

MRX/40 & 50 Diagnostics System

Reference Manual

Volume I: Overview

2701.104

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PREFACE

This manual provides an introduction to the software and supporting documentation that make up the Diagnostics System. The manual identifies the major categories of diagnostic tests, and briefly describes the tests contained in each category. Loading methods, execution, parameter modification, and error displays for the tests are described in general terms; references to specific manual(s) are made for detailed information. The latter part of the manual contains a user-oriented guide for applying the Diagnostics System to the isolation of a fault.

This volume is part of a four-volume set of **MRX/40 and 50 Diagnostics System Reference** manuals. The volumes of the set contain the following information:

1. **MRX/40 and 50 Diagnostics System Reference Manual
Volume I: Overview (2701.104)**
A general description of the Diagnostics System.
2. **MRX/40 and 50 Diagnostics System Reference Manual
Volume II: Shared Resources (MLI) Tests (2701.105)**
Description and operating procedures for all tests in the Autoload category, and some tests (Quick Look, Control, Command, Register Option) in the Stand-Alone category.
3. **MRX/40 and 50 Diagnostics System Reference Manual
Volume III: Stand-Alone I/O Tests (2701.106)**
Description and operating procedures for some tests (Communications, IOC, IOC Loop, Disc) in the Stand-Alone category, and the Disc Library Utility.
4. **MRX/40 and 50 Diagnostics System Reference Manual
Volume IV: System Peripheral Tests (2701.107)**
Description and operating procedures for all tests in the System category, The Directory List utility, and the Disc Pack Copy utility.

Additional manuals that support the Diagnostics System are as follows:

**MRX/40 and 50 Diagnostics System
Operating Procedures (2701.108)**

**MRX/40 and 50 Diagnostics System
Microdiagnostic Program Listing (2701.100)**

**MRX/40 and 50 Diagnostics System
Stand-Alone Disc Test and
IOC Test Program Listings (2701.103)**

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1. INTRODUCTION

The MRX/40 and 50 Diagnostics System detects and isolates faults occurring on the MEMOREX 7200 and 7300 Processing Units and related peripheral equipment. When in use, the diagnostic system requires total dedicated use of the system hardware, and at no time is dependent on the presence of other software.

The Diagnostics System consists of a software package and a supporting documentation package.

The diagnostic software package comprises both machine language and microcode routines contained on a disc pack and card decks.

The supporting documentation package consists of seven manuals and a microfilm set. This documentation provides descriptive material as well as procedures for loading, executing, and interpreting all of the routines of the software package.

The combined usage of the above packages affords the field engineer a diagnostic capability that ranges from the ability to check out a system from deadstart through the analysis of an intermittent fault in a component of an operational system.

2. DOCUMENTATION PACKAGE

The documentation package consists of seven manuals and a microfilm set, which support the diagnostic software by providing the following:

- Description of the tests and subtests that make up the diagnostic software.
- Procedures for step-by-step loading and execution of the tests.
- Procedures to allow introduction of variable parameters to the test execution: looping, stop on error, write patterns, etc.
- Guidelines to be used when interpreting test results.
- Procedures for step-by-step loading and execution of three diagnostic utilities.

The manuals and microfilm constituting the documentation package are identified and described in Table 2-1. Table 2-2 affords a user the ability to locate a source within the documentation package for a category of information pertaining to a specific diagnostic test or utility.

Table 2-1. Documentation Package

Document	Description
<p>MRX/40 and 50 Diagnostics System Reference Manual Volume I: Overview</p> <p>MRX/40 and 50 Diagnostics System Reference Manual Volume II: Shared Resources (MLI) Tests</p>	<p>Describes, in a general manner, the software and documents comprising the diagnostic system, and relates their simultaneous usage to the diagnostic philosophy.</p> <p>Provides test descriptions, loading and executing procedures, parameter modification instructions (where applicable), and test result interpretation for the following tests:</p> <p>Autoload (automatically loaded and executed):</p> <ul style="list-style-type: none"> Quick Look Memory/Bootstrap Quick Look 1 Quick Look 2 Control Initial Loader <p>Stand-alone (individually selected and executed by operator):</p> <ul style="list-style-type: none"> Quick Look Control Command Register Option

Table 2-1. Documentation Package (Continued)

Document	Description
<p>MRX/40 and 50 Diagnostics System Reference Manual Volume III: Stand-Alone I/O Tests</p>	<p>Provides test descriptions, loading and executing procedures, parameter modification instructions, and test result interpretation for the following utility and stand-alone (individually selected and executed) I/O channel related tests.</p> <ul style="list-style-type: none"> Communications (COMCHK, processor state 0) IOC (processor states 1 and/or 2) IOC Loop (processor states 1 and/or 2) Disc (processor state 3) Disc Library Utility
<p>MRX/40 and 50 Diagnostics System Reference Manual Volume IV: System Peripheral Tests</p>	<p>Provides test descriptions, loading and executing procedures, parameter modification instructions, and test result interpretation for the following utilities and system peripheral (individually selected and executed under control of maintenance monitor) tests.</p> <ul style="list-style-type: none"> Maintenance Monitor Disc Magnetic Tape Communications Terminal Card Equipment Line Printer Disc Pack Copy Utility Disc Directory List Utility
<p>MRX/40 and 50 Diagnostics System Microdiagnostic Program Listing</p>	<p>Provides test descriptions, loading and executing procedures, and test result interpretations for the shared resources microcode tests and utilities.</p>
<p>MRX/40 and 50 Diagnostics System Stand-Alone Disc Test and IOC Test Program Listings</p>	<p>Provides test descriptions, loading and executing procedures, and test result interpretations for the Stand-Alone Disc test or the Stand-Alone IOC (Input/Output Channel) test.</p>
<p>MRX/40 and 50 Diagnostics System Operating Procedures</p>	<p>Provides loading and executing procedures, parameter modification instructions, and test result interpretation for all Machine Language Diagnostic tests and Utilities (Table 2-2). The presentation contains only those elements required by a trained operator. A procedure for loading Microdiagnostic tests from a card device (as opposed to disc, which is covered in the Microdiagnostic Program Listing) is also provided.</p>
<p>Microfilm Set</p>	<p>Provides the program listing for all Microdiagnostic tests, Machine Language Diagnostic tests, and Utilities. These listings are to be used by a trained operator to interpret error displays.</p>

