Introduction to Open Boot 2.0

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Using the Forth Monitor

This chapter provides machine-specific information about controlling your system with the Open Boot 2.0 Forth Monitor. The machine functions described in here let you do the following things:

- Reset the system
- Run diagnostics
- Display system information
- Boot from the ok prompt
- Redirecting I/O
- Preserve data after a system crash.

Forth Monitor

The Forth Monitor is an interactive command interpreter based on the Forth programming language. The ok prompt indicates that you are in the Monitor, which gives you access to an extensive set of functions for performing hardware development, problem determination (fault isolation), software development, and debugging. All functions available through the Restricted Monitor mode are also available through the Forth Monitor.

The Forth Monitor is introduced here, and is described in more detail in *Open Boot 2.0 Command Reference, 800-6076-10.*

If you want to use the Forth Monitor, you have to invoke the Open Boot command interpreter, either before or after SunOS has booted. Invoke the command interpreter by typing `L1-A` from the SPARC system keyboard, or by pressing the Break key if you are using a dumb terminal as the system console.

The Open Boot command interpreter interface works in two modes:

- Forth Monitor (which shows `ok` as its prompt).
- Restricted Monitor (which shows a `>` prompt character),

Entering the Forth Monitor

To enter the Open Boot 2.0 Forth Monitor from the `>` prompt, type:

```
Type b (boot), c (continue), or n (new command mode)
> n
Type help for more information
ok
```

The Restricted Monitor starts the Forth Monitor and displays the `ok` prompt and help message.

The rest of this chapter assume that you are in the Forth Monitor (`ok` prompt).

Resetting the System

Occasionally you need to reset the system. The `reset` command, described in Table 1-1, resets the system without doing a power cycle.

To reset the system, type:

```
ok reset
```

The power-on self-test and initialization procedure begin immediately. All Forth definitions that you had previously entered, if any, are lost.

Table 1-1 System Resetting Commands

Command	Description
`reset`	Resets the entire system (similar to doing a power-cycle.)

Running Diagnostics

Several diagnostic routines are available from the Forth Monitor. These on-board tests let you check things such as the network controller, the floppy disk system, memory, installed SBus cards and SCSI devices, and the system clock. Table 1-2 lists diagnostic test commands.

Table 1-2 Diagnostic Test Commands

Command	Description
`probe-scsi`	Identify attached SCSI devices
`test-all`	Test all devices that have a built-in self-test method.
`test floppy`	Test the floppy drive, if installed
`test /memory`	Test main memory (number of megabytes indicated in NVRAM configuration parameter `selftest-#megs`).
`test net`	Test the network connection.
`watch-net`	Monitor the network connection.
`watch-clock`	Test the clock function

Testing the SCSI Bus

To check the SCSI for connected devices, type:

```
ok probe-scsi
  Target 3
    Unit 0      Disk   MAXTOR LXT-213S SUN02074.15
                Actual response depends on devices in SCSI chain
```

Testing Installed Devices

To test installed devices, type:

```
ok test-all
          Response(s) depends on which SBus cards are installed
```

Note: This test works only on those devicess having a test method included in their onboard PROM.

Testing Memory

When you use the memory testing routine, the system will test the number of megabytes of memory specified in the NVRAM parameter `selftest-#megs`. One megabyte of memory is tested as the default. If either the hardware diagnostic switch (if the system has one), or the NVRAM parameter `diag-switch?` is enabled, all the memory will be tested.

To test memory, type:

```
ok test /memory  There will be a delay while the PROM  tests the system before
                 the prompt returns to the display
Testing  1 megs of memory.  Still to go  1.
ok
```

If the system fails this test, you will see an error message. Otherwise, the `ok` prompt is displayed again.

Testing the Diskette Drive System

The diskette drive test determines whether the diskette drive is functioning properly. A formatted (HD) disk must be in the diskette drive for this test to complete successfully.

To test the diskette drive system, type:

```
ok test floppy
Testing floppy disk system.  A formatted
disk should be in the drive.
Test succeeded.
ok
```

Eject the diskette by typing `eject-floppy` at the `ok` prompt. If the test fails, you will see an error message.

Testing the Ethernet Controller

To test the on-board Ethernet controller, type:

```
ok test net
Internal Loopback test - (result)
External Loopback test - (result)
ok
```

The system responds with a message indicating the result of the test.

Note: The external loopback portion of this test will fail unless the system is connected to Ethernet.

