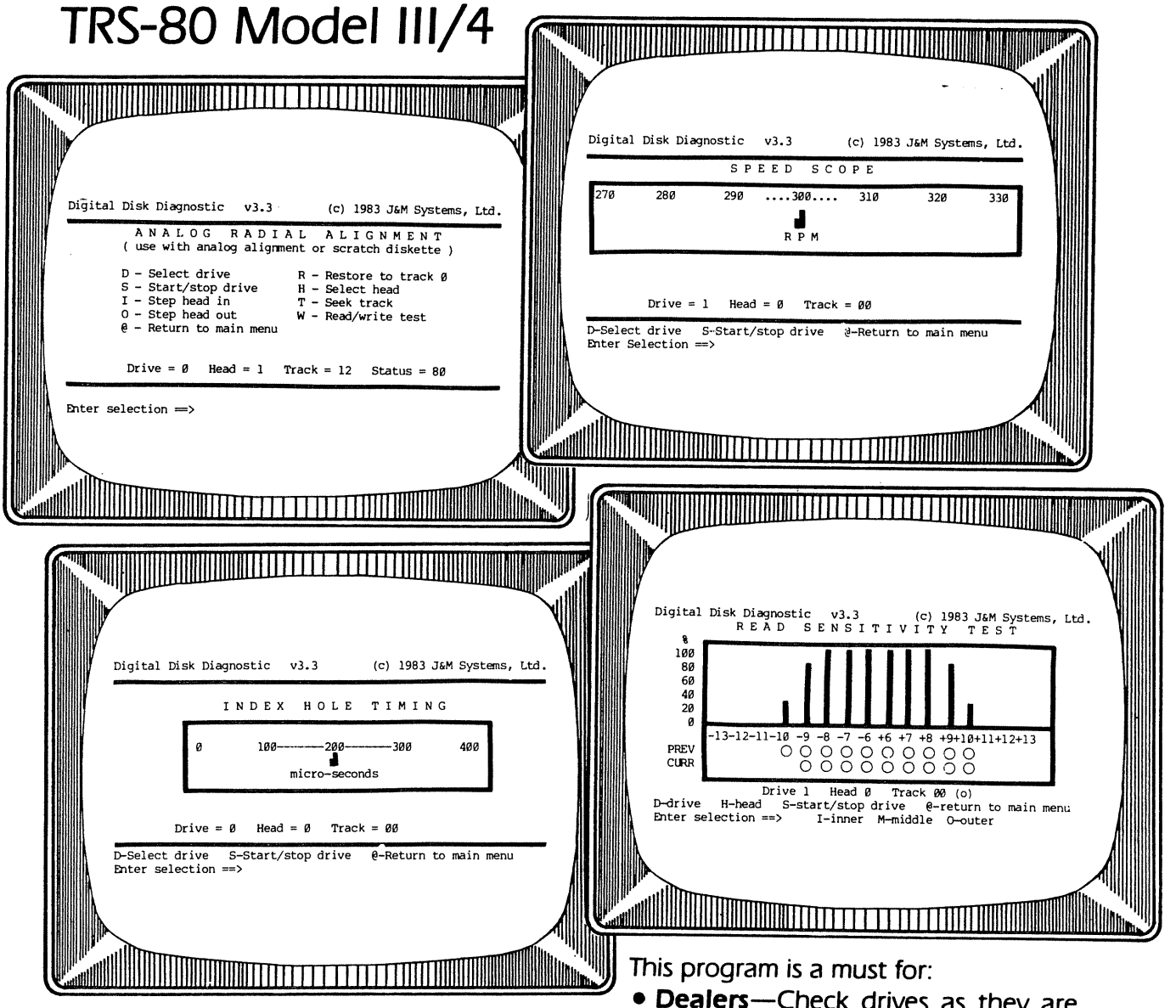
# Digital Disk Diagnostic Program

## TRS-80 Model III/4




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**
**$89—Double Sided**

J&M Systems, Ltd.
137 Utah NE, Albuquerque, NM 87108
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# DISK DRIVE ANALYSIS SYSTEM

**Version 3.3**

**For the TRS-80 Model III & 4**

## OPERATOR'S GUIDE

**October 1983**

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137 Utah N.E.
Albuquerque, NM 87108

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# Disk Drive Analysis System, Version 3.3

## Operator's Guide

## October 1983

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## CHAPTER ONE: INTRODUCTION

The Disk Drive Analysis System (DDA) from J & M Systems is the most comprehensive floppy disk drive diagnostic available for your TRS-80 Model III or Model 4 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 your floppy disk drives for head alignment, index hole timing, spindle speed, and other problems. 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 TWO: MAIN MENU

## TEST OPERATION

- The DDA System consists of three major components: The DDA Program, the Digital Diagnostic Disk (DDD), and the Operator's Manual. The DDA Program is loaded from the DDA Program disk.

To begin, insert the DDA Program Disk into Drive Ø, close the drive door, and press the reset button. The DDA Program will automatically load into memory and "come up running". As the program loads, the word "LOADING", followed by a series of dots, will appear on the screen:

LOADING.....

After the DDA Program has been loaded, it will display the Main Menu (Figure 1) and await your command. You may now remove the DDA Program Disk from Drive Ø. DDA is completely memory-resident, leaving all of your disk drives free for testing.

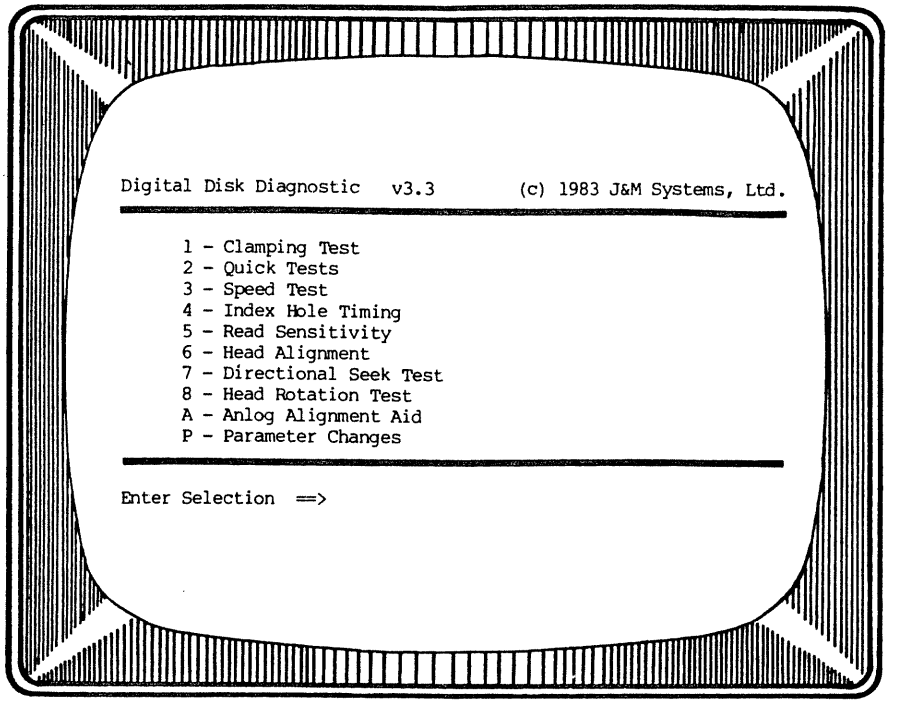


Figure 1 - Main Menu

The DDA Program consists of ten separate screens in addition to the Main Menu Screen. The screens may be activated only from the Main Menu. To activate a screen, simply press the key which corresponds to the desired screen any time the Main Menu is displayed.

## TEST SCREEN COMMANDS

Each of the DDA test screens includes a local command menu. Although there is only one set of test commands, not all commands are available for use on each screen. Only those commands required for the test are listed in the local command menu. Commands not listed in the local command menu will not operate on that screen.

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

Each of the commands used in the various test screens is described in detail here. Remember that a given test may not support all of the commands, but only those which are relevant to the test. The commands will operate in exactly the same manner on any test screen where they are used.

### D - Select test drive

The "D" Command is used to select the test drive. Pressing the "D" Key will cause the prompt:

Enter drive no. ==>

to be displayed in the lower left-hand corner of the screen. Respond to the prompt by entering a single-digit number in the range of Ø-3. The drive selected will become the default test drive for all test screens unless the "D" Command is used once again to change the test drive selection.

**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 selected to toggle between "Ø" and "1".

NOTE: The "H" Command is of use only for double-sided drives. Single side drives will only read side-Ø even though you have selected side-1.

