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PPCBug
Firmware Package

User's Manual
Part 1 and 2

PPCBUGA1/UM5 and PPCBUGA2/UM5

February 2001 Edition



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About This Manual

The *PPCBug Firmware Package User's Manual* provides information on the PPCBug firmware, the start-up and boot routines, the debugger commands, the one-line assembler/disassembler, and the debugger system calls.

Information in this manual applies to Motorola PowerPC™-based boards that use PPCBug as its resident debugger program. The majority of Motorola's PowerPC™-based boards including most VME, CompactPCI and ATX form factors are equipped with PPCBug.

This document is bound in two parts:

Part 1 (PPCBUGA1/UM5) contains the Table of Contents, List of Figures, and List of Tables for Chapters 1 through 3, Chapters 1 through 3 and the Index.

Part 2 (PPCBUGA2/UM5) contains the Table of Contents and List of Tables for Chapters 4 and 5 and Appendices A through H, and Chapters 4 and 5, Appendixes A through H, and the Index.

The diagnostics are covered in the *PPCBug Diagnostics Manual* (PPCDIAA/UM).

Summary of Changes

This is the fifth edition of the PPCbug Firmware Package User's Manual. It supersedes the fourth edition (UM4) and incorporates the following updates.

Where Updated	Description of Change
Overall Change	Most instances of PPC1Bug or PPC1 were changed to PPCxBug or PPCx to accommodate multiple versions of Bug, which have been released.
Chapter 1	Since PPCBug resides on most PowerPC boards, specific boards are no longer listed at the beginning of this chapter. A correction was made to the starting address (from $03F80000 to $03F40000) of the example described in the section titled *Memory Requirements* on page 1-3. A second example for the size and address requirements of NVRAM was added in the sections titled *Size and Address Requirements for NVRAM* on page 1-3. New LED/Serial Startup Diagnostic codes were added to Table 1-1 on page 1-8. The section titled *Multiprocessor Support (Remote Start)* on page 1-31 was completely revised.
Chapter 3	Several new commands were added (e.g., CACHE, IBM and MMGR), and several existing command descriptions were updated (e.g., ENV, NIOT, SROM, and TA).
Appendix G	The content was completely revised from the previous version of this manual.
Appendix H	Status codes were added for the 21143 and 82559ER controllers.

Overview of Contents

Chapter 1, General Information, provides an overview of PPCBug, memory requirements, an explanation of the start-up process, a "high-level" list of what PPCBug checks, a list of the LED/Serial startup diagnostic codes, a brief explanation on how to run the Debugger and Diagnostics firmware interactively, an explanation of the auto boot

process, an explanation of the ROMboot process, an explanation of the network auto boot process, an explanation on restarting the system, a description of the types of board failures, an explanation of the MPU clock speed calculation, a description of the disk I/O support, a description of the network I/O support, and an explanation of the multiprocessor support (remote start).

Chapter 2, Using the Debugger, contains a series of explanations on the various aspects of Debugger use including such subjects as command syntax, command arguments, command options, control characters, entering and debugging programs, system call routines in user programs, preserving the operating environment, context switching, and floating point support.

Chapter 3, Debugger Commands, a list of all current commands, and a detailed explanation of each command including command input and description.

Chapter 4, One-Line Assembler/ Disassembler, describes a PPCBug tool that allows you to create, modify and debug code written in PowerPC assembly language.

Chapter 5, *System Calls*, describes the PPCBug System Call handler, which allows system calls from user programs.

Appendix A, *Related Documentation*, lists related Motorola documentation, as well as other vendor documents and specifications.

Appendix B, *System Menu*, describes each menu item within the PPCx-Bug> or PPCx-Diag> environment.

Appendix C, *PPCBug Messages*, contains a series of tables listing all PPCBug messages and their meaning.

Appendix D, *S-Record Format*, describes the purpose and use of the S-Record format.

Appendix E, *Disk and Tape Controllers*, lists and describes the types of disk and tape controllers supported by PPCBug.

Appendix F, *Disk Status Codes*, lists and describes the various disk status codes supported by PPCBug.

Appendix G, *Establishing Network Connections with PPCBug*, describes a procedure that can be used to establish a network connection using standard PPCBug commands from a PowerPC board with a compatible network connectivity device.

Appendix H, *Network Communication Status Codes*, lists and describes two main types of network communication status codes: controller independent and controller dependent.

Comments and Suggestions

Motorola welcomes and appreciates your comments on its documentation. We want to know what you think about our manuals and how we can make them better. Mail comments to:

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In all your correspondence, please list your name, position, and company. Be sure to include the title and part number of the manual and tell how you used it. Then tell us your feelings about its strengths and weaknesses and any recommendations for improvements.

Conventions Used in This Manual

The following typographical conventions are used in this document:

bold

is used for user input that you type just as it appears. Bold is also used for commands, options and arguments to commands, and names of programs, directories and files.

italic

is used for names of variables to which you assign values. Italic is also used for comments in screen displays and examples, and to introduce new terms.

`courier`

is used for system output (for example, screen displays, reports), examples, and system prompts.

<**Enter**>, <**Return**> or <**CR**>

<**CR**> represents the carriage return or Enter key.

CTRL

represents the Control key. Execute control characters by pressing the Ctrl key and the letter simultaneously, for example, **Ctrl-d**.

|

separates two or more items from which to choose (one only)

[ ]

encloses an optional item that may not occur at all, or may occur once.

{ }

encloses an optional item that may not occur at all, or may occur one or more times.

A character precedes a data or address parameter to specify the numberic format, as follows (if not specified, the format is hexadecimal):

$	dollar	a hexadecimal character.
0x	Zero-x	
%	percent	a binary number.
&	ampersand	a decimal number.

Data and address sizes are defined as follows:

A *byte* is eight bits, numbered 0 through 7, with bit 0 being the least significant.

A *half-word* is 16 bits, numbered 0 through 15, with bit 0 being the least significant.

A *word* is 32 bits, numbered 0 through 31, with bit 0 being the least significant.

The MPU on the PowerPC board is programmed to big-endian byte ordering. Any attempt to use little-endian byte ordering will immediately render the debugger unusable

General Information 1

PPCBug Overview

PPCBug is a powerful evaluation and debugging tool for systems built around the Motorola PowerPC microprocessors. PPCBug firmware consists of three parts:

- Command-driven user-interactive software debugger. It is hereafter referred to as the *debugger*, which is described in this manual. Debugging commands are available for loading and executing user programs under complete operator control for system evaluation.
- Command-driven diagnostic package for testing and troubleshooting the PowerPC board, which is hereafter called the *diagnostics*. Refer to the *PPCBug Diagnostics Manual* for information on the diagnostics and the diagnostics utilities and self-tests.
- MPU, firmware, and hardware initialization routines, which are described in this manual.

The PPCBug firmware is implemented on most Motorola PowerPC-based products:

A PMCspan board added to any main board also interfaces with PPCBug.

They are collectively referred to in this manual as the *PowerPC board* or *board*.

The debugger includes:

- Commands for display and modification of memory
- Breakpoint and tracing capabilities
- Assembler and disassembler useful for patching programs

Various PPCBug routines that handle I/O, data conversion, and string functions are available to user programs through the System Call handler.

Because PPCBug is command-driven, it performs its various operations in response to user commands entered at the keyboard.

Comparison with other Motorola Bugs

The PPCBug is similar to previous Motorola firmware packages (e.g., MVME147Bug, MVME167Bug, MVME187Bug), with differences due to microprocessor architectures. These differences are primarily reflected in the instruction mnemonics, register displays, addressing modes of the assembler/disassembler, and argument passing to the system calls.

PPCBug Implementation

PPCBug is written largely in the C programming language, providing benefits of portability and maintainability. Where necessary, the assembly language has been used in separately compiled program modules that deal with processor-specific issues. No mixed-language modules are used.

Physically, PPCBug is contained in two socketed 32-pin PLCC Flash devices that together provide 1MB (256KB words) of storage. PPCBug uses the entire memory contained in the two devices.

The executable code is checksummed at every power-on or reset firmware entry. The result is checked with a pre-calculated checksum contained in the last 16-bit word of the Flash image.



Caution Although a command to allow the erasing and reprogramming of this Flash memory is available to you, keep in mind that reprogramming any portion of Flash memory will erase everything currently contained in Flash, including PPCBug.

Memory Requirements

The debugger requires approximately 768KB of read/write memory (i.e., DRAM). The debugger allocates this memory from the top, down. For example, on a system which contains 64MB ($04000000) of read/write memory, the debugger's memory page will be located at $03F40000 to $03FFFFFF.

Size and Address Requirements for NVRAM

Currently, Motorola uses the SGS-Thompson Timekeeper SRAM device (48T559, or M48T35), or equivalent. This is used on the PowerPlus boards and is structured by the Debugger as follows:

Example 1: NVRAM = 8192 bytes total size (with rtc):

Size/Area	Offset
5880 bytes user area	0000 - 16f7
2048 bytes debugger area	16f8 - 1ef7
256 bytes configuration area	1ef8 - 1ff7
8 bytes real time clock registers	1ff8 - 1fff

Example 2: NVRAM = 32768 bytes total size

Size/Area	Offset
30456 bytes user area	0000 - 76f7
2048 bytes debugger area	76f8 - 7ef7
256 bytes configuration area	7ef8 - 7ff7
8 bytes real time clock registers	7ff8 - 7fff

Set-up

Refer to the board installation and use manual for information on installing the hardware, configuring jumpers, and assigning the console monitor.

Start-up

At either power-up or system reset, PPCBug performs the MPU, hardware, and firmware initialization process (refer to *MPU, Hardware, and Firmware Initialization on page 1-5*). This process includes a checksum of the FLASH memory contents.

The following types of messages are displayed on the firmware console during the initialization process:

```
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PPCx Debugger/Diagnostics Release Version 4.x - xx/xx/xx/RMxx
COLDStart

Local Memory Found =04000000 (&67108864)

MPU Clock Speed =167Mhz

BUS Clock Speed =67Mhz

Reset Vector Location  : ROM Bank B
Mezzanine Configuration: Single-MPU
Current 60X-Bus Master : MPU0
Idle MPU(s)            : NONE

System Memory: 64MB, ECC Enabled (ECC-Memory Detected)

L2 Cache:      NONE

PPCx-Bug>
```

At this point, PPCBug is waiting for you to enter one of the commands described in Chapter 3, of this manual.

PPCBug may alternatively be configured via the **ENV** command to run selftest and/or autoboot automatically during startup. If so, then PPCBug will instead behave as follows:

The system pauses five seconds, during which you may terminate start-up, and exit to the diagnostics prompt, by pressing ESC or the Break key.

The system performs the self test diagnostics if you do not terminate system start-up. Upon successful completion of these tests, the system pauses another five seconds. You may terminate start-up, and exit to the diagnostics prompt, by pressing ESC or the Break key.

If you do not terminate system start-up, the system begins the boot routine that has been set up in the **ENV** command, either NVRAM Boot List Boot, Auto Boot, ROMboot, or Network Auto Boot.

If the self-tests fail, various error messages appear, and the diagnostics prompt appears.

Refer to Chapter 3, for information on setting the **ENV** command parameters.

MPU, Hardware, and Firmware Initialization

The MPU, hardware, and firmware initialization process is performed by the PPCBug power-up or system reset. The steps below are a high-level outline; not all of the detailed steps are listed.

1. Set MPU.MSR to known value.
2. Invalidate the MPU's data/instruction caches.
3. Clear all segment registers of the MPU.
4. Clear all block address translation registers of the MPU.
5. For "dual CPU only" boards (MVME460*x* or MTX), catch one CPU of a dual CPU and place it in a waiting loop.
6. Initialize the MPU bus to PCI bus bridge device.
7. Initialize the PCI bus to ISA bus bridge device.
8. Calculate the external bus clock speed of the MPU.
9. Delay for 750 milliseconds.
10. Determine the CPU board type.
11. Size the local read/write memory (i.e., DRAM).
12. Initialize the read/write memory controller.
13. Set base address of memory to $00000000.
14. Retrieve the speed of read/write memory.

15. Initialize read/write memory controller with the speed of read/write memory.
16. Retrieve the speed of read only memory (Flash).
17. Initialize read only memory controller with the speed of read only memory.
18. Enable the MPU's instruction cache.
19. Copy the MPU's exception vector table from $FFF00000 to $00000000.
20. Initialize the SIO (PC87303/PC87307/PC87308) resources' base addresses for boards that have the SIO device.
21. Initialize the Z8536 device if the board has the device.
22. Verify MPU type.
23. Enable the super-scalar feature of the MPU (boards with MPC604-type chips only).
24. Initialize the Keyboard Controller (PC87303/PC87307/PC87308) for boards that have the device.
25. Determine the debugger's Console/Host ports, and initialize the appropriate UART or Graphic devices.
26. Display the debugger's copyright message.
27. Display any hardware initialization errors that may have occurred.
28. Checksum the debugger object, and display a warning message if the checksum failed to verify.
29. Display the amount of local read/write memory found.
30. Verify the configuration data that is resident in NVRAM, and display a warning message if the verification failed.
31. Calculate and display the MPU clock speed. Verify that the MPU clock speed matches the configuration data, and display a warning message if the verification fails.

32. Display the BUS clock speed. Verify that the BUS clock speed matches the configuration data, and display a warning message if the verification fails.
33. For boards that have a Keyboard Controller display initialization errors that have occurred.
34. Probe PCI bus for supported Network devices.
35. Probe PCI bus for supported Mass Storage devices.
36. Initialize the memory/IO addresses for the supported PCI bus devices.
37. Execute self-test, if configured.
38. Extinguish the board fail LED, if there are no self-test failures or initialization/configuration errors.
39. Execute the configured boot routine, either ROMboot, Autoboot, or Network Autoboot. (PowerPlus architecture boards do not execute a configured boot routine.)
40. Execute the user interface (i.e., the `PPCx-Bug>` or `PPCx-Diag>` prompt).

LED/Serial Startup Diagnostic Codes

These codes are displayed on seven-segment LEDs at key points in the initialization of the hardware devices. Should the debugger fail to come up to a prompt, the last code displayed will indicate how far the initialization sequence had progressed before stalling. The serial port version of the startup codes is enabled by an **ENV** parameter:

Serial Startup Code Master Enable [Y/N]=N?

Under normal conditions, the startup sequence begins at 0x1100 and continues to the `PPC1-Bug>` prompt just after 0x11D4. RAM initialization problems may cause the startup sequence to terminate at the: (RawBug) prompt just after 0x11D8 instead.

The operating system boot sequence begins at 0x11E0 with the creation of residual data and continues to 0x11EC just before execution is passed to the boot image. The OS may have its own LED codes which are displayed after 0x11EC.

A line feed can be inserted after each serial code is displayed to prevent it from being overwritten by the next code. This is also enabled by an **ENV** parameter:

Serial Startup Code LF Enable [Y/N]=N?

The following firmware codes are always sent to 7-segment LEDs located at ISA I/O address 0x8C0. These codes can also be sent to the debugger serial port if the ENV parameter “Serial Startup Code Master Enable” is set to ‘Y’. The list of LED/serial codes follows.

Table 1-1. LED/Serial Startup Diagnostic Codes

Code (Hex)	Location in Startup
1100	Setting up MSR (startup begins)
1102	Invalidating caches
1104	Determining ROM or RAM execution mode
1106	Setting up machine state register
1108	Setting up CPU’s address translation registers
110A	Setting up CPU’s address translation table
110C	Shutting down redundant processors
110D	Init I/O path out to serial port
110E	Initializing super I/O chip (CPU initialization completed)
110F	Enable ISA bus access
1110	Initializing raw I/O device
1111	Initialize early stack memory
1112	Getting PHB (PCI Host Bridge) Table Pointer
1113	Disable all caches
1114	Initializing PCI bridge
1116	Initializing the powerup flag indicator
1118	Calculating the speed of the processor bus

Table 1-1. LED/Serial Startup Diagnostic Codes (Continued)

Code (Hex)	Location in Startup
111A	Waiting for hardware to initialize memory
111C	Setting up the DRAM init parameters
111E	Initializing DRAM in bridge/memory controller
1120	Setting up debugger memory page area
1122	Calculating and setting DRAM speed
1124	Calculating and setting ROM speed
1126	Enabling instruction cache
1128	Setting up debugger memory page tables
112A	Setting up debugger kernel pointers and saving registers
112B	Setup the exception control description
112C	Setting up buginit section pointers and runtime variables
1130	Retrieving the processor board type
1132	Initializing the Z8536
1134	Initializing local board status
1136	Retrieving the base board type
1138	Checking the level of the ABORT push-button
113A	Initializing the interrupt/timer controller
113C	Retrieving MPU identifier
113E	Enabling super-scalar modes
1140	Adding processor-specific work-arounds
1142	Getting the bus clock speed
1144	Initializing the keyboard controller
1145	Probe for PCI functions
1146	Initializing the PCI interrupt route control registers
1148	Starting PCI hierarchy configuration process
12nn	Probing PCI config space (nn = bbbddddd; bbb = bus#, ddddd = dev#
1149	Allocating PCI I/O & memory space and initializing PCI devices.

Table 1-1. LED/Serial Startup Diagnostic Codes (Continued)

Code (Hex)	Location in Startup
114A	Initializing RAVEN PCI space
114C	Initializing RAVEN time base registers
114D	Initialize RAVEN interrupt controller
114E	Initializing FALCON ROM
1150	Initializing VME bridge
1152	Initializing ISA bridge
1154	Sending speaker beep
1160	Checking abort switch state
1162	Initializing exception handling
1164	Initializing board identifier structure
1166	Initializing point break table
1168	Initializing macro subsystem
116A	Initializing configuration data area
116C	Initializing board information data area
116E	Initializing I/O (character) subsystem
1170	Initializing register file
1172	Getting bridge pointer
1174	Setting up local memory pointers
1176	Setting up local memory size variables
1178	Displaying sign-on messages
117A	displaying board initialization errors
117C	Verifying the ROM checksum
117E	Displaying memory size and misc errors
1180	Displaying MPU clock speed
1182	Verifying MPU clock speed
1184	Displaying bus clock speed
1186	Initializing network I/O subsystem

Table 1-1. LED/Serial Startup Diagnostic Codes (Continued)

Code (Hex)	Location in Startup
1188	Initializing disk I/O subsystem
118A	Initializing direction flags
118C	Initializing NVRAM (PReP) environment
118E	Initializing residual data pointer
1190	Initializing input/output pointers
1192	Initializing diagnostic subsystem
1194	Setting up special init section pointers and runtime variables
1196	Initializing abort switch
1198	Setting up board suffix and return environment
11A0	Retrieving the processor board type
11A2	Displaying memory warning and MPU configuration
11A4	Clearing MPU idle semaphores
11A6	Waiting for MPU logins
11A8	Displaying MPU status information
11AA	Setting up DRAM and bridge pointers
11AC	Initializing DRAM ECC/parity
11AE	Displaying DRAM information
11B0	Setting up misc. L2 cache variables
11B2	Setting up L2 cache size variables
11B4	Initializing and flushing L2 cache data parity
11B6	Displaying L2 cache parity state
11B8	Reading NVRAM contents
11BA	Verifying NVRAM header
11BC	Initializing NVRAM contents
11BE	Retrieving global environment variable pointers
11D0	Initializing processor timebase/decrementer registers
11D2	Enabling interrupts

Table 1-1. LED/Serial Startup Diagnostic Codes (Continued)

Code (Hex)	Location in Startup
11D4	Transferring control to monitor (initialization complete)
11D8	Error - dropping to RawBug
11E0	Initializing residual data structure
11E2	Adding vital product data
11E4	Adding processor information
11E6	Adding memory information
11E8	Adding PCI device information
11EA	Adding ISA device information
11EC	Residual data completed
12nn	Probing PCI config space (board specific)

Running the Diagnostics and Debugger

In order to use the diagnostics, terminate the start-up process by pressing ESC or the Break key during one of the four pauses (PowerPlus architecture boards in their default configuration may *not* pause at any of the four places.) The diagnostics prompt (`PPCx-Diag>`) appears. You may switch to the debugger prompt (`PPCx-Bug>`) by using the **SD** command.

Both the debugger and diagnostic commands are available from the diagnostic prompt. Only the debugger commands are available from the debugger prompt.

You may view a list of the diagnostics or debugger commands by using the **HE** (Help) command.

Note Some diagnostics depend on restart defaults that are set up only in a particular restart mode. Refer to the *PPCBug Diagnostics Manual, PPCDIAA/UM,* for the correct mode.

Refer to the *PPCBug Diagnostics Manual* for complete descriptions of the diagnostic routines available and instructions on how to invoke them.

Auto Boot

Note The PowerPlus architecture boards do *not* execute a configured boot routine.

Auto Boot is the default boot routine. It provides an independent mechanism for booting an operating system. No console is required. Autoboot selects the boot device from either a scan list of device types, a floppy diskette, a CD-ROM, tape, or a hard disk.

You may change the scan order, or configure Auto Boot to boot from a specific Controller Logical Unit Number (CLUN) and Device Logical Unit Number (DLUN) by changing the **ENV** command parameters for enabling Auto Boot (refer to Chapter 3, for information).

At power-up, Auto Boot is enabled. The following message is displayed on the system console:

```
Autoboot in progress... To abort hit <BREAK>
```

Following this message there is a delay to allow you to abort the Auto Boot process and gain control. Press either the BREAK key or the software abort or reset switch to abort Autoboot.

If you do not abort Auto Boot, the actual I/O is begun. The program pointed to within the boot-record of the media specified is loaded into RAM, and control is passed to it.

Upon power-up or system reset, PPCBug examines the validity of the configuration parameters in NVRAM. If there is a configuration error (e.g., corrupted data or checksum error), the PPCBug will initialize the configuration parameters using default values, and run AutoBoot. Following the auto-initialization of the configuration parameters, the PPCBug will reset the system to allow a start-up with the now default configuration parameters.

ROMboot

Note The PowerPlus architecture boards do *not* execute a configured boot routine.

ROMboot is a mechanism for booting an operating system from a user-defined routine stored in ROM. ROMboot executes at power-up (or optionally at reset) if it is configured and enabled in parameters set with the **ENV** command. It may also be executed with the **RB** (ROMboot) command.

Refer to Chapter 3, for information on setting the **ENV** command parameters for enabling ROMboot.

For ROMboot to work, a ROMboot routine must be stored in the FLASH memory to support it. If ROMboot code is installed, a user-written routine is given control (if the routine meets the format requirements). One use of ROMboot might be resetting SYSFAIL* on an unintelligent controller board.

The **NORB** command disables ROMboot.

For a user's ROMboot routine to gain control through the ROMboot linkage, four requirements must be met:

- Power must have just been applied (or at reset, if configured to do so with the **ENV** command).
- Your ROMboot routine must be stored within the PowerPC board FLASH memory map (or elsewhere in onboard memory, if configured to do so with the **ENV** command).
- The ASCII string "BOOT" must be located within the specified memory range.
- Your ROMboot routine must pass a checksum test, which ensures that this routine was really intended to receive control at power-up.

When the module is ready, it can be loaded into RAM. Use the **CS** command to generate, install, and verify the checksum.

The format of the beginning of the routine is:

Offset	Length	Contents	Description
$00	4 bytes	BOOT	ASCII string indicating possible routine; the checksum must be valid
$04	4 bytes	Entry Address	Word offset from “BOOT”
$08	4 bytes	Routine Length	Word; includes length from “BOOT” to and including a two-byte checksum
$0C	Length of name	Routine name	ASCII string containing routine name

If you want to make use of ROMboot, you do not have to fill a complete FLASH device. Any partial amount is acceptable, as long as:

- The identifier string “BOOT” starts on a word (FLASH and Direct spaces) or 8KB (local RAM and VMEbus spaces) boundary.
- The ROMboot routine size (in bytes) is evenly divisible by 2.
- The length parameter (offset $8) reflects where the checksum is, and the checksum is correct.

ROMboot searches predefined areas of the memory map for possible routines and checks for the “BOOT” indicator. Two events are of interest for any location being tested:

- The map is searched for the ASCII string “BOOT”.
- If the ASCII string “BOOT” is found, it is still undetermined whether the routine is meant to gain control at power-up or reset. To verify that this is the case, the bytes starting from “BOOT” through the end of the routine, excluding the two byte checksum, are run through the debugger checksum algorithm. If the result of the checksum is equal to the final two bytes of the ROMboot routine (the checksum), it is established that the routine was meant to be used for ROMboot.

Under control of the **ENV** command, the sequence of searches is as follows:

1. Search direct address for “BOOT”. The direct address points to an installed ROMboot routine. It is a variable that may be set using the **ENV** command.
2. Search complete ROM map.
3. Search local RAM, at all 8KB boundaries starting at the beginning of local RAM.
4. Search the VMEbus map (if so selected by the **ENV** command) on all 8KB boundaries starting at the end of the onboard RAM. VMEbus address space is searched both below (if the start address of local RAM is not located at 0) and above local RAM up to the beginning of FLASH Space.

Sample ROMboot Routine

The example ROMboot routine performs the following:

- Outputs a **<CR> <LF>** sequence to the default output port.
- Displays the date and time from the current cursor position.
- Outputs two more **<CR> <LF>** sequences to the default output port.
- Returns control to PPCBug.

Do the following to prepare the ROMboot routine (includes checksum calculation):

1. Assemble and link the code, leaving $00 in the even and odd locations destined to contain the checksum.
2. Load the routine into RAM (with S-records via the **LO** command, or from magnetic media using **IOP**).
3. Display entire ROMboot routine (checksum bytes are at $00010038 and $00010039).

```
PPC1-Bug>MD 10000 :10 <Return>
00010000  424F4F54 00000010 0000003A 54455354  BOOT.......:TEST
00010010  39400026 44000002 39400052 44000002  9@.&D...9@.RD...
00010020  39400026 44000002 39400026 44000002  9@.&D...9@.&D...
00010030  39400063 44000002 0000FFFF FFFFFFFF  9@.cD...........
```

4. Disassemble executable instructions.

```
PPC1-Bug>MD 10010:5;DI <Return>
00010010 39400026  SYSCALL     .PCRLF
00010018 39400052  SYSCALL     .RTC_DSP
00010020 39400026  SYSCALL     .PCRLF
00010028 39400026  SYSCALL     .PCRLF
00010028 39400063  SYSCALL     .RETURN
```

5. Perform checksum on locations $10000 through $10037 (refer to the **CS** command information in Chapter 3,).

```
PPC1-Bug>CS 10000:38/2;H <Return>
Effective address: 00010000
Effective count  : &56
Checksum: ACFA
```

6. Insert checksum into bytes $10038, $10039.

```
PPC1-Bug>M 10038;H <Return>
00010038 0000? ACFA. <Return>
```

7. Display the entire ROMboot routine with checksums.

```
PPC1-Bug>MD 10000 :10 <Return>
00010000  424F4F54 00000010 0000003A 54455354  BOOT.......:TEST
00010010  39400026 44000002 39400026 44000002  9@.&D...9@.RD...
00010020  39400026 44000002 39400026 44000002  9@.&D...9@.&D...
00010030  39400063 44000002 ACFAFFFF FFFFFFFF  9@.cD...........
```

8. Verify the functionality of the user ROMboot routine with the **RB** command.

```
PPC1-Bug>RB; V <Return>
ROMboot about to Begin... Press <ESC> to Bypass, <SPC> to Continue
Direct Add: FFC00000 FFFFFFFC: Searching for ROMboot Module at: 00010000
Executing ROMboot Module “TEST” at 00010000

MON MAR 27 10:39:08.00 1995

PPC1-Bug>
```

The sample ROMboot routine is now ready for use.

Network Auto Boot

Network Auto Boot (or Network Boot) is a software routine that provides a mechanism for booting an operating system using an Ethernet network as the boot device.

Network Auto Boot executes at power-up (or optionally at reset) if it is configured and enabled in parameters set with the **ENV** command.

This routine selects the boot device based on the Controller Logical Unit Number (CLUN) and Device Logical Unit Number (DLUN) which have been set in the **ENV** command.

Refer to Chapter 3, for information on setting the **ENV** command parameters for enabling Network Auto Boot.

If Network Boot is enabled, the following message is displayed on the system console at power-up:

```
Network Boot in progress... To abort hit <BREAK>
```

Following this message there is approximately a five-second delay before the actual I/O is begun. The program pointed to within the volume ID of the media specified is loaded into RAM and control is passed to it.

During the delay, you can gain control without Network Autoboot by pressing either the BREAK key or the software abort or reset switches.

Network Autoboot is controlled by parameters contained in the **NIOT** and **ENV** commands. These parameters allow the selection of specific boot devices, systems, and files and allow programming of the boot delay. Refer to the **NIOT** and **ENV** commands in Chapter 3, for more details.

Restarting the System

You can initialize the system to a known state in three different ways: reset, abort, and break. Each has characteristics which make it more appropriate than the others in certain situations.

Reset

Pressing and releasing the board front panel RESET switch initiates a system reset. Cold and warm reset modes are available. By default, PPCBug is in cold mode (refer to the **RESET** command description in Chapter 3). During cold reset, a total system initialization takes place, as if the PowerPC board had just been powered up. All static variables are restored to their default states. The breakpoint table and offset registers are cleared. The target registers are invalidated. Input and output character queues are cleared. Onboard devices are reset, and the first two serial ports are reconfigured to their default state.

During warm reset, the PPCBug variables and tables are preserved, as well as the target state registers and breakpoints.

Reset must be used if the processor ever halts, or if the PPCBug environment is ever lost, such as if the vector table is destroyed, or the stack is corrupted.

Abort

Abort is invoked by pressing and releasing the ABORT switch. Whenever abort is invoked while executing a user program (running target code), a snapshot of the processor state is captured and stored in the target registers. (When working in the debugger, abort captures and stores only the Instruction Pointer, status register, and format and vector information.) For

this reason, abort is most appropriate when terminating a user program that is being debugged. Abort should be used to regain control if the program gets caught in a loop. The target IP and register contents help to pinpoint the malfunction.

Pressing and releasing the ABORT switch generates a local board condition which interrupts the microprocessor. The target registers, reflecting the machine state at the time the abort switch was pressed, are displayed on the screen. Any breakpoints installed in the user code are removed, and the breakpoint table remains intact. Control is returned to the debugger.

Reset/Abort

You may wish to perform "double-button reset" by pressing the RESET and ABORT switches at the same time. Release RESET first, wait seven seconds, and then release ABORT. This resets all onboard devices, as well as sending a SYSRESET* signal if the board is the VMEbus system controller. It also ignores the parameters stored in NVRAM, and starts debugger execution with the same **ENV** parameters as if you had used the command **ENV;D**.

Break

A break is generated by pressing and releasing the **BREAK** key on the current-console keyboard. Break does not generate an interrupt. The only time break is recognized is when characters are sent or received by the console port. Break removes any breakpoints in the user code and keeps the breakpoint table intact. Break also takes a snapshot of the machine state if the function was entered using SYSCALL. This machine state is then accessible to you for diagnostic purposes.

Many times it may be desirable to terminate a debugger command prior to its completion; for example, the display of a large block of memory. Break allows you to terminate the command.

Board Failure

The following conditions result in a board failure. These conditions also give a WARNING message, if possible:

- Board initialization error/failure
- Debugger object checksum error
- Configuration data (NVRAM **ENV** parameters) failure (i.e., checksum)
- Configuration data (NVRAM **CNFG** parameters) failure (i.e., checksum)
- Calculated MPU clock speed does not match the associative **CNFG** parameter
- Calculated BUS clock speed does not match the associative **CNFG** parameter
- Selftest error/failure

If the board is equipped with a board fail LED, the LED will be illuminated when a board failure occurs.

SYSFAIL* Assertion and Negation (VMEbus Boards)

On VMEbus boards, the board fail is the same as the SYSFAIL indicator. At reset or power-up, the debugger asserts the VMEbus SYSFAIL* line (refer to the VMEbus specification).

The SYSFAIL* line is negated if debugger initialization is done and if none of the board failure conditions have occurred. However, SYSFAIL* stays asserted if any of the board failure conditions have occurred. In this way, the state of the debugger is indicated to the user or VMEbus masters. In a multi-computer configuration, other VMEbus masters could view the pertinent control and status registers to determine which CPU is asserting SYSFAIL* in the event of a board failure.

SYSFAIL* assertion and negation is also affected by the **ENV** command (refer to the **ENV** command in Chapter 3, for more information).

Notes *Assert* indicates a signal is active or true. *Negate* indicates a signal is inactive or false. These terms are used independently of the voltage levels (high or low) that they represent.

The asterisk (*) in the signal name SYSFAIL* denotes that the signal is true or valid when the it is low (SYSFAIL* is level sensitive).

MPU Clock Speed Calculation

The MPU clock speed is calculated and checked against the MPU clock speed parameter located in NVRAM, which you may set in the **CNFG** command. If the check fails, a warning message is displayed. The calculated clock speed is also checked against known clock speeds and tolerances.

Refer to Chapter 3, for information on setting the **CNFG** command parameters.

Disk I/O Support

The debugger can initiate disk input and output by communicating with intelligent disk controllers over the PCI bus. Disk support facilities built into the debugger consist of command-level disk operations, disk I/O system calls (only via one of the system call instructions) for use by user programs, and defined data structures for disk parameters (refer to Chapter 5, *System Calls* for information on system calls).

Parameters such as the address where the module is mapped and the type and number of devices attached to the controller module are kept in tables by PPCBug. Default values for these parameters are assigned at power-up and cold-start reset, but may be altered as described in *Default PPCBug Controller and Device Parameters* on page 1-27.

You can obtain a list of supported controllers with the **IOI** command. Appendix E contains a list of the controllers presently supported, as well as a list of the default configurations for each controller.

Blocks and Sectors

The logical block defines the unit of information for disk devices. A disk is viewed by PPCBug as a storage area divided into logical blocks. By default, the logical block size is set to 256 bytes for every block device in the system. The block size can be changed on a per device basis with the **IOT** command.

The sector defines the unit of information for the media itself, as viewed by the controller. The sector size varies for different controllers, and the value for a specific device can be displayed and changed with the **IOT** command.

When a disk transfer is requested, the start and size of the transfer is specified in blocks. PPCBug translates this into an equivalent sector specification, which is then passed on to the controller to initiate the transfer. If the conversion from blocks to sectors yields a fractional sector count, an error is returned and no data is transferred.

Device Probe

A device probe with entry into the device descriptor table is done whenever a specified device is accessed. This happens when system calls .DSKRD, .DSKWR, .DSKCFIG, .DSKFMT, and .DSKCTRL, and commands **IOC**, **IOP**, **IOT**, **MAR**, **MAW**, and **PBOOT** are used.

The device probe mechanism utilizes the SCSI commands **Inquiry** and **Mode Sense**. If the specified controller is non-SCSI, the probe simply returns a status of **device present and unknown.** The device probe makes an entry into the device descriptor table with the pertinent data. After an entry has been made, the next time a probe is done it simply returns with `device present` status (pointer to the device descriptor).

Disk I/O via Debugger Commands

The following debugger commands are provided for disk I/O. Refer to Chapter 3, for instructions for their use. When a command is issued to a particular controller LUN and device LUN, these LUNs are remembered in the debugger so that the next disk command uses the same controller and device.

IOI (Input/Output Inquiry)

The **IOI** command is used to probe the system for all possible CLUN/DLUN combinations and display inquiry data for devices which support it. The device descriptor table only has space for 16 device descriptors. With the **IOI** command, you can view the table and clear it if necessary.

IOP (Physical I/O to Disk)



Caution

If you start the **IOP** format procedure, it must be allowed to complete (PPCxBug> prompt returns) or else the disk drive may be totally disabled. This format procedure may take as long as half an hour.

The **IOP** command allows you to read or write blocks of data, or to format the specified device in a certain way. **IOP** creates a command packet from the arguments you specify, and then invokes the proper system call function to carry out the operation.

IOT (I/O Configure)

The **IOT** command allows you to change any configurable parameters and attributes of the device. In addition, it allows you to see the controllers available in the system.

IOC (I/O Control)

The **IOC** command allows you to send command packets as defined by the particular controller directly. **IOC** can also be used to look at the resultant device packet after using the **IOP** command.

PBOOT (Bootstrap Operating System)

The **PBOOT** command reads an operating system or control program from the specified device into memory, and then transfers control to it.

With the **H** option, **PBOOT** reads an operating system or control program from a specified device into memory, and then returns control to the debugger.

Disk I/O via Debugger System Calls

All operations that actually access the disk are done directly or indirectly by debugger system calls. (The command-level disk operations provide a convenient way of using these system calls without writing and executing a program.)

The following system calls are provided to allow user programs to do disk I/O:

.DSKRD	Disk read - system call to read blocks from a disk into memory
.DSKWR	Disk write - system call to write blocks from memory onto a disk
.DSKCFIG	Disk configure - system call to change the configuration of the specified device
.DSKFMT	Disk format - system call to send a format command to the specified device
.DSKCTRL	Disk control - system call to implement any special device control functions that cannot be accommodated easily with any of the other disk functions

Refer to Chapter 5, *System Calls* for information on using these and other system calls.

To perform a disk operation, the debugger must present a particular disk controller module with a controller command packet which has been prepared for the particular type of controller module. (This is accomplished in the respective controller driver module.) Typically, the command packets are different for each of the controller modules. The system call facilities which do disk I/O accept a generalized (controller-independent) packet format as an argument, and translate it into a controller-specific packet, which is then sent to the specified device. Refer to the system call descriptions in Chapter 5, *System Calls* for details on the format and construction of these standardized user packets.

The packets which a controller module expects to receive vary from controller to controller. The disk driver module for the particular board module must take the standardized packet given to a trap function and create a new packet which is specifically tailored for the disk drive

controller it is sent to. Refer to documentation on the particular controller module for the format of its packets. Refer to the **IOC** command section in Chapter 3, *Debugger Commands* for information on sending command packets.

Default PPCBug Controller and Device Parameters

PPCBug initializes the parameter tables for a default configuration of controllers (refer to Appendix E, *Disk and Tape Controllers*). If the system needs to be configured differently than this default configuration (for example, to use a different drive), then these tables must be changed.

Use the **IOT** command to reconfigure the parameter table manually for any controller and/or device that is different from the default. This is a temporary change and is overwritten if a cold-start reset occurs.

Disk I/O Error Codes

PPCBug returns an error code if an attempted disk operation is unsuccessful. Refer to Appendix F, *Disk Status Codes* for an explanation of disk I/O error codes.

Network I/O Support

The network autoboot firmware provides the capability to boot the CPU through the ROM debugger using a network (local Ethernet interface) as the boot device.

The booting process is executed in two distinct phases.

- The first phase allows the diskless remote node to discover its network identify and the name of the file to be booted.
- The second phase has the diskless remote node reading the boot file across the network into its memory.

Figure 1-1 on page 1-29 depicts the various modules (capabilities) and the dependencies of these modules that support the overall network boot function. They are described in the following paragraphs.

Physical Layer Manager Ethernet Driver

This driver surrounds and manages the Ethernet controller chip or module. Management includes the reception of packets, the transmission of packets, flushing of the receive buffer, and interface initialization.

This module ensures that the packaging and unpackaging of Ethernet packets is done correctly in the Boot PROM.

UDP and IP Modules

The Internet Protocol (IP) is designed for use in interconnected systems of packet-switched computer communication networks. The Internet Protocol provides for transmitting blocks of data called datagrams (hence User Datagram Protocol, or UDP) from sources to destinations, where sources and destinations are hosts identified by fixed length addresses.

The UDP and IP protocols are necessary for the TFTP and BOOTP protocols; TFTP and BOOTP require a UDP/IP connection.

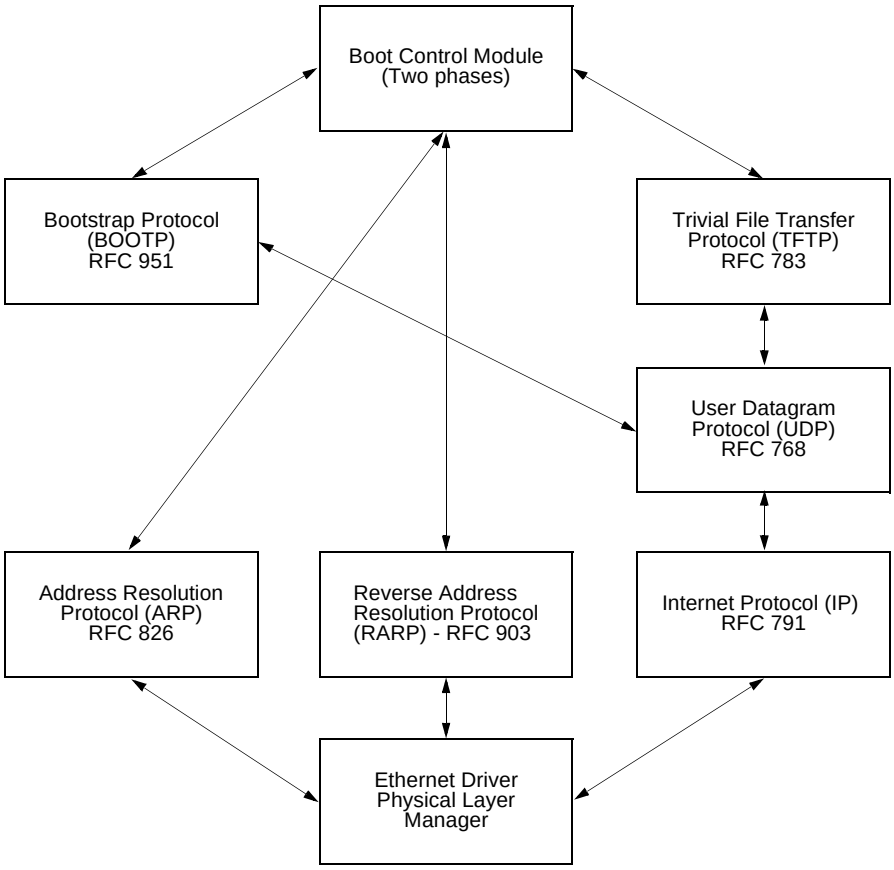


Figure 1-1. Network Boot Modules

RARP and ARP Modules

The Reverse Address Resolution Protocol (RARP) basically consists of an identity-less node that broadcasts a “whoami” packet onto the Ethernet and waits for an answer. The RARP server fills an Ethernet reply packet up with the target's Internet Address and sends it.

