

PAPER TAPE NO. 13207-16001

**HP 2000 COMPUTER SYSTEMS COMMUNICATIONS PROCESSOR  
FIRMWARE DIAGNOSTIC**

for

HP 21MX M-SERIES COMPUTER

and

HP 21MX E-SERIES COMPUTER



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# LIST OF EFFECTIVE PAGES

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# PRINTING HISTORY

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## SECTION I

### INTRODUCTION

#### 1-1. GENERAL

This diagnostic test program confirms proper operation of the HP 13207A or the HP 22702A 2000 Computer System Communications Processor Firmware. The HP 13207A Communication Processor Firmware is used in the HP 21MX M-Series Computer and the HP 22702A Communications Processor Firmware is used in the 21MX E-Series Computer. It operates in the 21MX M/21MX E-Series Computer with a minimum of 8K words of memory, and is one of the diagnostics executed in conjunction with the HP 2100 Series Computer Diagnostic Configurator. Communication to the operator is accomplished via the Memory Data (T) Register and/or the system console. The only operator input required is through the Switch (S) Register.

The test method consists of executing the instructions under test, and comparing the results to pre-determined or calculated values in memory. Since this diagnostic involves the use of many CPU base set instructions, it should be run only after the following diagnostics have been successfully executed:

- |  |   |  |
|--|---|--|
| a. Memory Reference Instruction Diagnostic   | } | Part of HP 2100 Long Diagnostic<br>(see paragraph 1-3) |
| b. Alter-Skip Instruction Diagnostic         |   |  |
| c. Shift-Rotate Instruction Diagnostic       |   |  |
| d. I/O Instructions and Interrupt Diagnostic |   |  |
| e. Memory Diagnostic                         |   |  |

#### 1-2. REQUIRED HARDWARE

The following hardware is required:

- a. An HP 21MX M/21MX E-Series Computer with at least 8K of memory and with register display capability.
- b. An HP 13207A/22702A 2000 Computer System Communications Processor Firmware Kit installed in computer.
- c. A diagnostic input device:
  1. Paper tape reader: HP 2737A/B, HP 2748A/B, HP 2758A (or teleprinter with paper tape reader)
  2. Magnetic tape unit: HP 7970B/E (9 track only)
  3. Cartridge disc: HP 7905A, HP 7900A, or HP 7901A (removable platter unit 0)
- d. An HP 12539 Time Base Generator (TBG) is required only for interrupt tests; all other tests may be run without a TBG.

A console device for message reporting is optional.

### 1-3. REQUIRED SOFTWARE

The following software is required:

- a. HP 2100 Series Computer Diagnostic Configurator
  - Binary Object Tape    part no. 24296-60001
  - Manual                    part no. 02100-90157
  
- b. HP 13207A/22702A 2000 Computer System Communications Processor Firmware Diagnostic\*
  - Binary Object Tape    part no. 13207-16001
  - Manual                    part no. 13207-90003

The diagnostic serial number of this diagnostic, which resides in memory location 126 (octal), is 101117.

The following software is recommended:

- HP 2100 Series Computer Long Diagnostic
  - Binary Object Tapes    part no. 24390-16001, 16002, 16003
  - Manual                    part no. 24390-90001

\* You may have this diagnostic on media other than paper tape and it may be part of a multiple file. For loading procedures and current date codes associated with your media, refer to Appendix A in the HP 2000 Diagnostic Configurator Manual, part no. 02100-90157, dated August 1976 or later.

**SECTION II**  
**PROGRAM ORGANIZATION**

**2-1. ORGANIZATION**

This diagnostic program consists of 8 tests which test the following 13 microcoded firmware routines:

<u>TEST</u>	<u>ROUTINE</u>
0	CRC Test
1	ENQ, PENQ, and DEQ Tests
2	IAL Test
3	READF, SAVE, AND RESTR Tests
4	LAI and SAI Tests
5	PFREX Test
6	PFREI Test
7	PFRIIO Test

**2-2. TEST CONTROL AND EXECUTION**

The program outputs a title message to the console device for operator information and then executes the tests according to the options selected on the Switch Register by the operator. The program also keeps count of the number of passes that have been completed and will output the pass count at the completion of each pass. The pass counter will be reset if the program is restarted.

**2-3. SELECTION OF TESTS BY OPERATOR**

The operator has the capability to select one particular test or a sequence of tests. Paragraph 3-4 outlines the operator test selection capability.

