PROM Monitor Reference

PRM-01-DOC

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About this Book

Audience

This manual is intended for system administrators responsible for maintaining and managing system resources.

Organization of this Manual

This manual describes the PROM (Programmable Read Only Memory) monitor, which initializes the system after power-on. The PROM monitor executes diagnostic tests to ensure that the machine is reasonably free of problems. It is also responsible for loading and starting the execution of standalone programs, including the RISC/os kernel. The PROM monitor provides system services to standalone programs.

This manual contains information on the following topics:

- Overview
- Initialization displays
- PROM monitor command summary
- PROM monitor environment variables
- Updating PROMs

Note that, throughout this manual, the term ‘‘4000 systems’’ refers to both the Magnum and Millennium 4000 systems.

For Further Reading

RISC/os System Administrator’s Guide	ROS-04-DOC
Magnum 4000/50PC and RC4130 Technical Reference	SYS-25-DOC

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PROM Monitor Reference

This manual describes the PROM (Programmable Read-Only Memory) monitor, which provides the tools for the following tasks:

- Performing basic functional testing of the CPU (including caches and floating point hardware), main memory, and the CPU to I/O subsystem interface
- Examining and changing system memory
- Downloading programs over serial lines (RS-232C)
- Booting programs from disk, tape, or Ethernet

The PROM monitor also provides utilities for altering configuration power-up options in nonvolatile RAM (NVRAM).

This manual is divided into the following sections:

- Overview
- Initialization displays
- Command summary
- Environment variables
- Updating PROMs

Overview

The PROM monitor uses system memory between physical addresses 0xA0000500 and 0xA001FFFF, and resides in PROM on the I/O (Input/Output) adapter board. The include file *prom/entrypt.h* describes conventions for memory use by standalone programs.

The PROM monitor is entered at 0xBFC00000 when the system is reset or powered up. The PROM monitor initializes the processor, caches, NVRAM, main memory, the I/O subsystem, and any other boards that are present.

The processor is initialized by:

- Initializing the system coprocessor status and cause registers
- Flushing the translation buffer
- Sizing and flushing the instruction and data caches
- Initializing environment variables from nonvolatile memory

The memory boards are initialized by:

- Probing to determine how many boards exist
- Determining the best memory interleave configuration
- Configuring the boards for refresh slot assignment and assigning base addresses

Power-On Diagnostics Initialization Display for 4000 Systems

The following power-on (PON) diagnostic messages appear on the monitor after the system is initialized and before the PROM monitor messages appear:

```
PON Diagnostics Version 5.05 MIPS OPT Wed May 27 16:45:05 PDT
1992 root..PASSED
```

If a power-on diagnostic failure is detected, a display similar to the sample in Figure 1 appears.

```
PON Diagnostics Version 5.05 MIPS OPT Wed May 27 16:45:05
PDT 1992 root..PASSED
  High Memory Test..... PASSED   I/O Cache Test....... PASSE
  NVRAM Test........... PASSED   Parallel Test........ PASSE
  Floppy Chip Test..... PASSED   Partial Write Test... PASSE
  Memory Parity Test... PASSED   Primary Dcache Test.. PASSE
  Primary ICache Test..*FAILED   Primary DTAG Test.... PASSE
  Primary ITAG Test.... PASSED   Secondary Cache Test.**N/A*
  FP Test.............. PASSED   Keyboard Selftest.... PASSE
  Keyboard BAT Test.... PASSED   Video board Test.....*FAILE
  SCSI Register Test... PASSED   Audio Chip Test...... PASSE
 Sonic Reset Test..... PASSED  Sonic Register Test.. PASSED
```

Figure 1: PON Diagnostics Display

The **N/A** string indicates that the test was not executed because the hardware is not part of this configuration. Refer to the *Power-On Diagnostic Manual* that accompanies your system for information about failed test results.