The Address Resolution Protocol (ARP) basically provides a method of converting protocol addresses (e.g., IP addresses) to local area network addresses (e.g., Ethernet addresses). The RARP protocol module supports systems which do not support the BOOTP protocol (refer to *BOOTP Module* below).

BOOTP Module

The Bootstrap Protocol (BOOTP) basically allows a diskless client machine to discover its own IP address, the address of a server host, and the name of a file to be loaded into memory and executed.

TFTP Module

The Trivial File Transfer Protocol (TFTP) is a simple protocol to transfer files. It is implemented on top of the Internet User Datagram Protocol (UDP or Datagram) so it may be used to move files between machines on different networks implementing UDP. The only thing it can do is read and write files from/to a remote server.

Network Boot Control Module

The control capability of the Network Boot Control Module is needed to tie together all the necessary modules (capabilities) and to sequence the booting process. The booting sequence consists of two phases. The first is address determination and bootfile selection, and the second is file transfer. The first phase utilizes the RARP/BOOTP capability and the second phase utilizes the TFTP capability.

Network I/O Error Codes

PPCBug returns an error code if an attempted network operation is unsuccessful. Refer to Appendix H, *Network Communication Status Codes* for an explanation of network I/O error codes.

Multiprocessor Support (Remote Start)

PPCBug can be configured to monitor a dual-ported resource and, upon receipt of a certain ‘signal’, pass program control to (that is, commence execution at) a user specified address.

Note PCI Remote Start is only supported on boards equipped with the DEC2155x PCI-to-PCI Bridge device.

A dual-ported resource is a hardware feature that makes local memory locations or registers available to remote processors as well as to the local processor.

This ‘remote start’ capability is provided to allow the user to take advantage of boards with dual-ported resources to implement and “bootstrap” a multiprocessor system where member processor boards can be tightly coupled via an interface such as the VME bus.

The PPCBug remote start package offers remote access to certain other PPCBug features in addition to the initiation of remote program execution.

PPCBug remote start can be utilized by either the MPCR or GCSR methods, which are described in the next subsections. Either or both methods can be enabled or disabled in the non-volatile PPCBug configuration by the **ENV** command. The name of this **ENV** parameter is "Remote Start Method Switch". The valid choices for this parameter are:

ENV Parameter Value	Remote Start Method Setting
G	GCSR method only
M	MPCR method only
B	both GCSR and MPCR methods active
N	none - remote start is disabled

Multiprocessor Control Register (MPCR) Method

The MPCR method of remote start is based on the use of dual-ported local memory resources.

A remote processor board (the host) can initiate PPCBug functions on the target processor board by issuing commands through the remote start memory interface. The target processor board is the one executing PPCBug, out of its local (on-board) resources.

The remote start memory interface is implemented using two contiguous words of local memory, defined as the Multiprocessor Control Register (MPCR), and Multiprocessor Address Register (MPAR).

The local address of MPCR is fixed, within PPCBug's reserved memory area which is located in the topmost portion of local RAM. This address can be calculated as <the local RAM size (in bytes)>-$1C000.

> **Note:** Care should be taken **not** to write to memory locations adjacent to the MPCR and MPAR as this could cause corruption of PPCBug internal variables and vector tables, resulting in possible PPCBug malfunction.

The host's access address of the MPCR is affected by memory mapping which is configured by the user and must be calculated accordingly.

The MPCR consists of two words used to control communication between processors. It is organized as follows:

Table 1-2. MPCR Method Remote Start Register Model

Register Name	Byte Offset	31 30 29 28 27 26 25 24	23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
MPCR	0	Command /Status	Reserved
MPAR	4	Address	

The status codes stored in the MPCR command/status byte are of two types:

- Status returned from PPCBug (the target processor)
- Status set (by the host processor)

The MPCR status codes that may be written to this location by PPCBug (the target processor) are:

ASCII Value	Hex Value	Indicated Status
0	($00)	Wait. PPCBug initialization is not yet complete.
'E'	($45)	The program pointed to by the MPAR address is executing.
'R'	($52)	Ready. The target board (PPCBug) is ready for a remote start command to be written to this register.

The MPCR command codes that may be set by the host processor are:

ASCII Value	Hex Value	Host Command Description
'G'	($47)	Commence program execution using Go Direct logic (refer to the **GD** command). The address of execution is specified in the MPAR address register.
'B'	($42)	Install breakpoints using the GO logic (refer to the **GO** command).
'P'	($50)	Program flash memory. The MPAR location contains the address of the flash memory programing control packet. **Note:** You can only program FLASH memory by the MPCR method. See the.PFLASH system call for a description of the FLASH memory program control packet structure.

The MPAR register contents specify an address parameter to be associated with the remote command.

At power-up, the PPCBug self-test routines initialize RAM, including the memory locations used for multi-processor support (MPCR and MPAR).

The MPCR contains $00 at power-up, indicating that initialization is not yet complete. As the initialization proceeds, the execution path comes to the "prompt" routine. Before sending the prompt, this routine places an **R** in the MPCR to indicate that initialization is complete. Then the prompt is sent.

If no terminal is connected to the port, the MPCR is still polled to see whether an external processor requires control to be passed to the dual-port RAM. If a terminal does respond, the MPCR is polled for the same purpose while the serial port is being polled for user input.

An ASCII **G** placed in the MPCR by a remote processor requests a Go Direct type of transfer; an ASCII B indicates that breakpoints are to be armed before control is transferred (like the **GO** command).

In either sequence, an **E** is placed in the MPCR to indicate that execution is underway just before control is passed to RAM. (Any remote processor could examine the MPCR contents.)

If the code being executed in dual-port RAM is to re-enter PPCBug, a system call using function $0063 (SYSCALL .RETURN) returns control to PPCBug with a new display prompt. Note that every time PPCBug returns to the prompt, an **R** is moved into the MPCR to indicate that control can be transferred once again to a specified RAM location.

GCSR Method

PPCBug supports the GCSR method of remote start, over the VMEbus, on boards equipped with the Universe PCI to VMEbus bridge.

When PPCBug is executing on the target processor board, a host processor board may initiate program execution by the target board's MPU using the GCSR method of remote start.

This method of remote start is implemented through the dual-ported register interface provided by the Universe MBOX registers. This interface is located at offset of $348 from the base address of the Universe CSR. The GCSR register model and its offset within the Universe CSR is the same regardless of which bus (VME or PCI) it is accessed from.

The GCSR method remote start register model is organized as shown in the following table:

Table 1-3. GCSR Method Remote Start Register Model

Universe Register Name	Byte Offset	31 30 29 28 27 26 25 24	23 22 21 20 19 18 17 16	15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
MBOX0	$348	LM/SIG Register	Reserved	GCSR0
MBOX1	$34C	GCSR1		GCSR2
MBOX2	$350	GCSR3		GCSR4
MBOX3	$354	GCSR5		Not Used

The LM/SIG register is assigned the following bit definitions:

Table 1-4. LM/SIG Register Bit Assignments

Bit	31	30	29	28	27	26	25	24
Name	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	SIG0

The VME host board can initiate program execution by the target board's MPU by issuing a remote GO command using the GCSR registers. The result is equivalent to the MPCR method (using command code B) described in a previous section.

The target board **GO** command is invoked by the VME host with the following sequence:

- The remote processor places the execution address for the target board MPU in general purpose registers 0 and 1 (GPCSR0=MS 16 bits, GPCSR1=LS 16 bits)
- The remote processor sets bit SIG0 of the LM/SIG register.
- The PPCBug firmware which is executing on the host board will clear SIG0, install breakpoints, and begin execution at the specified address.

Note: The above steps assume that the Universe CSR has been mapped to the VME address space so the host may access the Universe mailbox registers. The recommended method of mapping the Universe CSR is to configure the desired address and attributes with PPCBug's **ENV** command. The **ENV** command parameter identifiers for this are "VMEbus Register Access Image Control Register" and "VMEbus Register Access Image Base Address Register". For specific programming values, refer to the UniverseII User Manual, available from Tundra Semiconductor Corporation.

Data and Address Sizes

Data and address sizes are defined as follows:

A *byte* is eight bits, numbered 0 through 7, with bit 0 being the least significant.

A *half-word* is 16 bits, numbered 0 through 15, with bit 0 being the least significant.

A *word* is 32 bits, numbered 0 through 31, with bit 0 being the least significant.

Byte Ordering

The MPU on the PowerPC board is programmed to big-endian byte ordering. Any attempt to use little-endian byte ordering will immediately render the debugger unusable.

Using the Debugger 2

Entering Commands

The debugger is command-driven and performs its various operations in response to commands that you enter at the keyboard. When the PPCx-Bug> prompt appears on the screen, the debugger is ready to accept commands.

What you enter is stored in an internal buffer. Execution begins only after you press the Return key, allowing you to correct entry errors, if necessary, using the control characters (refer to *Control Characters* on page 2-6). After the debugger executes the command, the prompt reappears.

However, if the command causes execution of target code (for example **GO**) then control may or may not return to the debugger, depending on what the program does. For example, if a breakpoint has been specified, then control returns to the debugger when the breakpoint is encountered during execution of the user program. For more about this, refer to the **GD**, **GO**, and **GT** command descriptions in Chapter 3, *Debugger Commands*.

Alternately, the user program could return to the debugger by means of the System Call Handler routine .RETURN (refer to Chapter 5, *System Calls*).

Command Syntax

A debugger command is made up of the following parts:

- The command name
- Any required arguments, delineated with either a space or comma (precede the first argument with a space)
- Any required options. Precede an option or a string of options with a semi-colon (**;**). If no option is selected, the default options are used.

Command entry is either uppercase or lowercase.

2

Command Arguments

The following arguments are common to many of the commands. Additional arguments are defined in the description of the particular command in which they occur.

EXP	Expression (refer to *EXP* below)
ADDR	Address (refer to *ADDR* on page 2-4)
COUNT	Count; this is a numeric expression and has the same syntax as *EXP* (refer to *EXP* below)
RANGE	A range of memory addresses specified with a pair of arguments, either *ADDR ADDR* or *ADDR : COUNT*
TEXT	An ASCII string of up to 255 characters, delimited at each end by the single quote mark (')
PORT	Port Number (refer to *PORT* on page 2-6)

Use either a space or a comma as a delimiter between arguments. You may select the default value for an argument by inserting a pair of commas in place of the argument.

EXP

The EXP (expression) argument can be one or more numeric values separated by the arithmetic operators:

+	plus
-	minus
*	multiply by
/	divide by
&	logical AND
<<	shift left
>>	shift right

Numeric values may be expressed in either hexadecimal, decimal, octal, or binary by immediately preceding them with the proper base identifier.

Data Type	Base	Identifier	Example
Integer	Hexadecimal	$	$FFFFFFFF
Integer	Decimal	&	&1974, &10-&4
Integer	Octal	@	@456
Integer	Binary	%	%1000110

If no base identifier is specified, then the numeric value is assumed to be hexadecimal.

A numeric value may also be expressed as a string literal of up to four characters. The string literal must begin and end with the single quote mark (’). The numeric value is interpreted as the concatenation of the ASCII values of the characters. This value is right-justified, as any other numeric value would be.

String Literal	Numeric Value (Hexadecimal)
’A’	41
’ABC’	414243
’TEST’	54455354

Evaluation of an expression is always from left to right unless parentheses are used to group part of the expression. There is no operator precedence. Subexpressions within parentheses are evaluated first. Nested parenthetical subexpressions are evaluated from the inside out.

Valid expression examples:

Expression	Result (Hex)
FF0011	FF0011
45+99	DE
&45+&99	90
@35+@67+@10	5C

Expression	Result (Hex)
%10011110+%1001	A7
88<<4	880
AA&F0	A0

<< represents shift-left
& represents logical AND

The total value of the expression must be between 0 and $FFFFFFFF.

ADDR

The syntax for the *ADDR* argument is similar to the syntax accepted by the PowerPC one-line assembler. All control addressing modes are allowed. Refer to *Addressing Modes* in Chapter 4, *One-Line Assembler/ Disassembler*.

ADDR may also be specified in the address + offset form.

ADDR Formats

The *ADDR* format is:

HexadecimalNumber {[^**S**]|[^**s**]|[^**U**]|[^**u**]}|**R***n*

Enter *ADDR* as a hexadecimal number (e.g., 20000 for address $00020000). The address, or starting address of a range, can be qualified by a suffix, either **^S** or **^s** for supervisor address space, or **^U** or **^u** for user address space. The default, when the suffix is not specified, is supervisor.

Once a qualifier has been entered, it remains valid for all addresses entered for that command sequence, until either the debugger is reentered or another qualifier is provided.

In the alternate register number (**R***n*) form, the debugger uses the address contained in MPU Register **R***n*, where *n* is 0 through 31 (i.e., 0, 1, . . . 31).

If the address range specified as *ADDR ADDR*, with a size option of either **H** (half-word) or **W** (word), data at the second (ending) address is acted on only if the second address is a proper boundary for a half-word or word. Otherwise, the range is truncated so that the last byte acted upon is at an address that is a proper boundary.

Offset Registers

Eight pseudo-registers (Z0-Z7) called offset registers are used to simplify the debugging of relocatable and position-independent modules. The listing files in these types of programs usually start at an address (normally 0) that is not the one at which they are loaded, so it is harder to correlate addresses in the listing with addresses in the loaded program. The offset registers solve this problem by taking into account this difference and forcing the display of addresses in a relative address+offset format. Offset registers have adjustable ranges and may even have overlapping ranges. The range for each offset register is set by two addresses, base and top, both of which are standard in a given 64-bit offset register. Specifying the base and top addresses for an offset register sets its range. In the event that an address falls in two or more offset registers' ranges, the one that yields the least offset is chosen.

Note Relative addresses are limited to 1MB (5 digits), regardless of the range of the closest offset register.

PORT

The PORT argument is the logical number of the port to be used to input or output. Valid port numbers which may be used for these commands are as follows:

0 or **00**	Terminal port 0 (console port) is used for interactive user input and output (the default), or may also be used for the graphics adapter device. This port is labeled COM1 or SER1 or DEBUG on the PowerPC board or transition module.
1 or **01**	Terminal port 1 (host port) is the default for downloading, uploading, concurrent mode, and transparent modes. This port is labeled either COM2 or SER2 on the PowerPC board or transition module.

Command Options

Many commands have one or more options, represented in boldface type in the command descriptions. Precede an option or a string of options with a semi-colon (**;**). If no option is entered, the command's default options are used.

Control Characters

Some commands, such as **CNFG**, **MM**, or **RM**, allow you to edit parameter fields or the contents of registers or memory. You may use the following control characters to scroll through the listed items:

V or **v**	Go to the next field, register, or memory location. This is the default, and remains in effect until changed by entering one of the other special characters.
^	Back up to the previous field register, or memory location. This remains in effect until changed by entering one of the other special characters.
=	Re-open the same field register, or memory location.
.	Terminate the command, and return to `PPC1-Bug>` prompt

You may use the following control characters for limited editing while entering commands at the PPC1-Bug> prompt:

DEL Delete: move the cursor back one position and erase the character at the new cursor position. If a printer port is configured (hardcopy mode), a slash (/) character is typed along with the deleted character.

CTRL-h Performs the same function as **DEL**.

CTRL-x Cancel line: move the cursor to the beginning of the line. If a printer port is configured (hardcopy mode), a **<CR><LF>** sequence is issued along with another PPC1-Bug> prompt.

CTRL-d Redisplay the entire command line entered on the following line

CTRL-a Repeat the previous line. This happens only at the command line. The last line entered is redisplayed but not executed. The cursor is positioned at the end of the line. You may enter the line as is or you can add more characters to it. You can edit the line by backspacing and typing over old characters.

The XON and XOFF characters in effect for the terminal port may be entered to control the output from any debugger command, if the XON/XOFF protocol is enabled (default). The characters initialized by PPCBug are (you may change them with the **PF** command):

CTRL-s Wait: halt console output (XON)

CTRL-q Resume console output (XOFF).

Entering and Debugging Programs

There are various ways to enter a user program into system memory for execution. One way is to create the program using the Assembler/Disassembler, entering the program one source line at a time. After each source line is entered, it is assembled and the object code is loaded to memory. Refer to Chapter 4 for information on using the PPCBug Assembler/Disassembler.

Another way is to download an object file from a host system. The program must be in S-record format (refer to Appendix D) and may have been assembled or compiled on the host system. Alternately, you may create a program using the Assembler/Disassembler, and store the program to the host using the **DU** command. A communication link must exist between the host system and PowerPC board port 1 (Refer to the board installation and use manual). Later, download the file from the host to PowerPC board memory with the **LO** command.

Once the object code has been loaded into memory, you can set breakpoints if desired and run the code or trace through it.

System Call Routines in User Programs

Access to various debugger routines is provided via the System Call Handler. This gives a convenient way of doing character input/output and many other useful operations so that you do not have to write these routines into the target code.

The System Call handler is accessible through the **SC** (system call) instruction, with exception vector $00C00 (System Call Exception).

Refer to Chapter 5, *System Calls* for details on the routines available and how to invoke them from within a user program.

Preserving the Operating Environment

This section explains how to avoid contaminating the operating environment of the debugger. PPCBug uses some of the PowerPC board onboard resources to contain temporary variables and exception vectors. If the resources that PPCBug relies upon are disturbed, PPCBug may not function reliably.

If your application enables translation through the Memory Management Unit (MMU), and utilizes resources of the debugger (e.g., system calls), your application must create the necessary translation tables for the debugger to have access to its various resources. The debugger honors the enabling of the MMU; it does not alter or disable translation.

Memory Requirements

The debugger requires approximately 768KB (maybe less) of read/write memory. It allocates this amount of memory from the top portion of memory space. For example, on a system which contains 64 megabytes ($04000000) of read/write memory (DRAM), the debugger's memory page is located at $03F40000 to $03FFFFFF.

This memory space is used by the debugger for program stack, I/O buffers, variables, and register files. If a user program is loaded (booted, S-Records) into memory, and if this program is utilizing the debugger's programmatic interface (i.e., system calls), the program must not modify this allocated memory.

Whenever the host hardware is reset, the target IP is initialized to $00004000 (i.e., just above the memory space of the exception vector table), and the target pseudo stack pointer is initialized to the starting location of the debugger's read/write memory space. The target IP is set to the appropriate address if a program load operation (for example, the **PBOOT** command) is initiated.

Note that user programs should handle the stack area properly in that it should not write starting at the initialized location. Some compilers and assemblers may write to the stack prior to decrementing the stack.

The amount of read/write memory space that is allocated for the debugger, and by the debugger, may increase in future releases. To properly compensate for the increased read/write memory requirements, user programs may use the target register R1 as indicator for the top (plus 1) of usable memory.

Exception Vectors

The following exception vectors are reserved for use by the debugger:

00100 - System Reset	Used for the abort switch soft reset feature
00700 - Program	Used for instruction breakpoints
00C00 - System Call	Used for the System Call Handler
02000 - Run Mode	Used for instruction tracing

These vectors may be taken over under a user's application. However, prior to returning control to the debugger these vectors must be restored for proper operation of the affected features.

MPU Registers

Certain MPU registers must be preserved for their specific uses.

MPU Register SPR275

MPU register SPR275 is reserved for usage by the debugger. If SPR275 is to be used by the user program, it must be restored prior to using debugger resources (system calls) and or returning control to the debugger.

MPU Registers SPR272-SPR274

These MPU registers are used by the debugger as scratch registers.

Context Switching

Context switching is the switching from the debugger state to the user (target) state, or vice versa. This switching occurs upon the invocation of either the **GD**, **GN**, **GO**, **GT**, **T**, or **TT** commands, or the return from user state to the debugger state.

When the context switch transitions from the user state to the debugger state, the following MPU registers are captured:

PPC603-based boards:

R0-R31	General Purpose Registers
FR0-FR31	Floating Point Unit Data Registers
SR0-SR15	Segment Registers
SPR*n*	Special Purpose Registers (*n* is 1, 8, 9, 18, 19, 22, 25, 26, 27 268, 269, 275, 282, 287, 528 - 543, 976 - 981, 1008, 1010)
IP	Instruction Pointer (copy of SPR26)
MSR	Machine State Register (copy of SPR27)

CR	Condition Register
FPSCR	Floating Point Status/Control Register

PPC604-based boards:

R0-R31	General Purpose Registers
FR0-FR31	Floating Point Unit Data Registers
SR0-SR15	Segment Registers
SPR*n*	Special Purpose Registers (*n* is 1, 8, 9, 18, 19, 22, 25, 26, 27 268, 269, 275, 282, 287, 528 - 543, 1008, 1010, 1013, 1023)
IP	Instruction Pointer (copy of SPR26)
MSR	Machine State Register (copy of SPR27)
CR	Condition Register
FPSCR	Floating Point Status/Control Register

When the context switch transitions from the debugger state to the user state, the following MPU registers are restored:

PPC603-based boards:

R0-R31	General Purpose Registers
FR0-FR31	Floating Point Unit Data Registers
SPR*n*	Special Purpose Registers (*n* is 1, 8, 9, 275, 1010)
IP	Instruction Pointer, copied to SPR26
MSR	Machine State Register, copied to SPR27
CR	Condition Register
FPSCR	Floating Point Status/Control Register

PPC604-based boards:

0-R31	General Purpose Registers
FR0-FR31	Floating Point Unit Data Registers
SPR*n*	Special Purpose Registers (*n* is 1, 8, 9, 275, 1010, 1013, 1023)

IP	Instruction Pointer, copied to SPR26
MSR	Machine State Register, copied to SPR27
CR	Condition Register
FPSCR	Floating Point Status/Control Register

Note that on a restoration context switch, registers whose perspectives feature MMU characteristics and operating modes of the MPU are not restored. The debugger honors the user's MMU configuration. If the user's program wishes to utilize the programmatic interface (i.e., system calls) of the debugger, it must maintain the address translation of 1 to 1, and the I/O resources utilized by the debugger must be data cache inhibited.

Floating Point Support

The **MD** and **MM** commands allow display and modification of floating point data in memory. Use either the **MD** command or the **MM** command to assemble or disassemble floating point instructions.

Valid data types that can be used when modifying a floating point data register or a floating point memory location:

Integer Data Types

Byte	12
Half-Word	1234
Word	12345678

Floating Point Data Types

Single Precision Real	1_FF_7FFFFF
Double Precision Real	1_7FF_FFFFFFFFFFFF
Scientific Notation (decimal)	-3.12345678901234501_E+123

When entering data in single or double precision format, observe the following rules:

- The sign field is the first field and is a binary field.

- The exponent field is the second field and is a hexadecimal field.
- The mantissa field is the last field and is a hexadecimal field.
- The sign field, the exponent field, and at least the first digit of the mantissa field must be present (any unspecified digits in the mantissa field are set to zero).
- Each field must be separated from adjacent fields by an underscore.
- All the digit positions in the sign and exponent fields must be present.

Single Precision Real

The single precision real format would appear in memory as:

1-bit sign field	(1 binary digit)
8-bit biased exponent field	(2 hex digits, Bias = $7F)
23-bit fraction field	(6 hex digits)

A single precision number takes 4 bytes in memory.

Double Precision Real

The double precision real format would appear in memory as:

1-bit sign field	(1 binary digit)
11-bit biased exponent field	(3 hex digits, Bias = $3FF)
52-bit fraction field	(13 hex digits)

A double precision number takes 8 bytes in memory.

Note The single and double precision formats have an implied integer bit (always 1).

Scientific Notation

The scientific notation format provides a convenient way to enter and display a floating point decimal number. Internally, the number is assembled into a packed decimal number and then converted into a number of the specified data type.

Entering data in this format requires the following fields:

- An optional sign bit (+ or -).
- One decimal digit followed by a decimal point.
- Up to 17 decimal digits (at least one must be entered).
- An optional Exponent field that consists of:
  - An optional underscore.
  - The Exponent field identifier, letter E.
  - An optional Exponent sign (+, -).
  - From 1 to 3 decimal digits.

For more information about the floating point unit, refer to the *PowerPC 603 RISC Microprocessor User's Manual*, the *PowerPC 604 RISC Microprocessor User's Manual,* or the *PowerPC 750 RISC Microprocessor User's Manual.*

Debugger Commands 3

Introduction

This chapter contains descriptions of each debugger command, with one or more examples of each. The debugger commands are listed in Table 3-1.

Debugger Commands

All valid debugger commands are listed in the table below, and are described in alphabetical order on the following pages. The command syntax is shown using the symbols explained in Chapter 2.

Table 3-1. Debugger Commands

Command	Description
AS	One Line Assembler
BC	Block of Memory Compare
BF	Block of Memory Fill
BI	Block of Memory Initialize
BM	Block of Memory Move
BR	Breakpoint Insert
NOBR	Breakpoint Delete
BS	Block of Memory Search
BV	Block of Memory Verify
CACHE	Modify Cache State
CM	Concurrent Mode
NOCM	No Concurrent Mode
CNFG	Configure Board Information Block
CS	Checksum
CSAR	PCI Configuration Space READ Access (NOTE 2)
CSAW	PCI Configuration Space WRITE Access (NOTE 2)
DC	Data Conversion
DMA	Move Block of Memory
DS	One Line Disassembler
DU	Dump S-Records
ECHO	Echo String
ENV	Set Environment

Table 3-1. Debugger Commands (Continued)

Command	Description
FORK	Fork Idle MPU at Address (NOTE 2)
FORKWR	Fork Idle MPU with Registers (NOTE 2)
GD	Go Direct (Ignore Breakpoints)
GEVBOOT	Global Environment Variable Boot (NOTE 1)
GEVDEL	Global Environment Variable Delete (NOTE 1)
GEVDUMP	Global Environment Variable(s) Dump (NOTE 1)
GEVEDIT	Global Environment Variable Edit (NOTE 1)
GEVINIT	Global Environment Variable Initialization (NOTE 1)
GEVSHOW	Global Environment Variable(s) Display (NOTE 1)
GN	Go to Next Instruction
G, GO	Go Execute User Program
GT	Go to Temporary Breakpoint
HE	Help
IBM	Indirect Block Move
IDLE	Idle Master MPU (NOTE 2)
IOC	I/O Control for Disk
IOI	I/O Inquiry
IOP	I/O Physical (Direct Disk Access)
IOT	I/O Teach for Configuring Disk Controller
IRD	Idle MPU Register Display (NOTE 2)
IRM	Idle MPU Register Modify (NOTE 2)
IRS	Idle MPU Register Set (NOTE 2)
LO	Load S-Records from Host
MA	Macro Define/Display
NOMA	Macro Delete
MAE	Macro Edit
MAL	Enable Macro Listing
NOMAL	Disable Macro Listing
MAR	Load Macros
MAW	Save Macros
MD, MDS	Memory Display
MENU	System Menu
M, MM	Memory Modify
MMD	Memory Map Diagnostic
MMGR	Memory Manager
MS	Memory Set
MW	Memory Write
NAB	Automatic Network Boot
NAP	Nap MPU (NOTE 2)
NBH	Network Boot Operating System, Halt
NBO	Network Boot Operating System

Table 3-1. Debugger Commands (Continued)

Command	Description
NIOC	Network I/O Control
NIOP	Network I/O Physical
NIOT	Network I/O Teach (Configuration)
NPING	Network Ping
OF	Offset Registers Display/Modify
PA	Printer Attach
NOPA	Printer Detach
PBOOT	Bootstrap Operating System
PF	Port Format
NOPF	Port Detach
PFLASH	Program FLASH Memory
PS	Put RTC into Power Save Mode
RB	ROMboot Enable
NORB	ROMboot Disable
RD	Register Display
REMOTE	Remote
RESET	Cold/Warm Reset
RL	Read Loop
RM	Register Modify
RS	Register Set
RUN	MPU Execution/Status (NOTE 2)
SD	Switch Directories
SET	Set Time and Date
SROM	SROM Examine/Modify (NOTE 2)
SYM	Symbol Table Attach
NOSYM	Symbol Table Detach
SYMS	Symbol Table Display/Search
T	Trace
TA	Terminal Attach
TIME	Display Time and Date
TM	Transparent Mode
TT	Trace to Temporary Breakpoint
VE	Verify S-Records Against Memory
VER	Revision/Version Display
WL	Write Loop

Notes 1. This command was added at revision 1.8 of PPCBug, dated 10/05/95.

2. This command was added at Revision 3.1 of PPCBug, dated 2/26/97.

AS - One-Line Assembler

Command Input

AS *ADDR*

Description

The **AS** command provides access to the one-line assembler. It is synonymous with the Memory Modify (**MM**) command when used with the **DI** option (**MM** *ADDR* ;**DI**). Refer to *M, MM - Memory Modify* on page 3-130 for details on using the MM command. Refer to Chapter 4, *One-Line Assembler/ Disassembler* for information on using the one-line assembler.

BC - Block of Memory Compare

Command Input

BC *RANGE ADDR* [**;B**|**H**|**W**]

Options

B	Byte
H	Half-word
W	Word

Description

The **BC** command compares the contents of memory defined by *RANGE* with another place in memory, beginning at *ADDR*.

The option field is only allowed when *RANGE* is specified using a *COUNT*. In this case, the **B**, **H**, or **W** defines the size of the data that the *COUNT* is referring to. For example, a *COUNT* of 4 with an option of **W** would mean to compare 4 words (16 bytes). The default data type is word.

No confirmation is printed if the memory being compared matches. If the memory does not match, each mismatch is displayed. If the *RANGE* beginning address is greater than or equal to the end address, an error message is displayed and no comparison takes place.

For the following examples, assume that memory blocks 20000-20020 and 21000-21020 contain identical data.

Examples

Example 1: Compare the memory, with nothing printed.

```
PPC1-Bug>BC 20000 2001F 21000 <Return>
Effective address: 00020000
Effective address: 0002001F
Effective address: 00021000
PPC1-Bug>
```

Example 2: Compare the memory, with nothing printed.

```
PPC1-Bug>BC 20000:20 21000;B <Return>
Effective address: 00020000
Effective count  : &32
Effective address: 00021000
PPC1-Bug>
```

Example 3: Create a mismatch (using the **MM** command), and prints out the mismatches.

```
PPC1-Bug>MM 2100F;B <Return>
0002100F 21? 0. <Return>
PPC1-Bug>
```

```
PPC1-Bug>BC 20000:20 21000;B <Return>
Effective address: 00020000
Effective count  : &32
Effective address: 00021000
0002000F|21 0002100F|00
PPC1-Bug>
```

BF - Block of Memory Fill

Command Input

BF *RANGE data* [*increment*] [**;B**|**H**|**W**]

Arguments

data	Data pattern to be written to memory. If *data* does not fit into the selected data field length, then leading bits are truncated to make it fit. If truncation occurs, then a message is printed stating the data pattern which was actually written (or initially written if you specified an increment).
increment	Value that data is incremented following each write. If *increment* does not fit into the data field size, then leading bits are truncated to make it fit. If truncation occurs, then a message is printed stating the increment which was actually used.

Options

B	Byte
H	Half-word
W	Word

Description

The **BF** command fills the specified range of memory with a data pattern (*data*). If an *increment* is specified, then *data* is incremented by this value following each write, otherwise *data* remains a constant value.

A decrementing pattern may be accomplished by entering a negative increment. The data you enter is right-justified in either a byte, half-word, or word field (as specified by the data field length selected). The default field length is **W** (word).

If the upper address of the range is not on the correct boundary for an integer multiple of the data to be stored, then data is stored to the last boundary before the upper address. No address outside of the specified range is ever disturbed in any case. The `Effective address` messages displayed by the command show exactly where data was stored.

Examples

Example 1: For this example, assume that memory from $20000 through $2002F is clear.

Because no option is specified, the length of the data field defaults to word.

```
PPC1-Bug>BF 20000,2001F 4E71 <Return>
Effective address: 00020000
Effective address: 0002001F
PPC1-Bug>

PPC1-Bug>MD 20000:18;H <Return>
00020000 0000 4E71 0000 4E71  0000 4E71 0000 4E71   ..Nq..Nq..Nq..Nq
00020010 0000 4E71 0000 4E71  0000 4E71 0000 4E71   ..Nq..Nq..Nq..Nq
00020020 0000 0000 0000 0000  0000 0000 0000 0000   ................
```

Example 2: For this example, assume that memory from $20000 through $2002F is clear.

The specified data does not fit into the specified data field size, the data is truncated, and the `Data =` message is output.

```
PPC1-Bug>BF 20000:10 4E71;B <Return>
Effective address: 00020000
Effective count  : &16
Data = $71
PPC1-Bug>

PPC1-Bug>MD 20000:18;H <Return>
00020000 7171 7171 7171 7171  7171 7171 7171 7171   qqqqqqqqqqqqqqqq
00020010 0000 0000 0000 0000  0000 0000 0000 0000   ................
00020020 0000 0000 0000 0000  0000 0000 0000 0000   ................
PPC1-Bug>
```

Example 3: For this example, assume that memory from $20000 through $2002F is clear.

The word pattern does not fit evenly in the given range. Only one word is written and the `Effective address` messages reflect the fact that data is not written all the way up to the specified address.

```
PPC1-Bug>BF 20000,20006 12345678;W <Return>
Effective address: 00020000
Effective address: 00020003
PPC1-Bug>

PPC1-Bug>MD 20000:18;H <Return>
00020000 1234 5678 0000 0000  0000 0000 0000 0000   .4Vx............
00020010 0000 0000 0000 0000  0000 0000 0000 0000   ................
00020020 0000 0000 0000 0000  0000 0000 0000 0000   ................
```

Example 4: For this example, assume memory from $20000 through $2002F is clear.

```
PPC1-Bug>BF 20000:18 0 1;H <Return>
Effective address: 00020000
Effective count  : &48
PPC1-Bug>

PPC1-Bug>MD 20000:18;H <Return>
00020000 0000 0001 0002 0003  0004 0005 0006 0007   ................
00020010 0008 0009 000A 000B  000C 000D 000E 000F   ................
00020020 0010 0011 0012 0013  0014 0015 0016 0017   ................
PPC1-Bug>
```

BI - Block of Memory Initialize

Command Input

BI *RANGE* [**;B**|**H**|**W**]

Options

B	Byte
H	Half-word
W	Word

Description

The **BI** initializes parity for a block of memory. The **BI** command is non-destructive; if the parity is correct for a memory location, then the contents of that memory location are not altered.

The limits of the block of memory to be initialized may be specified using a *RANGE*. The option field specifies the data size in which memory is initialized if *RANGE* is specified using a *COUNT*. The option also specifies the size of data element to which the *COUNT* refers. The length option is valid only when a *COUNT* is used. The default data type is word.

BI works through the memory block by reading from locations and checking parity. If the parity is not correct, then the data read is written back to the memory location in an attempt to correct the parity. If the parity is not correct after the write, then the message `RAM FAIL` is output and the address is given.

This command may take several seconds to initialize a large block of memory.

Examples

Example 1:

```
PPC1-Bug>BI 0:10000;B <Return>
Effective address: 00000000
Effective count  : &65536
PPC1-Bug>
```

Example 2: For this example, assume system memory from $0 to $000FFFFF.

```
PPC1-Bug>BI 0,1FFFFF <Return>
Effective address: 00000000
Effective address: 001FFFFF
RAM FAIL AT $00100000
PPC1-Bug>
```

BM - Block of Memory Move

Command Input

BM *RANGE ADDR* [**;B**|**H**|**W**]

Options

B	Byte
H	Half-word
W	Word

Description

The **BM** command copies the contents of the memory addresses defined by *RANGE* to another place in memory, beginning at *ADDR*.

The option field is only allowed when *RANGE* is specified using a *COUNT*. In this case, the **B**, **H**, or **W** defines the size of the data that the *COUNT* is referring to. For example, a *COUNT* of 4 with an option of **W** would mean to move 4 words (or 16 bytes) to the new location. If an option field is specified without a *COUNT* in the *RANGE*, an error results.

The **BM** command is useful for patching assembly code in memory (refer to example 2).

The default data size is word.

Examples

Example 1: For this example, assume that memory from 20000 to 2000F is clear.

```
PPC1-Bug>MD 21000:10;H <Return>
00021000 5448 4953 2049 5320  4120 5445 5354 2121   THIS IS A TEST!!
00021010 0000 0000 0000 0000  0000 0000 0000 0000   ................
PPC1-Bug>

PPC1-Bug>BM 21000 2100F 20000 <Return>
Effective address: 00021000
Effective address: 0002100F
Effective address: 00020000
PPC1-Bug>
```

```
PPC1-Bug>MD 20000:10;H <Return>
00020000 5448 4953 2049 5320  4120 5445 5354 2121   THIS IS A TEST!!
00020010 0000 0000 0000 0000  0000 0000 0000 0000   ................
PPC1-Bug>
```


Example 2: Patch assembly code in memory

For this example, assume that you had a short program in memory at address 20000 (displayed with the **MD** command).

```
PPC1-Bug>MD 20000 2000F;DI <Return>
00020000 3C401000  ADDIS       R2,R0,$1000
00020004 60420001  ORI         R2,R2,$1
00020008 7C631378  OR          R3,R3,R2
0002000C 7CA53214  ADD         R5,R5,R6
PPC1-Bug>
```

To insert an ANDC between the OR instruction and the ADD instruction, Block Move the object code down four bytes to make room for the ANDC.

```
PPC1-Bug>BM 20008 20010 2000C <Return>
Effective address: 00020008
Effective address: 0002000F
Effective address: 0002000C
PPC1-Bug>
```

```
PPC1-Bug>MD 20000 20014;DI <Return>
00020000 3C401000  ADDIS       R2,R0,$1000
00020004 60420001  ORI         R2,R2,$1
00020008 7C631378  OR          R3,R3,R2
0002000C 7C631378  OR          R3,R3,R2
00020010 7CA53214  ADD         R5,R5,R6
PPC1-Bug>
```

Enter the ANDC at address 20008 using the **MM** command.

```
PPC1-Bug>MM 20008;DI <Return>
00020008 7C631378  OR          R3,R3,R2? ANDC R3,R3,R2 <Return>
00020008 7C631078  ANDC        R3,R3,R2
0002000C 7C631378  OR          R3,R3,R2? .<Return>
PPC1-Bug>
```

```
PPC1-Bug>MD 20000 20014;DI <Return>
00020000 3C401000  ADDIS       R2,R0,$1000
00020004 60420001  ORI         R2,R2,$1
00020008 7C631078  ANDC        R3,R3,R2
0002000C 7C631378  OR          R3,R3,R2
00020010 7CA53214  ADD         R5,R5,R6
PPC1-Bug>
```

BR - Breakpoint Insert
NOBR - Breakpoint Delete

Command Input

BR [*ADDR*[**:***COUNT*]]

NOBR [*ADDR*]

Description

The **BR** command sets a target code instruction address as a breakpoint address for debugging purposes. If, during target code execution, a breakpoint with 0 count is found, the target code state is saved in the target registers and control is returned back to the debugger. This allows you to see the actual state of the processor at selected instructions in the code.

Up to eight breakpoints can be defined. The breakpoints are kept in a table which is displayed each time either **BR** or **NOBR** is used. If an address is specified with the **BR** command, that address is added to the breakpoint table.

The *COUNT* argument specifies how many times the instruction at the breakpoint address must be fetched before a breakpoint is taken. The *COUNT*, if greater than zero, is decremented with each fetch. Every time a breakpoint with zero count is found, a breakpoint handler routine prints the CPU state on the screen and control is returned to the debugger.

NOBR is used for deleting breakpoints from the breakpoint table. If an address is specified, then that address is removed from the breakpoint table. If **NOBR** is entered with no address, then all entries are deleted from the breakpoint table and the empty table is displayed.