**2-4. MESSAGE REPORTING**

There are two types of messages output for diagnostics: error and information. Error messages are used to inform the operator when the device fails to respond to a given instruction or control sequence. Information messages are used to inform the operator of the progress of the diagnostic. If a console device is used, the printed message will be preceded by the letter E (error) or the letter

H (information) and a number (in octal). The number is also related to the halt code when a console device is not available. Examples of error and information messages are as follows (specific meanings are listed in section III):

Example — Error with halt

Message: E113 STACK POINTER BAD AFTER SAVE  
Halt Code: 106013 (octal) (T-Register)

Example — Information with halt

Message: H030 CRC TEST  
Halt Code: 102030 (octal)

Error messages can be suppressed by setting Switch Register bit 11 and error halts can be suppressed by setting Switch Register bit 14. This is useful when looping on a single section that has several errors. Information messages are suppressed by setting Switch Register bit 10.

## 2-5. LIMITATIONS

All microcode failure types are detected by the diagnostic except:

- a. If the microcode does not return control to the diagnostic program, test validity cannot be assured. This situation results in the cessation of messages to the operator. Pressing HALT on the computer will usually not halt the computer. The only remedy is to set the ~LINE switch to OFF.
- b. If the microcode returns control to the diagnostic program but not to the proper location, the effects are unpredictable and the results are meaningless.

## SECTION III

### OPERATING PROCEDURE

#### 3-1. OPERATING PROCEDURES

A flowchart of the operating procedures for loading the Diagnostic Configurator and this diagnostic is provided in figure 3-1.

If an unconfigured Diagnostic Configurator is available, start at entry point A on the flowchart.

If a configured Diagnostic Configurator is available, start at entry point B on the flowchart.

If a combined configured Diagnostic Configurator and an unconfigured Diagnostic is available, start at entry point C on the flowchart.

If a combined configured Diagnostic Configurator and a configured Diagnostic is available, start at entry point D on the flowchart.

#### 3-2. RUNNING THE DIAGNOSTIC

- a. If the Interruptibility tests are to be executed, go to step b. Otherwise, press Register Select, as required, to select the P-register for display in the Display Register. Enter 2000 (octal) into the Display Register and press STORE. Press PRESET and go to step d.
- b. Press Register Select, as required, to select the P-register for display in the Display Register. Enter 100 (octal) into the Display Register and press STORE. Press Register Select, as required, to select the S-register for display in the Display Register. Enter into bits 5-0 of the Display Register the select code of the time base generator (TBG) to be used for the Interruptibility test.
- c. Press STORE, PRESET, and RUN. The computer will come to a halt 102074 (octal).
- d. Press Register Select, as required, to select the S-Register for display in the Display Register. Enter the program options into the Display Register. (See table 3-1.) Press STORE.
- e. Press RUN. The following message will be printed on the console:

```
21MX 2000 COMPUTER SYSTEM COMM. PROC. FIRMWARE DIAGNOSTIC
```

At this point the diagnostic will come to a halt 102075 (octal) if Switch Register bit 9 was set to allow the operator to select a group of tests. (See paragraph 3-4.) After the operator has made his selection, automatic execution of all selected tests begins.