Initialization Display for the RC6380

During initialization, the RC6380 monitor displays status and test results. Figure 2 shows a typical display that appears when initialization is complete.

```
RC6380 MIPS Monitor: Version 5.36 OPT Mon Jan 13 12:22:04 PST 1992 roc
Memory size: 134217728 (0x8000000) bytes, 128 MB

Present Board Configuration Status

     SBC  HDWR CPU  FPA SOFT  SOFT
SLOT REV  TYPE REV  REV STATE TYPE    DESCRIPTION
---- ---- ---- ---- --- ----- ------  -------------
  1  A1.3 cpu  A1.1 4.0 on    master  MP-capable CPU0 512KB-Scache (2)
  2  A1.3 ioc  ---- --- ----- ------  MP-capable I/O Controller (2c)
  3  A1.3 mem  ---- --- ----- ------  MP-capable Abortable (11)
  4  A1.3 cpu  A1.1 4.0 idle  slave   MP-capable CPU1 512KB-Scache (2)
5-10 ---- ---- ---- --- ----- ------  Slot is empty

Information: memory and secondary cache have been initialized
Information: multi-processing mode enabled
Information: your current prom bootmode is m

>>
```

Figure 2: PROM Monitor Status and Test Result Display

The display in Figure 2 varies depending on the bootmode. For example, bootmode *m*, *w*, or *c* runs power–on diagnostics, so the display is preceded by diagnostics information. The informational messages also vary depending on conditions set by the PROM or user.

The following message appears if the PROM detects a power-off condition or a cache parity error and must initialize the caches and memories (after a power off, the data is invalid):

```
Information: memory and secondary cache have been
initialized
```

The following message informs you that the PROM has attempted to preserve the contents of memory and the secondary cache. You can use this information in determining whether to do a memory dump:

```
Information: memory and secondary cache are valid
```

The following messages indicate the current bootmode:

```
Information: your current prom bootmode is d
Information: your current prom bootmode is m
Information: your current prom bootmode is e
```

The following message indicates that the PROM has detected only one CPU in the system and has enabled *snoop* in all the SBC chips:

```
Information: cache coherency watch enabled
```

This message appears only when the following conditions exist:

- System has only one CPU
- All system bus chips are at revision 9 or greater
- CPU boards are MP-capable
- CPU chips are at revision A1.0 or greater
- CPU PRid Implementation field is a 6 (R6000A CPU)
- IOC boards are MP-capable
- Memory boards are MP-capable

The following message indicates that the PROM found more then one CPU in the system and has enabled *snoop* in all the SBC chips:

```
Information: multi-processing mode enabled
```

This message appears only when the following conditions exist:

- System has more than one CPU
- All system bus chips are at revision A1.0 or greater
- CPU boards are MP-capable
- CPU chips are at revision A1.0 or greater
- CPU Processor ID (PRid) Implementation field is a 6 (R6000A CPU)
- IOC boards are MP-capable

The following message indicates that initialization tests found parity errors in the secondary cache of CPU–*x* and initialized that cache. The message shows the logical CPU numbers of all CPUs with cache errors (all caches with errors are initialized):

```
WARNING: PARITY ERRORS FOUND IN SCACHE OF CPU–x
```

Command Summary

The following subsections list all the PROM monitor commands and give their syntax. For a full description of each command, see the corresponding manual page or the *prom*(1M) manual page.

Load Command

The *sload* command changes the PROM monitor mode to accept an *srecord* file. The syntax is as follows:

```
sload [–a] [–b] [console_dev]
```

Start-Up Commands

Table 1 summarizes the start-up commands.

Table 1: Start-Up Commands

Command	Purpose	Syntax
auto	Initiates the two-level operating system autoboot sequence.	auto
boot	Loads the specified program.	`boot` [`-f` *filename*] [`-n`] [*args*]
warm	Executes a warm boot of the system	warm

The syntax of the *filename* parameter for the *boot* command depends on the device, as shown in Table 2.

