ABSOLUTE BINARY PROGRAM 12907-16003
DATE CODE 1632

FAST FORTRAN PROCESSOR DIAGNOSTIC

reference manual

For HP 2100A/S Computers

NOTICE

The absolute binary code for this diagnostic is contained on one or more media (e.g., paper tape, cartridge tape, disc, and magnetic tape). The binaries also exist on single as well as multiple files. For the current date code(s) associated with these media, refer to appendix A in the *Diagnostic Configurator Manual,* part no. 02100-90157, dated August 1976 or later.

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INTRODUCTION

SECTION I

1-1. GENERAL

This diagnostic program confirms proper operation of the HP 12907A Fast FORTRAN Processor (FFP) for the HP 2100A/S Computer. The FFP consists of 13 library subroutines implemented by microcode on pROM chips.

1-2. REQUIRED HARDWARE

The following hardware is required:

a. HP 2100A/S Computer with a minimum 4K memory.

b. HP 12901 Floating-Point Hardware Accessory Kit.

c. HP 12907 Fast FORTRAN Processor Hardware Accessory Kit.

d. Console device for message reporting (recommended but not required).

e. Loading device for loading the diagnostic program.

f. HP 12539 Time Base Generator is required for the interrupt checks, which are made for the .XADD, .XSUB, .XMPY and .XDIV subroutines.

1-3. SOFTWARE REQUIREMENTS

The following software is required:

a. The Diagnostic Configurator (part numbers listed below) is used for equipment configuration and as a console device driver:

   Absolute binary program, part no. 24296-60001
   Reference Manual, part no. 02100-90157

b. Fast FORTRAN Processor Diagnostic

   Absolute binary program, part no. 12907-16003
   Reference Manual, part no. 12907-90003

The diagnostic serial number (DSN) is contained in memory location 126 (octal) of the program. The DSN for this program is 101110 (octal).

PROGRAM ORGANIZATION

SECTION II

2-1. ORGANIZATION

This diagnostic program consists of 13 tests plus a Control section and an Initialization section. The Initialization and Control sections accept the select code of the time base generator which is used to test the interruptible instructions. The tests are called into execution by the Control section as sequential or selectable subroutines.

2-2. TEST CONTROL AND EXECUTION

The program outputs a title message to the console device (if present) for operator information and then executes the tests according to the options selected on the Switch Register. The control section primarily checks Switch Register bits 15, 13 and 12.

The Control section keeps count of the number of passes that have been completed and will output the pass count at the completion of each pass (if Switch Register bit 10 is clear). The count will be reset only if the program is restarted.

Test sections are executed one after another in each diagnostic pass. User selection or default will determine which test sections will be executed. Refer to paragraph 2-3.

2-3. SELECTION OF TEST BY OPERATOR

The operator has the capability to select his own tests or sequence of tests with the help of Switch Register bit 9. Paragraph 3-4 outlines the test selection.

2-4. MESSAGE REPORTING

There are two types of messages: error and information. Error messages are used to inform the operator of a failure of the interface to respond to a given control or sequence. Information messages are used to inform the operator of the progress of the diagnostic or to instruct the operator to perform some operation related to the FFP functions. In this case, an associated halt will occur to allow the operator time to perform the function; the operator must then press RUN.

If a console device is used, the printed message will be preceded by an E (error) or H (information) and a number (in octal). The number is also related to the halt code when a console device is not available.

Example — Error with halt

Message: E121 OVERFLOW NOT SET
Halt Code: 106021 (T-register)

Example — Information only

Message: H140 .XADD TEST
Halt Code: None

Error messages can be suppressed by setting of 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. When Switch Register bit 12 is set, the tests that are selected will be repeated.

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 turn the power off and reload the diagnostic program.

b. If the microcode returns control to the diagnostic program but not to the proper location, the results are meaningless. Reload the diagnostic program to continue the test.

OPERATING PROCEDURES

SECTION III

3-1. OPERATING PROCEDURES

A flowchart of the operating procedure is provided in figure 3-1.

