

# RM05 Fault Isolation Guide

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## RM05 FAULT ISOLATION GUIDE

### SCOPE

This document is intended to supplement the existing RM05 documentation by providing additional troubleshooting information. Problems are listed by symptom and solution which should encompass the majority of all RM05 calls. If a problem cannot be satisfactorily resolved through the use of this manual, the FSE is urged to request additional support.

The RM05 has a VDE and NON-VDE version. The difference between the two will be called out in this guide where applicable.

Many specific error symptoms can be pinpointed to a module(s) or component(s). The most obvious and known combinations have been listed in this document. This of course is not to say all possibilities have been included. The overall accuracy of this document will be dependent on inputs from the field. This document is intended to be used in conjunction with the RM05 Field Maintenance Print Set.

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## 1.0 PRELIMINARY ACTION

### 1.1 REQUIRED EQUIPMENT

The following equipment should be available to troubleshoot an RM05 in minimum time:

1. Spares Kits
  - a. Spares Kit #1 29-23600
  - b. Spares Kit #2 29-23601
  - c. MBA Controller Kit
  - d. RHXX Spares
2. Scratch Pack - 30-17107-00
3. CE Pack - 30-17108-00
4. Field Test Unit
5. Maintenance Print Set - MP0175
6. Manuals (on micro fiche) and/or Micro fiche reader.
  - a. RM05 - Service Manual - EK-RM05-SV
  - b. RM05 - User's Guide - EK-ORM05-UG
  - c. BK7BIE/F Technical Description Manual- ER-BK7B1-TM
  - d. BK7BIE/F Illustrated Parts Breakdown - ER-BK7BI-IP
7. Special Tools - other than in Spares Kit #2
  - a. 15" #2 Phillips screwdriver
  - b. "C" Ring Removal/Replacement Tool Set
  - c. Heavy Duty Spring Replacement Tool (spring hook)
8. DVM
9. Oscilloscope (calibrated)
10. Field Service Tool Kit with dental mirror and penlight.
11. Diagnostics - up to date.

## 1.2 GETTING STARTED

### Customer Inputs

Many problems can be eliminated at this stage by doing a comprehensive investigation of the symptoms. Obviously, the object of the questions asked will be to determine whether there was really a hardware malfunction, or if the pack, operational procedures, or software are at fault. The questions will vary in each situation, but some of the major points are listed below. It is also advisable to verify the answers you get by other means if possible.

1. What are the apparent symptoms?
2. How often does the problem occur?
3. Can the problem be demonstrated? (If so, do it!)
4. Can the problem frequency be increased? (For easier scoping).
5. Has any disk related hardware or software been changed recently?
6. Did this problem ever occur before the change? Using the troubleshooting "tools" described in Section 1.1 and the customer input, you should be able to determine whether you actually have a problem in the RM05 subsystem. If you do, use Section 6 of this documentation to help isolate and fix the specific malfunction.

## 1.3 THINGS TO BE AWARE OF

### 1.3.1 File Corruption

Frequently the disk is blamed for a file or task that no longer loads or runs properly. While this can be caused by hardware, the software usually is at fault. If no device errors are shown on the console or errorlog, check the following key points:

- a. Is this a relatively new disk created by Preserve or DSC? (both utilities have bugs that can cause file corruption in the way bad blocks are handled, never trust a new disk)
- b. Is this pack any good? A block may have just gone bad and a read only exercise may pick up a bad header or data check. Run either the Performance Exerciser (CZRMU) LOAD AND START 204, "R" COMMAND, SWR = 3 for a 11/70, or for a VAX the Formatter (EVRAC) "Read All" Command. WRITE PROTECT THE DRIVE!!!

c. Has the affected software been changed recently?

If device errors are shown, keep reading.

### 1.3.2 Bad Packs

It is amazing how many calls result from a previously trusted pack suddenly giving errors. The symptoms can vary according to where the bad area is (header, data, etc.). The customer is responsible for pack maintenance including bad block mapping, and keeping a backup pack. Look for similarities in the failure that indicate it may happen during the same function and, if diagnostics run clean, ask the customer to use a backup pack. Obvious bad areas will show up on Errorlog provided it is not Errorlog or the system image that is bad.

### 1.3.3 Environmental Problems

This is a broad field that covers temperature, power and electromagnetic radiation. Power and grounding are the most frequent problems, so verify that the configuration has not been recently changed and pay attention to when the errors occur. Look for heavy equipment on the same power (or close by), plant shutdowns, idle time etc. In general keep your eyes open; radios; forklifts (the spark coil), and computer room air conditioners have caused problems. If you have reason to suspect environment, the only way to be sure is to consult an local environmental specialist.

### 1.3.4 Bus Loading

A.C. Unibus loading can cause virtually any error on any device on the Unibus and the fast devices see it first. The symptoms are usually intermittent, and diagnostics usually don't fail. The major clue is to look at a working bus with everything running (with a scope, hopefully), and look for dropouts in the signals large enough to cause a gate transition. See the Unibus Troubleshooting Guide (on microfiche-red section) section on AC loading for more detail.

### 1.3.5 Power Supplies

Check all supplies for voltage with a DVM if available. Then scope for ripple on the supplies; a prime cause of intermittents. Also check the connections. See table 3-1.

## 2.0 TROUBLESHOOTING AIDS

### 2.1 ERROR LOG

This is one of the most valuable and least used tools for system maintenance. If you don't know how to run it for the particular operating system, the customer and DEC software personnel probably will. The procedure should be entered in the Site Management Guide. There should be a software manual on site detailing the operation and printout of the Error Log.

#### NOTE

Be certain that the error file for the time of the failure is on the disk you're using, and that error logging is terminated so that the current file is available to the errorlog report generator. Otherwise, you may miss the errors you are looking for.

Error log will aid in determining:

1. Was there actually a hardware error? This helps you filter out corrupted file type problems.
2. What is common between errors? The bad blocks and time of day environmental problems show up here, as do most semi-solid hardware problems.
3. How often did the error occur? Tells you how likely it is that you will see a diagnostic failure.
4. What was the system doing at the time? Is one particular task or function always happening at the time of the failure? Are there system or other device errors involved?
5. What do the error symptoms indicate? This gives you a pre-diagnostic indication of what to look for, or exercise harder. On intermittents, this may be all you have to work with.

### 2.2 SITE MANAGEMENT GUIDE/LARS REPORTS

Look up the disk history in the LARS reports or maintenance log. Pay special attention to what adjustments were made and which parts were changed. Correlate this to the information you have from the customer. It is not unusual to find that the errorlog indicates a problem starting immediately after the last maintenance on the device. Also, check information on head alignments against the customer's disk pack usage log in situations indicating unreadable packs.

### 2.3 CUSTOMER DISK PACK USAGE LOG

Customers should keep track of pack usage, formatting, backups, and bad blocks. This information is quite useful when looking for a potential pack problem. Verify that the customer does look for and identify bad blocks on a regular basis.

### 2.4 ON-LINE DIAGNOSTICS

These diagnostics are generally quite easy to run and can be of great help in situations where the customer does not want to release the system. Unfortunately, they are installed at sysgen time and if the system doesn't have them, you won't be able to put them in easily. The diagnostic operating manuals are usually found in the customer's software manual set.

### 2.5 OFF-LINE DIAGNOSTICS

In many cases, off-line diagnostics will be the only available tool. Consequently it is a good idea to be very familiar with the individual diagnostics and exactly what they test. The 11/70 diagnostics listed are all off-line but the VAX diagnostics; Reliability, Functional, and Formatter can be run on line providing that a scratch pack is mounted on the tested drive(s). At the time of this writing, the current diagnostics for the RM05 are:

#### PDP11 DIAGNOSTICS

CZRML - RM02/03/05 Formatter  
CZRMM - RM02/03/05 Functional Test 1  
CZRMN - RM02/03/05 Functional Test 2  
CZRMO - RM02/03/05 Functional Test 3  
CZRMP - RM02/03/05 Diskless Diagnostic Part 1  
CZRMQ - RM02/03/05 Diskless Diagnostic Part 2  
CZRMR - RM02/03/05 Dual Port Logic Test Part 1  
CZRMS - RM02/03/05 Dual Port Logic Test Part 2  
CZRMT - RM02/03/05 Compatability Test  
CZRMU - RM02/03/05 Performance Exerciser  
CZRMV - RM02/03/05 Extented Drive Test

## VAX DIAGNOSTICS

EVRAA Reliability

EVRAC Disk Formatter

EVRDA RMØX Diskless

EVRDB RMØX Functional

There are many techniques in using diagnostics but the most common are "buildup" and "breakdown".

The buildup approach is commonly used when the failure is catastrophic and a working system is "builtup" using diagnostics to verify each section, in an effort to find the failure by starting with known good equipment and gradually adding the unknown elements.

The "breakdown" approach to diagnostics is generally applied to intermittent problems where basically the system works, but it gets errors. A general exerciser is run to get an indication of the cause of the error, and then the suspect sections are exercised with more specific diagnostics until the failing section is isolated.

Neither of these approaches is perfect in all cases, as the diagnostics generally overlap and assume that other parts of the system work. However, if you are aware of the limitations, the diagnostics can be an effective isolation method. You will find a more detailed description of the diagnostics in this section and an indication of the proper ones to use under the Error Bit Section 6.Ø.

### 2.5.1 CERHA

Listed As: RH7Ø Controller Diagnostics

Special Requirements: Functional Drive and Scratch Pack.

Test Description: Tests the RH7Ø using a disk drive for data transfers and some register check.

Suggested Use: When a controller register is suspect and a working RMØ5 is available.

Comments: This diagnostic uses Cylinder Ø of the disk, and could give errors if the media is bad.

### 2.5.2 CZRML

Listed: RM02/03/05 Formatter

Special Requirements: A working RM05 subsystem and scratch pack.

Test Description: Formats disk and updates the Bad Sector File.

Suggested Use: Pack formatting and updating the Bad Sector File.

Comments: Be sure the scratch media is properly formatted at all times because possibly the next time the system may not be able to format. A pack with a known good format is invaluable when trying to isolate a read problem.

To access the Bad Sector File utility routine, start the program at 204.

### 2.5.3 CZRMM, CZRMN, CZRMO

Listed as: RM02/03/05 Functional Test Part 1, 2, & 3

Special Requirements:

1. Formatted pack for Parts 2 and 3.
2. Certain areas on the pack must be error free.

Test Description: These diagnostics test RM Adapter logic not tested with the Diskless Diagnostics. It also tests the drive read/write and servo logic.

Part 1: Tests error detect logic, error abort logic, look ahead register, seek command, and offset command.

Part 2: Performs write and read of header & data; 1 sector write header and data, write check header and data, write and write check of 1's & 0's, format of multiple sectors, error logic, mid-transfer seeks.

Part 3: Performs write and write check data; 0's and 1's, write and write check multiple sectors, write and write check with implied seek. Also error logic (HCE, IVC), write current tests, peak shift tests, write and read each track, read and write check multi-sectors in offset mode.

Suggested Use:

1. Verify logic in RM Adapter not tested by Diskless 1 & 2.
2. Check basic drive read/write and seek functions.

Comments: This program will disturb the header format of a pack if not halted properly with a Control "C".

#### 2.5.4 CZRMP, CZRMQ

Listed as: RM02/03/05 Diskless Controller Part 1 & Part 2

**Special Requirements:** Drive interface cables must be plugged in and drive power turned on.

**Test Description:** Parts 1 and 2 combined, verify the operation of the RM subsystem up to the drive interface. No specific tests are performed on the RH70 and it is assumed to work.

**Suggested Use:** To detect errors and faults in the RM Adapter.

**Part 1:** Tests basic handshaking; register transfer; error detect logic; command decode; port request; attention logic; control sequencer.

**Part 2:** Tests additional error detect logic; CRC logic; data sequencer; ECC logic.

**Comments:**

1. The drive is used for unit selection.
2. The multiple sector transfer logic is not tested as well as the drive interface.

#### 2.5.5 CZRMR, CZRMS

Listed As: RM02/03/05 Dual Port Logic Test Part 1 & Part 2

**Special Requirements:**

1. Dual Controller Option.
2. Dual Controller Test Cable P/N 70-10507-02.
3. Power off drives not being tested.
4. Operator intervention - Part 2.

**Test Description:**

Part 1 tests the ability to seize and release each port. It also checks the timeout release.

Part 2 tests the duration of the timeout release and the port select switch which requires manual intervention.

**Suggested Use:** To test the basic operation of the port select logic.

**Comments:** Use Performance Exerciser CZRMU to test the dynamic dual port operation. See Para. 2.5.7

### 2.5.6 CZRMT

Listed As: Compatibility

Special Requirements: Formatted scratch pack.

Test Description: This diagnostic is designed to detect the following conditions which most commonly cause incompatibility between drives.

1. Head mis-alignment
2. Positioner lateral mis-alignment
3. Spindle/pack interface runout
4. Improper level of write current
5. Incorrect addressing of read/write heads

Suggested Use: This program is obviously used when incompatibility is suspected between drives.

Comments: Functional Test Part 3 and Extended Drive Test 20 should be run first to eliminate electrical problems with the drive (write current). If errors then occur with this diagnostic; it can be assumed that drive incompatibility is attributed to mechanical mis-alignments or tolerances.

### 2.5.7 CZRMU

Listed As: RM02/03/05 Performance Exerciser

Special Requirements:

1. Formatted pack. Packs using tests 16, 17, and 21 out of default mode, of the Extended Drive Test, will give data compare errors.
2. Addresses of known bad spots on the pack.

Test Description: Performance Exerciser is a good, general purpose, operating system like exerciser that maintains a high activity rate on a RM05 subsystem. It has two basic modes that are selected by the "Size" parameter. "Size" is the number of words transferred per read or write order.

Data Mode: Default mode and selects "Size", depending on available memory, up to 8192 words. This mode transfers multiple sectors per command rather than single sector transfers. For most efficient run time: Parameter "Random" = 1 and the SWR = 000001. Change parameter "Passes" to 99 for long runs. Load and start at 204.

Seek Verification Mode: Selected by setting "Size" to 256. This exercises the servo more than Data Mode since only one sector is transferred per command.

### Suggested Use:

1. As a final overall subsystem checkout.
2. To surface intermittents and give additional error and status information.
3. To check for multiple drive interaction.
4. To check customer packs for bad spots not logged in the bad block file. See Para. 9.8. WRITE PROTECT THE DRIVE!!! Load and Start at 204, SWR= 3 and "R" Command.
5. Dynamic dual port testing - use seek verification mode and SWR = 000001.

### Comments:

1. This is the best data transfer test and over all exerciser.
2. In many cases it will be faster to isolate problems with the lower level diagnostics, as they, exercise isolated sections faster and more thoroughly.

### 2.5.8 CZRMV

Listed as: RM02/03/05 Extended Drive Test

Special Requirements: KW-11P Clock for timing tests, and a formatted pack.

Test Description: Test assumes a working RH and RM Adapter and exercises the mechanical and data transfer ability of the drive itself. The sector/track addressing and positioning portions of the drive and RM Adapter are thoroughly checked. If a KW-11P is present, the mechanical timing of the drive is verified.

#### NOTE

Test 11 is an extensive positioning test and Test 21 is a stress test of the R/W and Servo system. They are not run in the default mode and must be selected by the operator.

### Suggested Use:

1. When mechanics of a drive are suspect.
2. When RH/RM Adapter tests have shown no errors. ("build up" approach)
3. Checking mechanical performance during P.M.

4. In conjunction with Performance Exerciser to isolate drive interaction problems.
5. Doing servo adjustments by modifying the parameters, LC, IC, R for test 1 or 2.

Comments:

1. Timing tests run regularly can track mechanical wear.
2. A better mechanical exerciser than Performance Exerciser due to run time and operation.
3. Not a good RH/RM Adapter check as all commands are not used extensively.

CAUTION

Test 16, 17, and 21 alters the data patterns when used alone. This causes data compare errors if the pack is used for Performance Exerciser. Always run Test 20 last to restore the pack (that's why test 21 is not run in default mode).

2.6 VAX DIAGNOSTICS

2.6.1 EVRAA

Listed As: RK06/RK07/RP0X/RM0X/RL02/TU58/RX02 Reliability

Special Requirements: A formatted pack which is not "Mounted" (VMS) with a volume name of "Scratch" or "Diagnostic".

Test Description: This program contains five RM03/05 related sections.

1. Qualification - verifies the drive to be tested will support all disk drive commands.
2. Seek Timing - this gives the average seek times in milli-seconds, from cylinder "0" to each prime cylinder (1,2,4,8,16,- 512). If there are two drives under test from different terminals, the seek times are invalid.
3. Media Test - Write and Write Checks 5 patterns every sector on the disk (except home and bad sector files). It doesn't report bad sectors listed in the bad sector file. After all the sectors have been written, the test goes into a mode with random patterns and random disk addresses.

4. **Multi-Drive Test** - tests up to 8 drives, transferring random data to random addresses to all drives in a concurrent mode. The function sequence is:
  - a. Drive clear
  - b. Write random data
  - c. Write Check data
  - d. Read data
  - e. Data compare
  
5. **Conversation Mode** - allows the Field Engineer to design and run simple test routines. Selectable functions such as Seek, Read, Write, Write Check can be run up to 8 drives simultaneously with selectable or random disk addresses and data patterns.

**Suggested Use:** As a final overall subsystem checkout. Also to give additional status and error information for intermittent problems.

**Comments:** Run Functional EVRDB for worst case seek testing.

#### 2.6.2 EVRAC

**Listed As:** Vax Disk Formatter

**Special Requirements:** Diagnostic Supervisor reference manuals.

**Test Description:** Formats the pack and writes the Bad Sector File. It is broken into six areas.

1. **INIT** - This section is run prior to all sections. It assigns a channel, builds a device dependent table, and determines if the media is a scratch pack or not. Init also adjusts buffer sizes. If in user mode (VMS), only one track transfers are done. If in stand alone, multi-track transfers are done.
  
2. **PACK INIT** - Format and writes a zero entry Bad Sector File on all sectors of the last track. After reading the Bad Sector File, the pack is formatted one track at a time.

### CAUTIONS

- a. This section should never be run unless the user verifies the disk subsystem is OK and the Bad Sector File is missing or corrupted.
  - b. This section has to be used to format new packs which do not have the Bad Sector Files written.
  - c. The new Bad Sector File is not written until the end of the Verify section.
3. **FORMAT** - Reads and validates the Bad Sector File and then formats one track at a time. If the Bad Sector File is not read, the program is aborted.
  4. **VERIFY** - Reads and validates the Bad Sector File and then reads the whole pack. Any bad sectors found are flagged and entered in the Bad Sector File. If the Bad Sector File can not be read, the program is aborted.
  5. **READ ALL** - Reads every sector on a pack and prints the data errors found. This is ideal for checking user packs that may have bad spots that are not flagged. As a precaution, **WRITE PROTECT THE DRIVE!**
  6. **FLAG BAD** - Allows for the manual update of the Bad Sector File. **CAUTION**, if this section is used, the home block will be rewritten with a label of "Scratch". This section is great for updating the Bad Sector File when bad sectors show up only under VMS or diagnostics but not with the Formatter.

**Suggested Use:** Pack formatting and updating the Bad Sector File.

**Comments:** This program can render customer packs useless. Beware of all implications and inform the customer of your intentions.

### 2.6.3 EVRDA

**Listed As:** RM03/05 Diskless Diagnostic

**Special Requirements:** The drive interface must be connected with the drive power turned on. Diagnostic Supervisor.

**Test Description:** This diagnostic consists of 80 tests which verify the operation of the RM Adapter up to the drive interface. It does not test the drive interface (RD and sections of the CS module) except for the drive select lines that are used.

**Suggested Use:** To verify the operation of the RM03/05 disk subsystem independent of the drive.

**Comments:** This diagnostic should always be used first when diagnosing disk subsystem problems.

#### 2.6.4 EVRDB

**Listed As:** RM03/05 Functional Test

**Special Requirements:** Scratch pack mounted and on line. Diagnostic Supervisor running.

**Test Description:** This diagnostic contains four test sections which can be selected via a section switch in the Start Command line.

1. **Data Transfers** - Executes all data transfer commands and verifies header logic. It also checks the addressability of all sector/tracks and the error detect logic.
2. **Seek Tests** - This section contains positioning tests which verify seek, recalibrate, offset, and return to centerline command functions. These test thoroughly check out the servo electro-mechanical hardware.
3. **Timing Tests** - This section verifies the pack rotational speed; minimum, average, and maximum seek times.
4. **Manual Intervention Tests** - Tests all operator interventions; pack acknowledge, read in preset, operator address plugs, and write lock switch.

**Suggested Use:** Verifies logic not tested in the RM Adapter with the Diskless Diagnostic and tests basic drive functions such as read/write and seeks.

### 3.0 POWER ON AND MOTOR SEQUENCE NON-VDE DRIVES

This section concerns from the time CB1 is turned on, the start switch is pressed, and the drive motor comes up to speed. The success of troubleshooting power on problems is dependent upon thorough and careful visual observations. A general inspection of all areas is in order for any power or motor problems.

1. Check all circuit breakers - CB1, CB2, CB3, CB4, CB5, CB6, CB7, and CB8.
2. Check for blower motor operation. Inspect the primary air filter at the bottom of the drive for need of cleaning and also check the absolute filter air pressure. If the air pressure is low, check for air leaks and/or replace the filter. Air pressure readings are with heads loaded at cylinder 0.

60 Hz - .15 or less, replace filter.  
50 Hz - .10 or less, replace filter.

3. Check the RM Adapter and drive power supplies for proper voltage and ripple levels. Replace any adjustable power supply if the voltage is grossly out of tolerance instead of adjusting it back to normal level. See para. 14.0. and Table 3-1.

### 3.1 POWER ON PROBLEMS

#### 3.1.1 CB1 Trips

A1Q1, A1Q5  
Blower Motor  
Time Meter  
A1C1, A1C2 - CAUTION: Capacitors charged  
YEN, YFN  
CR1-CR4  
T1, T2  
CB1

#### 3.1.2 CB2 Trips

A1Q1, A1Q5  
T3  
CB2

#### 3.1.2.1 Short In +20Y Distribution

K6, K7, K8  
YFN, YEN

#### 3.1.3 CB3 Trips

3.1.3.1 When CB1 Is Turned On

A1Q2, A1Q3

3.1.3.2 Immediately After The Start Switch Is Turned On

Parking Brake  
Motor

3.1.3.3 Shortly After Motor Starts Turning Also a Squealing  
Noise Is Heard

Belt Tension

3.1.3.4 Shortly After Motor Starts Turning

Belt Tension  
Motor

3.1.4 CB4 Trips

Carriage Lock Pin  
Head Load Switch Bad Or Misadjusted  
A17  
Servo Power Amp  
K7  
Voice Coil Assembly  
.22uf Capacitor at TB6 Pins 7 & 8  
CB4

3.1.5 CB5 OR CB6 Trips

5 Volt Regulator  
Module  
Servo Preamp  
YFN  
Control Panel (CB5 only)  
CB5 or CB6

3.1.6 CB7 Trips

Module A10, A14, A15, A16, A17, A18  
A2 Backplane short

3.1.7 CB8 Trips

E01  
A2 Backplane short  
CB8

- 3.1.8 All DC Voltages Missing At Test Points and No +20Y
  - CB2 Tripped - See para 3.1.2
  - YEN
  - A1Q1
  - CB5 or CB6 bad - interlock contacts
  - T3
  - +20Y may be loaded down but CB2 is not tripped see Paragraph 3.1.2.1
- 3.1.9 +28V, -20V, +20V, -9.7V, +9.7V Are Either All High or Low
  - AC input
  - A1C2 - CAUTION: Capacitor charged
  - T2
- 3.1.10 -46V, +46V AND -16V Are All Either High or Low
  - AC input
  - A1C1
  - T1
- 3.1.11 -46V, +46V, AND -16V Are Missing
  - A1Q5
  - YFN
  - 9.7V missing
- 3.1.12 Ripple Too High For Just One Voltage
  - YEN for all DC voltages except -16V
  - YFN for just -16V
- 3.2 DRIVE MOTOR PROBLEMS
  - 3.2.1 Drive Motor Starts When CB1 Is Turned On
    - A08
    - YFN
    - Start Switch
  - 3.2.2 Drive Motor Does Not Turn When Start Switch Is Pressed
    - 3.2.2.1 +20Y Missing At Pin 3 of A1Q2, A1Q3, A1Q4, AND 9.7V Is OK
      - YFN
      - A08

3.2.2.2 +20Y OK At Pin 3 of A1Q2, A1Q3, A1Q4, and 9.7V Is Missing

YEN  
CBE  
T2

3.2.2.3 +20Y OK At Pin 3 of A1Q2, A1Q3, A1Q4, and 208+ VAC Is OK At Pin 2

K8  
Motor overheated or bad

3.2.2.4 +20Y OK At Pin 3 of A1Q2, A1Q3, A1Q4, but 208+ VAC Is Missing Pin 2

A1Q2, A1Q3, A1Q4

3.2.3 Motor Overheats and Thermal Cutout Activates

A1Q4  
Motor

TABLE 3-1

DRIVE POWER SUPPLY LEVELS

Measure while the drive is performing 128 cylinder continuous seeks. Connect meter to power supply test points and be sure to use Ground T.P.

Voltage	Tolerance
+46	-2, +5
-46	+2, -5
+9.7	+/- 1
-9.7	+/- 1
+20	+/- 2
-20	+/- 2
+28	-/+ 2

The 5 volts is checked also with the 128 cylinder seeks but the test points are at the backplane.

+5	A2JD94-04A	+/- .05 volts
-5	A2JD94-01A	+/- .05 volts

### RM ADAPTER VOLTAGE LEVELS

Voltage	Test Point	Tolerance
+5V	Pin AA2	+4.9 to +5.2
-15V	Pin AB2	-14.8 to -15.3

TABLE 3-2

Triacs Q1, Q2, Q3, Q4, Q5 out of circuit readings.