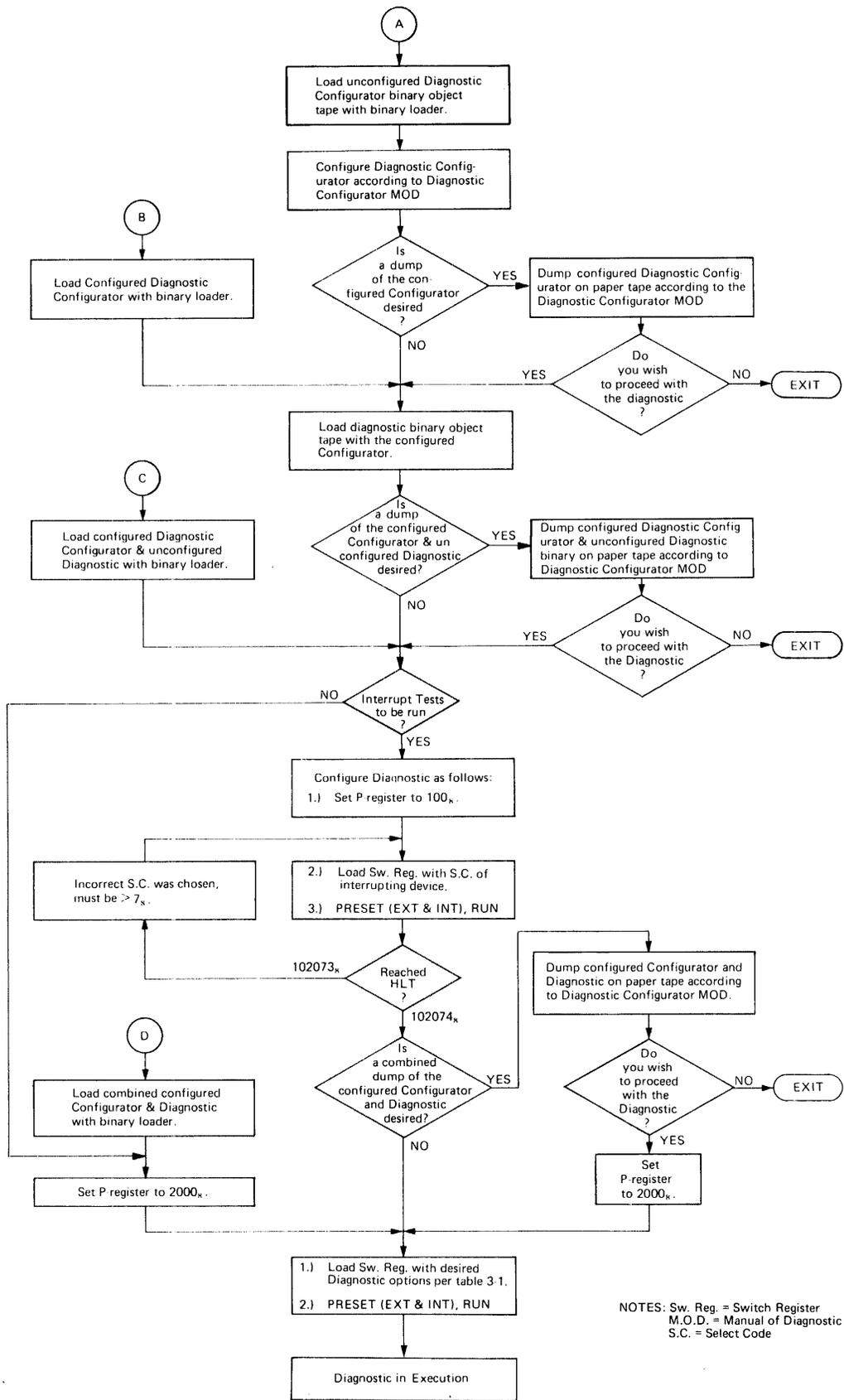


Figure 3-1. Operating Procedure Flowchart

If Switch Register bit 9 was not set, the diagnostic will not halt but will start automatic execution of all tests. Each test is preceded with a test title message. (See table 3-2.) Appropriate error messages are printed for software detected test failures. (See table 3-4.) After printing an error message, the diagnostic will halt with the appropriate halt code, unless the error halts are suppressed by Switch Register bit 14.

At the completion of all selected tests, the message PASS nnnnnn is printed, where nnnnnn is the octal pass count. A halt 102077 (octal) follows. The pass count will also be in the A-register.

*NOTE: Any time during diagnostic execution when Switch Register bit 9 is set, the test run aborts at the end of the current test with a halt 102075 (octal). This gives the operator the opportunity to specify a different group of tests. (See paragraph 3-4.) Switch Register bits 10 through 15 can be set/reset any time during diagnostic execution. The effects of these switch register settings are described in table 3-1.*

**Table 3-1. Switch Register Options**

BIT	MEANING IF SET
15	Halt (102076) at the end of each test; the A-register will contain the octal equivalent of the test just completed.
14	Suppress error halts.
13	Repeat last test executed (loop on test).
12	Repeat all selected tests after diagnostic run is complete without halting. The end of pass message "PASS XXXXX" will be output before looping.
11	Suppress error messages.
10	Suppress information messages.
9	Abort the current diagnostic execution and halt (102075); user may at this time specify a new set of tests in the A-register, clear bit 9 of the Switch Register, and press RUN.
8-6	Reserved.
5-0	Select code of TBG; used only for interrupt capability test.

### 3-3. RESTARTING THE DIAGNOSTIC

After the computer comes to a halt 102077 (octal) at completion of the diagnostic run, the operator can restart the diagnostic by selecting one of the following procedures.

- a. If the operator wishes to repeat the diagnostic as configured, press RUN.

- b. If the operator wishes to change only the set of tests, he does the following:
  1. Set bit 9 of the Switch Register
  2. Press RUN
  3. A halt 102075 (octal) will occur; execute the procedure described in paragraph 3-4.
- c. If the operator wishes to run the diagnostic *with* Interruptibility tests, while the previous run was executed *without* these tests, he must go to paragraph 3-2a.
- d. If the operator wishes to run the diagnostic *without* Interruptibility tests, while the previous run was executed *with* these tests, he must proceed to paragraph 3-1.