Examples

Example 1: Set some breakpoints.

```
PPC1-Bug>BR 1E000,1E200 1E700:&12 <Return>
BREAKPOINTS
0001E000        0001E200
0001E700:C
PPC1-Bug>
```

Example 2: Delete specified breakpoint.

```
PPC1-Bug>NOBR 1E200 <Return>
BREAKPOINTS
0001E000        0001E700:C
PPC1-Bug>
```

Example 3: Delete all breakpoints.

```
PPC1-Bug>NOBR <Return>
BREAKPOINTS
PPC1-Bug>
```

BS - Block of Memory Search

Command Input

BS *RANGE TEXT* [**;B**|**H**|**W**]

or

BS *RANGE data* [*mask*] [**;B**|**H**|**W** [,**N**] [,**V**]]

Arguments

TEXT	An ASCII text string that is matched against a range of memory
data	Data pattern that is matched against a range of memory
mask	A string that indicates which bit positions in *data* to compare to memory (a one is compared, a zero is not). The default is all ones.

Options

B	Byte
H	Half-word
W	Word
N	Non-aligned. The search is conducted on a byte-by-byte basis, rather than by half-words or words, regardless of the size of *data*.
V	Verify. Addresses and data are displayed only when the memory contents do not match *data*.

Description

The **BS** command searches the specified range of memory for a match with a an ASCII text string or a data pattern. This command has three modes.

String Search

In the string search mode, a search is carried out for the *TEXT* argument. The size option field indicates whether the *COUNT* field of *RANGE* refers to bytes, half-words, or words. If *RANGE* is not specified using a *COUNT*, then no options are allowed. If a match is found, then the address of the first byte of the match is output.

Data Search

In the Data Search mode, a data pattern (*data*) is matched against a range of memory. The size option indicates whether the *COUNT* field in *RANGE* refers to bytes, half-words, or words (the default is *word*).

The following actions occur during a data search:

1. *data* is right-justified and leading bits are truncated or leading zeros are added as necessary to make the data pattern the specified size.
2. A compare is made with successive bytes, half-words, or words (depending on the size in effect) within the range for a match with *data*.

   Comparison is made only on those bits at bit positions corresponding to a one in *mask*. If *mask* is not specified, the default is all ones (all bits are compared). The size of the mask is taken to be the same size as the data.

   If the **N** (non-aligned) option is selected, *data* is searched for on a byte-by-byte basis, rather than by half-words or words, regardless of the size of data. This is useful if a half-word (or word) pattern is being searched for, but is not expected to lie on a half-word (or word) boundary.
3. If a match is found, then the address of the first byte of the match is output along with the memory contents. If a mask was in use, then the actual data at the memory location is displayed, rather than the data with the mask applied.

Data Verification

If the **V** (verify) option has been selected, the addresses and data are displayed only when the memory contents do not match *data*. Otherwise this mode is identical to the Data Search mode.

For all three modes, information on matches is output to the screen in a four-column format. If more than 24 lines of matches are found, then output is inhibited to prevent the first match from rolling off the screen. A message is printed at the bottom of the screen indicating that there is more

to display. To resume output, you should simply press any character key. To cancel the output and exit the command, you should press the BREAK key.

If a match is found (or, in the case of Mode 3, a mismatch) with a series of bytes of memory whose beginning is within the range but whose end is outside of the range, then that match is output and a message is output stating that the last match does not lie entirely within the range. You may search non-contiguous memory with this command without causing a Bus Error.

For the examples below, assume the following data is in memory.

```
00030000 0000 0045 7272 6F72  2053 7461 7475 733D   ...Error Status=
00030010 3446 2F2F 436F 6E66  6967 5461 626C 6553   4F//ConfigTableS
00030020 7461 7274 3A00 0000  0000 0000 0000 0000   tart:...........
```

Examples

Example 1: Mode 1: The string is not found, so a message is output.

```
PPC1-Bug>BS 30000 3002F 'Task Status' <Return>
Effective address: 00030000
Effective address: 0003002F
-not found-
PPC1-Bug>
```

Example 2: Mode 1: The string is found, and the address of its first byte is output.

```
PPC1-Bug>BS 30000 3002F 'Error Status' <Return>
Effective address: 00030000
Effective address: 0003002F
00030003
PPC1-Bug>
```

Example 3: Mode 1: The string is found, but it ends outside of the range, so the address of its first byte and a message are output.

```
PPC1-Bug>BS 30000 3001F 'ConfigTableStart' <Return>
Effective address: 00030000
Effective address: 0003001F
00030014
-last match extends over range boundary-
PPC1-Bug>
```

Example 4: Mode 1, using *RANGE* with *COUNT* and size option: *COUNT* is displayed in decimal, and address of each occurrence of the string is output.

```
PPC1-Bug>BS 30000:30 't';B <Return>
Effective address: 00030000
Effective count  : &48
0003000A   0003000C   00030020   00030023
PPC1-Bug>
```

Example 5: Mode 2, using RANGE with *COUNT*: *COUNT* is displayed in decimal bytes, and the data pattern is found and displayed.

```
PPC1-Bug>BS 30000:18,2F2F;H <Return>
Effective address: 00030000
Effective count  : &48
00030012|2F2F
PPC1-Bug>
```

Example 6: Mode 2, the default size is word and the data pattern is not found, so a message is output.

```
PPC1-Bug>BS 30000,3002F 3D34 <Return>
Effective address: 00030000
Effective address: 0003002F
-not found-
PPC1-Bug>
```

Example 7: Mode 2, the size is half-word and non-aligned option is used, so the data pattern is found and displayed.

```
PPC1-Bug>BS 30000,3002F 3D34;HN <Return>
Effective address: 00030000
Effective Address: 0003002F
0003000F|3D34
PPC1-Bug>
```

Example 8: Mode 2, using *RANGE* with *COUNT*, mask option, and size option: *COUNT* is displayed in decimal, and the actual unmasked data patterns found are displayed.

```
PPC1-Bug>BS 30000:30 60,F0;B <Return>
Effective address: 00030000
Effective count  : &48
00030006|6F   0003000B|61   00030015|6F   00030016|6E
00030017|66   00030018|69   00030019|67   0003001B|61
0003001C|62   0003001D|6C   0003001E|65   00030021|61
PPC1-Bug>
```

Example 9: Mode 3, on a different block of memory, mask option, scan for words with low nibble nonzero: two locations failed to verify.

```
PPC1-Bug>BS 3000 1FFFF 0000 000F;VH <Return>
Effective address: 00003000
Effective address: 0001FFFF
0000C000|E501   0001E224|A30E
PPC1-Bug>
```

BV - Block of Memory Verify

Command Input

BV *RANGE data* [*increment*] [**;B**|**H**|**W**]

Arguments

data	Data pattern to be compared to memory. If *data* does not fit into the selected data field length, then leading bits are truncated to make it fit. If truncation occurs, then a message is printed stating the data pattern which was actually written (or initially written if you specified an increment).
increment	Value that data is incremented following each write. If *increment* does not fit into the data field size, then leading bits are truncated to make it fit. If truncation occurs, then a message is printed stating the increment which was actually used.

Options

B	Byte
H	Half-word
W	Word

Description

The **BV** command compares the specified range of memory against a data pattern. If an increment is specified, then data is incremented by this value following each comparison, otherwise data remains a constant value. A decrementing pattern may be accomplished by entering a negative increment. The data you entered is right-justified in either a byte, half-word, or word field (as specified by the option selected). The default field length is **W** (word).

If the range is specified using a *COUNT*, then the *COUNT* is assumed to be in terms of the data size.

If the upper address of the range is not on the correct boundary for an integer multiple of the data to be verified, data is verified to the last boundary before the upper address. No address outside of the specified range is read from in any case. The `Effective address` messages displayed by the command show exactly the extent of the area read from.

Examples

Example 1: For this example, assume memory from $20000 to $2002F is as indicated. In this example the default data element size is word, and the block verify was successful (i.e., nothing printed).

```
PPC1-Bug>MD 20000:18;H <Return>
00020000 4E71 4E71 4E71 4E71  4E71 4E71 4E71 4E71   NqNqNqNqNqNqNqNq
00020010 4E71 4E71 4E71 4E71  4E71 4E71 4E71 4E71   NqNqNqNqNqNqNqNq
00020020 4E71 4E71 4E71 4E71  4E71 4E71 4E71 4E71   NqNqNqNqNqNqNqNq
PPC1-Bug>

PPC1-Bug>BV 20000 2001F 4E714E71 <Return>
Effective address: 00020000
Effective address: 0002001F
PPC1-Bug>
```

Example 2: For this example, assume memory from $20000 to $2002F is as indicated. Mismatches are printed out.

```
PPC1-Bug>MD 20000:18;H <Return>
00020000 0000 0000 0000 0000  0000 0000 0000 0000   ................
00020010 0000 0000 0000 0000  0000 0000 0000 0000   ................
00020020 0000 0000 0000 0000  0000 4AFB 4AFB 4AFB   ..........J{J{J{
PPC1-Bug>

PPC1-Bug>BV 20000:30 0;B <Return>
Effective address: 00020000
Effective count  : &48
0002002A|4A   0002002B|FB   0002002C|4A   0002002D|FB
0002002E|4A   0002002F|FB
PPC1-Bug>
```

Example 3: For this example, assume memory from $20000 to $2002F is as indicated. Size is half-word, mismatches are printed out.

```
PPC1-Bug>MD 20000:18;H <Return>
00020000 0000 0001 0002 0003  0004 0005 0006 0007   ................
00020010 0008 FFFF 000A 000B  000C 000D 000E 000F   ................
00020020 0010 0011 0012 0013  0014 0015 0016 0017   ................
PPC1-Bug>
```

```
PPC1-Bug>BV 20000:18 0 1;H <Return>
Effective address: 00020000
Effective count  : &48
00020012|FFFF
PPC1-Bug>
```

CACHE - Cache Control

Command Input

CACHE;[D|E]

Options

D Disable instruction caches
E Enable instruction caches

Description

The CACHE command modifies the state of the L1 and L2 instruction caches. the disable option flushes both caches and then disables them. The enable option invalidates both caches and then enables them. Both commands can be safely executed from any cache state.

Example

```
PPC4-Bug>cache;d(L1 and L2 instruction caches are off)
PPC4-Bug>cache;e (L1 and L2 instruction caches are on)
```

CM - Concurrent Mode
NOCM - No Concurrent Mode

Command Input

CM [[*PORT*] [*ID-STRING*] [*BAUD*] [*PHONE-NUMBER*]]|[**;A**]|[**;H**]

NOCM

Arguments

ID-STRING	Device (i.e. modem) with which communications is established before the concurrent mode session is activated. If no identifier string is specified, **CM** will use an identifier string of "DUMB" by default. The identifier string must be one that is supported. If the identifier string is not found in the supported list, **CM** displays an error message.
BAUD	Baud rate. The baud rate must be supported by the device and must be supported by the debugger (110, 300, 600, 1200, 2400, 4800, 9600, 19200). If no baud rate is specified, **CM** uses the default baud rate for the device. This is also displayed along with the supported devices. If the baud rate is not supported, **CM** displays an error message.
PHONE-NUMBER	Phone number. This may be a string of any alphanumeric characters. This string is passed directly to the device driver if needed. In the case of modems, this string is added to the dial recognition string. If the phone number field is not specified, a dial-in condition is assumed (wait for call).

Options

A List all supported devices.

H Displays whether concurrent mode is active or not, and if it is, what secondary port number is being used by it.

Description

The **CM** command activates a mode in which everything that appears on the system console terminal is also echoed to the port specified by the *PORT* argument.

PORT is checked for inbound characters. These are also echoed to the system console terminal. If no port is specified, **CM** uses port 1 by default.

PORT must already be configured. The baud rate need not be specified because the port is reconfigured prior to activation. The preconfiguration of the port is done by using the **PF** (Port Format) command. If *PORT* is not currently assigned, **CM** displays an error message.

For any reason you may abort the concurrent mode setup by pressing the BREAK key. This may be necessary if the modem is not responding to commands from the debugger.

The **NOCM** command terminates concurrent mode which was activated by the **CM** command. Depending on the device and the port specified with the **CM** command, the communication link is appropriately closed.

Examples

Example1: List all devices supported by the debugger:

```
PPC1-Bug>CM;A <Return>
Concurrent Devices Supported
Device Name (ID-STRING) Default Baud
DUMB                    9600
UDS2662                 1200
UDS2980                 1200
UDS3382              1200
```

Example 2: Activate the concurrent mode.

```
PPC1-Bug>CM <Return>
Concurrent Mode Active
```

This results in the default settings remaining intact:

PORT	1
ID-STRING	DUMB
BAUD	9600 (default if ID-STRING is “DUMB”)
PHONE-NUMBER	null

Example 3: Activate the concurrent mode, with changes to the modem and the phone number.

```
PPC1-Bug>CM,,UDS2662,,16024383020 <Return>
Concurrent Mode Active
```

This results in the following changes:

PORT	1
ID-STRING	UDS2662
BAUD	1200 (default if ID-STRING is “UDS2662”)
PHONE-NUMBER	16024383020

Example 4: Activate the concurrent mode, with changes to the modem and the phone number.

```
PPC1-Bug>CM,,UDS2662,,16024383020 <Return>
Concurrent Mode Active
PPC1-Bug>CM,,UDS2662,,16024383020 <Return>
Concurrent Mode Already Active
PPC1-Bug>
```

An error occurs on the second entry because the concurrent mode is already active.

Example 3: Activate the concurrent mode, with changes to the modem, baud rate, and phone number.

```
PPC1-Bug>CM 2 UDS2980 1200 18007777777 <Return>
Concurrent Mode Active
PPC1-Bug>
```

This results in the following changes:

PORT	2
ID-STRING	UDS2980
BAUD	1200
PHONE-NUMBER	18007777777

Example 5: Activate the concurrent mode, with error.

```
PPC1-Bug>CM 2,,DUMB <Return>
Concurrent Mode Setup Failure
PPC1-Bug>
```

Example 6: Terminate the concurrent mode.

```
PPC1-Bug>NOCM <Return>
Concurrent Mode Terminated
PPC1-Bug>
```

Example 7: Attempt to terminate the previously terminated concurrent mode.

```
PPC1-Bug>NOCM <Return>
Concurrent Mode Not Active
PPC1-Bug>
```

CNFG - Configure Board Information Block

Command Input

CNFG [;[I] [M]]

Options

I	Initialize the board information block to zero.
M	Modify the board information block.

Description

The **CNFG** command displays the configure the board information block, and allows you to change the contents. The board information block, which is resident within the Non-Volatile RAM (NVRAM), contains various elements detailing specific operation parameters of the PowerPC board. which have been set up by the factory. The **CNFG** command does *not* describe the elements and their use.

The board information block contents are checksummed for validation purposes. This checksum is the last element of the block.

Refer to the board installation and use manual for the location, and contents of the board information block, and the size and logical offset of each element.

The parameters that are quoted are left-justified ASCII strings padded with space characters. The quotes are displayed to indicate the size of the string. Parameters that are not quoted are considered data strings, and data strings are right-justified. The data strings are padded with zeroes if the length is not met.

The **CNFG** information is configured in the factory. There is no need ever to modify these values unless the NVRAM gets corrupted.

Option **M** allows you to modify the board information block. When invoked, this command prompts for entry into each field. You may change the displayed value by typing a new value, followed by the Return key. To leave the field unaltered, press the Return key without typing a new value.

You may also enter a special character, either at the prompt or after typing new data, for scrolling through the fields. The special characters are:

V or **v**	Go to the next field. This is the default, and remains in effect until changed by entering one of the other special characters.
^	Back up to the previous field. This remains in effect until changed by entering one of the other special characters.
=	Re-open the same field
.	Terminate the **CNFG** command, and return control to the debugger

At the end of the modification session, you are prompted whether or not to update the NVRAM. Enter **Y** to cause the update to occur; any other response terminates the update (disregards all changes). The update also recalculates the checksum.

Note Be careful when modifying parameters. Correct board operation relies upon these parameters.

In the event of corruption of the board information block, the command displays question marks for nondisplayable characters. A warning message is also displayed in the event of a checksum failure.

Note When upgrading from an earlier version of the firmware, prior to PPC1BUG 1.7, it may be necessary to match the processor and bus clock frequencies to those displayed by the firmware during sign on. This only needs to be done if the firmware complains that there is a mismatch in values. To correct it, invoke **CNFG;M** from the firmware command line to correct the mismatched values.

Examples

Example 1: Shown below is a sample of a valid board information block:

```
PPC1-Bug>CNFG <Return>
Board (PWA) Serial Number= “MOT000061050”
Board Identifier= “MVME2603-001”
Artwork (PWA)= “01-W3015F01A”
MPU Clock Speed= “233”
Bus Clock Speed= “067”
Ethernet Address= 08003E20C983
Primary SCSI Identifier= “07”
System Serial Number= “163725”
System Identifier= “Motorola Series E603-166P”
License Identifier= “12345678”
PPC1-Bug>
```

Example 2: Shown below is a board information block with corrupted data.

```
PPC1-Bug>CNFG <Return>
WARNING: Board Information Block Checksum Error
Board (PWA) Serial Number = "???????????"
Board Identifier          = "???????????????"
Artwork (PWA) Identifier  = "???????????????"
MPU Clock Speed           = "????"
Bus Clock Speed           = "????"
Ethernet Address          = 000000000000
Primary SCSI Identifier   = "??"
System Serial Number      = "????????????"
System Identifier         = "?????????????????????????"
License Identifier        = "12345678 "
PPC1-Bug>
```

Example 3: Modify the Board Information Block.

```
PPC1-Bug>CNFG;M <Return>
WARNING: Board Information Block Checksum Error
Board (PWA) Serial Number = "???????????"? MOT000061050
Board Identifier          = "??????????????????"? MVME2603-001
Artwork (PWA) Identifier  = "??????????????????"? 01-W3015F01A
MPU Clock Speed           = "????"? 233
Bus Clock Speed           = "????"? 067
Ethernet Address          = 000000000000? 08003E20C983
Primary SCSI Identifier   = "??"? 07
System Serial Number      = "163725       "
System Identifier         = "Motorola Series E603-166P "
License Identifier        = "12345678 "
Update Non-Volatile RAM (Y/N)? y
PPC1-Bug>
```

Example 4: View the Board Information Block and the updates.

```
PPC1-Bug>CNFG
Board (PWA) Serial Number = "MOT000061050"
Board Identifier          = "MVME2603-001 "
Artwork (PWA) Identifier  = "01-W3015F01A "
MPU Clock Speed = "233"
Bus Clock Speed           = "067"
Ethernet Address          = 08003E20C983
Primary SCSI Identifier   = "07"
System Serial Number      = "163725       "
System Identifier         = "Motorola Series E603-166P "
License Identifier        = "12345678 "
PPC1-Bug>
```

CS - Checksum

Command Input

CS *RANGE* [**;B**|**H**|**W**]

Options

B	Byte
H	Half-word
W	Word

Description

The **CS** command calculates a checksum to verify the contents of a block of memory. It uses the same checksum routine that is run at system start-up. The checksum algorithm works as follows:

1. The checksum variable is set to zero.
2. Each data element is added to the checksum. If a carry is generated, a one is added to the checksum variable.

This process is repeated for each data element until the ending address is reached.

The option field serves both as a data size identifier and scale factor if a *COUNT* is specified as part of the *RANGE*. The size option is byte, half-word, or word for the items checked. The default data size is word.

The addresses used in the RANGE parameters can be provided in two forms:

- An absolute address (32-bit maximum).
- An expression using a displacement + relative offset register.

Examples

Example 1: Default size is word.

```
PPC1-Bug>CS 1000 2000 <Return>
Effective address: 00001000
Effective address: 00001FFF
Checksum: FF8D3E87
PPC1-Bug>
```

Example 2: Size is set to half-word.

```
PPC1-Bug>CS 1000 2000;H <Return>
Effective address: 00001000
Effective address: 00001FFF
Checksum: 3E15
PPC1-Bug>
```

Example 3: Size is set to byte, *COUNT* is in hexadecimal.

```
PPC1-Bug>CS FF800000:400;B <Return>
Effective address: FF800000
Effective count  : &1024
Checksum: 1C
PPC1-Bug>
```

Example 4: Default size is word, *COUNT* is in hexadecimal.

```
PPC1-Bug>CS FF800000:400 <Return>
Effective address: FF800000
Effective count  : &4096
Checksum: 00B50D05
PPC1-Bug>
```

CSAR - PCI Configuration Space READ Access

Command Input

CSAR *busnum devnum function addr* [**;B**|**H**|**W**]

Options

B	Byte
H	Half-word
W	Word (default)

Description

The **CSAR** command reads the location in PCI configuration space of the device at the PCI bus number specified by*:*

busnum	= the PCI bus number to be read
devnum	= the device number to be read
function	= the device function number to be read
addr	= the offset into the device configuration registers. *addr* must be between 0 and 255 decimal.
size (optional)	= the size of the location to be read

CSAR displays the value read.

Example: To read the register at offset 8 of the PCI device on PCI bus 0, which has a device ID of 12 (decimal), and function 0 of that device, do:

```
PPC1-Bug>csar 0 c 0 8<Return>
Read Data = 01000013
PPC1-Bug>
```

CSAW - PCI Configuration Space WRITE Access

Command Input

CSAW *busnum devnum function addr data* [**;B**|**H**|**W**]

Options

B	Byte
H	Half-word
W	Word (default)

Description

The **CSAW** command writes data to the location of the device in PCI configuration space at the PCI bus number specified by*:*

busnum	= the PCI bus number to be read
devnum	= the device number to be read
function	= the device function number to be read
addr	= the offset into the device configuration registers. *addr* must be between 0 and 255 decimal.
data	= the data that should be written
size (optional)	= the size of the location to be read

Example: To write the hexadecimal number **a** into the byte register at offset 3C of the PCI device on PCI bus 0, which has a device ID of 12 (decimal), and function 0 of that device, do:

```
PPC1-Bug>csaw 0 c 0 3C a;b<Return>
PPC1-Bug>
```

DC - Data Conversion

Command Input

DC *EXP* | *ADDR* [**;**[**B**] [**O**] [**A**]]

Options

B Display the output in binary

O Display the output in octal

A Display the ASCII character equal to the value. If the value is greater than $7F, the **A** option displays NA.

Description

The **DC** command calculates an expression into a single numeric value. This equivalent value is displayed in its hexadecimal and decimal representation. If the numeric value could be interpreted as a signed negative number (i.e., if the most significant bit of the 32-bit internal representation of the number is set), then both the signed and unsigned interpretations are displayed.

Examples

Example 1:

```
PPC1-Bug>DC 10 <Return>
          00000010 = $10 = &16
PPC1-Bug>
```

Example 2:

```
PPC1-Bug>DC &10-&20 <Return>
SIGNED  : FFFFFFF6 = -$A = -&10
UNSIGNED: FFFFFFF6 = $FFFFFFF6 = &4294967286
PPC1-Bug>
```

Example 3:

```
PPC1-Bug>DC 123+&345+@67+%1100001 <Return>
          00000314 = $314 = &788
PPC1-Bug>
```

Example 4:

```
PPC1-Bug>DC (2*3*8)/4 <Return>
          0000000C = $C = &12
PPC1-Bug>
```

Example 5:

```
PPC1-Bug>DC 55&F <Return>
          00000005 = $5 = &5
PPC1-Bug>
```

Example 6:

```
PPC1-Bug>DC 55>>1 <Return>
          0000002A = $2A = &42
PPC1-Bug>
```

Example 7:

```
PPC1-Bug>DC 1+2;B <Return>
DATA BIT: 33222222222211111111110000000000
NUMBER>>: 10987654321098765432109876543210
BINARY  : 00000000000000000000000000000011
PPC1-Bug>
```

Example 8:

```
PPC1-Bug>DC 1+2;BO <Return>
DATA BIT: 33222222222211111111110000000000
NUMBER>>: 10987654321098765432109876543210
BINARY  : 00000000000000000000000000000011
OCTAL   : 00000000003
PPC1-Bug>
```

Example 9:

```
PPC1-Bug>DC 1+2;BOA <Return>
DATA BIT: 33222222222211111111110000000000
NUMBER>>: 10987654321098765432109876543210
BINARY  : 00000000000000000000000000000011
OCTAL   : 00000000003
ASCII   : ETX
PPC1-Bug>
```

Example 10: For this example, assume R2=00030000 and the following data resides in memory:

```
00030000  11111111 22222222  33333333 44444444   ....""""3333DDDD

PPC1-Bug>DC R2 <Return>
          00030000 = $30000 = &196608
PPC1-Bug>
```

DMA - Block of Memory Move

Note This command works on boards with a VME2 bridge only.

Command Input

DMA *RANGE ADDR VDIR AM BLK* [**;B**|**H**|**W**]

Arguments

VDIR Direction of the transfer.

0 means the transfer occurs from the local bus to the VMEbus; **1** means the transfer occurs from the VMEbus to the local bus.

AM VMEbus address modifier of the transfer.

Refer to the VMEbus specification for the complete list of address modifiers. The VMEbus transfer address must also support transfers with the selected address modifier. Refer to the applicable board installation and use manual.

BLK Block transfer mode, which can be one of the following:

0	Block transfers disabled.
1	The DMA controller executes D32 block transfer cycles on the VMEbus. In the block transfer mode, the DMA controller may execute byte and two-byte cycles at the beginning and ending of a transfer in non-block transfer mode.
2	Block transfers disabled.
3	The DMA controller executes D64 block transfer cycles on the VMEbus. In the block transfer mode, the DMA controller may execute byte, two-byte, and four-byte cycles at the beginning and ending of a transfer in non-block transfer mode.

Options

B	Byte
H	Half-word
W	Word

Description

The **DMA** command moves blocks of data from the local bus to the VMEbus, or from the VMEbus to the local bus. This command. utilizes the hardware capability of Direct Memory Access (DMA). Refer to the board installation and use manual for a detailed description of DMA. You can not perform a DMA from the local bus to the local bus, or from the VMEbus to the VMEbus.

The **DMA** command copies (DMAs) the contents of the memory addresses defined by *RANGE* to another place in memory, beginning at *ADDR*.

The option field is only allowed when *RANGE* is specified using a *COUNT*. In this case, the **B**, **H**, or **W** defines the size of the data to which the *COUNT* is referring. For example, a *COUNT* of four with an option of **W** means to move four words (or 16 bytes) to the new location. If an option field is specified without a *COUNT* in the *RANGE*, an error results. The default data type is word.

Refer to the VMEbus specification for the complete description of block transfer mode. The VMEbus transfer address must also support block transfers if enabled, refer to the applicable board installation and use manuals.

At the end of the transfer, the **DMA** command displays the completion status of the transfer. A completion status of $1 is a successful transfer. Any other completion status means that the transfer was not successful. This status comes directly from the hardware status from the DMA controller.

Note If the block transfer modes are used to transfer data make sure that your VMEbus and VME memory actually support the block transfer modes.

When the command is given on a non-VMEbus board, the following message is shown:

```
This system does not host a VMEbus.
```

Be sure to set the high bit when specifying the address for the local memory. Setting the high bit directs the address to the PCI bus. The PCI bus actually strips the high bit and passes the address onward. When specifying the VMEbus address, be sure to specify the exact VME memory address (refer to the examples below). Refer to the board installation and use manual for information on the VMEbus.

Memory Location (Processor View)	As Used in the DMA Command
$0	$80000000
$4000	$80004000
$C1000000	$01000000
$C1002000	$01002000

Examples

Example 1: Transfer data from the VMEbus to the local bus with D32 block transfer cycles.

Fill memory on the VMEbus with an incrementing pattern (starts with a value of 0 and increments by 4). This makes it easier to illustrate some memory moves (DMAs) between the local bus and the VMEbus.

```
PPC1-Bug>BF C1000000 C2000000 0 4
Effective address: C1000000
Effective address: C1FFFFFF
PPC1-Bug>
```

First a range is given for the source location of the data on the VMEbus. Note that this is an exact address on the VMEbus. (From the beginning of the VME memory ($01000000 to $01800000).

The destination for the memory transfer is back to local memory on the board beginning at $0. Notice, that on the destination address the high bit is set. This is due to the PCI bus, the PCI bus masks the high bit and the actual data transfer maps to $0 (the beginning of local memory).

The *VDIR* argument is specified as $1 here because the transfer in this case should occur from the VMEbus to the local bus. The AM parameter is specified as $D to indicate (Extended Supervisory Data Access) for a simple data transfer. In this case, the block transfer was set to $1 which means that the DMA controller executes D32 block transfer cycles on the VMEbus.

```
PPC1-Bug>DMA 01000000 01800000 80000000 1 d 1 <Return>
Effective address: 01000000
Effective address: 017FFFFF
Effective address: 80000000
DMA Completion Status =00000001
PPC1-Bug>
```

By displaying the local memory which was the destination for the transfer we can see that the data from the VMEbus was transferred to local memory.

```
PPC1-Bug>MDS 0 <Return>
00000000  00000000 00000004 00000008 0000000C  ................
00000010  00000010 00000014 00000018 0000001C  ................
00000020  00000020 00000024 00000028 0000002C  ... ...$...(...,
00000030  00000030 00000034 00000038 0000003C  ...0...4...8...<
00000040  00000040 00000044 00000048 0000004C  ...@...D...H...L
00000050  00000050 00000054 00000058 0000005C  ...P...T...X...\
00000060  00000060 00000064 00000068 0000006C  ...‘...d...h...l
00000070  00000070 00000074 00000078 0000007C  ...p...t...x...|
00000080  00000080 00000084 00000088 0000008C  ................
00000090  00000090 00000094 00000098 0000009C  ................
000000A0  000000A0 000000A4 000000A8 000000AC  ................
000000B0  000000B0 000000B4 000000B8 000000BC  ................
000000C0  000000C0 000000C4 000000C8 000000CC  ................
000000D0  000000D0 000000D4 000000D8 000000DC  ................
000000E0  000000E0 000000E4 000000E8 000000EC  ................
000000F0  000000F0 000000F4 000000F8 000000FC  ................
00000100  00000100 00000104 00000108 0000010C  ................
00000110  00000110 00000114 00000118 0000011C  ................
00000120  00000120 00000124 00000128 0000012C  ... ...$...(...,
00000130  00000130 00000134 00000138 0000013C  ...0...4...8...<
00000140  00000140 00000144 00000148 0000014C  ...@...D...H...L
```

```
00000150  00000150 00000154 00000158 0000015C  ...P...T...X...\
00000160  00000160 00000164 00000168 0000016C  ...‘...d...h...l
00000170  00000170 00000174 00000178 0000017C  ...p...t...x...|
00000180  00000180 00000184 00000188 0000018C  ................
00000190  00000190 00000194 00000198 0000019C  ................
000001A0  000001A0 000001A4 000001A8 000001AC  ................
000001B0  000001B0 000001B4 000001B8 000001BC  ................
000001C0  000001C0 000001C4 000001C8 000001CC  ................
000001D0  000001D0 000001D4 000001D8 000001DC  ................
000001E0  000001E0 000001E4 000001E8 000001EC  ................
000001F0  000001F0 000001F4 000001F8 000001FC  ................
PPC1-Bug>
```

Example 2: Transfer data from the local bus to the VMEbus using D32 block transfer cycles.

```
PPC1-Bug>DMA 80000000 80800000 01000000 0 d 1 <Return>
Effective address: 80000000
Effective address: 807FFFFF
Effective address: 01000000
DMA Completion Status =00000001
PPC1-Bug>
```

We can use the block verify command to show that the incrementing pattern was copied to the destination VMEbus memory.

```
PPC1-Bug>BV C1000000 C1800000 0 4 <Return>
Effective address: C1000000
Effective address: C17FFFFF
PPC1-Bug>
```

Example 3: Transfer data from the local bus to the VMEbus. First, show the data at the destination so we can see it change.

```
PPC1-Bug>MD 100000:40 <Return>
00100000  7C3043AF 7CFFFBBF 7C3143A7 48FFFFDF  |0C.|...|1C.H...
00100010  00000001 00FFFC0F 00000003 00FFFFFF  ................
00100020  00048003 00FFFFFF 00000008 00FFEEEF  ................
00100030  0000000F 00FFFFFF 0000000D 00FFEEEF  ................
00100040  00000000 00FFF10F 0000000E 00FFD5FF  ...............
00100050  00000000 00FFF2EF 00000003 00FFFFBF  ................
00100060  0000000E 00FFFFFF 0000000A 00FFEAAF  ................
00100070  0000068E 00FFFFBF 00000001 00FFEFFF  ................
00100080  00000002 00FFF39F 00000002 00FFF39F  ................
00100090  00000001 00FFF91F 00000003 00FFDDDF  ................
001000A0  0000800F A0FFFFFF 0000020F 00FFF6EF  ................
001000B0  0000000D 00FFFFEF 0000200E 00FFF7FF  .......... .....
```

```
001000C0  00000004 00FFF88F 00000005 00FFFF2F  ................/
001000D0  00000009 00FFF84F 00000005 00FFFDDF  .......O........
001000E0  0008050F 00FFFFFF 0000000F 00FFFFFF  ................
001000F0  0000000D 00FFFF2F 00000008 00FFF7EF  ......./........
PPC1-Bug>DMA 80100000:40 01000000 0 d 0;W <Return>
Effective address: 80100000
Effective count  : &256
Effective address: 01000000
DMA Completion Status =00000001
PPC1-Bug>
```

In the above example, 256 bytes of data was moved from the local bus to the VMEbus. At the end of the transfer, the **DMA** command displays the completion status of the transfer.

View the transferred data:

```
PPC1-Bug>MD C1000000:40 <Return>
C1000000  7C3043AF 7CFFFBBF 7C3143A7 48FFFFDF  |0C.|...|1C.H...
C1000010  00000001 00FFFC0F 00000003 00FFFFFF  ................
C1000020  00048003 00FFFFFF 00000008 00FFEEEF  ................
C1000030  0000000F 00FFFFFF 0000000D 00FFEEEF  ................
C1000040  00000000 00FFF10F 0000000E 00FFD5F  ..............._
C1000050  00000000 00FFF2EF 00000003 00FFFBBF  ................
C1000060  0000000E 00FFFFFF 0000000A 00FFEAF  ................
C1000070  0000068E 00FFFFBF 00000001 00FFEFF  ................
C1000080  00000002 00FFF39F 00000002 00FFF39F  ................
C1000090  00000001 00FFF91F 00000003 00FFDDF  ................
C10000A0  0000800F A0FFFFFF 0000020F 00FFF6EF  ................
C10000B0  0000000D 00FFFFEF 0000200E 00FFF7FF  .......... .....
C10000C0  00000004 00FFF88F 00000005 00FFFF2F  ...............//
C10000D0  00000009 00FFF84F 00000005 00FFFDDF  .......O........
C10000E0  0008050F 00FFFFFF 0000000F 00FFFFFF  ................
C10000F0  0000000D 00FFFF2F 00000008 00FFF7EF  ......./........
PPC1-Bug>
```

Example 4: Transfer data from the VMEbus to the local bus.

Display the 64 bytes of data on the VMEbus which are to be transferred.

```
PPC1-Bug>MD C1000000:10 <Return>
C1000000  5A5A5A5A 5A5A5A5A 5A5A5A5A 5A5A5A5A  ZZZZZZZZZZZZZZZZ
C1000010  5A5A5A5A 5A5A5A5A 5A5A5A5A 5A5A5A5A  ZZZZZZZZZZZZZZZZ
C1000020  5A5A5A5A 5A5A5A5A 5A5A5A5A 5A5A5A5A  ZZZZZZZZZZZZZZZZ
C1000030  5A5A5A5A 5A5A5A5A 5A5A5A5A 5A5A5A5A  ZZZZZZZZZZZZZZZZ
PPC1-Bug>
```

Transfer the 64 bytes from the beginning of VMEbus memory to location $2000 in local memory. A display of the local memory shows the newly transferred data.

```
PPC1-Bug>DMA 01000000:10 80002000 1 D 0 <Return>
Effective address: 01000000
Effective count  : &64
Effective address: 80002000
DMA Completion Status =00000001
PPC1-Bug>MD 00002000:10 <Return>
00002000  5A5A5A5A 5A5A5A5A 5A5A5A5A 5A5A5A5A  ZZZZZZZZZZZZZZZZ
00002010  5A5A5A5A 5A5A5A5A 5A5A5A5A 5A5A5A5A  ZZZZZZZZZZZZZZZZ
00002020  5A5A5A5A 5A5A5A5A 5A5A5A5A 5A5A5A5A  ZZZZZZZZZZZZZZZZ
00002030  5A5A5A5A 5A5A5A5A 5A5A5A5A 5A5A5A5A  ZZZZZZZZZZZZZZZZ
```

Example 5: Attempt to DMA to non-existent VMEbus memory. The command displays the DMA controller status register and the DMA controller counter registers.

```
PPC1-Bug>DMA 80000000:15 05000000 0 D 0;B <Return>
Effective address: 80000000
Effective count  : &21
Effective address: 05000000
DMA Completion Status =00000002
DMA Byte Counter              =00000000
DMA Local Bus Address Counter =80000015
DMA VMEbus Address Counter    =05000004
PPC1-Bug>
```

DS - One-Line Disassembler

Command Input

DS *ADDR* [*:COUNT* | *ADDR*]

Description

The **DS** command enables the one-line disassembler. This command is synonymous with the Memory Display (**MD**) command when used with the **DI** option (**MD** *ADDR*;**DI**). Refer to *MD, MDS - Memory Display* on page 3-125 for details. Refer to Chapter 4 for information on using the one-line assembler.

DU - Dump S-Records

Command Input

DU [*PORT*] *RANGE* [*TEXT*] [*ADDR*] [*OFFSET*] [**;B**|**H**|**W**]

Description

The **DU** command outputs data from memory in the form of Motorola S-records to a port you specified. If port is not specified, the S-records are sent to the host port, and the missing port number must be delimited by two commas.

A size option is allowed only if a *COUNT* was entered as part of the *RANGE*, and defines the units of the *COUNT*. The default data type is byte.

The optional *TEXT* argument is for text that will be incorporated into the header (S0) record of the block of records that will be dumped.

The optional *ADDR* argument is to allow you to enter an entry address for code contained in the block of records. This address is incorporated into the address field of the block termination record. If no entry address is entered, then the address field of the termination record will consist of zeros. The termination record will be an S7, S8, or S9 record, depending on the address entered. Appendix D has additional information on S-records.

You may also specify an optional offset in the *OFFSET* argument. The offset value is added to the addresses of the memory locations being dumped, to come up with the address which is written to the address field of the S-records. This allows you to create an S-record file which will load back into memory at a different location than the location from which it was dumped. The default offset is zero.

Note If an offset is to be specified but no entry address is to be specified, then two commas (indicating a missing field) must precede the offset to keep it from being interpreted as an entry address.

Examples

Example 1: Dump memory from $20000 to $2002F to port 1.

```
PPC1-Bug>DU „20000 2002F <Return>
Effective address: 00020000
Effective address: 0002002F
PPC1-Bug>
```

Example 2: Dump 10 bytes of memory beginning at $30000 to the terminal screen (port 0).

```
PPC1-Bug>DU 0 30000:&10 <Return>
Effective address: 00030000
Effective count : &10
S0030000FC
S20E0300002602544535466084E4F7B
S9030000FC
PPC1-Bug>
```

Example 3: Dump memory from $20000 to $2002F to host (port 1). Specify a file named **TEST** in the header record and specify an entry point of $2000A.

```
PPC1-Bug>DU „20000 2002F 'TEST' 2000A <Return>
Effective address: 00020000
Effective address: 0002002F
PPC1-Bug>
```

ECHO - Echo String

Command Input

ECHO [*PORT*] {*hexadecimal number*} {*'string'*}

Description

The **ECHO** command displays strings to a configured port. ASCII *strings* can be entered by enclosing them in single quotes ('). To include a quote as part of a string, enter two consecutive quotes.

The hexadecimal number allows printing **<NL>**, **<CR>**, and other control symbols. A hexadecimal number must have two digits before it is displayed.

Note that one or more hexadecimal numbers and ASCII strings may be entered in the same command.

If the port number is not specified (substituted by commas), *ECHO* uses the current console port.

Examples

Example 1: Display the ASCII string to the current console port.

```
PPC1-Bug>ECHO „'quick brown fox jumps over the lazy dog' 0A <Return>
quick brown fox jumps over the lazy dog
PPC1-Bug>
```

Example 2: Send the ASCII string and a BELL character to port #1.

```
PPC1-Bug>ECHO 1 'this is a test' 07 <Return>
PPC1-Bug>
```

Example 3: In this example an error message results because the selected port is not configured.

```
PPC1-Bug>ECHO 2 'this is a test' <Return>
Logical unit $02 unassigned
PPC1-Bug>
```

Example 4: This example handles a string with quotes.

```
PPC1-Bug>ECHO „ 'This is "PPCBUG"' <Return>
This is “PPCBUG”
PPC1-Bug>
```

ENV - Set Environment

Command Input

ENV [**;**[**D**]]

Description

The **ENV** command allows you to view and configure all PPCBug operational parameters that are kept in Non-Volatile RAM (NVRAM). The operational parameters are saved in NVRAM and used whenever power is lost. (The NVRAM is also known as the Battery Backed Up RAM.)

Any time PPCBug uses a parameter from NVRAM, the NVRAM contents are first tested by checksum to insure the integrity of the NVRAM contents. In the instance of NVRAM checksum failure, certain default values are assumed.

