

Diagnostics Overview



This chapter describes the different types of diagnostic firmware and software tools available to you and how they are related.

Diagnostic Tools

The main categories of diagnostics follow:

- Boot PROM diagnostics
 - Power-On Self-Test (POST)
 - On-Board Diagnostics
- Sundiag System Exerciser
- Sun Diagnostic Executive

Besides these categories of diagnostics, this chapter briefly covers the Forth Toolkit, which is an interactive command interpreter based on the Forth programming language. For a more complete discussion of the Sun Forth Toolkit, see the *Open Boot PROM Toolkit User's Guide* or the *Introduction to Open Boot 2.0*.

The Forth Toolkit gives you access to an extensive set of functions for performing the following:

- Hardware development
- Problem determination (fault isolation)
- Software development
- Debugging

All functions available through the Monitor `>` prompt, except entering the Forth Toolkit, are also available through the Forth Toolkit.

How It Fits Together

The following is a description of how the various diagnostic tools work together in the different power-on modes. This description assumes you are using a graphics monitor to view test results. The flowchart in Figure 2-1 outlines the roles played by various diagnostics during the default boot mode.

When you turn on system power, the low-level POST code, stored in the boot PROM, is executed. Usually, if a test in the POST sequence fails, the system enters a scope loop by repeatedly accessing the failed parameter. See “How to Run the Power-On Self-Test” later in this chapter for more information.

If the POST passes, the system probes for SBus devices and interprets their drivers. Next, high level tests are performed. You will see the word `Testing` while the high level tests are running. After `Testing` is displayed, if you want to enter the Monitor, (indicated by the `>` prompt), press the `L1-A` keys simultaneously.

If the autoboot switch parameter is set to `false` (not the default), you will obtain either the `>` or `ok` prompt. The `>` prompt is the default prompt. You can change the default prompt to obtain the `ok` prompt, the Forth Toolkit prompt, as the default. To make the `ok` prompt the default prompt, see the *Open Boot PROM Toolkit User's Guide* or the *Introduction to Open Boot 2.0*.

If the autoboot switch parameter is set to `true` (default), and the diagnostic switch parameter is set to `false` (default), SunOS will be booted from the program `vmunix`. If the autoboot switch parameter is set to `true` (default), and the diagnostic switch parameter is set to `true` (not the default), SunOS will be booted from the command `le()vmunix`.

