CONTROL DATA CORPORATION

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APPLICATION NOTE

DIAGNOSTICS FOR MODEL 9410 FINCH™ DISK DRIVE

MAGNETIC PERIPHERALS INC.
a subsidiary of CONTROL DATA CORPORATION

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Diagnostics for Model 9410
FINCH Disk Drive

1.0 INTRODUCTION

In today's cost-conscious world, one of the most cost-effective tools possible for a computer system is a diagnostic program.

In just a few minutes of system run time, a diagnostic program would transfer the bulk of technical fault isolation from a highly skilled technician to the system operator. By developing a good diagnostic strategy, the operator will be able to determine whether the malfunction is with the FINCH Disk Drive or another part of the system. The error and status reports of the diagnostics permit the skilled technician to make an analysis of the problem without having to carry out "hands on" testing. This, then, would reduce down time and maintenance costs.

Due to FINCH configuration and application, a diagnostic program will be the user's prime method of problem isolation. With the FINCH, there are no indicator lamps to observe and no media to change. Due to its compact size, the operator may not even know where the FINCH is physically located within the system.

2.0 PLANNING THE DIAGNOSTIC STRATEGY

The diagnostic program should be strategically sectionalized, with each section designed to exercise a specific function of the drive. In this way fault detection, analysis, and correction will be greatly facilitated.

The FINCH disk drive performs three basic functions: write information; read information; and position the read/write heads. Each of these three basic functions will need to be thoroughly exercised on any drive tested to determine its performance ability.

If a fault is detected, the program should, in effect, diagnose the malfunction, thus shortening the actual repair cycle.

The diagnostic program designer must tailor specific functions, or subroutines, to the host-system parameters. The subroutines will be used either singly or in conjunction with other subroutines to perform a specific test operation. Sample subroutines are included in this document and are recommended as a guide in developing effective diagnostics.

A good diagnostic program will make use of additional features that may be available in the host system. One example would be the use of an accurate real-time clock to time seek operation to determine if the disk drive is meeting seek-time specification.

3.0 SUBROUTINES

The following are subroutines that are required for problem isolation.

1. Media Verification

Write and read shifting data patterns to detect marginal recording areas. These marginal areas are flagged and their addresses stored in memory. At completion of verification, defect addresses are written on a specified track or tracks on the disk. This is known as the "bad spot map."

2. Read and Store Bad Spot Map

Defect location addresses are read and stored in the operating program for reallocation use. This may not be required if the defect flag written on the disk also contains the alternate address.

3. Format

Write headers for each sector on each track utilized. A header contains cylinder, head, and sector information. Data fields should be zero filled.

4. Format Verify

Read headers confirm proper information and valid write of all headers.

5. Read Header-Seek Verify

Read first address found after a seek to verify that cylinder and head address compares with the seek address command.

6. Reallocation on Recognition Of Defect Flag

When a defect flag code is found in a header, the alternate address will be sought and the read/write operation will take place at the alternate location.

7. X to N Seeks

Seek from all cylinder addresses to all cylinder addresses as 0 to 1, 1 to 0, 0 to 2, etc.

8. Random Seek to Random Address

Random addresses are generated and utilized as seek addresses.

9. Incremental and Decremental Seeks

A continuous one-track seek from minimum to maximum and back to minimum cylinder addresses.

10. Rewrites

After performing a write, the information should be read to verify that it was written correctly. This can be accomplished with a bit-by-bit, a byte-by-byte, or CRC compare.

If an error is detected, the data should be rewritten and a read compare done for verification. A successful write should be accomplished in less than four writes (original plus three rewrites). A bad spot should be declared if the data cannot be successfully written at that address.

11. Rereads

If an error is detected during a read operation, a reread should be attempted. If after 10 rereads the errors are still present, an RTZ and seek to the desired address should be executed. Up to 10 additional reads are attempted after the unit is back at the desired address. If the error is still present, a bad spot should be declared.

NOTE

All seek operations should be followed by a read header for address compare to detect any positioning error.

12. Write Selected Data Pattern

Data fields are written with a predetermined or operator entered data pattern.

Recommended data pattern is DB6B(hexadecimal) 1101 1011 0110 1101

13. Read Selected Data Pattern

Data fields written in Item 10 are read for verification.