Monitoring the Network

To monitor the network connection, type:

```
ok watch-net
Internal Loopback test - suceeded
External Loopback test - suceeded
Looking for Ethernet packets.
'.' is a good packet. 'X' is a bad packet.
Type any key to stop
.....................................
ok
```

The system responds with a message indicating the result of the test.

Testing the Clock

To test the clock function, type:

```
ok watch-clock
Watching the 'seconds' register of the real time clock chip.
It should be ticking once a second.
Type any key to stop.
1                        Press any key to stop test
ok
```

The system responds by incrementing a number once a second.

Displaying System Information

The banner command, listed in Table 1-3, shows you the system banner, which includes the Ethernet address for the Ethernet controller, the contents of the IDPROM, and the version number of the PROM. The IDPROM contains information specific to each individual machine, including the serial number, date of manufacture, and Ethernet address assigned to the machine.

Table 1-3 System Information Display Commands

Command	Description
`banner`	Displays power-on banner

On a SPARCstation 2, the banner looks like this:

```
SPARCstation 2, Type 4 Keyboard
ROM Rev. 2.0, 12 MB memory installed, Serial #4660
Ethernet address 8:0:20:6:76:97, Host ID: 55001234
```

Booting the System From the Forth Monitor

The `boot` command loads the SunOS kernel or another executable program into memory, and executes that program when the program load completes.

To boot your system from the `ok` prompt, type the `boot` command using the standard boot syntax. See Chapter 3 for information about booting.

Redirecting I/O

There is an *emergency procedure*, in case a desired input source is unavailable.

For example, suppose you have set the NVRAM parameters for baud rate incorrectly, so that a power cycle leaves you without a usable source of input.

Table 1-4 Emergency Keyboard Commands

Command	Description
`L1-A` (from keyboard)	Redirect input to come from keyboard
`L1-F` (from keyboard)	Press and hold during power-up to redirect input and output to `ttya` at 9600 baud and prevent SBus device initialization
`L1-D` (from keyboard)	Press and hold during power-up to set the input NVRAM parameter `diag-switch?` to true (to set system in diagnostic mode)
`L1-N` (from keyboard)	Press and hold during power-up to reset all NVRAM parameters to default settings

Even when the Sun keyboard is inactive (because the serial port is being used for input), the `L1-A` key combination from the Sun keyboard will still be detected. When you press `L1-A`, the system resets the input source back from the current setting and accepts input to the keyboard.

Note: `L1-A` does not change the output source. If output is incorrect, then you might also need to restore the output to the screen connection by typing `screen output` and pressing `Return`. Characters are not echoed as you type. If you make a mistake, error messages are not displayed. If this procedure does not work correctly, you might need to type `n` and press `Return` to enter the Forth Monitor, and then type `screen output` and press `Return`.

Preserving Data After a System Crash

The `sync` command forces any information on its way to the hard disk to be written out immediately. This is useful if SunOS has crashed, or has been interrupted without preserving all data first.

The `sync` command actually returns control to the SunOS Operating System, which then performs the data saving operations. After the disk data has been synchronized, SunOS begins to save a *core image* of the operating system. This *core dumping* procedure is preceeded by the following message

```
dumping to vp xxxxxxxx offset xxxxxx
```

If you do not need this core dump, you can interrupt the operation with `L1-A`. Table 1-5 lists commands to control your disk.

Table 1-5 Disk Control Commands

Command	Description
`sync`	Calls SunOS to write any pending information to the hard disk. Also boots after syncing file systems.

Using Configuration Parameters

This chapter describes the configuration parameters contained in NVRAM. Changes made to these parameters are persistant (they carry over through power cycles, but you can change them). Topics covered include:

- Displaying and changing NVRAM parameters
- Setting security
- Input/output control
- Setting boot options

Configuration parameters should always be changed cautiously. When correctly used, these configuration parameters gives you flexibility in working with your system's hardware.

The configuration parameter commands listed in Table 2-1 have been created to simplify using these parameters.

NVRAM

The NVRAM contains user-settable choices that control various aspects of system initialization and booting, basic start-up machine configuration and related communication characteristics. These choices persist even when the system is turned off. This chapter describes how to access and change these parameters.

A portion of NVRAM, called `nvramrc`, is set aside for use by device drivers or the system's user. The amount of this non-volatile memory portion depends on the particular SPARC system.

Typically, nvramc space might be used by a device driver to save start up configuration parameters, or to patch device driver code.

You can edit nvramrc contents. This is described in *Open Boot 2.0 Command Reference, 800-6076-10.*

The procedures described in this chapter assume that you have started the Monitor, entered the Forth Monitor mode, and the ok prompt is displayed on your screen. See Chapter 1 for information about entering the Forth Monitor.

