worn pressure pads, weak head read electronics, dirty heads, and worn DDD diskettes.

ALIGNMENT ERROR

Figure 12 illustrates results obtained from a drive with a misaligned head. Poor head alignment is indicated when the histogram is asymmetrical about the center of the screen.

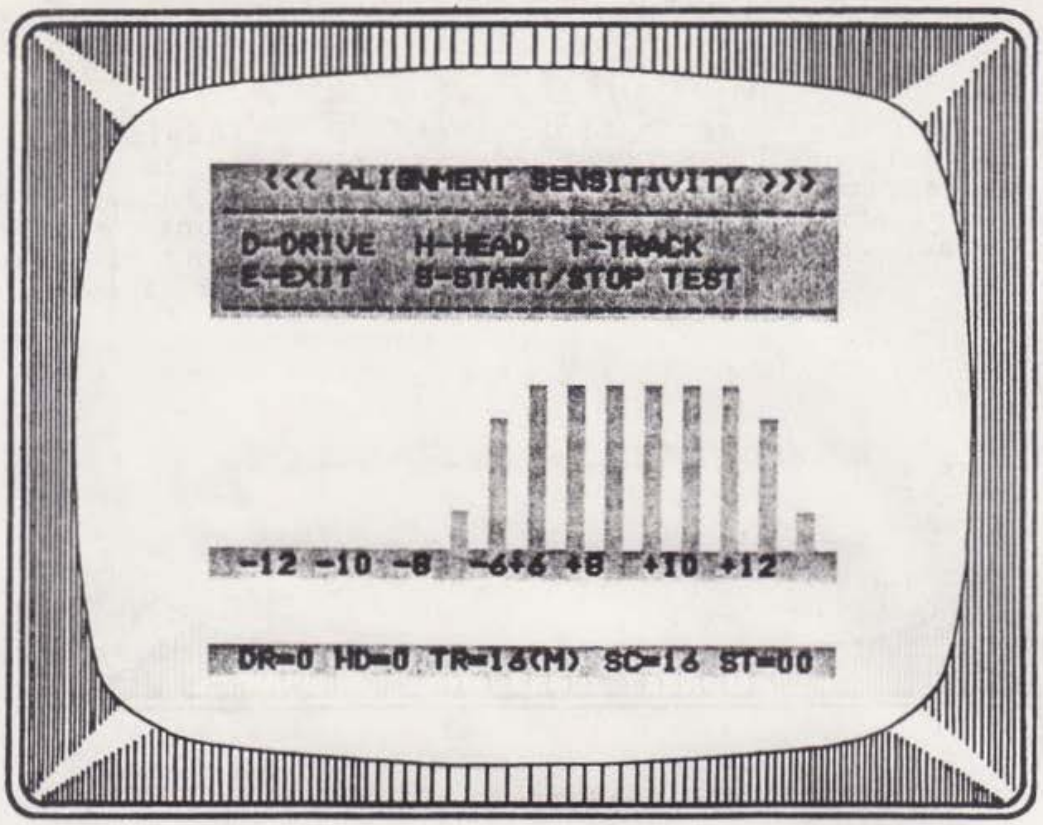

Figure 12: Head Out of Alignment

ADJUSTMENT

The general alignment procedure is described here. However, you should refer to the drive manufacturer's technical manual for a complete alignment procedure. Please note that J & M Systems cannot be responsible for any adjustments that you make! If you don't feel confident in making these adjustments, take your drive to someone you can trust to make the adjustments properly.

On most drives, the head is positioned by means of a stepper motor with a split-band positioner or a lead-screw positioner. Head alignment with a lead-screw positioner is typically accomplished by rotating the stepper motor. Loosen the stepper motor mounting screws slightly, then rotate the stepper motor slowly while watching the display. Once the head is aligned, carefully tighten the screws. Tightening the screws may affect the alignment, so the procedure may have to be repeated.

Head alignment with a split-band positioner typically involves moving a platform to which the stepper motor and head mechanism are mounted. The platform is usually moved by means of a screw or a cam. Loosen the platform screws slightly, then move the platform slowly while watching the display. Once the head is aligned, tighten the screws. Tightening the screws may affect the alignment so the procedure may have to be repeated.