Table 2: Filename Syntax for boot Command

Device	Boot File Name Syntax	System
SMD disk	`dkip`(*controller*, *unit*, *partition*) *path*	M/2000 SMD or RC6280
SCSI disk	`dksd`(*controller*, *target*, *partition*) *path*	Rx2030, RC3350, 4000 systems, or RC3x60G
VME SCSI disk	`dkij`(*controller*, *unit*, *partition*) *path*	RC3260, M/2000 SCSI, RC6260, or RC6380
SCSI disk	`dkis`(*controller*, *target*, *partition*) *path*	M/120 or RC3240
SCSI tape	`tqsd`(*controller*, *target*, *file*) *path*	Rx2030, RC3350, 4000 systems, or RC3x60G
VME SCSI tape	`tqij`(*controller*, *unit*, *file*) *path*	RC3260, M/2000 SCSI, RC6260, or RC6380
QIC tape	`tpqic`	Rx2030, RC3350, or RC3x60G
SCSI tape	`tqis`	RC3260, M/2000 SCSI, RC6260, or RC6380
Console uart	`tty`(*port #*)	
Ethernet	`bfs`(,*interface*, *controller*),*nfs()*	
Pseudo Console	`console`(*port #*)	
Boot Server	`bootp`()	

The user-supplied parameters for the *filename* syntax are as follows:

controller A number that specifies the device controller. If you do not specify a controller number, the default value 0 is used.

file *file* indicates which file on the tape; 0 indicates the first file.

interface *interface* indicates the type of Ethernet board in the system: *cmc* or *egl*. This is applicable only on systems that allow multiple Ethernet boards. For the RC3360 and RC3350, *interface* can also be *la* (for LANCE Ethernet interface).

partition	*partition* is a number specifying a disk partition (a logical portion of a disk). The partition base cylinder and size are determined by accessing the disk volume header stored on the disk itself. If you do not specify *partition*, the default value 0 is used.
path	*path* specifies a file on the media that contains the program to be booted. The syntax for the file referred to by *path* is specific to the device.
port#	*port#* indicates the serial I/O port number. This number can be either 0 or 1.
target	*target* is a number from 0 through 7 that indicates the SCSI device. 7 is normally received as the system ID.
unit	Multiple storage devices can be attached to a single device controller. *unit* indicates the specific device on a controller. If you do not specify a unit number, the default value 0 is used.

General Utility Commands

Table 3 summarizes the general utility commands available during execution of the PROM monitor.

Table 3: PROM Monitor General Utility Commands

Command	Purpose	Syntax
cat	Displays the contents of the files listed on the console.	`cat` *file1* [*file2... fileN*]
cpu	Enables and disables CPUs (implemented on the RC6380 system only).	`cpu` *cpu_number* `on|off`
disable	Disables input from and output to the specified console device.	`disable` [*console_dev*]
dump	Formats and displays the contents of memory.	`dump` [*format*] [*length*] *range*
enable	Allows input from and output to the specified console device.	`enable` [*console_dev*]
help	Displays the syntax for all commands.	`help` [*commandlist*]
init	Reinitializes the PROM monitor software state.	`init`
init_tod	Initializes the time-of-day chip.	`init_tod` [*secs*]

Table 3: PROM Monitor General Utility Commands

Command	Purpose	Syntax
pr_tod	Prints the contents of the time-of-day register.	`pr_tod`
printenv	Displays the value of the PROM environment variables.	`printenv` [*varlist*]
setenv	Creates a new PROM environment variable or changes an existing environment variable.	`setenv` [*var*] [*value*]
sload	Puts the PROM monitor in a mode to accept an *srecord* file.	`sload [-a] [-b]` [*console_dev*]
sprobe	Returns information for devices on the SCSI bus. M120, RC3230, RC3330, RC2030, RC3360 and 4000 systems only.	`sprobe`
unsetenv	Deletes an existing environment variable.	`unsetenv` [*var*]

Note: The *file1* parameter for the *cat* command has the same syntax as the *file-name* parameter of the *boot* command described in the previous section.

The *init_tod* command is supported only when the PROM monitor variable *boot-mode* is set to *d*.

Debugging Commands

Table 4 summarizes the debugging commands available during execution of the PROM monitor. These commands are generic to all platforms.

Table 4: PROM Monitor Debugging Commands

Command	Purpose	Syntax
fill	Fills the specified range of memory with the specified pattern.	`fill [`*length*`] [-v` *val*`]` *range*
g	Displays the contents of a single memory location in decimal, hexadecimal, and ASCII character formats.	`g [`*length*`]` *address*
go	Transfers control to code that is has been previously loaded.	`go [-c` *cpu_number*`] [`*entry*`] [`*cpu_number*`]`
p	Puts or sets the contents of a single memory location to a specified value.	`p [`*length*`]` *address value*
spin	Generates reference patterns for diagnostic use.	`spin [ [-c` *count*`] [-v` *value*`] -(r|w)(b|h|w)` *address* `]`

Table 5 summarizes the debugging commands that are specific to the RC6380 system.