NVRAM configuration parameters can be viewed and changed using the Forth Monitor commands listed in Table 2-1.

Table 2-1 Configuration Parameter Commands

Command	Description
printenv	Displays all current parameters and current default values (numbers are shown as decimal values)
setenv *parameter value*	Sets the *parameter* to the given decimal or text *value* (Changes are permanent, but usually only take effect after a reset)
set-default *parameter*	Resets the value of the named *parameter* to the factory default
set-defaults	Resets most parameter values to the factory defaults (see Table 2-2 for details)

Displaying Parameters

To display a list of the current parameter settings, type:

```
ok printenv
```

The system displays a formatted list of the current parameter settings, similar to the partial list shown below.

Note: Numeric parameters are displayed in decimal.

Parameter Name	Value	Default Value
sunmon-compat?	true	true
oem-logo		
oem-logo?	false	false
oem-banner		
oem-banner?	false	false
ttyb-mode	9600,8,n,1,-	9600,8,n,1,-
ttya-mode	9600,8,n,1,-	9600,8,n,1,-

Table 2-2 lists all current NVRAM configuration parameters. These may change with future systems, and not all systems will implement all the listed NVRAM parameters.

Table 2-2 NVRAM Configuration Parameters, continued on following page

Parameter	Description	Typical Default
auto-boot?	If true, boot automatically after power up	True
boot-device	Boot source	disk
boot-file	File to boot (an empty string lets /boot choose default)	*empty string*
diag-device	Diagnostic boot source	net
diag-file	File to boot from in diagnostic mode	*empty string*
diag-switch?	If true, run in diagnostic mode	False
fcode-debug?	If true, include name fields for plug-in device Fcodes	False
hardware-revision	System version information	*no default*
input-device	Power-on input device (keyboard, ttya or ttyb)	keyboard
keyboard-click?	If true, enable keyboard click	False
last-hardware-update	System update information	*no default*

Table 2-2. NVRAM Configuration Parameters, continued

Parameter	Description	Typical Default
local-mac-address?	If true, network drivers use own MAC address, not system's	False
mfg-switch?	If true, perform repeated system self-tests	False
nvramrc	Contents of nvramrc	(empty)
oem-banner?	If true, use custom OEM banner	False
oem-logo	Byte array custom OEM logo (enabled by oem-logo? true)	*no default*
oem-logo?	If true, use custom OEM logo (else use SUN Logo)	False
oem-banner	Custom OEM banner (enabled by oem-banner? true)	*empty string*
output-device	Power-on output device (screen, ttya or ttyb)	screen
sbus-probe-list	Which SBus slots are probed and in what order	0123
screen-#columns	Number of on-screen columns (characters / line)	80
screen-#rows	Number of on-screen rows (lines) used	34
scsi-initiator-id	SCSI bus address of host adapter, range 0-7	7
security-#badlogins	Number of incorrect security password attempts	*no default*
security-mode	System security level (none, command, full)	none
security-password	System security password (never displayed)	*no default*
selftest-#megs	Megabytes of RAM to test on power-up or on test-memory	1
skip-vme-loopback?	If true, POST doesn't do VMEbus loopback tests	False
sunmon-compat?	If true, come up with old-style monitor prompt '>'	True
testarea	One-byte scratch field, available for read / write test	0†
ttya-mode	ttya (baud rate, #bits, parity, #stop, handshake)	9600, 8, n, 1
ttyb-mode	ttyb (baud rate, #bits, parity, #stop, handshake)	9600, 8, n, 1
ttya-ignore-cd	If true, SunOS ignores carrier-detect on ttya	True
ttyb-ignore-cd	If true, SunOS ignores carrier-detect on ttyb	True
ttya-rts-dtr-off	If true, SunOS does not assert DTR and RTS on ttya	False
ttyb-rts-dtr-off	If true, SunOS does not assert DTR and RTS on ttyb	False
use-nvramrc?	If true, execute contents of nvramrc	False
watchdog-reboot?	If true, reboot after watchdog reset	False

Changing a Parameter's Value

Use the `setenv` command to change a parameter setting. The `setenv` command has the following format:

`setenv` *parametername value*

where

- *parametername* is one of the listed parameters.
- *value* is a numeric value or text string appropriate to the named parameter. Numeric values are entered in decimal.