### 3-4. TEST SELECTION

This diagnostic program provides the operator with a method to select a single test or sequence of tests to be run. The operator sets Switch Register bit 9 to indicate that a selection is desired. If the computer is halted, press RUN. The computer will come to a halt 102075 (octal) to indicate ready for selection. If the diagnostic is running, the test in progress will be completed; then the program will halt. Test control messages and halts are listed in table 3-3.

After the halt, the operator may select the desired test(s) by setting the A-register value equal to the desired test numbers. A-register bit 0 represents Test 0, bit 1 represents Test 1, etc. The operator now must clear Switch Register bit 9 and press RUN. The selected test(s) will then be run.

Table 3-2. Test Messages

COMMUNICATION MESSAGE	COMMENTS
21MX 2000 COMPUTER SYSTEM COMM. PROC. FIRMWARE DIAGNOSTIC	Introductory message output before pass 1.
H030 CRC TEST	Start Test 0
H040 ENQ, PENQ AND DEQ TESTS	Start Test 1
H060 IAL TEST	Start Test 2
H110 READF, SAVE AND RESTR TESTS	Start Test 3
H120 LAI AND SAI TESTS	Start Test 4
H130 PFREX TEST	Start Test 5
H140 PFREI TEST	Start Test 6
H150 PFRIIO TEST	Start Test 7

**Table 3-3. Test Control Messages and Halts**

HALT CODE	MESSAGE	MEANING
102074	None	Halt to allow input of the S.C. of the interface board to be used in the Interruptibility tests.
102075	None	Halt to allow test selection.
102076	None	End of test section; A-register holds test number just completed.
102077	PASS xxxxxx	Diagnostic run completed; A-register holds octal number of passes completed.
106077	None	Halt stored in location 2-77 to trap interrupts which may occur unexpectedly because of hardware malfunctions. M-register contains the select code of the I/O slot which interrupted. Diagnostic may be partially destroyed if halt occurs. The program may have to be reloaded; the problem should be corrected before proceeding.

Table 3-4. Error Information Messages and Halt Codes

HALT CODE	PROGRAM SECTION	ERROR MESSAGE
102031	TEST 0	E031 CRC ERROR
102032		E032 REGISTER(S) NOT RESTORED IN CRC
102041	TEST 1	E041 EMPTY QUEUE RETURN TAKEN ON AN NON-EMPTY QUEUE
102042		E042 EMPTY QUEUE RETURN NOT TAKEN ON AN EMPTY QUEUE
102043		E043 QHEAD NOT ZERO IN AN EMPTY QUEUE
102044		E044 QTAIL DOES NOT POINT TO ITSELF IN AN EMPTY QUEUE
102045		E045 ENQ-PENQ ERROR
102046		E046 DEQUE ERROR
102047		E047 REGISTER(S) NOT RESTORED IN ENQ
102051		E051 A,E OR O NOT RESTORED IN DEQ
102061	TEST 2	E061 BAD INDIRECT ADDRESS LIST GENERATED
102062		E062 INDIRECT ADDRESS LIST LONGER THAN REQUESTED
102063		E063 B, E OR O NOT RESTORED IN IAL
106011	TEST 3	E111 INS-READF ERROR
106012		E112 SAVE-RESTR ERROR
106013		E113 STACK POINTER BAD AFTER SAVE
106014		E114 STACK POINTER BAD AFTER RESTORE
106015		E115 REGISTER(S) NOT RESTORED IN INS
106016		E116 B, E OR O NOT RESTORED IN READF
106017		E117 REGISTER(S) NOT RESTORED IN SAVE
106021	TEST 4	E121 SAI ERROR
106022		E122 LAI ERROR
106023		E123 LAI ALTERS DATA READ
106024		E124 B, E OR O NOT RESTORED IN LAI
106025		E125 REGISTER(S) NOT RESTORED IN SAI
106031	TEST 5	E131 PFREX TRANSFER ERROR
106032		E132 ENTRY POINT NOT CLEARED
106033		E133 A, B OR E NOT RESTORED IN PFREX
106041	TEST 6	E141 PFREI TRANSFER ERROR
106042		E142 I-O NOT PERFORMED
106043		E143 SOFTWARE FLAG NOT SET
106044		E144 ENTRY POINT NOT CLEARED
106045		E145 A, B OR E NOT RESTORED IN PFREI
106051	TEST 7	E151 SOFTWARE FLAG NOT SET
106052		A152 I-O NOT PERFORMED
106053		E153 A, B OR E NOT RESTORED IN PFRIO