Table 5: 6380 Multiprocessing PROM Monitor Debugging Commands

Command	Purpose	Syntax
dbcs	Displays control space registers.	`dbcs` *slot_number*
dbs	Displays current status of boards and how the PROM uses them.	`dbs`
dcr	Displays current register contacts.	`dcr` *cpu_number*
dcs	Displays logical and physical relationships between CPUs on multiprocessor computer.	`dcs`
dnvr	Displays contents of NVRAM.	`dnvr [0x|0X]` *begin_offset* `[0x|0X]` *end_offset* `dnvr [0x|0X]` *begin_offset* `l|L` *length*
dpr	Displays register status contents at the time of the last reset.	`dpr` *cpu_number*

Table 5: 6380 Multiprocessing PROM Monitor Debugging Commands

Command	Purpose	Syntax
envr	Changes contents of NVRAM.	`envr [0x|0X]`*begin_offset* `[0x|0X]` *end_offset* `envr [0x|0X]` *begin_offset* `l|L` *length*
flush	Writes contents of a CPU's cache to memory.	`flush [`*cpu_number*`]`
fprdump	Displays contents of floating point registers.	`fprdump [`*cpu_number*`]`
idprom	Displays contents of ID PROM for designated slot.	`idprom` *slot_number*
jilt	Changes value of jilt bits for CPUs and IOCs.	`jilt 0x | OX` *jilt_value*
master	Selects master CPU.	`master [`*cpu_number*`]`
scdump	Displays contents of secondary cache for selected address range.	`scdump [`*range*`]`
snoop	Enables or disables snoop bit in Control Miscellaneous register	snoop on|off
tlb	Translates virtual address to physical memory address by using the contents of the translation lookaside buffer.	`tlb [-p` *pid*`]` *address*
vtag	Attempts to derive the virtual tag for a memory location.	`vtag [-c` *cpu_number*`]` *address*

Keyboard Commands

Table 6 lists the commands that are invoked by a single key or a CTRL key combination. To generate a CTRL key combination, press the CTRL key at the same time that you press an alphabetic character key.

Table 6: PROM Monitor Keyboard Commands

Key Sequence	Description
CTRL–H or DEL	Erases the previous character.
CTRL–U	Erases the entire line.
CTRL–C	Aborts the program that is currently running and returns control to the PROM monitor.

Table 6: PROM Monitor Keyboard Commands

Key Sequence	Description
CTRL–Z	Causes the current program to execute a breakpoint instruction. This command is used in conjunction with the standalone program *dbgmon* (*dbgmon* is part of SPP, a separate package that is available from MIPS.).
CTRL–D	Causes the standalone program to exit normally.
BREAK (S)	Cycles the baud rate for tty(0) and tty(1) among baud rates 110, 300, 1200, 2400, 4800, and 9600 by entering a BREAKs. The altered baud rate is valid only until the next RESET or until a new program is loaded. To change the baud rate permanently, change either the *lbaud* or *rbaud* environment variable.

Environment Variables

The PROM monitor maintains environment variables that are passed to booted programs. These variables are similar to RISC/os shell environment variables. The value of an environment variable is changed using the PROM monitor *setenv* command.

Some of the environment variables affect the operation of the PROM monitor and are in nonvolatile memory; when the machine is reset or powered-down, the monitor retains the values of these variables. Table 7 defines and describes the PROM environment variables.