3-2. RUNNING THE DIAGNOSTIC

The program will execute the diagnostic according to options selected in the Switch Register. At the completion of each pass of the diagnostic, the pass count is printed on the console device for operator information. If Switch Register bit 12 was not selected (set), the computer will halt with 102077 (octal) in the T-register. At this point, the A-register contains the pass count. To run another pass, press RUN.

3-3. RESTARTING

The program can be restarted by setting the P-register to 2000 (octal). Select Switch Register options shown in table 3-2 and press RUN.

If a trap cell halt occurs (106077 octal), the user must determine the cause of the interrupt or transfer of control to the location shown in the M-register. The program may need to be reloaded to continue.

3-4. TEST SELECTION BY OPERATOR

The Control section of the diagnostic provides the operator with a method to select his own test, or sequence of tests, to be run. The operator sets Switch Register bit 9 to indicate the desire to make a selection. The computer will come to a halt 102075 (octal) to indicate that it is ready for selection. If the program is running, the current test will be completed and then the program will halt. The operator then loads the A-register with the tests desired. A-register bit 0 represents Test 00, bit 1 represents Test 01, and so on through bit 12 which represents Test 14. (Refer to table 3-3.) The operator must then clear Switch Register bit 9 and press RUN. The operator's selection will then be run. If the operator clears all bits, the standard sequence will be run.