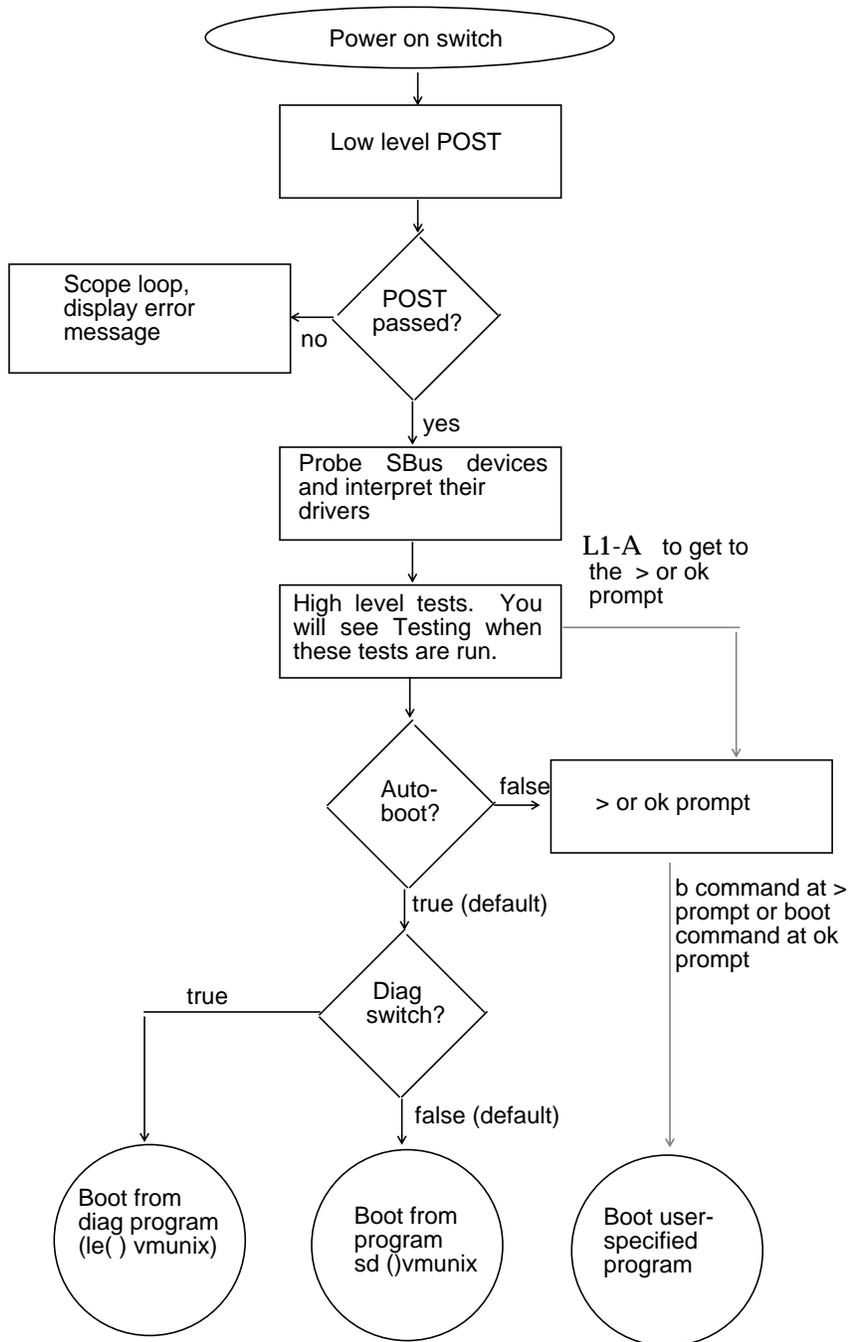


Figure 2-1 Default Boot Mode

To boot user-specified programs, such as the Sun Diagnostic Executive, you must be at the `>` or `ok` prompt. See “On-Board Diagnostics” later in this chapter for a detailed procedure on how to obtain the `>` and `ok` prompts.

autoboot switch parameter	diagnostic switch parameter	Result
false	(don't care)	<code>></code> or <code>ok</code> prompt
true	false	*boot SunOS (vmunix) from disk <code>sd ()</code>
true	true	*boot SunOS (vmunix) from network <code>le ()</code>

*The boot parameters represented here are default settings. The defaults may be changed by following the procedures listed in the *Open Boot PROM Toolkit User's Guide* or the *Introduction to Open Boot 2.0*.

When to Use Diagnostics

You should use each type of diagnostic tool in the appropriate circumstances. Table 2-1 provides a summary of the available diagnostic tools, and lists when to use each diagnostic tool.

Table 2-1 Summary of Available Diagnostic Tools

Diagnostic Tool	When or why to use
Power-On Self-Test	Executes automatically at power-on. The POST code resides in the boot PROM and is driven by the Por signal from the power supply. Described later in this chapter.
On-Board Diagnostics	Tests such as the Ethernet test, memory test, and the diskette drive controller test are available. You must be in the Forth Toolkit to run on-board diagnostics. Enter <code>n</code> from the <code>></code> prompt to enter the Forth Toolkit. The On-Board diagnostics reside in the boot PROM. Described later in this chapter.
Manufacturing Diagnostics	Runs POST in a continuous loop (see Figure D-1). Used in a manufacturing environment to achieve repetitive <i>burn-in</i> testing. Described in Appendix D.
Sundiag System Exerciser	Runs under SunOS. It displays real-time use of system resources and peripherals. The Sundiag System Exerciser tells you if your system is functioning correctly or not. If Sundiag fails, run the Power-On Self-Test. For instructions on how to use the Sundiag System Exerciser see the <i>Sundiag User's Guide</i> . If all power-on self-tests pass, then run the Sun Diagnostic Executive to identify the problem.
Sun Diagnostic Executive	Runs extensive, configurable subsystem tests independent of SunOS. Run the Sun Diagnostic Executive if all tests pass when you run POST. Running the Sun Diagnostic Executive allows you to troubleshoot which field replaceable unit needs to be replaced. See the <i>SunDiagnostic Executive User's Guide for the SPARCstations</i> for more information.
Monitor	Enters the Monitor when the operating system crashes. To boot SunOS or another program from the <code>></code> prompt, enter <code>b</code> . To resume execution of a halted program from the <code>></code> prompt, enter <code>c</code> . To enter the Forth Toolkit from the <code>></code> prompt, enter <code>n</code> . Described later in this chapter.
Forth Toolkit	Performs all functions available through the Monitor, except entering the Forth Toolkit. Changing NVRAM parameters. Resetting the system. Running diagnostics. Displaying system information. Redirecting input and output. See the <i>Open Boot PROM Toolkit User's Guide</i> or the <i>Introduction to Open Boot 2.0</i> for more information.