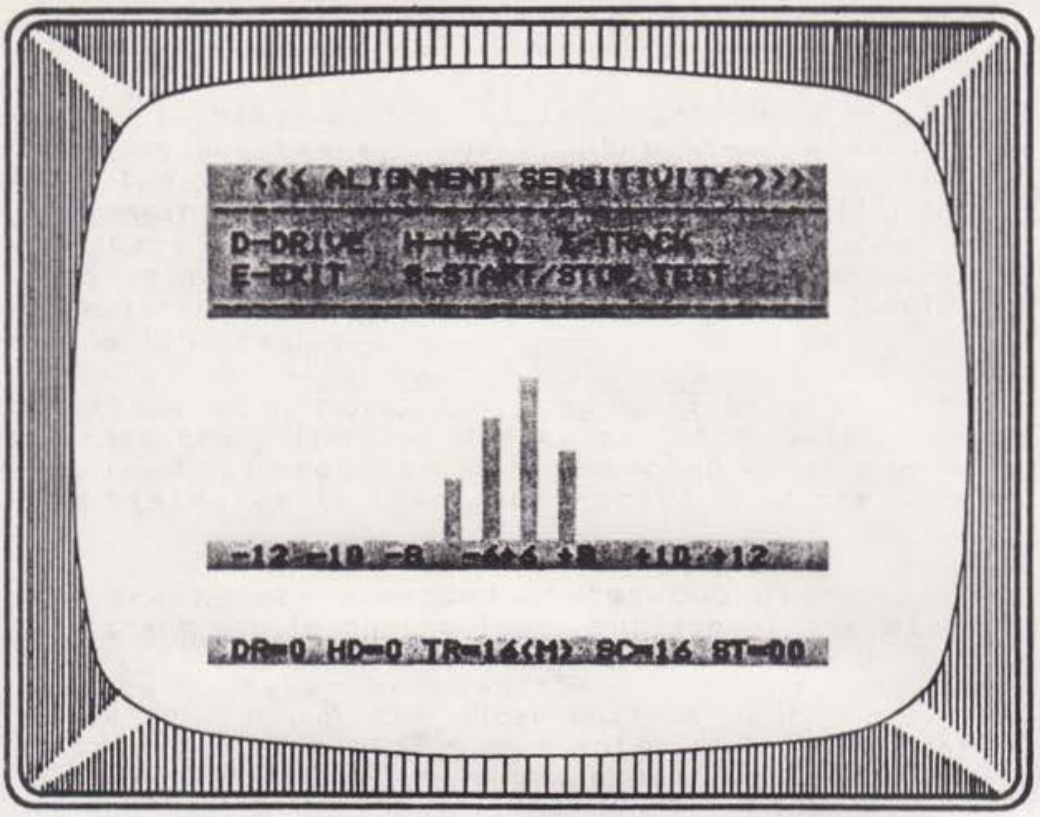

Figure 13: Poor Read Sensitivity

POOR READ SENSITIVITY

Figure 13 illustrates the test results from a drive that is properly aligned, but exhibits poor read sensitivity. This drive will exhibit very little tolerance to alignment. The drive may exhibit intermittent problems such as drifting in and out of alignment with time and temperature changes, excessive CRC errors, and inability to read disks recorded on other drives. In general, the drive will perform poorly.

WHAT TO DO

Poor read sensitivity is most often caused by a dirty head, or a worn pressure pad. Other causes include damaged head, weak read electronics, or excessive electomagnetic interference.

Try cleaning the head. Head cleaning kits are generally available at most any computer store. If the problem persists, try replacing the head pressure pad. These pads may be obtained from the manufacturer, or in some cases from a local computer store. If the problem still persists, you may heave to return the drive to the manufacturer for refurbishment.

HOW THE TEST WORKS

This test is based on a set of precision-recorded tracks on the DDD Disk called "progressive offset tracks". These tracks are recorded with each sector displaced progressively further away from the track center-line. The odd-numbered sectors are displaced progressively toward the spindle, while the even-numbered sectors are displaced progressively away from the spindle.

The following chart summarizes the displacement of each sector on the progressive offset tracks:

SECTOR	OFFSET (mils)	SECTOR	OFFSET (mils)
1	+6	2	-6
3	+7	4	-7
5	+8	6	-8
7	+9	8	-9
9	+10	10	-10
11	+11	12	-11
13	+12	14	-12
15	+13	16	-13

The test is based on the ability of the head to read each of the sectors on the track. The greater the distance between a sector and the head, the weaker the signal. As the sectors become increasingly displaced, the head signal will diminish to the point where there is insufficient signal to read properly. If the head is aligned properly with the track center-line, this point of marginal signal should occur at the same displacement on both sides of the center-line.

When the test begins, the head will be positioned to the requested test track (Inner, Middle, or Outer). The program will attempt to read all sectors on the selected track a total of five times. The histogram is then constructed, and the procedure is repeated.

Three tracks are provided on the DDD Disk for this test. The Inner track (I) is on the inner surface of the disk, nearest the spindle. The Middle track (M) is near the middle of the disk, roughly half-way between the inner and outer edge. The Outer track (O) is near the outer surface of the disk, furthest from the spindle. Typically, the outer track will exhibit the widest histogram, and the inner track will exhibit a more narrow histogram due to the increased flux density toward the center of the disk.

CHAPTER SEVEN: THE HEAD ALIGNMENT TEST

PURPOSE

The Head Alignment Test measures the radial alignment of the head to a precisely recorded standard track. This test is also useful as a tool when performing head alignment adjustments.

COMMAND SUMMARY

D - Select test drive
E - Exit to main menu
H - select head
S - Start/stop test
T - Select test track

Refer to Chapter 1 for a complete description of the operation of each of these commands.

TEST OPERATION

The Head Alignment Screen is activated from the Main Menu by selecting Test 6. The screen consists of a command menu at the top, an alignment "meter" in the center of the screen, and the Status Line at the bottom.

The alignment meter scale is calibrated in milli-inches (mils). The scale spans from -7 mils on the extreme left to +7 mils on the extreme right. The resolution of the "meter" is Ø.5 mils. The meter needle indicates the distance from the head to the track center-line. Negative displacement indicates that the head is misaligned away from the spindle, while positive displacement indicates that the head is misaligned toward the spindle.

Insert the DDD Disk into the test drive and press the "S" Key to start the test. A needle will be displayed in the "meter" indicating the alignment of the head with respect to the test track. Use the "T" Keys to select the Inner, Middle, or Outer test track.

NOTE: When the test is first started, and at any time during test operation, if DDA cannot read the DDD Disk, the meter needle will be erased. This can be caused by the drive door being open, no disk in the drive, or the disk being inserted improperly in the drive.