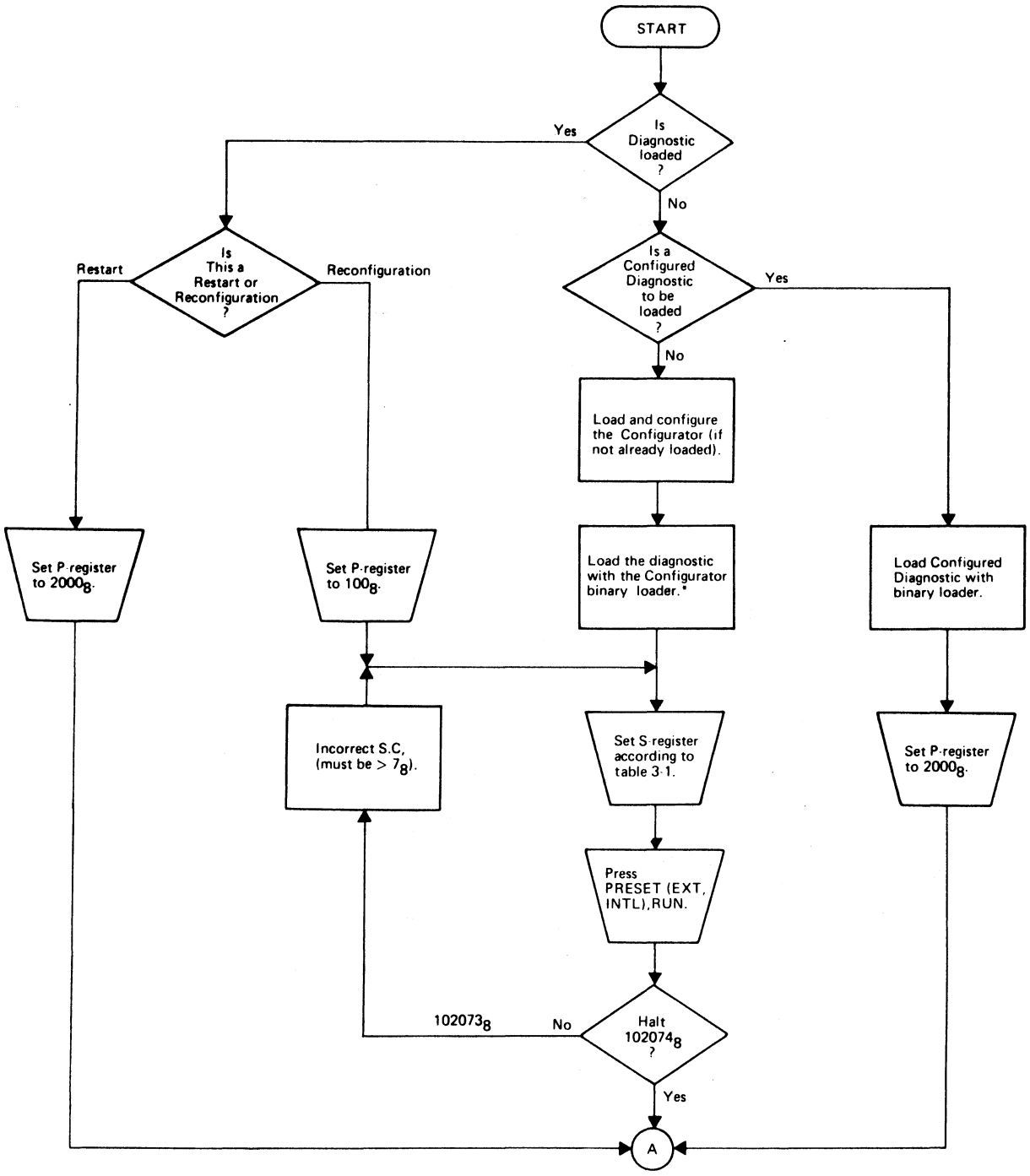

Figure 3-1. Operating Procedure Flowchart (Sheet 1 of 2)