Table 7: PROM Monitor Environment Variables

Variable	Description
bootfile	Specifies the default program that boots when the *–f* option to the *boot* command is not specified. Default is *dkip (0,0,8) sash* for non-6000 systems and *dkij(0,0,8) sash* for RC6260/6280/6380 systems. *dkip* specifies an SMD drive while *dkij* specifies a SCSI drive attached to a ''Jaguar'' VME-SCSI adapter.
bootmode	Controls the PROM monitor action in response to system resets. If *bootmode* is *m*, power-on diagnostics are run after a reset, and the PROM monitor enters command mode. If *bootmode* is *c*, the PROM monitor does a complete boot. A complete boot loads the file specified by the environment variable *bootfile* and passes it the argument *–a*. Typically, *bootfile* is the standalone shell (*sash*). The sash interprets the *–a* option as a request to load the operating system as specified in the volume header of the device from which *sash* was loaded. Use this mode if you want the machine to boot automatically after a power-down, reset, or system panic. If one or more power-on diagnostic tests fail, *bootmode* changes to *e* indicating diagnostic errors. Power-on diagnostics are skipped but memory is cleared for *bootmode e*. If the *bootmode* is *w*, then the PROM monitor attempts a warm boot on reset. A warm boot transfers control to a memory image that was loaded before resetting the system. The PROM monitor looks for a properly formatted restart block to determine if the memory image is present. A cold boot is performed if one of the following occurs: the restart block is incorrectly formatted, the PROM monitor does not find a restart block, or a warm boot has already been attempted with the restart block. If *bootmode* is *d*, it preserves the contents of memory across resets. It also skips running the system diagnostics and initialization of memory on power-up before entering command mode. If the system is powered up with bootmode *d*, the monitor command *init* should be issued before booting system programs. Default is *d*.

Table 7: PROM Monitor Environment Variables

<table>
<tr><th>Variable</th><th>Description</th></tr>
<tr><td>bus_test</td><td>Default is 1. Used by prom, sash, and kernel to determine if the ISA bus should be probed for the existence of the standard MIPS color serial board. If this variable is set to 0, PON diagnostics for color frame buffer and digi are skipped (RC3x30 only).

NOTE: If bus_test is 0, the PROM ignores the existence of the color board. Thus, this variable should not be set to 0 in a color system. A console setting of l enables the mono monitor or tty1 as console instead of the color monitor.</td></tr>
<tr><td>console</td><td>Default is l. Selects which devices are enabled as consoles on system power-up and after system resets.

Value — Description
r, t — tty(0), tty(1)
l,c,g,v — tty(0) for servers. For workstations, if keyboard and graphics boards are present, select the graphic monitor as console, otherwise select tty(0) (tty(1) for Rx3x30).
m — For Rx3x30 systesm, if a keyboard card is present, select the monochrome moniotr as console, otherwise select tty(1).
0 — tty(0)
1 — tty(1)
a — Enables all console devices. Do not use this value on a Rx3x30 system with a mouse attached to tty(0).

When set to the factory default l, only tty(0) is initially enabled as a console. If console is r, both tty(0) and tty(1) are enabled as consoles. It is possible to enable and disable consoles by command after a rest. Refer to the enable(1) or disable(1) manual pages. Default is r.</td></tr>
<tr><td>cpuid</td><td>Reserved for future use. Currently, this variable must be set to 0.</td></tr>
<tr><td>flag</td><td>When nonzero, this variable suppresses the printing of the MIPS header for the PROMs and standalone programs such as sash (RS2030 and RC2030 systems only).</td></tr>
<tr><td>keyboard</td><td>Determines the type of keyboard used: MIPS (default) for the UNIX-style keyboard and AT for the AT-style keyboard (2030 and RC3x30). Default is AT for 4000 systems.</td></tr>
<tr><td>keyswtch</td><td>Determines whether the CONTROL key and the CAPS LOCK key should be interpreted as interchanged on the AT-style keyboard (RC3x30 and 4000 systems only). keyswtch can have the value 0 for not interchanged or 1 for interchanged.</td></tr>
</table>