<u>Terminal</u>	<u>Reading</u>
+      - 3   --> 4	- 25 Ohms (Forward bias)
+      - 4   --> 3	- 1 K Ohms (Reverse bias)
1   --> 2	- Infinity
4   --> 1 or 2	- Infinity

### 3.3 POWER ON AND MOTOR SEQUENCE VDE DRIVES

This section concerns from the time CB1 is turned on, the start switch is pressed, and the drive motor comes up to speed. The success of troubleshooting power on problems is dependent upon thorough and careful visual observations. A general inspection of all areas is in order for any power or motor problems.

1. Check all circuit breakers - CB1, CB2, CB3, CB4, CB5, CB6, CB7, and CB8.
2. Check for blower motor operation. Inspect the primary air filter at the bottom of the drive for need of cleaning and also check the absolute filter air pressure. If the air pressure is low, check for air leaks and/or replace the filter. Air pressure readings are with heads loaded at cylinder 0.
  - 60 Hz - .15 or less, replace filter.
  - 50 Hz - .10 or less, replace filter.
3. Check the RM Adapter and drive power supplies for proper voltage and ripple levels. Replace any adjustable power supply if the voltage is grossly out of tolerance instead of adjusting it back to normal level. See paragraph 14.0 and Table 3-3.

### 3.4 POWER ON PROBLEMS

#### 3.4.1 CB1 Trips

Blower Motor  
Time Meter  
C1 - Caution: Capacitor charged  
FCFN Module  
T1-T2  
CB1

#### 3.4.2 CB2 Trips

T1  
FCFN Modules  
CB2

##### 3.4.2.1 Short in +20Y Distribution

K1  
CFNN

#### 3.4.3 CB3 Trips

E01  
A2 backplane short  
CB3

#### 3.4.4 When CB1 Is Turned On

Relay box

##### 3.4.4.2 Immediately After Start Switch Is Turned On

FCNN Module  
CFNN Module  
Voice Coil Assembly  
CB4

##### 3.4.4.3 Shortly After Motor Starts Turning Also A Squealing Noise is Heard

Belt tension

##### 3.4.4.4 Shortly After Motor Starts Turning

Belt tension  
Motor/brake assembly

- 3.4.5    **CB5 Trips**
  - CFNN module
  - Carriage locking pin
  - Voice coil assembly
  - K2 on CFNN module
- 3.4.6    **CB6 or CB7 Trips**
  - 5 volt regulator module
  - CCBN module
  - CB6 or CB7
- 3.4.7    **CB8 Trips**
  - Module A10, A14, A15, A16, A17, A18
  - A2 backplane short
- 3.4.8    **All DC Voltages Missing and no +20Y**
  - T2
  - F1-F8
  - CCBN module
  - FCFN module
  - Auxiliary circuit
  - Breakers CB3, CB6, CB7, CB8
  - T1
  - CB2
- 3.4.9    **+28v, +20v, -20v, -9.7v, Are Either All High or Low**
  - T2
  - CCBN module
- 3.4.10    **-46v and +46v Are Both High or Low**
  - T2
  - CCBN module (CR1, CR2, CR8, CR10)
- 3.4.11    **-46v and +46v Missing**
  - CCBN module (CR1, CR2, CR9, CR10)
  - 46v AC input
- 3.4.12    **Ripple Too High for Just one Voltage**
  - CCBN Module
- 3.5        **DRIVE MOTOR PROBLEMS**

### 3.5.1 Drive Motor Starts When CB1 is Turned On

A08 module  
Relay box  
Start switch

### 3.5.2 Drive Motor Does not Turn When Start Switch is Pressed

#### 3.5.2.1 +20Y is OK but 9.7v is Missing

CFNN module  
A08

#### 3.5.2.2 +20Y is OK But 9.7v is Missing

CCBN module  
CB6 or CB7

#### 3.5.2.3 +20Y is OK and 208 VAC is OK

K3 in relay box  
Motor/brake overheating or bad

#### 3.5.2.4 Motor Overheats and Thermal Cutout Activates

Relay box  
Motor/brake assembly

## 3.6 DRIVE POWER SUPPLY LEVELS

The drive power supply voltage levels are measured while the drive is performing 128 cylinder continuous seeks. Connect meter to power supply test points and be sure to use ground test point. Refer to table 3-3 for voltage tolerances.

The 5 volts is also checked while the drive is performing 128 cylinder continuous seeks. The test points are on the logic chassis backplane. Refer to Table 3-4.

Table 3-3

Voltage	Tolerance
+46	-2v, +5v
-46	+2v, +5v
+9.7	+1v
-9.7	+1v
+20	+2v
-20	+2v
+28	+2v

Table 3-4

Voltage	Test Point	Tolerance
+5v	A2JD94-04A	+.05 volts
-5v	A2JD94-01A	+.05 volts

3.7 PEAK TO PEAK RIPPLE

The peak to peak ripple should be checked using an oscilloscope to measure the ripple peak to peak ripple voltage between the ground jack and voltage test jacks on the power supply control panel. Refer to Table 3-5 for peak to peak ripple voltage.

Table 3-5

Voltage	Ripple
+46	4.5v
-46	4.5v
+20	1.0v
-20	1.0v
+28	1.0v

3.8 RM ADAPTER VOLTAGE LEVELS

The RM adapter voltage levels should also be checked, and adjusted if out of tolerance. Refer to Table 3-6 for voltage, test points, and tolerance.

Table 3-6

Voltage	Test Point	Tolerance
+5v	Pin AA2	+4.9v to +5.2v
-15v	Pin AB2	-14.8v to -15.3v

#### 4.0 HEAD LOAD SEQUENCE PROBLEMS

This section concerns problems during the actual head load operation after the start switch is pressed and the motor is up to speed. It also includes the head unload sequence and spindle braking. If the possible causes are different for NON-VDE and VDE they will be called out.

#### 4.1 HEADS DO NOT LOAD AFTER UP TO SPEED TIME OUT AND NO REVERSE CURRENT

##### NON-VDE

Head Load Switch  
Servo Power Amp  
K7  
Voice Coil

##### VDE

Head Load Switch  
Servo Power Amp  
Voice Coil

#### 4.2 HEADS DO NOT LOAD AFTER UP TO SPEED TIME OUT AND HOLD REVERSE IS OK, FOR BOTH NON-VDE AND VDE DRIVES

A20, A07, A12, A08, A17  
Servo Power Amp

#### 4.3 CARRIAGE HITS FORWARD STOP, CB4 TRIPS, FAULT LIGHT ON, AND HEADS STAY OUT ON PACK, FOR BOTH NON-VDE AND VDE DRIVES

A06, A19, A20  
Servo Power Amp

#### 4.4 CARRIAGE HITS FORWARD STOP, FAULT LIGHT ON, THEN CB4 TRIPS AND HEADS RETRACT, FOR BOTH NON-VDE AND VDE DRIVES

A20  
Servo Power Amp

#### 4.5 HEADS LOAD, HESITATES, AND THEN CREEP TO THE FORWARD EOT (INNER GUARD BAND), FOR BOTH NON-VDE AND VDE DRIVES

A06, A19, A20  
Servo Power Amp

#### 4.6 HEADS LOAD, BUT THEN UNLOAD, FAULT LIGHT ON, FOR BOTH NON-VDE AND VDE DRIVES

Servo Preamp \*  
Servo Head \*

- \* Disconnect A3TB1-1 (yellow wire) and load heads manually. Then Check for .3 -1.5vpp servo data at A18 Pins 23B and 25B. If not OK it is the Servo Preamp or Servo Head. If OK, it is one of the following.

A18, A19, A20

- 4.7 RTZ IS NON FUNCTIONAL, FOR BOTH NON-VDE AND VDE DRIVES  
A06, A07, A19, A20, A02, A12
- 4.8 UNABLE TO SEEK TO CLYINDER 1466 (8), FOR BOTH NON-VDE AND VDE DRIVES  
A06, A12, A20, A02
- 4.9 UNABLE TO FORCE A SEEK ERROR WITH FTU TO CYLINDER 1467 (8), FOR BOTH NON-VDE AND VDE DRIVES  
A06, A12, A20 ,A02
- 4.10 HEADS DO NOT UNLOAD WHEN START SWITCH IS TURNED OFF, START LIGHT OFF, PACK SPINNING, FOR BOTH NON-VDE AND VDE DRIVES  
A08, A07, A20, A17  
Start Switch  
YFN
- 4.11 DRIVE MOTOR BRAKE INOPERATIVE, NON-VDE DRIVE ONLY  
Open thermal resistor in CB3  
K8  
CR1-CR4  
Bad connection to motor connector P/J7
- 4.12 DRIVE MOTOR BRAKE INOPERATIVE, VDE DRIVE ONLY  
FCFN Module  
CCBN Module  
Bad Connection to Brake P8/J8  
Bad Connection to Motor P7/J7

## 5.0 POWER AND POWER FAIL PROBLEMS/RM ADAPTER

Disk drives are susceptible to power problems due to the low level amplitude analog signals used in the Read/Write circuitry. Any abnormal variations in the input power such as mismatched phase loading, voltage spikes, excessive surges or sags should be corrected immediately before any intermittent failures occur. Typical failures from abnormal line power have symptoms of long term data base corruption with no apparent error bit indications and frequent power supply related failures.

### 5.1 MASSFAIL

This signal is sent to all drives on the MASSBUS from their respective RH controller to indicate a power problem in the RH or the CPU. Under normal operation the system will power fail as the Massfail signal is received. Massfail provides an orderly shut down of the disk subsystem. Non Existant Drive errors will be evident if there is a problem with the Massfail signal on the MASSBUS or in the RM Adapter.

RH70 - Any Unibus device that generates AC Lo could be at fault.

RH780 - Check the +5 volt DC Lo signal at J3 of the 7100 power supply (#5).

#### NOTE

In order to have the Massfail signal function properly, the jumpers on the older H780 MASSBUS terminator modules must be configured correctly: W1 in, W2 out.

### 5.2 AC LO - UNSAFE, BIT 14 OF RMER1

The RM Adapter -15 volt regulator asserts AC Lo, which sets Unsafe, if low AC is detected for the RM Adapter power source.

#### NOTE

If the fault lite is not on in the drive and the unsafe bit is set, then the problem is with the RM adapter power supply.

### 5.3 DC LO

DC Lo does not flag an error bit but does give an obvious indication. All the RM Adapter registers are read as ones when examined but the RH registers are OK except for CS1.

## 6.0 ERROR BITS - CONTROL AND ERROR REGISTERS

This section gives the error definition with suggested diagnostics to use for trouble-shooting. Also given are the components which would cause the error and/or symptom.

When trying to locate a problem, it is assumed that the error and status logic is functioning properly. The list of possible defective components are listed in order of most likely to fail first and easiest to replace. These component listings are given to start you off in the right area but test equipment such as a scope and meter will be needed to isolate further. The status and error logic should be, for most cases, considered last unless it is obvious.

### STATUS AND ERROR LOGIC INCLUDES

1. Drive Interface Cables - A & B
2. M7686 - drive status, drive errors
3. A01, A02, A17 - drive status, drive errors

Multiple bits will be set when an error occurs. EXAMPLE: A parity error occurred. Bit 03 (PAR) of RMER1 and bit 03 (DPE) of RMER2 is set; bit 15 (ATA) and bit 14 (ERR) of RMDS; corresponding bit in RMAS; bit 15 (SC) and bit 14 (TRE) of RMCS1. Be aware of all bits when isolating an error condition.

Table 6-1 gives related FTU errors to subsystem errors. This can be used to relate the Error Log or Diagnostic printouts to errors when troubleshooting with the FTU.

Table 6-1

RM ADAPTER ERROR	FTU ERROR
ILF	NA
ILR	NA
RMR	NA
PAR	NA
FER & HCRC	Address and/or Read
FER	NA
WCF	NA
ECH & DCK	Address and/or Read
HCE	Address - because of head misselect SKI and/or Address because of misposition

Table 6-1 (Cont)

RM ADAPTER ERROR	FTU ERROR
HCE & HCRC	Address and/or Read
HCRC	Address and/or Read
AOE	NA
IAE	NA
WLE	Fault
DTE	Read after write Address error, Address and/or Read
OPI	Sector Count or no error
UNS & DVC	Fault
DCK	Address and/or Read
DPE	NA
DVC	Fault
LBC	Address and/or Read FTU Run hangs
LSC	NA
IVC	No Unit Ready
OPE	Plug No. doesn't equal switches No Unit Select
SKI	SKI Address
BSE & HCRC	Address and/or Read

6.1 CONTROL REGISTER

6.1.1 Control Register

BIT 13 MASSBUS CONTROL PARITY ERROR (MCPE) - RH70  
 BIT 17 - RH780

MCPE indicates that a parity error occurred on the Control Bus while reading an RM register to the RH. There is one RM Register that does not use parity on transfer to the RH. It is the Attention Register.

## THINGS TO KNOW WHEN TROUBLESHOOTING MCPE ERRORS

1. The number one cause of MASSBUS Parity Errors (especially on installations) seems to be in the cabling. Check the following:
  - A. Check the connections of the BC06R cables at the M5904's RH70 (Berg connector). The drain wire on the flat cable sometimes shorts against the etch on the M5904. This effects Data Bits 00, 06, or 12.
  - B. Check the connections of BC06R cables at the ZIF (Zero Insertion Force) connector located on the panel on the bottom rear of the cabinet.
  - C. Visually inspect the cable insulation on the BC06R cables for damage, kinks, breaks and other signs of wear.
  - D. A visual inspection of all ZIF connector mating pins is necessary.
  - E. Inspect the massbus terminator for bent pins, and broken or cracked resistor packs. MASSBUS terminators which have broken or cracked resistor packs will give intermittant parity errors.
2. To isolate solid MCPE problems, there are several features that will help out.
  - A. The maintenance switches on the M5922 and M5923 will disable all transceivers on that bus, for that drive.
  - B. In multiple RM05 installations, break the MASSBUS and move the terminator in order to isolate the problem. Remember, the MASSBUS must be terminated at all times, and at least one drive enabled on the bus, otherwise, erroneous parity errors will occur to non-existent drives. Use the MASSBUS TDR Tester to isolate.
  - C. If an eight drive system is in use, the first four drives will operate properly, but the last four drives will fail intermittently. This is due to the MASSBUS load of the last drives. The first four drives will see the load as a terminator.
3. MASSBUS Cable Length Specification - The MASSBUS specification clearly states that the maximum lengths for the flat (BC06R-XX) and round (BC06S-SS) cables are 120 feet and 160 feet, respectively. A linear interpolation must be used for mixed flat and round cable systems to calculate the maximum length. See the MASSBUS TDR Tester Manual.

## Diagnostics

11/70  
CZRMP Diskless  
CZRMQ Diskless 2  
CZRMU Performance Exerciser

VAX  
EVRDA Diskless  
EVRAA Reliability

Drive  
Not Drive Caused

RM Adapter  
Terminator or Jumpers (W1 and W2)  
Cables  
M5922, M5923  
Grounds  
M7686

RH70  
Cables  
M5904  
M8152

RH780  
M8278  
M9041

If TRE is not set and no errors are present or attention is set for no reason.

RH70  
M8151  
M5904 (B)

RH780  
M8278

### 6.1.2 Control Register

BIT 14 TRANSFER ERROR (TRE)

TRE indicates that an error occurred in either the RH controller or the Disk Drive. This error condition is the OR-ing of DLT, WCE, PE, NED, NEM, PGE, MXF, MDPE or an error bit in one or a combination of all three drive error registers.

### 6.1.3 Control Register

BIT 15 SPECIAL CONDITION (SC)

SC indicates that an error condition exists thru the TRE bit being set by MCPE. Also attention will set SC because of a normal condition such as the drive coming on line, or the completion of a positioning command. SC could set for either a normal or abnormal condition, it is just a flag for something happened.

Diagnostics

Depending on the error condition, all including DECX11

## DRIVE

Normally or abnormally the drive going on or offline will set SC thru the attention bit. Check for error conditions.

## RM ADAPTER

Check for error bits. If none set these modules may cause the problem if attention is set.

M7686  
M5922, M5923

Diagnostic

All including DECX11

Drive

RM Adapter

Check the error registers and refer to the specific error bit section of this manual.

If no errors are present

RH70  
M8151  
M8150

RH780  
M8278

If TRE is not set and no errors are present or attention is set for no reason.

RH70  
M8151  
M5904 (B)

RH780  
M8278

## 6.2 STATUS REGISTER

### 6.2.1 Status Register

BIT 08 MASSBUS DATA PARITY ERROR (MDPE) - RH70  
BIT 08 - RH780

An MDPE indicates a parity error was detected on the synchronous (data) bus lines during a read type data command. (Read, Read Header and Data, Write Check or Write Check Header and Data). The error could be caused anywhere from the RM Adapter to the RH.

## THINGS TO KNOW WHEN TROUBLESHOOTING MDPE ERRORS

1. The number one cause of MASSBUS Parity Errors (especially on installations) seems to be in the cabling. Check the following:

- A. Check the connections of the BC06R cables at the M5904's RH70 (Berg connector). The drain wire on the flat cable sometimes shorts against the etch on the M5904. This effects Data Bits 00, 06, or 12.
  - B. Check the connections of BC06R cables at the ZIF (Zero Insertion Force) connector located on the panel on the bottom rear of the cabinet.
  - C. Visually inspect the cable insulation on the BC06R cables for damage, kinks, breaks and other signs of wear.
  - D. A visual inspection of all ZIF connector mating pins.
  - E. Inspect the MASSBUS terminator for bent pins, and broken or cracked resistor packs. MASSBUS terminators which have broken or cracked resistor packs will give intermittent parity errors.
2. To isolate solid MDPE problems, there are several features that will help out.
- A. The maintenance switches on the M5922 and M5923 will disable all transceivers on that bus, for that drive.
  - B. In multiple RM05 installations, break the MASSBUS and move the terminator in order to isolate the problem. Remember, the MASSBUS must be terminated at all times, and at least one drive enabled on the bus, otherwise, erroneous parity errors will occur to non-existent drives. Also use the MASSBUS TDR Tester.
  - C. If an eight drive system is in use, the first four drives will operate properly, but the last four drives will fail intermittently. This is due to the MASSBUS load of the last drives. The first four will see the load as a terminator.
3. MASSBUS Cable Length Specification - The MASSBUS specification clearly states that the maximum lengths for the flat (BC06R-XX) and round (BC06S-XX) cables are 120 feet and 160 feet, respectively. A linear interpolation must be used for mixed flat and round cable systems to calculate the maximum length. See the MASSBUS TDR Tester Manual.

## Diagnostics

11/70

CZRMQ Diskless 2  
CZRMN Functional 2  
CZRMO Functional 3  
CZRMU Performance Exerciser

VAX

EVRDA Diskless  
EVRDB Functional  
EVRAA Reliability

Drive

DCL

Cables

M7685  
M5922, M5923

RH70

Cables

M5904  
M8150

RH780

M8277

M9041

### 6.2.2 Status Register

BIT 09 MISSED TRANSFER (MXF)

MXF indicates that the drive did not respond to a data transfer command within 650 msec for an RH70. Basically what happens is three conditions may cause this error condition. The first one being that the RH decoded a Data transfer command and the RM Adapter did not decode it or respond to it by sending "Occupied" back to the RH via the MASSBUS.

The second reason is that "EBL" from the RM Adapter via the MASSBUS was not received in the RH at the end of the sector with the word counter cleared (run cleared). The best thing to do is scope for "Occupied" or "EBL" if no other Diagnostics errors are present. It is possible to get MXF errors with other error conditions.

The third reason is that in an eight drive system, the first four drives will operate properly, but the last four drives will fail intermittently. The reason being is because of the MASSBUS load of the last drives. The first four drives will see the load as a terminator. Also check the MASSBUS terminator for broken or cracked resistor packs. This will give you intermittent parity errors in addition to a missed transfer error.

## Diagnostics

11/70

CZRMQ Diskless 2  
CZRMN Functional 2  
CZRMO Functional 3  
CZRMU Performance

VAX

EVRDA Diskless  
EVRDB Functional  
EVRAA Reliability

Drive  
Not Drive Caused

RM Adapter  
MASBUS Cable  
M5922, M5923  
M7686  
M7684

RH70  
Cable  
M5604-B or C  
M8151

RH780  
M8278  
M8277  
M9041

### 6.2.3 Status Register

Bit 10 PROGRAM ERROR (PGE)

PGE indicates for the RH70 & RH780 that software attempted to initiate a data transfer operation while currently performing one. In addition for the RH780, the program tried to load, MAP, VAR, or byte counter, or set maintenance mode during a data transfer command. Also for the RH750 an attempt to initiate a unacceptable data transfer command.

### Diagnostics

11/70  
CZRMQ Diskless 2  
CZRMN Functional 2  
CZRMO Functional 3

VAX  
EVRDA Diskless  
EVRDB Functional  
EVRAA Reliability

Drive  
Not a Drive Problem

RH70  
M8151

RH780  
M8278  
M8276

### 6.2.4 Status Register

Bit 11 NON EXISTANT MEMORY (NEM)

NEM sets when the controller is performing a DMA transfer and the memory address specified in the Bus address register is non-existent.

This problem can be caused by:

1. Software
2. Defective Memory Stack
3. Hardware problem with the Bus Address Register or error detection logic.

Diagnostics

11/70  
DECEX 11

VAX

RH70  
M8151  
M8152

RH780  
M8276  
M8275

6.2.5 Status Register

BIT 12 NON EXISTENT DRIVE (NED)  
BIT 18

RH70  
RH780

NED Sets when a program reads or writes a drive register in a drive which does not exist or is powered down. Essentially what happens is that the RH did not received "Transfer" on the MASSBUS 1.5 Usec after "Demand" was transmitted over the MASSBUS from the RH. Several things could cause NED.

1. Mass Fail is asserted. See para. 5.1
2. Drives are disabled by the enable switch on the M5922 or M5923.
3. Drive select lines or Logic is defective.
4. MASSBUS failure of "Demand" and or "Transfer" in the RH, RM Adapter, or MASSBUS cabling.
5. DEV Selected negated in RM Adapter.

Diagnostics

11/70  
CZRMP Diskless 1

VAX  
ERVDA Diskless

Drive  
Power on?

RM Adapter  
RM Adapter not powered on  
MASSBUS cables  
M7686  
M5922, M5923

RH70  
Cables  
M5904 (C)  
M8151  
M8153

RH780  
M8278  
M8276

### 6.2.6 Status Register

BIT 13 PARITY ERROR (PE)

PE indicates a parity error from memory is detected while the controller is performing a Write or Write-Check command.

Diagnostics

DECX11

Drive

Not a Drive Problem

RH70

M8152

M8151

### 6.2.7 Status Register

BIT 14 WRITE CHECK ERROR (WCE)

- RH70

BIT 09 & 10

- RH780

WCE sets when the controller is performing a write check operation and a word on the disk does not match the corresponding word in memory.

The thing to be aware of on troubleshooting WCE's is the status of the data check error bit. If Data Check is set with WCE set, the word on the Disk itself was read incorrectly. In other words, ignore the WCE.

If WCE is set alone one of two things happen. Data was changed on the parallel transfer to the RM Adapter or the Data was changed from the RM Adapter to memory.

Areas that could cause WCE.

1. MASSBUS - if an even number of bits were effected since parity would not detect this problem.
2. Data Transceiver in RH.
3. Incorrect Data Patterns on Pack when running Performance Exerciser.
4. NPR timing is bad. - 11/70

## Diagnostics

11/70

CZRMQ Diskless 2  
CZRMN Functional 2  
CZRMNO Functional 3  
CZRMU Performance Exerciser

VAX

EVRDA Diskless  
EVRDB Functional  
EVRAA Reliability

Drive

Could be if DCK set

RM Adapter

M7685  
M5922, M5923  
Cables

RH70

M8150  
M5904  
Cables

RH780

M8277  
M8275

The processor could also cause WCE.

### 6.2.8 Status Register

BIT 15 DATA LATE ERROR (DLT)  
BIT 11

- RH70  
- RH780

DLT Sets when the controller is unable to supply a data word during a write operation or accept a data word during a read/write check operation at the time the drive demands a transfer.

Usually DLT indicates a severely overloaded Bus but hardware problems with "Sync Clk" can also cause the error.

## Diagnostics

11/70

CZRMN Functional 2  
CZRMO Functional 3  
CZRMU Performance Exerciser  
DECEX 11

VAX

EVRDB Functional  
EVRAA Reliability

Drive

Not Drive Caused

RM Adapter

M7685  
M5922, M5923

RH70

M8151  
M8150

RH780

M8277  
M8276  
M9041

### 6.3 ERROR REGISTER 1

### 6.3.1 Error Register 1

#### BIT 00 ILLEGAL FUNCTION (ILF)

ILF indicates that an invalid function code was loaded into the control register (CSI). It is possible for the control bus to cause this error but usually bit 03 (parity error) of RMER1 will show up intermittently by itself.

#### Diagnostic

11/70  
CZRMP Diskless 1

VAX  
EVRDA Diskless  
EVRDA Diskless

Drive  
Not Drive Caused

RM Adapter  
M7686  
Software

See Parity Error

### 6.3.2 Error Register 1

#### BIT 01 ILLEGAL REGISTER (ILR)

ILR indicates a register address greater than 17 was selected. Normally a software flag-but several logic faults-can cause the error. They are the error detect, RH, and MASSBUS logic.

#### Diagnostics

11/70  
CZRMQ Diskless 1  
CZRMQ Diskless 2

VAX  
EVRDA Diskless

Drive  
Not Drive Caused

RM Adapter  
M7686  
M5922, M5923  
Terminator

RH70  
M5904

RH780  
M8278  
M9041

### 6.3.3 Error Register 1

#### BIT 02 REGISTER MODIFICATION REFUSED (RMR)

RMR indicates that an attempt was made to write a register, except the Attention Summary and Maintenance Register, when the "GO" bit was set.