Boot PROM Diagnostics

The diagnostics stored in the boot PROM include the following:

- Power-On Self-Test
- On-Board Diagnostics

The Power-On Self-Test (POST) is the default mode. If there is system trouble, you may want to run extended on-board diagnostics to take advantage of thorough tests including — but not limited to — Ethernet, memory, and diskette drive tests. See Figures 2-2 and 2-3 later in this chapter for an example of the tests comprising on-board diagnostics.

The boot PROM diagnostics are described in the following sections.

Power-On Self-Test (POST)

The Power-On Self-Test (POST) runs automatically when you turn on the system's power switch or reboot the system. The POST code, which resides in the boot PROM, is executed by the CPU (IU) when the Por signal is received from the power supply. The POST is a series of rudimentary tests designed to verify that a viable boot path exists for loading more extensive diagnostic software. The POST checks the system's main logic board and main memory. This test determines if enough of the system is functional so that SunOS can be booted.

Next, the firmware initializes the system, including the memory management unit (MMU), keyboard, mouse, serial ports, frame buffer, and memory. Additional initialization tasks are performed. These include, but are not limited to, setting up interrupt vectors and trap vectors and probing for SBus boards.

Following the system's successful initialization, SunOS is booted automatically, unless the NVRAM configuration options specify not to do so.

Power-On Self-Test Detailed Description

In order for the system to perform the POST, the Instruction Unit (IU) must be functional. The system must be able to fetch instructions from the boot PROM.

The POST includes the following tests:

- EPROM Checksum Test
- Segment Map Address Test
- Page Map Address Test
- Context Register Test
- Synchronous Error Register Test
- Synchronous Error Virtual Address Register Test
- Asynchronous Error Register Test
- Asynchronous Error Virtual Address Register Test
- System Enable Register Test
- Limited Main Memory Address Test
- Cache Tag Memory Test
- Cache Data Memory Test

Powering up the system resets the IU and puts the system in the *boot state*. Boot state forces all instruction fetches to the boot PROM. The Power-On Self-Test begins immediately. If you want to see the results of each test, you may attach a terminal to the system unit. See “How to Run the Power-On Self-Test” later in this chapter.

Usually, if a test in the POST sequence fails, the system enters a scope loop by repeatedly accessing the failed parameter. See “How to Run the Power-On Self-Test” later in this chapter for instructions on how to attach a terminal to the system unit, run POST, and conduct general troubleshooting.

For more information on POST see the *Open Boot PROM Toolkit User's Guide* or the *Introduction to Open Boot 2.0*.

How to Run the Power-On Self-Test

The procedure described in this section explains how to view and respond to the POST messages. You may connect a terminal to a serial port in order to view the POST messages. It also covers what to do if all POST tests pass.

Note – If you suspect that the main logic board might be bad but are not sure, do not follow the procedure described in this section. Instead, see “Before Replacing the Main Logic Board” in Chapter 4 for a comprehensive procedure that involves removing SBus boards, unplugging hard disk and diskette drives, and measuring the power supply voltages before running the POST test.

To run the POST and conduct general troubleshooting:

- 1. If desired, attach a terminal to the system unit, but this step is not mandatory in order to proceed with troubleshooting.**

To connect the terminal, see “Connecting Wyse WY-50 and VT-100 Terminals” in the *SPARCstation IPC Installation Guide*.

The terminal displays some of the POST results as the tests are run.

- 2. Turn on the system and the terminal (if attached).**

The system will start to boot. To interrupt the boot sequence and obtain the `ok` or `>` prompt, press L1-A on the system keyboard.

If you see the `ok` prompt, go to Step 4. If you see the `>` prompt, go to the next step.

