PAPER TAPE NO. 24321-16001

POWER FAIL/AUTO RESTART DIAGNOSTIC

for

hp-2100 SERIES COMPUTERS

reference manual

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 *HP 2000 Diagnostic Configurator Manual,* part no. 02100-90157, dated August 1976 or later.

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Power Fail/Auto Restart Diagnostic

Introduction

The Power Fail/Auto Restart Diagnostic confirms proper operation and timing of the power failure interrupt feature on HP 2100 series computers. This diagnostic is one of the HP 2000 computer system diagnostics executed in conjunction with the HP 2000 Computer Systems Diagnostic Configurator. Communication to the operator is provided through a teleprinter and the computer Memory Data Register (T-register). Diagnostic program options are input by the operator via the switch register. Power failure is induced by the operator manually in one of a number of possible ways (explained under "RUNNING THE DIAGNOSTIC").

The test method consists of executing a short looping program which waits for an interrupt to occur. When a power fail interrupt occurs, a fixed number of instructions are executed. When power comes back up, proper operation and timing of the power fail interrupt is verified by checking that the proper number of instructions were executed. Unexpected interrupts cause specially coded HALTs to occur.

This test is only valid if the CPU instruction set used has been previously verified. Hence this diagnostic should not be run until the following other CPU diagnostics have been successfully completed.

- Memory Reference Instruction Diagnostic
- Alter-skip Instruction Diagnostic
- Shift-rotate Instructions Diagnostic
- Memory Diagnostic
- Teletype Diagnostic (optional)

GENERAL ENVIRONMENT

Hardware Requirements

1. This diagnostic is run on 2100 series computers with a minimum of 4K of memory and with the Power Fail feature installed.

2. A paper tape reader is required to load the diagnostic only; a teleprinter paper tape reader can be used, if available.

3. A system console teleprinter is optional.

Software Requirements

The required software consists of the following binary object tapes:

1. HP 2000 Computer Systems Diagnostic Configurator (HP 24296)

2. Power Fail/Auto Restart Diagnostic, part no. 24321-16001.

Loading is performed using the Binary Loader (usually memory resident). See the *Front Panel Procedures* appropriate to the 2100 series computer being used, for use of the Binary Loader. The loader is described in the HP manual *Basic Binary Loader-Basic Binary Disc Loader* (HP 5951-1376).

Operating Procedures

Operating procedures are divided into three parts: Preparation for Diagnostic Run, Running the Diagnostic, and Diagnostic Messages and Halts.

PREPARATION FOR DIAGNOSTIC RUN

Before the tests can be initiated, the user performs the following actions in order:

- Load the Diagnostic Configurator
- Configure to available system hardware
- Load this diagnostic
- Dump the configuration for later use (optional)

Loading

Using the Binary Loader, load the Diagnostic Configurator. Perform the configuration procedure (see "Configuring," below), before loading the diagnostic. Then load the Power Fail/Auto Restart Diagnostic using the Configurator. The user may insure that the proper diagnostic is loaded by checking memory location 126_8 for the Diagnostic Serial Number = 101006_8.

Configuring

Procedures for inputting the system hardware configuration parameters are found in the *HP 2000 Computer Systems Diagnostic Configurator* manual (02100-90157) under "CONFIGURING."

The configuration procedure accepts six groups of parameters. This diagnostic requires only four groups to be defined. They are

- Computer type and options
- Teleprinter as system slow input device (optional)

- Teleprinter as system slow output device (optional)
- Memory size and type

The other parameters may be left undefined (zero). *Computer Type* and *Options* and *Memory Size* and *Type* vary from one 2100 series installation to the other. The user must determine the parameters of his installation and configure accordingly.

A teleprinter may be configured as the *Slow System Input Device* and *Slow System Output Device* to serve as operator/diagnostic communicator.

Dumping

Using procedures described in the Diagnostic Configurator manual, the user may dump the configured diagnostic from memory onto paper tape so that the configuration procedures need not be repeated. The dumped paper tape holding the configured diagnostic can thereafter be loaded via the Binary Loader.

RUNNING THE DIAGNOSTIC

Program Organization

This diagnostic program performs the series of routines described below:

START — This routine begins by printing a preamble message (refer to table 2, H0). It then fills unused memory with each location's address.

BKGND — This routine increments the right half (bits 0-7) of the switch register (2114 or later) two or three times each second and verifies the contents of all unused memory once each increment by comparing the contents with the location addresses.

PWRFL — This is the power fail interrupt routine. It calls RSTRT if power is being restored. If power is failing, this routine saves registers and estimates time before power is off.

RSTRT — This routine is entered through the PWRFL routine. It verifies proper operation of the PWRFL routine and increments the cycle count. The last part of PWRFL and all the associated counters are rebuilt in case power-off occurred during a fetch.

The primary test is performed following restoration of power by the operator. This check verifies that the length of time between power-fail and power-off exceeds the minimum defined for the computer being tested.

Secondary tests are executed by the diagnostic program after power-fail to ensure register recovery and to ensure that contents of main memory have not been changed by a power fail.

Switch Register Settings

Table 1 gives a summary of switch register program options. Note that switches 0 through 7 are not used for program option input. The positions are used for display purposes (see step 4 under Diagnostic Execution section for explanation of display via switch register).

Normally a HALT will occur after message H4 (refer to table 2). *Switch 12* set prevents this HALT from occurring and the diagnostic will go back to the background loop waiting for the next interrupt.

If *Switch 12* is clear, message H4 (refer to table 2) is printed.