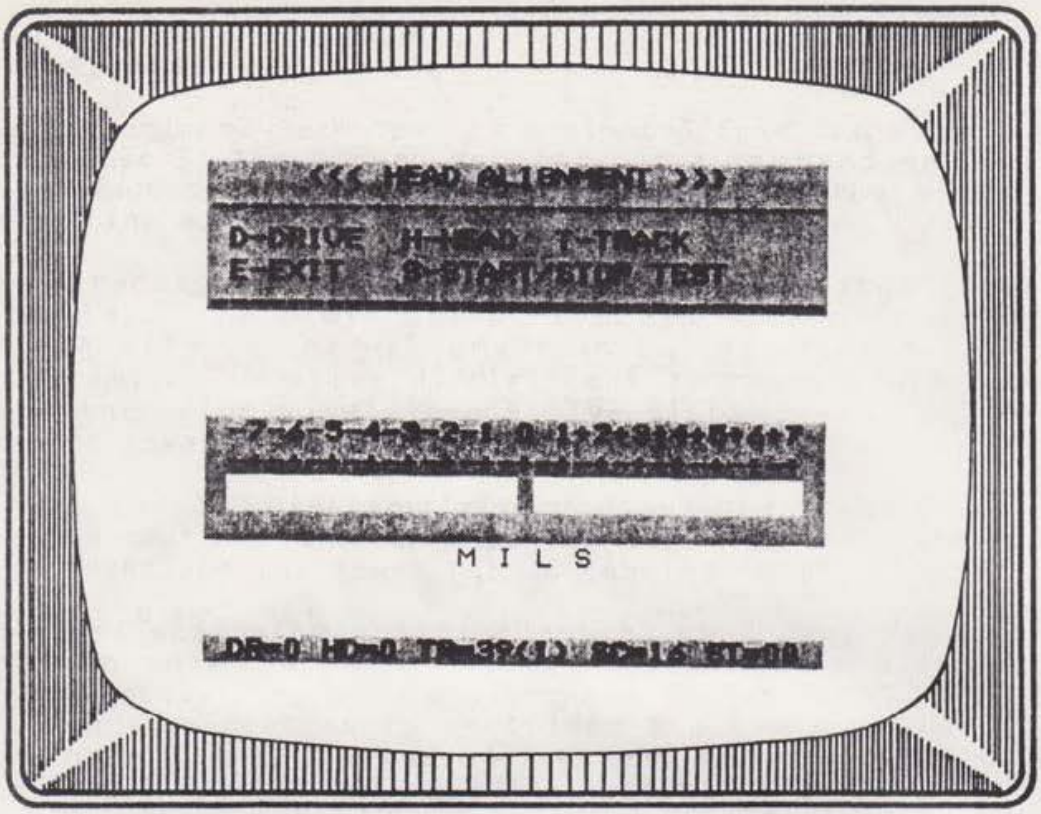

Figure 14: The Head Alignment Test Screen

TEST INDICATIONS

When the head is properly aligned, the meter needle will appear in the center of the meter under the "Ø" point on the scale. If the needle appears to the right of the "Ø" point, then the head is misaligned toward the spindle by the number of mils indicated on the scale above the needle. If the needle appears to the left of the "Ø" point, then the head is misaligned away from the spindle.

ADJUSTMENT

Refer to Chapter 6 for a discussion on head alignment.

CHAPTER EIGHT: THE DIRECTIONAL SEEK TEST

PURPOSE

The directional seek test provides a qualitative measure of the hysteresis in the disk drive head carriage mechanism. This is, in effect, a measure of how precisely the drive can repeatably position the head over any given track on the disk. A drive with a badly worn head carriage mechanism will exhibit poor repeatability in positioning the head over a given track.

COMMAND SUMMARY

D - Select test drive
E - Exit to main menu
H - Select head
S - Start/stop test

Refer to Chapter 1 for a complete description of the operation of each of these commands.

TEST OPERATION

The Directional Seek Test is activated from the Main Menu by selecting Test 6. The screen consists of a command menu at the top, the Directional Seek Meter in the middle of the screen, and the Status Line at the bottom.

The directional seek meter scale is calibrated in milli-inches (mils). The scale spans from -13 mils on the extreme left to +13 mils on the extreme right. The resolution of the meter is 1 mil. Negative displacement represents displacement away from the spindle, while positive displacement represents displacement toward the spindle.

Insert the DDD Disk in the test drive and press the "S" Key to start the test. The meter will display two bars. The top bar is labeled "IN" and the lower bar is labeled "OUT".

The test starts by positioning the head over Track Ø. The head is then moved in to the middle progressive offset track (progressive offset tracks are discussed in Chapter 6). The test then attempts to read every sector on the track. The "IN" bar displays the results. The bar will extend from the most negative readable sector to the most positive readable sector.

Next, the head is moved in to Track 39, then moved back out to the middle progressive offset track again. The track is again read with the results displayed by the bar labeled "OUT". The entire sequence continues until the test is stopped with the "S" Command or terminated with the "E" Command.