- 3. At the `>` prompt, enter `n`.**

This presents you with the Forth Toolkit prompt, `ok`.

- 4. Set the diagnostic switch to true, set the autoboot switch to false, and reset the system.**

To do this enter the commands shown in bold in the following example:

```
ok setenv diag-switch? true  
ok setenv auto-boot? false  
ok reset
```

The system is rebooted and POST is run

5. If all tests pass, go to the next step. If one or more of the following tests fails, do the following:

- If the EPROM Checksum Test fails, replace the main logic board. This situation is very unlikely. If the boot PROM is bad, it is very likely that the system will do nothing and appear dead.
Replace the main logic board as described in “Removing the Main Logic Board” and “Replacing the Main Logic Board” in Chapter 4.
- If the Limited Main Memory Address Test fails, numbers of Single Inline Memory Modules (SIMMs) are displayed on the terminal. SIMM numbers are indicated in Figure 4-4. Replace the defective SIMM. See “Single Inline Memory Modules (SIMMs)” in Chapter 4.
- If you see the following message: `Incorrect configuration checksum; Clearing to default values`, this means that the NVRAM configuration information has become corrupted. In this case, the boot PROM automatically attempts to restore the NVRAM contents to the factory default configuration. If the same message appears the next time the system is reset or powered on, the NVRAM chip may be defective and the main logic board should be replaced.
- If any other test fails, replace the main logic board. See “Removing the Main Logic Board” and “Replacing the Main Logic Board” in Chapter 4.
- If you see nothing on the display, look at the green LED indicator at the front of the system unit as you turn on the power switch. If the green indicator does not come on or flash, the main logic board may have failed. If the indicator comes on and there is still nothing on the display, check the graphics monitor and the monitor cable. If the graphics monitor is functional, the frame buffer may have failed. Replace the frame buffer SBus card. See “SBus Cards” in Chapter 4. If the monitor is connected to the on-board frame buffer, replace the main logic board. See “Removing the Main Logic Board” and “Replacing the Main Logic Board” in Chapter 4.

6. If all POST tests pass, run the Sun Diagnostic Executive with the cache disabled.

The Sun Diagnostic Executive is an independent operating system. It runs exhaustive subsystem tests independent of SunOS. See the *SunDiagnostic Executive User's Guide for the Desktop SPARCstations*.

7. **Reset the diagnostic mode changes. Enter the following at the `ok` prompt:**

```
ok setenv diag-switch? false
ok setenv auto-boot? true
ok reset
```

On-Board Diagnostics

You have access to a number of tests called On-board diagnostics. To invoke these tests, you must enter the Forth Toolkit.



Caution – In order to run On-board diagnostics, you must halt the system in an orderly manner. When the operating system or any other stand-alone program has already booted, do not use the L1-A keys to halt the system. Abruptly aborting program execution may cause damage to data files.

To run On-board diagnostics:

1. Save all your work and quit all applications.

2. As root, halt the system by entering

```
/usr/etc/halt.
```

You are presented with either the `>` prompt or the `ok` prompt. The `>` prompt is the default prompt. If you want to change the default prompt to the `ok` prompt, see the *Open Boot PROM Toolkit User's Guide* or the *Open Boot 2.0*.

If you see the `>` prompt, go to the next step. If you see the `ok` prompt, go to Step 4.

3. Enter `n` to enter the Forth Toolkit.

The `ok` prompt shows that you are in the Forth Toolkit.

4. Enter `help diag` to get a listing of tests comprising on-board diagnostics.

Figure 2-2 or 2-3 summarizes the steps you need to take to halt the system, enter the Forth Toolkit, and list the diagnostic tests.

```

# /usr/etc/halt
..... system messages are displayed
> n
ok help diag
                THIS MENU IS FOR OPEN BOOT PROM 1.X SYSTEMS
      Category:  Diag (diagnostic routines)
test-net        (--      ) test network interface
test-cache      (--      ) test cache tag and data fields
test-memory     (--      ) test main memory ; uses selftest-#megs options
test-floppy     (--      ) test floppy disk drive
watch-clock    (--      ) show ticks of real-time clock
probe-scsi     (--      ) show attached SCSI devices
ok