**I - Select Inner test track**

More than one test track is provided on the DDD Disk for some of the tests. For example, there are three progressive offset tracks used in the Radial Alignment Test. In these cases, the "I" Command is used to select the Inner test track. The exact track number selected may vary from test to test, but the inner test track is always the test track nearest to the spindle.

**M - Select Middle test track**

In those tests where there are three test tracks on the DDD Disk, the "M" Key is used to select the Middle test track. The exact track number selected may vary from test to test, but the Middle test track is always near the middle of the disk, roughly half-way between the inner and outer edge.

**O - Select Outer test track**

In those cases where there is more than one test track provided on the DDD Disk, the "O" Key is used to select the Outer test track. The exact track number selected may vary from test to test, but the Outer test track is always the test track nearest to the outer edge of the disk.

**S - Start/stop test**

When a test screen is first activated, the test drive will always be turned off. The "S" Command is used to alternately start and stop the test drive. The test will automatically start when the test drive is started, and will stop when the test drive is stopped.

If the test drive is OFF, press the "S" Key to start the drive. If the test drive is ON, hold the "S" Key depressed until the light on the test drive goes off.

**@ - Return to Main Menu**

The "@" Command will terminate the current test and return to the Main Menu. If the test drive is ON, it will be turned off. When the test is in progress and the test drive is on, hold the "@" Key depressed until the Main Menu is displayed.

## THE DRIVE STATUS LINE

All test screens include some form of the Drive Status Line. The Drive Status Line is a line on the screen which indicates the current test drive, the current head selection, and the current track selection. When a test screen is first activated, check the drive status line to ensure that the current selections are as desired before starting the test.

## THE ERROR SCREENS

There are two error screens which may appear during operation of DDA. One is the "NOT DDD" Error screen (Figure 2), and the other is the "DRIVE NOT READY" Error screen (Figure 3).

The NOT DDD Error screen (see Figure 2) will appear whenever you attempt to start a test and the disk in the test drive is not a DDD Disk. As stated on the screen, you have two options: Press the "@" Key to return to the main menu, or press any other key to continue the test without the DDD Disk. Note that the test results will be meaningless if the DDD Disk is not used.

The DRIVE NOT READY Screen (see Figure 3) will appear when the test drive is not ready, such as when the drive door is open, or there is no disk in the drive. Correct the problem, and press any key to return to the test menu.

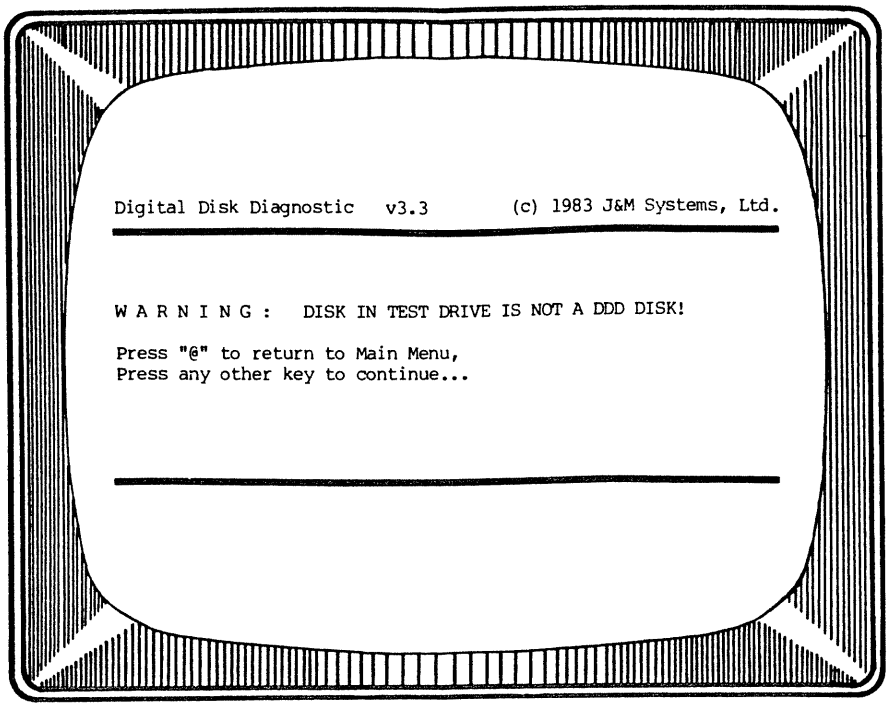


**Figure 2 - The "NOT DDD" Error Screen**

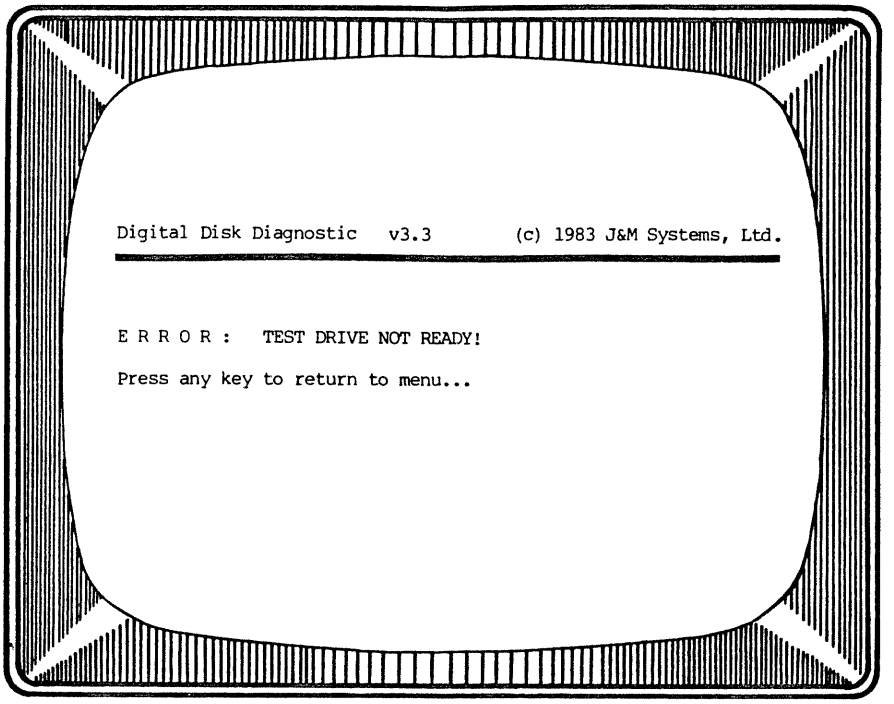


**Figure 3 - The "DRIVE NOT READY" Error Screen**

## CHAPTER THREE: THE CLAMPING TEST
(Eccenticity)

### PURPOSE

This test provides a qualitative measure of the diskette clamping. This is normally a function of the condition of the diskette hub. A badly worn diskette hub may lead to improper clamping, and the diskette will rotate eccentrically about the spindle. The main purpose of this test is to ensure that the DDD Disk is clamped properly prior to running any of the other tests, since improper clamping can lead to misleading test results. If the drives are too far out of alignment the results of the clamping test may be meaningless. If proper clamping cannot be achieved then proceed directly to test #5, the Read Sensitivity test, and perform an initial alignment.

### COMMAND SUMMARY

D - Select Test Drive
H - Select head
I - Select Inner test track
M - Select Middle test track
O - Select Outer test track
S - Start/stop test
@ - Return to Main Menu

### TEST OPERATION

The Clamping Test is activated from the Main Menu as Test #1. The screen consists of a bar in the center of the screen, a drive status line, and a command menu.

Insert the DDD Disk into the Test Drive and press the "S" Key to start the test. The display should show a group of 16 square blocks attached to the center bar. There should be 8 blocks on top of the bar, and 8 blocks on the bottom of the bar (Figure 4).

The "I", "M", and "O" keys are used to select one of three different test tracks on the DDD Disk. Each of the three tracks provides a different sensitivity to eccentricity. The Outer Track (O) is the least sensitive, while the Inner Track is the most sensitive.