## Diagnostics

11/70  
CZRMP Diskless 1

VAX  
EVRDA Diskless

Drive  
Not Drive Caused

RM Adapter  
M7686  
M5922, M5923

RH70  
M5904

RH780  
M8278

### 6.3.4 Error Register 1

BIT 03 PARITY ERROR (PAR)

PAR indicates a Parity error occurred while writing into an RM register or when Bit 03 (DPE) of RMER2 is set.

Normally indicates even parity was detected on the Control Bus lines or that even parity was detected on the Data Bus if Bit 03 (DPE) of RMER2 is set.

## Diagnostics

11/70  
CZRMP Diskless 1  
CZRMP Diskless 2  
CZRMM Functional 1  
CZRMN Functional 2  
CZRMO Functional 3  
CZRMU Performance Exerciser

VAX  
EVRDA Diskless  
EVRDB Functional  
EVRAA Reliability

Drive  
Not Drive Caused

RM Adapter  
Control Bus - M7686  
M5922, M5923  
Cables  
Terminator

Data Bus - See bit 03 of RMER2

RH70  
M5904  
M8152

RH780  
Cables  
M8278

### 6.3.5 Error Register 1

BIT 04 FORMAT ERROR (FER)

FER normally indicates that the wrong pack format is being used or the software did not condition the Format Bit in RMOF.

Abnormally it means bit 12 of the first header word was dropped but HCRC will indicate this. If HCRC is set, isolate the problem as a read error. See DCK..

### Diagnostics

11/70

CZRMP Diskless 1  
CZRMQ Diskless 2  
CZRML Format  
CZRMM Functional 1  
CZRMN Functional 2  
CZRMO Functional 3

VAX

EVRDA Diskless  
EVRDB Functional  
EVRAA Reliability

Drive

Pack Format  
If caused by a read  
see DCK

RM Adapter

M7685  
M7686

### 6.3.6 Error Register 1

BIT 05 WRITE CLOCK FAILURE (WCF)

WCF indicates, during a Write Header & Data or Write Data command, that the MASSBUS signal "Write Clock" was not received at the RM adapter after a "Sync Clock" was sent to the RH from the RM.

### Diagnostics

11/70

CZRMQ Diskless 2  
CZRMN Functional 2  
CZRMO Functional 3  
CZRMU Performance Exerciser

VAX

EVRDA Diskless  
EVRDB Functional  
EVRAA Reliability

Drive

Not Drive Caused

RM Adapter

M7686  
M5922, M5923

RH70

M5904 - C

RH780

M8277  
M9041

### 6.3.7 Error Register 1

BIT 06 ERROR CORRECTION HARD (ECH)

ECH indicates, at the end of an error correction, a non-ECC correctable error. Normally set with Bit 15 (DCK) of RMER1 during a uncorrectable ECC error. ECH should never be set without DCK. See DCK.

## Diagnostics

11/70  
CZRMP Diskless 1  
CZRMQ Diskless 2

VAX  
EVRDA Diskless

Drive  
ECH alone not drive  
caused. See DCK

RM Adapter  
M7685  
M7686

### 6.3.8 Error Register 1

#### BIT 07 HEADER COMPARE ERROR (HCE)

HCE indicates, without HCRC, FME, or BSE, that one of three mis-compares occurred.

#### NOTE

Head crash may also be a cause of HCE errors.

1. The Cylinder Address register and the first header word are not equal indicating:
  - a. Servo mis-position - this is usually associated with SKI errors.
  - b. Incorrect pack format
  - c. Logic failure - RM Adapter
2. The Track Address register and the track address portion of the second header are not equal indicating:
  - a. Head mis-selection - Drive logic
  - b. Incorrect pack format
  - c. Head plugs switched
  - d. Logic failure - RM Adapter
3. The Sector Address register and the sector address portion of the second header word are not equal indicating:
  - a. Incorrect pack format
  - b. Logic failure - RM adapter

## Diagnostics

11/70  
CZRMP Diskless 1  
CZRMQ Diskless  
CZRMV Extended Drive  
CZRMU Performance \*

VAX  
EVRDA Diskless  
EVRDB Functional

\* Gives header info on HCE's.

<u>Drive</u>	<u>RM Adapter</u>
<u>MIS-POSITION</u>	<u>M7684</u>
Servo adjustment	
A12, A08, A20, A07	
A19, A18, A02, A06	
Servo Preamp	
Servo Power Amp	
Velocity Transducer	
Servo Head/Servo Head Crash	
Carriage Way Bearings	
Arcing Coil or Flex Strip	
HEAD MIS-SELECT	M7684
A02, A01, A08	
E05	
Head Plugs Switched	
SECTOR MIS-SELECT	
A06, A10, A01, A02	M7684
May be associated with	M7685
OPI and DTE Errors.	
NO MIS-COMPARES	M7684
	M7685
	M7686

### 6.3.9 Error Register 1

#### BIT 08 HEADER CRC (HCRC)

HCRC indicates a read error in the header. When a compared bit is picked or dropped; HCE, BSE, or FER may be set. When an uncompared bit is picked, just HCRC will be set. If solid HCRC's are present or intermittent HCRC without; HCE, BSE, OR FER, the CRC logic is chief suspect. HCRC set with the other header error bits and random DCK indicates a problem with the read logic. See DCK.

### Diagnostics

#### 11/70

CZRMP Diskless 1  
 CZRMQ Diskless 2  
 CZRMM Functional 1  
 CZRMN Functional 2  
 CZRMO Functional 3  
 CZRMV Performance\*  
 \*SWR = 3; Size = 156

#### VAX

EVRDA Diskless  
 EVRDB Functional  
 EVRAA Reliability

<u>Drive</u>	<u>RM Adapter</u>
See DCK	M7685
	M7686

### 6.3.10 Error Register 1

#### BIT 09 ADDRESS OVERFLOW ERROR (AOE)

AOE indicates that a data transfer was requested beyond the last address of the pack - CYL 822, TRK 18, SECT 31. This occurs when the word count register large enough to cause a mid transfer seek beyond the last block. LBT of RMDS will also be set.

#### Diagnostics

11/70  
CZRMP Diskless 1  
CZRMQ Diskless 2  
CZRMN Functional 2  
CZRMV Performance

VAX  
EVRDA Diskless  
EVRDB Functional  
EVRAA Reliability

Drive  
Not Drive Caused

RM Adapter  
M7685  
M7686

Software  
Operating Software

### 6.3.11 Error Register 1

#### BIT 10 ILLEGAL ADDRESS ERROR (IAE)

IAE indicates that a value beyond the maximum RM05 Cylinder or Sector/Track address spectrum was written into either register and was flagged when the "Go" bit was set.

#### Diagnostic

11/70  
CZRMP Diskless 1  
CZRMQ Diskless 2  
CZRMM Functional 1  
CZRMN Functional 2  
CZRMN Functional 2

VAX  
EVRDA Diskless  
EVRDB Functional

Drive  
Not Drive Caused

RM Adapter  
M7685  
M7686

Software  
Operating Software

SEE PARITY ERROR - 6.3.4

### 6.3.12 Error Register I

#### BIT 11 WRITE LOCK ERROR (WLE)

WLE indicates that a write command was issued to a write locked drive.

#### Diagnostics

##### 11/70

CZRMP Diskless 1  
CZRMP Diskless 2  
CZRMM Functional 1  
CZRMM Functional 2

##### VAX

EVRDA Diskless  
EVRDB Functional

##### Drive

A01, A09  
Write Lock Switch

##### RM Adapter

M7684  
M7686  
Operator Error

### 6.3.13 Error Register 1

#### BIT 12 DRIVE TIMING (DTE)

DTE indicates more than one Sector Pulse occurred within a sector. This can be attributed to three areas:

1. Pack formatted incorrectly
2. Sector pulse generation logic. This may be associated with OPI errors. - Drive.
3. No read data from the drive into the RM Adapter.
4. Could be one of the first signs of a head crash.

#### Diagnostics

##### 11/70

CZRMP Diskless 1  
CZRMP Dskless 2  
CZRMM Functional 1  
CZRMM Functional 2  
CZRMO Functional 3  
CZRM1 Formatter  
CZRMO Performance

##### VAX

EVRDA Diskless  
EVRDB Functional  
EVRAC Formatter  
EVRAA Reliability

##### Drive

Pack Format  
A06, A01, A10, A13  
A15, A14, E03, E04  
R/W Head if just one  
track affected

##### RM Adapter

M7687  
M7684  
M7686

### 6.3.14 Error Register 1

#### BIT 13 OPERATION INCOMPLETE (OPI)

OPI indicates one of three problems:

1. No activity on the drive interface within 300ns after a seek is initiated by the RM Adapter.
2. The correct sector is not found in three index pulses - The Sector Address register does not equal the Sector Counter of the drive.
3. Run is not asserted within 20ms after the "GO" bit is set for a data transfer command.

#### Diagnostics

11/70

CZRMP Diskless 1  
CZRMQ Diskless 2  
CZRMM Functional 1  
CZRMN Functional 2  
CZRMO Functional 3  
CZRMU Performance

VAX

EVRDA Diskless  
EVRDB Functional  
EVRAA Reliability

Drive

Sector Problem  
A06, A10, A01, A02

RM Adapter

M7684  
M7686

No Drive Interface Activity  
A02, A12, A07

M7684  
M7686

Run Problem  
Not Drive Caused

RH70  
M5904  
M8152  
MASSBUS  
Cables

RH780  
M8277  
M8276  
M9041

### 6.3.15 Error Register 1

#### BIT 14 UNSAFE (UNS)

UNS indicates that a AC low condition exists with the RM Adapter power supply or that the drive has a Device Check error. See DVC.

## Diagnostics

11/70

All diagnostics  
are applicable

VAX

See DVC if set

Drive

Only if DVC is Set  
See DVC

RM Adapter

Low AC power input  
15 volt regulator  
M7686

### 6.3.16 Error Register 1

#### BIT 15 DATA CHECK ERROR (DCK)

DCK error without ECH indicates that one or more bits were picked or dropped in the data field within a 11 bit burst. With ECH, it indicates that more than 11 bits were picked or dropped in a row, or that two bits seperated by more than 11 bits were picked or dropped. Also if a bit was dropped or picked in the ECC field will set DCK. DCK usually indicates the drive is having a read problem. Other symptoms of drive read problems and not just ECC logic faults are; header errors with HCRC set; recoverable DTE's.

#### Causes of Read Errors

1. Read logic in the drive
2. Write logic in the drive
3. Servo logic
4. Pack
5. EMI noise

A good point to remember when using the performance exerciser program; is when a data check with or without ECH occurs during a write check, or write check header and data command, (51 or 52), with no data compare errors, this strongly indicates a ECC logic problem which is in the RM Adapter.

When troubleshooting, things to note are where and how errors are occurring.

TRACK - 1) All one track but different sectors indicates matrix, head, or even the pack.

2) All one track, same sector, cylinders consecutively close - indicates scratched pack.

3) Check for head crashes.

HIGH CYLINDERS - indicates read or write problem with drive.

RANDOM CYLINDERS - indicates possible drive problem. but if HCE, FME, and BSE occur with HCRC this clinches the drive. If no other errors are present the ECC logic may be at fault.

COMPATIBILITY - if packs are swapped between drives and errors are on one track head alignment may be required. Also, if errors occur only on high and low cylinders, carriage alignment may be necessary.

SERVO ERRORS - if SKI errors are present as well as data errors, tackle the servo error first.

### Diagnostics

#### 11/70

CZRMQ Diskless 2  
CZRMN Functional 1  
CZRMO Functional 3  
CZRMT Compatability  
CZRMV Extended Drive  
CZRMU Performance  
CZRML Formatter

#### VAX

EVRDA Diskless  
EVRDB Functional  
EVRAA Reliability  
EVRDC Formatter

#### Drive Indicatives:

1. Random, high density areas.
2. HCRC errors.
3. Surface related - track
4. Carriage ground.

#### RM Adapter Indicates:

1. Random without regard to high or low cylinders without HCRC.
2. No WRT CHK error with DCK error using the diagnostics on a WRT check command (51 or 53).

#### Drive

##### Pack

A14, A15, A10  
E03, E04, E05,  
R/W Head

#### RM Adapter

M7685  
M7687  
M7686  
A&B cables not grounded

A02, A19, A20 \*  
Servo Preamp \*  
Servo Power Amp \*  
Spindle Ground  
Spindle \*

\* These may be associated with W+R OFF CYL Faults

## 6.4 ERROR REGISTER 2

### 6.4.1 Error Register 2

#### BIT 03 DATA PARITY ERROR (DPE)

DPE indicates even parity was detected during a Write Data or Write Data and Header Command. This bit also sets Bit 03 (PAR) of RMER1. Since parity is checked at the output of the shift register in the RM Adapter, The DPE could occur anywhere from the shift register back to the RH.

#### Diagnostics

11/70

CZRMQ Diskless 2  
CZRMN Functional 2  
CZRMO Functional 3  
CZRMU Performance

VAX

EVRDA Diskless  
EVRDB Functional  
EVRAA Reliability

Drive

Not Drive Caused

RM Adapter

M7685  
M7686  
M5922, M5923  
Terminator  
Cables

### 6.4.2 Error Register 2

#### BIT 07 DEVICE CHECK (DVC)

DVC indicates one of six drive fault conditions.

1. Write Fault
  - a. Head winding shorted - replace head.
  - b. Write Driver output low.
  - c. Input current to Write Driver low.
  - d. +22 volts to Write Driver low.
  - e. No write transitions with Write Gate asserted.
2. Head Select Fault - multiple head select. Usually a bad head.
3. Write and Read Fault - simultaneous Write and Read Gate.
4. ON Cylinder Fault - On Cylinder goes away while reading or writing.
5. Voltage Fault - 46v, 5v, or 20v positive or negative voltage is low.
6. Servo Fault - No dibits 350ms after the head load sequence begins. No LED Indicator.

## Diagnostics

11/70

CZRMP Diskless 1  
CZRMQ Diskless 2  
CZRMM Functional 2  
CZRMN Functional 3  
CZRMO Extended Drive  
CZRMU Performance

VAX

EVRDA Diskless  
EVRDB Functional  
EVRAA Reliability

Drive

Write Fault  
A17, A10, A13, A02, A19, A01  
E02, E01

RM Adapter

M7684  
M7686  
-15volt supply  
glitches

Head Select Fault  
A17, E01, E05, E04 A08  
A01, A02

Write and Read Fault  
A17, A02, A19, E01, A13  
A01, A14, A15

On Cyl W+R Fault  
Pack  
A17, A02, A19, E02, A07  
A08, A20,  
Servo Preamp  
Servo Power amp  
Spindle

### 6.4.3 Error Register 2

BIT 10 LOSS OF BIT CLOCK (LBC)

LBC indicates that Bit Clock transitions were absent longer than 400ns. Bit Clock is derived from Read Clock and Servo Clock.

## Diagnostics

11/70

CZRMP Diskless 1  
CZRMQ Diskless 2  
CZRMM Functional 2  
CZRMO Functional 3  
CZRMU Performance

VAX

EVRDA Diskless  
EVRDB Functional  
EVRAA Reliability

Drive

A01, A15, A10  
Cable

RM Adapter

M7687  
M7686

#### 6.4.4 Error Register 2

##### BIT 11 LOSS OF SYSTEM CLOCK (LSC)

LSC indicates one of two problems.

1. With the "Go" Bit reset, System clock transition are absent longer than 3usecs.
2. With the "Go" Bit set, there is an absence of Prom address changes.
3. With the "Go" Bit set and Bit clock disappears, LBC and LSC will both be set.

#### Diagnostics

11/70

Same as Loss of Bit Clock

VAX

Same as Loss of Bit Clock

Drive

See LBC if LBC is set.

RM Adapter

M7684

M7686

M7687 if LBC set

#### 6.4.5 Error Register 2

##### BIT 12 INVALID COMMAND (IVC)

IVC indicates that "Volume Valid" or "Unit Ready" is not asserted when any command except "Read In Preset" or "Pack Acknowledge" is attempted.

#### Diagnostics

11/70

CZRMP Diskless 1

CZRMQ Diskless 2

CZRMM Functional 1

CZRMN Functional 2

VAX

EVRDA Diskless

EVRDB Functional

Drive

A17, A01

Cable

RM Adapter

M7684

M7686

#### 6.4.6 Error Register 2

##### BIT 13 OPERATOR PLUG ERROR (OPE)

OPE indicates the drive address plug is removed.

## Diagnostics

11/70  
All

VAX  
All

Drive  
Address plug removed.  
A17, Cable

RM Adapter  
M7684  
M7686

### 6.4.7 Error Register 2

#### BIT 14 SEEK INCOMPLETE (SKI)

SKI indicates one of three problems in the servo logic:

1. The drive is unable to do a seek within 500ms.
2. The Forward or Reverse EOT's (guard bands) were detected while heads are supposed to be On Cylinder or while seeks are being performed. EOT's could be detected for three reasons:
  - a. A mis-position occurred and the drive was forced to EOT on the next seek. Related to b. below.
  - b. Velocity problem caused an overshoot of the servo into the EOT. This would occur when seeking close to cylinders 0 and 822.
  - c. Faulty end of travel (EOT) detect logic.
3. A cylinder address greater than 822 was loaded into the drive. This SKI error should not occur unless there is an interface problem between the drive and the RM Adapter. This is because the RM Adapter would flag an Invalid Address Error and abort the command before loading a bogus cylinder address into the drive. If there were an interface problem other symptoms would be noticed. HCE due to head mis-selection, commands such as Read, Write, RTZ, improperly functioning. This form of SKI could also be due to faulty error logic.

## Diagnostics

11/70  
CZRMQ Diskless 2  
CZRMN Functional 2  
CZRMU Extended  
CZRMU Performance

VAX  
EVRDA Diskless  
EVRDB Functional  
EVRAA Reliability

<u>Drive</u>	<u>RM Adapter</u>
A08, A07, A06, A19,	M7684
A12, A18, A20, A02	M7686
Servo Power Amp	
Transducer	
Servo Preamp	
Servo Head	
Binding Carriage Way Bearings	

#### 6.4.8 Error Register 2

##### BIT 15 BAD SECTOR ERROR (BSE)

BSE indicates that bit 14 and or 15 of the first header word were read as a 0. Bit 14 and 15 are written as a zero to indicate a bad sector. This error is transparent to the operating system error log or during diagnostics because the format programs will flag these bad sectors in the Bad Sector File. The error will show up during a read error but HCRC will also be set.

#### Diagnostics

<u>11/70</u>	<u>VAX</u>
CZRMP Diskless 1	EVRDA Diskless
CZRMQ Diskless 2	EVRDB Functional
CZRMN Functional 2	EVRDC Formatter
CZRMO Functional 3	EVRAA Reliability
CZRML Formatter	
CZRMU Performance Exerciser	

<u>Drive</u>	<u>RM Adapter</u>
Not Drive Caused If	M7685
No Read Errors. See DCK	M7686
If Read Errors Are Present	M5922, M5923

## 7.0 BOOTSTRAP PROBLEMS

Bootstrap problems are one of the very common symptoms expressed by customers and may indicate any of a variety of problems throughout the system. Briefly, the bootstrap is a small program that tells the disk to read (Cyl 0, Sector 0, head 0) 1 block (256 words) into memory. This block contains a program that reads more programs off the disk into memory that forms the Operating System Monitor. The system is then considered "up" and ready to accept commands from the customer's operator. This entire operation assumes the basic system components (CPU, Memory, System Disk and Unibus) to be functioning completely. When this operation fails, there are a few basic steps to follow that should isolate any hardware problems:

1. Halt the CPU (do not hit the start switch which issues a system Init) and examine the disk registers for any error bits. If there are any error bit indications proceed to the section in this manual for that bit. If no error condition exists, examine the 11/70 maintenance registers or the standard PDP11 Memory parity registers for any error indications.
2. Determine if there are any other disk packs on site that have a bootable image and try them. Be sure not to use the "only" customer backup. A diagnostic pack is usually a good choice (keep it write protected). Also remember the "Expand" Operating System does not use interrupts like the customer's software.
3. If you have a multi-drive system, try to boot the pack on another drive. This may determine if you have a compatibility or data base corruption problem (see appropriate section).
4. If no other packs are available, try to bootstrap another device such as a tape unit, Floppy disk, etc. In order to run some diagnostics. Be sure to use the CPU instruction exerciser, test ROM Bootstrap, basic disk subsystem diagnostics. If no problems are found there is still the possibility of device interaction problems on the Unibus. DECX-11 should be run to isolate this type of problem.

If no apparent hardware problem can be found, you must assume the data on the pack to be corrupted. Please refer to the section on Data Base Corruption.

## 8.0 COMPATIBILITY

Compatibility is the ability to interchange media between like disk drives and read the data on the packs within the error rate Spec for the drive. Compatibility is made possible by keeping the mechanical tolerances that are defined by the head alignment and carriage way procedures.

It is possible to have what seems to be a compatibility problem between drives but really is an ELECTRICAL PROBLEM due to misadjustment or a defective component.

### 8.1 COMPATIBILITY PROBLEMS

Compatibility problems are defined as an inability of a drive to read data on a pack that was written on a different drive or drives. Two distinct areas arise, the data was written incorrectly (uncommon) or a drive is reading incorrectly (more common). There are also two data areas in each sector that are usually recorded on different drives. The header area is recorded only when the pack is formatted and the data area can be written at any time the system is in use. It is useful to determine on which drive the pack was formatted and on how many drives the pack has been used in order to isolate which drive has a problem. Please note that each of the two data areas (Header and Data) have separate error symptoms that are helpful in isolating the failing drive. Here are some hints on isolating a drive problem:

- Insure each drive runs the Performance Exerciser (11/70 - CZRMU) or Reliability (VAX - EVRAA) diagnostic on a scratch pack that is formatted on that same drive. Please note that bad spots may or may not be picked up on all drives.
- If on a 11/70, run the Compatability diagnostic (CZRMT).
- If on a VAX, run Formatter EVRAC and format the first drive. Then move the pack to the next (or suspect) drive and run "Read All". Any errors would indicate a drive is having problems reading the original data. If all drives have problems reading the pack, a problem should be suspected in the original drive where the pack was formatted.
- If the compatibility problem appears only on customer data packs be sure to have the customer back up his data before alignments, or replacing hardware.

## 8.2 INCOMPATIBILITY SYMPTOMS

The following items are causes of incompatibility symptoms:

1. Head Alignment
2. Carriage Way Alignment
3. Dirty Heads
4. Write Current - E01, E02, A12
5. Bad Pack

## 8.3 ERROR SYMPTOMS

The following is a list of error symptoms encountered when compatibility problems exist. Also included are the most probable failing unit and/or adjustment needed to correct the problem:

- DCK errors are the most common error symptom of drive incompatibility. It is usually common to a specific head or heads. If this symptom exists head alignment is most probably needed on one of the drives. If alignment is OK then a bad head or head matrix card E04 may be at fault. Be sure to try to simulate the failure with more than one pack as a pack could also exhibit this type of symptom.

HCRC errors indicate that the pack format may not be compatible. In this case, head alignment, a bad head or matrix module E04 may be at fault again. When faced with this type of problem, be sure to determine on which drive the pack was originally formatted and if any head alignments have been performed since that time. Constant HCRC errors between drive may indicate a possible miscalculation of the Header CRC word in one of the drives and would be due to a failure of the M7685.

- If the problem was isolated to a drive that is writing data that is incompatible with other drives the probable failing circuits would be the Write Precompensation (A13), write current source (E01, E02, A13), or the Matrix Module E04.

## 9.0 DATA BASE CORRUPTION

This section addresses problems that involve a loss of a customer's data. The common symptoms are; the system "hung", "crashed", "deteriorated" and can't be brought up without rebuilding the packs from a back-up tape or back-up disk packs. This problem becomes very hard to isolate because the error logging file on the disk is usually highly intermittent. Because of the customer's sensitivity to this type of failure, the success of isolating this type of failure hinges on a good action plan (isolation technique) that is explained to the customer. This type of failures can be attributed to the disk subsystem and also to such areas as the CPU, Unibus, memory, memory management, or even software. The following is a general isolation process that one could use:

- Determine the immediate history of whole system through talking with the operators, users, customer, other engineers, etc. Check previous error logs for evidence of any intermittent positioning problems such as HCE's, or SKI that would indicate a drive going to the wrong place on the pack. When checking the error log, be sure to note any system type errors (this would indicate a CPU Unibus or Memory type problem). Check field service reports, site logs, etc. to get additional information.
- Check for a history of MASSBUS Parity Errors either in error Register 1 or for a MASSBUS Data parity error in the RH Control Status I Register. Parity detection has one big fault - If you drop an even number of bits you do not detect an error. So it is possible to transfer data to or from the disk without knowledge of losing or destroying data.
- If you suspect the system disk drive on a multi-drive system, change unit numbers so that the system Disk resides on a different drive. In this case the error log file may be available to analyze if you suspect a disk problem on the original system disk drive.
- Note any changes in the environment such as installation of new equipment (add ons, air conditioners, or other office or industrial equipment) that would affect the power, loading, grounding, etc. on the system. Power fluctuation, ground failures, improper phase/load balancing have a high probability of causing these type of problems. Have an environmental specialist check the site if necessary. Be aware of any heat, humidity or static conditions that may be excessive.

- When you do get system time to run diagnostics, be sure to start all the CPU, Floating Point (if applicable,) Mem Mgmt, and memory diagnostics before you start with disk diagnostics (unless you have discovered in steps 1,2, and 3 that you definitely have a disk problem).

While running diagnostics check all the power supplies on the system - especially the +5volt regulators for the CPU, Mem, RH and RM Adapter. Vibration testing may also be helpful in isolating these problems. (Please use discretion as to the severity).