The debugger operational parameters (which are kept in NVRAM) are not initialized automatically on power-up/warm reset. It is up to you to invoke the **ENV** command. Once the **ENV** command is invoked and executed without error, debugger default and/or user parameters are loaded into NVRAM along with checksum data. If any of the operational parameters have been modified, these new parameters will not be in effect until a reset or power-up condition.

If the **ENV** command is invoked with the **D** option, ROM defaults will be loaded into NVRAM. If the **ENV** command is invoked without the **D** option, you are prompted to configure all operational parameters. You may change the displayed value by typing a new value, followed by the Return key. To leave the field unaltered, press the Return key without typing a new value.

Refer to the board installation and use manual for the location and contents of the board information block, and the size and logical offset of each element.

Note Not all ENV parameters are shown in this manual.

You may also enter a special character, either at the prompt or after typing new data, for scrolling through the fields. The special characters are:

V or **v**	Go to the next field. This is the default, and remains in effect until changed by entering one of the other special characters.
^	Back up to the previous field. This remains in effect until changed by entering one of the other special characters.
=	Re-open the same field
.	Terminate the **ENV** command, and return control to the debugger

Programming The VMEbus Slave Image Map Decoders.

The VMEbus slave image map decoders allow a VMEbus master to access the resources on the local primary PCI bus, and control the type of access to those resources. These decoders are located in the Universe VMEbus interface chip. The following general procedure can be used with the **ENV** command to configure the VMEbus slave image map decoders. This is not the only procedure that can be used to program the map decoders. More complete information on this subject can be found in the User's Manual for the Universe chip, the VMEbus specification, the PCI bus specification, and the Programmer's Guide for the specific board being used.

1. Determine the desired VMEbus base address. This is the starting, or lowest, address that any resource on the local PCI bus can be accessed on the VMEbus. This address must not allow an overlap of the Universe's control and status registers or any other VMEbus resource's address space. The first VMEbus slave decoder (for VME slave image 0) has a 4K-byte resolution but VMEbus slave images 1, 2, and 3, have a 64K-byte resolution.

2. Determine the desired VMEbus bound address. This is the ending, or highest, address that any resource on the local PCI bus can be accessed on the VMEbus. The address on the VMEbus must lie within the window defined by the base and bound addresses to gain a response.

3. Determine any necessary VMEbus translation offset. The offset value is added to the VMEbus address to create the PCI bus address.

4. Determine the necessary VMEbus slave image control. The value used for slave image control is made up of several bit fields which specify how reads and writes will be processed by the Universe device. The desired value can be determined by progressively ORing together the selected bit fields described below.

   To select the type of PCI address space that will respond in the defined VMEbus window, use the following:
   0x00000000 for PCI Memory space, zero no bits are set.
   0x00000001 for PCI I/O space.
   0x00000002 for PCI Configuration space.

   To lock PCI transactions resulting from VMEbus Read-Modify-Writes, OR the following value with that chosen above:
   0x00000040

   To enable 64-bit PCI transactions, OR the following value with those chosen above: 0x00000080

   To select the VMEbus address space accesses to decode, OR the value defined here with those chosen above:
   0x00000000 for A16 space, zero no bits are set.
   0x00010000 for A24 space.
   0x00020000 for A32 space.

   To select the mode of VMEbus accesses to decode, OR the value defined here with those chosen above:
   0x00100000 for non-privileged.
   0x00200000 for supervisor.
   0x00300000 for both non-privileged and supervisor, two bits set.

   To select the type of VMEbus accesses to decode, OR the value defined here with those chosen above:
   0x00400000 for data.
   0x00800000 for program.
   0x00C00000 for both data and program, two bits are set.

   To enable prefetch reads for incoming VMEbus block read cycles, OR the following value with those chosen above:
   0x20000000

   To enable posted writes of incoming data on the VMEbus, OR the following value with those chosen above: 0x40000000

To enable the selected VME Slave Image Map Decoder, OR the following value with those chosen above: 0x80000000

As an example, a control value of: 0xE0F20000
decodes A32, non-privileged and supervisor, data and program VMEbus space, with prefetch reads, and posted writes enabled.

It is the user's responsibility to ensure that the selected control bits are not destructive, and that the resources present on the VMEbus and PCI bus support the access and transaction controls chosen.

ENV Command Parameters

The parameters that can be configured with ENV are listed and described in your board-specific installation and use manual.

Systems with Wide SCSI Drives Running AIX

If AIX (or some other OS) is booted on a system with wide SCSI drives, and then the system is reset, PPCBug will not be able to access the wide SCSI drives. This problem may be corrected by running **ENV** and enabling PPCBug to reset the SCSI bus on startup as follows:

```
Local SCSI Bus Reset on Debugger Startup [Y/N] = N? y
```

This **ENV** change should be made to all PowerPlus architecture systems running AIX.

Note This problem is fixed in PPCBug release 3.2 and later.

LED/Serial Startup Diagnostic Codes

These codes can be displayed at key points in the initialization of the hardware devices. Should the debugger fail to come up to a prompt, the last code displayed will indicate how far the initialization sequence had progressed before stalling. The codes are enabled by an **ENV** parameter:

Serial Startup Code Master Enable [Y/N]=N?

A line feed can be inserted after each code is displayed to prevent it from being overwritten by the next code. This is also enabled by an **ENV** parameter:

Serial Startup Code LF Enable [Y/N]=N?

The list of LED/serial codes is included in the section on MPU, Hardware, and Firmware Initialization in Chapter 1.

Memory Usage Control

The amount of RAM that PPCBug uses may be contained with an NVRAM parameter. This parameter is set by the ENV line:

```
Maximum Memory Usage (Mb, 0=AUTO) = 1?
```

If the parameter is set to a non-zero value, it is interpreted as the maximum number of megabytes that PPCBug is allowed to control. At start-up, one megabyte at the top of physical memory is set aside. If more than this is required, allocation is expanded toward smaller addresses unless the specified maximum value is achieved. If this occurs, the current memory request will be denied followed, most likely, by failure of the current activity.

If the parameter is set to zero, expansion is unlimited.

In no case, however, is expansion allowed to exceed one-half of the available memory regardless of how high the parameter is set.

Two things should be considered in setting this parameter:

1. Memory, once acquired, is never returned. The total memory used sets the system's maximum use level. This number may be obtained using the Memory Manager Query command (MMGR).
2. Expansion is incremental and on demand. Only what is actually required will be used.

Thus, the total used is the system's current maximum usage level gauge. This number may be obtained, after the system has exercised, using the Memory Manager Query command (MMGR).

FORK - Fork Idle MPU at Address

Note This command is for multi-processor boards only.

Command Input

FORK *MPU# ADDR*

Description

The **FORK** command allows you to fork an idle processor to target code that is pointed to by the *ADDR* argument. The *MPU#* argument depends on your configuration and idle processors present. It is the target code's responsibility to load the processor's registers. Once a processor is forked, the only means back to the idle state would be by execution of the system call **.IDLEMPU**. Refer to the *System Calls* chapter in this manual for the description of the system call.

To inquire of the BUG about idle processors, refer to the **RUN** command.

Example

Fork processor #1 to address $10000.

```
PPC1-Bug>fork 1 10000
PPC1-Bug>
```

FORKWR - Fork Idle MPU with Registers

Note This command is for multi-processor boards only.

Command Input

FORKWR *MPU#*

Description

The **FORKWR** command allows you to fork an idle processor to target code. The associated register set is loaded before execution. The *MPU#* argument depends on your configuration and idle processors present.

The idle processor's registers can be examined/modified by the commands **IRD**, **IRM**, and **IRS**. Once a processor is forked, the only means back to the idle state would be by execution of the system call **.IDLEMPU**. Refer to the *System Calls* chapter in this manual for the description of the system call.

To inquire of the BUG about idle processors, refer to the **RUN** command.

Example

Fork processor #1.

```
PPC1-Bug>forkwr 1
PPC1-Bug>
```

GD - Go Direct (Ignore Breakpoints)

Command Input

GD [*ADDR*]

Description

The **GD** command starts target code execution. If an address is specified, it is placed in the target IP. Execution starts at the target IP address. Unlike **GO**, breakpoints are not inserted.

Once execution of the target code has begun, control may be returned to the debugger by one of the following conditions:

- The abort or reset switch on the debugger host was pressed.
- An unexpected exception occurred.

Example

The following program resides at $20000.

```
PPC1-Bug>DS 20000:10 <Return>
00020000 3C600004  ADDIS       R3,R0,$4
00020004 60631000  ORI         R3,R3,$1000
00020008 7C641B78  OR          R4,R3,R3
0002000C 3CA00005  ADDIS       R5,R0,$5
00020010 60A51000  ORI         R5,R5,$1000
00020014 3CC00000  ADDIS       R6,R0,$0
00020018 90C40000  STW         R6,$0(R4) ($00041000)
0002001C 38840004  ADDI        R4,R4,$4
00020020 7F042840  CMPL        CRF6,0,R4,R5
00020024 409AFFF4  BC          4,26,$00020018
00020028 38C60001  ADDI        R6,R6,$1
0002002C 38E7FFFF  ADDI        R7,R7,$FFFFFFFF
00020030 7C641B78  OR          R4,R3,R3
00020034 2B070000  CMPLI       CRF6,0,R7,$0
00020038 409AFFE0  BC          4,26,$00020018
0002003C 00000000  WORD        $00000000
PPC1-Bug>
```

Set breakpoint at $20028.

```
PPC1-Bug>BR 20028 <Return>
BREAKPOINTS
00020028
PPC1-Bug>
```

Initialize R7 and start target the program.

```
PPC1-Bug>RM R7 <Return>
R7     =00000000 ? FFFFFFFF. <Return>
PPC1-Bug>

PPC1-Bug>GD 20000 <Return>
Effective address: 00020000
```

To exit target code, press the abort switch. Note that the breakpoint was not taken.

```
Exception: System Reset (Soft)
SRR0 =00020020 SRR1 =00003030 Vector-Offset =00100
IP     =00020020 MSR    =00003030 CR     =00000080 FPSCR  =00000000
R0     =00000000 R1     =00020000 R2     =10000001 R3     =00041000
R4     =000410F4 R5     =00051000 R6     =00009A46 R7     =FFFF65B9
R8     =00000000 R9     =00000000 R10    =00000000 R11    =00000000
R12    =00000000 R13    =00000000 R14    =00000000 R15    =00000000
R16    =00000000 R17    =00000000 R18    =00000000 R19    =00000000
R20    =00000000 R21    =00000000 R22    =00000000 R23    =00000000
R24    =00000000 R25    =00000000 R26    =00000000 R27    =00000000
R28    =00000000 R29    =00000000 R30    =00000000 R31    =00000000
SPR0   =00000000 SPR1   =00000000 SPR8   =00000000 SPR9   =00000000
00020020 7F042840  CMPL        CRF6,0,R4,R5
PPC1-Bug>
```

GEVBOOT - Global Environment Variable Boot

Command Input

GEVBOOT *Variable-Name*

Description

The **GEVBOOT** command permits the user to boot the system using a Global Environment Variable, *Variable-Name*, which is a “fw-boot-path”.

Background: Residual Data and Boot List

Recent releases of IBM AIX requires that the PReP style of residual data be provided by the system firmware. Previous releases of IBM's AIX did not require that residual data be implemented.

Residual data, basically, informs the operating system of the system attributes (i.e., what devices are present, how are they configured, are they bootable?, etc.). To some degree, it is an abstraction of the hardware that the system firmware provides.

IBM has further defined what residual data should look like now.

This latest version of IBM AIX also requires that the system firmware must support a boot list. This boot list contains a list of bootable devices that the firmware utilizes to boot the system. This boot list is housed within a Global Environment Variable (GEV). The GEVs are kept in the PReP partition of NVRAM, more specifically, the global environment variable area. Through this GEV, the OS/user can configure the system for its boot device selection policy.

This latest version of IBM AIX also requires that the system firmware support the PReP style of network booting. The PReP style of network boot treats the network boot image the same as a mass storage (e.g., hard disk, floppy) boot image. The network boot feature facilitates AIX network install manager (NIM) feature.

Requirements

Some high-level requirements that this release meets are:

- Residual Data as specified above.
- Boot List Support via "fw-boot-path", "fw-boot-device", and "boot-file" global environment variables
- Network Boot, PReP style
- OEM Banner support
- Initialization of the PIRQ*x* (PCI Interrupts) route control registers.
- System uniqueness (i.e., board serial number)

The "boot list" and "OEM banner support" requirements require that the firmware be capable of reading and writing global environment variables. These variables are housed within the global environment area of NVRAM (i.e., the PReP partition).

Each mass storage device, and network interface supported from the firmware must identify itself. This identification is per the firmware device naming convention, as outlined in the IBM document. The device naming convention follows the Open Firmware device naming convention. The GE variables, "fw-boot-path" and "fw-boot-device", consist of device names.

Global Environment Variables (GEVs)

The product supports the following GEVs:

- MOT-OEM-BANNER
  This variable is used by the firmware to display the OEM banner (if initialized). The contents of this GEV are displayed prior to the display of the firmware copyright message.
- MOT-OEM-ID
  This variable is used by the firmware to apply any special switches, product variations, other alterations as needed.

- fw-boot-path
  This variable contains a list (four maximum) of boot devices which can be booted from. The OS maintains this variable. This is a read-only variable from the firmware's perspective. (The firmware does not impose any limit upon the length of this list.) However, this variable may be modified by utilizing the **GEVEDIT** command.

- fw-boot-device
  This variable contains the boot device path from the current boot device (i.e., the device just booted from, mass storage or network). This variable is updated on each successful boot (i.e., IPL loaded).

- ClientIPAddr
  This variable is updated on each successful network boot. It contains the client's internet protocol address.

- ServerIPAddr
  This variable is updated on each successful network boot. It contains the server's internet protocol address.

- GatewayIPAddr
  This variable is updated on each successful network boot.It contains the gateway internet protocol address to the server.

- NetMask
  This variable is updated on each successful network boot. It contains the internet protocol address mask. The mask is applied to both the server's and client's IP address to determine if the gateway must be used.

- boot-file
  This variable is updated on each successful network boot. It contains the name of the boot file.

Styles of Booting

The older Motorola mode of mass storage device booting was also preserved for backward compatibility. However, priority is given to the new style of booting (i.e., NVRAM boot list).

The older product supports booting from the network. However, it does not support it as per the PReP specification. The PReP specification specifies the boot image from a mass storage device to be the same when booting from a network interface. The older support treats the network boot image as a raw binary, no format understood. The new support understands the PReP boot image. The PReP boot image does have a defined format. The network boot image may be loaded any where in memory, as per the PReP specification.

Support has been added to the product to enable the PReP style of networking booting. The former style is also preserved for backward compatibility. However, priority is given to the new style of network booting. This capability is in the form of a new **ENV** parameter.

Both styles of network booting are supported. The new style of networking booting (i.e., PReP) is controlled by an **ENV** configuration parameter. The default state of the **ENV** configuration parameter is set to enable the PReP style of network booting. Disabling this parameter will effectively default the network boot process to the past mode of network booting (i.e., no file format understood). This support is identified by the following **ENV** parameter:

`Network PReP-Boot Mode Enable [Y/N],` *defaults to 'Y'*

PPC1Bug revision 1.8 added a new global environment variable (GEV) "fw-boot-path" boot to the global firmware boot process. The boot priority, for both mass storage device boot and network interface boot, is given first to the "fw-boot-path" GEV.

To support this, a new boot process has been added. This boot process is labeled "NVRAM Boot List" boot.This new boot process is identified by the **ENV** command parameters of:

`NVRAM Boot List (GEV.fw-boot-path) Boot Enable [Y/N],` *defaults to 'Y'*
`NVRAM Boot List (GEV.fw-boot-path) Boot at power-up only [Y/N],` *defaults to 'N'*
`NVRAM Boot List (GEV.fw-boot-path) Boot Abort Delay,` *defaults to 5*

The default state of the **ENV** configuration parameter is set to 'Y' for yes/enabled. This gives boot priority to the devices listed within the "fw-boot-path" GEV. Setting this **ENV** configuration parameter to 'N' for no/disabled, effectively changes the behavior of boot policy to the same behavior as prior products. If the "fw-boot-path" GEV is not initialized, this also effectively has the same behavior as prior products.

This new boot takes priority over all other boots (i.e., Auto Boot, Network Boot). This boot may also be executed manually from the firmware command line via the **GEVBOOT** command.

The following global environment variables are updated upon each successful network boot: fw-boot-device, ClientIPAddr, ServerIPAddr, GatewayIPAddr, NetMask, and boot-file.

The "fw-boot-device" GEV is updated upon each boot instance. This is done regardless of the specified boot policy. Both the mass storage device boot module, and the network interface boot module are modified to set the GEV at every successful boot instance.

The "fw-boot-path" GEV is a list (a maximum of four) of "fw-boot-device" GEVs. Boot priority is always given to the first device in the list.

Example

*Show storage devices via **ioi***

```
PPC1-Bug>ioi;d
I/O Inquiry Status:
CLUN DLUN CNTRL-TYPE DADDR DTYPE RM Inquiry-Data
 1 0 PC8477 0 $00 Y <None>
Device-Name =/pci@80000000/pci8086,484@b,0/PNP0700@3f0/floppy@0
```

fw-boot-path needs to be defined as a device that was shown to be available via ***ioi***

```
PPC1-Bug>gevshow
fw-boot-device=/pci@80000000/pci1011,9@e,0:0,0
ClientIPAddr=144.191.24.121
ServerIPAddr=144.191.24.252
GatewayIPAddr=144.191.12.252
NetMask=255.255.255.0
boot-file=/usr/tmp/jdcham.ram
fw-boot-path=/pci@80000000/pci8086,484@b,0/PNP0700@3f0/floppy@0
Total Number of GE Variables =7, Bytes Utilized =313, Bytes Free =1999
```

gevboot *automatically uses fw-boot-device -- in this example it fails because there is no floppy in the drive with a bootable image*

```
PPC1-Bug>gevboot

NVRAM Boot List about to Begin... Press <ESC> to Bypass, <SPC> to Continue
Scanning System for Attached Boot Devices
/pci@80000000/pci8086,484@b,0/PNP0700@3f0/floppy@0
/pci@80000000/pci1011,9@e,0:0,0

Attempting BOOT from Devices Specified by the GE Variable “fw-boot-path”
/pci@80000000/pci8086,484@b,0/PNP0700@3f0/floppy@0
PPC1-Bug>
```

GEVDEL - Global Environment Variable Delete

Command Input

GEVDEL *Variable-Name*

Description

The **GEVDEL** command permits the user to selectively delete a Global Environment Variable, *Variable-Name*.

Example

```
PPC1-Bug>gevdel testvar
testvar=12345

Update Global Environment Area of NVRAM (Y/N)? y
PPC1-Bug>
```

Show that the variable is deleted

```
PPC1-Bug>gevshow
fw-boot-device=/pci@80000000/pci1011,9@e,0:0,0
ClientIPAddr=144.191.24.121
ServerIPAddr=144.191.24.252
GatewayIPAddr=144.191.12.252
NetMask=255.255.255.0
boot-file=/usr/tmp/jdcham.ram
Total Number of GE Variables =6, Bytes Utilized =184, Bytes Free =2128
PPC1-Bug>
```

GEVDUMP - Global Environment Variable(s) Dump

Command Input

GEVDUMP

Description

The **GEVDUMP** command permits the user to dump to the console, in a hexadecimal/ASCII fashion, the contents of NVRAM (i.e., the PReP partition). These contents include the NVRAM Header + Data.

Example

```
PPC1-Bug>gevdump

01F8B000  00 04 01 02 07 E8 59 C3  02 00 01 00 00 00 00 00 ......Y.........
01F8B010  00 00 00 00 00 00 00 00  00 00 00 00 00 00 00 00 ................
01F8B020  00 00 00 00 00 00 00 00  00 00 00 00 00 00 00 00 ................
01F8B030  00 00 00 00 00 00 00 00  00 00 00 00 00 00 00 00 ................
01F8B040  00 00 00 00 00 00 00 00  00 00 00 00 00 00 00 00 ................
01F8B050  00 00 00 00 00 00 00 00  00 00 00 00 00 00 00 00 ................
01F8B060  00 00 00 00 00 00 00 00  00 00 00 00 00 00 00 00 ................
01F8B070  00 00 00 00 00 00 00 00  00 00 00 00 00 00 00 00 ................
01F8B080  00 00 00 00 00 00 00 00  00 00 00 00 00 00 00 00 ................
01F8B090  00 00 00 00 00 00 00 00  00 00 00 00 00 00 00 00 ................
01F8B0A0  00 00 00 00 00 00 00 00  00 00 00 00 00 00 00 00 ................
01F8B0B0  00 00 00 00 00 00 00 00  00 00 00 00 00 00 00 00 ................
01F8B0C0  00 00 00 00 00 00 00 F8  00 00 09 08 00 00 00 00 ................
01F8B0D0  00 00 00 00 00 00 0C 00  00 00 04 00 00 00 00 00 ................
01F8B0E0  00 00 00 00 00 00 00 00  00 00 0A 00 00 00 02 00 ................
01F8B0F0  19 94 01 04 21 27 48 00  66 77 2D 62 6F 6F 74 2D ....!'H.fw-boot-
```

```
01F8B100  64 65 76 69 63 65 3D 2F  70 63 69 40 38 30 30 30 device=/pci@8000
01F8B110  30 30 30 30 2F 70 63 69  31 30 31 31 2C 39 40 65 0000/pci1011,9@e
01F8B120  2C 30 3A 30 2C 30 00 43  6C 69 65 6E 74 49 50 41 ,0:0,0.ClientIPA
01F8B130  64 64 72 3D 31 34 34 2E  31 39 31 2E 32 34 2E 31 ddr=144.191.24.1
01F8B140  32 31 00 53 65 72 76 65  72 49 50 41 64 64 72 3D 21.ServerIPAddr=
01F8B150  31 34 34 2E 31 39 31 2E  32 34 2E 32 35 32 00 47 144.191.24.252.G
01F8B160  61 74 65 77 61 79 49 50  41 64 64 72 3D 31 34 34 atewayIPAddr=144
01F8B170  2E 31 39 31 2E 31 32 2E  32 35 32 00 4E 65 74 4D .191.12.252.NetM
01F8B180  61 73 6B 3D 32 35 35 2E  32 35 35 2E 32 35 35 2E ask=255.255.255.
01F8B190  30 00 62 6F 6F 74 2D 66  69 6C 65 3D 2F 75 73 72 0.boot-file=/usr
01F8B1A0  2F 74 6D 70 2F 6A 64 63  68 61 6D 2E 72 61 6D 00 /tmp/jdcham.ram.
01F8B1B0  00 00 00 00 00 00 00 00  00 00 00 00 00 00 00 00 ................
01F8B1C0  00 00 00 00 00 00 00 00  00 00 00 00 00 00 00 00 ................
01F8B1D0  00 00 00 00 00 00 00 00  00 00 00 00 00 00 00 00 ................
01F8B1E0  00 00 00 00 00 00 00 00  00 00 00 00 00 00 00 00 ................
01F8B1F0  00 00 00 00 00 00 00 00  00 00 00 00 00 00 00 00 ................
```

:

More stuff in between

:

```
01F8BF00  00 00 00 00 00 00 00 00  00 00 00 00 00 00 00 00 ................
01F8BF10  00 00 00 00 00 00 00 00  00 00 00 00 00 00 00 00 ................
01F8BF20  00 00 00 00 00 00 00 00  00 00 00 00 00 00 00 00 ................
01F8BF30  00 00 00 00 00 00 00 00  00 00 00 00 00 00 00 00 ................
01F8BF40  00 00 00 00 00 00 00 00  00 00 00 00 00 00 00 00 ................
01F8BF50  00 00 00 00 00 00 00 00  00 00 00 00 00 00 00 00 ................
01F8BF60  00 00 00 00 00 00 00 00  00 00 00 00 00 00 00 00 ................
01F8BF70  00 00 00 00 00 00 00 00  00 00 00 00 00 00 00 00 ................
01F8BF80  00 00 00 00 00 00 00 00  00 00 00 00 00 00 00 00 ................
01F8BF90  00 00 00 00 00 00 00 00  00 00 00 00 00 00 00 00 ................
01F8BFA0  00 00 00 00 00 00 00 00  00 00 00 00 00 00 00 00 ................
01F8BFB0  00 00 00 00 00 00 00 00  00 00 00 00 00 00 00 00 ................
01F8BFC0  00 00 00 00 00 00 00 00  00 00 00 00 00 00 00 00 ................
01F8BFD0  00 00 00 00 00 00 00 00  00 00 00 00 00 00 00 00 ................
01F8BFE0  00 00 00 00 00 00 00 00  00 00 00 00 00 00 00 00 ................
01F8BFF0  00 00 00 00 00 00 00 00  00 00 00 00 00 00 00 00 ................

PPC1-Bug>
```

GEVEDIT - Global Environment Variable Edit

Command Input

GEVEDIT *Variable-Name*

Description

The **GEVEDIT** command permits the user to selectively edit a Global Environment Variable, *Variable-Name*.

This writing of new, or modification of existing, global environment variables, is available from the command line (i.e., on demand), or at any time within the product (i.e., a function call).

Example

```
PPC1-Bug>gevedit testvar
testvar=12345

Update Global Environment Area of NVRAM (Y/N)? y
PPC1-Bug>
```

Show the new variable

```
PPC1-Bug>gevshow
fw-boot-device=/pci@80000000/pci1011,9@e,0:0,0
ClientIPAddr=144.191.24.121
ServerIPAddr=144.191.24.252
GatewayIPAddr=144.191.12.252
NetMask=255.255.255.0
boot-file=/usr/tmp/jdcham.ram
testvar=12345
Total Number of GE Variables =7, Bytes Utilized =196, Bytes Free =2116
PPC1-Bug>
```

GEVINIT - Global Environment Variable Initialization

Command Input

GEVINIT

Description

The **GEVINIT** command permits the user to initialize the NVRAM Header (i.e., the PReP partition) information.

Initialization of the NVRAM PReP partition is available from the command line (i.e., on demand), or at any time when the system's firmware initializes itself (i.e., buginit()).

The auto initializing of the NVRAM (PReP partition) header, is controlled by an **ENV** configuration parameter. The default state of this parameter is set to enabled. The following is the **ENV** parameter syntax:

`Auto-Initialize of NVRAM Header Enable [Y/N],` *defaults to 'Y'*

If you answer Y, it will initialize the header; if you answer N, it won't.

Examples

GEVINIT *example with (yes) for update*

```
PPC1-Bug>gevinit

Update Global Environment Area of NVRAM (Y/N)? y
PPC1-Bug>
```

GEVINIT *example with (no) for update*

```
PPC1-Bug>gevinit

Update Global Environment Area of NVRAM (Y/N)? n
PPC1-Bug>
```

GEVSHOW - Global Environment Variable(s) Display

Command Input

GEVSHOW [*string*]

Description

The **GEVSHOW** command permits the user to selectively display the contents of a currently configured global environment variable (by typing *string*, where *string* is the name of a variable), or to display all currently configured global environment variables.

Reading of global environment variables (GEV read) is available from the command line (i.e., on demand), or at any time within the product (i.e., a function call).

Example

```
PPC1-Bug>gevshow
fw-boot-device=/pci@80000000/pci1011,9@e,0:0,0
ClientIPAddr=144.191.24.121
ServerIPAddr=144.191.24.252
GatewayIPAddr=144.191.12.252
NetMask=255.255.255.0
boot-file=/usr/tmp/jdcham.ram
Total Number of GE Variables =6, Bytes Utilized =184, Bytes Free =2128
PPC1-Bug>
```

GN - Go to Next Instruction

Command Input

GN

Command Input

The **GN** command sets a temporary breakpoint at the address of the next instruction (the instruction that follows the current instruction), and starts target code execution. After setting the temporary breakpoint, the sequence of events is similar to that of the **GO** command.

GN is especially helpful when debugging modular code because it allows you to trace through a subroutine call as if it were a single instruction.

Example

The following section of code resides at address $20000.

```
PPC1-Bug>DS 20000:6 <Return>
00020000 3C600004  ADDIS       R3,R0,$4
00020004 60631000  ORI         R3,R3,$1000
00020008 3C800000  ADDIS       R4,R0,$0
0002000C 608400FE  ORI         R4,R4,$FE
00020010 4800FFF1  BL          $00030000
00020014 80620000  LWZ         R3,$0(R2) ($FFF0178C)
PPC1-Bug>
```

The following simple routine resides at address $30000.

```
PPC1-Bug>DS 30000 <Return>
00030000 3CA00000  ADDIS       R5,R0,$0
00030004 2B040000  CMPLI       CRF6,0,R4,$0
00030008 419A0014  BC          12,26,$0003001C
0003000C 98A30000  STB         R5,$0(R3) ($00000000)
00030010 3884FFFF  ADDI        R4,R4,$FFFFFFFF
00030014 38630001  ADDI        R3,R3,$1
00030018 4BFFFFEC  B           $00030004
0003001C 4E800020  BCLR        20,0
PPC1-Bug>
```

Execute up to the BL instruction.

```
PPC1-Bug>RM IP <Return>
IP     =00020020 ? 20000. <Return>
PPC1-Bug>
```

```
PPC1-Bug>GT 20010 <Return>
Effective address: 00020010
Effective address: 00020000
At Breakpoint
IP     =00020010 MSR    =00003030 CR     =00000020 FPSCR  =00000000
R0     =00000000 R1     =00020000 R2     =FFF0178C R3     =00041000
R4     =000000FE R5     =00000000 R6     =00000000 R7     =00000000
R8     =00000000 R9     =00000000 R10    =00000000 R11    =00000000
R12    =00000000 R13    =00000000 R14    =00000000 R15    =00000000
R16    =00000000 R17    =00000000 R18    =00000000 R19    =00000000
R20    =00000000 R21    =00000000 R22    =00000000 R23    =00000000
R24    =00000000 R25    =00000000 R26    =00000000 R27    =00000000
R28    =00000000 R29    =00000000 R30    =00000000 R31    =00000000
SPR0   =00000000 SPR1   =00000000 SPR8   =00020014 SPR9   =00000000
00020010 4800FFF1  BL          $00030000
PPC1-Bug>
```

Use the **GN** command to trace through the subroutine call and display the results.

```
PPC1-Bug>GN <Return>
Effective address: 00020014
Effective address: 00020010
At Breakpoint
IP     =00020014 MSR    =00003030 CR     =00000020 FPSCR  =00000000
R0     =00000000 R1     =00020000 R2     =FFF0178C R3     =000410FE
R4     =00000000 R5     =00000000 R6     =00000000 R7     =00000000
R8     =00000000 R9     =00000000 R10    =00000000 R11    =00000000
R12    =00000000 R13    =00000000 R14    =00000000 R15    =00000000
R16    =00000000 R17    =00000000 R18    =00000000 R19    =00000000
R20    =00000000 R21    =00000000 R22    =00000000 R23    =00000000
R24    =00000000 R25    =00000000 R26    =00000000 R27    =00000000
R28    =00000000 R29    =00000000 R30    =00000000 R31    =00000000
SPR0   =00000000 SPR1   =00000000 SPR8   =00020014 SPR9   =00000000
00020014 80620000  LWZ         R3,$0(R2) ($FFF0178C)
PPC1-Bug>
```

G, GO - Go Execute User Program

Command Input

G [ADDR], **GO** [*ADDR*]

Description

The **G** and **GO** command initiates target code execution. All previously set breakpoints are enabled. If an address is specified, it is placed in the target IP. Execution starts at the target IP address. The sequence of events is as follows:

1. If an address is specified, it is loaded in the target IP.
2. If a breakpoint is set at the target IP address, the instruction at the target IP is traced (executed in trace mode).
3. All breakpoints are inserted in the target code.
4. Target code execution resumes at the target IP address.

At this point control may be returned to the debugger by one of the following conditions:

- A breakpoint with a count of 0 was found.
- The abort or reset switch on the debugger host was pressed.
- An unexpected exception occurred.

When you invoke **G** or **GO**, control may or may not return to the debugger, depending on the outcome of the user program.

Example

The following program resides at $30000.

```
PPC1-Bug>DS 30000 <Return>
00030000 3CA00000  ADDIS       R5,R0,$0
00030004 2B040000  CMPLI       CRF6,0,R4,$0
00030008 419A0014  BC          12,26,$0003001C
0003000C 98A30000  STB         R5,$0(R3) ($000410FE)
00030010 3884FFFF  ADDI        R4,R4,$FFFFFFFF
00030014 38630001  ADDI        R3,R3,$1
00030018 4BFFFFEC  B           $00030004
0003001C 4E800020  BCLR        20,0
PPC1-Bug>
```

Initialize R3/R4, set some breakpoints, and start the target program.

```
PPC1-Bug>RM R3 <Return>
R3     =000410FE? 68000 <Return>
R4     =00000000? 34. <Return>
PPC1-Bug>
```

```
PPC1-Bug>BR 30018 3001C <Return>
BREAKPOINTS
00030018               0003001C
PPC1-Bug>
```

```
PPC1-Bug>GO 30000 <Return>
Effective address: 00030000
At Breakpoint
IP    =00030018 MSR   =00003030 CR    =00000040 FPSCR  =00000000
R0    =00000000 R1    =00020000 R2    =FFF0178C R3    =00068001
R4    =00000033 R5    =00000000 R6    =00000000 R7    =00000000
R8    =00000000 R9    =00000000 R10   =00000000 R11   =00000000
R12   =00000000 R13   =00000000 R14   =00000000 R15   =00000000
R16   =00000000 R17   =00000000 R18   =00000000 R19   =00000000
R20   =00000000 R21   =00000000 R22   =00000000 R23   =00000000
R24   =00000000 R25   =00000000 R26   =00000000 R27   =00000000
R28   =00000000 R29   =00000000 R30   =00000000 R31   =00000000
SPR0  =00000000 SPR1  =00000000 SPR8  =00020014 SPR9  =00000000
00030018 4BFFFFEC  B           $00030004
PPC1-Bug>
```

Remove breakpoint at this location (* represents the current instruction pointer).

```
PPC1-Bug>NOBR * <Return>
BREAKPOINTS
0003001C
PPC1-Bug>
```

Continue target program execution.

```
PPC1-Bug>G <Return>
Effective address: 00030018
At Breakpoint
IP     =0003001C MSR    =00003030 CR     =00000020 FPSCR  =00000000
R0     =00000000 R1     =00020000 R2     =FFF0178C R3     =00068034
R4     =00000000 R5     =00000000 R6     =00000000 R7     =00000000
R8     =00000000 R9     =00000000 R10    =00000000 R11    =00000000
R12    =00000000 R13    =00000000 R14    =00000000 R15    =00000000
R16    =00000000 R17    =00000000 R18    =00000000 R19    =00000000
R20    =00000000 R21    =00000000 R22    =00000000 R23    =00000000
R24    =00000000 R25    =00000000 R26    =00000000 R27    =00000000
R28    =00000000 R29    =00000000 R30    =00000000 R31    =00000000
SPR0   =00000000 SPR1   =00000000 SPR8   =00020014 SPR9   =00000000
0003001C 4E800020  BCLR         20,0
PPC1-Bug>
```

Remove breakpoints and restart the target code.

```
PPC1-Bug>NOBR <Return>
BREAKPOINTS
PPC1-Bug>
```

```
PPC1-Bug>GO 30000 <Return>
Effective address: 00030000
```

The outcome is dependent on the loaded application.

GT - Go to Temporary Breakpoint

Command Input

GT *ADDR*

Command Input

The **GT** command sets a temporary breakpoint and starts target code execution. A count may be specified with the temporary breakpoint. Control is given at the target IP address. All previously set breakpoints are enabled. The temporary breakpoint is removed when any breakpoint with a count of 0 is encountered.

After setting the temporary breakpoint, the sequence of events is similar to that of the **GO** command. At this point control may be returned to the debugger by one of the following conditions:

- A breakpoint with a count of 0 was found.
- The abort or reset switch on the debugger host was pressed.
- An unexpected exception occurred.

Example

The following program resides at $20000 and $30000.

```
PPC1-Bug>DS 20000:7 <Return>
00020000 3C600004  ADDIS       R3,R0,$4
00020004 60631000  ORI         R3,R3,$1000
00020008 3C800000  ADDIS       R4,R0,$0
0002000C 608400FE  ORI         R4,R4,$FE
00020010 4800FFF1  BL          $00030000
00020014 80620000  LWZ         R3,$0(R2) ($FFF0178C)
00020018 4BFFFFE8  B           $00020000
PPC1-Bug>
```

```
PPC1-Bug>DS 30000:8 <Return>
00030000 3CA00000  ADDIS       R5,R0,$0
00030004 2B040000  CMPLI       CRF6,0,R4,$0
00030008 419A0014  BC          12,26,$0003001C
0003000C 98A30000  STB         R5,$0(R3) ($00041004)
00030010 3884FFFF  ADDI        R4,R4,$FFFFFFFF
00030014 38630001  ADDI        R3,R3,$1
00030018 4BFFFFEC  B           $00030004
0003001C 4E800020  BCLR        20,0
PPC1-Bug>
```

Set a breakpoint.

```
PPC1-Bug>BR 20014 <Return>
BREAKPOINTS
00020014
PPC1-Bug>
```

Set IP to start of program, set temporary breakpoint, and start target code.

```
PPC1-Bug>RM IP <Return>
IP   =00020010 ? 20000. <Return>
PPC1-Bug>
```

```
PPC1-Bug>GT 20010 <Return>
Effective address: 00020010
Effective address: 00020000
At Breakpoint
IP    =00020010 MSR   =00003030 CR    =00000040 FPSCR  =00000000
R0    =00000000 R1    =00020000 R2    =FFF0178C R3     =00041000
R4    =000000FE R5    =00000000 R6    =00000000 R7     =00000000
R8    =00000000 R9    =00000000 R10   =00000000 R11    =00000000
R12   =00000000 R13   =00000000 R14   =00000000 R15    =00000000
R16   =00000000 R17   =00000000 R18   =00000000 R19    =00000000
R20   =00000000 R21   =00000000 R22   =00000000 R23    =00000000
R24   =00000000 R25   =00000000 R26   =00000000 R27    =00000000
R28   =00000000 R29   =00000000 R30   =00000000 R31    =00000000
SPR0  =00000000 SPR1  =00000000 SPR8  =00020014 SPR9   =00000000
00020010 4800FFF1  BL          $00030000
PPC1-Bug>
```

Set another temporary breakpoint at $20000 and continue the target program execution.

```
PPC1-Bug>GT 20000 <Return>
Effective address: 00020000
Effective address: 00020010
At Breakpoint
IP     =00020014 MSR    =00003030 CR     =00000020 FPSCR  =00000000
R0     =00000000 R1     =00020000 R2     =FFF0178C R3     =000410FE
R4     =00000000 R5     =00000000 R6     =00000000 R7     =00000000
R8     =00000000 R9     =00000000 R10    =00000000 R11    =00000000
R12    =00000000 R13    =00000000 R14    =00000000 R15    =00000000
R16    =00000000 R17    =00000000 R18    =00000000 R19    =00000000
R20    =00000000 R21    =00000000 R22    =00000000 R23    =00000000
R24    =00000000 R25    =00000000 R26    =00000000 R27    =00000000
R28    =00000000 R29    =00000000 R30    =00000000 R31    =00000000
SPR0   =00000000 SPR1   =00000000 SPR8   =00020014 SPR9   =00000000
00020014 80620000  LWZ         R3,$0(R2) ($FFF0178C)
PPC1-Bug>
```

Note that a breakpoint from the breakpoint table was encountered before the temporary breakpoint.

HE - Help

Command Input

HE [*COMMAND*]

Description

The **HE** command displays information about the debugger commands.

HE displays the description and the syntax of the command specified in the *COMMAND* argument.

Without the *COMMAND* argument, **HE** displays a list of the debugger commands and their descriptions.