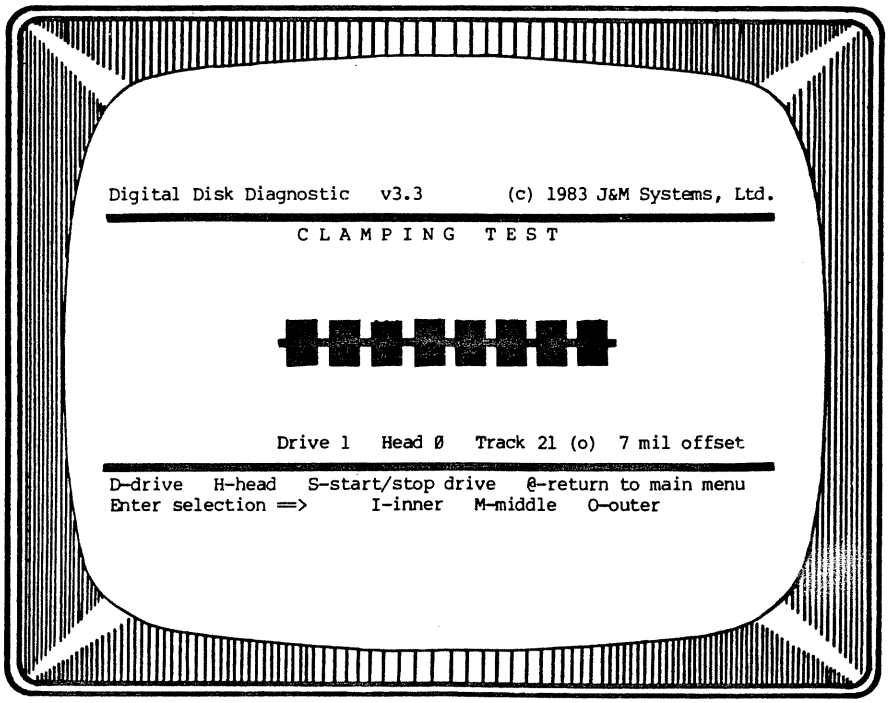


Figure 4 - Proper Clamping

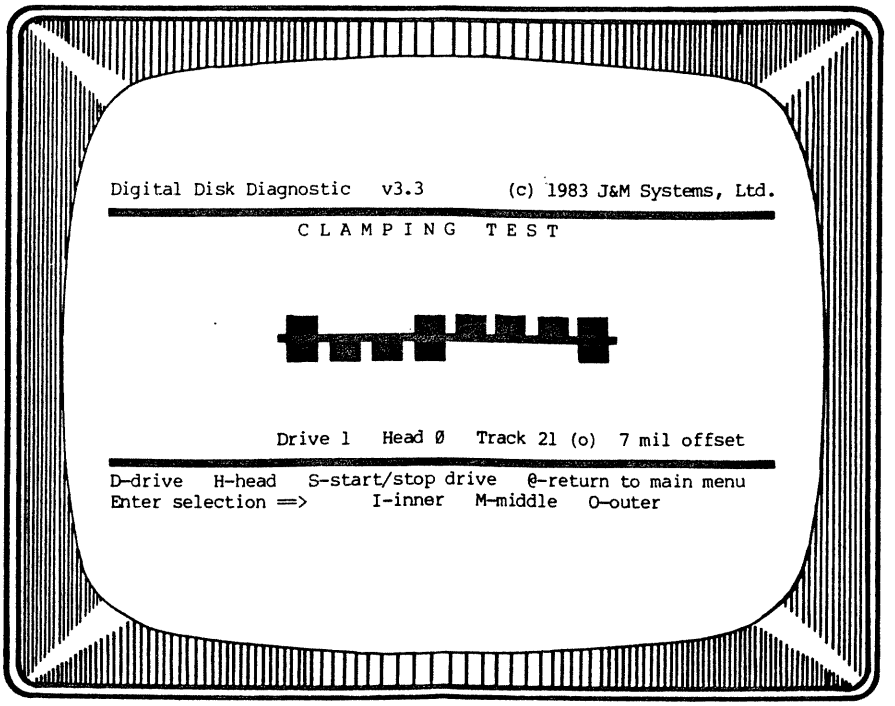


Figure 5 - Improper Clamping, Reclamp.

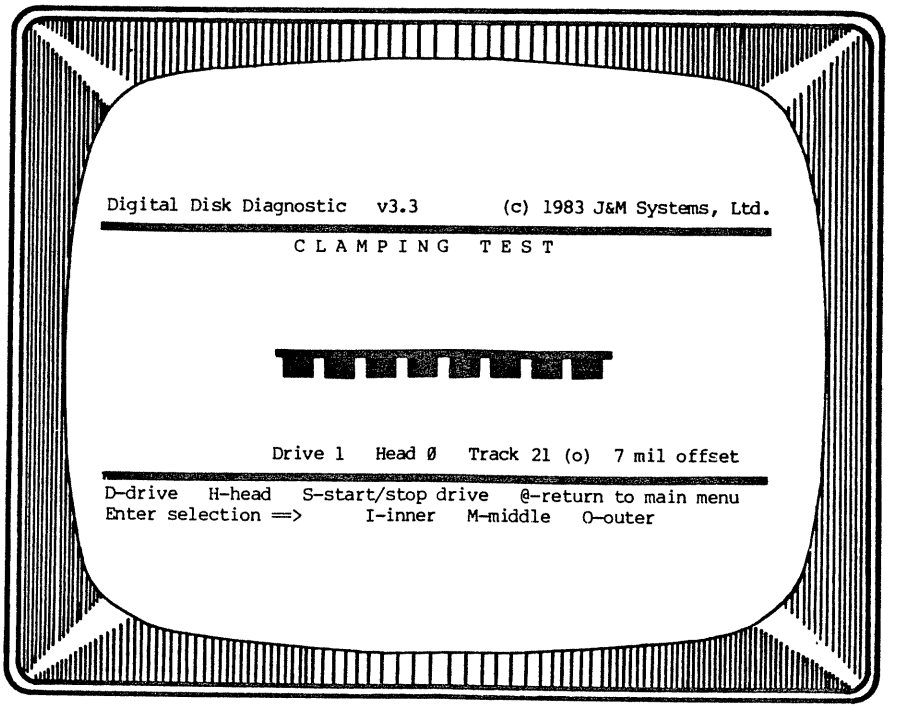


Figure 6 - Radial Alignment Error

**TEST INDICATIONS**

Three typical test screens are shown here. Figure 4 shows what a screen looks like if the diskette is clamped properly. Also note the sensitivity, figure 4 is at 7 mils offset which is the least sensitive. Try progressivly more sensitive tracks until the 9-mil offset track displays this pattern. Note that some drives will never be able to read plus and minus 9 mills and you will have to settle for a less sensitive track.

Figure 5 shows what clamping error due to eccentricity looks like. The display indicates that it reads the inner sectors better on half its revolution and reads the outter tracks better during the other half of the revolution.

Figure 6 shows what the display would look like if the heads were out of alignment. You may have to do a preliminary drive alignment before you will be able to get satisfactory clamping results.

## HOW THE TEST WORKS

The Eccentricity Test is based on 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 the track center-line. The odd-numbered sectors are displaced slightly toward the center of the disk, while the even-numbered sectors are displaced slightly away from the center of the disk. So, alternate sectors are displaced in alternate directions from the track center-line.

On the Outer test track, 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 it. If a drive 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 turns, the track center-line will drift away from the head toward the spindle, then back toward the head, crossing under, then drifting back away form the head and away from the spindle. Thus, some of the sectors will come closer to the head than the distance that they are displaced form the center-line, while others will end up further from the head than the distance that they are displaced from the track center-line.

The Clamping test displays a block above the center bar for each odd-numbered sector that it can read. A block is displayed below the bar for each even-numbered sector that it reads. 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.

So, if the head is properly aligned and the DDD Disk is perfectly clamped, there will be no missing blocks and the screen will look like 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 the display more likely indicates an alignment problem.

**ADJUSTMENTS**

In general there are no adjustments for eccentricity. As stated above the usual cause of this problem is a worn center hole. If the diskette is not the problem, then you may have a bent spindle or very worn bearings. In either case you will have to return the drive to the manufacture or a competent technician.