Table 2-2. Sources of Information for Diagnostic Tests and Utilities

Diagnostic Test/Utility	Type of Information Desired			
	Test Description	Loading/Executing	Parameter Modification	Interpreting Test Results
Microdiagnostic Tests (tests written in microcode):				
CPU1	5	5	not applicable	5 and 8
CPU2	5	5	not applicable	5 and 8
CPU3	5	5	not applicable	5 and 8
Main Storage	5	5	not applicable	5 and 8
Integrated File Adapter (IFA)	5	5	not applicable	5 and 8
Input/Output Channels (IOC)	5	5	not applicable	5 and 8
Microdiagnostic Utilities	5	5	not applicable	5 and 8
Expanded CPU	5	5	not applicable	5 and 8
Machine Language Diagnostic Tests (tests written in machine language):				
Autoload:				
Quick Look Memory/Bootstrap	2	2 and 7	not applicable	2,7, and 8
Quick Look 1	2	2 and 7	not applicable	2,7, and 8
Quick Look 2	2	2 and 7	not applicable	2,7, and 8
Control	2	2 and 7	not applicable	2,7, and 8
Initial Loader	2	2 and 7	not applicable	2,7, and 8
Stand-Alone:				
Command	2	2 and 7	2 and 7	2,7, and 8
Quick Look	2	2 and 7	2 and 7	2,7, and 8
Register Option	2	2 and 7	2 and 7	2,7, and 8
Control	2	2 and 7	2 and 7	2,7, and 8
Communications	3	3 and 7	3 and 7	3,7, and 8
Input/Output Channel (IOC)	3	3 and 7	3 and 7	3,6,7,and 8
Disc	3	3 and 7	3 and 7	3,6,7,and 8
Maintenance Monitor	4	4 and 7	4 and 7	4,7, and 8
System:				
Disc	4	4 and 7	4 and 7	4,7, and 8
Magnetic Tape	4	4 and 7	4 and 7	4,7, and 8
Communications Terminal	4	4 and 7	4 and 7	4,7, and 8
Card Equipment	4	4 and 7	4 and 7	4,7, and 8
Line Printer	4	4 and 7	4 and 7	4,7, and 8
Utilities (written in machine language):				
Disc Library	3	3 and 7	3 and 7	3,7, and 8
Disc Directory List	4	4 and 7	not applicable	4,7, and 8
Disc Pack Copy	4	4 and 7	not applicable	4,7, and 8
1	Ref. Manual, Vol. I; Overview	5	Microdiagnostic Program Listing	
2	Ref. Manual, Vol. II; Shared Resources (MLI) Tests	6	Stand-Alone Disc Test and IOC Test Program Listing	
3	Ref. Manual, Vol. III; Stand-Alone I/O Tests	7	Operating Procedures	
4	Ref. Manual, Vol. IV; System Peripheral Tests	8	Microfilm Set	

3. SOFTWARE PACKAGE

The diagnostic software package is a series of tests and related utilities located on card decks and/or a disc pack. The disc pack contains every test (except the Expanded CPU Microdiagnostic tests) and utility included in the diagnostic system. A few key tests are duplicated in the form of card decks. The Expanded CPU Microdiagnostic tests (supplementary tests that vary with size of control storage) are provided only in the form of card decks. The disc pack is used as the primary source for diagnostic tests or utilities. The card decks function as a backup test source in the event the disc system is not available or cannot be loaded.

DISC PACK

The Diagnostic System Disc (DSD) pack is the primary source for tests and utilities required during a diagnostic situation. The DSD contains every test (except the Expanded CPU Microdiagnostic tests) and utility constituting the diagnostic system software package.

Diagnostic tests and utilities are written in either microcode or machine language. Tests and utilities written in microcode are referred to as Microdiagnostic tests and utilities (Table 2-2). The remaining tests and the utilities are written in machine language. As shown in Table 2-2, machine language tests fall into three subcategories: Autoload, Stand-Alone, and System. A brief description of each test in the diagnostic system is provided under *Microdiagnostic Tests* or *Machine Language Tests* in this section, as applicable. Refer to *Utilities* in this section for a brief description of the various diagnostic utilities.