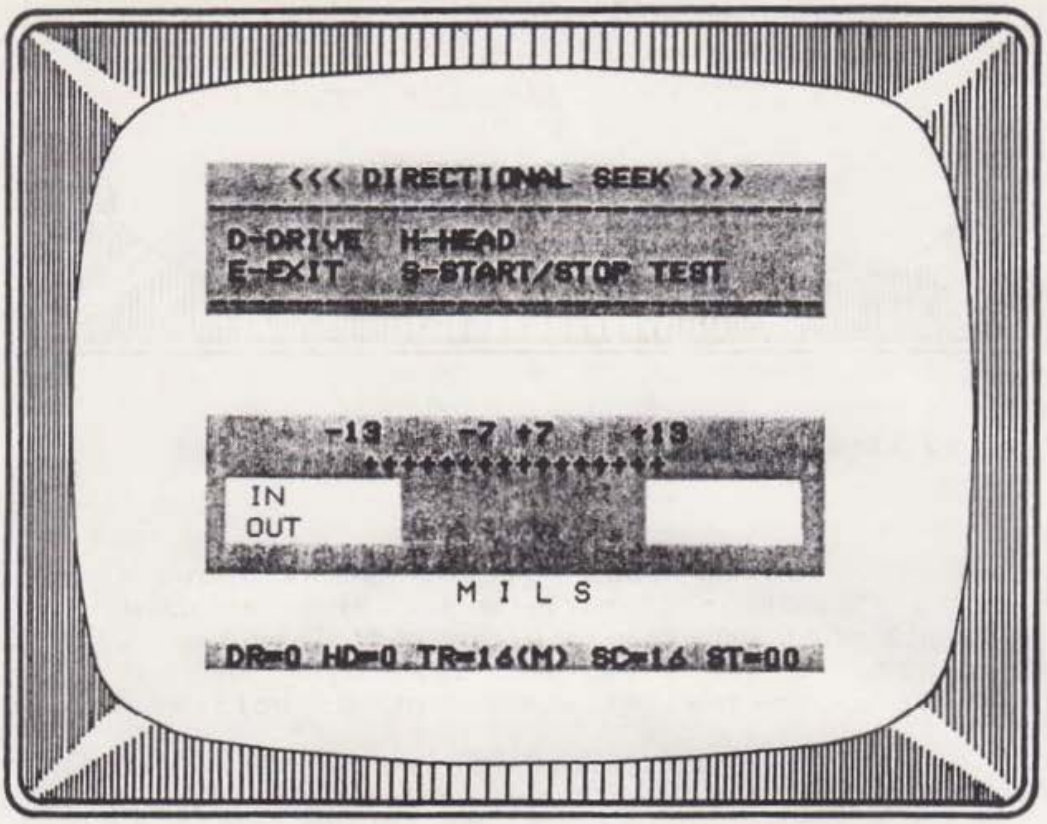

Figure 15: Directional Seek Display

TEST INDICATIONS

This test measures the radial alignment of the head to the DDD Disk. The alignment is checkec after the head has been moved IN to the test track. The results of this test are displayed in the row marked "IN". The alignment is again checked after the head has been moved OUT to the test track, with the results displayed in the row labeled "OUT". Any consistent difference in the two rows is probably attributable to hysteresis.

Hysteresis is a measure of the "slop" in the drive mechanism. A drive which exhibits extreme hysteresis will tend to position the head closer to the spindle when it moves the head away from the spindle than it will when it moves the head toward the spindle. The resulting display would show an "IN" bar which is consistently skewed to the left of the "OUT" bar.

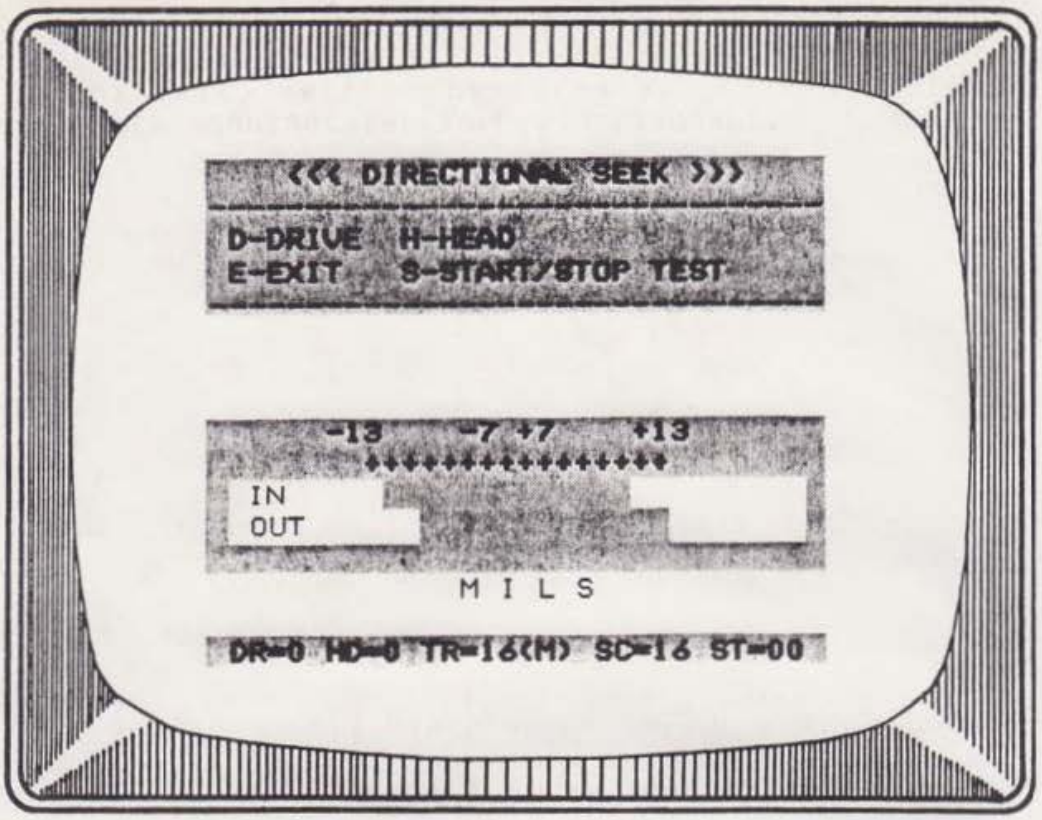

Figure 16: Poor Directional Seek Results

It is important to realize that the exact position of the bar ends with respect to the scale is relatively unimportant in this test. How well the bars are centered is a function of head alignment. The important consideration in this test is the relative location of the bars with respect to each other.