Recommended data pattern is DB6B(hexadecimal) 1101 1011 0110 1101

14. Write Selected Complemented Patterns on Alternate Tracks

A predetermined or operator-selected pattern is written on a track; its complement is written on the adjacent track in a continuous mode.

Recommended data pattern is DB6B (hexadecimal) 1101 1011 0110 1101

15. Read Selected Patterns on Alternate Tracks

Read the data generated in Item 12 for data accuracy.

16. Write Random Data

Random data is generated and written.

17. Read Random Data

Data generated in Item 14 is read to verify accuracy.

18. Status Checks

Whenever a connect or seek is executed on the drive, a Ready status should be expected. Write Fault status should be monitored as this is the only other status line available for drive monitoring. An incorrect status line should halt the program and report the error status to the operator.

4.0. OPERATOR SELECTION OPTIONS

To correctly utilize these subroutines and to complete the diagnostic strategy plan, the characteristics of the FINCH disk drive need to be understood.

The only method of determining whether the heads are positioned correctly is to read the header information from the data track and compare it to the commanded address.

If a seek to any cylinder address involving a specific data head was reported as a seek error, this would be a read problem and not a positioning problem since the read header information on that surface only is not comparing with the commanded address.

Due to the construction of the FINCH, it is important to define head and media problems as opposed to electronics problems. Remember that servicing items in the upper sealed environmental enclosure (heads, media, actuator, etc.) requires special facilities, while printed-circuit-board replacement requires no special facilities.

Following is a list of operator option selections and interventions.

1. Head Selection

   Run test routines on 1,2 or 3 heads.

2. Cylinder Address Selection

   Run seek operations on any one cylinder, any set of cylinder limits or all cylinders.

3. Seek Only, Read Only, Write Only, or Combinations of Seeks, Reads, and Writes.

   Data operations run in conjunction with seeks or seeks run with data operation performed.

4. Loop on Test Section

   Option of running all tests sequentially or looping on a test section or sections.

5. Stop on error or log and report errors at end of tests.

5.0 PROBLEM DIAGNOSIS

The following are subroutines to determine failure mode and possible corrective action.

1. Commanded: Connect (Unit Select)

Error Status: Not Ready (No unit selected reply)

Possible Causes:

a. Drive power supply not functioning.
b. Drive, power supply, controller cables not properly connected.
c. Internal drive malfunction.
d. Program malfunction.

Prognosis:

If "c," off-line maintenance is required.

2. Commanded: Seek to "X" Address

Error Status: Address (Header) Non-Compare

Possible Causes:

a. Read error. (Rereads should have been attempted automatically.) Media recertification may be required.
b. Positioning errors (drive malfunction).
c. Program/controller malfunction.

Prognosis:

Run incremental/random and X to N seek routines. If problem persists, off-line maintenance is required.

3. Commanded: Write

Error Status: Write Fault

Possible Causes:

a. Controller malfunction.
b. Improperly seated cables.
c. Improper power supply voltages.
d. Disk drive internal malfunction.

Prognosis:

If "d," off-line maintenance is required.

4. Commanded: Write

Error Status: Write Errors

Possible Causes:

a. Improperly seated cables.
b. Undetected bad spot. Media recertification may be required.
c. Program malfunction.
d. Internal drive malfunction.

Prognosis:

If "d," off-line maintenance is required.

5. Commanded: Read

Error Status: Recoverable Read Errors

Possible Causes:

a. Improperly seated cables.
b. Controller malfunction.
c. Marginal recording area on disk.
d. Program malfunction.

Prognosis:

If "c," media recertification is indicated. An excess of recoverable read or write errors may be indicative of degrading media. This would then require off-line maintenance.

6. Commanded: Read

Error Status: Unrecoverable Read Errors

Possible Causes:

a. Improperly seated cables.
b. Program or controller malfunction.
c. Defective recording area on disk.
d. Drive malfunction.