Table 3-1 provides a detailed map of the content of the DSD. In terms of general organization and relationships, the DSD contains the following:

1. A comprehensive program library in object code for:
 - All Microdiagnostic tests (except Expanded CPU tests) and utilities
 - Up to 15 versions of Normal System Microcode
 - All Machine Language Autoload tests

Tests in the related active library (item 2) are selected from this library.

2. An active program library in object code for:
 - The applicable Microdiagnostic tests (except applicable Expanded CPU tests) and utilities
 - The applicable version of Normal System Microcode

- The applicable Machine Language Autoload tests

This is the library that is used when one of the tests in these categories is being conducted, or Normal System Microcode is loaded.

3. A message library for providing the operator with error displays and parameter solicitation text.

4. A program library in object code for:

- All Machine Language Stand-Alone and System tests
- The diagnostic machine language utilities

This library is both comprehensive (it contains all tests in these categories) and active (a test's applicability to the related system is coded).

5. A source code library for all machine language tests (Autoload, Stand-alone, and System) and utilities.
6. A number of directories and space maps for handling the organization and maintenance of the disc contents.

CARD DECKS

The following tests and utilities, each located on a separate card deck, constitute the diagnostic system card decks. (Each test with the exception of the Expanded CPU tests, is a duplicate of its counterpart on the disc pack. The tests are briefly described under Microdiagnostic Tests, Machine Language Tests, or Utilities, as applicable.)

1. CPU 1 Microdiagnostic test
2. CPU 2 Microdiagnostic test
3. CPU 3 Microdiagnostic test
4. The following (usage depends on options installed in system) Main Storage Microdiagnostic tests:
 - a. Basic protect (deck includes job accounting tests, but these tests are performed only if specified by operator)
 - b. Basic protect with ECC (deck includes job accounting tests, but these tests are performed only if specified by operator)

Table 3-1. Diagnostics System Disc Map

Cylinder	Track	Content
0	0	Active Quick Memory (machine language) test
0	1 thru E	Active Microdiagnostic (microcode) tests (except Expanded CPU tests; card decks only) and utilities
0	F thru 13	Active Normal System Microcode
1		Active Autoload (machine language) tests, less Quick Memory
2	0 and 1	Directory of active Microdiagnostic tests, Normal System Microcode, and Autoload tests
2	2 and 3	Directory of Stand-alone and System tests and Utilities (machine language)
2	4 and 5	Directory of Messages
2	6 and 7	Directory of Templates
2	8 and 9	Directory of Comprehensive Microdiagnostic tests (except Expanded CPU tests) and utilities, Normal System Microcode, and Autoload tests
2	A	Space Map for Stand-Alone and System tests and Utilities (70 byte record)
2	B	Space Map for Active Microdiagnostic tests, Normal System Microcode, and Autoload tests (10 byte record)
2	C	Space Map for Messages (960 byte record)
2	D	Space Map for Templates (960 byte record)
2	E thru 13	unused
3 thru 6		Comprehensive Microdiagnostic test, Normal System Microcode, and Autoload test program library
7 thru 14		Messages library
15 thru 22		Templates library
23 thru 50		Combined active/comprehensive (coded) Stand-Alone and System test and Utilities library
51		Reserved for Pack Catalog
52 thru 175		Source code library for all Machine Language tests (Autoload, Stand-Alone, and System) and Utilities, including a 25-cylinder scratch buffer for assemblies
176 thru 199		unused
200 thru 202		Alternate tracks

5. IFA Microdiagnostic tests
6. IOC Microdiagnostic tests
7. Expanded CPU Microdiagnostic tests
8. Microdiagnostic utilities
9. Stand-Alone (machine language) Disc tests

Test numbers 1 through 8 are microcode tests and utilities designed to check the operation of the processing unit's shared resources. Test number 9 is a machine language test that checks the operation of the disc system.

Test numbers 1 through 9, considered as a group, are designed primarily for use in a situation where diagnostic analysis is required, but for one reason or another, the disc system cannot be used to bring in the diagnostic tests from the disc pack. In this particular situation, the card decks would be loaded and executed (according to procedures in the **Diagnostic System Operating Procedures** manual), one deck at a time, starting with deck number 1. Decks 1 through 6 would be used to verify operation of the processing unit shared resources. Decks 7 and 8 would be used on an if required basis. Then, normal system microcode would be loaded from a system deck, and operation of the disc drive system would be checked by deck 9. When the ability to load from disc has been restored, the entire list of Microdiagnostic tests should be performed from the disc pack before proceeding to the Machine Language tests.

MICRODIAGNOSTIC TESTS

The term microdiagnostic defines those tests of the diagnostic system that are written in microcode. This group of tests is designed to detect, isolate, and identify failures located in the shared resources logic. Some of the Machine Language tests also do testing within shared resources to provide a backup test capability for those failures not detected by the Microdiagnostics.

Microdiagnostic tests (except Expanded CPU tests; provided on card decks only) are normally loaded from the DSD. However, the tests are duplicated in the form of card decks, and can be loaded from a card-reading device in the event the operator is unable to load from the disc system. The related documentation provides procedures for either method of loading.