# CHAPTER FOUR: THE QUICK TEST

## PURPOSE

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

- Spindle speed
- Index hole timing
- Radial alignment
- Azimuth (Head Rotation)
- Hysteresis (Directional Seek)

## COMMAND SUMMARY

D - Select Test Drive
S - Start/Stop Test
@ - Return to Main Menu

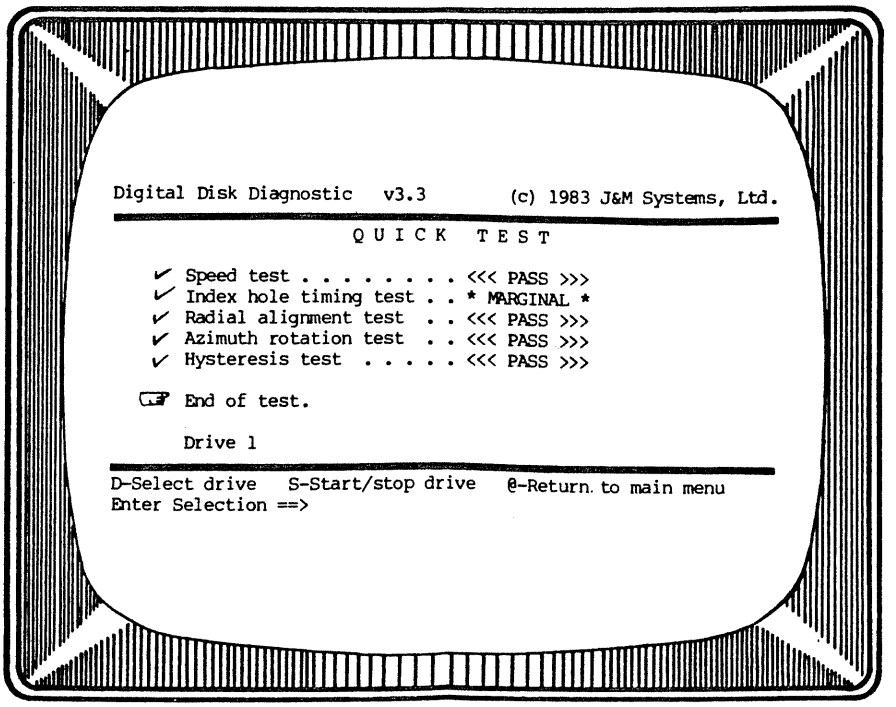


Figure 7 - Quick Test

## TEST OPERATION

The Quick Test is activated from the Main Menu as test #2. When activated, the Test Drive number will be displayed on the screen. If you wish to change the Test Drive, use the "D" Command. Remember to insert the DDD Disk into the Test Drive prior to starting the test.

Use the "S" Key to start the test. Once the test is started, it cannot be stopped from the keyboard. When all testing is complete, the Test Drive will stop, and the pointer will be at "End of test". To re-run the test, use the "S" Key to start the test again.

Use the "@" Key to return to the Main Menu. The "@" Key will have no affect while the test is in progress. The "@" Key may be used to return to the Main Menu only before the test has been started, or after all testing has been completed.

## TEST INDICATIONS

The Quick Test will test each of the five parameters in turn, starting at the top of the list, and working down the list. While a parameter is under test, a "pointing hand" symbol will appear to the left of the parameter name on the screen. When testing of the parameter is complete, a check-mark will replace the "pointing hand", and the "pointing hand" will move down to the next parameter in 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 test | Related DDA Test(s) |
|---|---|
| Spindle speed | Spindle speed test (3) |
| Index hole timing | Index hole timing test (4) |
| Radial Alignment | Read Sensitivity (5)<br>Head Alignment (6) |
| Azimuth rotation | Head Rotation (8) |
| Hysteresis | Directional Seek (7) |

## CHAPTER FIVE: 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
S - Start/stop test
@ - Return to Main Menu

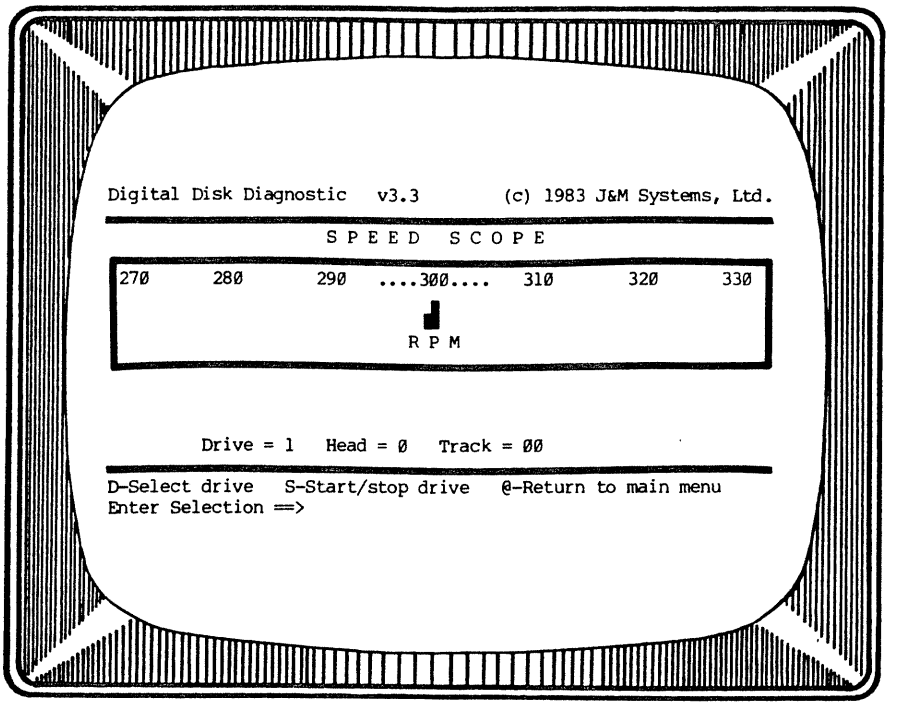


Figure 8 - Speed Display

**TEST OPERATION**

The Spindle Speed Test is activated from the Main Menu as Test #3. The test screen consists of a speed "meter", a drive status line, and a command menu.

The speed "meter" in the center of the screen is calibrated in Revolutions Per Minute (RPM). The scale spans from 270 RPM on the extreme left to 330 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 any disk into the test drive. This test does not require the use of the DDD Disk. Press the "S" Key to start the test. 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 adjustment may be made while watching the meter display.

**TEST INDICATIONS**

The spindle speed of a 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.

**ADJUSTMENT**

The speed is adjusted by means of a variable resistor on the servo board. Look for a board that connects to the drive motor to identify the servo board. Some of the newer drives do not have a speed adjustment as the motor speed is under microprocessor control.

If the speed cannot be adjusted, then the servo board must be replaced or the drive must be returned to the manufacture or a service depot for repair.

# CHAPTER SIX: 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 micro-seconds plus or minus 50% (100-300 us).

## COMMAND SUMMARY

D - Select Drive
S - Start/Stop test
@ - Return to Main Menu

## TEST OPERATION

The Index Hole Timing Test is activated from the Main Menu as Test #4. The test screen consists of a timing "meter", a drive status line, and a command menu.

The timing "meter" in the center of the screen is calibrated in micro-seconds (us). The scale spans from 0 us on the extreme left to 400 us on the extreme right. The resolution of the meter is 10 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 photo-detector may be adjusted while watching the meter display.

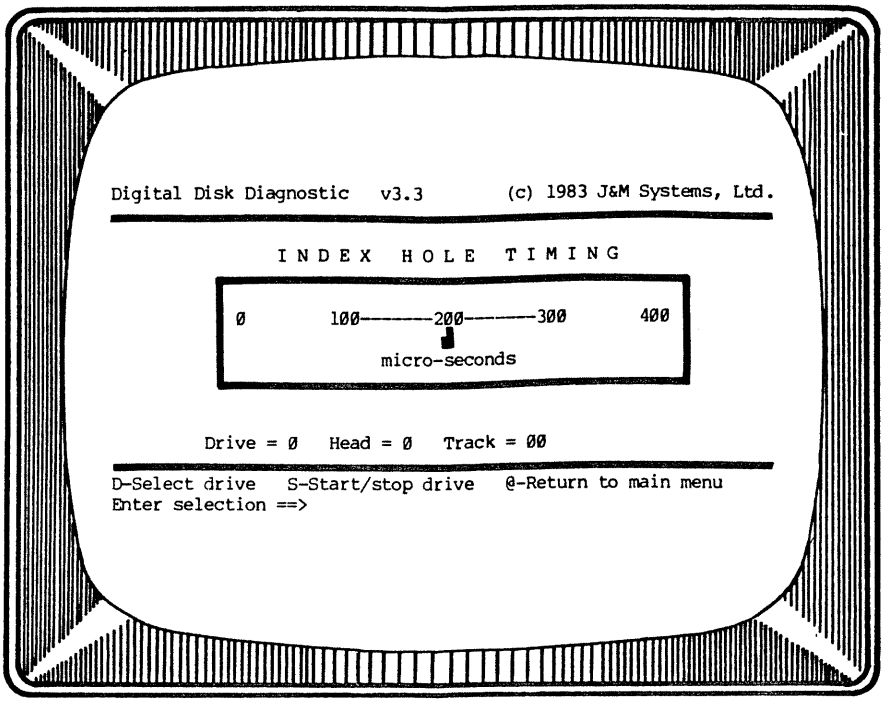


Figure 9 - Index Hole Timing Display

**TEST INDICATIONS**

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

**ADJUSTMENT**

Look for a the photodetector assembly that detects the presence of index holes. It will be aligned with the index hole window when the diskette is fully inserted in the drive. The photodetector assembly will be held in place with a screw which may be loosened. Move the assembly while watching the display until the proper timing is achived, then tighten the screw. The final tightening may change the results and this adjustment may have to be repeated.