To change the setting of the `auto-boot?` parameter from true to false, enter:

```
ok setenv auto-boot? false
ok
```

This command sets the `auto-boot?` parameter flag to false. This means that the next time the system is powered on or reset the auto-boot feature is turned off. The system will not try to boot the SunOS after self-tests and initialization have completed.

Resetting Default Values

You can reset one or most of the parameters back to the original defaults using the `set-default` and `set-defaults` commands. These commands have the following format:

- `set-default` *parametername*
- `set-defaults`

where

- *parametername* is one of the listed parameters.

To reset the `auto-boot?` **parameter to its original default setting (true), type:**

```
ok set-default auto-boot?
ok
```

To reset most parameters to their default settings, type:

```
ok set-defaults
ok
```

Once the default for a parameter is changed or reset, a system reset is usually required for the parameter setting to actually take effect. You can use the `reset` command to reset the system when you have changed a parameter.

A system reset (which is very similar to a power cycle) does not necessarily include booting, depending on how the configuration parameters are specified. The parameters that relate to system booting require a system boot for the parameter to take effect.

Table 2-3 lists additional NVRAM configuration commands, which are used only rarely.

Table 2-3 Configuration Parameter Command Primitives

Command	Description
parameter	Return the (current) field value
`show` *parameter*	Display the (current) field value (numbers shown in decimal)
`to` *parameter*	Change a (current) field value (may be used to enter strings with embedded blanks) Examples: `false to auto-boot?` " *Text string*" `to oem-banner`

Security

Setting the `security-mode` parameter to `full` or `command` security restricts the set of actions others are allowed to perform, thus making it more difficult for them to break into your computer network. There are three security modes:

1. none
2. command
3. full

In `none` security mode, any command can be executed at the boot prompt `>` with no password required. `Command` security mode is the next level of security and `full` security mode is the most secure. In both `command` and `full` security, passwords are required to execute certain commands at the boot prompt `>`.

A password is never required from the `ok` prompt, regardless of security mode. However, a password is required to *get* to the `ok` prompt in either `command` or `full` security modes.

Table 2-4 lists the security parameters.

Table 2-4 Security Parameters

Parameter	Default	Description
`security-mode`	`none`	System security level (`none`, `command`, `full`)
`security-password`	*no default*	System security password (*do not* set this directly)
`security-#badlogins`	*no default*	Number of incorrect security password attempts

No Security

With `security-mode` set to `none` (default), no password is required to enter any command at the boot prompt `>`. Anyone can execute the three commands at the boot prompt `>` without a password:

- `b` (boot)
- `n` (new)
- `c` (continue).

If you previously set the security to `command` or `full` security and want to set the system to no security, enter the following:

```
ok setenv security-mode none
```

The next time the system checks the boot PROM's security, it will determine that no security (`security-mode none`) has been set for the user.

It is also possible to change the PROM security mode using the `/etc/eeprom` SunOS utility.

Command Security

With `security-mode` set to `command`, a password is not required if you type the `b` command at the boot prompt `>`. However, if you follow the `b` command with a parameter, a password is required.

A password is required to execute the `n` command from the boot prompt `>`. The `c` command never asks for a password. Examples follow:

```
> b                    (no password required)
> c                    (no password required)
> b filename           (password required)
PROM Password:         (password is not echoed as it is typed)
> n                    (password required)
PROM Password:         (password is not echoed as it is typed)
```

To set the security password and `command` security mode, enter the following at the `ok` prompt:

```
ok password
ok New password (only first 8 chars are used):
ok Retype new password:
ok setenv security-mode command
```

Note: Although this example works, you should normally set the two security parameters with the `eeprom` command from SunOS.

The security password you assign follows the same rules as the `root` password, a combination of six to eight letters and numbers. The security password can be the same as the `root` password, or you can assign a security password different from the `root` password.

Caution – The security password is important to remember. If you forget your security password, your system will be unbootable and you must call Sun's customer support service to make your machine bootable again.

You don't have to reset the system. The security feature takes effect as soon as the Sun-Compatible mode (> prompt) is entered.

If you enter an incorrect security password, there will be a delay of about 10 second before the next boot prompt > appears. The number of times that an incorrect security password is typed is stored in the `security-#badlogins` parameter. This parameter is a 32-bit signed number (680 years worth of attempts at 10 seconds per attempt). This parameter can be set to 0 with the `setenv` command. Its value can be displayed with the `printenv` command. An example of setting the value of `security-badlogins` to 0 follows:

```
ok setenv security-#badlogins 0
```

Note: If you enter the `boot` command in command or full security mode, the PROM will revert to the > prompt the next time that the PROM command interpreter is entered.