Examples

Example 1:

```
PPC1-Bug>HE MD <Return>
Memory Display:
MD[S] <ADDR>[:<COUNT>|<DEL><ADDR>][;[B|H|W|S|D][DI]]
PPC1-Bug>
```

Example 2:

```
PPC1-Bug>HE <Return>
AS       Assembler
BC       Block of Memory Compare
BF       Block of Memory Fill
BI       Block of Memory Initialize
BM       Block of Memory Move
BR       Breakpoint Insert
BS       Block of Memory Search
BV       Block of Memory Verify
CM       Concurrent Mode
CNFG     Configure Board Information Block
CS       Checksum a Block of Data
CSAR     PCI Configuration Space READ Access
CSAW     PCI Configuration Space WRITE Access
DC       Data Conversion and Expression Evaluation
DMA      Move Block of Memory
DS       Disassembler
DU       Dump S-Records
ECHO     Echo String
```

```
ENV      Set Environment to Bug/Operating System
FORK     Fork Idle MPU at Address
FORKWR   Fork Idle MPU with Registers
G        "Alias" for "GO" Command
GD       Go Direct (Ignore Breakpoints)
GEVBOOT  Global Environment Variable Boot
GEVDEL   Global Environment Variable Delete
GEVDUMP  Global Environment Variable(s) Dump
Press "RETURN" to continue
GEVEDIT Global Environment Variable Edit
GEVINIT Global Environment Variable Initialization
GEVSHOW Global Environment Variable(s) Display
GN       Go to Next Instruction
GO       Go Execute User Program
GT       Go to Temporary Breakpoint
HE       Help on Command(s)
IDLE     Idle Master MPU
IOC      I/O Control for Disk
IOI      I/O Inquiry
IOP      I/O Physical to Disk
IOT      I/O "Teach" for Configuring Disk Controller
IRD      Idle MPU Register Display
IRM      Idle MPU Register Modify
IRS      Idle MPU Register Set
LO       Load S-Records from Host
M        "Alias" for "MM" Command
MA       Macro Define/Display
MAE      Macro Edit
MAL      Enable Macro Expansion Listing
MAR      Macro Load
MAW      Macro Save
MD       Memory Display
MDS      Memory Display
MENU     System Menu
MM       Memory Modify
Press "RETURN" to continue
MMD      Memory Map Diagnostic
MS       Memory Set
MW       Memory Write
NAB      Network Automatic Bootstrap Operating System
NAP      Nap MPU
NBH      Network Bootstrap Operating System and Halt
NBO      Network Bootstrap Operating System
NIOC     Network I/O Control
NIOP     Network I/O Physical
NIOT     I/O "Teach" for Configuring Network Controller
```

```
NOBR     Breakpoint Delete
NOCM     No Concurrent Mode
NOMA     Macro Delete
NOMAL    Disable Macro Expansion Listing
NOPA     Printer Detach
NOPF     Port Detach
NORB     No ROM Boot
NOSYM    Detach Symbol Table
NPING    Network Ping
OF       Offset Registers Display/Modify
PA       Printer Attach
PBOOT    Bootstrap Operating System
PF       Port Format
Press "RETURN" to continue
PFLASH   Program FLASH Memory
PS       Put RTC Into Power Save Mode for Storage
RB       ROM Bootstrap Operating System
RD       Register Display
REMOTE   Connect the Remote Modem to CSO
RESET    Cold/Warm Reset
RL       Read Loop
RM       Register Modify
RS       Register Set
RUN      MPU Execution/Status
SD       Switch Directories
SET      Set Time and Date
SROM     SROM Examine/Modify
SYM      Attach Symbol Table
SYMS     Display Symbol Table
T        Trace
TA       Terminal Attach
TIME     Display Time and Date
TM       Transparent Mode
TT       Trace to Temporary Breakpoint
VE       Verify S-Records Against Memory
VER      Revision/Version Display
WL       Write Loop
PPC1-Bug>
```

IBM - Indirect Block Move

Command Input

```
IBM <ADDR>[<RANGE>];<D|E|I|N|P>[R|W]
```

Description

The <ADDR> parameter specifies the buffer address in linear memory space that will either be the source or the destination of the block copy.

The optional <RANGE> parameter specifies the indirect memory space start address and the block length. The entire indirect memory space will be copied if this parameter is not specified.

The <D|E|I|N|P> parameter specifies one of several indirect memory spaces. The D (Drawbridge SROM), E (Ethernet SROM), I (I2C SROM), and P (PCI configuration space) selections will probe for compatible devices and prompt the user to confirm the device instance as each instance is located. The N (NVRAM) selection only supports one NVRAM device and will not prompt the user to confirm the device instance.

The optional [R|W] parameter specifies the copy direction. R (read) copies a block of data from indirect memory space to linear memory space and W (write) prompts the user for confirmation and then copies a block of data from linear memory space to indirect memory space. The R direction will be used if this parameter is not specified.

Refer to example on next page.

Example

```
PPC4-Bug>ibm 200000;i

Device Address =$A0 (N/Y)? y
Source = I2C SROM (A0:0) 0000 - 00FF
Destination = RAM 00200000 - 002000FF
Size = 100 (&256) bytes
PPC4-Bug>md 200000:40
00200000 4D4F544F 524F4C41 0100010A 4D564D45 MOTOROLA....MVME
00200010 32343331 2D31020C 30312D57 33333934 2431-1..01-W3394
00200020 46303142 03073333 38333138 350410C0 F01B..3383185
00200030 00808000 BA000000 00000000 00000005 ................
00200040 0414DC93 80060405 F5E10009 03373530 ............750
00200050 0A04FF41 04C90B0C 000122C4 10040220 ...A...".......
00200060 20005005 0B0CFFFF FFFF0802 02080801 .P.............
00200070 78020E0F FFFFFFFF 20020220 00000001 x..... .. .....
00200080 0201040D 0401FCA0 550F0400 020000FF ......U........
00200090 FFFFFFFF FFFFFFFF FFFFFFFF FFFFFFFF ................
002000A0 FFFFFFFF FFFFFFFF FFFFFFFF FFFFFFFF ................
002000B0 FFFFFFFF FFFFFFFF FFFFFFFF FFFFFFFF ................
002000C0 FFFFFFFF FFFFFFFF FFFFFFFF FFFFFFFF ................
002000D0 FFFFFFFF FFFFFFFF FFFFFFFF FFFFFFFF ................
002000E0 FFFFFFFF FFFFFFFF FFFFFFFF FFFFFFFF ................
002000F0 FFFFFFFF FFFFFFFF FFFFFFFF FFFFFFFF ................
PPC4-Bug>
```

IDLE - Idle Master MPU

Note This command is for multi-processor boards only.

Command Input

IDLE

Description

The **IDLE** command allows you to idle the current processor. Care should be taken not to idle it when all other processors are idle. The only way to correct this problem is by an MPU reset.

To inquire of the BUG about idle processors, refer to the **RUN** command.

Example

Idle current processor.

```
PPC1-Bug>idle
PPC1-Bug>
```

IOC - I/O Control for Disk

Command Input

IOC

Description

The **IOC** command sends command packets directly to a disk controller. The packet to be sent must already reside in memory and must follow the packet protocol of the particular disk controller. This packet protocol is outlined in the documentation for the SCSI controller (refer to Appendix A, *Related Documentation*).

This command may be used as a debugging tool to issue commands to the disk controller to locate problems with either drives, media, or the controller itself.

When invoked, this command prompts for the controller and drive required. The default controller LUN (CLUN) and device LUN (DLUN) when **IOC** is invoked are those most recently specified for **IOP**, **IOT**, or a previous invocation of **IOC**. The command also prompts for an address where the controller command is located. You may change the displayed value by typing a new value, followed by the Return key. To leave the field unaltered, press the Return key without typing a new value.

You may also enter a special character, either at the prompt or after typing new data, for scrolling through the fields. The special characters are:

V or **v**	Go to the next field. This is the default, and remains in effect until changed by entering one of the other special characters.
^	Back up to the previous field. This remains in effect until changed by entering one of the other special characters.
=	Re-open the same field
.	Terminate the **IOC** command, and return control to the debugger

The power-up default for the packet address is the area which is also used by the **PBOOT** and **IOP** commands for building packets. **IOC** displays the command packet, and if you so instruct it, sends the packet to the disk controller, following the proper protocol required by the particular controller.

A device probe with entry into the device descriptor table is done whenever a specified device is accessed via **IOC**.

The device probe mechanism utilizes the SCSI commands Inquiry and Mode Sense. If the specified controller is non-SCSI, the probe simply returns a status of `device present and unknown`. The device probe makes an entry into the device descriptor table with the pertinent data. After an entry has been made, the next time a probe is done it simply returns with `device present` status (pointer to the device descriptor).

Example

Send the packet at $10000 to a controller device configured as CLUN #0. Specify an operation to the hard disk which is at DLUN #1.

```
PPC1-Bug>IOC <Return>
Controller LUN  =00? <Return>
Device LUN      =00? 1 <Return>
Packet address  =000012BC? 10000 <Return>
00700074  0000 0000 8004 000E  0000 0000 0000 0000  ................
00700084  0000 0006 1200 0000  2400 0000 0000 0000  ........$.......
00700094  0000 0000 0000 0000  0000 0000 0000 0000  ................
007000A4  0000 0000 0000 0000  0000 0000 0000 0000  ................
007000B4  0000 0000 0000 0000  0000 0024 0040 0000  ...........$.@..
007000C4  0000 0000 0000 0000  0000 0000 0018 AFC8  ................
007000D4  0000 0000 0000 0000  0000 0000 0000 0000  ................
007000E4  0000 0000 0000 0000  0000 0000 0000 0000  ................
Send Packet=Y (Y/N)? y
PPC1-Bug>
```

IOI - I/O Inquiry

Command Input

IOI [**;**[**C**|**D**|**L**|**N**]]

Options

C	Clear the Device Descriptor Table.
D	List Devices while probing
L	List the Device Descriptor Table.
N	List the Devices currently configured

Description

The **IOI** command inquires for all of the possible attached devices. If no option is specified, this command probes the system for all possible CLUN/DLUN combinations. Both the CLUN and DLUN parameters have the range of 0 to 255 (decimal).

If the probed device supports an inquiry operation (SCSI devices), the command will display the inquiry data along with the CLUN, DLUN, controller type, device address, device type, and the removable media attribute. If a device does not support inquiry data, the message `<None>` will be displayed.

The probe ordering starts with a CLUN of zero and a DLUN of zero. Once the probe is done, the DLUN is incremented by one and the probe is executed again, the incrementing of the DLUN and the probing continues until the DLUN reaches 256. At this point the CLUN is incremented by one and the DLUN is set to zero, the probing of DLUNs from zero to 255 is performed. The probing continues until the CLUN reaches 256.

When the ENV option “Serial Startup Code Master Enable” is set to ‘Y’, the CLUN/DLUN numbers are displayed on the console as the probe occurs.

The CLUN/DLUN numbers in this case are shown on the screen as:

[mmnn]

where: mm = the CLUN number and

while: nn = the DLUN number

The CLUN/DLUN numbers are always sent to the 7-segment LEDs regardless of the ENV setting.

With the variable number of devices that can now be attached to a given system, the memory requirements to house the pertinent device descriptors cannot be met. The debugger reserves space for 16 device descriptors. The device descriptor table (16 entries) can be viewed or cleared by this command with the **L** and **C** options, respectively.

Each mass storage boot device and network interface boot device is identified by a device name. Each device type that the product supports is contained/listed within device probe tables. These tables are modified to contain the associative device name.

At probe time, the probed device's name is copied into the dynamic device configuration tables housed within NVRAM. This will only be done, of course, if the device is present. The user may view the system's device names by performing the following operations.

For mass storage devices while probing, the **D** option allows users to display the device names of the attached devices. These device names are per the IBM firmware and the IBM AIX naming conventions.

To view the device names of mass storage devices which are currently configured (or have been accessed via a boot (**PBOOT**), or via an I/O operation (**IOP**)), use the **N** option.

Examples

Example 1: Probe for all possible devices. As a device is found (probe was successful) it is displayed to the console with the associative inquiry data.

```
PPC1-Bug>IOI <Return>
I/O Inquiry Status:
CLUN  DLUN  CNTRL-TYPE  DADDR  DTYPE  RM  Inquiry-Data
   0  0     NCR53C825   0      $00    N   SEAGATE ST31200N         8630
   0  30    NCR53C825   3      $05    Y   TOSHIBA CD-ROM XM-3401TA 1094
   1  0     PC8477      0      $00    Y   <None>
PPC1-Bug>
```

Note that if the board has a secondary SCSI, and both primary and secondary SCSI controllers are connected with the same SCSI cable, all SCSI peripherals will be listed twice by **IOI** because they can be accessed by either primary or secondary SCSI controller:

```
PPC1-Bug>IOI  <Return>
I/O Inquiry Status:
CLUN  DLUN  CNTRL-TYPE  DADDR  DTYPE  RM  Inquiry-Data
   0  10    NCR53C825   1      $00    N   SEAGATE ST11200N ST31230 0660
   0  30    NCR53C825   3      $05    Y   TOSHIBA CD-ROM XM-5301TA 0925
   1  0     PC8477      0      $00    Y   <None>
  12  10    NCR53C825   1      $00    N   SEAGATE ST11200N ST31230 0660
  12  30    NCR53C825   3      $05    Y   TOSHIBA CD-ROM XM-5301TA 0925
PPC1-Bug>
```

Example 2: List (view) the current device descriptors as found in the device descriptor table.

```
PPC1-Bug>IOI;L  <Return>

I/O Inquiry Device Descriptor Table Status:
CLUN  DLUN  CNTRL-TYPE  CNTRL-Address   RM      Device-Type
0     30    VME???      $FFF47000       N       $00/Direct-Access
2     30    VME327      $FFFFA600       Y       $01/Sequential-Access
PPC1-Bug>
```

Example 3: Clear the device descriptor table.

```
PPC1-Bug>IOI;C  <Return>
PPC1-Bug>
```

This option is useful in the event the table becomes full and a device that has not been accessed is accessed.

IOP - I/O Physical (Direct Disk Access)

Command Input

IOP

Description

The **IOP** command allows you to read, write, or format any of the supported disk or tape devices.

When invoked, this command goes into an interactive mode, prompting you for all the parameters necessary to carry out the command. You may change the displayed value by typing a new value, followed by the Return key. To leave the field unchanged, press the Return key without typing a new value.

You may also enter a special character, either at the prompt or after typing new data, for scrolling through the fields. The special characters are:

V or **v**	Open the next field. This is the default, and remains in effect until changed by entering one of the other special characters.
^	Back up and open the previous field
=	Re-open the same field
.	Terminate the **IOP** command, and return control to the debugger

The disk SYSCALL functions (trap routines) are used by **IOP** to access the specified disk or tape (refer to Chapter 5, *System Calls*).

A device probe with entry into the device descriptor table is done whenever a specified device is accessed via **IOP**.

The device probe mechanism utilizes the SCSI Inquiry and Mode Sense commands (SCSI devices) or ATA Identify Data and Initialize Device Parameters commands (ATA devices). ATAPI devices are queried only for their inquiry data. If the specified controller is non-SCSI or non-ATA/ATAPI, the probe simply returns the message `device present and unknown`. The device probe makes an entry into the device

descriptor table with the pertinent data. After an entry has been made, the next time a probe is done it simply returns with the message `device present` (pointer to the device descriptor).

Initially (after a cold reset), all the parameters used by **IOP** are set to certain default values. However, any new values entered are saved and are displayed the next time that the **IOP** command is invoked.

The following prompts appear (some prompts are device-dependent):

```
Controller LUN   =00?
```

The Logical Unit Number (LUN) of the controller to access

```
Device LUN       =00?
```

The LUN of the device to access

```
Read/Write/Format =R?
```

The command function:

R Read blocks of data from the selected device into memory

W Writes blocks of data from memory to the selected device

F Formats the selected device;



Caution If you start the **IOP** format procedure, it must be allowed to complete (`PPC1Bug>` prompt returns) or else the disk drive may be totally disabled. This format procedure may take as long as half an hour.

For disk devices, either a track or the whole disk can be selected by a subsequent field. This option only applies to SCSI Direct Access devices (type $00). When the format operation is selected, the `Flag Byte` prompt is displayed. A flag byte of $08 specifies to ignore the grown defect list when formatting. A flag byte of $00 specifies not to ignore the grown defect list when formatting.

```
Memory Address   =00003000?
```

The starting address for the memory block to be accessed. For disk read operations, data is written starting at this location. For disk write operations, data is read starting at this location.

```
Starting Block      =00000000?
```

The starting disk block number to access. For disk read operations, data is read starting at this block. For disk write operations, data is written starting at this block. For disk track format operations, the track that contains this block is formatted.

```
Number of Blocks  =0002?
```

The number of data blocks to be transferred on a read or write operation.

```
Address Modifier    =00?
```

Note Changing this Address Modifier parameter works for the MVME160*x* series modules only.

```
Track/Disk      =T (T/D)?
```

T Format a disk track

D Format the entire disk

```
File Number     =0000?
```

The starting file number to access (for streaming tape devices)

```
Flag Byte       =00?
```

The flag byte is used to specify variations of the same command, and to receive special status information. Bits 0 through 3 are used as command bits; bits 4 through 7 are used as status bits. The following bits are defined for streaming tape read and write operations.

Bit 7	Filemark flag. If 1, a filemark was detected at the end of the last operation.
Bit 3	Disk formatting. It is ignored on tape operations.
Bit 2	Reset Controller Flag. If 1, a controller reset will take place if possible before the requested operation takes place.
Bit 1	Ignore File Number (IFN) flag. If 0, the file number field is used to position the tape before any reads or writes are done. If 1, the file number field is ignored, and reads or writes start at the present tape position.
Bit 0	End of File flag. If 0, reads or writes are done until the specified block count is exhausted. If 1, reads are done until the count is exhausted or until a filemark is found. If 1, writes are terminated with a filemark.

```
Retension/Erase   =R (R/E)?
```

R	Retension tape when a format operation is scheduled
E	Erase and retension tape when a format operation is scheduled

After all the required parameters are entered, the disk access is initiated. If an error occurs, an error status word is displayed. Refer to Appendix F for an explanation of any error status codes that are returned.

Examples

Example 1: Read 25 blocks starting at block 370 from device 2 of controller 0 into memory beginning at address $50000.

```
PPC1-Bug>IOP <Return>
Controller LUN   =00? <Return>
Device LUN       =00? 2 <Return>
Read/Write/Format=R? <Return>
Memory  Address  =00003000? 50000 <Return>
Starting Block   =00000000? &370 <Return>
Number of Blocks =0002? &25 <Return>
Address Modifier =00? <Return>
PPC1-Bug>
```

Example 2: Write 14 blocks starting at memory location $7000 to file 6 of device 0, controller 4. Append a filemark at the end of the file.

```
PPC1-Bug>IOP <Return>
Controller LUN   =00? 4 <Return>
Device LUN       =02? 0 <Return>
Read/Write/Format=R? W <Return>
Memory  Address  =00050000? 7000 <Return>
File Number      =00000172? 6 <Return>
Number of Blocks =0019? E <Return>
Flag Byte        =00? %01 <Return>
Address Modifier =00? <Return>
PPC1-Bug>
```

Example 3: Format the specified device with the option **not** to ignore the grown defect list.

```
PPC1-Bug>IOP
Controller LUN    =00? <Return>
Device LUN        =00? <Return>
Read/Write/Format =R? F <Return>
Starting Block    =00000000? <Return>
Track/Disk (T/D)  =D? <Return>
Flag Byte         =00? <Return>
Address Modifier  =00? <Return>
PPC1-Bug>
```

Example 4: Format the specified device **with** the option to ignore the grown defect list.

```
PPC1-Bug>IOP
Controller LUN    =00? <Return>
Device LUN        =00? <Return>
Read/Write/Format =R?  F <Return>
Starting Block    =00000000? <Return>
Track/Disk (T/D)  =D? <Return>
Flag Byte         =00? 8 <Return>
Address Modifier  =00? <Return>
PPC1-Bug>
```

IOT - I/O Configure Disk Controller

Command Input

IOT [**;**[**A**|**F**|**H**|**T**]]

Options

A	List all the disk controllers which are supported by PPCBug. SCSI controllers are identified with an asterisk (*). Each PCI controller is only listed once.
F	Force a device descriptor into the Device Descriptor Table. This option makes it easier to debug a particular device, in the event the device probe for the specified device fails.
H	List all the disk controllers which are available to the system. SCSI controllers are identified by an asterisk (*).
T	Probe the system for I/O controllers. This option basically invokes the **IOI** command with no options.

Description

The **IOT** command allows you to set-up (“teach”) a new disk configuration in the PPCBug for use by the system call disk functions. **IOT** lets you modify the controller and device descriptor tables used by the system call functions for disk access. Note that because the PPCBug commands that access the disk use the system call disk functions, changes in the descriptor tables affect all those commands. These include the **IOP** and **PBOOT** commands, and also any user program that uses the system call disk functions.

Refer to Table E-2 for information on formatting floppy disk drives.

Before attempting to access the disks with the **IOP** command, you should verify the parameters and, if necessary, modify them for the specific media and drives used in the system. (Refer to Appendix E for details.)

Note that during a boot, the configuration sector is normally read from the disk, and the device descriptor table for the LUN used is modified accordingly. If you wish to read/write using **IOP** from a disk that has been booted, **IOT** will not be required, unless the system is reset.

A device probe with entry into the device descriptor table is done whenever a specified device is accessed via **IOT**.

The device probe mechanism utilizes the SCSI commands Inquiry and Mode Sense. If the specified controller is non-SCSI, the probe simply returns the status `device present and unknown`. The device probe makes an entry into the device descriptor table with the pertinent data. After an entry has been made, the next time a probe is done it simply returns with the status `device present` (pointer to the device descriptor).

Note that reconfiguration is only necessary when you wish to read or write a disk which is different than the default set by the **IOP** command. Reconfiguration is normally done automatically by the **PBOOT** command when booting from a disk which is different from the default.

When invoked without options, the **IOT** command enters an interactive subcommand mode where the descriptor table values currently in effect are displayed one-at-a-time. You may change the displayed value by typing a new value, followed by the Return key. To leave the field unaltered, press the Return key without typing a new value.

You may also enter a special character, either at the prompt or after typing new data, for scrolling through the fields. The special characters are:

V or **v**	Open the next field. This is the default, and remains in effect until changed by entering one of the other special characters.
^	Back up and open the previous field
=	Re-open the same field
.	Terminate the **IOT** command, and return control to the debugger

All numerical values are interpreted as hexadecimal numbers. You may enter decimal values by preceding the number with an **&**.

The following information prompts appear with the default field values (some of the prompts are device-dependent):

```
Controller LUN       =00?
```

The Controller LUN

```
Device LUN            =00?
```

The Device LUN

If the Controller LUN and Device LUN selected do not correspond to a valid controller and device, then **IOT** outputs the message `Invalid LUN` and you are prompted for the two LUNs again.

```
Device Type [00-1F]  =00?
```

$00	Direct-access (e.g., magnetic disk)
$01	Sequential-access (e.g., magnetic tape)
$02	Printer
$03	Processor
$04	Write-once (e.g., some optical disks)
$05	CD-ROM
$06	Scanner
$07	Optical Memory (e.g., some optical disks)
$08	Medium Changer (e.g., jukeboxes)
$09	Communications
$0A, $0B	Graphic Arts Pre-Press
$0C-$1E	Reserved
$0F	Unknown or no device type

Only the $00, $01, $05, and $07 are supported by the I/O controller drivers.

Attribute Parameters

The parameters and attributes that are associated with a particular device are determined by a parameter and an attribute mask that is a part of the device definition. The device that has been selected may have any combination of the following parameters and attributes:

```
Sector Size:
0- 128 1- 256 2- 512
3-1024 4-2048 5-4096 =01 (0-5)?
```

The number of data bytes per sector.

```
Block Size:
0- 128 1- 256 2- 512
3-1024 4-2048 5-4096 =01 (0-5)?
```

The units in which a transfer count is specified when doing a disk/tape block transfer. The block size can be smaller, equal to, or greater than the physical sector size, as long as *(Block Size) * (Number of Blocks) / (Physical Sector Size)* is an integer.

```
Sectors/Track          =0020?
```

The number of data sectors per track, and is a function of the device being accessed and the sector size specified.

```
Starting Head          =10?
```

The starting head number for the device. It is normally zero for Winchester and floppy drives. It is nonzero for dual volume SMD drives.

```
Number of Heads        =05?
```

The number of heads on the drive.

```
Number of Cylinders    =0337?
```

The number of cylinders on the device. For floppy disks, the number of cylinders depends on the media size and the track density.

```
Precomp. Cylinder      =0000?
```

The cylinder number at which precompensation should occur for this drive. This parameter is normally specified by the drive manufacturer.

```
Reduced Write Current Cylinder =0000?
```

The cylinder number at which the write current should be reduced when writing to the drive. This parameter is normally specified by the drive manufacturer.

`Interleave Factor =00?`

The manner in which the sectors are formatted on a track. Normally, consecutive sectors in a track are numbered sequentially in increments of 1 (interleave factor of 1). The interleave factor controls the physical separation of logically sequential sectors. This physical separation gives the host time to prepare to read the next logical sector without requiring the loss of an entire disk revolution.

`Spiral Offset =00?`

The number of sectors that the first sector of each track is offset from the index pulse. This is used to reduce latency when crossing track boundaries.

`ECC Data Burst Length =0000?`

The number of bits to correct for an ECC error when supported by the disk controller

`Step Rate Code =00?`

The rate at which the read/write heads can be moved when seeking a track on the disk. The encoding is as follows:

Step Rate Code (Hex)	Winchester Hard Disks	3-1/2 and 5-1/4 Inch Floppy	8-Inch Floppy
00	0 msec	12 msec	6 msec
01	6 msec	6 msec	3 msec
02	10 msec	12 msec	6 msec
03	15 msec	20 msec	10 msec
04	20 msec	30 msec	15 msec

```
Single/Double DATA Density =D (S/D)?
```

S Single (FM) data density

D Double (MFM) data density

```
Single/Double TRACK Density =D (S/D)?
```

The density (tracks per inch)

S 48 TPI = Single Track Density

D 96 TPI = Double Track Density

```
Single/Equal_in_all Track zero density =S (S/E)?
```

The data density of track 0, either a single density or equal to the density of the remaining tracks. For Equal_in_all, the Single/Double data density flag indicates the density of track 0.

```
Slow/Fast Data Rate   =S (S/F)?
```

The data rate for floppy disk devices

S 250 kHz data rate

F 500 kHz data rate

```
Gap 1                       =07?
```

The number of words of zeros that are written before the header field in each sector during format.

```
Gap 2                       =08?
```

The number of words of zeros that are written between the header and data fields during format and write commands

```
Gap 3                       =00?
```

The number of words of zeros that are written after the data fields during format commands

```
Gap 4                      =00?
```

The number of words of zeros that are written after the last sector of a track and before the index pulse

```
Spare Sectors Count    =00?
```

The number of sectors per track allocated as spare sectors. These sectors are only used as replacements for bad sectors on the disk.

Examples

Example 1: Examine the default parameters of a 5-1/4 inch floppy disk.

```
PPC1-Bug>IOT <Return>
Controller LUN       =00? <Return>
Device LUN           =00? 2 <Return>
Device Type [00-1F]  =00? <Return>
Removable Media = Y (Y/N)? <Return>
Sector Size:
0- 128 1- 256 2- 512
3-1024 4-2048 5-4096 =01 (0-5)? <Return>
Block Size:
0- 128 1- 256 2- 512
3-1024 4-2048 5-4096 =01 (0-5)? <Return>
```

```
Sectors/track        =0010? <Return>
Number of heads      =02? <Return>
Number of cylinders  =0050? <Return>
Precomp. Cylinder    =0028? <Return>
Step  Rate  Code     =00?  <Return>
Single/Double TRACK density=D (S/D)?  <Return>
Single/Double  DATA  density    =D  (S/D)?  <Return>
Single/Equal_in_all  Track  zero density =S (S/E)? <Return>
Slow/Fast Data Rate  =S (S/F)? <Return>
PPC1-Bug>
```

Example 2:

```
PPC1-Bug>iot;a <Return>
I/O Controllers Supported:
CLUN  CNTRL-TYPE  CNTRL-Address  N-Devices
   1  PC8477     $800003F0       1
   2  PC87303IDE   $80000 1F0      2
   X  NCR53C810      Any PCI       *
   X  NCR53C825      Any PCI       *
   X  NCR53C875      Any PCI       *
   X  SL82C105       Any PCI       4
   X  PBC-EIDEF1     Any PCI       4
PPC1-Bug>
```

IRD, IRM, IRS - Idle MPU Register Display/Modify/Set

Note These commands are for multi-processor boards only.

Command Inputs

IRD *MPU# ARGS*

IRM *MPU# ARGS*

IRS *MPU# ARGS*

Descriptions

The **IRD** command allows you to display the idle processor's registers. The idle processor is specified by the argument *MPU#*. This argument depends on your configuration. The *ARGS* argument is equivalent to the argument string as required by the command **RD**. Refer to the **RD** command for argument syntax.

The **IRM** command allows you to examine/modify the idle processor's registers. The idle processor is specified by the argument *MPU#*. This argument depends on your configuration. The *ARGS* argument is equivalent to the argument string as required by the command **RM**. Refer to the **RM** command for argument syntax.

The **IRS** command allows you to display/set a particular register of the idle processor's register set. The idle processor is specified by the argument *MPU#*. This argument depends on your configuration. The *ARGS* argument is equivalent to the argument string as required by the command **RS**. Refer to the **RS** command for argument syntax.

Refer to the individual commands (**RD**, **RM**, and **RS**) for examples.

LO - Load S-Records from Host

Command Input

LO [*PORT*] [*ADDR*] [**;**[**X**] [**C**] [**T**]] [**=***text*]

Arguments

PORT Port to be used for the downloading.
The default is port 1.

ADDR Offset address which is to be added to the address contained in the address field of each record. This causes the records to be stored to memory at different locations than would normally occur. The contents of the automatic offset register are not added to the S-record addresses.

Options

More than one option may be used.

X Echo the S-records to your terminal as they are read in at the host port.

C Ignore checksum. A checksum for the data contained within an S-record is calculated as the S-record is read in at the port. Normally, this calculated checksum is compared to the checksum contained within the S-record and if the compare fails, an error message is sent to the screen on completion of the download. If this option is selected, then the comparison is not made.

T System Call code. This option causes **LO** to set the target register R04 to 'LO$01' ($4C4F2001).
The ASCII string LO indicates the **LO** command. The code **$01** indicates system call support with stack parameter/result passing and system call disk support.
This code can be used by the downloaded program to select the appropriate calling convention when invoking debugger functions (necessary because some Motorola debuggers use conventions different from PPCBug, and they set a different code in R05).

=text The command that is sent to the host before the debugger begins to look for S-records at the host port. The command is sent to the host device to initiate the download. Do not enclose *text* in quote marks. Do not separate the = and *text* with a space. If the host is operating full duplex, the string is also echoed back to the host port by the host and appears on your terminal screen.

Description

The **LO** command downloads Motorola S-record files from a host system to the debugger host. The **LO** command accepts serial data from the host and loads it into memory.

Note You can download S-records at any baud rate supported by both the debugger and the host system. If the **X** option is specified, make sure that the baud rate of the host system is less than or equal to the baud rate of the console. If there are any problems loading the records, reduce the baud rate of the host.

In order to accommodate host systems that echo all received characters, the above-mentioned text string is sent to the host one character at a time and characters received from the host are read one-at-a-time. After the entire command has been sent to the host, **LO** keeps looking for a line feed (**LF**) character from the host, signifying the end of the echoed command. No data records are processed until this **<LF>** is received. If the host system does not echo characters, **LO** still keeps looking for a **<LF>** character before data records are processed. For this reason, it is required in situations where the host system does not echo characters, that the first record transferred by the host system be a header record. The header record is not used but the **<LF>** after the header record serves to break **LO** out of the loop so that data records are processed.

The S-record format (refer to Appendix D, *S-Record Format*) allows for an entry point to be specified in the address field of the termination record of an S-record block. The contents of the address field of the termination record (plus the offset address, if any) are put into the target IP. Thus, after a download, you need only enter **GO** instead of **GO** *ADDR* to execute the code that was downloaded.

If a non-hexadecimal character is encountered within the data field of a data record, then the part of the record which had been received up to that time is printed to the screen and the PPCBug error handler is invoked to point to the faulty character.

If the embedded checksum of a record does not agree with the checksum calculated by PPCBug and if the checksum comparison has not been disabled via the C option, then an error condition exists. A message is output stating the address of the record (as obtained from the address field of the record), the calculated checksum, and the checksum read with the record. A copy of the record is also output. This is a fatal error and causes the command to abort.

When a load is in progress, each data byte is written to memory and then the contents of this memory location are compared to the data to determine if the data stored properly. If for some reason the compare fails, then a message is output stating the address where the data was to be stored, the data written, and the data read back during the compare. This is also a fatal error and causes the command to abort.

Because processing of the S-records is done character-by-character, any data that was deemed good will have already been stored to memory if the command aborts due to an error.

Example

For this example, assume that a host system was used to create the following program:

```
        .file   “test.s”
#
# retrieve contents of the RTC registers
#
        .toc
T.FD:   .tc     FD.4330000080000000[tc] ,1127219200,-2147483648
        .toc
T..test:
        .tc     ..test[tc], test[ds]
T..LDATA:
        .tc     ..LDATA[tc], .LDATA
T..LRDATA:
        .tc     ..LRDATA[tc], .LRDATA
#
```

```
        .align  2
        .globl  test[ds]
        .csect  test[ds]
        .long   .test[pr], TOC[tc0], 0
        .globl  .test[pr]
        .csect  .test[pr]
.test:
        mfspr   r4,4            # load RTC upper register
        stw     r4,0(r3)        # write to caller's buffer
        mfspr   r4,5            # load RTC lower register
        stw     r4,4(r3)        # write to caller's buffer
        bclr    0x14,0x0        # return to the caller
FE_MOT_RESVD.test:
        .csect  [rw]
        .align  2
.LDATA:
        .csect  [rw]
        .align  2
.LRDATA:
```

Also assume program has been compiled and linked to start at address 65040000, and the program was converted into an S-record file named **test.mx** as follows:

```
S325650400007C8402A6908300007C8502A6908300044E80002000000000650400006504002412
S30D650400200000000000000069
S7056504000091
```

Load this file into memory for execution at address $40000 as follows:

```
PPC1-Bug>TM <Return>
Escape character: $01=^A.
```

Go into transparent mode to establish host link, input the necessary character sequences to gain access to the S-Record file **test.mx**.

.
.
.

Exit transparent mode by inputting the escape character sequence, default is **Ctrl-a**. At this point control will return to the debugger prompt.

.

```
PPC1-Bug>
```

```
PPC1-Bug>LO „-65000000 ;X=cat test.mx <Return>
cat test.mx
S325650400007C8402A6908300007C8502A6908300044E800020000000006504000065040
02412
S30D6504002000000000000000069
S7056504000091
PPC1-Bug>
```

The S-records are echoed to the terminal because of the X option.

The offset address of -65000000 was added to the addresses of the records in TEST.MX and caused the program to be loaded to memory starting at $40000. The text `cat test.mx` is an operating system command line that caused the file to be copied by the operating system to the port which is connected with the debugger host's host port.

```
PPC1-Bug>DS 40000,40014 <Return>
00040000 7C8402A6  MFSPR       R4,4
00040004 90830000  STW         R4,$0(R3) ($00041000)
00040008 7C8502A6  MFSPR       R4,5
0004000C 90830004  STW         R4,$4(R3) ($00041004)
00040010 4E800020  BCLR        20,0
PPC1-Bug>
```

The target IP now contains the entry point of the code in memory ($40000).

```
PPC1-Bug>RD <Return>
IP     =00040000 MSR    =00003030 CR     =00000020 FPSCR  =00000000
R0     =00000000 R1     =00020000 R2     =FFF0178C R3     =00041000
R4     =00000000 R5     =00000000 R6     =00000000 R7     =00000000
R8     =00000000 R9     =00000000 R10    =00000000 R11    =00000000
R12    =00000000 R13    =00000000 R14    =00000000 R15    =00000000
R16    =00000000 R17    =00000000 R18    =00000000 R19    =00000000
R20    =00000000 R21    =00000000 R22    =00000000 R23    =00000000
R24    =00000000 R25    =00000000 R26    =00000000 R27    =00000000
R28    =00000000 R29    =00000000 R30    =00000000 R31    =00000000
SPR0   =00000000 SPR1   =00000000 SPR8   =00020014 SPR9   =00000000
00040000 7C8402A6  MFSPR       R4,4
PPC1-Bug>
```

MA - Macro Define/Display
NOMA - Macro Delete

Command Input

MA [*NAME*|**;L**]

NOMA [*NAME*]

Description

The **MA** command allows you to define a macro consisting of any number of debugger commands with optional parameter specifications.

NOMA command is used to delete either a single macro or all macros.

The *NAME* argument is a macro name, which may be any combination of one to eight alphanumeric characters.

Enter **MA** without a macro name to view a list of all currently defined macros and their definitions.

When **MA** is invoked with the name of a currently defined macro, the macro definition is displayed. Line numbers, which are assigned in increments of 10, are shown to facilitate editing with the **MAE** command.

If **MA** is invoked with a valid name that does not currently have a definition, then the debugger enters the macro definition mode. In response to each macro definition prompt `M=`, type a debugger command followed by the return key. To exit the macro definition mode, press the Return key (null line) at the prompt.

Commands are not checked for syntax until the macro is invoked. A macro must contain primitive debugger commands (i.e., no definition). If the macro contains errors, you may either edit it with the **MAE** command or delete with the **NOMA** command and redefine it.

Macro definitions are stored in a string pool of fixed size. If the string pool becomes full while in the definition mode, the offending string is discarded, a message `STRING POOL FULL, LAST LINE DISCARDED` is printed and the user is returned to the debugger command prompt. This also happens if the string entered would cause the string pool

to overflow. The string pool has a capacity of 511 characters. The only way to add or expand macros when the string pool is full is either to delete or edit macro(s).

Debugger commands contained in macros may reference arguments supplied at invocation time. Arguments are denoted in macro definitions by embedding a back slash (\) followed by a numeral. Up to ten arguments are permitted, numbered 0 through 9. A definition containing a back slash followed by a zero would cause the first argument to that macro to be inserted in place of the string "\0". Similarly, the second argument would be used in place of the string "\1".

For instance, you may create a macro named ARGUE, with three arguments, \0, \1, and \2. Entering **ARGUE 3000 1 ;B** at the debugger prompt invokes the macro, with the text strings **3000**, **1**, and **;B** replacing the \0, \1, and \2 respectively, within the body of the macro.

The **L** option toggles the loop continuous macro mode. If the current macro mode is loop continuous, once a macro is invoked, it will automatically be re-invoked for continuous operation.

To delete a macro, invoke **NOMA** followed by the name of the macro. Invoking **NOMA** without specifying a valid macro name deletes all macros. If **NOMA** is invoked with a valid macro name that does not have a definition, an error message is printed.

Examples

Example 1: Define the macro ABC.

```
PPC1-Bug>MA ABC <Return>
M=MD 3000 <Return>
M=GO \0 <Return>
M= <Return>
PPC1-Bug>
```

Example 2: Define the macro DIS.

```
PPC1-Bug>MA DIS <Return>
M=MD \0:17;DI <Return>
M= <Return>
PPC1-Bug>
```

Example 3: List all currently defined macros.

```
PPC1-Bug>MA <Return>
MACRO ABC
010 MD 3000
020 GO \0
MACRO DIS
010 MD \0:17;DI
PPC1-Bug>
```

Example 4: List the definition of the macro **ABC**.

```
PPC1-Bug>MA ABC <Return>
MACRO ABC
010 MD 3000
020 GO \0
PPC1-Bug>
```

Example 5: Delete the macro **DIS**.

```
PPC1-Bug>NOMA DIS <Return>
PPC1-Bug>
```

Example 6: List all currently defined macros.

```
PPC1-Bug>MA <Return>
MACRO ABC
010 MD 3000
020 GO \0
PPC1-Bug>
```

Example 8: Delete all defined macros.

```
PPC1-Bug>NOMA <Return>
PPC1-Bug>
```

Example 9: List all currently defined macros.

```
PPC1-Bug>MA <Return>
NO MACROS DEFINED
PPC1-Bug>
```

MAE - Macro Edit

Command Input

MAE *NAME LINE #* [*STRING*]

Arguments

NAME	Macro name, which may be any combination of one to eight alphanumeric characters
LINE #	Line number (1-999) to be replaced or where a new line is to be inserted
STRING	Line to be inserted or replaced

Description

The **MAE** command allows you to edit a macro. **MAE** is line oriented and allows inserting, deleting, and replacing individual lines.

Replace a line by specifying its line number and the replacement text.

Insert a line between two existing lines by specifying a *LINE #* that is between line numbers of the two existing lines. For instance, assign *LINE #* 15 to a new line that you want to insert between lines 010 and 020. The text of the new line is the *STRING*.

Delete a line by specifying a line number and not adding any replacement text.

The MAE command displays the macro, as edited, with the lines renumbered in increments of 10.

Attempting to delete a nonexistent line results in an error message being displayed. **MAE** does not permit deletion of a line if the macro consists only of that line; you must remove it using the **NOMA** command.

MAE operates only on previously defined macros (use **MA** to define new macros).

Line numbers serve one purpose: specifying the location within a macro definition to perform the editing function. After the editing is complete, the macro definition is displayed with a new set of line numbers.

Examples

Example 1: Add a line to macro ABC.

List definition of macro ABC.

```
PPC1-Bug>MA ABC <Return>
MACRO ABC
010 MD 3000
020 GO \0
PPC1-Bug>
```

Then add a line to macro ABC.

```
PPC1-Bug>MAE ABC 15 RD <Return>
MACRO ABC
010 MD 3000
020 RD
030 GO \0
PPC1-Bug>
```

Example 2: Replace line 010 from macro ABC.

```
PPC1-Bug>MAE ABC 10 MD 10+Z0 <Return>
MACRO ABC
010 MD 10+Z0
020 RD
030 GO \0
PPC1-Bug>
```

Example 3: Remove the specified line from the macro ABC.

```
PPC1-Bug>MAE ABC 30 <Return>
MACRO ABC
010 MD 10+Z0
020 RD
PPC1-Bug>
```

MAL - Enable Macro Listing
NOMAL - Disable Macro Listing

Command Input

MAL

NOMAL

Description

The **MAL** command allows you to view expanded macro lines as they are executed. This is especially useful when errors result, as the line that caused the error appears on the display.