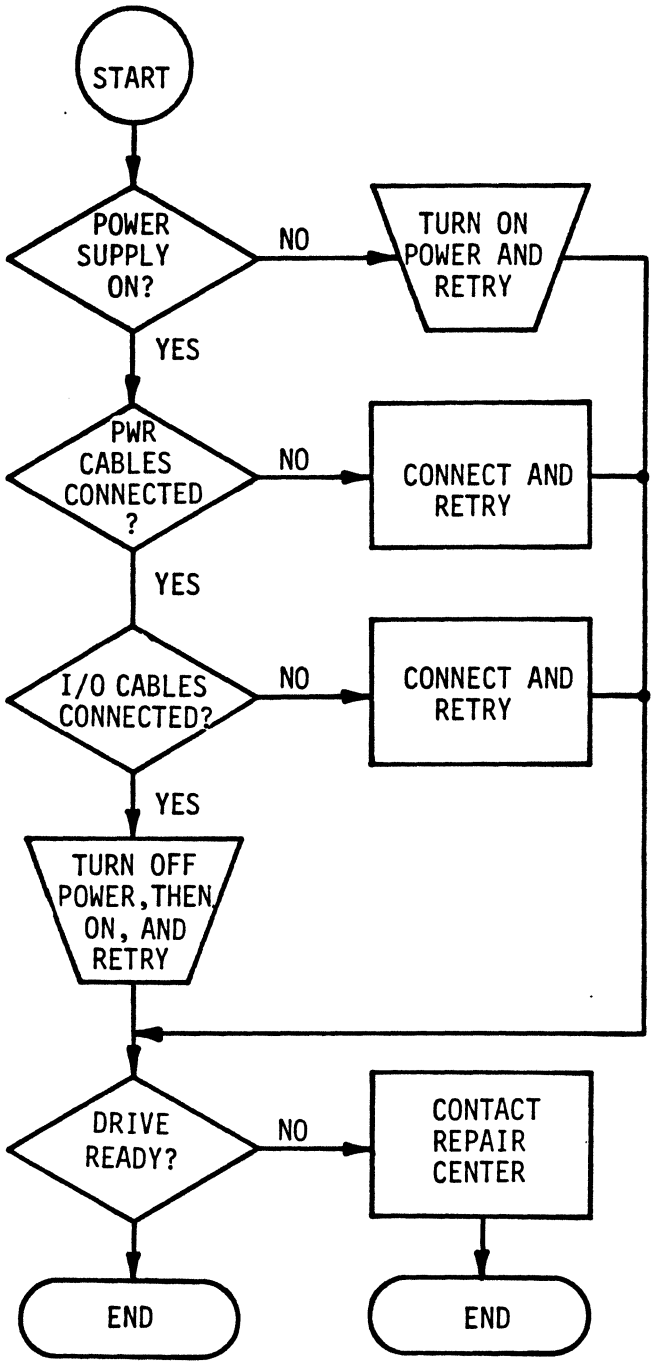
Prognosis:

If "c," media recertification required. Excessive defects or "d" requires off-line maintenance.