Full Security

The `full` security mode is the most restrictive. With `security-mode` set to `full`, a password is required any time you type the `b` command at the boot prompt > (either `b` alone or `b` followed by a parameter).

A password is required to execute the `n` command from the boot prompt >. The `c` command never asks for a password. Examples follow:

```
> c                    (no password required)
> b                    (password required)
PROM Password:         (password is not echoed as it is typed)
> b filename           (password required)
PROM Password:         (password is not echoed as it is typed)
> n                    (password required)
PROM Password:         (password is not echoed as it is typed)
```

To set the security password and `full` security, enter the following at the `ok` prompt:

```
ok password
ok New password (only first 8 chars are used):
ok Retype new password:
ok setenv security-mode full
```

Input and Output Control

Table 2-5 lists the configuration parameters related to the control of system input and output. You can use these parameters to assign the power-on defaults for input and output, and to adjust the communication characteristics of the `ttya` and `ttyb` serial ports. These values do not take effect until the next system reset.

Table 2-5 Input and Output Control Parameters

Parameter	Default	Description
`input-device`	keyboard	Console input device (`keyboard`, `ttya`, or `ttyb`)
`output-device`	screen	Console output device (`screen`, `ttya`, or `ttyb`)
`ttya-mode`	9600, 8, n, 1, -	`ttya` (baud, #bits, parity, #stop, handshake)
`ttyb-mode`	9600, 8, n, 1, -	`ttyb` (baud, #bits, parity, #stop, handshake)

Setting Serial Port Characteristics

The communications characteristics for the two serial ports, `ttya` and `ttyb`, are set using the following values for the parameters `ttya-mode` and `ttyb-mode`.

The default settings for both `ttya` and `ttyb` for most Sun systems are:

9600 baud
8 data bits
no parity
1 stop bit
no handshake

- baud, #bits, parity, #stop, handshake

where:

- *baud* 110, 300, 1200, 2400, 4800, 9600, 19200, 38400 (bits/second)
- *#bits* 5, 6, 7, 8 (data bits)
- *parity* n=none, e=even, o=odd, m=mark, s=space (parity bit)
- *#stop* 1=1, . =1.5, 2=2 (stop bits)
- *handshake* -=none, h=hardware (rts/cts), s=software (xon/xoff)

To set ttya to 1200 baud, seven data bits, one stop bit, even parity, and no handshake, type:

```
ok setenv ttya-mode 1200,7,e,1,-
ok
```

Note: rts/cts and xon/xoff handshaking are not implemented on all systems. In this case, the handshake parameter is silently ignored.

Selecting Input and Output Device Options

The `input-device` and `output-device` parameters control the system's selection of input and output devices after a power-on reset. The default `input-device` value is `keyboard` and the default `output-device` value is `screen`. Input and output can be set to the following values:

Table 2-6 I/O Device Parameters

input-device	output-device
keyboard*	screen**
ttya	ttya
ttyb	ttyb

* keyboard implies standard Sun keyboard

**screen implies frame buffer video display

When the system is reset or power-cycled, the named device becomes the default input or output device.

To set ttya as the power-on default input device, type this command:

```
ok setenv input-device ttya
ok
```

Note: If you select `keyboard` for `input-device`, but it isn't plugged in, input will be accepted from `ttya` after the next power cycle or system reset. If you select `screen` for `output-device`, but no onboard framebuffer is available, output will be sent to `ttya` after the next power cycle or system reset.

Selecting Boot Options

You can use the configuration parameters to determine whether the system will automatically boot after the system start-up tests and initialization. In addition, the parameters can be used to select the boot device and the program to be booted. Table 2-7 lists the parameters that control boot options.

Table 2-7 Boot Options Parameter

Parameter	Default	Description
`auto-boot?`	True	Determines whether the system will automatically boot after the power-on self-test and system initialization. If true and `diag-switch?` is set to false, the Open Boot tries to boot from whatever device and file are specified by `boot-device` and `boot-file` parameters.
`boot-device`	disk	Boot device name.
`boot-file`	*empty string*	Boot source file.

The `boot-device` parameter defaults to the internal disk drive. The `boot-device` parameter is used during auto-boot or when you boot the system manually without specifying a filename. To specify that the file `myunix` to be auto-booted single-user from the Ethernet server, type:

```
ok setenv boot-device net
ok setenv boot-file myunix -s
ok boot          Specified booting begins immediately
```

Controlling Power-On Self-Test

You can make the system perform a more thorough self-test during power-on by enabling the diagnostic switch parameter `diag-switch?` . After `diag-switch?` is enabled, additional status messages are sent out (some to `ttya` and some to the specified output device) and *all* of memory is tested.