The individual tests that comprise the Microdiagnostic tests are as follows:

<u>Test</u>	<u>Major Areas Tested</u>
1. CPU1	<ul style="list-style-type: none">a. Majority of microcode instructionsb. A_{μ} and B_{μ} registers and ALU logicc. All registers in current processor's basic register filed. Block point update of P_{PTR} registere. Overflow and link in P_{μ} registerf. Extended register file, group I F-register and microinstructions that use the R1 and R2 fields in the F-register for addressing
2. CPU2	<ul style="list-style-type: none">a. Remainder (refer to CPU1) of microcode instructionsb. Read and write F and P_{μ} registers for all processor statesc. Extended register file, group II registers
3. CPU3	<ul style="list-style-type: none">a. Busy/active for all processor states using LBB (microinstruction) to set bitsb. Resync register clocking logicc. Clear I/O 1 and 2 inputs to busy/active logic for processor states 0 through 4d. Ability of processor states 0 through 3 to invoke priority overridee. Consecutive cycle logic for all processor statesf. Real Time Clock register for minimum/maximum update timing and proper incrementing
4. Main Storage	Main storage. The active Microdiagnostic tests on the disc and the card decks contain this test in a form that is compatible with any main storage configuration from 16K to 64K.
5. IFA	Integrated File Adapter, processor state 3. Can be used to check for presence of disc drives even to the point of causing a disc drive to be exercised, but all tests are performed solely for the reason of checking IFA logic.
6. IOC	Input/Output Channel, processor states 1 and/or 2. All testing is limited to the logic of the processor states. No tests performed on logic beyond drivers and receivers.

<u>Test</u>	<u>Major Areas Tested</u>
7. Expanded CPU	Those areas (gates and addresses) of control storage not tested by CPU1, 2, and 3 (which test a 4K configuration). Tests are provided only in the form of card decks. Operator selects and runs only that deck that corresponds to the control storage capacity of the particular system.

LOADING AND EXECUTING

All Microdiagnostic tests are provided on the DSD and on card decks in object code. Detailed loading and executing procedures are provided in the diagnostic system documentation package (refer to Table 2-2). If the load is to be made from card decks, refer to the **Diagnostics Operating Procedures** manual for the procedure.

The analytic nature of Microdiagnostic tests makes it mandatory that the actual test loading and executing is always preceded by a specific pre-loading procedure. Additionally, and again because of their analytic nature, the sequence of test performance should include all tests in the following order:

1. CPU1
2. CPU2
3. CPU3
4. Main Storage
5. IFA
6. IOC

The pre-loading procedure includes five separate sequences:

1. Initial Switch Setting Sequence
2. Power On Sequence (performed only if power is not yet applied)
3. System Reset Sequence. This sequence verifies operation of the Data and Address registers, sets the $P\mu$ (P micro) and $S\mu$ (S micro) registers to zero, and generally configures the initial state of the processing limit to that required to start testing.
4. Reset/Load Sequence. Loads CPU1 Microdiagnostic test.
5. CS (Control Storage) Scan Test. Verifies the accuracy of the CPU1 load in control storage.

Upon completion of the pre-loading procedure, the operator executes the CPU1 test. Each remaining Microdiagnostic test is performed, in the previously mentioned order, by performing a reset/load to load the test, pressing the SYSTEM RESET pushbutton, and starting processor state 4. An S_{μ} register content of 0000 indicates a normal (no fault) termination for each Microdiagnostic test. Refer to *Error Displays* to make interpretations of other register contents.

ERROR DISPLAYS

During the loading and execution of the Microdiagnostic tests, the progress and/or success of the test is indicated, at various points during the test, by the contents of various registers. The procedure for conducting the test instructs the operator when to look at a particular register and what to do next based on the content of the register. When, because of the register contents, the test procedure sends the operator to either the SUXXX ERROR STOP IN LISTING or makes reference to the SHARED RESOURCES FAULT LOG, interpretations of the listing or the log should be made according to the following guidelines.

The previously mentioned log and listing are two separate documents contained in the Microdiagnostic Program Listing manual. If the procedure makes direct reference to the FAULT LOG, it is because the fault has occurred during the pre-loading procedure. The pre-loading tests are not under software control and, therefore, do not have a related program listing. In this situation the operator's sole source of information for isolating the fault is the SHARED RESOURCES FAULT LOG. To use the log, identify the pre-loading sequence (system reset, SR; reset load, RL; or control storage scan, CSS) being performed when the fault occurred and note the contents of the S_{μ} register. Using these two elements, enter the FAULT LOG and make an interpretation of the fault according to the following example.

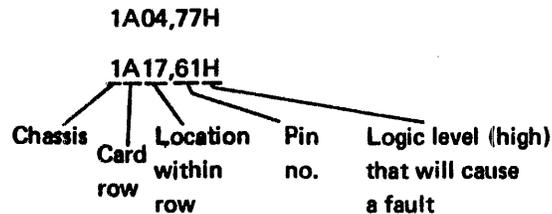
Example

Assume a fault occurring during the control storage scan (CSS) sequence and an S_{μ} register content of 4000. Entering the SHARED RESOURCES FAULT LOG with these known elements yields the following list of entries:

SHARED RESOURCES FAULT LOG									
LOCATION	TEST	SU	AU	BU	DREG	ADRS	DATA	SREG	COMMENTS
1B17,91H	CSS	4000					05BF		CS-PE
1B17,10H	CSS	4000					05DF		CS-PE
1B17,85H	CSS	4000					05DF		CS-PE
1A04,77H	CSS	4000					05FF		
1A17,61H	CSS	4000					05FF		
1A04,32L	CSS	4000					8486		CS-PE
1A04,32H	CSS	4000					85FF		CS-PE
1A17,TP09L	CSS	4000					85FF		CS-PE
1A17,17HI	CSS	4000					85FF		CS-PE

Diagram annotations: A bracket on the left side of the table groups the last four rows (1A04,32L to 1A17,17HI). A circled '3' is connected to the LOCATION column of the first row in this group. A circled '1' is connected to the SU column of the first row in this group. A circled '2' is connected to the DATA column of the last row in this group.