A drive with acceptable hysteresis will result in the two bars being vertically aligned most of the time, as illustrated in Figure 15. As illustrated in Figure 16, a drive with unacceptable hysteresis will result in the two bars being consistently misaligned with each other. This is due to drive consistently reading a different group of sectors depending on which direction the head traveled to the destination track.

HOW THE TEST WORKS

This test makes use of the middle progressive offset track of the DDD Disk. The progressive offset tracks are discussed in detail in Chapter 6 of this manual. For the purpose of this discussion, it is only necessary to understand that the middle progressive offset track is used to determine the alignment of the head to the DDD Disk track.

The absolute alignment of the head is irrelevant to this test. Rather, the test is concerned with the repeatability of the alignment. It is important that the drive be able to place the head in the same position every time it moves to a given track. Its ability to do so is limited for the most part only by the degree of hysteresis in the head carriage mechanism.

In summary, the test displays the difference in alignment when the head is moved in one direction to a given track from the alignment when the head is moved in the opposite direction to the same track.

ADJUSTMENT

There is no adjustment for hysteresis on most drives. If the drive exhibits extreme hysteresis, it should probably be returned to the manufacturer for refurbishment.

CHAPTER NINE: THE HEAD ROTATION TEST

PURPOSE

The Head Rotation Test provides a measure of the angle at which the head intercepts the track center-line. For maximum read sensitivity, the head center-line should be parallel to the track tangent line.

The Head Rotation Test provides a histogram display indicating percentage of good reads on the vertical axis versus angular displacement on the horizontal axis.

COMMAND SUMMARY

D - Select test drive
E - Exit to main menu
H - Select head
S - Start/stop test

Refer to Chapter 1 for a complete description of the operation of each of these commands.

TEST OPERATION

The Head Rotation Test is activated from the Main Menu by selecting Test 8. The screen consists of a command menu at the top, an angular displacement scale toward the bottom, and the Status Line at the bottom. The scale is calibrated in minutes (1/60 degree), spanning from -42 minutes on the extreme left to +42 minutes on the extreme right in 3-minute increments.

Insert the DDD Disk into the test drive and press the "S" Key to start the test. After several seconds, a histogram will appear above the scale. The test will continue indefinitely, updating the histogram every few seconds, until it is stopped with the "S" Command, or terminated with the "E" Command.

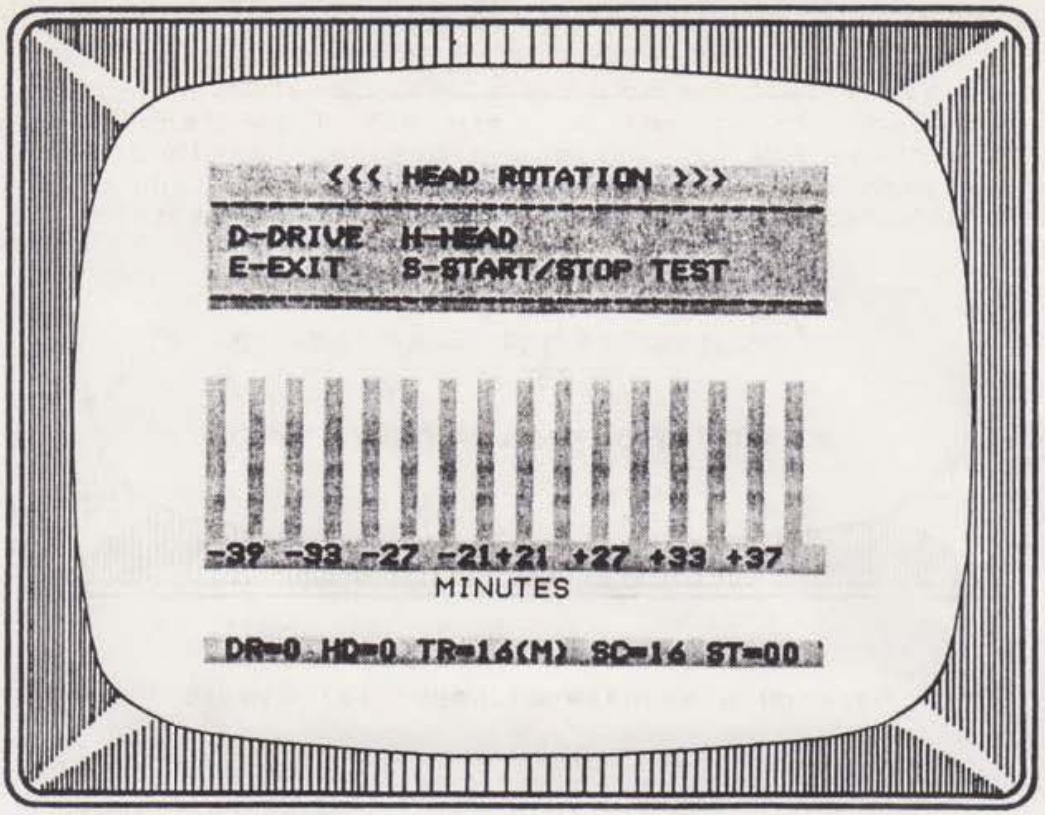

Figure 17: Head parallel to test track

TEST INDICATIONS

A head which is oriented properly with respect to the Head Rotation test track will result in a histogram which is symmetrical and well centered above the scale. If the head is twisted such that the leading edge is closer to the spindle than the trailing edge, then the center of the histogram will be shifted toward the right-hand side of the screen. If the head is twisted such that the leading edge is further from the spindle than the trailing edge, then the center of the histogram will be shifted toward the left-hand side of the screen.