- If you have a DECX11 system exerciser, be sure to vary the default word count values in each I/O module for the tapes and disks on the system. When running the exerciser allow for at least one full pass of relocation thru all available memory.
- If you have isolated the failure to the disk subsystem and not to a particular drive there may be a quick way to isolate the RH controller by using another RH that may be on the system. This usually only involves changing some jumpers for the CSR, Vector Address, and number of registers for the specific device. In the 11/70, be sure to try the RH70 in another backplane slot.
- If you isolate the problem to the RM05 drive itself and have no error bit symptoms to go on, the drive is writing indiscriminately on the pack and the problem is in the write circuits. This can be verified by taking the corrupted pack and doing a spiral read header and data of the pack. Remember you must have previous knowledge of any bad spots on the pack; any new bad sectors indicate there was a write error that was unrecoverable that caused the data corruption. For the 11/70, use the Performance Exerciser diagnostic (CZRMU), Load and start address 204, "R" Command with SWR = 3. For VAX, use Formatter (EVRAC) "Read All" command. WRITE PROTECT THE DRIVE!!!

#### NOTE

Above all, keep the customer informed on what you are doing, why you are doing it and the complexity of trying to troubleshoot this type of problem.

## 10.0 DRIVE NOT READY OR DRIVE HANGS

This section deals with problems where the only symptoms are that the drive drops offline or appears to hang up (cannot be accessed by the software). This section should not be referenced when an actual hardware error, such as DVC has caused the drive to go "Offline".

There are three basic symptoms to look for in these types of problems.

- Loss of the VV Bit due to loss of MOL. See IVC.
- Loss Volume Valid (VV bit) without the loss of MOL. See IVC.
- Drive does not return to a ready condition after a command and does not have any specific error symptom. This symptom typically evidences itself intermittently under the customer's operating system and can be caused by numerous problems throughout the system. In order to isolate this type of failure, one must be on site when the failure occurs, halt the system and examine the RM05 registers. Pay particular notice to drive ready (bit 7 of the RMDS) not set and the status of the following bits: VV, MOL, PIP, GO, DPR, DRQ or PSEL.

The condition of these bits indicate the area of the failure, i.e. the RM05 logic. Specific failures will depend on the conditions exemplified by these status bits. Also see RM02/03 Technical Tip on Fault Card latching or errors.

11.0 DUAL PORT PROBLEMS

This section addresses typical problems with symptoms described as "dual port access: "CR port hang/select". All Port arbitration logic is located in the RM Adapter and provides the function of deciding which MASSBUS accesses the drive at any one time. Nearly all dual port related problems can be isolated to the M7686 module, one of the M5922 or M5923 MASSBUS transceivers, or a MASSBUS cable (BC06S or BC06R). There are several things one should know about the dual port option:

- The dual port option is implemented by a jumper on the RM Adapter backplane. In addition to the jumper on the backplane two M5923 modules, and the MASSBUS cables for Port B are also required.

Dual Port

Single Port

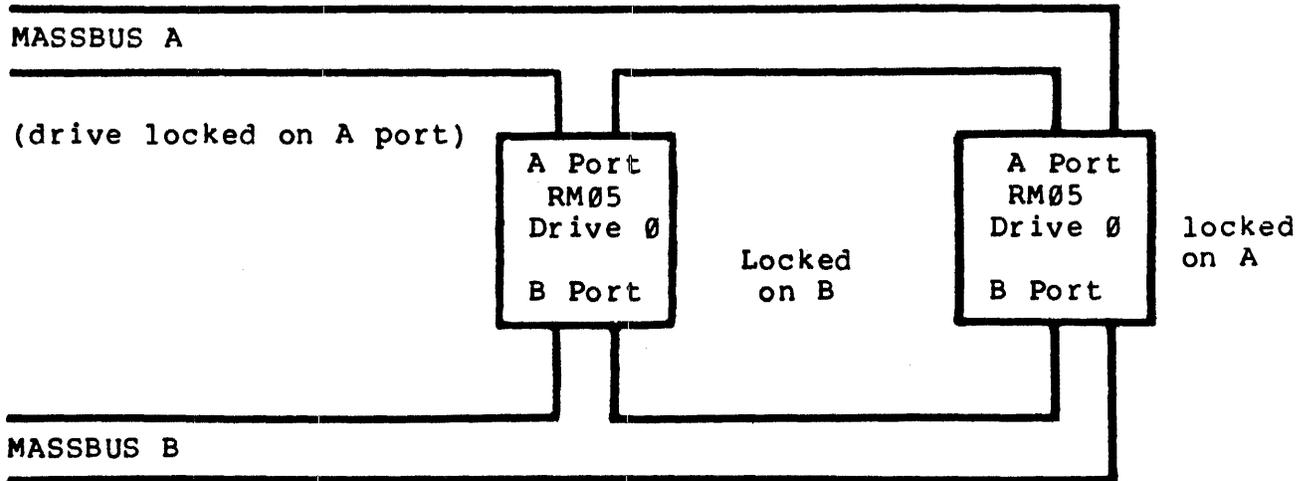
backplane jumper 5 - 6 out, of J1

jumper 5 - 6 in J1

- There may not be two drives with the same unit number physically cabled on the same massbus even though they may be selected on alternate ports.

EXAMPLE:

ILLEGAL CONFIGURATION



- The port select switch cannot be changed once the heads are loaded, but will not effect the port selection until MOL goes from low to high. This occurs when the pack is spun down, and back up again. The normal port select switch change would occur whenever the pack is changed.

- "Init" pulse does not clear the drive Attn bit if the drive is selected on the other port. (i.e. Unibus Init doesn't clear ATA bit when the drive is select locked on B port). Be careful when running DECX11 as it uses unibus "Init" to clear Attention bits. In order to clear Attention bits on opposite ports, the attention summary register (RMAS) must be written with a "one" to the corresponding Attention bit even though the drive is locked on the other port.

EXAMPLE: If dual ported drive 1 is locked on the A port, the B port Attention bit can only be cleared by writing a 000002 to the RMAS register on the B MASSBUS.

- Customer written handler for dual ported drives have been known to have problems when dealing with the RPAS register. One reason is that the upper byte of the RPAS register may be read as all "ones" or all "zeros" depending on the condition of the Attn bits on the opposite port. Be sure that customers use "byte" instructions when addressing the RMAS register.
- For 11/70 systems, the Performance Exerciser (CZRMU) is ideal for worse case diagnostic testing. Run Performance Exerciser from each CPU simultaneously.

## 12.0 PACK ERRORS

In the RM05, as in all other third generation or higher disk drives, the pack has become part of the electronics. This is due to the special information that is prerecorded at time of manufacturing on the "servo surface" of the pack. This information is used both for positioning (in seekings & Track following) and for timing to synchronize data being written and read on the other "data surfaces" of the pack. Because of the complexity of these packs the RM05-P is the only pack we recommend and furthermore, the RM05 error rate specifications apply to only RM05's with RM05-P packs. We have no control over the packs of other vendors that may or may not function satisfactorily in the RM05. We test each pack before we sell it.

- No errors allowed on cylinder 0, track 0 and 1, because this is the boot area.
- No errors allowed on cylinder 822, track 18, because this is the Bad Sector File area.
- Not more than 20 uncorrectable sectors per "P" packs; no uncorrectable errors per "PX" packs; not more than 48 defective sectors per pack and not more than 10 errors per surface. See 12.4.
- If you have a pack that exceeds any of these conditions, it should not be used for customer applications or as a diagnostic media (XXDP). It could however be used as a scratch pack on which to run diagnostics.
- Random DCH errors could be generated by a pack. You may also run into a pack that has one surface that gives DCK's & ECH's. This usually looks like a head problem.
- Intermittent HCE & SKI errors may be attributed to a pack with excessive radial runout of the servo tracks (pack wobble) or worn spindle bearings. This can be checked by using the procedure in the Drive Hardware Maintenance Manual under "Track Following Check" - Page 2-80 of the Installation & Check Out Section.
- HCRC and DTE errors can be caused by bad spots on the pack. If these errors occur consistently on specific addresses, this indicates the pack is at fault. These errors due to the pack should be classified as unrecoverable (hard) errors and flagged in the bad block map of the operating system. The Formatter program will also flag them.

### 13.0 UNEXPECTED ATTENTION BITS

Attention bits are indicator (flag) bits to the RH (CPU controller) that some important event has occurred in an RM05 (including the RM Adapter) on the MASSBUS. This bit is used for program interrupts to software (either operating systems or diagnostics). Each drive has a separate attention bit and dual ported drives have 2 attention bits; one for the A Port and one for the B Port. The condition of the Attn bit is sampled as bit 15 of the RMDS register. Each drive's bit is also accessible in the RMAS register; the bit position in the register corresponds to the drive unit number i.e., bit 0 of the RMAS register is the Attention bit setting is usually caused by something happening in Drive 0. It is rarely a problem by itself.

Please note the following hints:

- If you intend to work on a drive off-line throw both switches on the M5922 or M5923 modules, this will disable all signals, including Attention bits, from the MASSBUS. This would be advisable when using the RM05 Field Test Unit if the customer is running on other drives on the system.
- Be aware that MASSBUS parity is not used when accessing the RMAS register on the MASSBUS.
- Any "hung" Attn Bits (with no other indications such as MCPE, MDPE or PAR) is usually traced to the M7686.
- Many Diagnostic error printouts begin with "Unexpected Attention" or "Attention from an Off-line Unit." These are rarely Attn bit problems and only indicate that one of the conditions described in Table 13-1 has occurred.
- Attn in the RH sets SC (bit 14 of RMCS1) which sets Intr which causes the trap (program interrupt).

The following is a Table of conditions that set the Attention bit; take notice of the condition of port selection in order to see if both A and/or B bits are set or cleared.

TABLE 13-1

CONDITION	ATTN/BIT	PORT SELECTED
1. Power up of RM05.	set	Both A & B set regardless of the Port selected.
2. Any error condition detected in RMER1, RMER2. (Attn will not set for errors in the upper byte of RMCS2 or the TRE and MCPE conditions).	set	Only the Attn bit of the selected port.
3. Successful completion of a seek command.	set	Only the Attn bit of the selected port.
4. Successful completion of an Offset or Return to Centerline command.	set	Only the Attn bit of the selected port.
5. Any change MOL bit (the online condition either the drive going online, offline, or into standby).	set	Both A & B set regardless of port selected.
6. In Dual Port Programmable mode, a port request is made and the drive is busy on the other port, when the drive is released the Attn bit sets on the requesting port.	set	The requesting port's bit set.
7. Unibus Init or drive clear command.	clr.	Clear Attn bit only on drives selected on the port issuing the command or Init.
8. Issuing any command with the Go bit set.	clr.	Only the Attn bit of the selected port.
9. Writing a 1 in the RMAS position the respective drive	clr.	any corresponding Attn bit on that particular bus regardless of port selection.

## 14.0 ADJUSTMENTS

If the drive adjustments; negative or positive 5 volt, Course Position Gain Integrator Gain, and Fine Velocity Gain are found to be grossly off, replace the associated module providing you know no one has tampered with the adjustment-previous to your checking.

The reason for module replacement is that a component has degraded drastically, and it would be better to replace the module now, than to do an adjustment and have another failure shortly afterwards.

### 14.1 SERVO ADJUSTMENTS

Extended Drive RM05 11/70 diagnostic (CZRMV) and Functional RM05 VAX diagnostic (EVRDB) timing tests are a great tool for troubleshooting velocity problems. Remember that a KW11P Clock is necessary to do the timing tests on the 11/70.

Two known symptoms that the timing test indicates are:

1. Forward and Reverse Seek times differ more than 1 milli-second.
2. The Maximum Seek Time is too slow although the Average Seek time is at the minimum.

Both these symptoms indicate a problem. Usually A20, A19, or A07 can cause the problem, but the Servo Power Amp or the Velocity Transducer can also.

### 14.2 FINE VELOCITY GAIN

In some cases when the head load occurs osciallation will start.

If oscillation of the positions exists, Fine Velocity Gain is adjusted too far off. Readjustment will correct the oscillations.

- Scope test point C of of the A20 card.
- Observe the 500 Hz sinewave.
- Adjust the pot until the sinewave dissappears. You are now within specifications range for timing adjustments.

If oscillation persists change the Tack Rod Magnet. This is done because the Tack Rod Magnet is of low magnetism. This will cause the field in the coil to collapse and the result will be that the heads will have maximum velocity, and hit the crash stop.

### 14.3 HEAD ALIGNMENT

If head alignment is necessary and the offset is more than 200MV, have the customer back up all his packs that were written on the misaligned drive before doing the alignment.

## 15.0 FLOW DIAGRAMS/TEST POINTS

The flow diagram contained in this section are to aid you in troubleshooting the following areas of the RM05 Disk Drive.

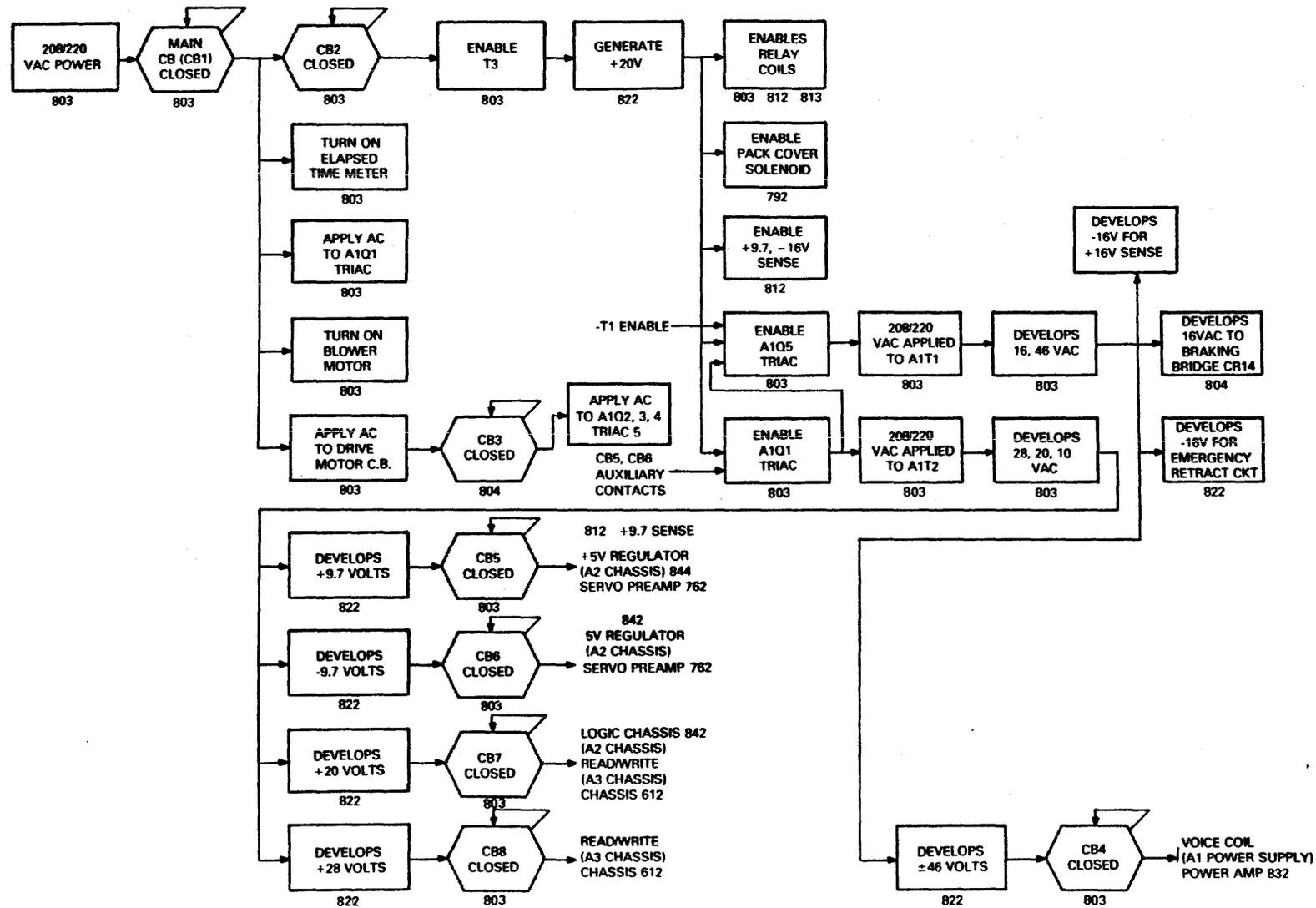
- Power Distribution (one flow)
- RM05 First Seek (four flows)
- RM05 Forward/Reverse Seek (four flows)
- NRZ to MFM Write Data (two flows)
- RM05 Unload/Power Off/Emergency Retract (two flows)

These diagrams give the print set cross reference numbers so you can correlate the flows to the print set. The flow diagrams are labeled as Figures 15-1 through 15-5.

In addition to the flow diagram there are several tables which give you the proper test points to scope. These tables are to be used in conjunction with the flow diagrams. The tables will list the following:

- Print Set Cross Reference Number
- Proper Test Point
- Signal Names

These tables are labeled as Tables 15-1 through 15-8. These tables are for both the NON-VDE and VDE versions of the RM05 drives.

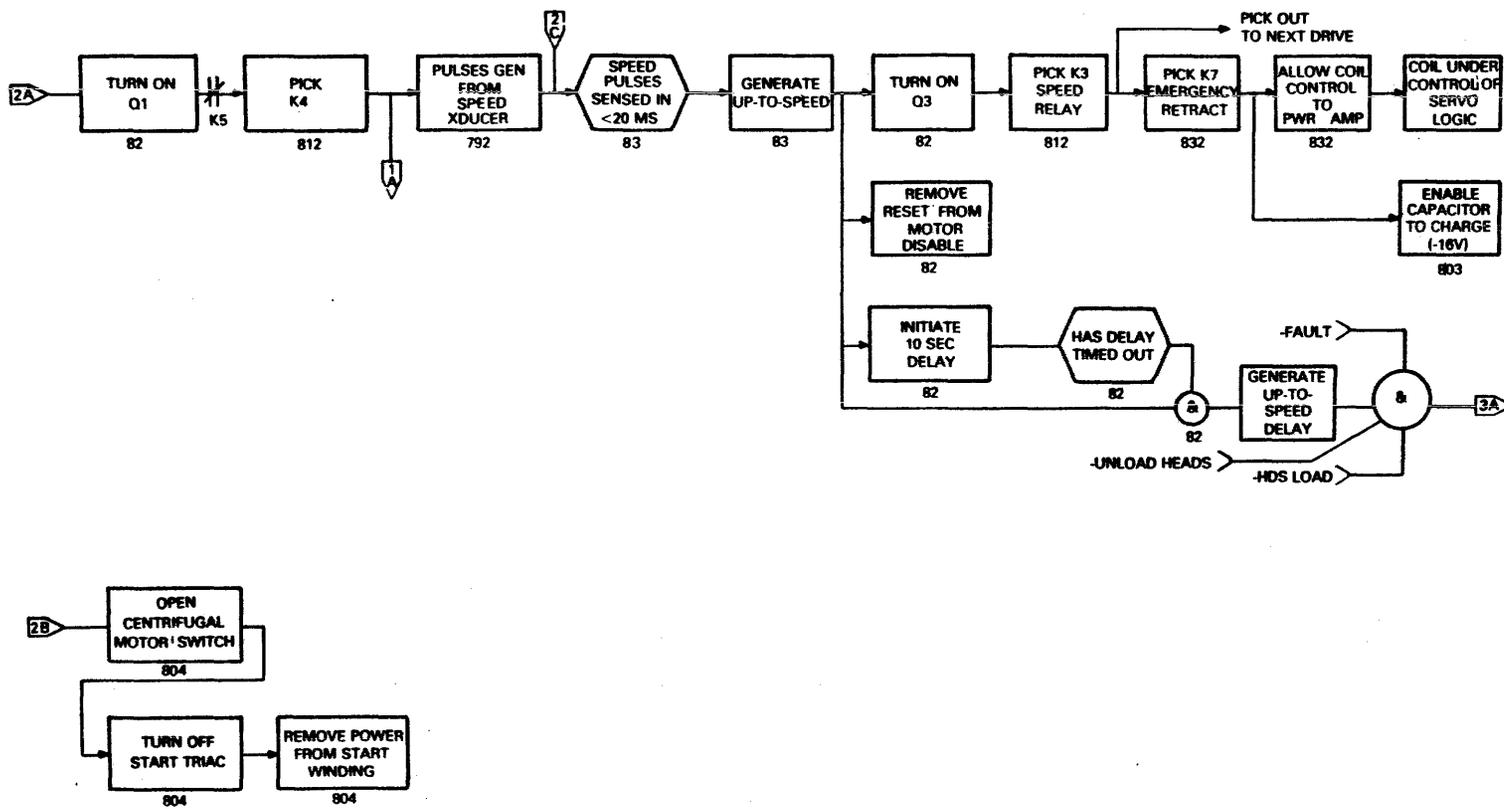


RM05 POWER DISTRIBUTION

CZ-0118

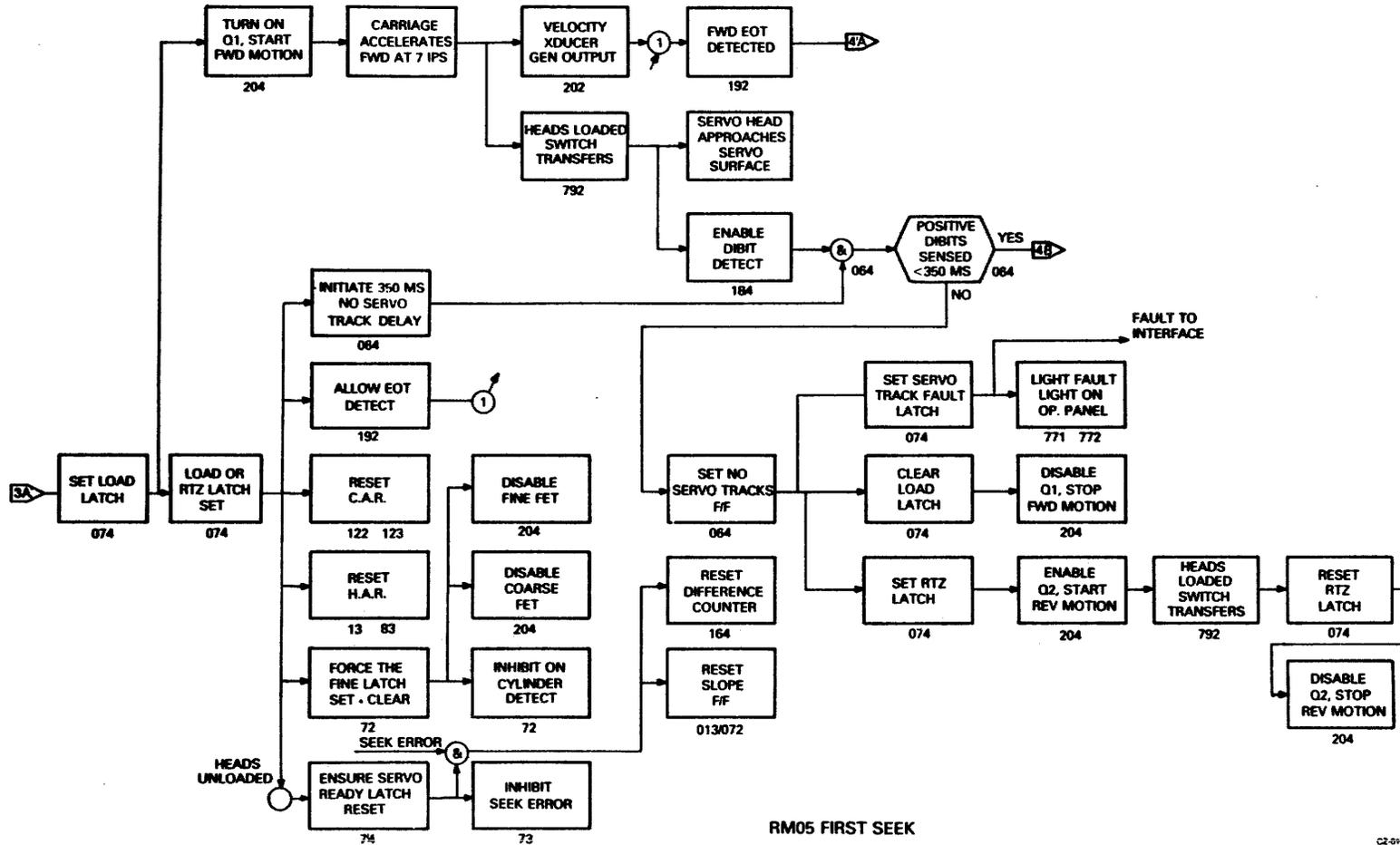
Figure 15-1 RM05 Power Distribution





C2-0100

Figure 15-2 RM05 First Seek (Sheet 2 of 4)