## CHAPTER SEVEN: THE READ SENSITIVITY TEST

### PURPOSE

Read Sensitivity refers to the ability of the drive to read the low level signals on the DDD diskette. This is done by reading the progressive offset sectors on a selected track. As the sectors are offset further from centerline the head must be more sensitive if it is to read the sector.

### COMMAND SUMMARY

D - Select test drive
H - Select head
I - Select Inner test track
M - Select Middle test track
O - Select Outer test track
S - Start/stop test
@ - Return to Main Menu

### TEST OPERATION

The Radial Alignment Test is activated from the Main Menu as Test #5. The screen consists of a bordered area in the center, a drive status line, and a command menu. The bordered area forms two boxes with a scale separating them. The scale is calibrated in mils (milli-inches) from -13 mils on the extreme left to +13 mils on the extreme right.

Insert the DDD Disk into the test drive and press the "S" Key to start the test. After a few seconds, a row of "happy faces" and/or dots should appear in the lower box. A short time later, a second row of "happy faces" and/or dots will appear in the lower box. Immediately after the upper row of "happy faces" appears, a histogram (bar chart) will appear in the upper box. 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 "@" Command.

Use the "I", "M", and "O" Commands to position the head over the Inner, Middle, and Outer test tracks, respectively. The test track may be selected before starting the test, or while the test is in progress.

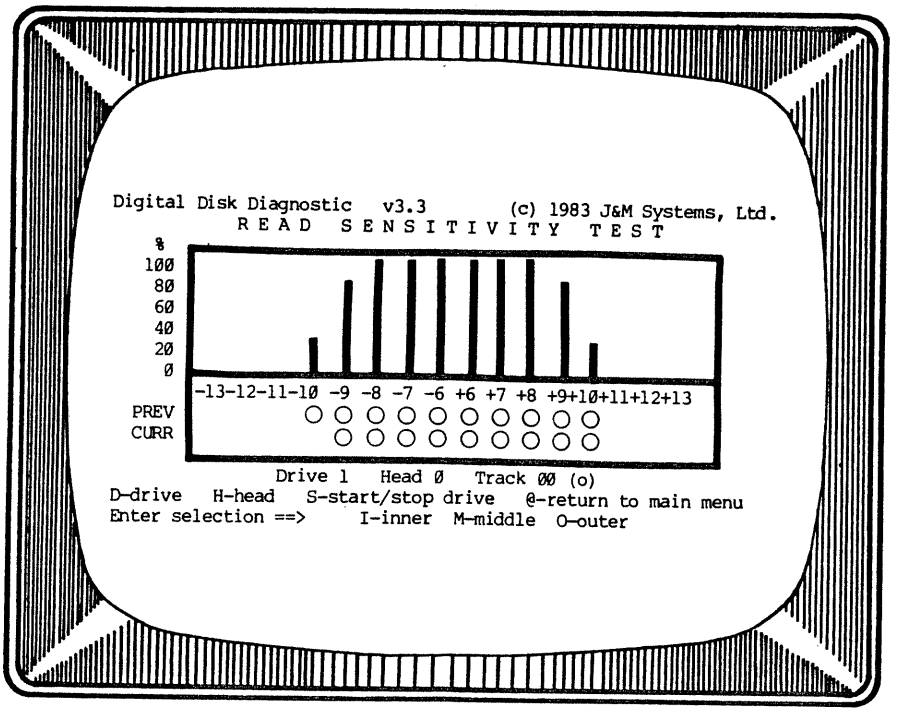


Figure 10 - Normal Sensitivity, Proper Alignment

**NORMAL DISPLAY**

Figure 10 shows a perfectly aligned drive with normal read sensitivity sholders. Each vertical bar depects how many times out of 5 tries the offset sector was read. The 100% bars indicate that every time an attempt was made to read these sectors they were read without error. the 20% bar indicates that out of 5 attempts the sector was read only once. On the fringes this is normal.

Most newly designed drives will show a display with 100% bars from -13 mils to +13 mils. As the drive ages and is worn the upper and lower limits will be reduced. Other factors that will effect the width of the display is a weak read amplifier, dirty heads, or a word DDD diskette.

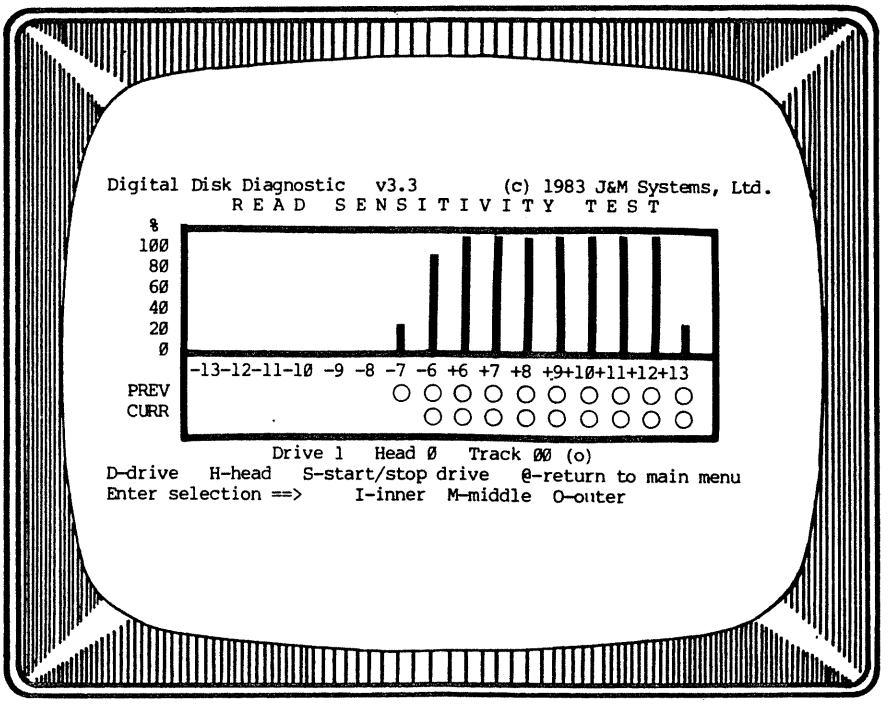


Figure 11 - Head Out of Alignment

**ALIGNMENT ERROR**

Figure 11 shows a drive with normal read sensitivity, but the heads are out of alignment. This screen can be used for making the actual adjustment, but Test #6 is easier to use.

**ADJUSTMENT**

Refer to the drive manufactures technical reference manual for the alignment adjustments. If you do not have a manual but are good mechanically and have lots of guts, try the following. The head is positioned by means of a stepper motor that drives either a split-band positioner or a lead-screw positioner. A lead-screw positioner is usually adjusted by loosening the screws that secure the stepping motor and then rotating the stepper motor until the head is aligned. A split-band positioner is usually adjusted by loosening two or three screws that secure the stepper motor and head platform. The platform is adjusted with a screw or a cam. After retightening the screws check the alignment to make sure it is still OK.