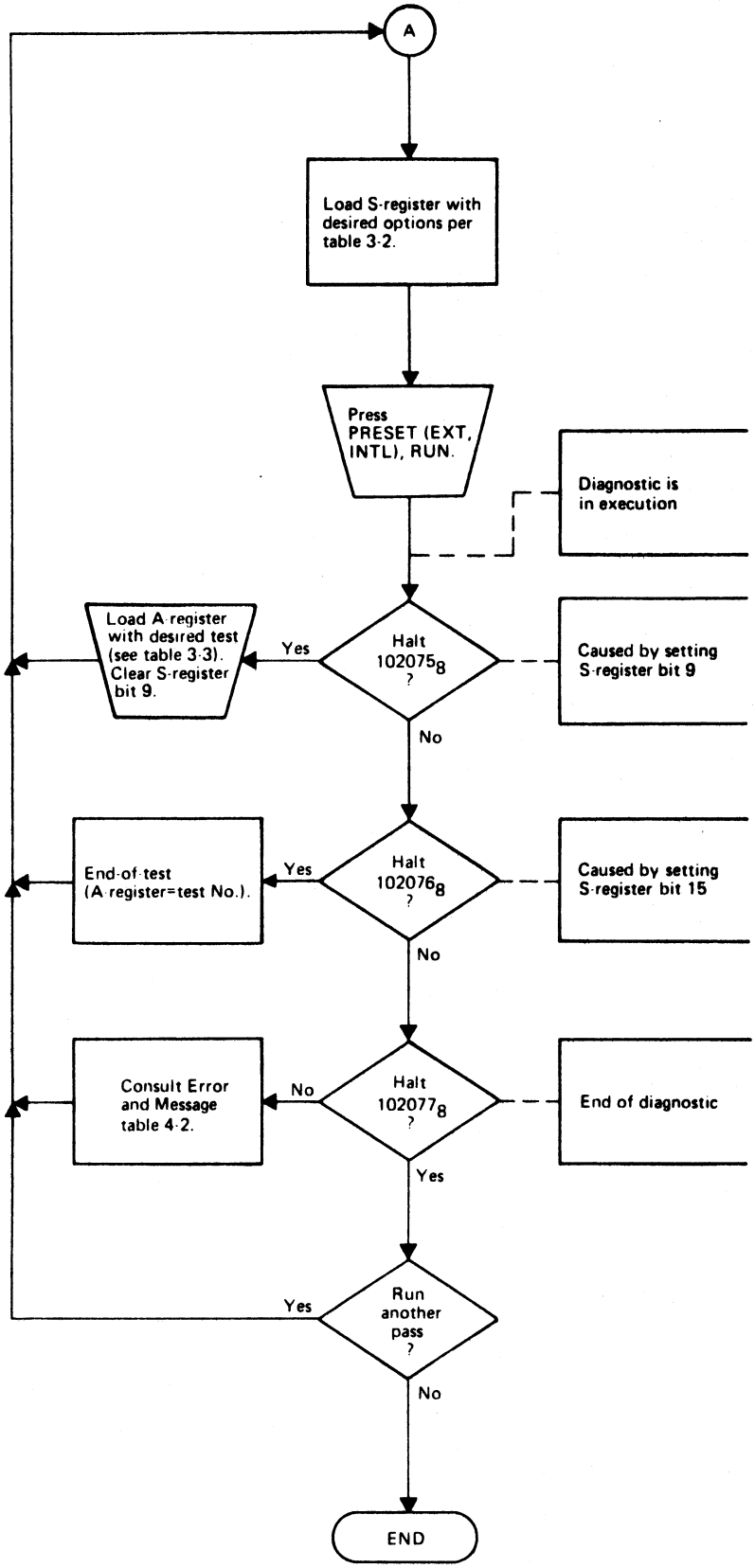

Figure 3-1. Operating Procedure Flowchart (Sheet 2 of 2)

Table 3-1. Initial Switch Register Settings

BIT	MEANING IF SET
5-0	Select Code of Time Base Generator
15-6	Reserved

Table 3-2. Switch Register Options

BIT	MEANING IF SET
8-0	Reserved
9	Abort current diagnostic execution and halt (102075); user may specify a new group of tests in the A-register (see table 3-3), clear bit 9, and then press RUN.
10	Suppress non-error messages.
11	Suppress error messages.
12	Repeat all selected tests after diagnostic run is complete without halting. Message "PASS XXXXXX" will be output before looping unless bit 10 is set or console is not present. Also those tests requiring operator intervention will be suppressed.
13	Repeat last test executed (loop on test).
14	Suppress error halts.
15	Halt (102076) at the end of each test; the A-register will contain the test number in octal.

Table 3-3. Test Selection by Operator

A-REGISTER BIT	IF SET WILL EXECUTE*	
	TEST	AND VERIFY OPERATION OF
0	0	.GOTO Subroutine
1	1	.ENTR Subroutine
2	2	.ENTP Subroutine
3	3	.SETP Subroutine
4	4	..MAP Subroutine
5	5	SNGL Subroutine
6	6	DBLE Subroutine
7	7	.XADD Subroutine
8	10	.XSUB Subroutine
9	11	.XMPY Subroutine
10	12	.XDIV Subroutine
11	13	.DFER Subroutine
12	14	.XFER Subroutine

*IF ALL BITS OF THE A-REGISTER ARE CLEARED ALL 13 TESTS WILL BE EXECUTED.

DIAGNOSTIC PERFORMANCE

SECTION IV

4-1. TEST DESCRIPTION

The 12907A Fast FORTRAN Processor Diagnostic provides 13 tests to exercise each of the 13 microcoded subroutines, which constitute the Fast FORTRAN Processor. The general method is to call each subroutine to exercise the functions. Each test section listed below tests one microcoded subroutine.

TEST SECTION	TITLE
0	.GOTO
1	.ENTR
2	.ENTP
3	.SETP
4	..MAP
5	SNGL
6	DBLE
7	.XADD
10	.XSUB
11	.XMPY
12	.XDIV
13	.DFER
14	.XFER

Note: Refer to the Relocatable Subroutines (02116-91780) for each of the following subroutines.

4-2. .GOTO — TEST 0

Microcode for the .GOTO subroutine is tested for five different parameter groups and for 16 levels of indirect addressing.

4-3. .ENTR — TEST 1

Microcode for the .ENTR subroutine is tested for the actual number of parameters less than, equal to, and greater than the allowed number of parameters. Verifies that microcode is testing for Memory Protect Violation when storing the subroutine return address and when transferring the parameter addresses.

4-4. .ENTP — TEST 2

Since this subroutine is simply another entry point into the .ENTR subroutine, one test is performed to verify that the microcode executes properly for the actual number of parameters less than the allowed number of parameters.

4-5. .SETP — TEST 3

Microcode for the .SETP subroutine is tested for one case. It is also verified that the microcode tests for Memory Protect Violation when storing the values.

4-6. ..MAP — TEST 4

Microcode for the ..MAP subroutine is tested for several elements of a two-dimensional array and then for several elements of a three-dimensional array.