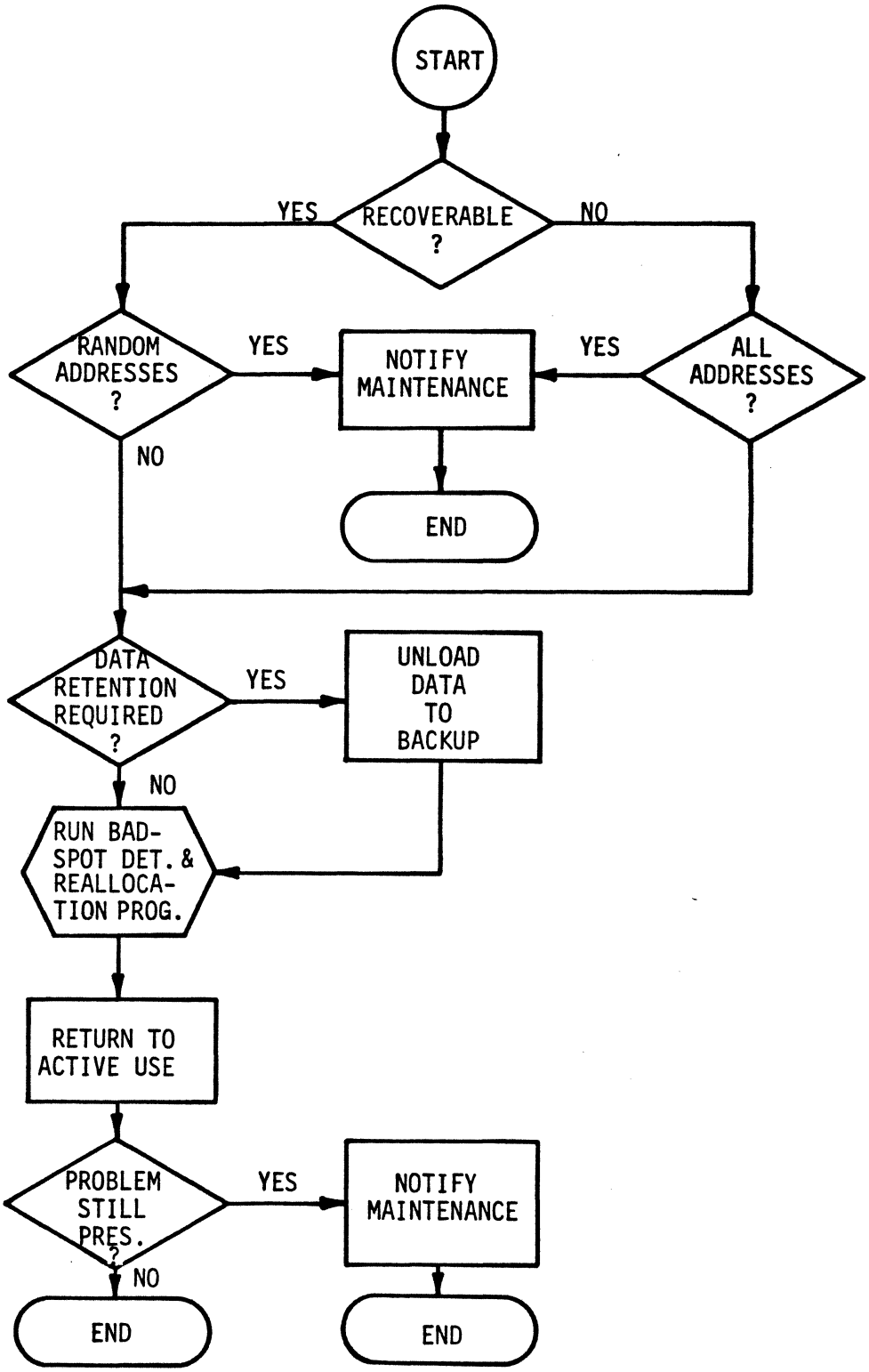
6.0 DIAGNOSTIC FLOW CHARTS

The following flow charts are for operator level problem diagnosis.

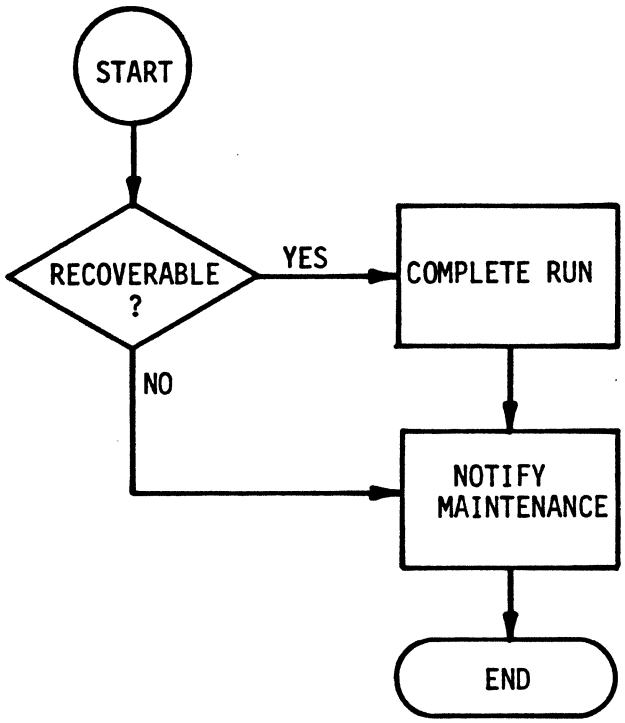
DRIVE NOT READY



READ/WRITE ERRORS



SEEK ERRORS


START
RECOVERABLE ?
YES
COMPLETE RUN
NO
NOTIFY MAINTENANCE
END

TECHNICAL INQUIRY

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_____

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For additional information contact:

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