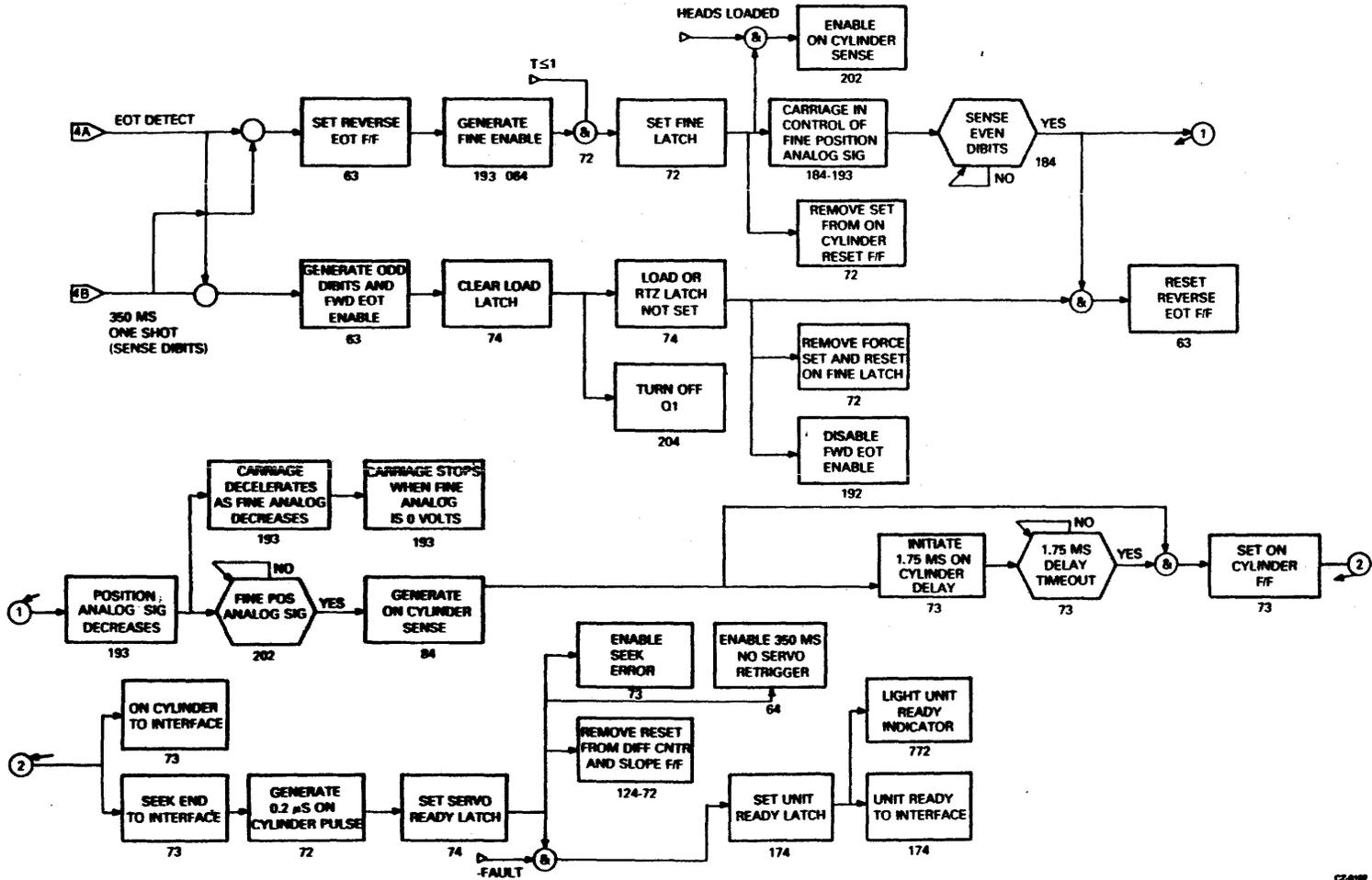


RM05 FIRST SEEK

C2-0101

Figure 15-2 RM05 First Seek (Sheet 3 of 4)

Figure 15-2 RM05 First Seek (Sheet 4 of 4)



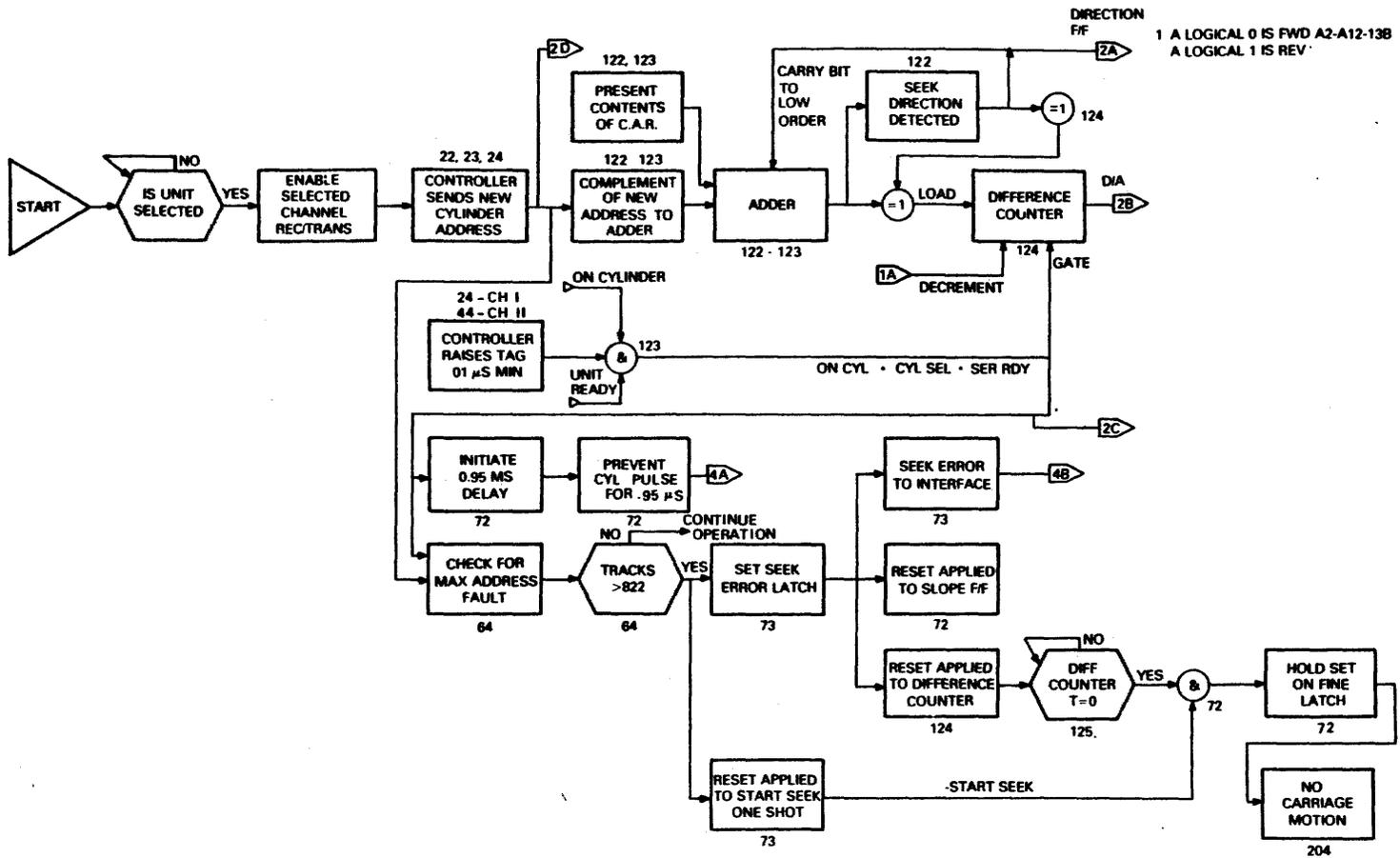
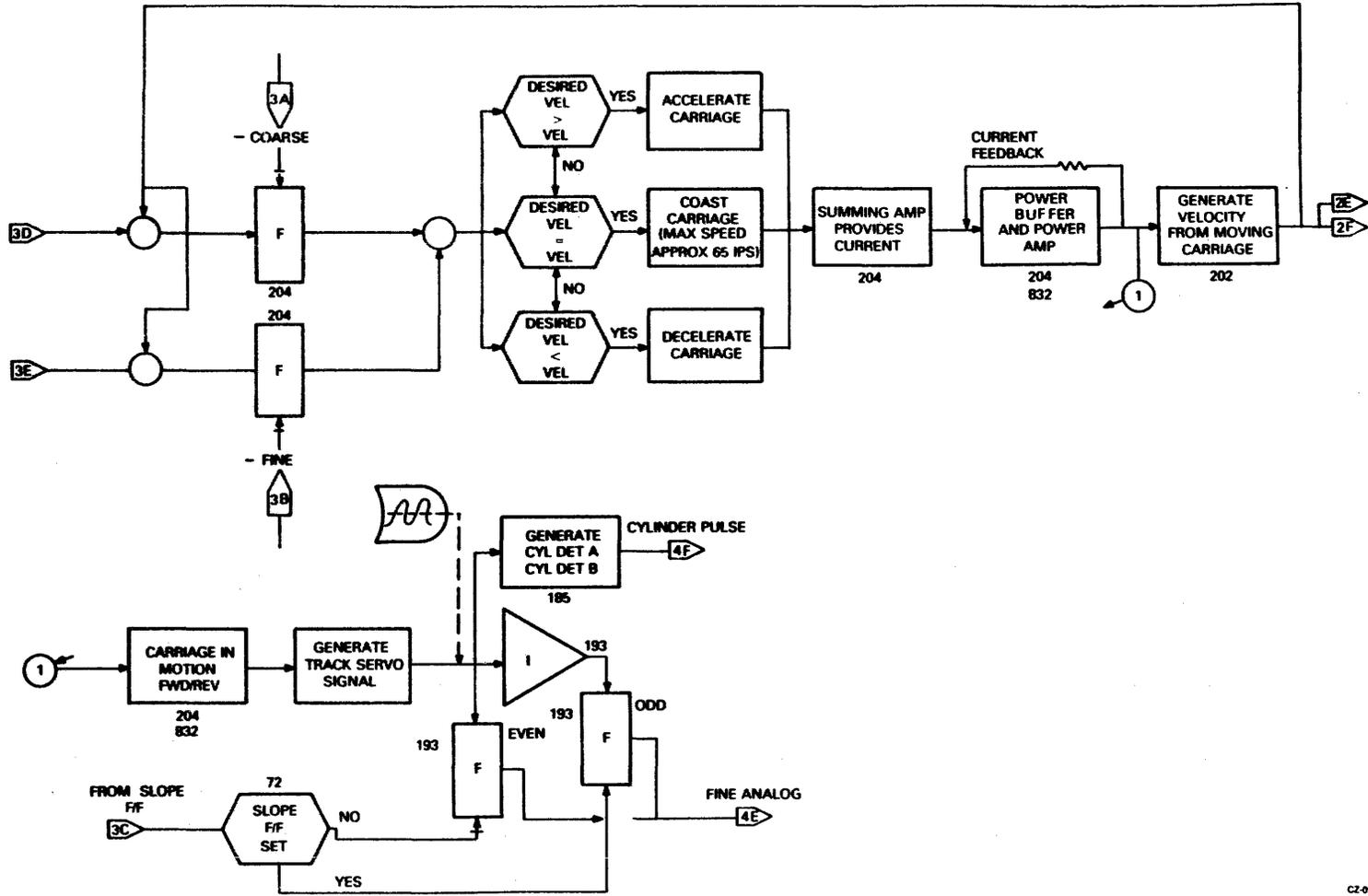


Figure 15-3 Forward/Reverse Seek (Sheet 1 of 4)



Figure 15-3 Forward/Reverse Seek (Sheet 3 of 4)





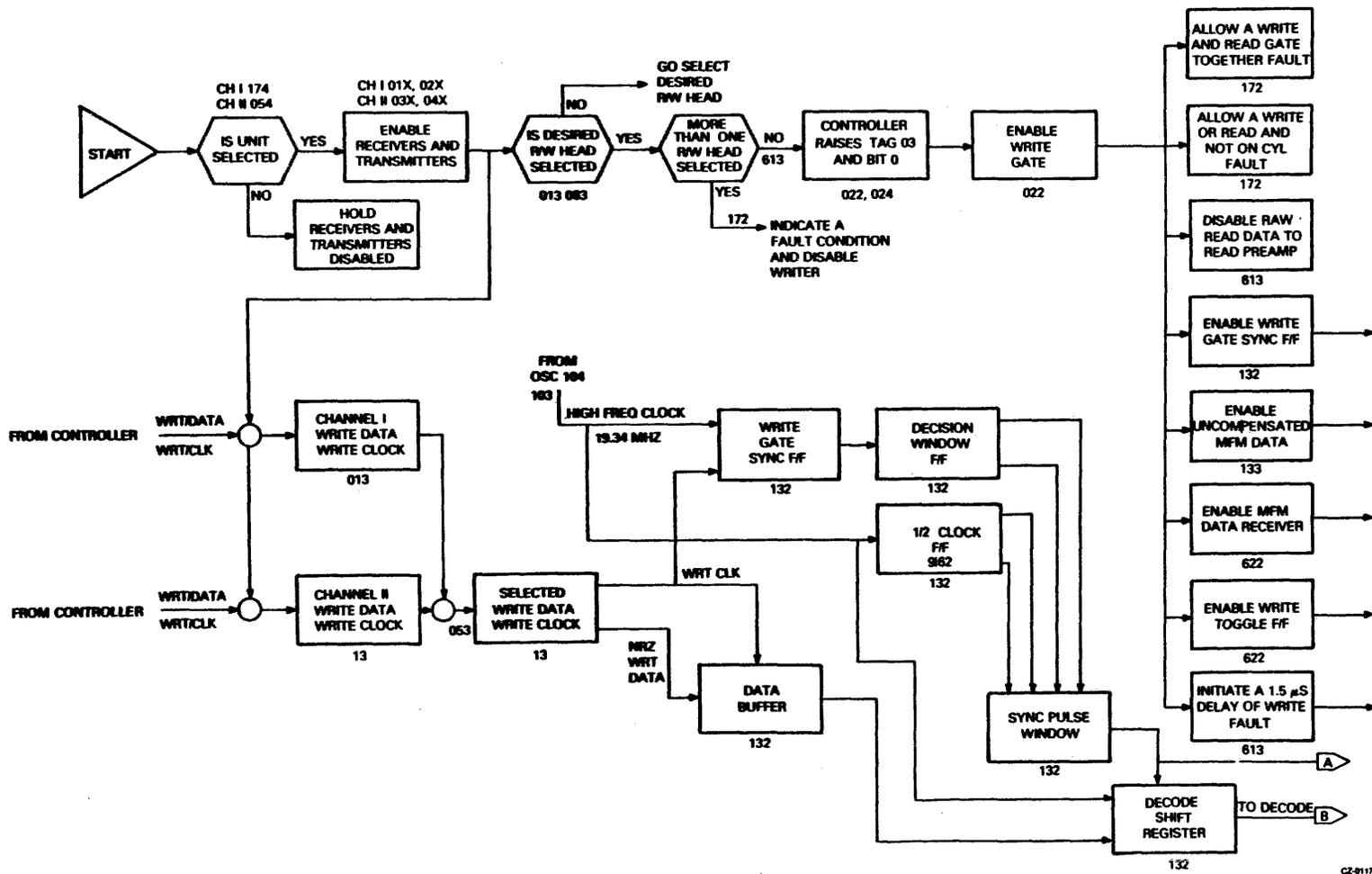
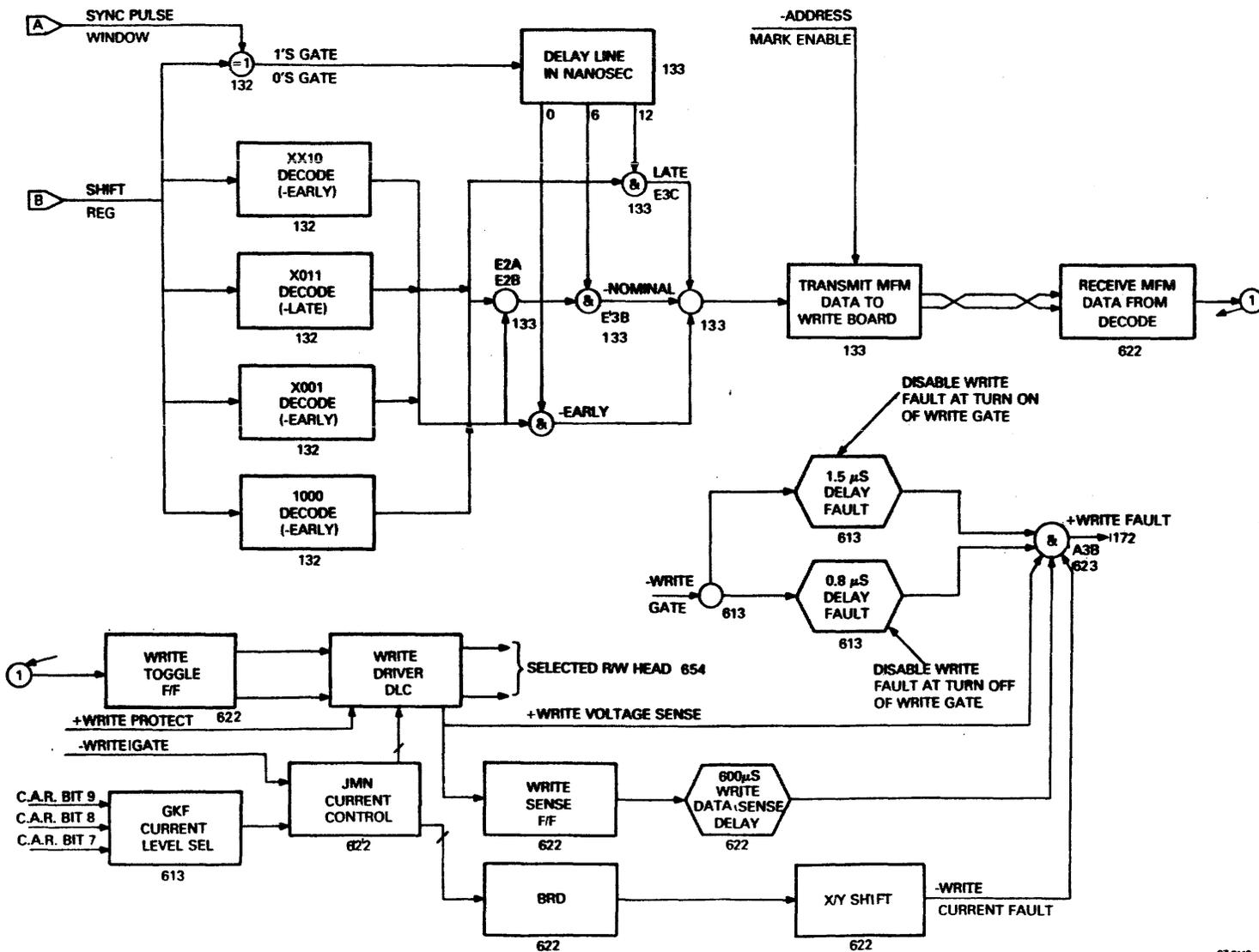
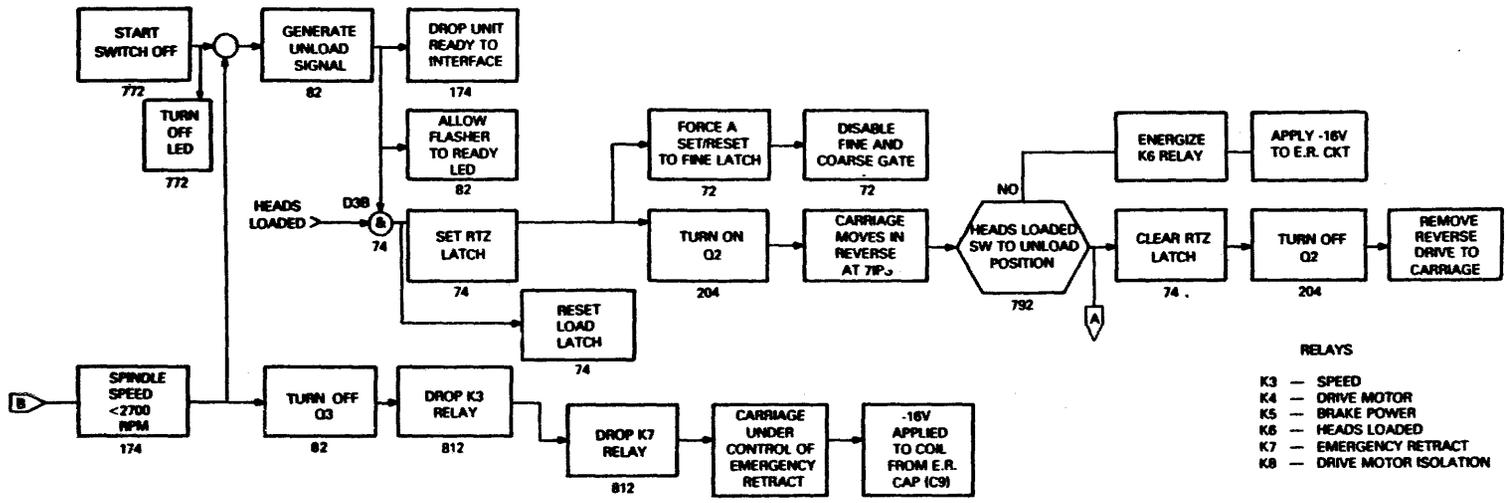


Figure 15-4 NRZ to MFM Write Data (Sheet 1 of 2)

C2-017

Figure 15-4 NRZ to MFM Write Data (Sheet 2 of 2)



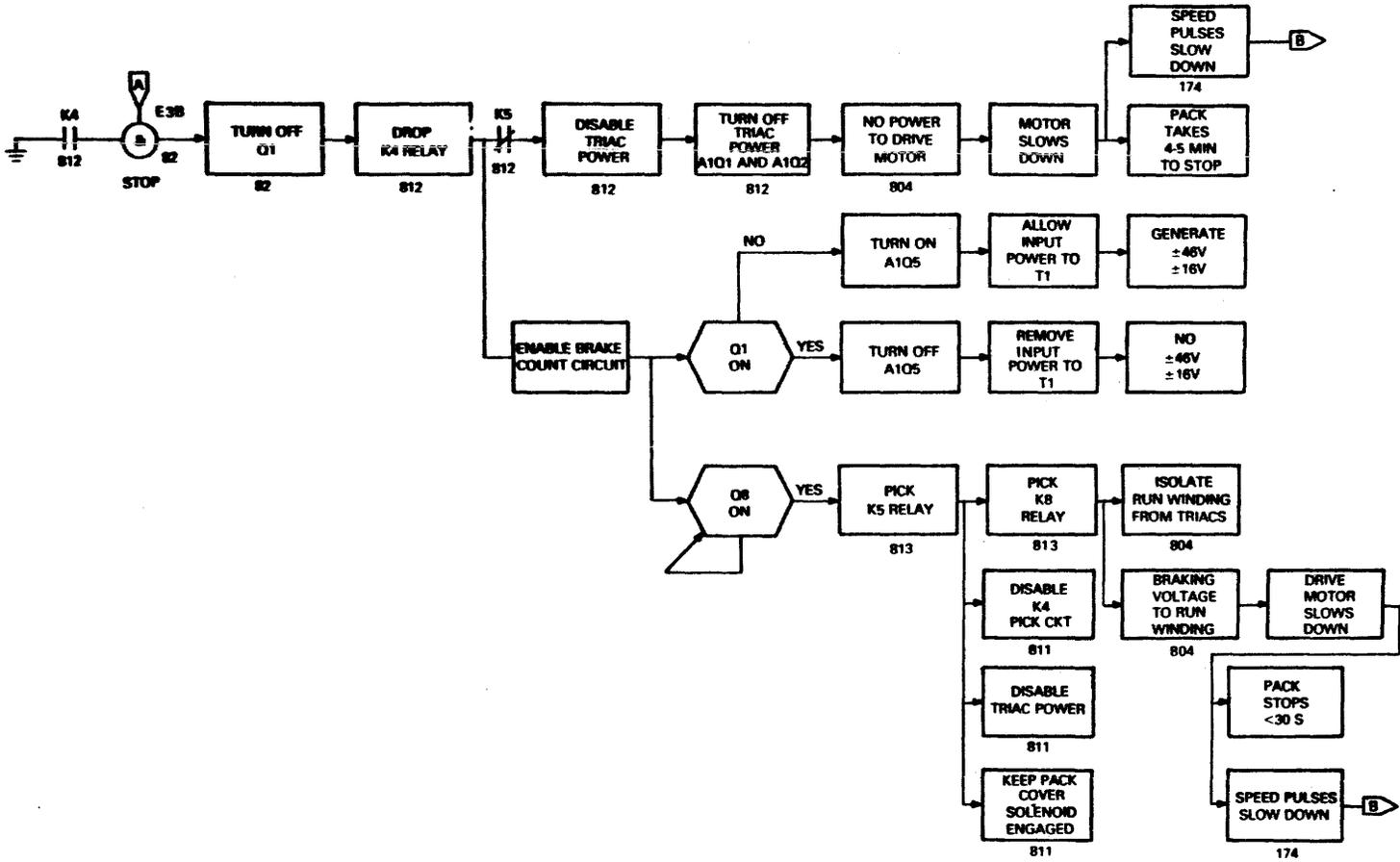


- RELAYS
- K3 — SPEED
  - K4 — DRIVE MOTOR
  - K5 — BRAKE POWER
  - K6 — HEADS LOADED
  - K7 — EMERGENCY RETRACT
  - K8 — DRIVE MOTOR ISOLATION

CZ-9108

Figure 15-5 RM05 Unload/Power Off/Emergency Retract (Sheet 1 of 2)

Figure 15-5 RM05 Unload/Power Off/Emergency  
Retract (Sheet 2 of 2)



CZ-410P

**Table 15-1 Power Distribution Test Points NON-VDE**

Print Set Cross Reference Number	Test Point	Signal Name
803	CB2A	Circuit Breaker*
822	A1TB2-5	+20 V
792	A3PJ4-A	Pack Cover Solenoid
822	A1TB1-6	-16 V
822	A1TB2-3	+9.7 V
822	A1TB2-2	-9.7 V
822	A1TB2-5	-20 V
822	A1TB2-1	+28 V
822	A1TB2-8/7	+46 V