The **NOMAL** command is used to suppress the listing of the macro lines during execution.

The use of **MAL** and **NOMAL** is a convenience for you and in no way interacts with the function of the macros.

MAR - Load Macros

Command Input

MAR [*controllerLUN*] [[*deviceLUN*] [*block#*]]

Arguments

controllerLUN	Logical Unit Number (LUN) of the controller to which the following device is attached. This initially defaults to LUN 0.
deviceLUN	LUN of the device to save/load macros to/from. This initially defaults to LUN 0.
block#	Number of the block on the above device that is the first block of the macro list. This initially defaults to block 2.

Description

The **MAR** command loads macros that have previously been saved by **MAW**. Care should be taken to avoid attempting to load macros from a location on the disk or tape other than that written to by the **MAW** command. While **MAR** checks for invalid macro names and other anomalies, the results of such a mistake are unpredictable.

Note **MAR** discards all currently defined macros before loading from disk or tape.

Default are set each time either **MAR** or **MAW** is invoked. When either command has been used, the default controller, device, and block numbers are set to those used. If macros were loaded from controller 0, device 2, block 8 with command **MAR**, the defaults for a later invocation of **MAW** would be the same.

Errors encountered during I/O are reported along with the 16-bit status word returned by the I/O routines.

Example

For the example, assume that controller 0, device 2 is accessible.

Load macros from block 3.

```
PPC1-Bug> MAR 0,2,3 <Return>
PPC1-Bug>
```

List macros.

```
PPC1-Bug> MA <Return>
MACRO ABC
010 MD 3000
020 GO \0
PPC1-Bug>
```

Define macro ASM.

```
PPC1-Bug> MA ASM <Return>
M=MM \0;DI
M= (CR)
PPC1-Bug>
```

List all macros.

```
PPC1-Bug> MA <Return>
MACRO ABC
010 MD 3000
020 GO \0
MACRO ASM
010 M=MM \0;DI
PPC1-Bug>
```

MAW - Save Macros

Command Input

MAW [*controllerLUN*] [[*deviceLUN*] [*block#*]]

Arguments

controllerLUN	Logical Unit Number (LUN) of the controller to which the following device is attached. This initially defaults to LUN 0.
deviceLUN	LUN of the device to save/load macros to/from. This initially defaults to LUN 0.
block#	Number of the block on the above device that is the first block of the macro list. This initially defaults to block 2.

Description

The **MAW** command saves the currently defined macros to disk or tape.

The selected block number, controller LUN, and device LUN are displayed, followed by a prompt to confirm the save (`OK to proceed (y/n)?`).

The list is saved as a series of strings and may take up to three blocks. If no macros are currently defined, no write is done. A `NO MACRO DEFINED` message is displayed.

Default are set each time either **MAR** or **MAW** is invoked. When either command has been used, the default controller, device, and block numbers are set to those used. If macros were loaded from controller 0, device 2, block 8 with command **MAR**, the defaults for a later invocation of **MAW** would be the same.

Errors encountered during I/O are reported along with the 16-bit status word returned by the I/O routines.

Example

For the example, assume that controller 0, device 2 is accessible.

Load macros from block 3.

```
PPC1-Bug> MAR 0,2,3 <Return>
PPC1-Bug>
```

List macros.

```
PPC1-Bug> MA
MACRO ABC
010 MD 3000
020 GO \0
PPC1-Bug>
```

Define macro ASM.

```
PPC1-Bug> MA ASM <Return>
M=MM \0;DI
M= (CR)
PPC1-Bug>
```

List all macros.

```
PPC1-Bug> MA <Return>
MACRO ABC
010 MD 3000
020 GO \0
MACRO ASM
010 M=MM \0;DI
PPC1-Bug>
```

Save macros to block 8, previous device.

```
PPC1-Bug> MAW „8 <Return>

Saving to:  VME320, Controller 0, Drive 2, Block/File Number 8
Number of Logical Blocks = 2
OK to proceed (y/N)? Y <Return>
PPC1-Bug>
```

MD, MDS - Memory Display

Command Input

MD *ADDR*[**:***COUNT* | *ADDR*] [**;** [**B**|**H**|**W**|**S**|**D**|**DI**]]

MDS *ADDR*[**:***COUNT* | *ADDR*] [**;** [**B**|**H**|**W**|**S**|**D**|**DI**]]

Options

Integer Data Types

B Byte

H Half-word

W Word

Floating Point Data Types

S Single Precision

D Double Precision

DI Enable the one-line disassembler. All other options are invalid if **DI** is selected.

Description

The **MD** and **MDS** commands display the contents of multiple memory locations all at once.

The default data type is word. Also, for the integer data types, the data is always displayed in hexadecimal along with its ASCII representation.

The optional *COUNT* argument specifies the number of data items to be displayed (or the number of disassembled instructions to display if the disassembly option is selected). The default is 8 for **MD**. **MDS** displays 128 items (a sector) as the default.

To re-execute the command, press the Return key at the prompt immediately after the command has executed. The command displays an equal number of data items or lines beginning at the next address.

Examples

Example 1:

```
PPC1-Bug>MD 22000;H <Return>
00022000  2800 1942 2900 1942  2800 1842 2900 2846  (..B)..B(..B).(F
PPC1-Bug> <Return>
00022010  FC20 0050 ED07 9F61  FF00 000A E860 F060  | .Pm..a....h’p’
PPC1-Bug>
```

Example 2: For this example, assume the microprocessor register state is R5=00023627.

```
PPC1-Bug>MD R5:&19;B <Return>
00023627  4F 82 00 C5 9B 10 33 7A DF 01 6C 3D 4B 50 0F 0F  O..E..3z_.l=KP..
00023637  31 AB 80                                          1+.
PPC1-Bug>
```

Example 3:

```
PPC1-Bug>MD 30000;DI <Return>
00030000 3CA00000  ADDIS       R5,R0,$0
00030004 2B040000  CMPLI       CRF6,0,R4,$0
00030008 419A0014  BC          12,26,$0003001C
0003000C 98A30000  STB         R5,$0(R3) ($00041004)
00030010 3884FFFF  ADDI        R4,R4,$FFFFFFFF
00030014 38630001  ADDI        R3,R3,$1
00030018 4BFFFFEC  B           $00030004
0003001C 4E800020  BCLR        20,0
PPC1-Bug>
```

Example 4:

```
PPC1-Bug>MD 20000;D <Return>
00020000 0_521_9415513BBFC7C= 3.1400000000000010_E+0087
00020008 1_740_05800C000D2A5=-5.8508426708663386_E+0250
00020010 0_2B3_BFF25B8031E80= 1.9999900000000014_E-0100
00020018 0_47C_97EC34022A8D5= 6.7777778899999985_E+0037
00020020 0_423_6FEB11A600001= 9.8762300000000015_E+0010
00020028 0_3F8_47B56E95931C5= 1.0000876423100000_E-0002
00020030 0_2B8_407C89A021ADB= 4.5789000000000044_E-0099
00020038 0_44C_52D0F4552863F= 2.0000179999999999_E+0023
PPC1-Bug>
```

Example 5:

```
PPC1-Bug>MD 10000;S <Return>
00020000 0_A4_194155= 1.6455652147200000_E+0011
00020004 0_27_3BFC7C= 4.7454405384196168_E-0027
00020008 1_E8_005800=-4.0673757930760459_E+0031
0002000C 1_80_00D2A5=-2.0128567218780518_E+0000
00020010 0_56_3BFF25= 6.6789829960070541_E-0013
00020014 1_70_031E80=-3.1261239200830460_E-0005
00020018 0_8F_497EC3= 1.0316552343750000_E+0005
0002001C 0_80_22A8D5= 2.5415546894073486_E+0000
PPC1-Bug>
```

Example 6:

```
PPC1-Bug>MDS 30000 <Return>
00030000  3CA00000 2B040000 419A0014 98A30000  <...+...A.......
00030010  3884FFFF 38630001 4BFFFFEC 4E800020  8...8c..K...N..
00030020  FFFFFFFF FFFFFFFF FFFFFFFF FFFFFFFF  ................
00030030  FFFFFFFF FFFFFFFF FFFFFFFF FFFFFFFF  ................
00030040  00000000 00000000 00000000 00000000  ................
00030050  00000000 00000000 00000000 00000000  ................
00030060  FFFFFFFF FFFFFFFF FFFFFFFF FFFFFFFF  ................
00030070  FFFFFFFF FFFFFFFF FFFFFFFF FFFFFFFF  ................
00030080  00000000 00000000 00000000 00000000  ................
00030090  00000000 00000000 00000000 00000000  ................
000300A0  FFFFFFFF FFFFFFFF FFFFFFFF FFFFFFFF  ................
000300B0  FFFFFFFF FFFFFFFF FFFFFFFF FFFFFFFF  ................
000300C0  00000000 00000000 00000000 00000000  ................
000300D0  00000000 00000000 00000000 00000000  ................
000300E0  FFFFFFFF FFFFFFFF FFFFFFFF FFFFFFFF  ................
000300F0  FFFFFFFF FFFFFFFF FFFFFFFF FFFFFFFF  ................
00030100  00000000 00000000 00000000 00000000  ................
00030110  00000000 00000000 00000000 00000000  ................
00030120  FFFFFFFF FFFFFFFF FFFFFFFF FFFFFFFF  ................
00030130  FFFFFFFF FFFFFFFF FFFFFFFF FFFFFFFF  ................
00030140  00000000 00000000 00000000 00000000  ................
00030150  00000000 00000000 00000000 00000000  ................
00030160  FFFFFFFF FFFFFFFF FFFFFFFF FFFFFFFF  ................
00030170  FFFFFFFF FFFFFFFF FFFFFFFF FFFFFFFF  ................
00030180  00000000 00000000 00000000 00000000  ................
00030190  00000000 00000000 00000000 00000000  ................
000301A0  FFFFFFFF FFFFFFFF FFFFFFFF FFFFFFFF  ................
000301B0  FFFFFFFF FFFFFFFF FFFFFFFF FFFFFFFF  ................
000301C0  00000000 00000000 00000000 00000000  ................
000301D0  00000000 00000000 00000000 00000000  ................
000301E0  FFFFFFFF FFFFFFFF FFFFFFFF FFFFFFFF  ................
000301F0  FFFFFFFF FFFFFFFF FFFFFFFF FFFFFFFF  ................
PPC1-Bug>
```

Example 7:

```
PPC1-Bug>MDS 30000;B <Return>
00030000  3C A0 00 00 2B 04 00 00  41 9A 00 14 98 A3 00 00  <...+...A.......
00030010  38 84 FF FF 38 63 00 01  4B FF FF EC 4E 80 00 20  8...8c..K...N..
00030020  FF FF FF FF FF FF FF FF  FF FF FF FF FF FF FF FF  ................
00030030  FF FF FF FF FF FF FF FF  FF FF FF FF FF FF FF FF  ................
00030040  00 00 00 00 00 00 00 00  00 00 00 00 00 00 00 00  ................
00030050  00 00 00 00 00 00 00 00  00 00 00 00 00 00 00 00  ................
00030060  FF FF FF FF FF FF FF FF  FF FF FF FF FF FF FF FF  ................
00030070  FF FF FF FF FF FF FF FF  FF FF FF FF FF FF FF FF  ................
PPC1-Bug>
```

Example 8:

```
PPC1-Bug>MDS 30000;H <Return>
00030000  3CA0 0000 2B04 0000  419A 0014 98A3 0000  <...+...A.......
00030010  3884 FFFF 3863 0001  4BFF FFEC 4E80 0020  8...8c..K...N..
00030020  FFFF FFFF FFFF FFFF  FFFF FFFF FFFF FFFF  ................
00030030  FFFF FFFF FFFF FFFF  FFFF FFFF FFFF FFFF  ................
00030040  0000 0000 0000 0000  0000 0000 0000 0000  ................
00030050  0000 0000 0000 0000  0000 0000 0000 0000  ................
00030060  FFFF FFFF FFFF FFFF  FFFF FFFF FFFF FFFF  ................
00030070  FFFF FFFF FFFF FFFF  FFFF FFFF FFFF FFFF  ................
00030080  0000 0000 0000 0000  0000 0000 0000 0000  ................
00030090  0000 0000 0000 0000  0000 0000 0000 0000  ................
000300A0  FFFF FFFF FFFF FFFF  FFFF FFFF FFFF FFFF  ................
000300B0  FFFF FFFF FFFF FFFF  FFFF FFFF FFFF FFFF  ................
000300C0  0000 0000 0000 0000  0000 0000 0000 0000  ................
000300D0  0000 0000 0000 0000  0000 0000 0000 0000  ................
000300E0  FFFF FFFF FFFF FFFF  FFFF FFFF FFFF FFFF  ................
000300F0  FFFF FFFF FFFF FFFF  FFFF FFFF FFFF FFFF  ................
PPC1-Bug>
```

MENU - System Menu

Command Input

MENU

Description

The **MENU** command displays the System Menu, which is shown below:

```
1  Continue System Start Up
2  Select Alternate Boot Device
3  Go to System Debugger
4  Initiate Service Call
5  Display System Test Errors
6  Dump Memory to Tape
Enter Menu #:
```

You can return to the debugger by entering **3** at the `Enter Menu #` prompt. (If you execute the Menu command from the `PPC1-Diag>` prompt, menu option **3** will return you to the PPCBug diagnostics.)

Refer to Appendix B for information on using the System Menu.

M, MM - Memory Modify

Command Input

M *ADDR* [**;**[[**B**|**H**|**W**|**S**|**D**] [**A**] [**N**]]|[**DI**]]**,**

MM *ADDR* [**;**[[**B**|**H**|**W**|**S**|**D**] [**A**] [**N**]]|[**DI**]]

Options

Integer Data Types

B Byte

H Half-word

W Word

Floating Point Data Types

S Single Precision

D Double Precision

Other Options:

N Disable the read portion of the command

A Force alternate location accesses only

DI Enable the one-line assembler/disassembler. All other options are invalid if this option is selected.

Description

The **M** and **MM** command are used to view and change the contents of memory. The command reads and displays the contents of memory at the specified address and prompts you with a question mark (?).

You may change the displayed value by typing a new value followed by the Return key. To leave the memory location unchanged, press the Return key without typing a new value. That memory location is closed and the next location is opened.

You may also enter a special character, either at the prompt or after typing new data, for scrolling through the memory locations. The special characters are:

V or **v**	Open the next memory location. This is the default, and remains in effect until changed by entering one of the other special characters.
^	Back up and open the previous memory location
=	Re-open the same memory location (this is useful for examining I/O registers or memory locations that are changing over time)
.	Terminate the **MM** command, and return control to the debugger

The command reads the memory and verifies that the new contents match what was written. An error message appears if the value read back is not the same as the value written (i.e., if the write was not allowed).

When the one-line assembler/disassembler is enabled, the contents of the specified memory location are disassembled and displayed and you are prompted with a question mark (?) for input. At this point, you have three choices:

- Press the Return key. This closes the present location and continues with disassembly of next instruction.
- Enter a new source instruction and press the Return key. This invokes the assembler, which assembles the instruction and generates a listing file of one instruction.
- Enter a period (**.**) and press the Return key. This closes the present location and exits the **M** and **MM** command.

If a new source line is entered, the present line is erased and replaced by the new source line entered. If a printer port is configured (hard copy mode), a line feed is done instead of erasing the line.

If an error is found during assembly, an error message such as `NON-EXISTENT OPERAND` or `NON-EXISTENT MNEMONIC` appears. The location being accessed is redisplayed.

Refer to Chapter 4 for information on the PPCBug assembler.

Examples

Example 1: Access location $20000, modify memory, modify and backup, and modify memory and exit.

```
PPC1-Bug>MM 20000;H <Return>
00020000 1234? <Return>
00020002 5678? 4321 <Return>
00020004 9ABC? 8765^ <Return>
00020002 4321? <Return>
00020000 1234? ABCD. <Return>
PPC1-Bug>
```

Example 2: Word access to location $20004 with alternate location access option enabled, modify and reopen location, and exit memory modify.

```
PPC1-Bug>MM 10004;WA <Return>
00020004 CD432187? <Return>
0002000C 00068010? 68010+10= <Return>
0002000C 00068020? <Return>
0002000C 00068020? . <Return>
PPC1-Bug>
```

Example 3: Assemble a new source line.

```
PPC1-Bug>MM 40000;DI <Return>
00040000 00000000  WORD     $00000000? ADDIS R10,R0,1000 <Return>
00040000 3D401000  ADDIS    R10,R0,$1000
00040004 00000000  WORD     $00000000? ORI R10,R10,FFFF <Return>
00040004 614AFFFF  ORI      R10,R10,$FFFF
00040008 00000000  WORD     $00000000? . <Return>
PPC1-Bug>
```

Example 4: New source line with error.

```
PPC1-Bug>MM 40008;DI <Return>
00040008 00000000  WORD        $00000000? FOO R20,R0,10 <Return>
Assembler Error: Unknown Mnemonic

00040008 00000000  WORD        $00000000? ORI R20,R0,10 <Return>
00040008 60140010  ORI         R20,R0,$10
0004000C 00000000  WORD        $00000000? . <Return>
PPC1-Bug>
```

Example 5: Step to next location and exit MM.

```
PPC1-Bug>MM 40000;DI <Return>
00040000 3D401000  ADDIS       R10,R0,$1000? <Return>
00040004 614AFFFF  ORI         R10,R10,$FFFF? .<Return>
PPC1-Bug>
```

Example 6: Double precision floating point numbers.

```
PPC1-Bug>MM 20000;D <Return>
00020000 3.140000000000001_E+87? 1.2 <Return>
00020008 -5.8508426708663386_E+250? 2 <Return>
00020010 1.9999900000000014_E-100? 4.357E+10 <Return>
00020018 6.7777778899999985_E+37? 2.765E-99 <Return>
00020020 9.8762300000000015_E+10? -4.876E-34 <Return>
00020028 1.00008764231_E-2? -1.023E101 <Return>
00020030 4.5789000000000044_E-99? 1_7FF_FFFFFFFFFFFF. <Return>
PPC1-Bug>

PPC1-Bug>MD 20000:7;D <Return>
00020000 0_3FF_3333333333333= 1.2000000000000000_E+0000
00020008 0_400_0000000000000= 2.0000000000000000_E+0000
00020010 0_422_449F2E0FFFFFF= 4.3569999999999992_E+0010
00020018 0_2B7_830E4EB15EA1B= 2.7650000000000032_E-0099
00020020 1_390_4410D74F66DA5=-4.8760000000000030_E-0034
00020028 1_54E_762B1924BFDD5=-1.0230000000000001_E+0101
00020030 1_7FF_FFFFFFFFFFFF=-0.FFFFFFFFFFFF000_E-0FFF
PPC1-Bug>
```

Example 7: Attempt to write to a location that is not available.

```
PPC1-Bug>MM 80000080 <Return>
80000080 00000000 ? 1
** WARNING: NO MATCH **
80000080 00000000 ? .
PPC1-Bug>
```

MMD - Memory Map Diagnostic

Command Input

MMD *RANGE INCREMENT* [**;B**|**H**|**W**]

Options

B	Byte
H	Half-word
W	Word

Description

The **MMD** command is used to find and display ranges of addresses that are readable. This is done by reading memory locations within the *RANGE*. If a successful transaction to a location is completed, that address is included in a found range, else in a not-found range. The transaction (a read) is done with the data type specified on the command line.

INCREMENT is the value that is added to the old transaction address after the transaction is complete to form the next transaction address. The *INCREMENT* will be scaled by the data type, i.e., 1x for byte, 2x for half-word, and 4x for word.

The default data type is word.

Examples

Example 1: Look for any memory between $0 and $10000000 with an increment of $10000 by bytes. MMD reports that only $800000 (8Mbytes) of memory was found.

```
PPC1-Bug>MMD 0 10000000 10000;B <Return>
Effective address: 00000000
Effective address: 10000000
$00000000-$007F0000 PRESENT
$00800000-$0FFF0000 NOT-PRESENT
PPC1-Bug>
```

Example 2: Look for any memory between $10000000 and $FFFFFFFF with an increment of $40000 by bytes.

```
PPC1-Bug>MMD 10000000 FFFFFFFF 40000;B <Return>
Effective address: 10000000
Effective address: FFFFFFFF
$10000000-$7FFC0000 NOT-PRESENT
$80000000-$9FFC0000 PRESENT
$A0000000-$FFEC0000 NOT-PRESENT
$FFF00000-$FFFC0000 PRESENT
PPC1-Bug>
```

MMGR - Memory Manager

Command Synopsis

MMGR D [flag]
Q [S [addr] | F | A]
A size [align [addr [Z]]]
F addr
E start size

Description

The MMGR command provides access to PPCBug Memory Manager services. These services encompass the following three categories:

- Diagnostic(D) - controls the degree of textual information the manager will provide concerning its activities.
- Query (Q) - provides information about the current state of managed memory.
- Active (A, F, or E) - controls memory use on behalf of the user.

Diagnostic Command - MMGR D [flag]

This command accesses the diagnostic flag that controls the density of the memory manager monolog. If the flag parameter is omitted, the response is the current value. Otherwise, the flag is set to the provided value and there is no response. The flag is bit-wise interpreted as follows:

0 Only failure, error, and catastrophic information provided.

1 Enables validation and verification of managed memory. Errors of management and memory misuse are reported. This mode of operation is not recommended for extended use, since it requires some extra processing.

2 Provides tracking of allocation and free requests.

4 Provides commentary and displays the allocated list after allocation/free activities.

8 More detailed commentary and displays some data from the start and end of each allocated block.

While these levels are essentially independent, it is intended that the more detailed information levels will be requested in concert with lower levels.

Query Commands - MMGR Q [S [addr] | F | A]

The query interface will provide information on the current state of managed memory. Queries may be one of three types.

System — If the second parameter is S, or there is no second parameter, system data is displayed (see Example 1).

If a third parameter is used, it will be interpreted as an address where the above data is to be deposited. The form is as defined by the structure `MemQuery_t` in `mem_mgr.h`

Free List — If the second parameter is **F**, the free list is displayed. The blocks are numbered, sorted in ascending address order, and each is accompanied by its size.

Allocated List — If the second parameter is **A**, the allocated list is displayed. The blocks are numbered, sorted in ascending address order, and each is accompanied by its size. The first and last blocks listed are list terminators and are specified as zero size.

Active Commands - MMGR A size [align [addr[z]]]
F addr
E start size

Allocate — If the first parameter is **A**, memory is allocated from the PPCBug's partition. **Size** must be specified, and it is rounded up to a minimum allocation size. **Align** is an operational parameter that requests a byte-boundary for block alignment. If this value is not a power of two, it is rounded up until it is. **Addr** is an optional parameter that requests that a specific address be allocated. **Z** is an optional parameter that requests that the allocated block be zero filled. The optional parameters are position

dependent so each must be provided up to the last one desired. For this reason, zero is taken to be a harmless value. See example number 2.

Free — If the first parameter is **F**, previously allocated memory at the specified address is put back on the free list. There are no optional parameters for this command. Special care is recommended with this command as it is possible to free up memory that is currently in use!

Expand — If the first parameter is **E**, the PPCBug's memory partition is expanded. The expansion parameters need not specify an area contiguous with the current partition, but if not, a phantom block covering the gap appears on the allocated list. If the request overlaps memory that is currently being managed, Bug displays an error message.

Examples:

Example 1: Display System Values

```
PPC4-Bug>MMGR Z S <Return>
MemMgr Query: start(0x1F00000), size(0xFA000), free(0x95904), alloc(0x646B4)
MemMgr Query: - alloc[biggest(0x32064) #(26)], free[biggest(0x880A0)#(13)]
MemMgr Query: - Overhead Sys(0x48) Block(0x1C) bytes.
```

Where:

start — is the lowest address in the managed partition,

size — is the total number of bytes in the partition less that required for system management,

free — is the sum of bytes in all of the free blocks,

alloc — is the sum of bytes in all of the allocated blocks,

alloc[biggest — is the size of the largest allocated block in bytes,

alloc[# — is the count of allocated blocks

free[biggest — is the size of the largest free block in bytes,

free[# — is the count of free blocks

Overhead Sys is the number of bytes required for system management,

Overhead Block is the byte per block management usage.

Example 2: Display the free list

```
PPC4-Bug>MMGR Q F <Return>
MemMgr: FREE LIST
Control=0x1F00000, Range=0x1F00048-0x1FF9FFF Size=0xF9FB8 Debug=0
 1 (0x1F00048-0x000090) 2 (0x1F0309C-0x000004) 3 (0x1F03C34-0x000004)
 4 (0x1F04384-0x000004) 5 (0x1F05234-0x000004) 6 (0x1F0A73C-0x000004)
 7 (0x1F0BA4C-0x000004) 8 (0x1F0BA8C-0x000004) 9 (0x1F4FCBC-0x000004)
10 (0x1F50CDC-0x000004)11 (0x1F514FC-0x000004)12 (0x1F5BF44-0x0880BC)
13 (0x1FEC7E4-0x00D81C)
```

Where:

Control is the location of the manager's control block

Range is the largest and smallest address in the managed partition

Size is the total number of allocatable bytes in the managed partition. If there are no gaps, it will be the difference of the range values.

Debug is the current value of the Debug flag.

Example 3: Allocate a sixteen byte aligned, zero filled, 1000 byte block.

```
PPC4-Bug>MMGR A 1000 10 0 Z <Return>
0x1000 cleared bytes allocated at 0x1F5DFA0
```

Example 4: Free the block allocated in Example 2

```
PPC4-Bug>MMGR F 1F5DFA0 <Return>
Free memory block at 0x1F5DFA0 OK
```

MS - Memory Set

Command Input

MS *ADDR* {*Hexadecimal number*} {*'string'*}

Arguments

Hexadecimal number	Hexadecimal value to be written to memory. It is not assumed to be of a particular size, so it can contain any number of digits (as allowed by command line buffer size). If an odd number of digits are entered, the least significant nibble of the last byte accessed will be unchanged.
string	An ASCII string to be written to memory. Enclose it in single quotes (*'*). To include a quote as part of *string*, enter two consecutive quotes.

Description

The **MS** command writes data to memory starting at the specified address.

Note that one or more hexadecimal numbers and ASCII strings may be entered in the same command.

Example

For this example, assume that memory is initially cleared:

```
PPC1-Bug>MS 25000 0123456789ABCDEF 'This is "PPC1Bug"' 23456 <Return>
PPC1-Bug>

PPC1-Bug>MD 25000:20;B <Return>
00025000  01 23 45 67 89 AB CD EF  54 68 69 73 20 69 73 20  .#Eg....This is
00025010  22 45 56 4D 42 75 67 22  23 45 60 00 00 00 00 00  "PPC1Bug"#E'.....
PPC1-Bug>
```

MW - Memory Write

Command Input

MW *ADDR DATA* [**;B**|**H**|**W**]

Options

B	Byte
H	Half-word
W	Word

The default data size is word.

Description

The **MW** command writes a data pattern (*DATA*) to a specific location (*ADDR*). No verify (read) is performed.

Examples

Example 1:

```
PPC1-Bug>MW 1E000 55AA55AA <Return>
Effective address: 0001E000
Effective data   : 55AA55AA
PPC1-Bug>

PPC1-Bug>MD 1E000 <Return>
0001E000  55AA55AA 00000000 00000000 00000000  U.U.............
0001E010  00000000 00000000 00000000 00000000  ................
PPC1-Bug>
```

Example 2:

```
PPC1-Bug>MW 1E000 77;B <Return>
Effective address: 0001E000
Effective data   : 77
PPC1-Bug>

PPC1-Bug>MW 1E000 <Return>
0001E000  77AA55AA 00000000 00000000 00000000  w.U.............
0001E010  00000000 00000000 00000000 00000000  ................
PPC1-Bug>
```

Example 3:

```
PPC1-Bug>MW 1E002 33CC;H <Return>
Effective address: 0001E002
Effective data   : 33CC
PPC1-Bug>

PPC1-Bug>MD 1E000 <Return>
0001E000  77AA33CC 00000000 00000000 00000000  w.3.............
0001E010  00000000 00000000 00000000 00000000  ................
PPC1-Bug>
```

NAB - Network Auto Boot

Command Input

NAB

Description

The **NAB** command re-invokes the network auto boot feature. This command simply invokes the **NBO** command with the specified parameters saved in NVRAM for the specified network interface. This invocation occurs at system start-up and can be specified at either power-up or at any reset condition.

Refer to *NBO - Network Boot Operating System* on page 3-147.

The clock must be running in order for this command to work properly. Use **TIME ;L** to see if the clock is running. Use the **SET** command to start and initialize the clock.

NAP - NAP MPU

Note This command is for multi-processor boards only.

Command Input

NAP *MPU#*

Options

None

Description

The **NAP** command puts an idling CPU into a tight cached loop from which it will never exit. The napping CPU will not intrude onto the bus. This command is useful during performance analysis when it is desirable to allow one single CPU access to the bus without having to share bus bandwidth with another CPU.

To cause a processor to leave the napping state, a board reset must be issued.

This command will issue an error message if the system does not contain two processors.

Example: To 'nap' processor 1, do:

```
PPC1-Bug>NAP 1<Return>
PPC1-Bug>
```

NBH - Network Boot Operating System, Halt

Command Input

NBH [*ControllerLUN*] [*DeviceLUN*] [*ClientIPAddress*] [*ServerIPAddress*] [*String*]

Arguments

ControllerLUN	Logical Unit Number (LUN) of the controller to which the following device is attached. It defaults to LUN 0.
DeviceLUN	LUN of the device to boot from. It defaults to LUN 0.
ClientIPAddress	Internet Protocol Address of the client, basically my/source IP address. It defaults to an IP address of 0 (refer to the **NIOT** command).
ServerIPAddress	Internet Protocol Address of the server, basically the destination IP address. It defaults to an IP address of 0 (refer to the **NIOT** command).
String	A character string. Up to 2 strings may be specified, usually the name of the file to boot and an optional string (string 2). String 2, if specified, is passed to the booted file. To specify string 2, a delimiter must be used to differentiate from string 1 (boot filename). Both character strings default to a null character string (refer to the **NIOT** command).

Description

The **NBH** command loads an operating system or control program from the server into memory, and halts. This command functions in exactly the same way as the **NBO** command, except that control is not given to the loaded program.

After the registers are initialized, control is returned to the debugger monitor and the prompt reappears on the terminal screen. Because control is retained by the debugger, all of the debugger's facilities are available for debugging the loaded program if necessary.

The device and controller configuration parameters used when **NBH** is initiated can be examined via the **NIOT** command.

Note that certain arguments will be passed (through MPU registers) to the loaded program.

Refer to *NBO - Network Boot Operating System* on page 3-147 for examples and further explanation.

Note The clock must be running in order for this command to work properly. Use **TIME ;L** to see if the clock is running. Use the **SET** command to start and initialize the clock.

NBO - Network Boot Operating System

Command Input

NBO [*ControllerLUN*] [*DeviceLUN*] [*ClientIPAddress*] [*ServerIPAddress*] [*String*]

Arguments

ControllerLUN	Logical Unit Number (LUN) of the controller to which the following device is attached. It defaults to LUN 0.
DeviceLUN	Logical Unit Number (LUN) of the device from which to boot. It defaults to LUN 0.
ClientIPAddress	Internet Protocol Address of the client, basically my/source IP address. It defaults to an IP address of 0 (refer to the **NIOT** command).
ServerIPAddress	Internet Protocol Address of the server, basically the destination IP address. It defaults to an IP address of 0 (refer to the **NIOT** command).
String	String of characters. Up to 2 strings may be specified, usually the name of the file to boot and a optional string (string 2). String 2, if specified, is passed to the booted file. To specify string 2 a delimiter must be used to differentiate from string 1 (boot filename). Both character strings default to a null character string (refer to the **NIOT** command).

Description

The **NBO** command loads an operating system or control program from the server into memory and gives control to it (execute). The load and execution address of the file is specified via the configuration parameters. The device and controller configuration parameters used when **NBO** is initiated can be examined via the Network I/O Teach (**NIOT**) command.

NBO uses primarily the BOOTP, RARP, and TFTP protocols to load the boot file. Refer to the DARPA Internet Request for Comments RFC-951, RFC-903, and RFC-783, respectively, for the description of these

protocols. You may skip the BOOTP phase (address determination and bootfile selection) by specifying the IP addresses (server and client) and the boot filename; the booting process would then start with the TFTP phase (file transfer) of the boot sequence.

When the IP addresses are 0 they always force a BOOTP/RARP phase to occur first. If all (client and server) of the IP addresses are known/specified, the TFTP phase occurs first. If this phase fails in loading the boot file, the BOOTP/RARP phase is initiated prior to subsequent TFTP phase. If the filename is not specified, this also forces a BOOTP/RARP phase to occur first. Note that the defaults specified by the command always initiates a BOOTP/RARP phase. In any case the booting (server) IP address is displayed as well as that of any failing IP address.

Once the IP addresses are obtained from the BOOTP server (or the configuration parameters, if specified), the IP addresses are checked to see if the server and the client are resident on the same network. If they are not, the gateway IP address is used as the intermediate server to perform the TFTP phase with.

If the server has only RARP capability, you need to specify the name of the boot file, either by the command line or the configuration parameters (refer to the **NIOT** command).

Prior to the TFTP phase an ARP request is transmitted for the hardware (Ethernet) address of the server.

At selected times (when prompted or a time-out condition exists), the booting process can be aborted by pressing the BREAK key on the console keyboard or by pressing the abort switch on the front panel.

Note that certain arguments are passed (through MPU registers) to the loaded program. The following is a list of the MPU registers and their contents:

R3	Controller Logical Unit Number (CLUN) of the boot
R4	Device Logical Unit Number (DLUN) of the boot
R5	System Call Support available
R6	Base address of Network Controller Device
R7	Execution Address of Load Program

R8	Address to IPAs (Client, Server, Gateway)
R9	Pointer to Filename String (i.e., string start)
R10	Pointer to Filename String (i.e., string end + 1)
R11	Pointer to Argument String (i.e., string start)
R12	Pointer to Argument String (i.e., string end + 1)

Invoke the **NIOT** command with the **H** option to see which LUNs are available. Refer to Appendix G for a list of LUNs.

NBO uses primarily the BOOTP and TFTP protocols to load the boot file. Refer to the DARPA Internet Request for Comments RFC-951 and RFC-783, respectively, for the description of these protocols. You may skip the BOOTP phase (address determination and bootfile selection) by specifying the IP addresses (server and client) and the boot filename; the booting process would then start with the TFTP phase (file transfer) of the boot sequence.

You may invoke **NBO** without any arguments. Depending on the interface's configuration parameters, the display of various IP addresses and the boot file name signifies that the BOOTP phase was successful. The booting process halts and waits about 5 seconds for you to abort (by pressing the BREAK key).

If you do not abort, a **<CR><LF>** sequence is printed to signify the entrance into the TFTP phase of the boot process. Once this phase is started, you cannot abort unless a time-out condition arises. When the boot file is loaded into the user memory, the statistics of the TFTP phase (file transfer) are displayed. The boot process continues with loading of the MPU registers and execution of the loaded file.

Whenever an error occurs, the booting process is terminated and the error code is displayed. The error codes are listed in Appendix H.

The clock must be running in order for this command to work properly. Use **TIME ;L** to see if the clock is running. Use the **SET** command to start and initialize the clock.

Examples

Example 1: Boot from controller LUN 0, device LUN 0, with default client address of 255.255.17.34, server IP address of 255.255.17.21, and bootfile **/tftpboot/load**.

```
PPC1-Bug>NBO 0 0 255.255.17.34 255.255.17.21 /ot/load <Return>
       ...
```

Example 2: Boot from controller LUN 0, device LUN 0, with default client IP address, server IP address 255.255.17.21, and the default bootfile.

```
PPC1-Bug>NBO 0 0,,255.255.17.21 <Return>
        ...
```

Example 3: Invoke **NBO** with no arguments:

```
PPC1-Bug>NBO <Return>
Network Booting from: AM79c970, Controller 0, Device 0
Loading: Operating System
Client IP Address          = 255.255.24.10
Server IP Address          = 255.255.11.81
Gateway IP Address         = 255.255.24.254
Subnet IP Address Mask     = 255.255.24.254
Boot File Name      = /riscy/fwdb/NETLOADER/nbldexp/M88K/nbld.out
Argument File Name         =

Network Boot File load in progress... To abort hit <BREAK>

Bytes Received =&8912, Bytes Loaded =&8912
Bytes/Second =&2970, Elapsed Time =3 Second(s)
 ...
```

NIOC - Network I/O Control

Command Input

NIOC

Description

The **NIOC** command sends command packets directly to the Ethernet network interface driver. The packet to be sent must already reside in memory and must follow the packet protocol of the interface. This command facilitates in the transmission and reception of raw packets (command identifiers 2 and 3, listed below), as well as some control (command identifiers 0, 1, 4, and 5, listed below).

The command packet specifies the network interface (CLUN/ DLUN), command type (identifier), the starting memory address (data transfers), and the number of bytes to transfer (data transfers). The command types are listed in this header file as well.

The command types (identifiers) are as follows:

0 Initialize device/channel/node

1 Get hardware (Ethernet) address (network node)

2 Transmit (put) data packet

3 Receive (get) data packet

4 Flush receiver and receive buffers

5 Reset device/channel/node

The initialization (type 0) of the device/channel/node must always be performed first. If you have booted or initiated some other network I/O command, the initialization would already have been done.

The flush receiver and receive buffer (type 4) would be used if, for example, the current receive data is no longer needed, or to provide a known buffer state prior to initiating data transfers.

The reset device/channel/node (type 5) would be used if another operating system (node driver) needs to be control of the device/channel/node. Basically, put the device/channel/ node to a known state.

Whenever an error occurs, the initiated I/O control process is terminated and the appropriate error code is displayed. The error codes are listed in Appendix H.

When invoked, **NIOC** enters an interactive mode which prompts for information required to perform the command. You may change the displayed value by typing a new value, and the Return key. To leave the field unaltered, press the Return key without typing a new value.

You may also enter a special character, either at the prompt or after typing new data, for scrolling through the registers. The special characters are:

V or **v**	Open the next field. This is the default, and remains in effect until changed by entering one of the other special characters.
^	Back up and open the previous field
=	Re-open the same field
.	Terminate the **NIOC** command, and return control to the debugger

The clock must be running in order for this command to work properly. Use **TIME ;L** to see if the clock is running. Use the **SET** command to start and initialize the clock.

Examples

Example 1: Initialize (type 0) the device/channel/node.

```
PPC1-Bug>NIOC <Return>
Controller LUN                  =00? <Return>
Device LUN                      =00? <Return>
Packet Address                  =00006454? <Return>
00006454 0000 0000 0000 0000 0000 0000 0000 0000      ................
00006464 0000 0000                                    ....
Send Packet (Y/N)                =N? Y <Return>
PPC1-Bug>
```

Example 2: Retrieve the hardware address of the specified network interface (type 1). Note that the transfer byte count is set to zero; this specifies all possible data associated with the address retrieval. This also holds true for the reception of data packets.

```
PPC1-Bug>NIOC <Return>
Controller LUN                  =00? <Return>
Device LUN                      =00? <Return>
Packet Address                  =00006454? <Return>
00006454 0000 0000 0000 0001 0000 E000 0000 0000        ................
00006464 0000 0000        ....
Send Packet (Y/N)                =N? Y <Return>
PPC1-Bug>
```

View the address data retrieval.

```
PPC1-Bug>MD E000:6;B <Return>
0000E000 08 00 3E 21 0F CC        ..>!..
PPC1-Bug>
```

Example 3: View the packet to transmit, ARP Request.