- ① Initial entry into the log made on the basis of these two known items.
- ② Once in the log, the operator finds these additional items to aid in isolating the fault. The Data register is observed to contain 05FF, and the CS PARITY ERROR indicator is not lighted.
- ③ The known items at this point have now isolated the fault to these two possibilities:



The operator checks the signal at both locations: 1A04-77 is high, 1A17-61 is low. The operator replaces the card at location 1A04.

If a fault occurs while performing one of the Microdiagnostic tests, the procedure will make reference to the SUXXX ERROR STOP IN LISTING. In this situation, the operator may be able to gain diagnostic information from both the related program listing and the FAULT LOG to isolate the fault. The operator's first source for information should always be the program listing for the test that was running when the fault occurred. Enter the listing with the S_{μ} register contents. The listing supplies an explanation of the error and identifies instructions that were performed since passing the last point in the program at which an error stop could have occurred. The listing may also provide additional isolation procedures to be performed by the operator. The second possible source of diagnostic information is the SHARED RESOURCES FAULT LOG. To use the log, identify the Microdiagnostic test (CPU1, 1; CPU2, 2; CPU3, 3; Main Storage, M; IFA, IFA; IOC, IOC) being performed when the fault occurred. With this information and the S_{μ} register content, attempt to find an entry FAULT LOG (as was mentioned previously, not all S_{μ} register stops are listed in the log). Usage of the two information sources (listing and log), is shown in the following example.

Example

Assume a fault occurring during the CPU1 test and a S_{μ} register content of 08BF. Entering the CPU1 program listing with the S_{μ} contents yields the following list of entries:

①
CPU1 MICRODIAGNOSTIC

LOCATN	OBJECT	A	B	ADDR	SOURCE STATEMENT	7200/7300 MICRO ASSEMBLY
08B8	D480	0	0	00	LAW-10 LBW-10 FOR 4	9F0D
08B9	6400	0	0	00		FFFF TO A MICRO
08BA	4C84	0	0	04		FFFF TO B MICRO
						PERFORM EXCLUSIVE OR OF FFFF IN A WITH FFFF IN B
08BB	D084	0	0	04	③ LAW 4	670D
08BC	5080					RESULT SHOULD BE 0000
08BD	1382	1	1	02	SKZ	378D
08BE	F010				CLR X2	240F
					SYNC	D41F
						EOR OF FFFF IN A AND FFFF IN B FAILED. A CONTAINS FAILING BIT OR BITS.

- ① Initial entry into program listing made on the basis of these two known items.
- ② Description of detected fault.
- ③ Instructions performed in detecting the fault.

The last sentence in the description of the detected fault could be used to isolate the fault, but the operator should always attempt to find more detailed information in the SHARED RESOURCES FAULT LOG. Upon doing so, the following list of entries is found.

SHARED RESOURCES FAULT LOG

LOCATION	TEST	SU	AU	BU	DREG	ADRS	DATA	SREG	COMMENTS
1A28.67L	1	08BF	0008	FFF7					
1A28.87H	1	08BF	000F	FFFF					
1A27.67L	1	08BF	0080	FF7F					
1A27.87H	1	08BF	00F0	FFFF					
1A26.67L	1	08BF	0800	F7FF					
1A26.87H	1	08BF	0F00	FFFF					
1A25.67L	1	08BF	8000	7FFF					
1A25.87H	1	08BF	F000	FFFF					
1A07.73H	1	08BF	FFFF	FFFF					

- ① Initial entry into the log made on the basis of these two known items.
- ② Once in the log, the operator finds these additional items to aid in isolating the fault. The $A\mu$ and $B\mu$ registers contents are observed to be 8000 and 7FFF, respectively.
- ③ A check of the signal level on pin 67 at location 1A25, reveals the level to be at ground. Since the listing indicates that a low (L.) at this pin causes a fault, the operator replaces the card at location 1A25.

MACHINE LANGUAGE TESTS

Machine Language tests are those tests of the diagnostic system written in machine language. This group of tests is designed to detect, isolate, and identify failures located in the processing unit and any attached peripheral equipment.

Machine language tests are, in almost every case, loaded from the DSD. Only the Stand-Alone Disc Test is duplicated on a card deck. This card deck would be used in a situation where diagnostics are required, but, for one reason or another, the operator cannot load tests from the disc system. In this particular situation, the operator would load and run each Microdiagnostic test from card decks, load the normal system microcode from cards, and finally load and execute the card deck for the Stand-Alone Disc test in an effort to gain use of the disc system.

The machine language tests fall into three categories:

- Autoload tests
- Stand-Alone tests
- System tests

The individual tests that comprise the Machine Language tests are described (a more detailed description is provided in the applicable reference manual) below.