Note: Some SPARC systems have a hardware diagnostic switch. Setting either the hardware switch or `diag-switch?` runs the full tests on power-up. See your systems POST documentation for more information.

Table 2-8 lists the power-on testing parameters.

Table 2-8 Boot Option Parameters

Parameter	Default	Description
`diag-switch?`	False	When `diag-switch?` is `true`, the boot PROM tries to boot the program specified by the `diag-file` parameter, from the device specified by the `diag-device` parameter. When `diag-switch?` is `false`, the system will not call out the diagnostic tests as they are run, unless a test fails, and will not run any additional tests. **Note:** Regardless of the default value, all systems are shipped from the factory with a current value of false for `diag-switch?`
`mfg-switch?`	False	When true, the system repeats the power-on self-test and initialization sequence until interrupted with the `L1-A` key sequence.
`selftest-#megs`	1	Number of megabytes of RAM to test on power-up or by using the `test /memory` command. This value is ignored if `diag-switch?` is true.
`diag-device`	net	Diagnostic boot source device
`diag-file`	*empty string*	Diagnostic boot source filename

To power-up in diagnostic mode if `diag-switch?` is set to false:

1. Set the `diag-switch?` parameter to true, or set hardware selftest switch, if system has one.
2. Reset the system.

```
ok setenv diag-switch? true
ok reset
```

The system Field Service Manual has more information about using diagnostics.

Using the Restricted Monitor

This chapter explains how to access and use the boot Open Boot Restricted Monitor. The Restricted Monitor operates like the monitor used by pre-SPARCstation 1 Sun workstations, and is restricted in that it offers a small set of functions compared to the Forth Monitor. The Restricted Monitor supports three commands that let you boot the system, continue a halted program, or enter the Forth Monitor.

Restricted Monitor

The Restricted Monitor mode presents a basic interface for the most common PROM use — booting the system. It operates like the PROM monitor of pre-SPARCstation 1 Sun workstations.

When you enter the Restricted Monitor, the boot prompt > appears on the display screen. From the boot prompt you may execute an abbreviated set of commands. These commands let you boot the system, continue the execution of a halted program, or enter the Forth Monitor.

Starting the Monitor

The boot PROM interface operates independently from SunOS. Figure 3-1 lists the three ways you can start the interface.

Boot PROM commands can modify any location in memory. Therefore, if you enter commands incorrectly so that the PROM is unable to execute what you've entered, the system becomes *hung* and stops responding to input from the keyboard.

If that happens, you must perform a power cycle to bring the system back to normal operation. Once you perform the power cycle, you can interrupt the power-up sequence to return to the command interpreter.

When performed as described on the following pages, a power cycle will not produce any adverse effects on your system.

Table 3-1 Starting the Boot PROM Interface

Method	Procedure
Performing a Power-Cycle and Interrupting Power-Up Sequence	1. If necessary, turn power to the system unit off after turning off any connected peripherals and wait 10 seconds 2. Turn on the power to the display (if necessary) 3. After turning on any connected peripheral devices, turn on the power to the system unit, and wait several seconds 4. When the memory-test message appears, press `L1-A`
Halting SunOS (normal method)	1. Save all open files 2. Quit all applications 3. In a multi-user system, alert all users 3. In a shell window, become the system superuser and type: **`/etc/halt`**
Aborting SunOS (if hung system)	1. Press `L1-A` 2. If at > prompt, type **`n`** 3. At `ok` prompt type **`sync`** 4. When you see the word `rebooting`, press `L1-A` again 5. At the `ok` prompt type **`old-mode`** to return to the > prompt (if desired)

Performing a Power Cycle

When your system becomes *hung*, do a power cycle to return the system to normal operation.

To perform a power cycle:

1. Turn off the power to any external devices. (Refer to the documentation for the particular device, if required, for proper power-off procedures.)
2. Turn off the power to the system unit. (Refer to the system Installation Guide for the position of the power switch.)
3. Wait a minimum of 10 seconds.
4. Turn on external peripherals, if any.
5. Turn the system power back on. Don't panic if nothing seems to happen for a while. The Power-On Self Test (POST) operation will take a while, partly depending on how much memory your system contains.

Caution – Always allow 10 seconds between turning off the power and turning it back on again. This pause prevents possible damage to power supply components in your system unit.

Caution –The system unit should be the last device turned off and the last one turned back on when you do a power cycle.