4-7. SNGL — TEST 5

Microcode for the SNGL subroutine is tested for several extended precision numbers, including those which cause underflow and overflow. It is verified that the microcode saves and restores the Memory Protect Fence register address.

4-8. DBLE — TEST 6

Microcode for the DBLE subroutine is tested for several single precision numbers. It is verified that microcode tests for Memory Protect Violation when storing results.

4-9. .XADD — TEST 7

Microcode for .XADD subroutine is tested for several operands, including those which cause underflow and overflow conditions. The interruptibility of the microcode is tested.

4-10. .XSUB — TEST 10

Microcode for .XSUB subroutine is tested for several operands.

4-11. .XMPY — TEST 11

Microcode for .XMPY subroutine is tested for several operands, including those which cause underflow and overflow conditions. The interruptibility of the microcode is tested.

4-12. .XDIV — TEST 12

Microcode for .XDIV subroutine is tested for several operands, including those which cause an underflow and overflow conditions. Division by zero is tested.

4-13. .DFER — TEST 13

Microcode for .DFER subroutine is tested for one case. It is verified that the microcode tests for Memory Protect Violation during transfer.

4-14. .XFER — TEST 14

Microcode for .XFER subroutine is tested for one case.

4-15. DIAGNOSTIC MESSAGES AND HALTS

The diagnostic communicates to the operator through the console, via a CPU halt, or both, based on configuration and switch register settings. Thus, messages consist of halt codes (T-register and A-register values) and/or output to the console.

4-16. HALT SUMMARY

Table 4-1 lists octal halt codes and their meanings.

Table 4-1. Halt Code Summary

HALT CODE	MEANING
102030-102060 106000-106062 103000-103021	Error (E) messages 30_8 to 221_8 described in table 4-2.
102073	Halt indicating select code input error during "Starting Up" procedure. Input valid select code; press RUN.
102074	Valid select code entry was made; make program option switch register setting and press RUN.
102075	Halt to allow test selection in A-register; make test selection and press RUN.
102076	End of test section halt; A-register holds test number just completed.
102077	Diagnostic completed; A-register holds octal number of passes completed.
106077	Trap cell halts stored in CPU memory locations 2_8 to 77_8; indicates hardware malfunction.
106070-106076	Refer to *Diagnostic Configurator Reference Manual* for these halts.

4-17. MESSAGE SUMMARY

Table 4-2 lists diagnostic messages in diagnostic message order number. The test that outputs each message is also indicated in the same table. These tests are described in paragraph 4-1.

"TC" in table 4-2 refers to the Test Control program; otherwise, the numbers refer to the test number.

Table 4-2. Error Information Messages and Halt Codes

HALT CODE	TEST SECTION	MESSAGE	COMMENTS
102073	TC	NONE	Invalid S.C. entered during configuration. Valid select codes are $10\text{-}77_8$. Load S-register bits 5-0 with valid S.C. and press RUN.
102074	TC	NONE	Halt to allow input of the S.C. of the interface board to be used in the interruptibility tests.
102075	TC	NONE	Halt to allow test selection.
102076	TC	NONE	End of test section; A-register holds test number just completed.
102077	TC	PASS XXXXXX	Diagnostic run completed; A-register holds octal number of passes completed.
106077	TC	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.
106070-106076	Diag. Config.	NONE	See *Diagnostic Configurator Reference Manual* for meanings of these halts.
NONE	TC	START 2100A/S FFP DIAGNOSTIC	Diagnostic title message.
NONE	TC	TEST *nn*	Indicates to which test a list of error messages, which follow, belongs.
NONE	TC	PASS *nnnnnn*	All selected tests of the diagnostic have been completed; *nnnnnn* is the octal number of passes completed; A-register holds the octal number of passes completed, if halt is invoked.
NONE	0	H030 .GOTO TEST	Header message for test 0.
102030	0	E030 FAILED FOR INDIRECT ADDRESSING	The 16 levels of indirect addressing were not properly processed.
102031	0	E031 FAILED FOR J=0	Control did not return to the location pointed to by the first address pointer.
102032	0	E032 FAILED FOR J=NEG	Control did not return to the location pointed to by the first address pointer.
102033	0	E033 FAILED FOR J>16	Control did not return to the location pointed to by the last (16th) address pointer.
102034	0	E034 FAILED FOR J=8	Control did not return to the location pointed to by the 8th address pointer.
NONE	1	H050 .ENTR TEST	Header message for test 1.
102050	1	E050 FAILED FOR ACTUAL NR OF PARAM. < ALLOWED NR	Subtest 1 failed.