<u>Test</u>	<u>Major Area Tested</u>
1. Autoload Quick Memory/Bootstrap	Performs basic testing of main storage and determines the amount of storage available for program execution. (Also loads Bootstrap which is used to load each Autoload test after execution of the previous test.)
2. Autoload Quick Look 1	Performs basic testing of a portion of the machine language instruction repertoire (see test number 3).
3. Autoload Quick Look 2	Performs basic testing of a portion of the machine language instruction repertoire (see test number 2).
4. Autoload Control	Checks privileged and control instructions, the addressability of all registers that can be reached with the Read Any Register or Write Any Register instructions, inter-processor state communication, and priority processing.
5. Autoload Initial Loader	Does no testing. Monitors and controls loading of tests. Affords operator some load and dump control.

<u>Test</u>	<u>Major Area Tested</u>
6. Stand-Alone Command	A series of subtests, some of which use random data and complimentary-type instructions (multiply and divide, binary to decimal and decimal to binary) to check each other, and others which require machine language simulation to test the results. Each subtest is run in each processor state. Test runs continuously until the operator intervenes or an error occurs.
7. Stand-Alone Quick Look	Same as the Autoload Quick Look 1 and 2 tests, except that it runs continuously until the operator intervenes or an error occurs.
8. Stand-Alone Register Option	Verifies operation of Bounds register and checks storage protection with a variety of read and/or write operations performed (in processor states 5, 6, and 7) with a variety of Bounds register configurations. Verifies job accounting register operation (if applicable).
9. Stand-Alone Control	Same as Autoload Control test, except that it runs continuously until the operator intervenes or an error occurs.
10. Stand-Alone Communications	Verifies Integrated Communications Adapter (ICA; processor state 0) operation with a variety of selectable routines. Test allows operator to exercise full operational capability or a specific area of operation.
11. Stand-Alone IOC	Checks Input/Output Channels (processor states 1 and 2) and a connected peripheral device(s). Operator establishes a command sequence which is continually looped-on as the accuracy of the sequence is checked.
12. Stand-Alone IOC Loop	Checks IOC only. Ability of channel to communicate with itself is used along with a variety of routines to check channel(s) operation.
13. Stand-Alone Disc	Checks Integrated File Adapter (IFA, processor state 3) and a connected disc storage drive. Operator establishes a command sequence which is continually looped-on as the accuracy of the sequence is checked.

<u>Test</u>	<u>Major Area Tested</u>
14. Stand-Alone Maintenance Monitor	Does no testing. Monitors, controls, and supports operator/system test interface operations through either the operator console (communication terminal) or the system (processing-unit) control panel.
15. System Disc	Tests operation of the disc drive subsystem. Uses preselected subtests, but allows operator to select other subtests and introduces variations in test performance. Two test versions allow operator to run either a general test encompassing seeks and reads, or a more comprehensive test array.
16. System Magnetic Tape	Tests operation of magnetic tape subsystem. Uses preselected subtests, but allows operator to select other subtests and introduce variations in test performance. Two test versions allow operator to exercise one tape drive or multiple drives during execution of the test.
17. System Communications Terminal	Tests operation of 1240 communications terminal. Uses preselected subtests, but allows operator to select other subtests and introduce variations in test performance.
18. System Card Equipment	Tests console card reader and card reader/punch operation. Uses preselected subtests, but allows operator to select other subtests and introduce variations in test performance.
19. System Line Printer	Tests line printer operation. Uses preselected subtests, but allows operator to select other subtests and introduce variations in test performance.

LOADING AND EXECUTING

Loading and execution of Machine Language tests from the DSD varies according to the category (Autoload, Stand-Alone, or System) of the particular test (Figure 3-1).

The operator must ensure that the normal system microcode is loaded in control storage (loaded from DSD upon completion of Microdiagnostic tests) before running Machine Language tests. When the Machine Language test sequence is performed from the DSD, each Autoload test is automatically loaded and executed, in turn, when the system control panel AUTOLOAD switch is pressed. The autoload sequence stops after loading the Autoload Initial Loader.