This method lets the peripheral devices reset themselves so that the system correctly maps them in when it restarts.

Interrupting the Power-Up Sequence

The most common way to start the PROM interface is to interrupt the power-up sequence. You can interrupt the power-up sequence anytime you turn the system unit on, or when you reset the system from the keyboard.

To interrupt the power-up sequence (assuming the system is powered off):

1. Turn on the power to the display.
2. Turn on the power to the system unit.
3. When the line "`Testing` *nnn* `megs of memory`" appears on the display, press `L1-A`.

   The power-up sequence halts and the system displays a brief message and the boot prompt `>`.

```
Type b (boot), c (continue), or n (new command mode)
>
```

Halting the Operating System

To start the Restricted Monitor when SunOS is running, you must first halt SunOS, carefully. When you halt SunOS, the RestrictedMonitor starts automatically if `sunmon-compat?` is set to `true`.

When the system is running SunOS, you should see a machine prompt in an open shell window that looks something like this:

```
hostname%
```

To halt the operating system and start the PROM user interface:

1. Save and quit all open files. See the *Sun System User's Guide* for information about ending a work session.
2. Quit all open applications.
3. Become superuser as described in the *Sun System Network Manager's Guide*. Type **`/bin/su`** and press `Return`.
4. In a multi-user system, alert all users.
5. Type **`/etc/halt`** and press Return.

The system displays system halt messages followed by the boot prompt.

```
hostname% /bin/su
Password:
hostname# /etc/halt
Syncing file systems . . . done
Halted

Type b (boot), c (continue), or n (new command mode)
>
```

Aborting a Hung System

When the operating system appears to be running but the system does not respond to the mouse and/or keyboard, the system is hung. When you abort a hung system, the PROM user interface automatically starts. If the following sequence does not work — that is, if the system does not respond to the abort attempt — perform a power cycle to return the system to normal operation. If a power cycle does not restore normal system function, call your field service representative for further assistance.

Caution –When the operating system or any other standalone program has already booted, it is preferable not to use `L1-A` to halt the machine. Aborting program execution with `L1-A` can damage currently open data files.

To abort a hung system and start the PROM user interface:

On some keyboards, L1 appears on the front face of the Stop key.

1. Press `L1-A`.
2. Type `n` and press Return.
3. The system displays a help message and an `ok` prompt.
4. Type `sync` and press Return.
5. Press `L1-A` again when you see the word `rebooting`.
6. Type **`old-mode`** and press `Return`, to return to the > prompt (if desired).

```
Press L1-A
Type b (boot), c (continue) or n (new command mode)
> n
Type help for more information
ok sync
When you see the word rebooting, press L1-A again
ok old-mode
Type b (boot), c (continue) or n (new command mode)
>
```

The sync command helps prevents the system from losing data that was not preserved when the system hung.

Restricted Monitor Functions

The Open Boot Restricted Monitor mode provides access to the most common PROM use, booting the system. All functions available through this mode are also available through the Forth Monitor.

You can disable the Restricted Monitor mode by setting some NVRAM parameters. See Chapter 2 for information about modifying NVRAM configuration parameters.

Three commands are supported by the Restricted Monitor mode. These commands are:

- b for booting the system,
- c for continuing the execution of a halted program, and
- n for entering the new command mode called the Forth Monitor.

Both c and n are single character commands, but b supports the standard Open Boot 2.0 booting command syntax.

Booting From the > Prompt

The boot command loads SunOS or other executable programs into memory and executes that program when the program load completes.

All booting operations function identically, whether you are in Restricted Monitor mode or in the Forth Monitor. The only difference is that you must type out the entire word `boot` (with a following space if options are used) from the Forth Monitor.

To boot your system, enter a `boot` command. See the next section "Boot Command Syntax" for the boot command format and the options summary in Table 3-3 for further details. Syntax for both the > prompt and the Forth Monitor `ok` prompt is shown in the following examples. Some systems' device names might be different.

Table 3-2 Boot Commands

Restricted Monitor >	Forth Monitor ok	Description
`b`	`boot`	Boot system using defaults
`b -as`	`boot -as`	Boot `sd0` with flags `-a` (interactive flag) and `-s` (single-user operation)
`b net`	`boot net`	Boot `vmunix` from the network
`b /sbus/esp/sd@0,0:b mydiag`	`boot /sbus/esp/ sd@0,0:b mydiag`	Boot `mydiag` from SCSI drive target address 0, partition b.