HOW THE TEST WORKS

The Azimuth Rotation Test is similar in concept to the Alignment Sensitivity Test. A track is provided on the DDD Disk which has sectors written with progressively increasing angular rotation with respect to the track center-line. Odd-numbered sectors are angularly displaced such that the leading edge is nearer the spindle than the trailing edge. Even-numbered sectors are angularly displaced such that the leading edge is further from the spindle than the trailing edge.

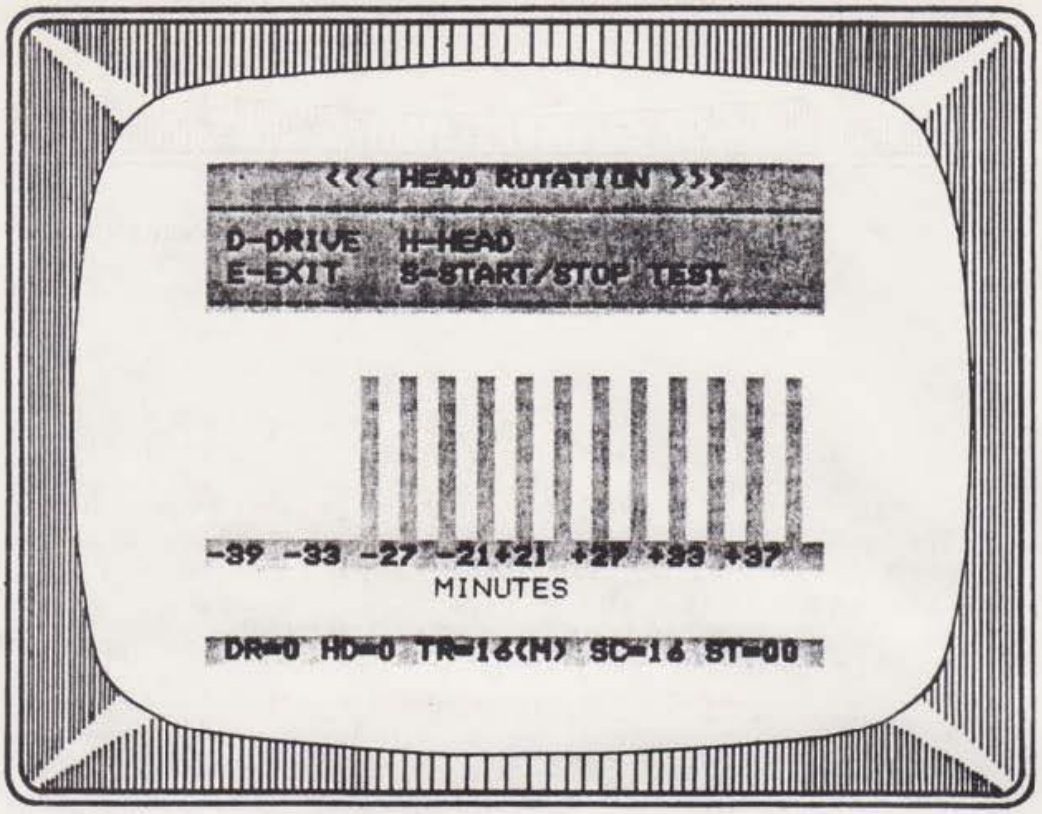

Figure 18: Results with Head Rotated

The following chart summarizes the angular displacement of each sector on the Head Rotation test track:

SECTOR	ANGULAR DISPLACEMENT (minutes)	SECTOR	ANGULAR DISPLACEMENT (minutes)
1	+21	2	-21
3	+24	4	-24
5	+27	6	-27
7	+30	8	-30
9	+33	10	-33
11	+36	12	-36
13	+39	14	-39
15	+42	16	-42

The basis of the Head Rotation Test is the marginal ability of the head to read data that is angularly displaced from the head center-line. As the sectors become increasingly displaced, the head signal will diminish to the point where there is insufficient signal to read properly. If the head is oriented parallel to the track tangent line, this point of marginal signal will occur at the same point of angular displacement in both directions.

ADJUSTMENT

Head rotation affects only the relative position of the histogram shoulders. The overall width of the histogram is not a function of head rotation, but rather, read sensitivity. If the histogram is off-center by less than 9 minutes, then the head rotation is probably within acceptable limits. But, if the histogram is off-center by more than about 9 minutes, then the head rotation is probably causing problems.

There is no adjustment for head rotation on most drives. On drives which do provide head rotation adjustments, the adjustment is extremely sensitive. If the results show extreme head rotation, the drive should be probably be returned to the manufacturer for repair.

CHAPTER TEN: THE ANALOG ALIGNMENT AID

PURPOSE

The Analog Alignment Aid is not a test in the same sense as the other DDA tests. This screen is provided to assist in disk drive troubleshooting and repair. It will be useful if you wish to repair a disk drive in the more traditional manner, using an oscilloscope and an Analog Alignment Disk.