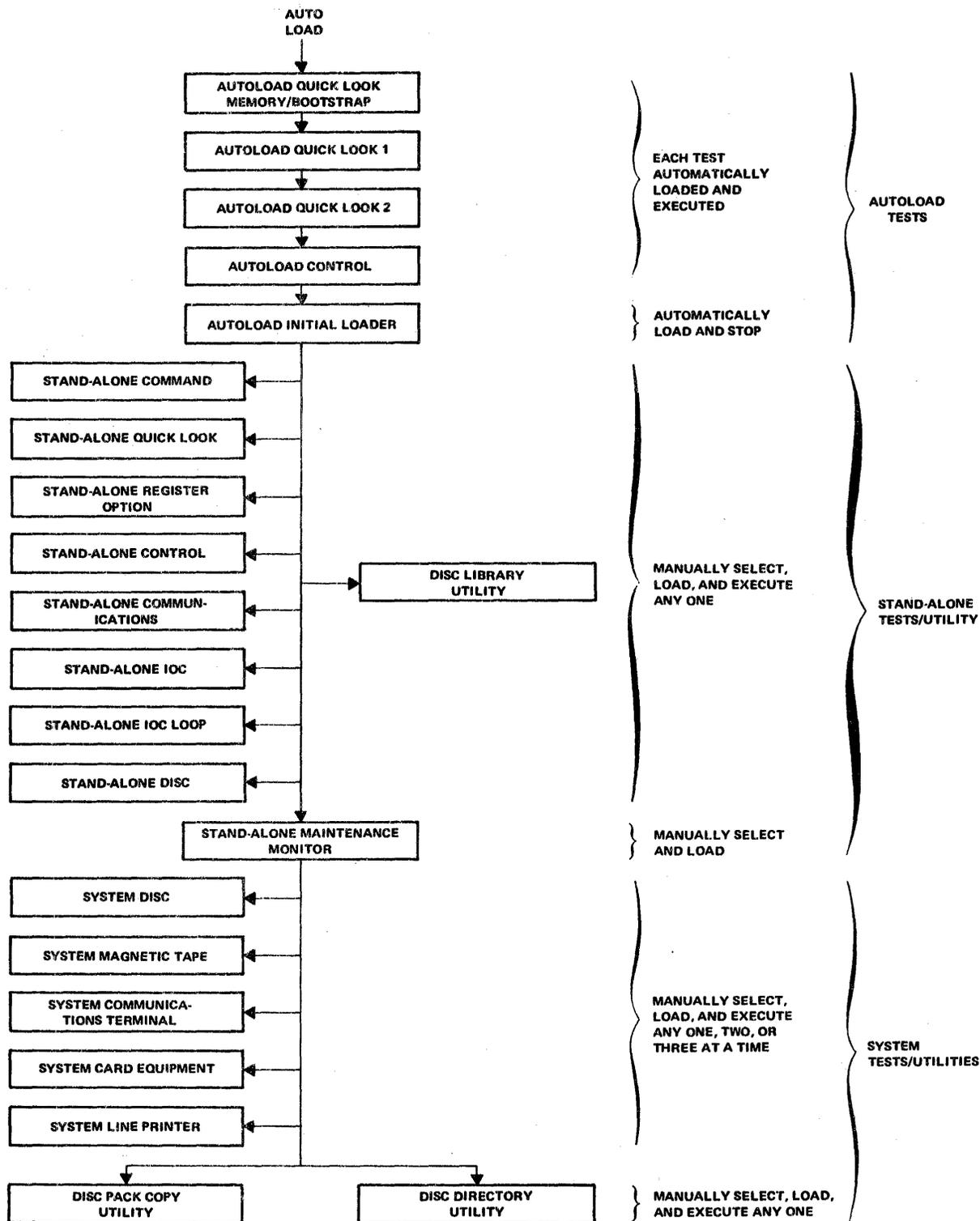


Figure 3-1. Machine Language Tests and Utilities on the DSD

The operator is confronted with three possible courses of action at this point:

1. Load and execute a Stand-Alone test
2. Load and execute the Disc Library Utility (refer to *Utilities*)
3. If a System test, Disc Pack Copy utility, or Disc Directory utility is to be performed, load Stand-Alone Maintenance Monitor

No matter which of the three activities the operator does, the loading is done from the system control panel. If the operator picks either action 1 or 2, the related test or utility will remain in control after being executed: operator must perform another AUTOLOAD in order to gain access to another Stand-Alone test or utility. If the operator picks action 3, Maintenance Monitor enters an idling mode after being loaded. The operator may now load (from either the system control panel or the operator console) up to three separate System tests, each running concurrently in a separate processor state (5, 6, 7). (There are, however, restrictions on what combination of tests may be run. The related operating procedures provide a method for determining which combinations are possible for a particular system configuration.) Additional System tests may be loaded and executed as previous system tests are completed.

PARAMETER MODIFICATION

Parameters are the variable entities of a test. Parameters include such things as:

- Which subtests will be used
- Write patterns
- Looping
- Error suppression
- Stop on error

Parameters for Autoload tests are preselected and cannot be changed by the operator.

Parameters for Stand-Alone tests are unique to each particular test. Parameters can be changed at the time of test execution according to the related operating procedure.

Each System test includes certain preselected parameters. The preselected parameters can be modified by the operator. The System control panel or the operator console are used for this purpose. The related operating procedure provides the required information.

ERROR DISPLAYS

During the loading and execution of Machine Language tests the progress and/or success of the test(s) is displayed for the operator. The method of display, as well as the volume of information contained in the display, will vary in accordance with the category of the test being run.

Errors detected by the Autoload and the Stand-Alone tests are displayed via the Address and the Data registers. In some cases, the manual being used to run the test will contain sufficient information to isolate the fault. However, most error analysis and isolation requires reference to the applicable program listing (included in either a manual or the microfilm file, Table 2-2).

Errors detected during a System test are subject to variations that relate to the amount of available main storage and the operation of the operator console and the disc storage system: available main storage affects method of displaying information, and the method of display is affected by whether or not the operator console and the disc system are operating. As a result, an error detected by the Diagnostic System during a System test can be displayed in one of three ways:

1. When the operator console is inoperative or less than 24K of main storage is available, error displays are provided via a series of Address and Data register contents. To gain all information pertaining to the error, the operator must make a written record of the contents of both registers and then press bit 1 of the Address register, repeating this procedure until the registers contain all zeros, or the test begins running again or stops. Error information derived from the registers occurs in the following form:

<u>Address Register</u>	<u>Data Register</u>
OXMN	YYYY
OXDN	YYYY
OXDN	YYYY
.	.
.	.
.	.