Table 7: PROM Monitor Environment Variables

Variable	Description
language	Determines the language and font assumed for the user interface. Default is American (RC3x30 and 4000 systems only).
lbaud	Specifies the baud rate for tty(0), which is uart A on the CPU board and typically the local console. You can set the baud rate to: 75, 110, 134, 150, 300, 600, 1200, 1800, 2400, 4800, or 9600. For 4000 systems, baud rates of up to 19200 are supported. If an illegal baud rate is specified, 9600 baud is used.
magic	If this parameter is not equal to *RISCPROM*, the vendor and model parameters will be set to their default values on the next reset (not on RC2030, RS2030, M/120 or M/2000).
model	Indicates the machine model (not on RC2030).
netaddr	Specifies the internet address for the node. This is used by the bootfile service software in the standalone I/O (saio) library and *bfs* command.
ponmask	*ponmask* is a 32-bit word containing results of the power-on diagnostic tests. A 0 in a bit position indicates the test passed, and a 1 indicates the test failed. The meaning of each bit is machine specific.
rbaud	Specifies the baud rate for tty(1), which is uart B on the CPU board and typically the remote console. You can set it to: 75, 110, 134, 150, 300, 600, 1200, 1800, 2400, 4800, or 9600. For 4000 systems, baud rates of up to 19200 are supported. If you specify an illegal baud rate, 9600 baud is used.
resetepc	Indicates the program counter the machine was executing when the machine was reset.
resetra	Indicates the contents of the return address register when the machine was reset. Not on RC6260/6280/6380.
rootname	Specifies the device on which the root partition of kernel resides. The default is 0, which indicates that the default RISC/os root file system is used. For RC6260/6280/6380 systems, 0 indicates that ijc0d0s0 is used. Otherwise, it specifies the root partition (such as, ijc0d1s0 or sdc0d0s1).

Table 7: PROM Monitor Environment Variables

Variable	Description
screensize	**NOTE:** this variable is specific to 4000 systems. *screensize* is a string of 11 numeric fields separated by non-digit characters that controls the screen resolution and video timing that are programmed into the video board. The 11 fields are: **field** — **units** screen width — pixels screen height — pixels vertical refresh rate — Hz parameter format code — NA, must be 0 pixel rate — MHz horizontal front porch — pixels horizontal sync width — pixels horizontal back porch — pixels vertical front porch — scan lines vertical sync width — scan lines vertical back porch — scan lines You should not need to set the video timing fields; the PROM monitor has a table of values for the following formats/monitors: 1024x768 60 Hz 1024x768 72 Hz 1280x1024 60 Hz To select one of the table entries you only need to specify the first 3 fields. Any fields that are omitted are assumed to be zero.
scsi_id	Default is 7. Allows users to specify the CPU's *scsi_id* on the SCSI bus; valid values are 0 through 7. The *sprobe* command, along with disk and tape drivers, also makes use of the *scsi_id*. On power-up, reset, or initialization of the system, if there is a warning of duplicated *scsi_id* on the console, use the *sprobe* command to verify the SCSI configuration (RC3x30 and 4000 systems only). **Note**: Make sure that none of the SCSI devices on the SCSI bus has the same target ID as the CPU *scsi_id*.

Table 7: PROM Monitor Environment Variables

Variable	Description
scsi_reset	Default is 1. Specifies whether the SCSI bus should be reset on power-up or reset of the system. When this variable is set to 0, no reset of the SCSI bus is performed. This should be used only in configurations with more than one RC3360, RC3350, RC3260, or 4000 systems on the SCSI bus and *scsi_reset* is set to 1 on at least one of the systems. **Note**: This variable should normally be set to 1. A value of 0 could result in a hung system during shutdown.
special_6000	When bit zero is set, the I/O subsystem is not initialized by the PROM. The default value is 0x0. RC6260/6280/6380 only.
use_ bootparams	Specifies if the boot parameters should be used in determining the root and swap devices in a diskless operation (RC3360, RC3350, RC3260, RC3x30, and 4000 systems only).
vendor	Default is *MIPS*. A string that forms part of the monitor invocation message (not on M/120, RS2030, RC2030, or M/2000).
version	Indicates the version of the installed PROMs; it is used by the kernel to determine which PROMs are installed in the machine. This environment variable cannot be changed.
ramprom	Default is 1. If this variable is set to 1, the PROM monitor code is copied to the highest 256K byte of memory and executed out of RAM. This results in a higher execution speed during PROM monitor mode. For 4000 systems only.

Updating PROMs

You can update RISC/os or NT PROM software on the Magnum 4000 and Millenium 4000 systems as new software becomes available on distribution diskettes. You do not have to open the system's cabinet and physically change the PROMs. For information on how to install new PROM software using a diskette, refer to the *Release Notes* that accompany the distribution media.