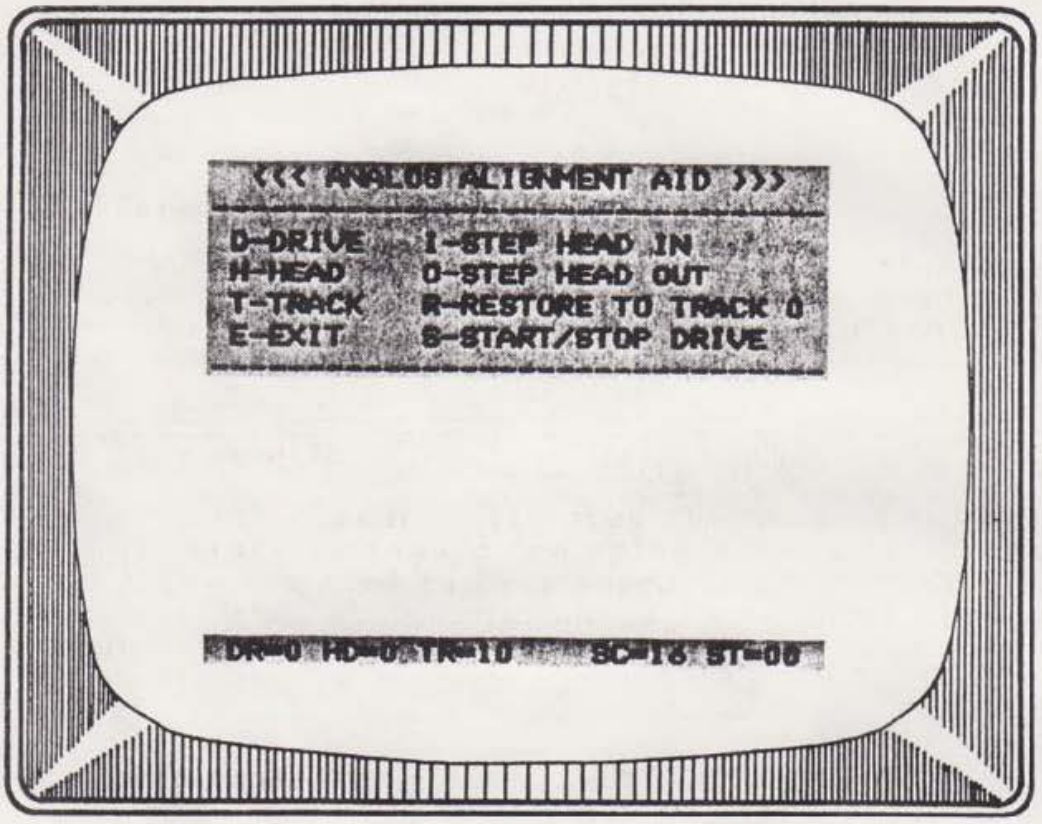

Figure 19: The Analog Alignment Aid Screen

TEST OPERATION

The Analog Alignment Aid is activated from the Main Menu by selecting Test "A". The screen consists of a command menu at the top and the Status Line at the bottom of the screen.

The Status Line indicates the current test drive (DR), the currently selected head (HD), the current track (TR), the current sector (SC), and the current Floppy Disk Controller Status Code (ST). Refer to Chapter 1 for a complete description of the Status Line.

D - Select Test Drive

Use the "D" Command to select a drive for test. Pressing the "D" Key will cause the drive number to change, as indicated by the "DR=" indication on the Status Line. Press the "D" Key as many times as required until the desired Drive Number appears on the Status Line. Note that this command is affected by the number of drives parameter (see Chapter 11).

E - Exit to main menu

Use the "E" Key to terminate the Analog Alignment Aid and return to the main menu.

H - Select head

The "H" Command toggles the head selection of the test drive. If the currently selected head is Head Ø, pressing the "H" Key will select Head 1. If the currently selected head is Head 1, pressing the "H" Key will select Head Ø.

I - Step head IN

The "I" Command will step the head of the test drive one (1) track IN toward the spindle. The "I" Command will not allow the head to be stepped in further than Track 39. Note that the "R" Command should be executed first when the Analog Alignment Aid is first activated to ensure that the track display is correct.

O - Step head OUT

The "O" Command will step the head of the test drive one (1) track OUT away from the spindle. The "O" Command will not allow the head to be stepped out beyond Track Ø. Note that the "R" Command should be executed first when the Analog Alignment Aid is first activated to ensure that the track display is correct.

R - Restore (home) head to Track Ø

The "R" Command will move the head of the test drive to the Track Ø (home) position by stepping the head OUT until the Track Ø Switch is activated. Note that this command should be executed first when the Analog Alignment Aid is first activated to ensure that the track display is correct.

S - Start/Stop Test Drive Motor

The "S" Command is used to alternately start and stop the spindle motor of the test drive. If the motor is off, pressing the "S" Key will turn it on. If the motor is on, pressing the "S" Key will turn it off.

T - Seek Track

The "T" Command positions the head of the test drive over any track (Ø-39). Pressing the "T" Key will cause the prompt

ENTER TRACK ==>

to appear in the lower, left-hand corner of the screen (replacing the Status Line). Respond by entering a two-digit track number (ØØ-39). DDA will not respond to any first digit entry that is not in the range of Ø-3.

NOTE: Execution of the "I", "O", "R", or "T" Commands will automatically start the test drive spindle motor. The motor will then remain on indefinitely until it is turned off with the "S" Command or the test is terminated with the "E" Command.