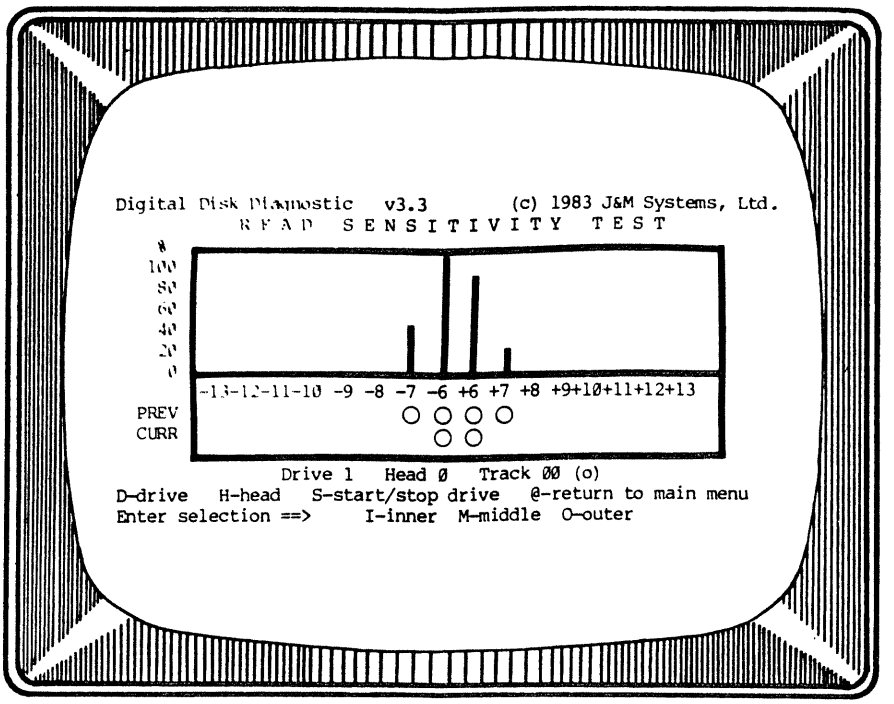


Figure 12 - Poor Read Sensitivity

**POOR READ SENSITIVITY**

Figure 12 depicts a drive that is in perfect alignment but has poor read sensitivity. This drive will exhibit characteristics such as drifting in and out of alignment with time and temperature changes, CRC errors, cannot read disks produced on other machines, sometimes can read a diskette but other times cannot read the same diskette.

**WHAT TO DO**

Read sensitivity can be caused by one or more of the following problems: dirty heads; head loading out of adjustment; RFI interference at the heads from other sources; weak read amplifiers; or damaged heads. At minimum you should clean the heads using a commercial head cleaning kit available at most computer stores. If this does not clear the problem, then the drive should be returned to the manufacture or a qualified service shop for further repairs or adjustments.

**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 such that each sector is displaced progressively further away from the track center-line. The odd-numbered sectors are displaced toward the spindle, while the even-numbered sectors are displaced 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. 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 then attempt to read all sectors on the track. For each sector that is read properly (no CRC Error), a "happy face" will be displayed in the "CURR" (current) row of the lower box, under the point on the scale corresponding to the offset of the sector. The test will continue until it has attempted to read each of the sectors a total of five times. At this point, the latest results are displayed on the row marked "PREV" (previous) in the lower box, and the histogram is built. This procedure repeats indefinitely until the test is stopped.

Three tracks are provided on the DDD Disk for this test. The "Inner" track is on the inner surface of the disk, nearest the spindle. The "Middle" track is near the middle of the disk, roughly half-way between the inner and outer edge. The "Outer" track 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 EIGHT: THE HEAD ALIGNMENT TEST

## PURPOSE

This test is designed to assist in head alignment. This test is similar to the Read Sensitivity Test, but only the center of the total good sectors is displayed, making this test easier to use when aligning a drive.

## COMMAND SUMMARY

D - Select test drive
H - select head
I - Select inner test track
M - Select middle test track
O - Select outer test track
S - Start/stop test
@ - Return to Main Menu

## TEST OPERATION

The Head Alignment Screen is activated from the Main Menu by as test #6. The screen consists of an alignment "meter", a drive status line, and a command menu.

The alignment "meter" 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.

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 "I", "M", and "O" Keys to select the Inner, Middle, or Outer test track.

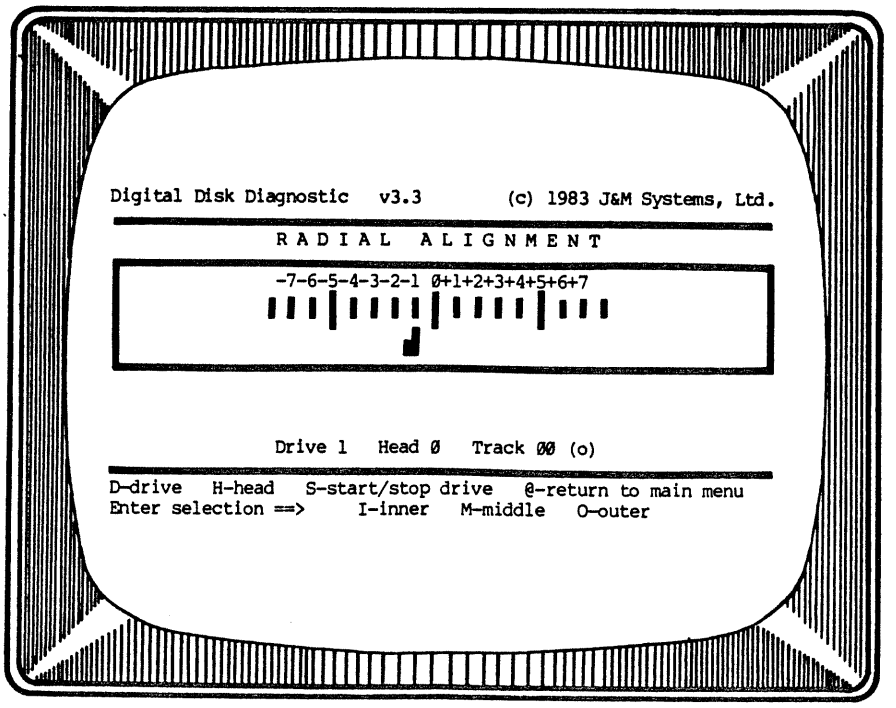


Figure 13 - Radial Alignment Meter

**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 the last chapter for a discussion on head alignment.

## CHAPTER NINE: DIRECTIONAL SEEK TEST
(Hysteresis)

### 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 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
S - Start/stop test
@ - Return to Main Menu

### TEST OPERATION

The test is activated from the Main Menu as test #6. The screen consists of a scale in the center of the screen, a drive status line, and a command menu.

Insert the DDD Disk in the test drive and press the "S" Key to start the test. The display will show two rows of "happy faces". One row is labeled "IN", the other row is labeled "OUT". The scale indicates displacement from track center-line in mils.

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 8). The test then attempts to read every sector on the track. When a sector is read properly, a "happy face" is displayed in the row labeled "IN" in a position corresponding to the displacement of the 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 in the row labeled "OUT". The entire sequence continues until the test is stopped with the "S" or "@" Command.

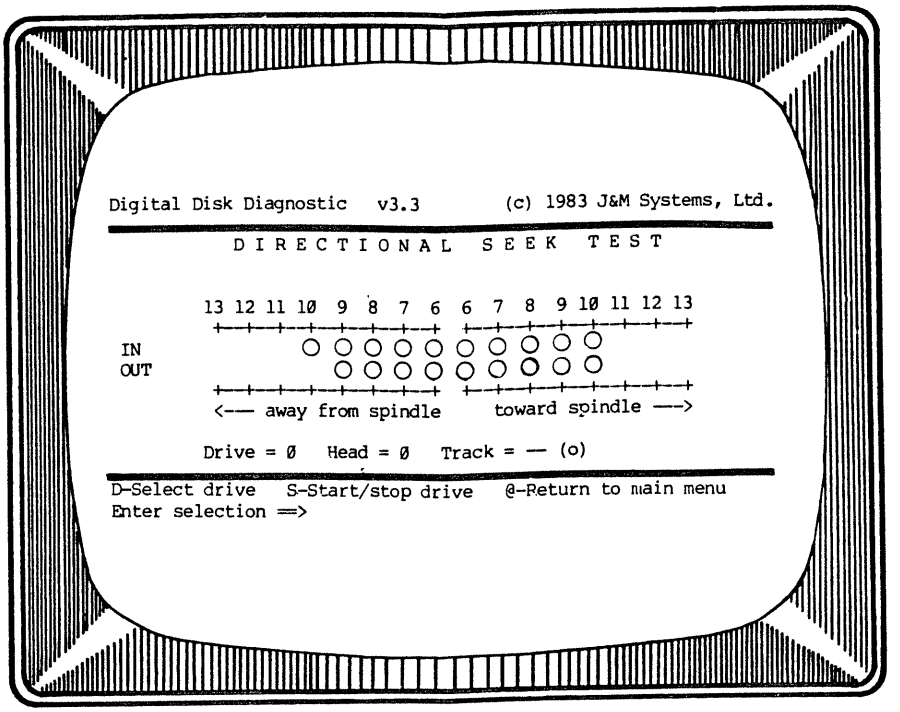


Figure 14 - Directional Seek Display

**TEST INDICATIONS**

This test measures the radial alignment of the head to the DDD Disk. The alignment is checked 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 "happy faces" in the "IN" row consistently skewed to the left of those in the "OUT" row.