\* Warning! Line Voltage

**Table 15-2 Power Distribution Test Points VDE**

Print Set Cross Reference Number	Test Point	Signal Name
803	CB2	Circuit Breaker
792	A3PJ4-A	Pack Cover Solenoid
804	CB6-5	+9.7v
804	CB7-6	-9.7v
804	CB8-7	+20v
804	CB8-8	-20v
804	CB3-1	+28v
804	CB5-3	+46v
804	CB5-4	-46v

**Table 15-3 First Seek Test Points NON-VDE**

Print Set Cross Reference Number	Test Point	Signal Name
803	A1TP6,7	C.B.7, +20v
803	A1TP5	C.B.6, -9.7v
803	A1TP4	C.B.5, +9v
772	J201-12B	Start
792	PA83-06B	(Start)
812	P8-06	Pick
804	J7-2,3	Motor*
804	J7-7	Motor Speed Interlock
802	J4-F	Pull Speed Relay
792	PA83-03B	Speed Pulses
174	A17-TPD	Speed Pulse Sense
173	A17-TPB	Up to Speed
082	A08-27B	Pull Speed Relay
812	P5-22	Pull Speed Relay
082	A08-TPC	Up to Speed Delay
074	A07-23B	Up to Speed Delayed

Table 15-3 First Seek Test Points NON-VDE (Cont)

Print Set Cross Reference Number	Test Point	Signal Name
204	A20-32B	Forward Current
202	A20-26A	Velocity Transducer
063	A06-16A	Forward EOT Enable
074	A07-24B	Heads Loaded
074	A07-06B	Load + RTZ
072	A07-16A	Fine
073	A07-15B	Load + RTZ + Seek Error
072	A07-04B	Slope
064	A06-06A	Set
063	A06-27A	No Servo Track
074	A07-31A	Servo Fault
204	A20-27B	Heads Load
074	A07-12B	RTZ
063	A06-30B	Rev. EOT FF
064	A06-28B	Fine Enable
063	A06-07B	Odd Dibits + Fwd EOT Enable
074	A07-29B	Heads Load
063	A06-30B	Rev. EOT FF
194	A19-22A	Fine Position Analog
072	A07-15A	On Cylinder Sense
073	A07-03B	ON CYLINDER FF
072	A07-17B	T < 1
073	A07-32A	SEEK END
072	A07-A1.7	ON CYLINDER PULSE
074	A07-10B/07B	SERVO READY
072	A07-04B	SLOPE
174	A17-12B	READY
174	A17-26B	UNIT READY
084	A08-31B	TRIGGER
203	A20-12A	TRIGGER

\* WARNING! LINE VOLTAGE

Table 15-4 First Seek Test Points VDE

PRINT SET CROSS REFERENCE NUMBER	TEST POINT	SIGNAL NAME
804	A1TP6,7	CB8, +20V
804	A1TP5	CB6, -9.7v
804	A1TP6	CB7, -9v
772	J201-12B	-Start
792	PA83-06B	(Start)
823	A1J4-4	Pick In
805	A1J7-2,3	Motor*
805	A1J6-7	Motor Speed Interblock
802	A1J4-F	Pull Speed Relay
792	PA83-03B	Speed Pulses
174	A17-TPD	Speed Pulse Sense
173	A17-TPB	Up to Speed
082	A08-27B	Pull Speed Relay
822	J4-6	Pull Speed Relay
082	A08-TPC	Up to Speed Delay
074	A07-23B	Up to Speed Delayed
204	A20-32B	Forward Current
202	A20-26A	Velocity Transducer
063	A06-16A	Forward EOT Enable
074	A07-24B	Heads Loaded
074	A07-06B	Load + RTZ
072	A07-16A	Fine
073	A07-15B	Load + RTZ + Seek
		Error
072	A07-04B	Slope
064	A06-06A	Set
063	A06-27A	No Servo Track
074	A07-31A	Servo Fault
204	A20-27B	Heads Load
074	A07-12B	RTZ
063	A06-30B	Rev. EOT FF
064	A06-28B	Fine Enable
063	A06-07B	Odd Dibits + Fwd EOT Enable
074	A07-29B	Heads Load
063	A06-30B	Rev. EOT FF
194	A19-22A	Fine Position Analog
072	A07-15A	On Cylinder Sense
073	A07-03B	On Cylinder FF
072	A07-17B	T < 1
073	A07-32A	Seek End
072	A07-A1.7	On Cylinder Pulse

Table 15-4 First Seek Test Points VDE (Cont)

PRINT SET CROSS REFERENCE NUMBER	TEST POINT	SIGNAL NAME
074	A07-10B/07B	Servo Ready
072	A07-04B	Slope
174	A17-12B	Ready
174	A17-26B	Unit Ready
084	A08-31B	Trigger
203	A20-12A	Trigger

\* Warning! Line Voltage

Table 15-5 Forward/Reverse Seek NON-VDE And VDE

Print Set Cross Reference Number	Test Point	Signal Name
022	A02-03B	+Tie High
122	A12-13B	Rev + Fwd
122	A12-07A	On Cyl & Cyl Sel & Sr Rdy
072	A07-30B	Cylinder Pulse Blanking
065	A06-33A	Maximum Address Fault
073	A07-11A	Seek Error
072	A07-04B	Slope
073	A07-TPC	Start Seek
125	A12-07B	T=0
072	A07-16A	Fine FF
122	A12-13B	Rev + Fwd
073	A07-TPB	(Seek)
073	A07-03A	On Cylinder
073	A07-32A	Seek End
125	A12-07B	T=0
072	A07-A4.B	Direction
073	A07-TPC	Start Seek
072	A07-16A	Fine FF
203	A20-A4.4	D/A Converter
203	A20-TPB	Position Converter
203	A20-C1.1	(Velocity)
204	A20-25A	Summing Amp Output
184	A18-TPF	Cylinder Pulse Detect A
184	A18-TPG	Cylinder Pulse Detect B
072	A07-04B	Slope
194	A19-22A	Fine Position Analog
072	A07-13A	Velocity Integrator Clamp
064	A06-21A	Fine Enable
072	A07-17B	T < 1
194	A19-C1.1	Fine Position Signal
194	A19-TPC	Fine Position Analog
204	A20-TPC	Current Sense
202	A20-32A	On Cylinder Sense
063	A06-16B	Forward + Reverse EOT

Table 15-5 Forward/Reverse Seek NON-VDE And VDE (Cont)

Print Set Cross Reference Number	Test Point	Signal Name
084	A08-31B	On Cylinder Sense
073	A07-11A	Seek Error
012	A01-07B	Seek Error
032	A03-07B	Seek Error
012	A01-24B	On Cylinder
032	A03-24B	On Cylinder
072	A07-A1.7	On Cylinder Pulse
125	A12-07B	T=0
084	A08-31B	Trigger*
184	A18-TPF	Trigger*
184	A18-TPG	Trigger*
062	A06-TPC	Trigger*
073	A07-30A	Trigger*
072	A07-07A	Trigger*

Table 15-6 Write Data Test Points NON-VDE and VDE

Print Set Cross Reference Number	Test Point	Signal Name
012	A01-21B	Pull Up
022	A02-03B	Tie High
032	A03-21B	Ch II Enable
042	A04-03B	Ch II Enable
612	E01-TPF	Multiple Head Select Fault
024	A02-TPB	Control Select
022	A02-27B	Write Gate
172	A17-22B	Write/Read Fault
172	A17-23B	On Cylinder (W+R) Fault
613	E01-TPC	Read Enable
132	A13-TPD	Write Gate
622	E02-08B	Write Enable
622	E02-08B	Write Enable
613	E01-TPW	Write Fault Blanking On
013	A01-10B	Write Data
013	A01-10A	Write Clock
104	A10-30B	High Frequency Clock
053	A05-16B	Write Data
053	A05-22A	Write Clock
132	A13-A4.0	Write Gate Sync
132	A13-TPE	MFM Data
132	A13-A2.6	Sync Pulse Window
132	A13-B2.3	1's Gate + 0's Gate
133	A13-27A	Compensated MFM Data
133	A13026B	Address Mark Enable
133	A13-29A/B	MFM Data
622	E02-B2.9	Write Toggle FF
612	E01-TPX	Current Control
622	E02-TPX	Write Sense

**Table 15-6 Write Data Test Points NON-VDE and VDE (Cont)**

Print Set Cross Reference Number	Test Point	Signal Name
622	E02-C2.5	Write Sense FF
622	E02-TPC	BRD
613	E01J2-07A	Write Gate
623	TPE	Write Fault
062	A06-TPC	Trigger*

**Table 15-7 Unload/Power Off/Emergency Retract Test Points NON-VDE**

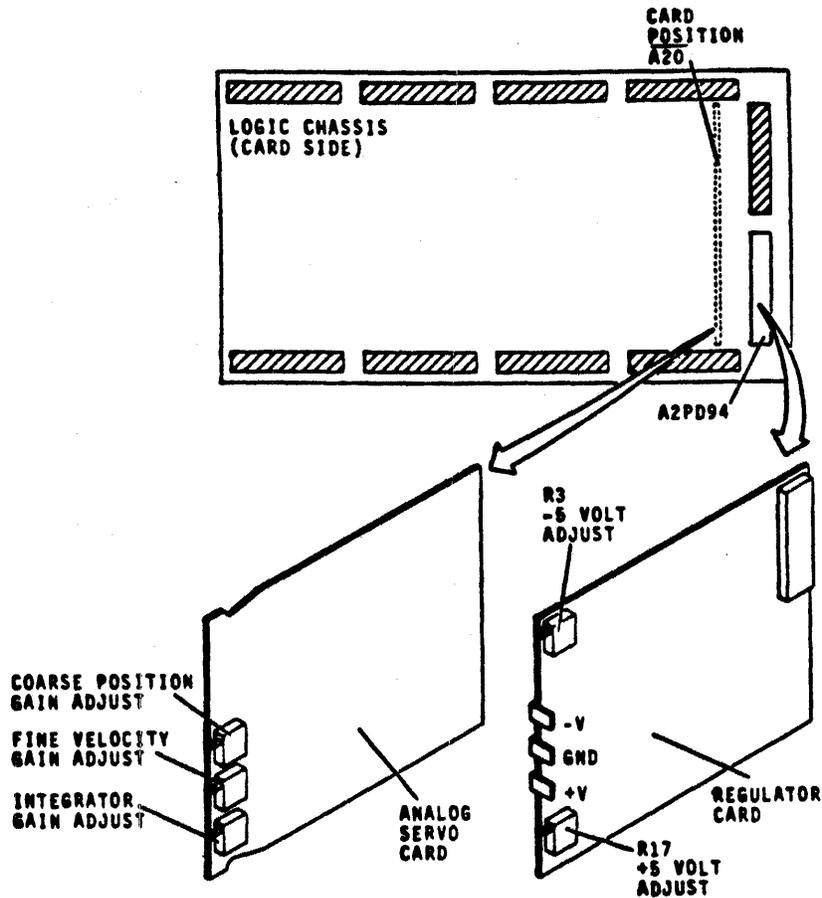
Print Set Cross Reference Number	Test Point	Signal Name
772	J201-12B	Start
082	A08-27B	Pull Speed Relay
812	AP15-22	Pull Speed Relay
803	A1P5-19	K7 Power
082	A08-24A	Unload Heads
074	A07-29B	Load Latch
074	A07-12B	RTZ Latch
074	A07-06B	(Load.RTZ)
072	A07-16A	Fine
072	A07-16B	Coarse
204	A20-B1.1	(Load.RTZ.Fine) Gate
204	A20-B1.1	(Load.RTZ.Fine) Gate
082	A08-27A	Pull Motor Relay
812	A1P5-02	PULL Motor Relay
812	A1P5-04	Triac Power
813	YFN	Brake Latch
813	A1P5-01	PULL K8

**Table 15-8 Unload/Power Off/ Emergency Retract Test Points VDE**

Print Set Cross Reference Number	Test Point	Signal Name
772	J201-12B	Start
082	A08-27B	Pull Speed Relay
822	J4-06	Pull Speed Relay
804	J1-10	-46 Emg Ret Volt
082	A08-24A	Unload Heads
074	A07-29B	Load Latch
074	A07-12B	RTZ Latch
074	A07-06B	(Load + RTZ)
072	A07-16A	Fine
072	A07-16B	Coarse
082	A08-27A	Pull Motor Relay
822	J4-9	Pull Motor Relay

NOTES

## RM05 SERVICE ADJUSTMENTS AND PROCEDURES



### +5 Volt and -5 Volt Adjustments

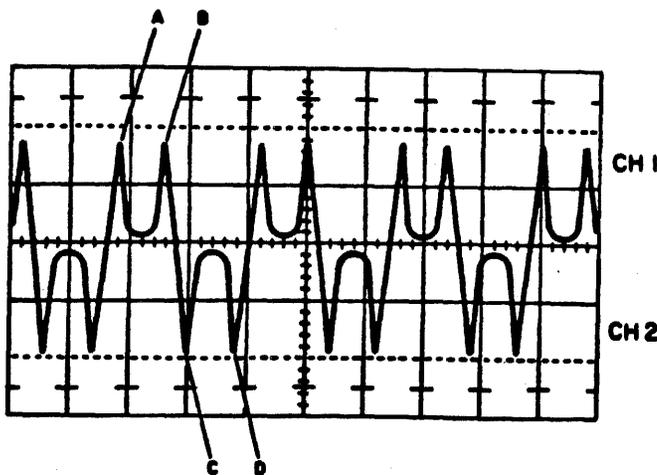
- 1.) Using the FTU or hand toggle, command continuous seeks between cylinders 000 and 128.
- 2.) Connect positive voltmeter lead to A2JD94-04A on logic backplane. Connect negative lead to GND on the regulator card.
- 3.) Adjust +5 (R17) to measure +5.1 Volts (+0.05 V).
- 4.) Connect negative voltmeter lead to A2JD94-01A on logic backplane. Connect positive lead to GND on the regulator card.
- 5.) Adjust -5 (R3) to measure -5.1 Volts (+0.05 V).

### Head Alignment Procedure

- 1.) Install head alignment card in logic rack A2. Connect FTU and meter leads.
- 2.) Mount CE pack on drive and allow it to thermally stabilize. CDC recommends that the pack be spinning with heads loaded for at least 60 minutes.

If the CE pack has just been removed from another drive which had been running for 60 minutes and the drive you are installing it on has been running for 60 minutes, then the recommended stabilization period is 15 minutes.

- 3.) Read the RM05 head alignment flow chart. Perform The servo head offset check.
  - 3A.) Set the alignment card Servo/Read-Write switch to the Servo position. Set X.1/X1 to the X1 position.
  - 3B.) Command continuous seeks between cylinders 360<sub>g</sub> and 365<sub>g</sub> for 30 seconds. Command a direct seek to cylinder 004<sub>g</sub>.
  - 3C.) Compare dibit pattern with example in this book. Toggle the Positive/Negative switch and record readings in both positions. Meter readings to the right of zero are positive and readings to the left of zero are negative. The positive value minus the negative value equals the amount off Offset. Or... (P) - (N) = OFFSET.
  - 3D.) If the amount of offset is outside the +60 mV range, there exists a problem in the servo system.
  - 3E.) Next, command a direct seek to cylinder 005<sub>g</sub>. Repeat steps 3C and 3D. Add offset readings from cylinders 004<sub>g</sub> and 005<sub>g</sub>. This sum should range between +75 mV and -75 mV. If it doesn't, you have a problem in the servo system.



BALANCED DIBIT PATTERN

OSCILLOSCOPE  
SETTINGS

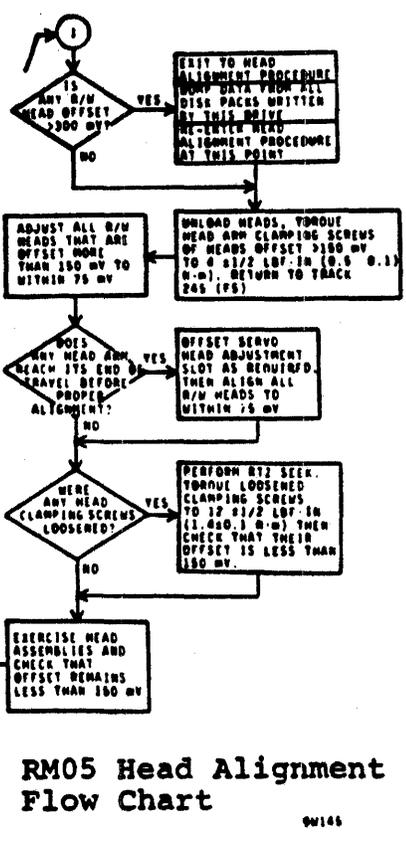
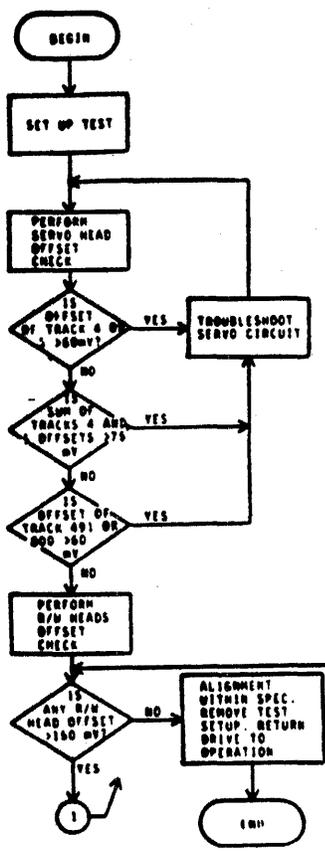
CH1- 2 volts/div.  
CH2- Not Used

Time Base  
A- 2 $\mu$ S /div.  
B- Not Used

Triggering  
INTERNAL POSITIVE

CH1- Connected to  
Dibits Test point  
Y on alignment  
card.

- 4.) Command a direct seek to cylinder 753<sub>g</sub>. Install carriage locking pin into alignment hole.
- 5.) Set S/RW switch to the RW position. Calculate the offset of all read-write heads by the same method used in step 3C. If all offsets fall within the +150 mV range then the alignment is within spec.
- 6.) Any head that is greater than the +150 mV range is mis-aligned. If any head is +300mV offset, then back up the data pack for this drive before continuing to the head alignment. Remove alignment pin from drive.

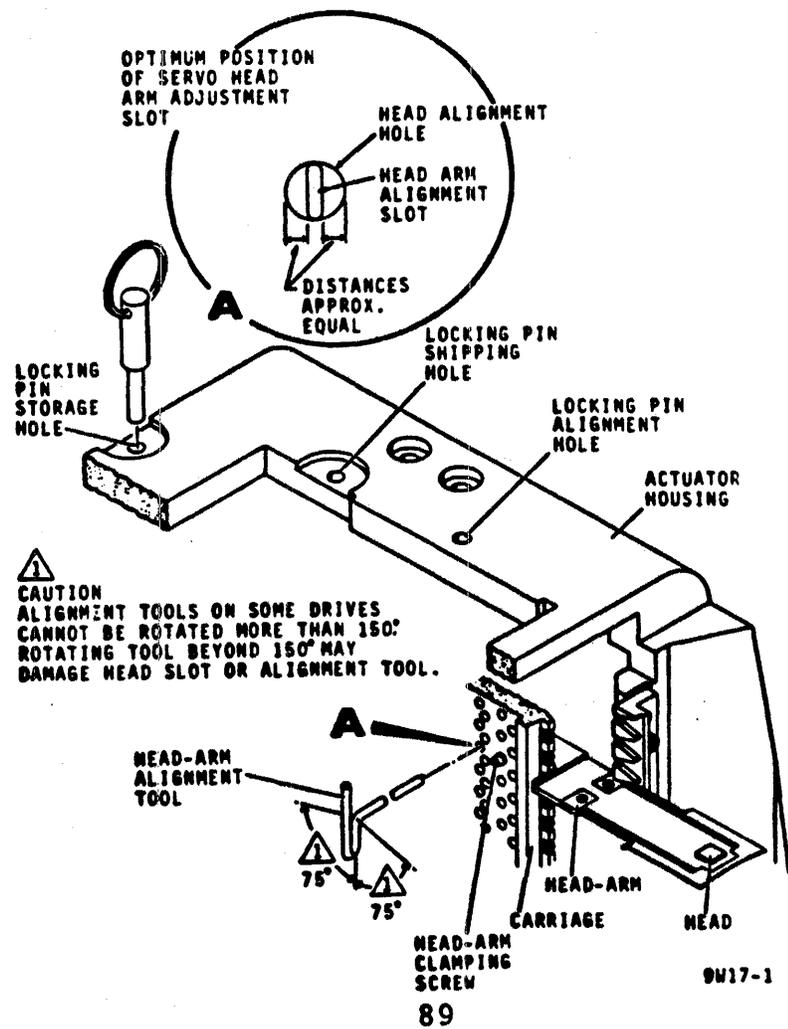


DISK SURFACE NUMBER	HEAD-ARM NUMBER
0	00
1	01
2	02
3	03
4	04
5	05
6	06
7	07
8	08
9	09
10	SERVO
11	10
12	11
13	12
14	13
15	14
16	15
17	16
18	17
19	18

**RM05 Head Alignment Flow Chart**

**RM05 Head Arm Alignment**

9W146



9W17-1

\*\*\*\*\*CAUTIONS\*\*\*\*\*

These two notes appear in the CDC Service Manual for the RM05 and are well worth memorizing before you attempt a head alignment.

If the heads perform an unscheduled retract and the START and FAULT lights are both off, immediately turn off the +20Y breaker. You have dropped +5 Volts and run the risk of burning up the voice coil. Only after you've thus disabled the DC power supply should you check to see if the power-down resulted from a failure on the AC line. The blower will still be on if the AC power is OK.

Caution #2: Should an emergency retract occur with the locking pin in the alignment track lock hole, the following may occur.

- 1.) Blown fuse
- 2.) Tripped DC circuit breaker
- 3.) Blown power amplifier transistors
- 4.) Any of the above = Unretracted heads on a stationary CE pack.

Head Alignment Continued...

- 7.) If heads 16, 17, or 18 require adjustment, move the servo preamp cover before proceeding. (At this point the drive should be stopped.)
- 8.) Loosen screws on the heads to be adjusted and torque them to 4 + 1/2 lbf-in.
- 9.) Start the drive and command a direct seek to cylinder 753.

NOTE

Force exerted during head alignment can move the heads from the alignment cylinder to an adjacent cylinder, resulting in an improper alignment. Prevent this by connecting a jumper from A07-11A (seek error) to ground. Be sure to remove the jumper before commanding another seek.

If you use this jumper, remember to put the jumper on the signal end while the power is off. Then, when the drive is powered up and on cylinder, place the other end of the jumper to ground.

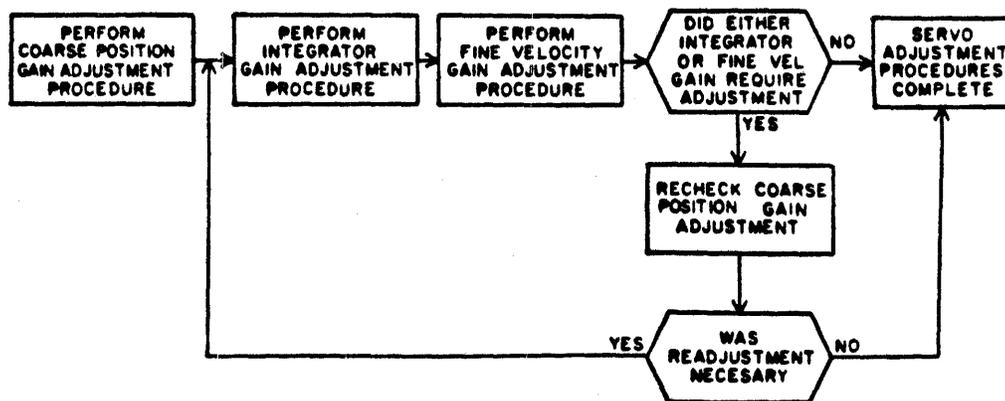
- 10.) Using the FTU, select the head to be aligned. To prevent personal injury, place the locking pin in the alignment track lock hole. Remember to remove it before commanding another seek.
- 11.) Install head alignment tool so that the tool pin engages the hole in the head-arm alignment slot. Observe the oscilloscope and adjust head to obtain a balanced dibit pattern.
- 12.) Observe the null meter and adjust the head until the offset is less than + 75 mV. If head cannot be brought into alignment, you may have to re-center the servo head. Any adjustment of the servo head will require realignment of all data heads.

- 13.) Remove carriage locking pin and also the jumper from A07-11A. Spin down the drive.
- 14.) Final torque all the heads to 12  $\pm$  1/2 lbf-in.
- 15.) Spin up drive and check to see that all heads adjusted are within specifications. Readjust those which are outside of the  $\pm$  150 mV limits.

When head alignment is complete, perform all servo checks.

### SERVO SYSTEM CHECKS AND ADJUSTMENTS

The servo system adjustments are interactive and must be performed in sequence to be valid. The servo system flow chart shows the order in which they must be performed.



- 1.) COARSE POSITION GAIN. Prepare the drive for use with the FTU.
  - 2.) Command continuous seeks between 000g and 1466.g
  - 3.) Connect oscilloscope CH1 to A07-03A (+On Cylinder).
  - 4.) External Trigger scope to A07-07A (-Forward Seek).
  - 5.) Observe display. If distance between on cylinder pulses is not between 50 to 54 mS, adjust top potentiometer on card A20 to meet this spec.
- 1.) INTEGRATOR GAIN ADJUSTMENT. Command continuous seeks between cylinders 000g and 200.g Set up scope as indicated in drawing on the next page. Adjust the scope until the two sloped curves are displayed as in the drawing.
  - 2.) You want to examine closely the second to last discontinuity. This will require some fiddling with the scope in order to lock this portion of the wave.
  - 3.) Adjust the bottom pot on the A20 board until the wave is correct.