Table 4-2. Error Information Messages and Halt Codes (Continued)

HALT CODE	TEST SECTION	MESSAGE	COMMENTS
102051	1	E051 FAILED FOR ACTUAL NR OF PARAM.= ALLOWED NR	Subtest 2 failed.
102052	1	E052 FAILED FOR ACTUAL NR OF PARAM.> ALLOWED NR	Subtest 3 failed.
102053	1	E053 NO CHECK ON MEM PROT VIOLATION	Microcode does not test for Memory Protect violation.
102054	1	E054 RETURN ADDRESS NOT STORED IN CORRECT LOCATION	Microcode failed to store return address in correct location.
102055	1	E055 RETURN ADDRESS NOT IN A-REG.	A-register does not contain the return address of the subroutine, which called the routine .ENTR.
102056	1	E056 INCORRECT ADDR. IN B-REG.	B-register should contain the address of the first location into which *no* parameter address was stored. In the case that the number of actual parameters is equal to or larger than the number of allowed parameters, the B-register should contain the address of the last allowed parameter location + 1.
NONE	2	H060 .ENTP TEST	Header message for test 2.
102060	2	E060 FAILED FOR ACTUAL NR OF PARAM.< ALLOWED NR	Test failed.
NONE	3	H100 .SETP TEST	Header message for test 3.
106000	3	E100 A-REG. NOT=0 UPON RETURN	A-register does not contain the initial value (zero) upon return from microcode.
106001	3	E101 B-REG. DOES NOT CONTAIN LAST ADDRESS+1 UPON RETURN	B-register does not contain the correct address upon return from microcode.
106002	3	E102 INCORRECT VALUE STORED	Microcode stored an incorrect value or did not store anything in a certain location.
106003	3	E103 MORE LOCATIONS FILLED THAN REQUESTED	Correct values were stored in the requested locations, but the next locations were also altered.
106004	3	E104 NO CHECK ON MEM PROT VIOLATION	Microcode does not check on Memory Protect violation.
NONE	4	H110 ..MAP TEST	Header for test 4.
106010	4	E110 DATA ERROR ACT *xxxxxx* EXP *yyyyyy*	Invalid data=*xxxxxx* was returned by microcode; data should have been *yyyyyy*; when the error Halt occurs (T-REG=106010), the A-register and B-register contain the actual and expected data, respectively.
NONE	5	H120 SNGL TEST	Header for test 5.

Table 4-2. Error Information Messages and Halt Codes (Continued)