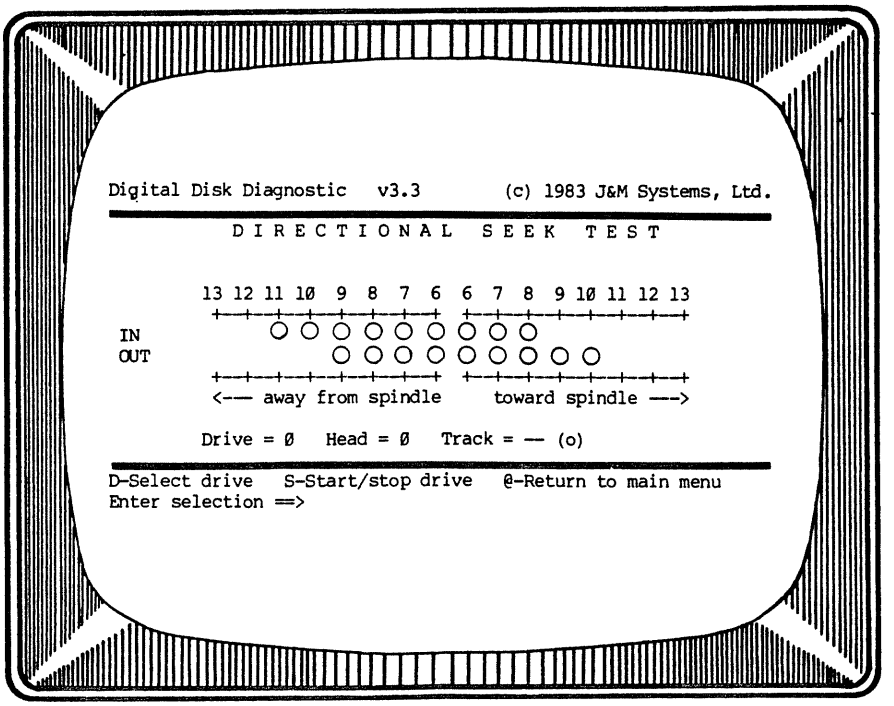


Figure 15 - Directional Seek Error

It is important to realize that the exact position of the "happy faces" with respect to the scale is relatively unimportant in this test. The important consideration is the placement of the "happy faces" in the two rows with respect to each other. A drive with acceptable hysteresis will show the two rows vertically aligned most of the time. Figure 14 shows a drive with an acceptable pattern. Figure 15 shows that the drive consistintly reads a different group of sectors depending on which direction the heads traveled to the destination track. A drive with unacceptable hysteresis will show the two rows consistently misaligned.

**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 8 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.

Thus, the test seeks to point out any 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.

## HEAD ROTATION TEST
(Azimuth)

### 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.

### COMMAND SUMMARY

D - Select test drive
H - Select head
S - Start/stop test
@ - Return to Main Menu

### TEST OPERATION

The Azimuth Rotation Screen is activated from the Main Menu as command #8. The screen consists of a bordered area in the center, a drive status line, and a command menu. The bordered area forms two boxes with a scale separating them. The scale is calibrated in minutes (1/60 degree). The scale spans 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 row of "happy faces" and/or dots should appear in the lower box. A short time later, a second row of "happy faces" and/or dots will appear in the lower box. Immedeately thereafter, a histogram will appear in the upper box. The test will continue indefinitely, updating the histogram every few seconds, until it is stopped with the "S" Command, or terminated with the "@" Command.

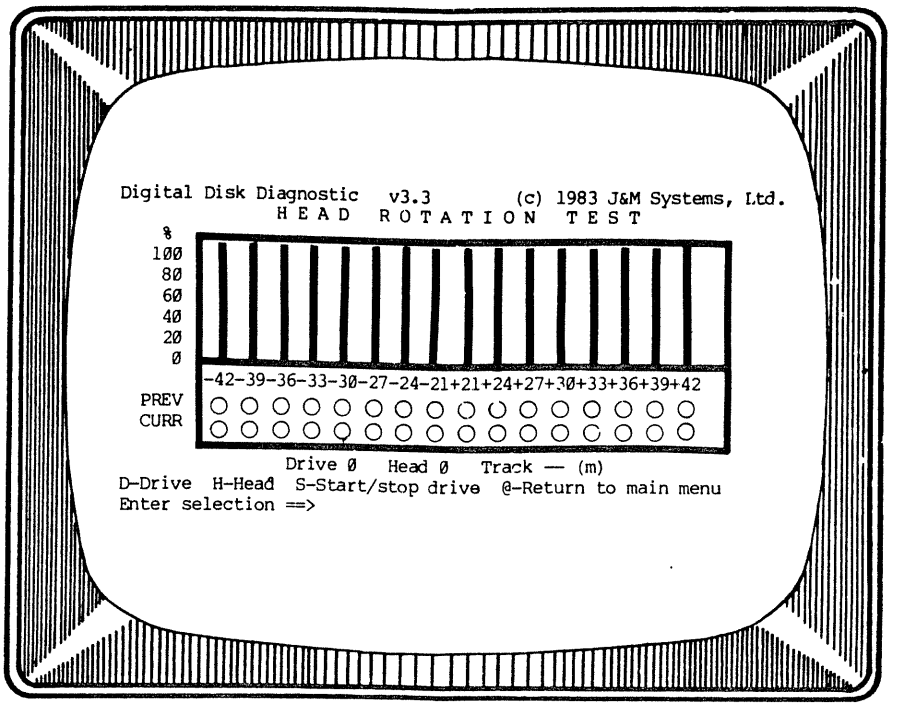


Figure 16 - Head Rotation Display - Good

**TEST INDICATIONS**

A head which is oriented properly with respect to the Azimuth Rotation test track will result in a histogram which is symmetrical and well centered. If the head is twisted such that the leading edge of the head 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 box. If the head is twisted such that the leading edge of the head 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 Radial Alignment 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.

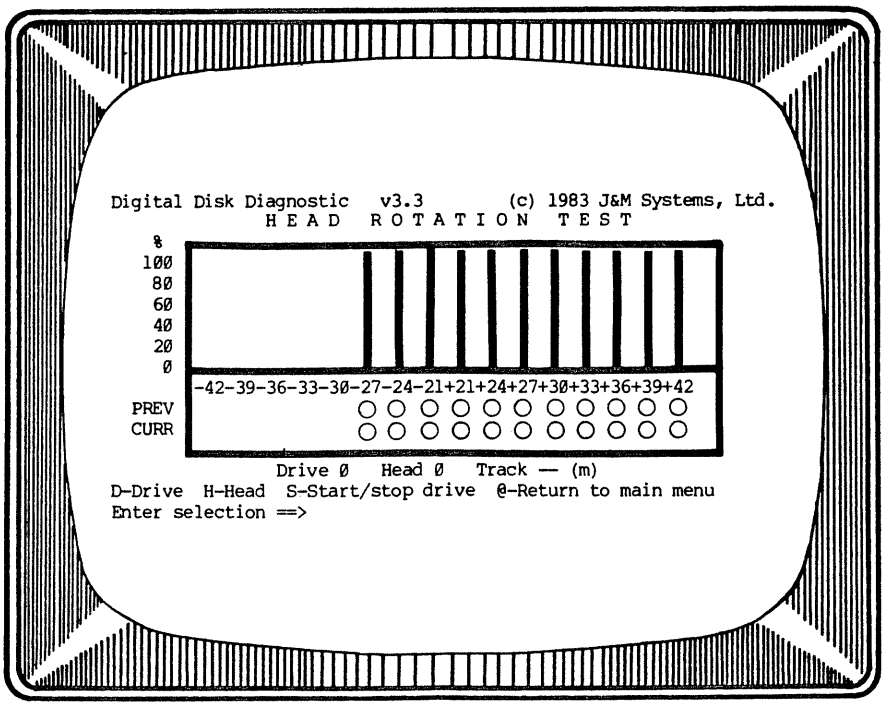


Figure 17 - Head Rotation, Bad.

The following chart summarizes the angular displacement of each sector on the Azimuth 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 |

As with the Radial Alignment Test, the basis of the Azimuth 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.

# CHAPTER ELEVEN: 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. This will be useful when you wish to repair a disk drive in the more traditional manner, using an oscilloscope and an Analog Alignment Disk.