Where:

X = User processor state (5, 6, or 7) executing the test

MN = Message number (applicable manual provides error code interpretation on basis of number)

DN = Display number (incremented by one for each activation of Address register bit 1). Number of displays can vary from one to 20 depending on error.

YYYY = Hexadecimal data defining error (applicable manual defines content).

- When disc drive 0 (numeral zero etched on unit number plug) is inoperative or being tested, but the operator console is operative, and a minimum of 24K is available in main storage, error display occurs at the operator console. The error information printout occurs in the following form:

A	OXMN	D	YYYY
A	OXDN	D	YYYY
A	OXDN	D	YYYY
.	.	.	.
.	.	.	.
.	.	.	.

Where:

A describes adjacent four characters immediately to the right as a content of the Address register

D describes adjacent four characters to the right as a content of the Data register

All other codes (X, DN, MN, Y) are the same as described under 1.

- When disc drive 0 (numeral zero etched on unit number plug) is operative and not being tested, the operator console is operative, and a minimum of 24K is available in main storage, error display occurs at the operator console. The error information printout occurs in a form similar to that in the following example:

PX STATUS ERROR

SEGMENT NUMBER, SUBTEST NUMBER	A	OXMN	D	YYYY
CHANNEL NUMBER, DEVICE ADDRESS	A	OXDN	D	YYYY
COMMAND, STATUS EXPECTED	A	OXDN	D	YYYY
.
.
.

┌────────── Description field ───────────┐ ┌── Error information ─┐

Where:

The error information is the same as previously described. The description field consists of a user processor state identifier (PX), a description of the error (STATUS ERROR), and descriptions of the YYYY characters (SEGMENT NUMBER identified by the two most-significant characters, SUBTEST NUMBER identified by the

two least-significant characters). The overall length and the content of the printout varies with the error being displayed.

UTILITIES

The Diagnostic System Disc (DSD) pack contains machine language and microdiagnostic utilities. These utilities do not perform tests or figure directly in a diagnostic situation, but rather, provide auxiliary-type support to the Diagnostic System.

MACHINE LANGUAGE UTILITIES

There are three machine language utilities as described below:

1. Disc Pack Copy Utility – allows information on disc pack installed on disc drive unit number 0 to be duplicated on a disc pack installed on disc drive unit number 1 (assumes both disc packs have been initialized). Utility can also be used to check the integrity of specified cylinders of data on a disc pack.
2. Disc Directory List Utility – allows operator to derive listings of information for the following DSD items:
 - Directory of Active Microdiagnostic and Autoload (machine language) programs
 - Directory of Comprehensive Microdiagnostic and Autoload (machine language) programs
 - Directory of Messages
 - Messages wording
 - Directory of Templates
 - Templates wording
 - Directory of Active Machine Language (Stand-Alone and System) programs
 - Directory of Comprehensive Machine Language (Stand-Alone and System) programs
 - Space map for DSD (display of DSD track and record usage)

The applicable listing includes elements such as test number, first-byte-address (FBA), last-byte-address (LBA), cylinder, head, record blocks allocated, blocks reserved, etc. This information is useful in determining if and where unused space is located on the DSD, which System tests may be run simultaneously, and in general verifying a proper diagnostic system.

3. Disc Library Utility – allows operator to establish or modify the content and organization of the DSD, by supporting the following activities:
 - Formatting the disc
 - Allocating disc space
 - Dumping messages, templates, Machine Language tests, and Microdiagnostic tests
 - Establishing a Machine Language test as active or otherwise
 - Building an active program library of Microdiagnostic and Autoload (Machine Language) tests
 - Punching a program in punch funny (also called card image or column binary) format
 - Deleting a member(s) of a library
 - Packing (compressing members of) a library

MICRODIAGNOSTIC UTILITIES

There are three microdiagnostic utilities, as described below:

1. Panic Dump routine – dumps (to printer) the contents of the basic and extended registers of each processor state and all non-zero main storage locations.
2. Communications Scoping routine – aids oscilloscope troubleshooting of the ICA (processor state 0) by providing selectable test sequences to loop within selectable communication adapters.
3. Main Storage Chip Addressing test – a routine that runs simultaneously in processor states 0 and 4 and checks all possible combinations of addressing of each main storage chip.

4. USING THE DIAGNOSTICS SYSTEM

The Diagnostics System is a series of tests designed to run in a certain sequence by a machine which is configured in a specific manner. The operator controls both the test sequence and machine configuration (switch settings); therefore, the operator also controls the effectiveness of the Diagnostics System.

An operator that pays strict attention to each step of the procedure for a test will probably not experience problems affiliated with an improper configuration. Test sequencing, however, can cause problems for an operator. Generally, problems of this type are incurred by an operator who improperly assumes the location of a fault and takes shortcuts in using the Diagnostics System in an effort to verify his assumption. Figure 4-1 contains recommendations for using the Diagnostics System in a manner which avoids test sequence problems.

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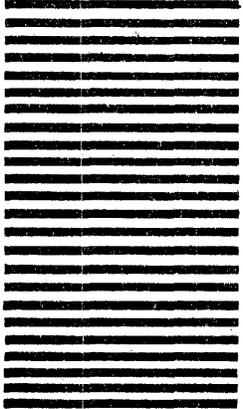
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