```

Figure 2-2 Halting the System and Displaying On-Board Diagnostics (Open Boot PROM 1.X Systems)

```

# /usr/etc/halt
..... system messages are displayed
> n
ok help diag
                THIS MENU IS FOR OPEN BOOT PROM 2.X SYSTEMS
      Category:  Diag (diagnostic routines)
test device-specifier (-- ) run selftest method for specified device
      Examples:
      test /memory      - test memory
      test /sbus/le     - test net
      test net          - test net (device-specifier is an alias)
      test floppy       - test floppy disk drive
watch-clock    (--      ) show ticks of real-time clock
probe-scsi     (--      ) show attached SCSI devices
ok

```

Figure 2-3 Halting the System and Displaying On-Board Diagnostics (Open Boot PROM 2.X Systems)

These on-board tests allow you to test the network controller, the diskette drive system, memory, the cache, and the system clock. See “Diagnostic Routines” in the *Open Boot PROM Toolkit User’s Guide* or the *Introduction to Open Boot 2.0* for a detailed description and step-by-step instructions of the available on-board diagnostic tests.

To return to the Monitor > prompt, enter the following:

```
ok  old-mode  
>
```

Sundiag System Exerciser

The Sundiag System Exerciser, which runs under SunOS, displays real-time use of system resources and peripheral equipment such as Desktop Storage Packs and External Storage Modules. The System Exerciser is run in the manufacturing environment as the final test that the system is functioning properly before being shipped.

The exerciser is shipped with SunOS. If it has been selected during the SunInstall (operating system loading) procedure, it can be run at any time.

The Sundiag System Exerciser is found in the `/usr/diag/sundiag` directory. If it is not found on the system hard disk or server, it may be loaded from tape. For information on how to use the Sundiag System Exerciser, see the *Sundiag User's Guide*. Appendix A, "Loopback Connectors" in the *Sundiag User's Guide* explains how to connect the external loopback connectors required for some options.

If Sundiag passes, the system is operating properly. If Sundiag fails, the system is not operating properly. To identify the problem when Sundiag fails, first run the POST. If all POST tests pass, next run the Sun Diagnostic Executive to isolate the problem.

Sun Diagnostic Executive

The Sun Diagnostic Executive is an independent operating system. It runs exhaustive subsystem tests independent of SunOS. Run the Sun Diagnostic Executive if all POST tests pass in order to troubleshoot which field-replaceable unit needs to be replaced. For information on how to run the POST, see "How to Run the Power-On Self-Test" earlier in this chapter. The Diagnostic Executive, which provides you with thorough diagnostics, is described in the *SunDiagnostic Executive User's Guide for the Desktop SPARCstations*.

Monitor and Forth Toolkit

The Monitor is a basic diagnostic utility. If disaster befalls your operating system, the Monitor, indicated by the `>` prompt, automatically starts. You can also choose to enter the Monitor by halting the system. To enter the Forth Toolkit, indicated by the `ok` prompt, enter `n` from the `>` prompt.

The following procedure explains how to enter the Monitor and the Forth Toolkit.

To enter the Monitor and the Forth Toolkit:

1. Save all your work and quit all applications.

2. As root, enter `/usr/etc/halt`.

The system syncs the file systems and brings you to either the `>` or `ok` prompts. The `>` prompt is the default prompt. You will see the `ok` prompt if you reset the system parameters to have the `ok` prompt, the Forth Toolkit prompt, as the default prompt. For Non-Volatile RAM system configuration parameters used during reset, see Appendix C in this book. To have the `ok` prompt as the default, see the *Open Boot PROM Toolkit User's Guide*.

If you see the `ok` prompt, you are already in the Forth Toolkit and need to do nothing further. If you see the `>` prompt, go to the next step.

3. Enter `n` to enter the Forth Toolkit.

The `ok` prompt shows that you are in the Forth Toolkit.

Figure 2-4 summarizes the steps you need to take to halt the system and enter the Forth Toolkit.

```
# /usr/etc/halt
> n
ok
```

Figure 2-4 Halting the System and Entering the Forth Toolkit

For extensive information on tests you can run from the Forth Toolkit, see the *Open Boot PROM Toolkit User's Guide* or the *Introduction to Open Boot 2.0*.

To return to the Monitor > prompt, from the Forth Toolkit:

```
ok old-mode  
>
```