This example illustrates the transmission (type 2) of a packet (ARP Request). The transfer byte count specifies how many bytes are to be transmitted. If the transfer byte count is below the minimum transmit byte count for the specified interface, the driver rounds to the minimum and places it into your packet. However, the specified network interface driver does not round down to the maximum if the transfer byte count exceeds the maximum. You must ensure packet integrity (e.g., source and destination addresses) for the specified network interface; the driver does not insert any data.

```
PPC1-Bug>MD E000:&21 <Return>
0000E000 FFFF FFFF FFFF 0800 3E21 0FCC 0806 0001        ........>!......
0000E010 0800 0604 0001 0800 3E21 0FCC ffff 0B2C        ........>!.....,
0000E020 FFFF FFFF FFFF 8610 1112        ..........
PPC1-Bug>

PPC1-Bug>NIOC <Return>
Controller LUN                  =00? <Return>
Device LUN                      =00? <Return>
Packet Address                  =00006454? <Return>
00006454 0000 0000 0000 0002 0000 E000 0000 002A        ................
00006464 0000 0000        ....
Send Packet (Y/N)   =N? Y <Return>
PPC1-Bug>
```

Example 4:

This example illustrates the reception of data (type 3). The driver does not block (waits for incoming data). The control/status word field signifies whether or not data has been received. Currently only one status bit is specified, bit 16, the receipt of data. This bit is cleared if no data is present. It is set if receive data is present. The transfer byte count is also set to the number of bytes associated with this receive data packet. This field is only valid when bit 16 is set.

```
PPC1-Bug>NIOC <Return>
Controller LUN                  =00? <Return>
Device LUN                      =00? <Return>
Packet Address                  =00006454? <Return>
00006454 0000 0000 0000 0003 0000 E000 0000 0000        ................
00006464 0000 0000                                      ....
Send Packet (Y/N)               =N? Y <Return>
PPC1-Bug>
```

View the address data retrieval.

```
PPC1-Bug>NIOC <Return>
Controller LUN                  =00? <Return>
Device LUN                      =00? <Return>
Packet Address                  =00006454? <Return>
00006454 0000 0000 0000 0003 0000 E000 0000 0222        ................
00006464 0001 0000                                      ....
Send Packet (Y/N)               =N? N <Return>
PPC1-Bug>
```

View the address data retrieval.

```
PPC1-Bug>MD E000:222;B <Return>
0000E000 FF FF FF FF FF FF 08 00 3E 20 C8 0A 08 00 45 00    .......> ....E.
0000E010 02 14 00 00 00 00 40 11 25 5E 90 BF 18 FE 90 BF    ......@.%^......
0000E020 18 FF 02 08 02 08 02 00 55 34 02 01 00 00 00 02    ........U4......
0000E030 00 00 C0 13 01 00 00 00 00 00 00 00 00 00 00 00    ................
0000E040 00 03 00 02 00 00 90 BF 82 00 00 00 00 00 00 00    ................
0000E050 00 00 00 00 00 03 00 02 00 00 C0 13 02 00 00 00    ................
0000E060 00 00 00 00 00 00 00 00 00 04 00 02 00 00 90 BF    ................
0000E070 63 00 00 00 00 00 00 00 00 00 00 00 02 00 02 00    c...............
0000E080 00 00 90 BF 83 00 00 00 00 00 00 00 00 00 00 00    ................
0000E090 00 04 00 02 00 00 90 BF 03 00 00 00 00 00 00 00    ................
0000E0A0 00 00 00 00 00 03 00 02 00 00 90 BF 84 00 00 00    ................
0000E0B0 00 00 00 00 00 00 00 00 00 04 00 02 00 00 90 BF    ................
0000E0C0 04 00 00 00 00 00 00 00 00 00 00 00 03 00 02 00    ................
0000E0D0 00 00 90 BF 85 00 00 00 00 00 00 00 00 00 00 00    ................
0000E0E0 00 04 00 02 00 00 90 BF 06 00 00 00 00 00 00 00    ................
0000E0F0 00 00 00 00 00 03 00 02 00 00 90 BF 86 00 00 00    ................
0000E100 00 00 00 00 00 00 00 00 00 04 00 02 00 00 90 BF    ................
0000E110 E6 00 00 00 00 00 00 00 00 00 00 00 02 00 02 00    ................
0000E120 00 00 90 BF 87 00 00 00 00 00 00 00 00 00 00 00    ................
0000E130 00 04 00 02 00 00 90 BF C7 00 00 00 00 00 00 00    ................
0000E140 00 00 00 00 00 02 00 02 00 00 90 BF 88 00 00 00    ................
0000E150 00 00 00 00 00 00 00 00 00 04 00 02 00 00 90 BF    ................
0000E160 28 00 00 00 00 00 00 00 00 00 00 00 02 00 02 00    (...............
0000E170 00 00 DE 01 08 00 00 00 00 00 00 00 00 00 00 00    ................
0000E180 00 02 00 02 00 00 90 BF 08 00 00 00 00 00 00 00    ................
0000E190 00 00 00 00 00 04 00 02 00 00 90 BF E8 00 00 00    ................
0000E1A0 00 00 00 00 00 00 00 00 02 00 02 00 00 90 BF       ................
0000E1B0 89 00 00 00 00 00 00 00 00 00 00 00 04 00 02       ................
0000E1C0 00 00 90 BF 29 00 00 00 00 00 00 00 00 00 00 00    ....)...........
0000E1D0 00 04 00 02 00 00 90 BF AA 00 00 00 00 00 00 00    ................
0000E1E0 00 00 00 00 00 04 00 02 00 00 90 BF 8A 00 00 00    ................
0000E1F0 00 00 00 00 00 00 00 00 00 04 00 02 00 00 90 BF    ................
0000E200 0A 00 00 00 00 00 00 00 00 00 00 00 03 00 02       ................
0000E210 00 00 90 BF AB 00 00 00 00 00 00 00 00 00 00 00    ................
0000E220 00 04                                                ..
```

Example 5: Flush the receiver and receive buffers (type 4).

```
PPC1-Bug>NIOC <Return>
Controller LUN                  =00? <Return>
Device LUN                      =00? <Return>
Packet Address                  =00006454? <Return>
00006454 0000 0000 0000 0004 0000 0000 0000 0000        ................
00006464 0000 0000                                      ....
Send Packet (Y/N)               =N? Y <Return>
PPC1-Bug>
```

This entry point is useful when the interface has not been accessed for some time and you do not want receive data. The Network I/O commands (i.e., **NAB**, **NBH**, **NBO**, **NIOP**, and **NPING**) use this feature prior to any Network I/O transactions.

NIOP - Network I/O Physical

Command Input

NIOP

Description

The **NIOP** command allows you to get files from the supported Ethernet network interfaces and put files to the supported Ethernet network interfaces. When invoked, this command goes into an interactive mode, prompting you for all parameters necessary to carry out the command. This command basically uses the TFTP protocol to perform the file transfer.

The IP addresses for the TFTP session are obtained from the configuration parameters. The IP addresses are checked to see if the server and the client are resident on the same network. If they are not, the gateway IP address is used as the intermediate server to perform the TFTP session with. The filename character string has a maximum length of 64 bytes.

Whenever an error occurs, the TFTP session is terminated and the error code is displayed. The error codes are listed in Appendix H.

Upon successful transfer of the specified file, the TFTP session statistics are displayed.

When invoked, this command goes into an interactive mode, which prompts for information required to perform the command. You may change the displayed value by typing a new value, and the Return key. To leave the field unaltered, press the Return key without typing a new value.

You may also enter a special character, either at the prompt or after typing new data, for scrolling through the fields. The special characters are:

V or **v**	Open the next field. This is the default, and remains in effect until changed by entering one of the other special characters.
^	Back up and open the previous field
=	Re-open the same field
.	Terminate the **NIOP** command, and return control to the debugger

The **NIOP** command utilizes the necessary configuration parameters to perform the TFTP file transfer. Prompts appear for entering the parameters. Refer to *NIOT - Network I/O Teach (Configuration)* on page 3-161 for a description of the parameters.

Note that winding (indexing) into a file is possible on a read (get), there is a drawback in this feature due to the nature of TFTP, the entire file is transferred across the network. But only the desired section of the file is written to the user memory.

Refer to the DARPA Internet Request for Comments RFC-783 for the description of the TFTP protocol. Prior to the TFTP session an ARP request is transmitted for the hardware (Ethernet) address of the server.

At time-out conditions the file transfer process can be aborted by pressing the BREAK key on the console keyboard or by pressing the abort switch on the front panel.

Note The clock must be running in order for this command to work properly. Use **TIME ;L** to see if the clock is running. Use the **SET** command to start and initialize the clock.

The field prompts are shown below.

```
Controller LUN   =00?
```

The Logical Unit Number (LUN) of the controller to access

```
Device LUN       =00?
```

The LUN of the device to access

```
Get/Put          =G?
```

G Read/get from host

P Write/put to host

```
File Name        =?
```

The name of the file to load/store. On a write the file must exist on the host system and also be writable (write permission). The filename string must be null terminated. The maximum length of the string is 64 bytes inclusive of the null terminator.

Note The path of the file name to load/store must point to a tftp boot area on the host system. See your host system administrator for details on configuring a tftp boot area.

```
Memory Address =00004000?
```

Address of buffer in memory. On a read, data is read to (received to) starting at this address. On a write, data is written (sent) starting at this address.

```
Length           =00000001?
```

The number of bytes from the data transfer address to transfer. A length of 0 specifies to transfer the entire file on a read. On a write the length must be set to the number of bytes to transfer.

```
Byte Offset      =00000001?
```

The offset into the file on a read. This permits users to wind into a file.

Example

Read a file into memory.

This example illustrates the reading (or getting) of the file **/tftboot/motorola.bin** from the specified server (refer to the **NIOT** command) into memory at address 00010000. The length field of 0 signifies to load the entire file. The load (get) of a file can be truncated to

a desired length by specifying the desired length (non-zero). The byte offset field can be used to wind (index) into a file (only used on file reads, gets).


```
PPC1-Bug>NIOP <Return>
Controller LUN   =00? <Return>
Device LUN       =00? <Return>
Get/Put          =G? <Return>
File Name        =? /tftboot/motorola.bin <Return>
Memory Address   =0000E000? 10000 <Return>
Length           =00000000? <Return>
Byte Offset      =00000000? <Return>
Bytes Received =&8912, Bytes Loaded =&8912 <Return>
Bytes/Second =&8912, Elapsed Time =1 Second(s) <Return>
PPC1-Bug>
```

NIOT - Network I/O Teach (Configuration)

Command Input

NIOT [;[**A**|**H**|**D**]]

Options

A	Display the Network Controllers/Nodes that are supported by this version of the firmware. Each PCI controller is only listed once.
H	Display all Network Controllers/Nodes that are present in the system. The display also includes the Protocol (Internet) and Hardware (Ethernet) addresses.
D	List Devices while probing

Description

The **NIOT** command allows you to set-up ("teach") a new network configuration on the debugger for use by the .NETxxx system calls. **NIOT** lets you modify the controller and device descriptor tables used by the .NETxxx system calls for network access. Note that because the debugger commands that access the network use the same interface as the system calls, changes in the descriptor tables affect all those commands. These commands include **NIOP**, **NBO**, **NBH**, and also any user program that uses the .NETxxx system calls.

Each controller LUN and device LUN combination has its own descriptor table which houses configuration and run-time parameters. If the controller and device LUNs are used for Network Automatic Boot, any changes made by this command are saved in NVRAM.

Each mass storage boot device and network interface boot device is identified by a device name. Each device type that the product supports is contained/listed within device probe tables. These tables are modified to contain the associative device name.

At probe time, the probed device's name is copied into the dynamic device configuration tables housed within in NVRAM. This will only be done, of course, if the device is present. The user may view the system's device names by the performing the following operations.

For network interface devices, the **D** option allows users to display the device names of the attached devices. These device names are per the IBM firmware and the IBM AIX naming conventions.

When invoked, this command goes into an interactive mode, which prompts for information required to perform the command. You may change the displayed value by typing a new value, and the Return key. To leave the field unaltered, press the Return key without typing a new value.

You may also enter a special character, either at the prompt or after typing new data, for scrolling through the fields. The special characters are:

V or **v**	Open the next field. This is the default, and remains in effect until changed by entering one of the other special characters.
^	Back up and open the previous field
=	Re-open the same field
.	Terminate the **NIOT** command, and return control to the debugger

You will be prompted to save changes.

The field prompts are shown below. A retry value of 0 is interpreted as no maximum, always retry.

```
Node Control Memory Address=FFE10000?
```

The starting address of the necessary memory needed for the transmit and receive buffers. 256KB are needed for the Ethernet driver (transmit/receive buffers).

As of version 1.8 of PPC1Bug, the node control memory address is dynamically calculated. The saved version(i.e., NVRAM) is now ignored.

```
Client IP Address          =255.255.255.255?
```

The IP address of the client. The firmware is considered the client.

```
Server IP Address          =255.255.255.255?
```

The IP address of the server. The server is the host system from which the specified file is retrieved.

```
Subnet IP Address Mask     =255.255.255.0?
```

The subnet IP address mask. This mask is used to determine if the server and client are resident on the same network. If they are not, the gateway IP address is used as the intermediate target (server).

```
Broadcast IP Address       =255.255.255.255?
```

The broadcast IP address that the firmware utilizes when a IP broadcast needs to be performed.

```
Gateway IP Address         =255.255.255.255?
```

The gateway IP address. The gateway IP address would be necessary if the server and the client do not reside on the same network. The gateway IP address would be used as the intermediate target (server).

```
Boot File Name (“NULL” for None)       =?
```

The name of the boot file to load. Once the file is loaded, control is passed to the loaded file (program). To specify a null filename, the string “NULL” must be used; this resets the filename buffer to a null character string.

```
Argument File Name (“NULL” for None)   =?
```

The name of the argument file. This file may be used by the booted file (program) for an additional file load. To specify a null filename, the string “NULL” must be used; this resets the filename buffer to a null character string.

```
Boot File Load Address     =001F0000?
Boot File Execution Address=001F0000
```

The load and execution addresses of the boot file.

```
Boot File Execution Delay  =00000000?
```

The delay, in seconds, before control is passed to the loaded file (program).

```
Boot File Length           =00000000?
```

The number of bytes from the data transfer address to transfer. A length of 0 specifies to transfer the entire file on a read. On a write the length must be set to the number of bytes to transfer.

```
Boot File Byte Offset      =00000000?
```

The offset into the file on a read. This permits users to wind into a file.

```
BOOTP/RARP Request Retry   =00?
TFTP/ARP Request Retry     =00?
```

The number of retries that should be attempted prior to giving up. A retry value of zero specifies always to retry (not give up).

```
Trace Character Buffer Address=00000000?
```

The starting address of memory in which to place the trace characters. The receive/transmit packet tracing are disabled by default (value of 0). Any non-zero value enables tracing. Tracing would only be used in a debug environment and normally should be disabled. Care should be exercised when enabling this feature; you need to ensure that adequate memory exists. The following characters are defined for tracing:

?	Unknown
&	Unsupported Ethernet Type
*	Unsupported IP Type
%	Unsupported UDP Type
$	Unsupported BOOTP Type
[	BOOTP Request
]	BOOTP Reply
+	Unsupported ARP Type
(	ARP Request
)	ARP Reply
-	Unsupported RARP Type
{	RARP Request
}	RARP Reply
^	Unsupported TFTP Type
\	TFTP Read Request
/	TFTP Write Request
<	TFTP Acknowledgment
>	TFTP Data
|	TFTP Error
,	Unsupported ICMP Type
:	ICMP Echo Request
;	ICMP Echo Reply

```
BOOTP/RARP Request Control: Always/When-Needed (A/W)  =W
```

A BOOTP/RARP request is always sent, and the accompanying reply expected

W BOOTP/RARP request is sent if needed (i.e., IP addresses of 0, null boot file name)

```
BOOTP/RARP Reply Update Control: Yes/No (Y/N)         =Y
```

This parameter specifies the updating of the configuration parameters following a BOOTP/RARP reply. Receipt of a BOOTP/RARP reply would only be in lieu of a request being sent.

Examples

Example 1: Invoke **NIOT** with no options. This shows the interactive session for the various configuration parameters.

```
PPC1-Bug>NIOT <Return>
Controller LUN          =00? <Return>
Device LUN              =00? <Return>
Node Control Memory Address =FFE10000? <Return>
Client IP Address             =255.255.255.255? <Return>
Server IP Address             =255.255.255.255? <Return>
Subnet IP Address Mask        =255.255.255.0? <Return>
Broadcast IP Address          =255.255.255.255? <Return>
Gateway IP Address            =255.255.255.255? <Return>
Boot File Name (“NULL” for None)           =? <Return>
Argument File Name (“NULL” for None)       =? <Return>
Boot File Load Address        =001F0000? <Return>
Boot File Execution Address   =001F0000? <Return>
Boot File Execution Delay     =00000000? <Return>
Boot File Length              =00000000? <Return>
Boot File Byte Offset         =00000000? <Return>
BOOTP/RARP Request Retry      =00? <Return>
TFTP/ARP Request Retry        =00? <Return>
Trace Character Buffer Address =00000000? <Return>
BOOTP/RARP Request Control: Always/When-Needed (A/W) =W? <Return>
BOOTP/RARP Reply Update Control: Yes/No (Y/N)       =Y? <Return>
PPC1-Bug>
```

Example 2: Display the network controllers/nodes that are present in the system.

```
PPC1-Bug>niot;h <Return>
Network Controllers/Nodes Available
CLUN  DLUN  Name      Address    IP-Address/H-Address
0     0     DEC21143  $00007000  255.255.24.10/08003E282029
11    0     I82559    $00008800  0.0.0.0/08003E261B8F
PPC1-Bug>
```

Example 3: Display the Network Controllers/Nodes that are supported by PPCBug.

```
PPC1-Bug>niot;a <Return>
Network Controllers/Nodes Supported
CLUN  DLUN  Name      Address
   X     0  DEC21040  Any PCI
   X     0  DEC21140  Any PCI
   X     0  DEC21143  Any PCI
   X     0  I82559  Any PCI
PPC1-Bug>
```

Caution

If you use the **NIOT** debugger command, the network interface configuration parameters need to be saved/retained in the NVRAM, somewhere in the offset range $00000000 through $00000FFF. The **NIOT** parameters do not exceed 128 bytes in size. The location for these parameters is determined by setting the **ENV** pointer `Network Auto Boot Configuration Parameters Offset (NVRAM)`. If you have used the exact same space for your own program information or commands, they will be overwritten and lost.

You can relocate the network interface configuration parameters in this space by using the **ENV** command to change the `Network Auto Boot Configuration Parameters Offset (NVRAM)` from its default of `FFFFFFFF` to the value you need so as to be clear of your data within NVRAM.

NPING - Network Ping

Command Input

NPING *ControllerLUN DeviceLUN SourceIP DestinationIP* [*NPackets*]

Arguments

ControllerLUN	Logical Unit Number (LUN) of the controller to which the device is attached.
DeviceLUN	Logical Unit Number (LUN) of the device.
SourceIP	Internet Protocol Address of the Source (initiator, ECHO_REQUEST).
DestinationIP	Internet Protocol Address of the Destination (target, ECHO_RESPONSE).
NPackets	Number of packets to send. It defaults to infinity.

Description

The **NPING** command probes the network. This probing facilitates the testing, measurement, and management of the network. **NPING** utilizes the ICMP protocol's mandatory ECHO_REQUEST datagram to elicit an ICMP ECHO_RESPONSE from a host or gateway.

The packet size has a fixed length of 128 bytes.

At any time an error occurs, the **NPING** session is terminated and the appropriate error code is displayed. The error codes are listed in Appendix H. The receive packet is checked for checksum and data integrity.

Prior to the **NPING** session an ARP request is transmitted for the hardware (Ethernet) address of the destination. The source and destination IP addresses must always be specified. No gateway IP address is used.

Refer to the DARPA Internet Request for Comments RFC-792 for the description of the ICMP protocol.

If the destination does not respond within 10 seconds, the command continues on with the next transmission. Between each successful transmit/receive packet there is a one second delay; this is done so as not to inundate the network.

If the number of packets is not specified on the command line, the command will indefinitely transmit/receive packets. You must press the BREAK key to abort the session.

The clock must be running in order for this command to work properly. Use **TIME ;L** to see if the clock is running. Use the **SET** command to start and initialize the clock.

Examples

Example 1: Transmit/receive $10 (16) ping packets. Once the ping session is complete, the command displays the statistics of the session.

```
PPC1-Bug>NPING 0 0 255.255.24.10 255.255.24.254 10 <Return>
Source IP Address                              = 255.255.24.10
Destination IP Address                         = 255.255.24.254
Number of Packets Transmitted =16, Packets Lost =0, Packet Size =128
PPC1-Bug>
```

Example 2: This example illustrates the indefinite transmission/ reception of packets.

```
PPC1-Bug>NPING 0 0 255.255.24.10 255.255.24.254 <Return>
Source IP Address                              = 255.255.24.10
Destination IP Address                         = 255.255.24.254
(<BREAK> key pressed)
Number of Packets Transmitted =1955, Packets Lost =0, Packet Size =128
PPC1-Bug>
```

OF - Offset Registers Display/Modify

Command Input

OF [**Z***n*[**;A**]]

Description

The **OF** command allows you to access and change pseudo-registers called offset registers. These registers are used to simplify the debugging of relocatable and position-independent modules.

There are eight offset registers Z0-Z7, but only Z0-Z6 can be changed. Z7 always has both base and top addresses set to 0. This allows the automatic register function to be effectively disabled by setting Z7 as the automatic register.

Each offset register has two values: base and top. The base address is the absolute least address that is used for the range declared by the offset register. The top address is the absolute greatest address that is used.

OF without the argument or option displays all offset registers. An asterisk indicates which register is the automatic register.

The argument **Z***n* is the register that is displayed or modified register.

The option **A** sets register **Z***n* as the automatic register. The automatic register is one that is automatically added to each absolute address argument of every command unless an offset register is explicitly added. An asterisk indicates which register is the automatic register.

When invoked with the **Z***n* argument, this command goes into an interactive mode, prompting you for information. You may change the displayed register by typing a new value, followed by pressing the Return key. To leave the register unaltered, press the Return key without typing a new value.

Enter the following parameters:

[*base_address* [*top_address*]]

or

[*base_address* [**:** *byte_count*]]

The *top_address* must equal or exceed the *base_address*. Wrap-around is not permitted. The default for *byte_count* is 1MB.

You may also enter a special character, either at the prompt or after typing new data, for scrolling through register **Z***n*. The special characters are:

V or **v**	Open the next register. This is the default, and remains in effect until changed by entering one of the other special characters.
^	Back up and open the previous register
=	Re-open the same register
.	Terminate the **OF** command, and return control to the debugger

Offset register rules:

- At power-up and cold start reset, Z7 is the automatic register.
- At power-up and cold start reset, all offset registers have both base and top addresses preset to 0. This effectively disables them.
- Z7 always has both base and top addresses set to 0; it cannot be changed.
- Any offset register can be set as the automatic register.
- The automatic register is always added to every absolute address argument of every debugger command where there is not an offset register explicitly called out.
- There is always an automatic register. A convenient way to disable the effect of the automatic register is by setting Z7 as the automatic register. Note that this is the default condition.

Examples

Example 1: Display offset registers.

```
PPC1-Bug>OF <Return>
Z0 =00000000 00000000  Z1 = 00000000 00000000
Z2 =00000000 00000000  Z3 = 00000000 00000000
Z4 =00000000 00000000  Z5 = 00000000 00000000
Z6 =00000000 00000000  Z7*= 00000000 00000000
PPC1-Bug>
```

Example 2: Modify some offset registers.

```
PPC1-Bug>OF Z0 <Return>
Z0 =00000000 00000000? 20000 200FF <Return>
Z1 =00000000 00000000? 25000:200^ <Return>
Z0 =00020000 000200FF? .<Return>
PPC1-Bug>
```

Look at location $20000.

```
PPC1-Bug>M 20000;DI <Return>
00000+Z0 3C600004  ADDIS       R3,R0,$4? .<Return>
PPC1-Bug>
```

```
PPC1-Bug>M Z0;DI <Return>
00000+Z0 3C600004  ADDIS       R3,R0,$4? .<Return>
PPC1-Bug>
```

Example 3: Set Z0 as the automatic register.

```
PPC1-Bug>OF Z0;A <Return>
Z0*=00020000 000200FF? .<Return>
PPC1-Bug>
```

To look at location $20000

```
PPC1-Bug>M 0;DI <Return>
00000+Z0 3C600004  ADDIS       R3,R0,$4? .<Return>
PPC1-Bug>
```

To look at location 0, override the automatic offset.

```
PPC1-Bug>M 0+Z7;DI <Return>
00000000 7FB143A6  MTSPR       273,R29? .<Return>
PPC1-Bug>
```

PA - Printer Attach
NOPA - Printer Detach

Command Input

PA [*PORT*]

NOPA [*PORT*]

Description

The **PA** command attaches a printer to the parallel or serial port that you specify. Multiple printers may be attached. When the printer is attached, everything that appears on the system console terminal is also echoed to the attached port. If no port is specified, **PA** does not attach a port.

The **NOPA** command detaches a port. If no port is specified, **NOPA** detaches all attached ports.

The specified port (*PORT*) must be configured and functional. When attaching to a parallel port, the printer must be on-line and functioning. Due to the nature of a parallel port, a potential hang condition could result if the printer device is not handshaking correctly.

If the port is not currently assigned, **PA** displays a message. If **NOPA** is attempted on a port that is not currently attached, a message is displayed.

The port being attached must already be configured using the **PF** command. Refer to *PF - Port Format NOPF - Port Detach* on page 3-183.

Examples

Example 1: Attach logical unit $02.

```
PPC1-Bug>PA 2 <Return>
PPC1-Bug>
```

Example 2: Display current attached printers.

```
PPC1-Bug>PA <Return>
Printer $02 attached
PPC1-Bug>
```

Example 3: Detach device at logical unit $02.

```
PPC1-Bug>NOPA 2 <Return>
Printer $02 detached
PPC1-Bug>
```

Example 4: Detach all possible attached printers.

```
PPC1-Bug>NOPA <Return>
PPC1-Bug>
```

PBOOT - Bootstrap Operating System

Command Input

PBOOT ; A

PBOOT ; V

PBOOT *CLUN DLUN PARTITION* [*String*] [**;H**]

Arguments

CLUN	Controller Logical Unit Number (*CLUN*). The default is 00.
DLUN	Device Logical Unit Number (*DLUN*). The default is 00. The CLUN/DLUN argument pair is the set of parameters that the **IOI** command reports as attached/found/probed devices. Refer to *IOI - I/O Inquiry* on page 3-92 for a complete description.
PARTITION	Partition Number The default is 0, which specifies to boot from the first bootable partition, starting with 1 and stepping through 4. You may also select a partition (1 through 4).
String	A string of characters which is displayed as a comment at boot time.

Options

A Auto Boot. This option, with no other options, permit the user to boot the system using the Auto Boot routine, as it would be invoked from the system start-up. This permits users to autoboot the system from an interrupted system boot scenario.

V Verbose. This option is the same as **A**, with the addition of displaying boot process messages to allow the user to examine the autoboot process.

H Boot and halt. Control is *not* passed to the booted program, but back to the debugger monitor.

This option is useful for examining and patching the booted program, and or setting instruction breakpoints prior to execution. Once the interim commands are invoked the user may simply use the **GO** command to pass control to booted program.

PBOOT with the **H** option is analogous to the **BH** command in other Motorola debuggers.

Description

The **PBOOT** command loads an operating system or control program from a mass storage device (e.g., hard disk) into memory and give control to it.

Dependent upon the boot device type, the bootable device contains the length and offset-into parameters of the boot program. Floppy diskette devices and sequential access (i.e., streaming tape) devices do not contain a partition table, other devices do.

Devices that require a partition table must contain at least one boot partition to be bootable. These devices contain a boot record block (512 bytes in size) which contains the partition table. The format of the boot record is an extension of the PC environment. The boot record is composed of a PC compatibility block and a partition table. To support media interchange, the PC compatibility block may contain an x86-type program. The entries in the partition table identify the PowerPC Reference Platform boot partition and its location in the media.

The layout of the boot record must be designed as shown in the Figure 3-1. The first 446 bytes of the boot record contain a PC compatibility block, the next four entries contain a partition table totaling 64 bytes, and last two bytes contain a signature.

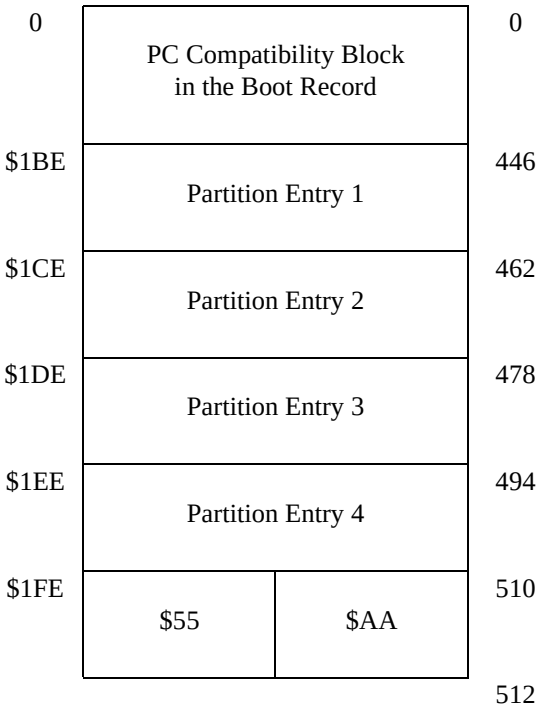


Figure 3-1. Boot Record

Figure 3-2 identifies the PowerPC Reference Platform partition table entry by the $41 value in the system indicator field.

All other fields are ignored by the debugger except for the beginning sector and number of sectors fields. Note that these are really *not* sector entities, but logical block entities. The logical block size is 512 bytes, the same size as the boot record.

partition begin	boot ind	head	sector	cyl
partition end	sys ind	head	sector	cyl
beginning sector	32-bit start RBA (zero-based) (LE)			
number of sectors	32-bit RBA count (one-based) (LE)			

Figure 3-2. PowerPC Reference Platform Partition Table Entry

The 32-bit start RBA is zero-based. The 32-bit count RBA value is one-based and indicates the number of 512-byte blocks. The count is always specified in 512-byte blocks, even if the physical sectoring of the target device is not 512-byte sectors.

The devices that are not required to contain a boot record (i.e., partition table) are treated as if they have a single partition. Basically, the entire media contents is the data within the partition.

Figure 3-3 identifies the layout of the $41 type partition and the process of loading the image. The PC Compatibility Block in the boot partition may contain x86-type program. When executed on an x86 machine, this program displays a message indicating that this partition is not applicable to the current system environment.

The second relative block in the boot partition contains the Entry Point Offset, Load Image Length, Flag Field, OS_ID field, ASCII Partition Name field, and the Reserved1 area. The 32-bit value Entry Point Offset (little endian byte ordering) is the offset (into the image) of the entry point of the PowerPC Reference Platform boot program. The Entry Point Offset is used to allocate the Reserved1 space. The Reserved1 area from offset 554 to Entry Point - 1 is reserved for implementation specific data and future expansion.

The 32-bit value Load Image Length (little endian byte ordering) is the length, in bytes, of the load image. The Load Image Length specifies the size of the data physically copied into the system RAM by the debugger. Note, that the debugger can load the boot program image anywhere into system RAM, the boot program is responsible for positioning.

Once the boot partition is located by using the boot record, the debugger will typically:

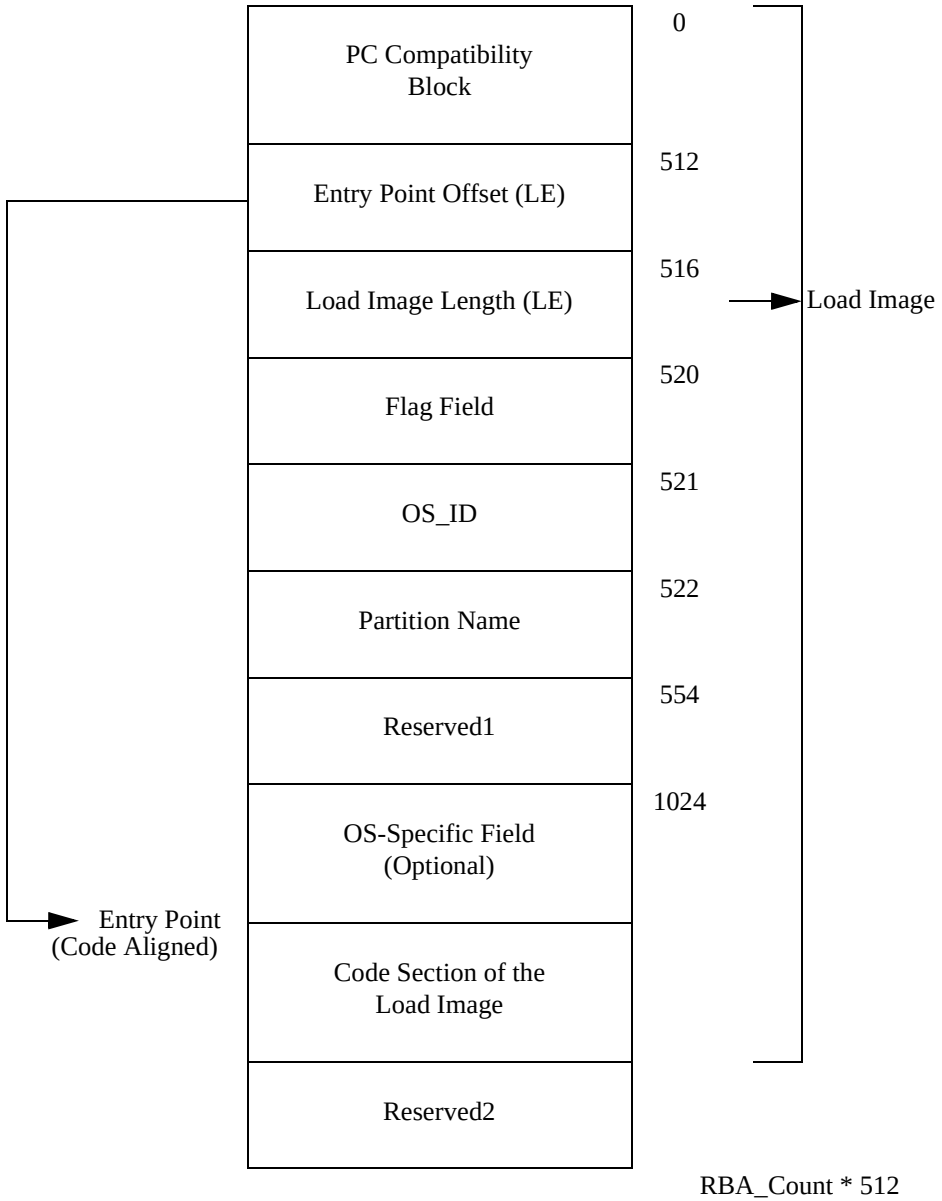


Figure 3-3. Layout of the $41-Type Partition

1. Read into memory the second 512-byte block of the load image.
2. Determine the load image length, which runs to, but does not include, the Reserved2 space.
3. Allocate a buffer in system RAM for the load image transfer (no fixed location).
4. Transfer the remaining portion of the load image into system RAM from the boot device (the Reserved2 space is not loaded).

After the load image has been loaded, the debugger transfers control to the entry point of the loaded code. The state of the machine at this point is as follows:

- ❏ Interrupts are masked (i.e., MPU.MSR.EE bit is set a 0).
- ❏ System I/O addresses are in the contiguous mode.
- ❏ The system is Big-Endian mode.
- ❏ The instruction cache is enabled (L1 only).
- ❏ MPU.GPR3 is set to the starting address of the residual data.
- ❏ MPU.GPR4 is set to the starting address of the load image.
- ❏ MPU.GPR5 is set to a zero.

Examples

Example 1: This example demonstrates a boot and halt scenario. The boot device is an CDROM device, as observed by the **IOI** command output.

Note that in this example it was necessary to delimit the remaining arguments to enable the **H** option. This delimiting of arguments specifies to use the defaults for the corresponding argument.

```
PPC1-Bug>IOI <Return>
I/O Inquiry Status:
CLUN  DLUN  CNTRL-TYPE  DADDR  DTYPE  RM  Inquiry-Data
   0     0  NCR53C825   0      $00    N   SEAGATE  ST31200N         8630
   0    30  NCR53C825   3      $05    Y   TOSHIBA  CD-ROM XM-3401TA 1094
   1     0  PC8477      0      $00    Y   <None>
PPC1-Bug>PBOOT 0 30,,,;H <Return>
Booting from: NCR53C825, Controller 0, Drive 30
Loading: Operating System

IPL loaded at: $00080000
IP     =00080430 MSR    =00003040 CR     =00000000 FPSCR  =00000000
R0     =00000000 R1     =03FA0000 R2     =00000000 R3     =00000000
R4     =00000000 R5     =00000000 R6     =00000000 R7     =00000000
R8     =00000000 R9     =00000000 R10    =00000000 R11    =00000000
R12    =00000000 R13    =00000000 R14    =00000000 R15    =00000000
R16    =00000000 R17    =00000000 R18    =00000000 R19    =00000000
R20    =00000000 R21    =00000000 R22    =00000000 R23    =00000000
R24    =00000000 R25    =00000000 R26    =00000000 R27    =00000000
R28    =00000000 R29    =00000000 R30    =00000000 R31    =00000000
SPR0   =00000000 SPR1   =00000000 SPR8   =00000000 SPR9   =00000000
00080430 48000005  BL          $00080434
PPC1-Bug>DS * <Return>
00080430 48000005  BL          $00080434
00080434 7E8000A6  MFMSR       R20
00080438 4C00012C  ISYNC
0008043C 7E94A278  XOR         R20,R20,R20
00080440 3A941040  ADDI        R20,R20,$1040
00080444 7E800124  MTMSR       R20
00080448 4C00012C  ISYNC
0008044C 7E94A278  XOR         R20,R20,R20
PPC1-Bug>AS 80438
00080438 4C00012C  ISYNC       ? sync
PPC1-Bug>GO <Return>
Effective address: 00080430
.
.
.
```

Example 2: This example demonstrates a boot from a direct-access device (i.e., hard disk). The fourth partition was specified. The device in this example does *not* contain a bootable fourth partition table entry.

```
PPC1-Bug>PBOOT 0 0 4 <Return>
Booting from: NCR53C825, Controller 0, Drive 0
Loading: Operating System

Partition Not Bootable
PPC1-Bug>
```

Example 3: This example demonstrates a boot from a direct-access device (i.e., hard disk). The default partition is used due to the lack of the *PARTITION* argument.

```
PPC1-Bug>PBOOT 0 0 <Return>
Booting from: NCR53C825, Controller 0, Drive 0
Loading: Operating System

IPL loaded at: $00080000
.
.
.
```

The above example is equivalent of:

```
PPC1-Bug>PBOOT,,, <Return>
Booting from: NCR53C825, Controller 0, Drive 0
Loading: Operating System

IPL loaded at: $00080000
.
.
.
```

Example 4: This example demonstrates a boot and halt from the PC8477 Disk Controller (i.e., floppy disk controller).

```
PPC1-Bug>PBOOT 1 0,,,;H <Return>
Booting from: PC8477, Controller 1, Drive 0
Loading: Operating System

IPL loaded at: $00080000
IP    =00080400 MSR   =00003040 CR    =00000000 FPSCR  =00000000
R0    =00000000 R1    =03FA0000 R2    =00000000 R3    =00000000
R4    =00000000 R5    =00000000 R6    =00000000 R7    =00000000
R8    =00000000 R9    =00000000 R10   =00000000 R11   =00000000
R12   =00000000 R13   =00000000 R14   =00000000 R15   =00000000
R16   =00000000 R17   =00000000 R18   =00000000 R19   =00000000
R20   =00000000 R21   =00000000 R22   =00000000 R23   =00000000
R24   =00000000 R25   =00000000 R26   =00000000 R27   =00000000
R28   =00000000 R29   =00000000 R30   =00000000 R31   =00000000
SPR0  =00000000 SPR1  =00000000 SPR8  =00000000 SPR9  =00000000
00080400 7C0000A6  MFMSR       R0
PPC1-Bug>
```

PF - Port Format
NOPF - Port Detach

Command Input

PF [*PORT*]

NOPF [*PORT*]

Description

The **PF** command allows you to examine and change the serial input/output environment. **PF** may be used to configure a port that is already assigned or assign and configure a new port. **PF** supports PowerPC board drivers and the ports on each.

PORT is the port to be assigned or configured. Without *PORT* specified, **PF** displays a list of the current port assignments.

The **NOPF** command removes a port assignment. Serial ports “DEBUG” (LUN 0), “HOST” (LUN 1), and “Console” (LUN dependent, “DEBUG” LUN by default) are removable.

To assign or configure a port, invoke the command with the port number (*PORT*). Assigning and configuring may be accomplished consecutively. You are prompted to configure the port parameters. You may change the displayed value by typing a new value, followed by the Return key. To leave the field unaltered, press the Return key without typing a new value.

You may also enter a special character, either at the prompt or after typing new data, for scrolling through the fields. The special characters are:

V or **v**	Go to the next field. This is the default, and remains in effect until changed by entering one of the other special characters.
^	Back up to the previous field. This remains in effect until changed by entering one of the other special characters.
=	Re-open the same field
.	Terminate the **PF** command, and return control to the debugger

Any changes will remain in effect until a reset operation occurs, or another **PF** execution. The reset operation, via the debugger, will set serial ports "DEBUG" (LUN 0, port 0) and "HOST" (LUN 1, port 1) to the default parameters. (Refer to *Auto Boot* in Chapter 1 for details on terminal setup.)

Note Only nine ports may be assigned at any given time. *PORT* must be in the range 0 to $1F.

Listing Current Port Assignments

PF lists the names of the PowerPC board and port for each assigned port number (LUN) when the command is invoked with the port number omitted.

Example

```
PPC1-Bug>PF <Return>
Current port assignments:  (Port #: Board name, Port name)
[00: MPC603PPC1- "DEBUG"] [01: MPC603PPC1- "HOST"]
Console = [00: MPC603PPC1- "DEBUG"]
PPC1-Bug>

Current port assignments:  (Port #: Board name, Port name)
[00: PC16550- "DEBUG"] [01: PC16550- "HOST"]
Console = [00: PC16550- "DEBUG"]
PPC1-Bug>
```

Configuring a Port

These are the configurable parameters (these may vary depending on the driver):

`Port base address:`

The base address of the port. This is useful for supporting PowerPC boards with adjustable base addressing.