Note: Boot defaults can be changed by changing the values of NVRAM configuration parameters. The NVRAM defaults are only used if the boot command has no arguments. See Chapter 2 for information about changing defaults.

Boot Command Syntax

The syntax of the `boot` command follows. Extra spaces and tabs typed in the command line are ignored. All arguments shown in italics are optional. When using command options, the command word `boot` must be followed by a space.

> **b** *[device-alias filename options]*

ok **boot** *[device-alias filename options]*

Table 3-3 lists the boot commands and their syntax. Not all systems will have all the devices, such as floppy drives, listed in the table.

Table 3-3 Boot Command Options

Option		Description
device-alias can be:	`net`	LANCE Ethernet
	`disk`	hard disk
	`tape`	SCSI tape
	`floppy`	3-1/2" diskette drive
	`cdrom`	CD-ROM drive
filename	Default = `vmunix`	The name of the program to be booted, such as `stand/diag` or `vmunix`. *filename* is relative to the root of the selected device and partition (if specified). If *filename* is not given, the boot program uses the default file name, which is currently `vmunix`.
options	-a	Prompts interactively for the device and name of the file to boot.
	-b	Pass the -b flag through the kernel to init (8) to skip execution of the `/etc/rc.local` script.
	-h	Halt after loading the program.
	-s	Pass the -s flag through the kernel to init (8) for single-user operation.
	-i *initname*	Pass the -i *initname* to the kernel to tell it to run *initname* as the first program rather than the default `/sbin/init`.

Table 3-4 lists representative device aliases and their syntax. Remember that not all systems will have all the devices listed in the table, such as floppy drives, some have devices not listed in the table, and not all systems will name their devices in the same order.

The heading "Old Path" in Table 3-4 refers to the Open Boot 1.*n* usage for the equivalent SBus device.

Table 3-4 Device aliasess

Alias	Boot Path	Old Path	Description
disk	`/sbus/esp/sd@3,0`	`sd(0,0,0)`	Default disk (1st internal)
disk0	`/sbus/esp/sd@3,0`	`sd(0,0,0)`	First internal disk `sd0`
disk1	`/sbus/esp/sd@1,0`	`sd(0,1,0)`	Second internal disk `sd1`
disk2	`/sbus/esp/sd@2,0`	`sd(0,2,0)`	External disk `sd2`
disk3	`/sbus/esp/sd@0,0`	`sd(0,3,0)`	External disk `sd3`
tape	`/sbus/esp/st@4,0`	`st(0,0,0)`	First tape drive `st0`
tape0	`/sbus/esp/st@4,0`	`st(0,0,0)`	First tape drive `st0`
tape1	`/sbus/esp/st@5,0`	`st(0,1,0)`	Second tape drive `st1`
cdrom	`/sbus/esp/sd@6,0:c`	`sd(0,6,2)`	`munix` from cdrom
cdroma	`/sbus/esp/sd@6,0:a`	`sd(0,6,0)`	from cdrom partition `a`
net	`/sbus/le`	`le(0,0,0)`	unix from Ethernet
le	`/sbus/le`	`le(0,0,0)`	unix from Ethernet
floppy	`/fd`	`fd(0,0,0)`	from floppy drive

You can use the Forth Monitor's `devalias` command to list all available `aliases` on a given SPARC system.

Continuing a Halted Program

The `c` command is useful if you have halted SunOS or another program by pressing `L1-A`. To resume execution of a halted program:

```
Type b (boot), c (continue), or n (new command mode)
> c
```

Program execution resumes. Once execution resumes, you can refresh the display and remove any screen artifacts.

- From SunView, select `Redisplay All` from the SunView menu.
- From OpenWindows, select `Refresh` from the Utilities menu.

Note: From the ok prompt, the command go performs the same function as typing c at the > prompt.

Entering the Forth Monitor

To enter the Open Boot Forth Monitor mode from the > prompt, type:

```
Type b (boot), c (continue), or n (new command mode)
> n
Type help for more information
ok
```

The monitor starts the Forth Monitor and displays the ok prompt and help message.

Returning to the > Prompt

All the functions available from the boot prompt are available in the Forth Monitor from the ok prompt. However, if you want to exit the Forth Monitor and return to the > prompt, enter:

```
ok
ok old-mode
Type b (boot), c (continue), or n (new command mode)
>
```

After entering the Forth Monitor, you can work directly with your system's hardware.

Even if you are familiar with the Forth programming language, you should read *Open Boot 2.0 Command Reference* for a description of the version of Forth and programming environment supported by the Open Boot 2.0.