Table 1. Switch Register Settings

Switch	Meaning If Set
0-7	Reserved to display background cycling pattern
8	Reserved
9	Reserved
10	Suppress non-error messages
11	Suppress error messages to teleprinter
12	Loop on diagnostic. Clear to print number of passes and HALT 102077_8
13	Reserved
14	Suppress HALT after each test failure (MDR = 102002_8 to 102077_8)
15	HALT execution of background program (MDR = 102076_8)

Diagnostic Execution

1. Place the ARS/$\overline{\text{ARS}}$ (Automatic Restart) switch in the ARS position. This switch is found on Card A7 on the 2100A/S computers. For the 21MX, remove the bottom cover of the processor. The switch A1S2 is on Card A1 (CPU).

2. Make switch register settings required.

3. Press PRESET (INTERNAL and EXTERNAL, if applicable).

4. Press RUN.

   Result: The message

   H0 2100 SERIES POWER FAIL DIAGNOSTIC

   is printed. The background program executes, producing a pattern in the right eight bits of the switch register (pattern not displayed on 2115 or 2116) which increments approximately three times a second to indicate the background is running. The diagnostic program is now ready to process a Power Fail interrupt.

5. Next the power failure test is performed. If the user wishes to test the ability of the power fail interrupt to restart from HALT mode, the user may HALT the CPU before creating the power failure.

   Terminate the CPU power in one of the following ways:

   a. Turn POWER switch on CPU to OFF position, or

   b. Remove the power cord (pull the plug) from the electrical outlet, or

   c. Decrease the line voltage below 100 Volts A.C. for 2100-series or 85 Volts A.C. for 21MX-computer series.

6. Restore power (optionally holding down at the same time the EXTERNAL PRESET switch, if the CPU is 2100A or 2100S). If the HALT mode was used in step 5 or if the EXTERNAL PRESET switch was used, set program address register (P-register) to 100_8. Press RUN.

   Result: Proper handling of the power fail interrupt is verified. The diagnostic completes a cycle.

   If switch register 12 is clear, the message

   H4 THERE HAVE BEEN *nnn* TESTS
   OF THE POWER FAIL

   is printed where *nnn* is the number of cycles of the diagnostic completed. Then the program will HALT (MDR = 102077_8) unless bit 12 of switch register is set. If halted, pressing run restarts test.

   If the power fail interrupt was handled correctly, the background program is reentered and the diagnostic is ready for another cycle.

DIAGNOSTIC MESSAGES AND HALTS

The diagnostic communicates to the operator by teleprinter, HALTS, or both, based on switch register settings. Thus messages consist of both HALT codes (MDR or T-register, A-register, and B-register data) and teleprinter text. Message text and HALT codes are summarized in Table 2. MDR contents are listed in the HALT code column; A- or B-register contents, if applicable, are also listed in this column enclosed by parentheses.

Message formats consist of a letter, message number, and message text. If the letter is an "H," the message is information. If the letter is an "E," the message indicates an error in CPU handling of the power fail interrupt. Message text is only printed if switch register bit 11 is clear.

Table 2. Diagnostic Messages

Text	Octal MDR (A- & B-reg) HALT Code	Routine	Meaning
H0 2100 SERIES POWER FAIL DIAGNOSTIC		START	Preamble to test
E1 WRONG COMPUTER TYPE	102001	START	Computer type in location 115_8 invalid. Reconfigure diagnostic configurator.
E2 CHANGED CORE, ADDRESS = *xxxxxx* CONTENTS = *yyyyyy*	102002 (A=*xxxxxx*, B=*yyyyyy*)	BKGND	Echo-check failed in unused core; address not equal to contents; *xxxxxx* is octal memory address *yyyyyy* is contents of address
E3 SHUTDOWN ROUTINE DID NOT COMPLETE. SHOULD COMPLETE *mmm* USECS, COMPLETED *nnn* USECS	102003 (A=*xxxxxx*, B = *yyyyyy*)	RSTRT	Primary power fail interrupt test failed; CPU failed to sustain execution for more than *nnn* decimal (*xxxxxx* octal) microseconds; should have lasted at least *mmm* decimal (*yyyyyy* octal).
H4 THERE HAVE BEEN *nnn* TESTS OF THE POWER FAIL	102077	BKGND	Indicates *nnn* decimal cycles of the diagnostic have occurred; only printed when switch 12 is clear. A-register contains the pass count in octal.
E5 POWER FAIL ROUTINE NOT ENTERED	102005	RSTRT	No interrupt occurred after the last power failure.
	102006	PWRFL	Power did not fail after a "Power Fail Interrupt" occurred or flag logic was clear when it should have been set.
E7 B-REGISTER NOT EQUAL TO COUNT, B = *xxxxxx* COUNT = *yyyyyy*	102007	BKGND	B-register should be equal to right half of switch register (bits 0 to 7), but power failure disturbed equality; *xxxxxx* = octal contents of B-register; *yyyyyy* = octal contents of switch.
	102076	BKGND	Program HALTED due to setting of switch register bit 15.
	1060*xx*	Any	Trap cell HALT; *xx* = select code of device; this HALT necessitates reload.

Test Sections

TESTS

The primary test is performed in the routine PWRFL following restoration of power. This test verifies that the length of time between the power fail interrupt and power failure exceeds the minimum defined for the computer being tested. Secondary tests are made to verify register recovery and memory contents.

The BKGND (background) routine verifies on each of its loops that memory contents set into unused memory locations by the START routine (initializer) have not been disturbed.

After power comes up, the RSTRT routine is entered from PWRFL. It verifies proper execution of PWRFL and increments the diagnostic cycle count. The diagnostic is reinitialized and the BKGND routine is reentered.