### OSCILLOSCOPE SETTINGS

LOGIC GND TO SCOPE GND

VOLTS / DIV

CH 1 - 0.5V/CM  
CH 2 - NOT USED

TIME / DIV

A - 0.5MS/CM  
B - NOT USED

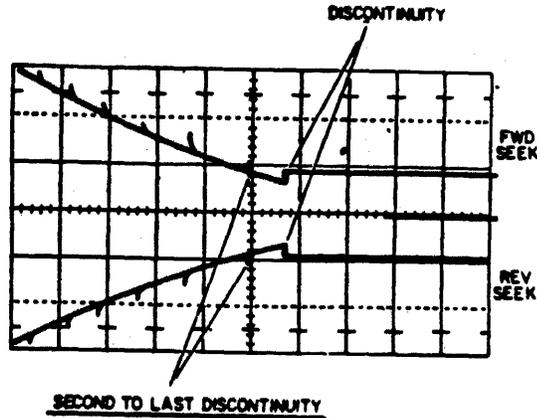
NOTE:  
HORIZ DISPLAY  
SET TO MAG x 10

TRIGGERING

A - POSITIVE EXT ON A12-17B (+T ≤ 7)  
B - NOT USED

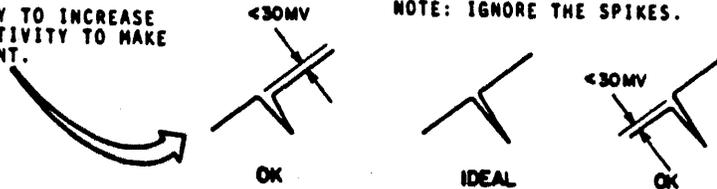
PROBE CONNECTIONS

CH 1 TO A20-TPD (+ DESIRED VELOCITY)  
CH 2 - NOT USED



NOTE:  
IT IS NECESSARY TO INCREASE  
VERTICAL SENSITIVITY TO MAKE  
THIS MEASUREMENT.

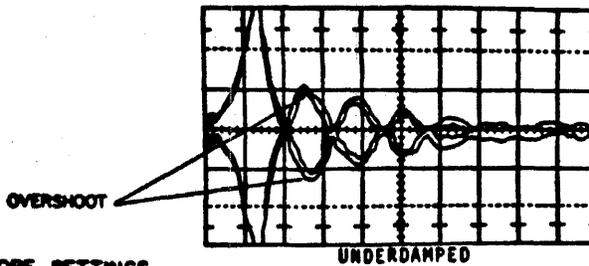
NOTE: IGNORE THE SPIKES.



9W18

### INTEGRATOR GAIN WAVEFORM

- 1.) FINE VELOCITY GAIN. Command a read in conjunction with a continuous seek between cylinders 000<sub>g</sub> and 001<sub>g</sub>.
- 2.) Connect and adjust scope as indicated by the drawing on the next page.
- 3.) The top wave form in the drawing is an overshoot condition which is not desirable. Adjust the middle pot on the A20 module to as nearly as possible resemble the ideal waveform. Best operation is attained with it adjusted slightly toward the under shoot waveform which can be seen in the final waveform.
- 4.) Command a sequential seek between cylinders 000<sub>g</sub> to 1466<sub>g</sub> in conjunction with a read.
- 5.) Note that the displayed waveform should look similar to the Final Check waveform. If any overshoot exists greater than 0.5 Volts, adjust the middle pot on card A20 until the specification is met.



**OSCILLOSCOPE SETTINGS**

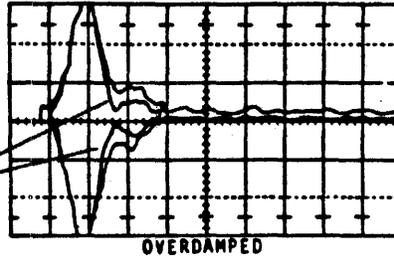
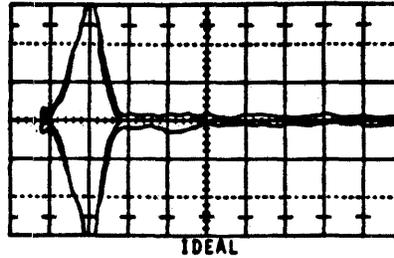
LOGIC GND TO SCOPE GND

VOLTS / DIV  
 CH 1 - 0.5V/CM  
 CH 2 - NOT USED

TIME / DIV  
 A - 1MS/CM  
 B - NOT USED

TRIGGERING  
 A - NEGATIVE ON A07-30A<sup>1A1/102</sup>  
 (-SEEK)  
 B - NOT USED

PROBE CONNECTIONS  
 CH 1 TO A19-TPC  
 (+FINE POSITION ANALOG)  
 CH 2 - NOT USED



**INITIAL FINE VELOCITY GAIN**

**OSCILLOSCOPE SETTINGS**

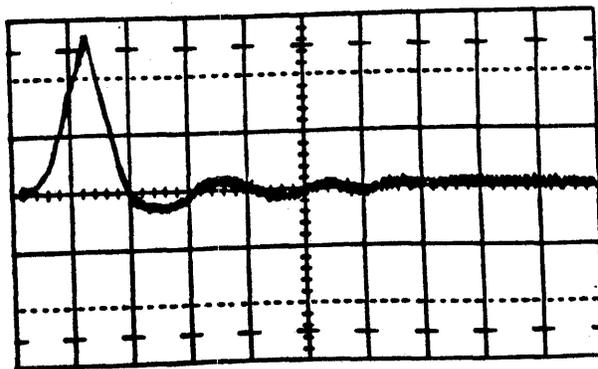
LOGIC GND TO SCOPE GND

VOLTS / DIV  
 CH 1 - 0.5V/CM  
 CH 2 - NOT USED

TIME / DIV  
 A - 0.1MS/CM  
 B - NOT USED

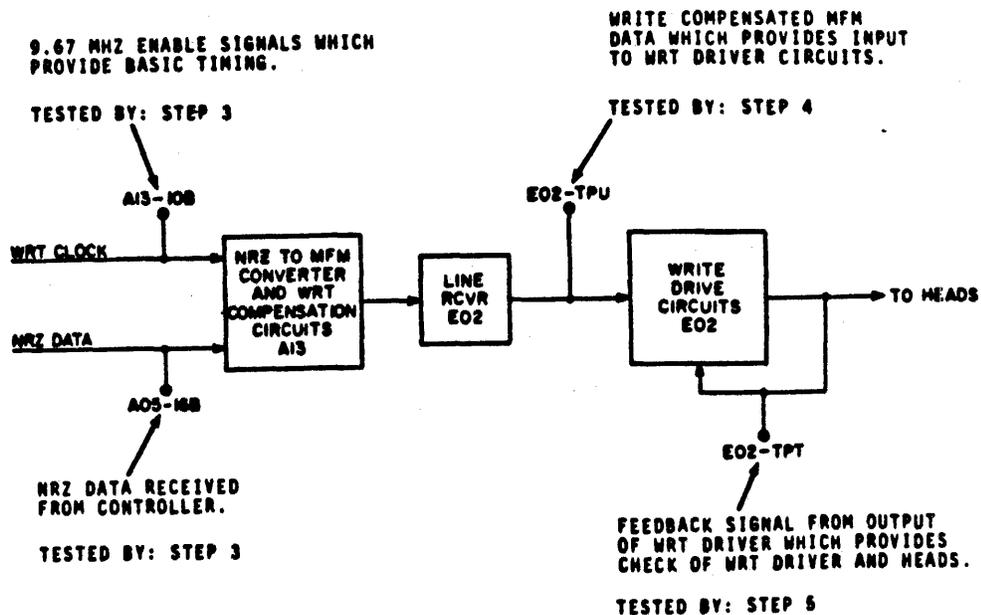
TRIGGERING  
 A - EXT, A07-30A (-SEEK)  
 B - NOT USED

PROBE CONNECTIONS  
 CH 1 TO A19-TPC (+FINE POSITION ANALOG)  
 CH 2 - NOT USED



**FINAL FINE VELOCITY GAIN**

# RM05 Write Circuits Tests



- 1.) Connect the drive to the FTU and command a 1010 bit pattern write to the disk.
- 2.) Check each test point from the block diagram above against the waveforms on the next few pages. Scope set-ups are included with each drawing.

### OSCILLOSCOPE SETTINGS

LOGIC GND TO SCOPE GND

VOLTS / DIV  
 CH 1 - 0.2V / CH  
 CH 2 - 0.2V / CH

TIME / DIV  
 A - 2NS / CH  
 B - 0.05 S / CH

TRIGGERING  
 A - +EXT. A06-TPC (INDEX)  
 B - -INT

PROBE CONNECTIONS (10X PROBES)  
 CH 1 TO A13-TPE (NRZ DATA)  
 CH 2 TO A13-TPB (WRT STROBE)

NOTE: SET TO DISPLAY MODE TO ALT AND TRIGGER MODE TO CH 1 ONLY.  
 ALSO SET HORIZONTAL DISPLAY TO B (DELAYED SWEEP)



OSCILLOSCOPE SETTINGS

LOGIC GND TO SCOPE GND

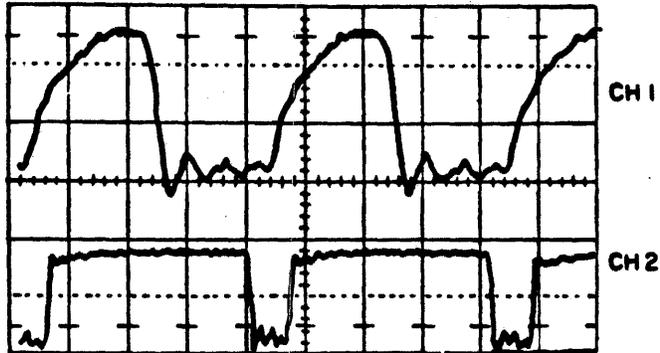
VOLTS / DIV  
CH 1 - 0.2V/CM  
CH 2 - 0.2V/CM

TIME / DIV  
A - 2MS/CM  
B - 0.05 $\mu$ S/CM

TRIGGERING  
A - +EXT, A06-TPC (+INDEX)  
B - -INT

PROBE CONNECTIONS (10X PROBES)  
CH 1 TO A13-TPE (NRZ DATA)  
CH 2 TO E02-TPU

NOTE: SET DISPLAY MODE TO ALT AND TRIGGER MODE TO CH 1 ONLY.  
ALSO SET HORIZONTAL DISPLAY TO B (DELAYED SWEEP)



RM05 Write Driver Input

OSCILLOSCOPE SETTINGS

LOGIC GND TO SCOPE GND

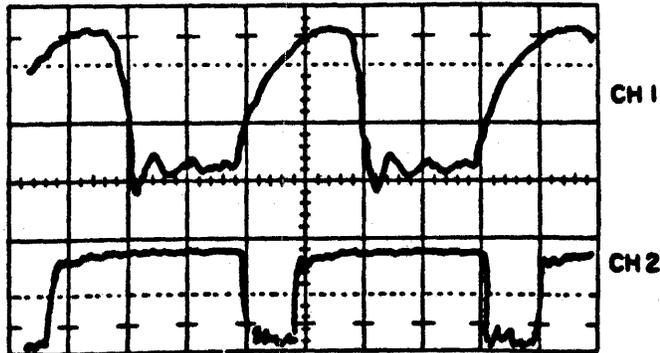
VOLTS / DIV  
CH 1 - 0.2V/CM  
CH 2 - 0.2V/CM

TIME / DIV  
A - 2MS/CM  
B - 0.05 $\mu$ S/CM

TRIGGERING  
A - +EXT, A06-TPC (+INDEX)  
B - -INT

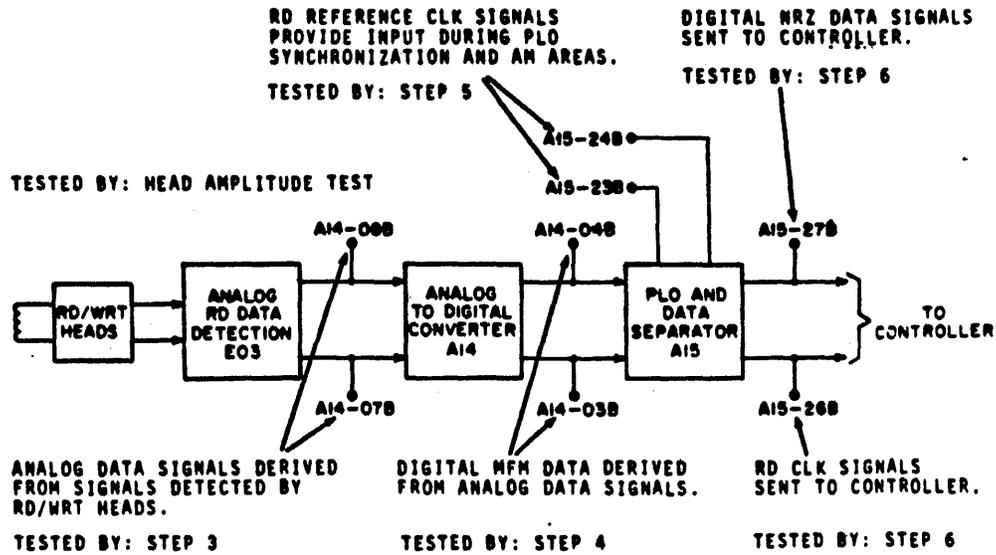
PROBE CONNECTIONS (10X PROBES)  
CH 1 TO A13-TPE (NRZ DATA)  
CH 2 TO E02-TPT

NOTE: SET DISPLAY MODE TO ALT AND TRIGGER MODE TO CH 1 ONLY.  
ALSO SET HORIZONTAL DISPLAY TO B (DELAYED SWEEP)



RM05 Write Driver Output

## RM05 Read Circuits Tests



- 1.) Connect drive to FTU. Command a write data, pattern 1010.
- 2.) Command drive to read pattern 1010. Verify that all waveforms are consistent with those shown on next few pages. Scope setups are included with the waveforms.

### RM05 Analog Read Data Waveform

LOGIC GND TO SCOPE GND

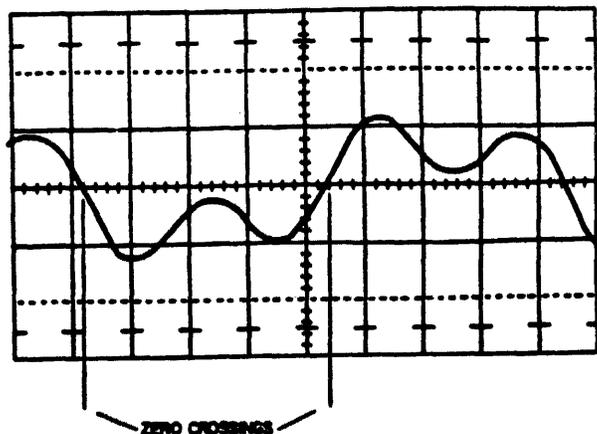
VOLTS / DIV  
 CH 1 - 0.1V/CM  
 CH 2 - 0.1V/CM

TIME / DIV  
 A - 2NS/CM  
 B - 0.05 S/CM

TRIGGERING  
 A - +EXT, A06-TPC (+INDEX)  
 B - -INT

PROBE CONNECTIONS (10X PROBES)  
 CH 1 TO A14-08B (-ANALOG DATA)  
 CH 2 TO A14-07B (+ANALOG DATA)

NOTE: SET DISPLAY MODE TO ADD AND INVERT ONE CHANNEL. ALSO SET HORIZONTAL DISPLAY TO B (DELAYED SWEEP)



OSCILLOSCOPE SETTINGS

LOGIC GND TO SCOPE GND

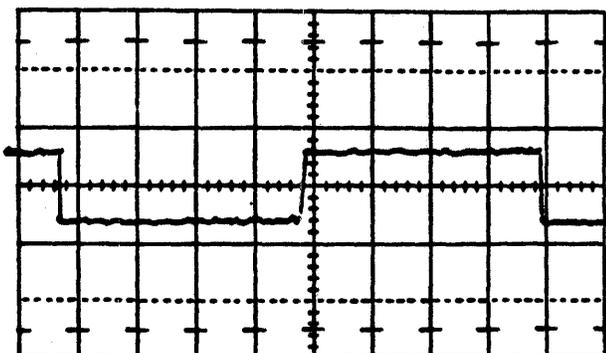
VOLTS / DIV  
CH 1 - 0.1V/CM  
CH 2 - 0.1V/CM

TIME / DIV  
A - 2NS/CM  
B - 0.05S/CM

TRIGGERING  
A - +EXT, A06-TPC (+INDEX)  
B - -INT

PROBE CONNECTIONS (10X PROBES)  
CH 1 TO A14-03B (+RD DATA)  
CH 2 TO A14-04B (-RD DATA)

NOTE: SET DISPLAY MODE TO ADD AND INVERT ON CHANNEL.  
ALSO SET HORIZONTAL DISPLAY TO B (DELAYED SWEEP)



RM05 Data Latch Output Waveform

READ CLOCK CHECKS...

Use same setup as above except move CH1 probe to A15-24B.  
Move CH2 probe to A15-23B. Observe that the displayed  
signal has a frequency of 4.84 Mhz.

NOTE: SET DISPLAY MODE TO ALT AND TRIGGER MODE TO CH 1 ONLY.  
ALSO SET HORIZONTAL DISPLAY TO B (DELAYED SWEEP)

OSCILLOSCOPE SETTINGS

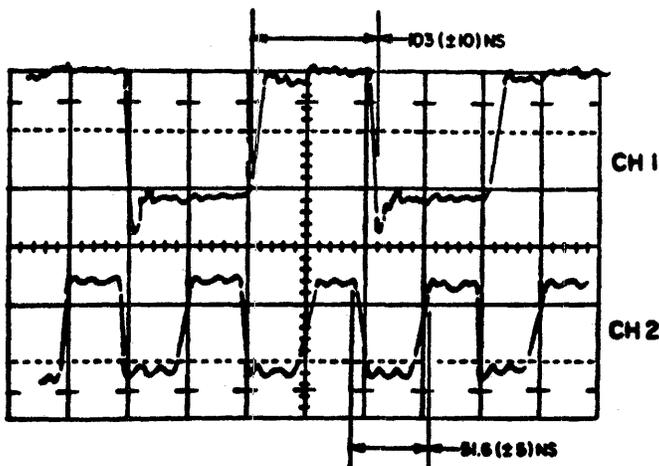
LOGIC GND TO SCOPE GND

VOLTS / DIV  
CH 1 - 0.2V/CM  
CH 2 - 0.2V/CM

TIME / DIV  
A - 2NS/CM  
B - 0.05 $\mu$ S/CM

TRIGGERING  
A - -EXT, A15-12B (-READ GATE)  
B - -INT

PROBE CONNECTIONS (10X PROBES)  
CH 1 TO A15-27B  
CH 2 TO A15-26B



RM05 Read Data to Read Clock Timing

## RM05 Head Amplitude Check

This procedure will verify that the amplitude of the signal off of the R/W head is sufficient to allow reliable processing of data.

Amplitude is inversely proportional to the frequency of recording data. Therefore, the highest amplitude will be observed when reading all ones. The lowest amplitude will be observed when reading alternating ones and zeros.

- 1.) Connect drive to FTU. Command drive to seek to cylinder 1466. Command drive to write all ones on each head of that cylinder.
- 2.) Connect External trigger (negative) to A06-TPC (Index). Connect CH1 to E03-TPB. Connect CH2 to E03-TPC and set display mode to ADD and invert one channel. Set Volt/div and Time/div as required.
- 3.) Command drive to read all ones and step through each head in turn. The minimum level should be 130 mV peak to peak.
- 4.) Command drive to seek to cylinder 001, and write a 1010 pattern on all heads.
- 5.) Command drive to read. Step through each head in turn and verify that the amplitude of each is a maximum of 1100 mV.

## Index Timing Check.

- 1.) Connect CH1 to A06-TPC (+Index). Trigger internal positive.
- 2.) Observe that the Index is a logic one for 2.5 (+0.3) uSec.
- 3.) Observe that the time between pulses is approximately 16.7 mS.

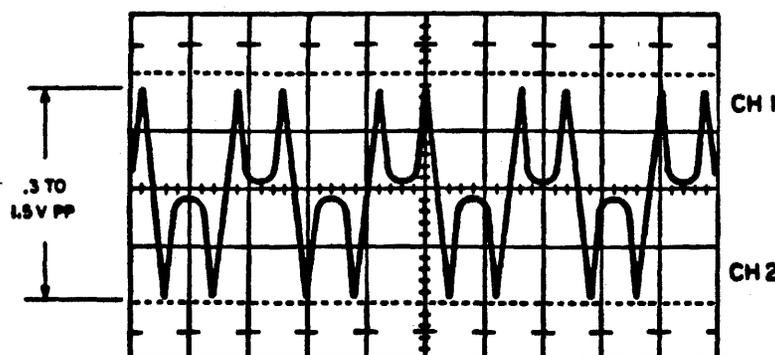
## Speed Sensor Output Check

- 1.) Connect CH1 to A17-17A. Trigger internal positive.
- 2.) Observe amplitude on scope. Signal should have positive and negative amplitudes of at least 600mV. If not, the speed sensor gap may be misadjusted.

## SERVO AMPLITUDE CHECK

NOTE: SET DISPLAY MODE TO ADD AND INVERT ONE CHANNEL

### OSCILLOSCOPE SETTINGS



LOGIC GND TO SCOPE GND

VOLTS / DIV  
CH 1 - 0.5V / CM  
CH 2 - 0.5V / CM

TIME / DIV  
A - 1μS CM  
B - NOT USED

TRIGGERING  
A - INTERNAL NEGATIVE  
B - NOT USED

PROBE CONNECTIONS  
CH 1 TO A18-25B (-DIBITS)  
CH 2 TO A18-23B (+DIBITS)

## OSCILLOSCOPE SETTINGS

LOGIC GND TO SCOPE GND

VOLTS / DIV

CH 1 - 0.1V/CM (READ SCALE AS 100MV)  
CH 2 - NOT USED

TIME / DIV

A - 2MS/CM  
B - NOT USED

TRIGGERING (POSITIVE/EXTERNAL)

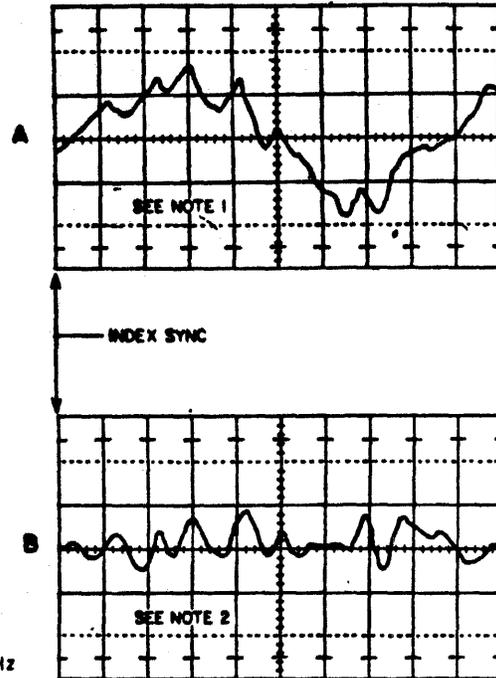
A - INDEX  
B - NOT USED

PROBE CONNECTIONS

CH 1 TO A19-TPC (FINE POS ANALOG)  
CH 2 - NOT USED

### NOTES:

1. MORE THAN NORMAL RUNOUT RESULTS IN THE WAVEFORM HAVING A 60 Hz SINUSOIDAL COMPONENT AS SHOWN ON WAVEFORM A. AS AMOUNT OF RUNOUT INCREASES, THE PEAK TO PEAK AMPLITUDE OF THE 60 Hz COMPONENT INCREASES.
2. NORMAL RUNOUT IS SHOWN ON WAVEFORM B. IN THIS CASE, THE AMPLITUDE OF THE 60Hz SINUSOIDAL COMPONENT IS LESS THAN 400MV PEAK TO PEAK.



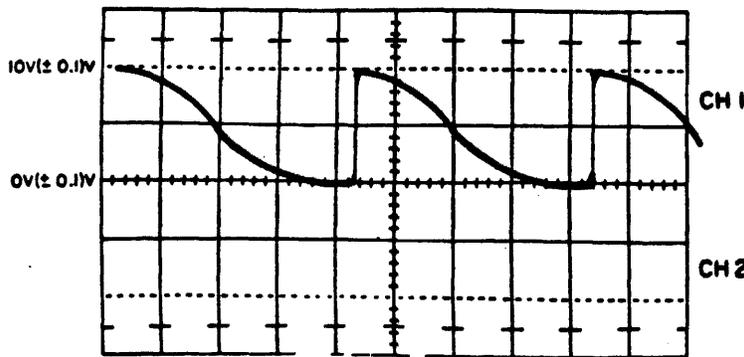
## RM05 TRACK FOLLOWING CHECK

Inability to stay on track may be due to excessive pack or spindle assembly runout. It may also be due to drifting or 'hunting' servo circuits or bad AGC action. Inability of the heads to follow the track may cause read errors or occasionally cause the drive to lose On Cylinder.

- 1.) Connect the drive to the FTU. Connect the scope as indicated above. (Index is A06-TPC).
- 2.) Command a direct seek to cylinder 620.g. Observe the display using the above for reference. If the 60 Hz component is greater than 400 mV, then excessive runout exists.
- 3.) If runout exists, note the phase relationship of the 60 Hz component.
- 4.) Stop the drive. Note the position of the pack on the spindle and remove the pack. Replace the pack 90 degrees (1/4 turn) from where it was. Start the drive and command a direct seek to cylinder 620.g.
- 5.) Compare phase relationships with the signal now displayed and the one obtained earlier.
  - a. If the phase relationship of both waveforms are the same, then runout is due to the disk pack or a servo fault.
  - b. If phase relationship has changed, then the runout is due to the spindle or again a servo fault.