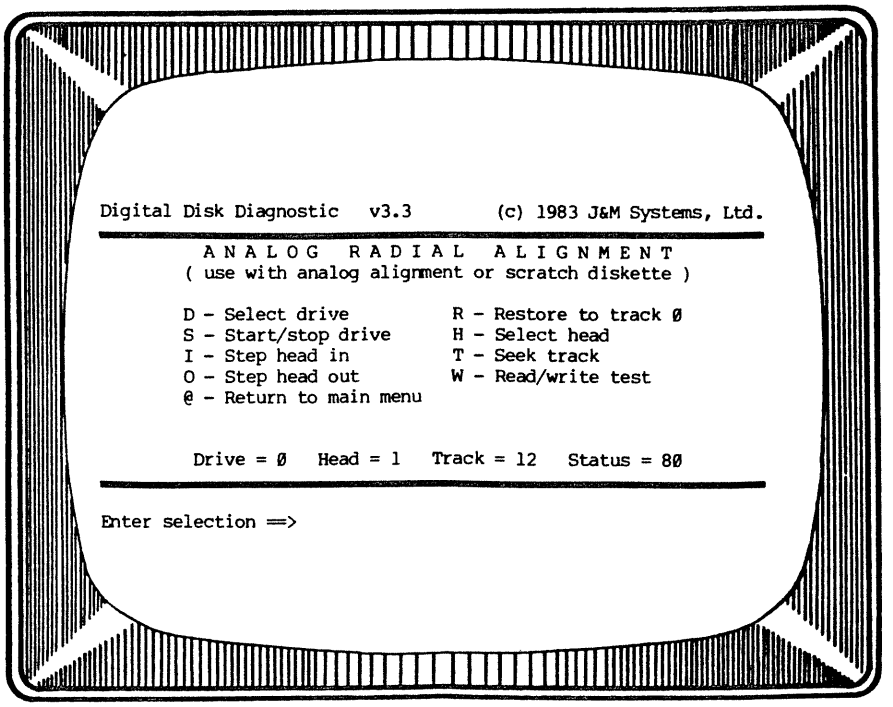


Figure 18 - Analog Alignment Menu

## TEST OPERATION

The Analog Alignment Aid is activated from the Main Menu as test "A". The screen consists of a command menu and a "Drive Status Line" near the bottom of the screen.

The Drive Status Line indicates the current test drive (0-3), the currently selected head (0-1), the current track (00-39), and the current Floppy Disk Controller (FDC) Status Code.

**D - Select Test Drive**

Use the "D" Command to select a drive for test. Pressing the "D" Key will cause the prompt

Enter drive no. ==>

to appear in the lower, left-hand corner of the screen. Respond by entering a 1-digit number (Ø-3).

**H - Select head**

The "H" Command will toggle to the other head of the test disk drive.

**I - Step head IN**

The "I" Command will step the head of the Test Drive one (1) track IN toward the spindle.

**O - Step head OUT**

The "O" Command will step the head of the Test Drive one (1) track OUT away from the spindle.

**R - Restore (home) head to Track Ø**

The "R" Command will move the head of the Test Drive to the Track Ø (home) position. The head will be stepped out toward track Ø until the Track Ø Switch is activated.

**S - Start/Stop Test Drive Motor**

The "S" Command is used to alternately start and stop the 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 no. ==>

to appear in the lower, left-hand corner of the screen. Respond by entering a two-digit track number (ØØ-39).

**W - Write/Read Test**

The "W" Command initiates a write/read test on the disk in the Test Drive. Be sure to insert a formatted scratch disk in the Test Drive before starting this test!

The Write/Read Test will write random data on all sectors of the currently selected track, then read the sector back, comparing what was read to what was written. The test track may be changed at any time during the test using the R, I, O, or T Commands.

When the "W" Key is pressed, a display will appear, consisting of 16 numbers across the screen. At the bottom of the screen, the message

Place scratch diskette in drive...
Press <ENTER> to begin test, @ to cancel test

will appear at the bottom of the screen. To cancel the Write/Read Test, simply press the "@" Key. Otherwise, be sure that a formatted scratch disk is in the test drive, then press the ENTER Key, and the test will begin.

As each sector is tested, a "happy face" symbol will appear under the sector number on the screen if the test passed. A dot (.) will appear under the sector number if the test fails. The test will continue indefinitely until either the "S" Key or the "@" Key is pressed.

**Test Indications**

A disk drive which is in good condition should show no more than about 2 or 3 sector failures per pass, and the failures should shift from one sector to another more or less randomly. A problem may be indicated if one or more sectors show repeated failures pass after pass. However, note that the results of this test are affected by the condition of the diskette as much as by the drive itself. If repeated failures occur, try another diskette before making any judgement.

## THE FLOPPY DISK CONTROLLER (FDC) STATUS CODE DISPLAY

The FDC Status Code displayed on the Analog Alignment Aid Screen (and other DDA Screens) is a bit-mapped code supplied by the FDC at the completion of each FDC Command. The display is updated after the completion of each command and to indicate the completion status of the command.

The interpretation of the Status Code changes depending on the command which was just executed. Upon the completion of all commands except read and write commands (eg, after R, I, O, or T) the code has the following interpretation:

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

After the completion of any read or write command, such as during the Write/Read Test, the bits within the FDC Status Code have the following interpretation:

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

## CHAPTER TWELVE: CHANGING THE PROGRAM PARAMETERS

### PURPOSE

Changing the program parameters 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 Parameter Change Screen is provided for this purpose.

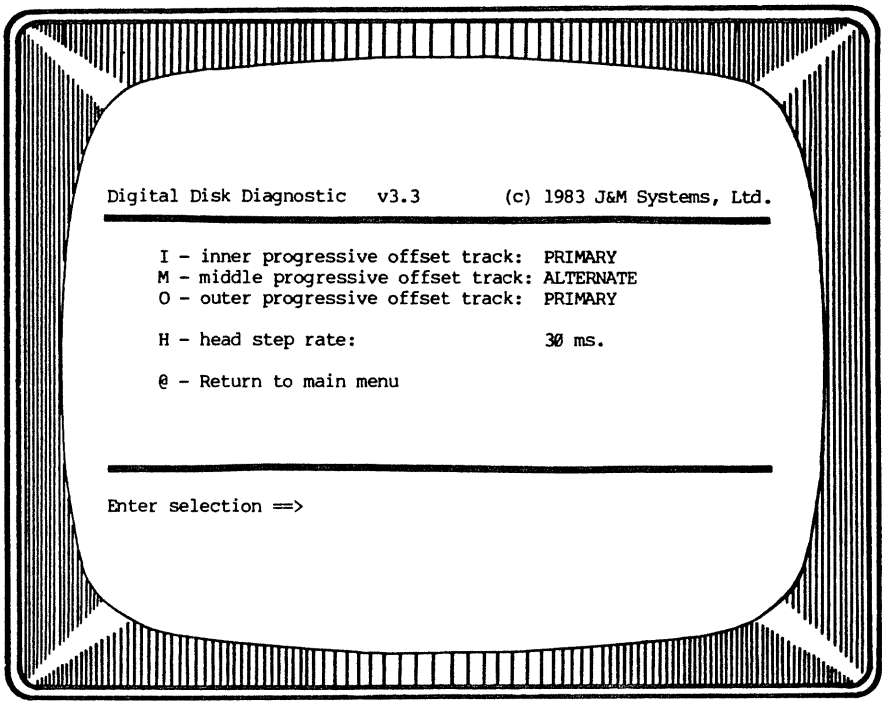


Figure 19 - Parameter Change Screen

### OPERATION

The Change Parameter Screen is activated from the Main Menu by the "P" Command.

There are two sets of progressive offset tracks on the DDD Disk (the function of these tracks is explained in Chapter 8 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.

To select between the primary and alternate sets, use the "I", "M", and "O" Keys. Each time one of these keys is pressed, the associated 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.

The head step rate selection is provided for convenience. Since virtually any floppy disk drive can operate properly with a head step rate of 30 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 "H" Key. Each time you press the "H" Key, one of four step rates will be displayed (6, 12, 20, and 30 ms.). Press the "H" Key as many times as necessary until the desired step rate is displayed. The step rate is then selected, and will remain in effect until you change it again. Note, however, that each time you run DDA, it will always default to a step rate of 30 ms.

After selecting the desired primary and alternate progressive offset tracks, and/or head step rate, return to the Main Menu by pressing the "@" Key.