HALT CODE	TEST SECTION	MESSAGE	COMMENTS
106020	5	E120 DATA ERROR ACT *xxxxxx xxxxxx* EXP *yyyyyy yyyyyy*	Microcode returned the single precision number *xxxxxx xxxxxx* instead of *yyyyyy yyyyyy*; when the error Halt occurs (T-REG= 106020), the A-register holds the first word and the B-register holds the second word of the returned data; pressing RUN will cause a halt (T-REG= 107000) where A-register holds the first word and B-register holds the second word of the expected data.
106021	5	E121 OVERFLOW NOT SET	The number processed by the microcode caused an underflow or overflow condition, but the Overflow register was not set.
106022	5	E122 FENCE ADDR NOT SAVED	The Memory Protect Fence address was not saved and restored.
106023	5	E123 OVERFLOW SET	The Overflow should not be set.
NONE	6	H130 DBLE TEST	Header for test 6.
106030	6	E130 DATA ERROR ACT *xxxxxx xxxxxx xxxxxx* EXP *yyyyyy yyyyyy yyyyyy*	The extended precision number *xxxxxx xxxxxx xxxxxx* was returned instead of *yyyyyy yyyyyy yyyyyy;* when the error Halt occurs (T-REG= 106030), the A- and B-registers contain the first and second words of returned data; pressing RUN will cause another halt (T-REG= 107000) to occur where the A-register holds the third word of the actual data; pressing RUN again will cause another halt (T-REG= 107001) where the A- and B-registers hold the first and second words of the expected data; pressing RUN yet again will cause the final halt in the series (T-REG= 107002) where the A-register holds the third word of the expected data.
106031	6	E131 NO CHECK ON MEM PROT VIOLATION	Microcode does not check for memory protect violation.
NONE	7	H140 .XADD TEST	Header for test 7.
106040	7	E140 DATA ERROR ACT *xxxxxx xxxxxx xxxxxx* EXP *yyyyyy yyyyyy yyyyyy*	The extended precision number *xxxxxx xxxxxx xxxxxx* was returned instead of *yyyyyy yyyyyy yyyyyy*; when the error halt occurs (T-REG= 106040), the A- and B-registers hold the first and second word of actual data; pressing RUN will cause another halt (T-REG= 107000) to occur where the A-register holds the third word of the actual data; pressing RUN again will cause another halt (T-REG= 107001) where the A- and B-registers hold the first and second words of the expected data; pressing RUN yet again will cause the final halt in the series (T-REG= 107002) where the A-register holds the third word of the expected data.
106041	7	E141 OVERFLOW NOT SET	The number processed by microcode caused an underflow or overflow condition, but the Overflow register was not set.
106042	7	E142 NOT INTERRUPTIBLE	Microcode does not check for interrupt.

Table 4-2. Error Information Messages and Halt Codes (Continued)

HALT CODE	TEST SECTION	MESSAGE	COMMENTS
106043	7	E143 OVERFLOW SET	The overflow should not be set.
NONE	10	H150 .XSUB TEST	Header for test 10.
106050	10	E150 DATA ERROR ACT *xxxxxx xxxxxx xxxxxx* EXP *yyyyyy yyyyyy yyyyyy*	The extended precision number *xxxxxx xxxxxx xxxxxx* was returned instead of *yyyyyy yyyyyy yyyyyy*; when the error halt occurs (T-REG= 106050), the A- and B-registers hold the first and second words of the actual data; pressing RUN will cause the same sequence of halts described in error messages E130 and E140, showing the rest of the actual and expected values.
NONE	11	H160 .XMPY TEST	Header message for test 11.
106060	11	E150 DATA ERROR ACT *xxxxxx xxxxxx xxxxxx* EXP *yyyyyy yyyyyy yyyyyy*	The extended precision number *xxxxxx xxxxxx xxxxxx* was returned instead of *yyyyyy yyyyyy yyyyyy*; when the error halt occurs (T-REG= 106060), the A- and B-registers hold the first and second words of the actual data; pressing RUN will cause the same sequence of halts described in error messages E130 and E140, showing the rest of the actual and expected values.
106061	11	E161 OVERFLOW NOT SET	The operation caused an overflow or underflow condition, but the Overflow register was not set.
106062	11	E162 NOT INTERRUPTIBLE	Microcode does not check for interrupt.
NONE	12	H200 .XDIV TEST	Header message for test 12.
103000	12	E200 DATA ERROR ACT *xxxxxx xxxxxx xxxxxx* EXP *yyyyyy yyyyyy yyyyyy*	The extended precision number *xxxxxx xxxxxx xxxxxx* was returned instead of *yyyyyy yyyyyy yyyyyy;* when the error halt occurs (T-REG= 103000), the A- and B-registers hold the first and second words of the actual data; pressing RUN will cause the same sequence of halts described in messages E130 and E140.
103001	12	E201 OVERFLOW NOT SET	The operation caused an overflow or underflow condition, but the Overflow register was not set.
NONE	13	H210 .DFER TEST	Header message for test 13.
103010	13	E210 FAILED	Microcode failed to execute the operation correctly.
103011	13	E211 NO CHECK ON MEM PROT VIOLATION	Microcode does not check for Memory Protect violation.
NONE	14	H220 .XFER TEST	Header message for test 14.
103020	14	E220 FAILED	Microcode failed to execute the operation correctly.
103021	14	E221 RETURN AT INCORR LOC	Microcode returned to wrong memory location.

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