CHAPTER ELEVEN: CHANGING THE PROGRAM PARAMETERS

PURPOSE

The Program Parameters Screen is not a test at all, but does have an affect on some of the tests within the DDA Program. Several of the DDA Program test parameters may be changed by the user during the course of testing. The Program Parameter Screen is provided for this purpose.

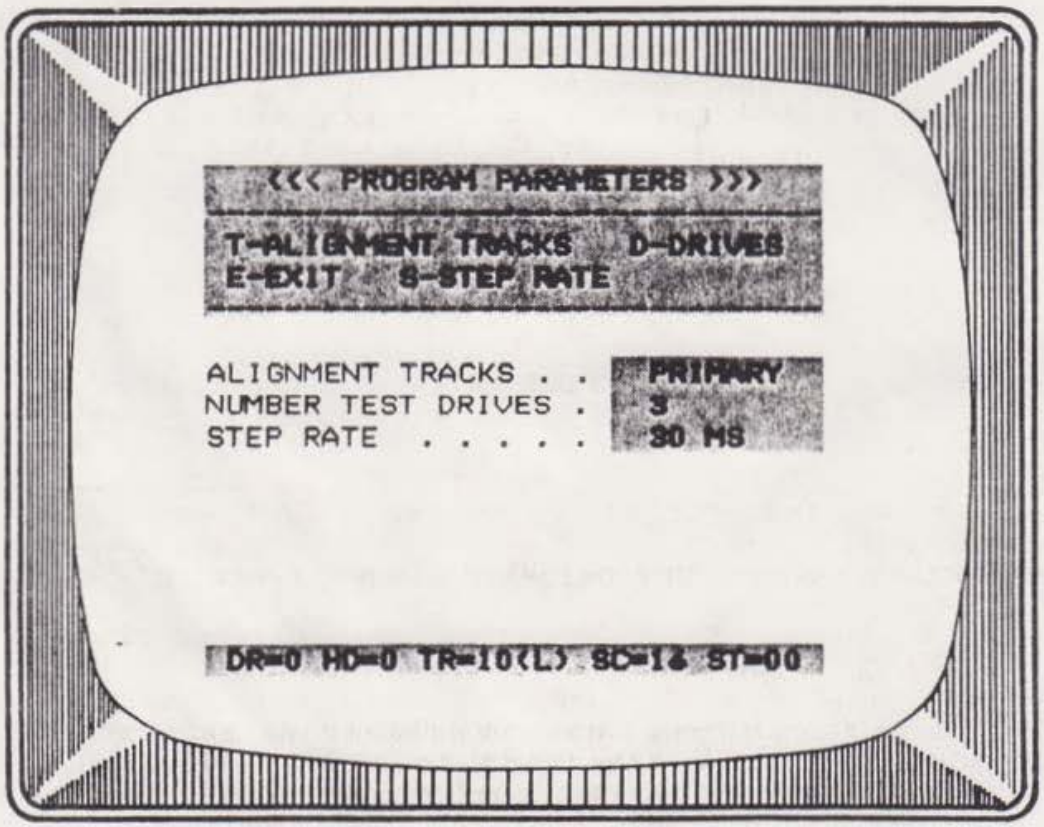

Figure 20: The Program Parameter Screen

THE COMMANDS

The Change Parameter Screen is activated from the Main Menu by the "C" Command. This screen provides four commands as described here.

D - Select number of test drives

Since the Color Computer provides for up to four drives, the "D" Command has been provided so that you can select the number of drives on which you wish to allow testing. DDA defaults to allow 3 test drives, Drives Ø-2. If you wish another number, press the "D" Key until the desired number of drives appears on the display.

Actually, there is probably little need to change this parameter unless you wish to test Drive 3 or you wish to restrict testing to only Drive Ø, or only Drives Ø and 1. Whatever number of test drives you select will affect the range of options provided by the "D" Command on all other screens.

E - Exit to main menu

The "E" Command is used to terminate the Program Parameters Screen and return to the Main Menu. Once you have selected all parameters as desired, simply press the "E" Key to return to the main menu. The new parameters will remain in effect until you change them again, or until the program is re-loaded and restarted.

S - Change head step rate

The head step rate selection is provided for convenience only. Since virtually any floppy disk drive can operate properly with a head step rate of 3Ø ms, this is the default used by the DDA Program. So, it is not necessary to change the head step rate at all. However, if you wish, and if your drives are capable of a faster step rate, you may select any one of 4 step rates.

To select a new step rate, simply press the "S" Key. Each time you press the "S" Key, one of four step rates will be displayed (6,12, 2Ø, and 3Ø ms.). Press the "S" Key as many times as necessary until the desired step rate is displayed. The new step rate is then selected, and will remain in effect until you change it again. Note, however, that each time you re-load and run DDA, it will always default to a step rate of 3Ø ms.

T - Select alignment tracks

There are two sets of progressive offset tracks on the DDD Disk (the function of these tracks is explained in Chapter 6 of this manual). One set is designated "Primary", the other "Alternate". The alternate set is intended primarily as backup in the event that the primary set becomes overly worn with use.

You may wish to use the alternate tracks if you suspect that the primary set is worn to the point where it is afecting test results. To switch between the primary and alternate sets, use the "T" Key. Each time the "T" Key is pressed, the display will toggle between "ALTERNATE" and "PRIMARY", and the appropriate set of tracks will be used for all further testing until the selection is again changed.

Note that the DDA program always defaults to the "PRIMARY" test tracks when it is loaded and executed.