# RM05 SERVO CHECKS

## OSCILLOSCOPE SETTINGS



LOGIC GND TO SCOPE GND

VOLTS / DIV  
CH 1 - 5V/CM  
CH 2 - NOT USED

TIME / DIV  
A - 5MS/CM  
B - NOT USED

TRIGGERING  
A - NEG EXT, A07-07A (-FWD SEEK)  
B - NOT USED

PROBE CONNECTIONS  
CH 1 TO A20-TPB  
CH 2 - NOT USED

### D to A Output Check

The D to A converter produces some maximum value and steps down as each track is crossed. It should produce 0 V when on cylinder. The above waveform was taken doing continuous seeks between cylinders 000<sub>g</sub> and 200<sub>g</sub>.

### Cylinder Pulse Blanking Delay Check

Command continuous seeks between cylinders 000<sub>g</sub> and 003<sub>g</sub>. Connect CH1 to A07-30B (+ Cylinder Pulse Blanking). Trigger positive internal. Observe that the Cylinder Pulse Blanking delay is a one for 950 (+50) uSec.

### Cylinder Pulse One Shot Check

Make same preparations as Cylinder pulse blanking check except connect CH1 to A07-22A (+Cylinder Pulses). Observe that the cylinder pulse is a one for 10 (+2.5) uSec.

## OSCILLOSCOPE SETTINGS

### Cylinder Pulse Switching Level Check

LOGIC GND TO SCOPE GND

TIME / DIV  
A - .2 MS/CM  
B - NOT USED

PROBE CONNECTIONS  
CH 1 TO A18-09 B (+TRACK SERVO SIGNAL)  
CH 2 - NOT USED

VOLTS / DIV  
CH 1 - .5V/CM  
CH 2 - NOT USED

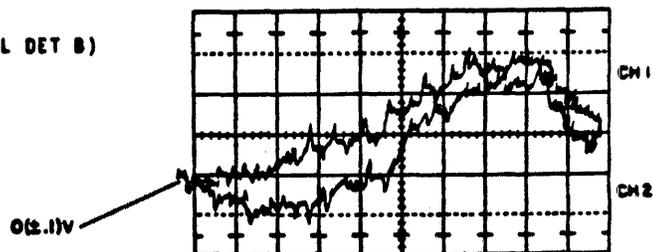
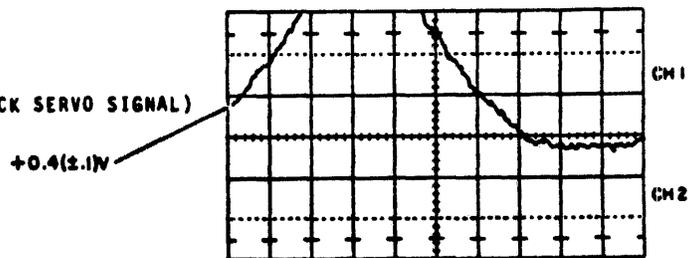
TRIGGERING  
A - NEG EXT, A18-08B (+CYL DET B)  
B - NOT USED

VOLTS / DIV  
CH 1 - .1V/CM  
CH 2 - NOT USED

TRIGGERING  
A - POS EXT, A18-08B (+CYL DET B)  
B - NOT USED

NOTE:

TIME/DIV AND PROBE CONNECTIONS ARE COMMON TO ALL THE FOLLOWING WAVEFORMS. ---



## Cylinder Pulse Switching Level Check

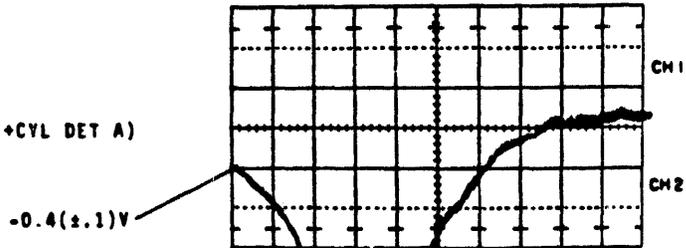
The waveform on the preceding page was taken under the following conditions:

Drive connected to FTU. Command sequential seeks between cylinders 000<sub>g</sub> and 1466<sub>g</sub> (forward). The other two waveforms are below this text.

### OSCILLOSCOPE SETTINGS

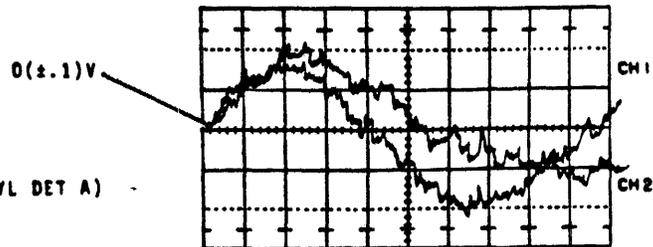
VOLTS / DIV  
CH 1 - .5V/CM  
CH 2 - NOT USED

TRIGGERING  
A - NEG EXT. A18-07B (+CYL DET A)  
B - NOT USED



VOLTS / DIV  
CH 1 - .1V/CM  
CH 2 - NOT USED

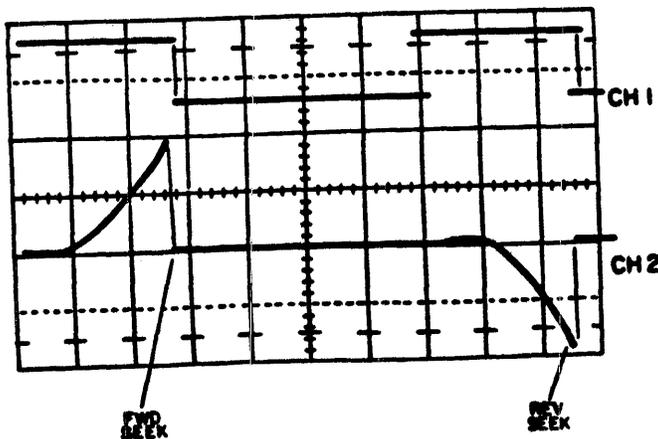
TRIGGERING  
A - POS EXT. A18-07B (+CYL DET A)  
B - NOT USED



## Fine Enable Switching Level

Connect the drive to FTU and command continuous seeks between cylinders 000<sub>g</sub> and 001<sub>g</sub>. Compare display with drawing below.

NOTE: SET DISPLAY MODE TO CHOP.



### OSCILLOSCOPE SETTINGS

LOGIC GND TO SCOPE GND

VOLTS / DIV  
CH 1 - 5V/CM  
CH 2 - 0.5V/CM

TIME / DIV  
A - 0.5MS/CM  
B - NOT USED

TRIGGERING  
A - EXT NEG. A20-12A (-FWD SEEK)  
B - NOT USED

PROBE CONNECTIONS  
CH 1 TO A20-10A (-FINE ENABLE)  
CH 2 TO A20-TP6 (+INTEGRATED VEL)

**NOTES**

# FIELD CHANGE ORDER

DATE APPROVED APR 04 1980 PAGE 1 OF 5

EQUIPMENT IDENTIFICATION NO. <b>TB3A2A</b>	PRODUCT NAME <b>FTU FIELD TEST UNIT</b>	FCO PACKAGE P/N <b>89053768</b>		CLASS I <input checked="" type="checkbox"/> II <input type="checkbox"/>
	FIELD UNITS AFFECTED <b>TB3A2A</b>	AFFECTED BY FCO	YES NO	
MFG. INCORPORATION SERIES CODE <u>21</u>	SERIES CODE 06 THROUGH 19 SEE ITEM 4	PUBLICATIONS	<input checked="" type="checkbox"/> <input type="checkbox"/>	
		SOFTWARE CHECKOUT	<input type="checkbox"/> <input checked="" type="checkbox"/>	
		SAFETY	<input type="checkbox"/> <input checked="" type="checkbox"/>	

THIS FCO MUST CONTAIN THE FOLLOWING SUBJECTS IN ORDER:  
1. REASON FOR CHANGE. 2. MANUALS AFFECTED. 3. DESCRIPTION OF CHANGE. 4. REFERENCES.  
5. INSTALLATION PROCEDURE. 6. PARTS AND SPECIAL TOOLS REQUIRED. 7. PARTS AND TOOLS AVAILABILITY.  
8. REMOVED PARTS DISPOSITION. 9. ATTACHED DOCUMENTS.

- REASON FOR CHANGE: ALLOW TB3A2A TO SELECT ALL HEADS ON THE 9766.
- MANUALS AFFECTED: TB3A2A HARDWARE MAINTENANCE MANUAL (83322710)
- DESCRIPTION OF CHANGE: REWORK W/W ASSEMBLY AND ADD A DIODE TO COMPONENT SIDE OF LOGIC BOARD.
- REFERENCES: THIS CHANGE WILL BE INSTALLED BY MANUFACTURING IN UNITS WITH SERIAL NUMBERS 3990, 3998 AND ABOVE.
- INSTALLATION PROCEDURE: **NOTE:** A 30 AWG WIRE WRAP TOOL AND 30 AWG WIRE WRAP WIRE ARE REQUIRED FOR THIS CHANGE.

- A. OPEN FTU TO GAIN ACCESS TO W/W BACKPANEL.
- B. MAKE FOLLOWING CHANGES TO WIRE WRAP ASSEMBLY:

DELETE:

ORIGIN	DESTINATION	LEVEL
D26-012	JC31-035	2
E30-006	E13-005	2
E30-006	F19-011	1

REF. ECO PE54280

ORIGINATOR <b>4-3-80</b> <b>J.P. STUDENSKI</b>	ENGINEER <b>4-3-80</b> <b>D. GABRIELSON</b>	MFG <b>4-1-80</b> <i>[Signature]</i>	PC <b>4-4-80</b> <i>[Signature]</i>	QA <b>4-7-80</b> <i>[Signature]</i>	FCO ADMINISTRATOR <i>[Signature]</i>
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PE 54280

# FIELD CHANGE ORDER

APR 04 1980

DIV.	F.C.O. NO.	REV.
PL	54280	

PAGE 2

## INSTALLATION PROCEDURE CONT'D

ADD:

<u>ORIGIN</u>	<u>DESTINATION</u>	<u>LEVEL</u>
E30-006	JC31-018	1
F04-006	JC31-035	2
F04-012	D26-012	2
E30-006	E13-005	2

C. ON THE COMPONENT SIDE OF THE LOGIC BOARD, SOLDER THE SILICON DIODE {24553500} BETWEEN PINS 6 & 12 OF CHIP LOCATION F04. INSURE THE NEGATIVE OR CATHODE END OF THE DIODE IS ATTACHED TO PIN 6. IF IN DOUBT AS TO WHICH END IS NEGATIVE OR THE CATHODE, CHECK WITH VOM TO VERIFY CORRECT POLARITY.



D. CLOSE FTU AND CONNECT TO A 9766. OPERATE DRIVE AND FTU CHECKING THE FTU'S ABILITY TO SELECT ALL HEADS ON THE 9766.

E. LOG FCO ON UNIT FCO LOG.

F. UPDATE MAINTENANCE MANUAL DIAGRAMS WITH PAGES 4, 5 AND 6. UPDATE MAINTENANCE MANUAL WIRE LIST.

6. PARTS & SPECIAL TOOLS: FCO KIT NUMBER {89053768} SEE ASSEMBLY PARTS LIST

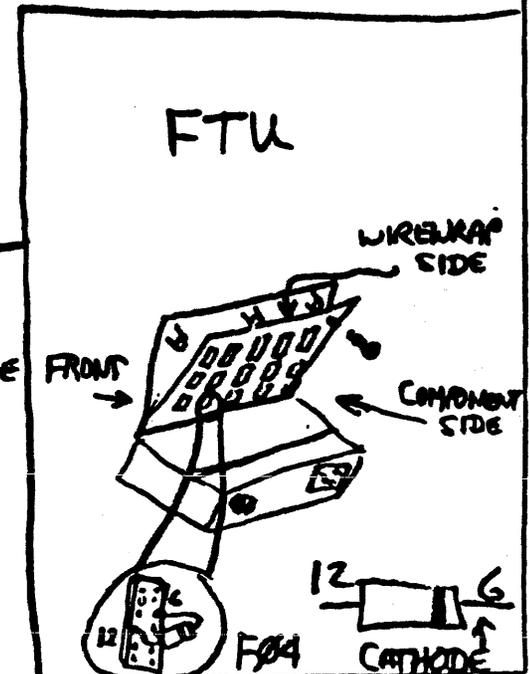
7. AVAILABILITY: KITS DUE BEGINNING APRIL 11, 1980

8. REMOVED PARTS: N/A

9. ATTACHED DOCUMENTS: N/A

REMOVE 3 SCREWS FROM COMPONENT SIDE OF FTU LOGIC. LOWER PC BOARD DOWN TO POWER

SUPPLY BY HINGED BOTTOM. SEE NEXT PAGE FOR WIREWRAP SIDE DIAGRAM.



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APR 04 1980

DIV.	F.C.O. NO.	REV.
PE	54280	
PAGE 3		

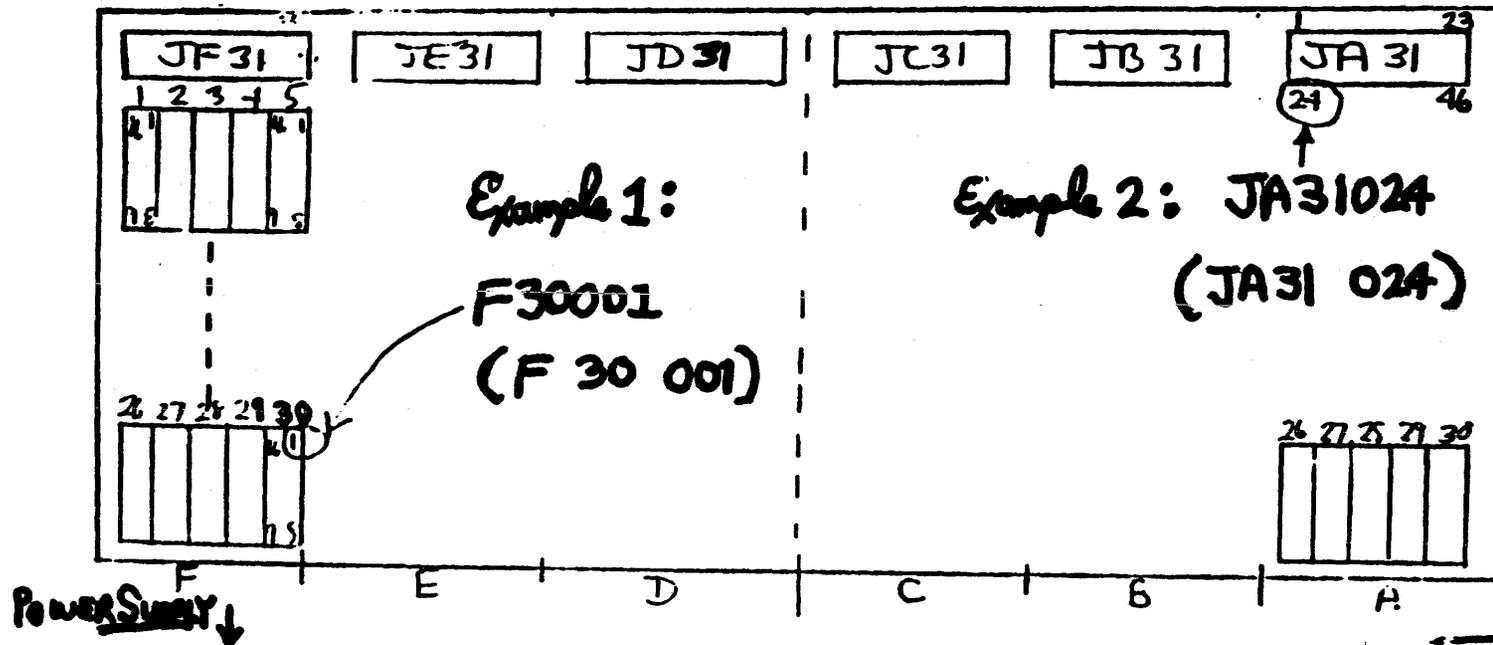
**ASSEMBLY PARTS LIST**

DIV.	ASSEMBLY NUMBER	REV.	DESCRIPTION		
052	89053768		FCO KIT PE54280		
FIND NO.	PART NUMBER	QUANTITY	U/M	PART DESCRIPTION	
001	24553500	001	ea	SILICONE DIODE	

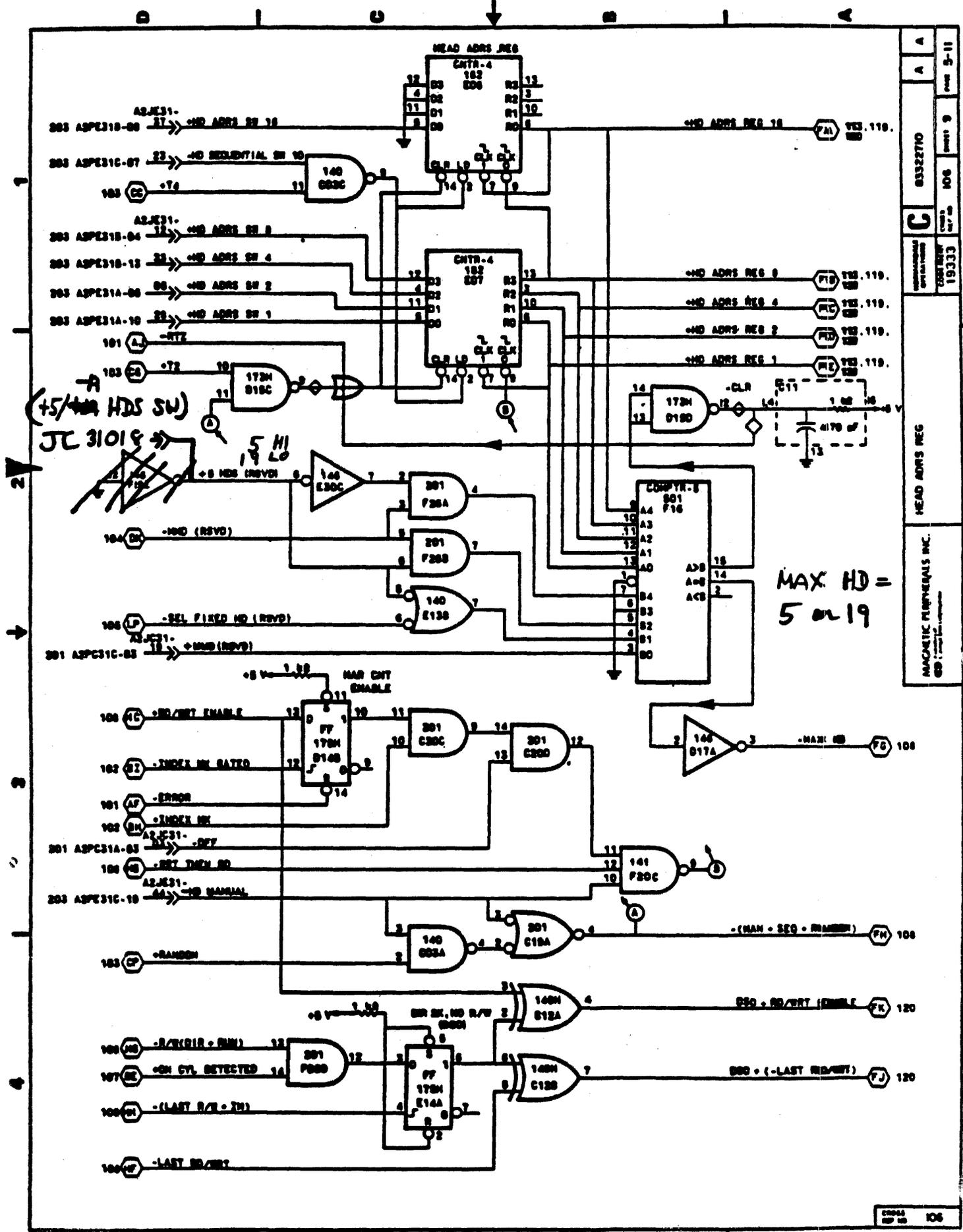
WIREWRAPE CONFIGURATION

PANEL ↑

PC BOARD - PIN SIDE



105



(+5V HDS SW)  
JL 31019

MAX HD =  
5 or 19

REVISED	DATE	BY	REASON
19333	106	9	5-11
HEAD ADRS REG			
MACANIC PERIPHERALS INC.			



<b>digital</b>	<b>FIELD SERVICE TECHNICAL MANUAL</b>				Option or Designator
	12 Bit <input type="checkbox"/>	16 Bit <input checked="" type="checkbox"/>	18 Bit <input type="checkbox"/>	36 Bit <input type="checkbox"/>	RM05

Title <b>RM05 HEAD CRASHES</b>			Tech Tip Number <b>RM05-TT-</b>		
Author <b>Bill Peters</b>		F.S. Office <b>Maynard</b>		Date <b>2-28-81</b>	Revision <b>A</b>
Processor Applicability			Mgr./Sup.		Date
All <b>16 VAX</b>			Approval:		Date
Cross Reference					

Due to the very low flying height of the heads and the critical characteristics of the RM05 packs, it is recommended that if a head crash is experienced, you should replace all the heads in the drive. There is no way you can determine with the unaided eye whether or not the remaining heads are good or not. This requires a microscope and a thorough knowledge of head construction.

In the event of a crash, the following steps should be taken:

- 1.) Because the RM05 uses a perforated shroud assembly, you must disassemble the shroud and clean the deck area very thoroughly. Some repeat crashes have been attributed to contamination left in the drive from the original crash.
- 2.) Take no chances. Replace every head when reassembling the drive. Visually inspect each head for signs of improper assembly or contamination before installing.
- 3.) Inspect the positioner and magnet for metal particles. **BE THOROUGH IN EVERY RESPECT.**
- 4.) When drive is reassembled, allow the drive to purge for a minimum of 30 minutes. Visually inspect the shroud area before installing a new scratch pack.
- 5.) When the pack has spun up for a few minutes and things look stable, you can then procede with the head alignment procedures.

Here are some important points to remember:

CDC does not recommend head or media cleaning on the 9766. The tolerances involved are much more critical than the RP06 or similar drives.

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<b>digital</b>	<b>FIELD SERVICE TECHNICAL MANUAL</b>				Option or Designator
	12 Bit <input type="checkbox"/>	16 Bit <input type="checkbox"/>	18 Bit <input type="checkbox"/>	36 Bit <input type="checkbox"/>	<b>RM05</b>

Title <b>RM05 HEAD CRASHES (Continued)</b>			Tech Tip Number <b>RM05-TT-</b>		
Author <b>Bill Peters</b>		F.S. Office <b>Maynard</b>		Date <b>2-28-81</b>	Revision <b>A</b>
Processor Applicability			Mgr./Sup.		Date
All - <b>11 VAX</b>			Approval:		Date
					Cross Reference

Due to the 'Burnished media' technology used on these packs, the normal pack cleaning procedures tend to leave a residue on the platter surfaces. The media requires a special power wash cycle to insure that all the residue is removed. Again, only a keen eye trained to recognize a media defect can spot a problem by inspecting a pack. CDC recommends a program of media inspection at certain intervals but will not recommend any cleaning. Therefore a clean environment and proper storage of media to prevent pack contamination is strongly suggested.

If you have not done so already, purge all RM05 drives of any absolute filter assemblies with a date code of June 1, 1980 to October 31, 1980. These assemblies have been found to be a source of contamination. Epoxy used in the construction of the filter is in some cases chipping off and entering the air flow. The date code is found stamped on a yellow sticker attached to the filter. The part number for the absolute filter is 29-23591.

The maintainability group for the RM05 needs to have more complete reporting of RM05 head crashes. It has been found that some RM05 calls, especially if they are repeat crashes, have been reported on LARS against systems. This makes accurate performance statistics difficult at best. The last page of this Tech-Tip is a reporting format which should be used in every instance of a RM05 head crash until further notice. Send the completed form to: Bill Peters, Corporate Field Support Group, PK3-2 /K11. We will appreciate your assistance in this very much.

Until the head crash problem has been resolved, we recommend that all branches have their RM05 CE and scratch packs inspected at least once a month by an outside company. This is necessary to eliminate the possibility that our test packs may be a source of contamination.

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<b>ORIGINAL</b>	<b>FIELD SERVICE TECHNICAL MANUAL</b>				Option or Designator
	12 Bit <input type="checkbox"/>	16 Bit <input checked="" type="checkbox"/>	18 Bit <input type="checkbox"/>	36 Bit <input type="checkbox"/>	<b>RM05</b>

Title <b>RM05 HEAD CRASHES (Continued)</b>			Tech Tip Number <b>RM05-TT-</b>		
Author <b>Bill Peters</b>		F.S. Office <b>Maynard</b>		Date <b>2-28-81</b>	Revision <b>A</b>
Processor Applicability		Mgr./Sup.		Date	Cross Reference
<b>11 VAX</b>		Approval:		Date	

PLEASE USE THIS FORM TO DOCUMENT RM05 HEAD CRASHES FOR  
 MAINTAINABILITY ENGINEERING IN COLORADO.

\*\*\*\*\*

Branch Office \_\_\_\_\_ Cost Center \_\_\_\_\_  
 Customer Name \_\_\_\_\_ LARS Log # \_\_\_\_\_  
 RM05 Serial # \_\_\_\_\_ Pack Serial # \_\_\_\_\_  
 Date of failure \_\_\_\_\_ Date of installation \_\_\_\_\_  
 Hour Meter reading \_\_\_\_\_ Suspected cause \_\_\_\_\_

Site Environment \_\_\_\_\_

Name of Engineer \_\_\_\_\_ Tele. \_\_\_\_\_

Additional comments: \_\_\_\_\_

**SEND TO: Bill Peters  
 Corporate Field Support Group  
 129 Parker Street PK3-2 /K11  
 Maynard, Mass.**

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