`Baud rate [110,300,600,1200,2400,4800,9600,19200]?`

The baud rate

Note If a number base is not specified, the default is decimal, not hexadecimal.

```
Even, Odd, or No Parity [E,O,N] = N?
```

E Even

O Odd

N Disabled

```
Character width [5,6,7,8] = 8?
```

Character width, in bits

```
Stop Bits [1,2] = 1?
```

The number of stop bits

Example

Change the number of stop bits to 2.

```
PPC1-Bug>PF 1 <Return>
Baud rate [110,300,600,1200,2400,4800,9600,19200] = 9600? <Return>
Even, Odd, or No Parity [E,O,N] = N? <Return>
Character width [5,6,7,8] = 8? <Return>
Stop Bits [1,2] = 1? 2 <Return>
Auto Xmit enable on CTS* [Y,N] = N? . <Return>
OK to proceed (y/n)? Y <Return>
PPC1-Bug>
```

Assigning a New Port

These are the configurable parameters (these may vary depending on the driver):

```
Name of board?
```

The device driver. Press the Return key to see a list the currently supported PowerPC drivers and ports. The controllers are:

VKIO	VGA Keyboard I/O
PC16550	Asynchronous Communications
Z85C230	Serial Communications
PC87303	Parallel Printer

`Name of port?`

The name of the port. The available boards are:

DEBUG	Serial Port 1
HOST	Serial Port 2
CPP	Parallel Printer Port

`Port base address = $00000000?`

The base address of the port

`XON = $11=^Q?`

`XOFF = $13=^S?`

Flow control (software handshake) characters (case sensitive). ASCII control characters or hexadecimal values are accepted.

If the new port has not been configured, the interactive configuration mode is entered (refer to *Configuring a Port* on page 3-184). If the new port has been configured, the `OK to proceed (y/n)?` prompt appears.

PF does not initialize any hardware until you have responded with a **Y** to prompt `OK to proceed (y/n)?`. Pressing the BREAK key on the console any time prior to this step or responding with an **N** at the prompt leaves the port unassigned.

Example

```
PPC1-Bug>PF 10 <Return>
Logical unit $10 unassigned
Name of board? <Return>
Boards and ports supported:
VKIO:  DEBUG
PC16550:  DEBUG, HOST
Z85C230:  DEBUG, HOST
PC87303:  CPP
Name of board? VKIO <Return>
Name of port? DEBUG <Return>
Port base address = $00000000? <Return>
XON = $11=^Q? <Return>
XOFF = $13=^S?. <Return>
OK to proceed (y/n)? Y <Return>
PPC1-Bug>
```

NOPF Port Detach

The **NOPF** command unassigns the port number (*PORT* argument). Only one port may be unassigned at a time. Invoking **NOPF** without a port number does not unassign any ports.

PFLASH - Program FLASH Memory

Command Input

PFLASH *SSADDR SEADDR DSADDR* [*IEADDR*] [**;**[**A**|**R**] [**X**]]

PFLASH *SSADDR***:***COUNT DSADDR* [*IEADDR*] [**;**[**B**|**W**|**L**] [**A**|**R**] [**X**]]

Arguments

SSADDR	Source starting address of the binary image to program the FLASH memory with
SEADDR	Source ending address of the binary image to program the FLASH memory with
DSADDR	Destination starting address of the FLASH memory to program the binary image to
COUNT	Number of elements to program. A colon (:) is required to indicate that the second argument is *COUNT* instead of *SEADDR*.
IEADDR	Instruction execution address (i.e., PC/IP). This address points to a reset vector for MPC60*x* architectures.

Options

B	Byte
H	Half-word
W	Word
R	Allow the automatic reset (local) of the hardware upon completion of programming the FLASH Memory, only when the programming is completed error free. Resetting is done only if the board supports it.
A	Allow the automatic reset (local) of the hardware upon completion of programming the FLASH Memory. Resetting is done only if the board supports it.
X	Allow the FLASH Memory driver to always execute the passed execution address, even on error. This option is valid only when you specify the instruction execution address.

Description

The **PFLASH** command loads an application or program into Flash memory. The command line arguments are checked (e.g., does the destination range lie completely within the Flash memory?, are there overlapping address spaces?, are the address arguments aligned?). If an argument does not pass, an appropriate error message is displayed and control is passed back to the monitor with the Flash memory contents undisturbed.

Physically, PPCBug is contained in two socketed 32-pin PLCC Flash memory devices that together provide 1MB ($00100000) of storage. PPCBug uses the entire memory contained in the two devices. The executable code is checksummed at every power-on or reset firmware entry. The result is checked with a pre-calculated checksum contained in the last 16-bit word of the Flash image.

The element size is determined by the size (**B**, **W**, or **L**) option. The default **B**.

If the programming agent is the debugger and it is resident in the Flash memory, it may have to download the Flash memory driver. The downloaded driver uses the board's system fail LED and NVRAM to communicate programming errors. This hardware notification of a Flash memory programming error is only necessary if you are reprogramming the programming agent's text and data space. Otherwise, errors are communicated by means of the programming terminal (serial I/O).

Upon error free completion of the Flash memory programming, control is passed back to the monitor. If the instruction execution address argument is specified, control will be passed to this address. If the programming agent is reprogrammed and the instruction execution address argument is not specified, control remains within the Flash memory driver (do nothing, wait for reset).

If the Flash memory driver was downloaded, messages are not displayed on the terminal. If return from the downloaded driver is not possible, and the instruction execution or the local reset option is not specified, upon successful completion, the driver blinks the FAIL LED at the rate of once per 1/2 second. Upon any error the driver illuminates the FAIL LED (no blinking).

If the Flash memory driver was not downloaded, one or more of the following messages may be displayed on the terminal:

```
FLASH Memory PreProgramming Error: Address-Alignment
FLASH Memory PreProgramming Error: Address-Range
FLASH Memory Programming Complete
FLASH Memory Programming Error: Zero-Phase
FLASH Memory Programming Error: Erase-Phase
FLASH Memory Programming Error: Write-Phase

FLASH Memory Programming Error: Erase-Phase_Time-Out
FLASH Memory Programming Error: Write-Phase_Time-Out
FLASH Memory Programming Error: Verify-Phase
```

The ";r" option on the "pflash" command is most frequently used because without this option the user does not know when the "pflash" command function has completed. When the ";r" option is used on the "pflash" command, it is important to remember that it uses the current setting from the "RESET" command (i.e., the "warm/cold" selection from the command.)

Note A full board reset must be done in order for the "pflash" command to work correctly (i.e., that the "RESET" command specifies a "COLD" reset.) If you have recently reset your board with a warm reset - please make sure that you reexecute the "RESET" command with the cold option prior to reflashing your board with the PFLASH command (refer to the RESET command for further details).

Example

The following is an example of programming the Flash memory with an updated version of the debugger. The example assumes that the updated version has been loaded into memory.

```
PPC1-Bug>BM FFF00000:100000/4 100000 <Return>
Effective address: FFF00000
Effective count  : &1048576
Effective address: 00100000
PPC1-Bug>PFLASH 100000:100000 FFF00000;R <Return>
Source Starting/Ending Addresses      =00100000/001FFFFF
Destination Starting/Ending Addresses =FFF00000/FFFFFFFF
Number of Effective Bytes             =00100000 (&1048576)
```

```
Program FLASH Memory (Y/N)? Y <Return>
```

The reset option **R** was utilized to restart the debugger. If it was not used, the user would not know when the programming is complete.

PS - Put RTC into Power Save Mode

Command Input

PS

Description

The **PS** command turns off the oscillator in the RTC chip. The PowerPC board is shipped with the RTC oscillator stopped to minimize current drain from the onchip battery. Normal cold start of the board with the PPCBug FLASH devices installed gives the RTC a “kick start” to begin oscillation.

Use **SET** command to restart the clock.

Example

```
PPC1-Bug>PS <Return>
(Clock is in Battery Save Mode)
PPC1-Bug>
```

RB - ROMboot Enable
NORB - ROMboot Disable

Command Input

RB[**;V**]

NORB

Description

The **RB** command invokes the search for and booting from a ROMboot routine encoded in FLASH memory on the board. However, the routine can be stored in other memory locations, if configured to do so with the **ENV** command. Refer also to *ROMboot* in Chapter 1.

The **V** option enables verbose mode operation.

NORB disables the search for a ROMboot routine, but does not change the options chosen.

The default condition is with the ROMboot function disabled.

Examples

Example 1: For this example, assume the existence of a valid ROMboot routine at $10000.

```
PPC1-Bug>RB <Return>
ROMboot in progress... To abort hit <BREAK>
FRI SEP 15 11:50:21.00 1994
PPC1-Bug>
```

Example 2: For this example, assume the existence of a valid ROMboot routine at $10000.

```
PPC1-Bug>RB;V <Return>
ROMboot in progress... To abort hit <BREAK>
Direct Adr: FFC00000 FFC00000: Searching for ROMboot Module at: FFC00000
ROM       : FFC00000 FFC7FFFC: Searching for ROMboot Module at: FFC7E000
Local RAM : 00000000 00FFFFFC: Searching for ROMboot Module at: 00010000
Executing ROMboot Module "TEST" at 00010000
FRI SEP 15 11:50:21.00 1989
PPC1-Bug>
```

Example 3:

```
PPC1-Bug> NORB <Return>
ROM boot disabled
PPC1-Bug>
```

RD - Register Display

Command Input

RD [{[+|-|=] [*DNAME*] [/]}{[+|-|=] [*REG1*[-*REG2*]] [/]}] [**;E**]

Arguments

DNAME	**MPU** for Microprocessor Unit, **DEF** for default
REG1	First register in a range of registers
REG2	Last register in a range of registers

Description

The **RD** command displays the register state associated with the target program (refer to the **GO** command). The instruction pointed to by the target IP is disassembled and displayed also. Internally, a register mask specifies which registers are displayed when **RD** is executed.

At reset time, this mask is set to display the default (**DEF**) registers only. This register mask can be changed with the **RD** command. The optional arguments allow you to enable or disable the display of any register or group of registers. This is useful for showing only the registers of interest, minimizing unnecessary data on the screen; and also in saving screen space.

The **E** option elects an internal bank of registers that is updated upon every exception, regardless of whether the exception occurred while executing target code or the debugger itself. This option allows you to get a glimpse of what was happening when a debugger command caused an exception. These registers are not accessible using other debugger commands.

Use the following characters with the arguments:

+	The device or register range is to be added
-	The device or register range is to be removed, except when used between two register names. In this case, it indicates a register range.

=	The device or register range is to be set. This character followed by **DEF** in the *DNAME* argument restores the register mask to select those registers originally displayed.
/	A required delimiter between device names and register ranges

Note the following when specifying any arguments in the command line:

- The +, -, or = qualifier applies to the next register range only.
- If no qualifier is specified, a + is assumed, even for the default.
- All device names should appear before any register names.
- The command line arguments are parsed from left to right, with each argument being processed after parsing; thus the sequence in which qualifiers and registers are organized has an impact on the resultant register mask.
- When specifying a register range, *REG1* and *REG2* do not have to be of the same class.
- The register mask used by **RD** is also used by all exception handler routines, including the trace and breakpoint exception handlers.

The MPU registers, in ordering sequence, are (total of 117 registers):

IP	Instruction Pointer
MSR	Machine State Register
CR	Condition Codes Register
FPSCR	Floating Point Status/Control Register
R0-R31	General Purpose (32)
SR0-SR15	Segment Registers (16)
SPR0-SPR1023	Special Purpose Registers (33)
FR0-FR31	Floating Point Data Registers (32)

Examples

Example 1: Default display - MPU subset (also called out by DEF):

```
PPC1-Bug>RD <Return>
IP     =00040010 MSR    =00003030 CR     =00000020 FPSCR  =00000000
R0     =00000000 R1     =00020000 R2     =FFF0178C R3     =00041000
R4     =22EDB280 R5     =00000000 R6     =00000000 R7     =00000000
R8     =00000000 R9     =00000000 R10    =00000000 R11    =00000000
R12    =00000000 R13    =00000000 R14    =00000000 R15    =00000000
R16    =00000000 R17    =00000000 R18    =00000000 R19    =00000000
R20    =00000000 R21    =00000000 R22    =00000000 R23    =00000000
R24    =00000000 R25    =00000000 R26    =00000000 R27    =00000000
R28    =00000000 R29    =00000000 R30    =00000000 R31    =00000000
SPR0   =00000000 SPR1   =00000000 SPR8   =00020014 SPR9   =00000000
00040010 4E800020  BCLR         20,0
PPC1-Bug>
```

Example 2: Change the mask to display all MPU registers.

```
PPC1-Bug>RD +MPU <Return>
IP     =00040010 MSR    =00003030 CR     =00000020 FPSCR  =00000000
R0     =00000000 R1     =00020000 R2     =FFF0178C R3     =00041000
R4     =22EDB280 R5     =00000000 R6     =00000000 R7     =00000000
R8     =00000000 R9     =00000000 R10    =00000000 R11    =00000000
R12    =00000000 R13    =00000000 R14    =00000000 R15    =00000000
R16    =00000000 R17    =00000000 R18    =00000000 R19    =00000000
R20    =00000000 R21    =00000000 R22    =00000000 R23    =00000000
R24    =00000000 R25    =00000000 R26    =00000000 R27    =00000000
R28    =00000000 R29    =00000000 R30    =00000000 R31    =00000000
SR0    =60000000 SR1    =00000000 SR2    =00000000 SR3    =00000000
SR4    =00000000 SR5    =00000000 SR6    =00000000 SR7    =00000000
SR8    =E7F00008 SR9    =E7F00009 SR10   =00000000 SR11   =00000000
SR12   =00000000 SR13   =00000000 SR14   =00000000 SR15   =60000000
SPR0   =00000000 SPR1   =00000000 SPR4   =00AD6BA7 SPR5   =22EE2A00
SPR8   =00020014 SPR9   =00000000 SPR18  =40000000 SPR19  =FFEC0000
SPR20  =FFEC0000 SPR21  =FFEC0000 SPR22  =16A30500 SPR25  =00000000
SPR26  =00040010 SPR27  =00083030 SPR272 =00004210 SPR273 =00000000
SPR274 =00000000 SPR275 =00000000 SPR282 =00083030 SPR286 =00083030
SPR528 =0000000E SPR529 =0000007F SPR530 =FFF0000F SPR531 =FFF00047
SPR532 =00000000 SPR533 =00000000 SPR534 =00000000 SPR535 =00000000
SPR1008=80810080 SPR1009=00000000 SPR1010=00000000 SPR1013=00000000
SPR1023=00000000
FR0    =0_3DE_70C6B50A527AC= 1.6770000000000003_E-0010
FR1    =0_407_0000000000000= 2.5600000000000000_E+0002
FR2    =0_40C_3880000000000= 1.0000000000000000_E+0004
FR3    =1_3FF_0000000000000=-1.0000000000000000_E+0000
FR4    =0_400_8000000000000= 3.0000000000000000_E+0000
FR5    =0_000_0000000000000= 0.0000000000000000_E+0000
```

```
FR6    =0_000_0000000000000= 0.0000000000000000_E+0000
FR7    =0_000_0000000000000= 0.0000000000000000_E+0000
FR8    =0_000_0000000000000= 0.0000000000000000_E+0000
FR9    =0_000_0000000000000= 0.0000000000000000_E+0000
FR10   =0_000_0000000000000= 0.0000000000000000_E+0000
FR11   =0_000_0000000000000= 0.0000000000000000_E+0000
FR12   =0_000_0000000000000= 0.0000000000000000_E+0000
FR13   =0_000_0000000000000= 0.0000000000000000_E+0000
FR14   =0_000_0000000000000= 0.0000000000000000_E+0000
FR15   =0_000_0000000000000= 0.0000000000000000_E+0000
FR16   =0_000_0000000000000= 0.0000000000000000_E+0000
FR17   =0_000_0000000000000= 0.0000000000000000_E+0000
FR18   =0_000_0000000000000= 0.0000000000000000_E+0000
FR19   =0_000_0000000000000= 0.0000000000000000_E+0000
FR20   =0_000_0000000000000= 0.0000000000000000_E+0000
FR21   =0_000_0000000000000= 0.0000000000000000_E+0000
FR22   =0_000_0000000000000= 0.0000000000000000_E+0000
FR23   =0_000_0000000000000= 0.0000000000000000_E+0000
FR24   =0_000_0000000000000= 0.0000000000000000_E+0000
FR25   =0_000_0000000000000= 0.0000000000000000_E+0000
FR26   =0_000_0000000000000= 0.0000000000000000_E+0000
FR27   =0_000_0000000000000= 0.0000000000000000_E+0000
FR28   =0_000_0000000000000= 0.0000000000000000_E+0000
FR29   =0_000_0000000000000= 0.0000000000000000_E+0000
FR30   =0_000_0000000000000= 0.0000000000000000_E+0000
FR31   =0_000_0000000000000= 0.0000000000000000_E+0000
00040010 4E800020  BCLR        20,0
PPC1-Bug>
```

Afterwards, every time **RD** is executed, all MPU registers are displayed.

To change the mask and disable the display of MPU registers, execute the following command:

```
PPC1-Bug>RD -MPU <Return>
00040010 4E800020  BCLR        20,0
PPC1-Bug>
```

Example 3: Add only FR0 and FR1 to the original default display.

```
PPC1-Bug>RD FR0/FR1 <Return>
IP     =00040010 MSR    =00003030 CR     =00000020 FPSCR  =00000000
R0     =00000000 R1     =00020000 R2     =FFF0178C R3     =00041000
R4     =22EDB280 R5     =00000000 R6     =00000000 R7     =00000000
R8     =00000000 R9     =00000000 R10    =00000000 R11    =00000000
R12    =00000000 R13    =00000000 R14    =00000000 R15    =00000000
R16    =00000000 R17    =00000000 R18    =00000000 R19    =00000000
R20    =00000000 R21    =00000000 R22    =00000000 R23    =00000000
R24    =00000000 R25    =00000000 R26    =00000000 R27    =00000000
R28    =00000000 R29    =00000000 R30    =00000000 R31    =00000000
SPR0   =00000000 SPR1   =00000000 SPR8   =00020014 SPR9   =00000000
FR0     =0_3DE_70C6B50A527AC= 1.6770000000000003_E-0010
FR1     =0_407_0000000000000= 2.5600000000000000_E+0002
00040010 4E800020  BCLR         20,0
PPC1-Bug>
```

Example 4: Remove R10-R21 and R29 from the previous display.

```
PPC1-Bug>RD -R10-R21/-R29 <Return>
IP     =00040010 MSR    =00003030 CR     =00000020 FPSCR  =00000000
R0     =00000000 R1     =00020000 R2     =FFF0178C R3     =00041000
R4     =22EDB280 R5     =00000000 R6     =00000000 R7     =00000000
R8     =00000000 R9     =00000000 R22    =00000000 R23    =00000000
R24    =00000000 R25    =00000000 R26    =00000000 R27    =00000000
R28     =00000000 R30     =00000000 R31     =00000000
SPR0   =00000000 SPR1   =00000000 SPR8   =00020014 SPR9   =00000000
FR0     =0_3DE_70C6B50A527AC= 1.6770000000000003_E-0010
FR1     =0_407_0000000000000= 2.5600000000000000_E+0002
00040010 4E800020  BCLR         20,0
PPC1-Bug>
```

Example 5: Set the display to R2 and R31 only. (Note that this sequence sets the display to R2 only, then adds register R31 to the display.)

```
PPC1-Bug>RD =R2/R31 <Return>
R2     =FFF0178C R31    =00000000
00040010 4E800020  BCLR         20,0
PPC1-Bug>
```

Example 6: Restore the display to the original set.

```
PPC1-Bug>RD =DEF <Return>
IP     =00040010 MSR    =00003030 CR     =00000020 FPSCR  =00000000
R0     =00000000 R1     =00020000 R2     =FFF0178C R3     =00041000
R4     =22EDB280 R5     =00000000 R6     =00000000 R7     =00000000
R8     =00000000 R9     =00000000 R10    =00000000 R11    =00000000
R12    =00000000 R13    =00000000 R14    =00000000 R15    =00000000
R16    =00000000 R17    =00000000 R18    =00000000 R19    =00000000
R20    =00000000 R21    =00000000 R22    =00000000 R23    =00000000
R24    =00000000 R25    =00000000 R26    =00000000 R27    =00000000
R28    =00000000 R29    =00000000 R30    =00000000 R31    =00000000
SPR0   =00000000 SPR1   =00000000 SPR8   =00020014 SPR9   =00000000
00040010 4E800020  BCLR        20,0
PPC1-Bug>
```

REMOTE - Remote

Command Input

REMOTE

Description

The **REMOTE** command initiates a service call through a remote modem. This command duplicates the Initiate Service Call option of the System Menu, which is assessed through the **MENU** command.

Refer to *MENU - System Menu* on page 3-129 and to Appendix B, *System Menu* for information on service calls.

RESET - Cold/Warm Reset

Command Input

RESET

Description

The **RESET** command allows you to specify the level of reset operation that will be in effect when a **RESET** exception is detected by the processor. A reset exception can be generated by pressing the **RESET** switch on the debugger host.

Two **RESET** levels are available:

Cold	This is the standard level of operation, and is the one defaulted to on power-up. In this mode, all the static variables are initialized every time a reset is done.
Warm	In this mode, all the static variables are preserved when a reset exception occurs. This is convenient for keeping breakpoints, offset register values, the target register state, and any other static variables in the system.

Use the “warm” RESET option with caution, since using this option will prevent the execution of the full board initialization on *ALL* RESETs until this option is modified to “cold”.

Control may passed to the boot routine, System Menu, or the diagnostics prompt, according to the **ENV** command parameters.

Example

Set to “cold” start.

```
PPC1-Bug>RESET <Return>
Cold/Warm Reset [C,W] = C? c <Return>
Execute Local SCSI Bus Reset [Y,N] = N? <Return>
Execute Local (CPU) Reset [Y,N] = N? Y<Return>

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PPC1Bug Debugger/Diagnostics Release Version x.x - mm/dd/yy
COLD Start

Local Memory Found =nnnnnnnn (&nnnnnnnn)
```

```
MPU Clock Speed =xxMhz
BUS Clock Speed =xxMhz
PPC1-Bug>
```

RL - Read Loop

Command Input

RL *ADDR*[**;B**|**H**|**W**]

Options

B	Byte
H	Half-word
W	Word

Description

The **RL** command establishes an infinite loop consisting of a processor load instruction targeted to the given address and of the given length (the default data size is word), followed by a branch instruction back to the load. Hence the address is accessed repeatedly in rapid succession.

The read loop can only be terminated by an external occurrence, such as an interrupt (usually an abort), a reset from the RST switch, or power cycle.

RM - Register Modify

Command Input

RM [*REG*]

Description

The **RM** command allows you to display and change the target registers.

REG is the target register. If *REG* is not specified, all the registers are displayed in sequence.

When invoked without options, the **RM** command enters an interactive mode where the register contents currently in effect are displayed one-at-a-time on the console for the operator to examine. You may change the displayed value by typing a new value, followed by the Return key. To leave the register unaltered, press the Return key without typing a new value.

You may also enter a special character, either at the prompt or after typing new data, for scrolling through the registers. The special characters are:

V or **v**	Open the next register. This is the default, and remains in effect until changed by entering one of the other special characters.
^	Back up and open the previous register
=	Re-open the same register
.	Terminate the **RM** command, and return control to the debugger

Examples

Example 1: Modify register R5 and exit.

```
PPC1-Bug>RM R5 <Return>
R5       =12345678?  ABCDEF. <Return>
PPC1-Bug>
```

Example 2: Modify register FR0 and view the results.

```
PPC1-Bug>RM FR0 <Return>
FR0  =0_384_4ED67D467D9BF= 1.2300000000000004_E-0037? 1.677E-10 <Return>
FR1  =0_000_0000000000000= 0.0000000000000000_E+0000? &256 <Return>
FR2  =0_000_0000000000000= 0.0000000000000000_E+0000? 10000 <Return>
FR3  =0_000_0000000000000= 0.0000000000000000_E+0000? -1 <Return>
FR4  =0_000_0000000000000= 0.0000000000000000_E+0000? &1+&2. <Return>
PPC1-Bug>RM FR0 <Return>
FR0  =0_3DE_70C6B50A527AC= 1.6770000000000003_E-0010? <Return>
FR1  =0_407_0000000000000= 2.5600000000000000_E+0002? <Return>
FR2  =0_40C_3880000000000= 1.0000000000000000_E+0004? <Return>
FR3  =1_3FF_0000000000000=-1.0000000000000000_E+0000? <Return>
FR4  =0_400_8000000000000= 3.0000000000000000_E+0000? . <Return>
PPC1-Bug>
```

Example 3: List all registers.

```
PPC1-Bug>RM <Return>
IP      =00040010? <Return>
MSR     =00003030? <Return>
CR      =00000020? <Return>
FPSCR   =00000000? <Return>
R0      =00000000? <Return>
R1      =00020000? <Return>
R2      =FFF0178C? <Return>
R3      =00041000? <Return>
...
R29     =00000000? <Return>
R30     =00000000? <Return>
R31     =00000000? <Return>
SR0     =60000000? <Return>
SR1     =00000000? <Return>
SR2     =00000000? <Return>
...
SR13    =00000000? <Return>
SR14    =00000000? <Return>
SR15    =60000000? <Return>
SPR0    =00000000? <Return>
SPR1    =00000000? <Return>
SPR4    =00AD6BA7? <Return>
SPR5    =22EE2A00? <Return>
SPR8    =00020014? <Return>
SPR9    =00000000? <Return>
SPR18   =40000000? <Return>
SPR19   =FFEC0000? <Return>
```

```
SPR20  =FFEC0000? <Return>
SPR21  =FFEC0000? <Return>
SPR22  =16A30500? <Return>
SPR25  =00000000? <Return>
SPR26  =00040010? <Return>
SPR27  =00083030? <Return>
SPR272 =00004210? <Return>
SPR273 =00000000? <Return>
SPR274 =00000000? <Return>
SPR275 =00000000? <Return>
SPR282 =00083030? <Return>
SPR286 =00083030? <Return>
SPR528 =0000000E? <Return>
SPR529 =0000007F? <Return>
SPR530 =FFF0000F? <Return>
SPR531 =FFF00047? <Return>
SPR532 =00000000? <Return>
SPR533 =00000000? <Return>
SPR534 =00000000? <Return>
SPR535 =00000000? <Return>
SPR1008=80810080? <Return>
SPR1009=00000000? <Return>
SPR1010=00000000? <Return>
SPR1013=00000000? <Return>
SPR1023=00000000? <Return>
FR0    =0_3DE_70C6B50A527AC= 1.6770000000000003_E-0010? <Return>
FR1    =0_407_0000000000000= 2.5600000000000000_E+0002? <Return>
FR2    =0_40C_3880000000000= 1.0000000000000000_E+0004? <Return>
...
FR29   =0_000_0000000000000= 0.0000000000000000_E+0000? <Return>
FR30   =0_000_0000000000000= 0.0000000000000000_E+0000? <Return>
FR31   =0_000_0000000000000= 0.0000000000000000_E+0000? <Return>
CPUIEN =0000FEFB? .<Return>
PPC1-Bug>
```

RS - Register Set

Command Input

RS *REG* [*EXP*|*ADDR*]

Description

The **RS** command allows you to change the data in the specified target register. It works in essentially the same way as the **RM** command.

REG is the target register.

When invoked without options, the **RM** command enters an interactive mode where the register contents currently in effect are displayed one-at-a-time. You may change the displayed value by typing a new value followed by the Return key. To leave the register unchanged, press the Return key without typing a new value.

You may also enter a special character, either at the prompt or after typing new data, for scrolling through the registers. The special characters are:

V or **v**	Open the next register. This is the default, and remains in effect until changed by entering one of the other special characters.
^	Back up and open the previous register
=	Re-open the same register
.	Terminate the **RS** command, and return control to the debugger

Examples

Example 1: Change register R5.

```
PPC1-Bug>RS R5 12345678 <Return>
R5      =12345678
PPC1-Bug>
```

Example 2: Examine register R5.

```
PPC1-Bug>RS R5 <Return>
R5      =12345678
PPC1-Bug>
```

Example 3: Examine register FR0.

```
PPC1-Bug>RS FR0 <Return>
FR0     =0_44D_09F7E57C92CC4= 3.1399999999999997_E+0023
PPC1-Bug>
```

Example 4: Set register FR0 contents.

```
PPC1-Bug>RS FR0 1.23E-37 <Return>
FR0     =0_384_4ED67D467D9BF= 1.2300000000000004_E-0037
PPC1-Bug>
```

RUN - MPU Execution/Status

Note This command is for multi-processor boards only.

Command Input

RUN [*MPU#*]

Description

The **RUN** command allows you to inquire of the BUG the current state of each of the processors. The command also allows you to switch an idle processor to the current processor (processor executing the debugger). The *MPU#* argument depends on your configuration and idle processors present. If your configuration is less than a two processor setup, an error message will be displayed instead.

Examples

Example 1:

```
PPC1-Bug>run                    (current state of all possible processors)
MPU0 : MASTER
MPU1 : IDLE
PPC1-Bug>
```

Example 2:

```
PPC1-Bug>run 1                  (switch to processor #1 as master/current)
PPC1-Bug>

PPC1-Bug>run                    (current state of all possible processors)
MPU0 : IDLE
MPU1 : MASTER
PPC1-Bug>
```

Descriptions of all possible states:

State	Description
IDLE	Processor is idle (can be forked).
UNKNOWN	Processor never became idle from start up (power-up/reset).
EXECUTING TARGET	Processor has been forked to target code.
ERROR	Illegal state.
EXCEPTION PROCESSING PENDING	Processor is stalled at the exception handler semaphore (see NOTE).

Note The debugger only permits one processor to execute the debugger monitor. This is achieve by placing a semaphore prior to the exception handler access. The stalled processor will wait indefinitely. The current/master processor must be idled, forked, or executed (**GO**, **GT**, **GN**, **GD** commands) before the stalled processor is serviced.

SD - Switch Directories

Command Input

SD

Description

The **SD** command allows you to switch from the debugger directory to the diagnostic directory or from the diagnostic directory to the debugger directory. The prompt indicates the current directory (`PPCx-Bug>` for the debugger, and `PPCx-Diag>` for the diagnostics).

The commands in the current directory (the directory that you are in at the particular time) may be listed using the **HE** command.

The debugger commands are available from either directory, but the diagnostic commands are only available from the diagnostic directory.

Examples

Example 1: Switch from the debugger directory to the diagnostic directory.

```
PPC1-Bug>SD <Return>
PPC1-Diag>
```

Example 2: Switch from the diagnostic directory to the debugger directory.

```
PPC1-Diag>SD <Return>
PPC1-Bug>
```

SET - Set Time and Date

Command Input

SET *mmddyyhhmm*

Description

The **SET** command starts the RTC and sets the time and date. The argument, *mmddyyhhmm*, represents two digits each of month, day, year, hour, and minutes. Hours should be in Military (24-hour) form.

mmddyyhhmm is validated to ensure that it corresponds to a legal date and time, and if valid, the time-of-day clock is updated to correspond, and a formatted date and time message is displayed as a check. The **SET** command may be repeated to correct the date and time.

The clock must be running in order for the network I/O commands (i.e., **NAB**, **NBH**, **NBO**, **NIOC**, **NIOP**, and **NPING**) to work properly. Use **TIME ;L** to see if the clock is running. Use the **SET** command to start and initialize the clock.

Use the **TIME** command to display the current date and time of day (refer to *TIME - Display Time and Date* on page 3-228).

Example

Set the date and time:

```
PPC1-Bug>SET 05151405 <Return>
MON MAY 15 14:05:00.00 1995
PPC1-Bug>
```

SROM - SROM Examine/Modify

Command Input

SROM [*offset*][;E|D|I]

Options:

E Ethernet (Default)
D Drawbridge, PCI-PCI bridge
I I^2C-bus controller

Description:

The **SROM** command allows the user to examine and modify the contents of the network SROM attached to the Ethernet chips (see Appendix H for supported controllers).

When the command is invoked, the user will be prompted with choices of base addresses of the chips which have attached SROMs. Upon selection of the device, the SROM contents is read into a buffer and the user allowed to view and edit the buffer. If changes are made to the buffer contents, the user is prompted whether to allow the SROM to be updated or not. The **SROM** command also automatically calculates the required SROM checksum and writes it to the SROM if allowed by the user.

The optional *offset* argument allows the user to specify what offset within the buffer to begin viewing/editing at. If omitted, a default value of 0 is used for *offset*.

The SROM command may be called with an option to specify which SROM is to be read. Option ‘E’ specifies the Ethernet SROM. Option ‘D’ specifies the SROM for the DEC21554 non-transparent PCI-PCI bridge, sometimes known as the Drawbridge. Option ‘I’ specifies the I^2C bus controller.

If no option is specified the SROM Command will default to the Ethernet SROM.

When the command is entered at the BUG prompt, an opportunity is given to edit the SROM for each device present on any attached PMCspan board, as well as the base board.



Caution

The network SROM is programmed at the factory to reflect specific board configuration parameters. The Ethernet interface relies on the accuracy of this information to operate properly under both BUG and any installed Operating Systems. Consequently, do not modify the SROM contents unless there is a well understood reason for doing so.

Examples:

Example 1: To simply view the first 26 bytes of SROM contents and not change any entry:

```
PPC1-Bug>srom

Device Address =$80804000 (N/Y)? y
Reading SROM into Local Buffer.....
$00 (&000) 5710?
$02 (&002) 0000?
$04 (&004) 0000?
$06 (&006) 0000?
$08 (&008) 0000?
$0A (&010) 0000?
$0C (&012) 0000?
$0E (&014) 0000?
$10 (&016) AF00?
$12 (&018) 0301?
$14 (&020) 0800?
$16 (&022) 3E25?
$18 (&024) 3157? .
PPC1-Bug>
```

Example 2: Assume the proper Ethernet address was 08003E263157 instead of 08003E253157. It could be modified as follows:

```
PPC1-Bug>srom

Device Address =$80804000 (N/Y)? y
Reading SROM into Local Buffer.....
$00 (&000) 5710?
$02 (&002) 0000?
$04 (&004) 0000?
$06 (&006) 0000?
$08 (&008) 0000?
$0A (&010) 0000?
$0C (&012) 0000?
$0E (&014) 0000?
$10 (&016) AF00?
$12 (&018) 0301?
$14 (&020) 0800?
$16 (&022) 3E25? 3e26.

Update SROM (Y/N)? y

Calculate CRC (Y/N)? y
Writing SROM from Local Buffer.....
Verifying SROM with Local Buffer...
PPC1-Bug>
```

Example 3: To simply view the byte at offset $10 of the Ethernet controller.

```
PPCx-Bug>SROM 10 ;e<Return>

Device Address =$00007000 (N/Y)?y
Reading SROM into Local Buffer.....
$10 (&016) AF00?.
PPCx-Bug>
```

Example 4: To simply view the byte at offset $1C of the Drawbridge (PCI to PCI controller).

```
PPC1-Bug>SROM 1C ;d<Return>

Device Address =$0000A000 (N/Y)?y
Reading SROM into Local Buffer....
$1C (&028) 00?.
PPCx-Bug>
```

Example 5: To simply view the byte at offset $20 of the I^2C device at address A8.

```
PPCx-Bug>SROM 20 ;i<Return>

Device Address =$A0(N/Y)?n

Device Address = $A8(N/Y)?y
Reading SROM into Local Buffer....
$20 (&032)20?.
PPCx-Bug>
```

Example 6: To view the bytes starting at offset $1E and change the value at offset $20 of the I^2C device at address A0 from ‘AA’ to ‘FF’.

```
PPCx-Bug>SROM 1E ;i<Return>

Device Address =$A0 (N/Y)?y
Reading SROM into Local Buffer.....
$1E (&030) FF?<Return>
$1F (&031) FF?<Return>
$20 (&032) AA? FF
$21 (&033) FF?.

Update SROM (Y/N)?y
Writing SROM from Local Buffer....
Verifying SROM with Local Buffer....
PPCx-Bug>
```

SYM - Symbol Table Attach
NOSYM - Symbol Table Detach

Command Input

SYM [*ADDR*]

NOSYM

Description

The **SYM** command attaches a symbol table to the debugger. Once a symbol table has been attached, all displays of physical addresses are first looked up in the symbol table to see if the address is in range of any of the symbols (symbol data). If the address is in range, it is displayed with the corresponding symbol name and offset (if any) from the symbol's base address (symbol data). In addition to the display, any command line input that supports an address as an argument can now take a symbol name for the address argument. The address argument is first looked up in the symbol table to see if it matches any of the addresses (symbol data) before conversion takes place.

It is your responsibility to load the symbol table into memory. This command is analogous to the system call .SYMBOLTA. Refer to Chapter 5 for the description of the system call.

ADDR is the location where the symbol table begins in memory. The default address of the symbol table is your default instruction pointer. The symbol table must be word-aligned.

The Number of Entries in Symbol Table field governs the size of the symbol table. The Symbol Data field must be word-aligned and the Symbol Name field must consist only of printable characters (ASCII codes $21 through $7E). The symbol name may be terminated with a null ($00) character. The symbol data fields must be ascending in value (sorted numerically).

The format of the symbol table is shown below:

Offset	Field Description
$00	Number of entries in symbol table (32 bit word).
$04	Symbol Data - Entry #0 (32 bit word)
$08	Symbol Name - Entry #0 (24 bytes)
$20	Symbol Data - Entry #1 (32 bit word)
$24	Symbol Name - Entry #1 (24 bytes)
$XX	Table End (dependent on the number of entries)

Upon execution of the command, the debugger performs a sanity check on the symbol table with the above rules. The symbol table is not attached if the check fails.

The **NOSYM** command allows you to detach a symbol table from the debugger.

This command is analogous to the system call .SYMBOLTD. Refer to Chapter 5 for the description of the system call.

Examples

Example 1: Attach symbol table at address $0001E000

```
PPC1-Bug>SYM 1E000 <Return>
PPC1-Bug>
```

Example 2:

```
PPC1-Bug>MD 0 <Return>
_ldchar+$0000  00010203 04050607 08090A0B 0C0D0E0F  ................
_ldchar+$0010  10111213 14151617 18191A1B 1C1D1E1F  ................
PPC1-Bug>
```

Example 3:

```
PPC1-Bug>MD _LDCHAR <RETUrn>
_ldchar+$0000  00010203 04050607 08090A0B 0C0D0E0F  ................
_ldchar+$0010  10111213 14151617 18191A1B 1C1D1E1F  ................
PPC1-Bug>
```

Example 4:

```
PPC1-Bug>MD _LDCHAR+4 <Return>
_ldchar+$0004  04050607 08090A0B 0C0D0E0F 10111213  ................
_ldchar+$0014  14151617 18191A1B 1C1D1E1F 20212223  ............ !"#
PPC1-Bug>
```

Example 5:

```
PPC1-Bug>BF _LDCHAR:8 0 <Return>
Effective address: _ldchar+$0000
Effective count  : &32
PPC1-Bug>MD _LDCHAR <Return>
_ldchar+$0000  00000000 00000000 00000000 00000000  ................
_ldchar+$0010  00000000 00000000 00000000 00000000  ................
PPC1-Bug>
```

Example 6: Detach symbol table.

```
PPC1-Bug>NOSYM <Return>
PPC1-Bug>
```

SYMS - Symbol Table Display/Search

Command Input

SYMS [*symbol-name*]|[**;S**]

Description

The **SYMS** command displays the attached symbol table or search the attached symbol table.

Specify a *symbol-name* to search the symbol table for a particular symbol. Enter a character string in *symbol-name* to search the symbol table for all of symbols that begin with the character string.

The **S** option displays the attached symbol table in ascending ASCII order.

A symbol table must be attached for this command to execute. Refer to *SYM - Symbol Table Attach NOSYM - Symbol Table Detach* on page 3-218.

Examples

Example 1: Display the attached symbol table.

```
PPC1-Bug>SYMS <Return>
_stchar                   00001020
_ldchar                   000028A0
_sizmemory                00004930
PPC1-Bug>
```

Example 2: Search the attached symbol table for symbol _ldchar.

```
PPC1-Bug>SYMS _LDCHAR <Return>
_ldchar                   000028A0
PPC1-Bug>
```

Example 3: Search the attached symbol table for all symbols starting with **_s**.

```
PPC1-Bug>SYMS _S <Return>
_stchar                   00001020
_sizmemory                00004930
PPC1-Bug>
```

Example 4: Display the attached symbol table in ascending ASCII order.

```
PPC1-Bug>SYMS;S <Return>
_ldchar                   000028A0
_sizmemory                00004930
_stchar                   00001020
PPC1-Bug>
```

T - Trace

Command Input

T [*COUNT*]

Description

The **T** command executes one instruction at a time, displaying the target state after execution. **T** starts tracing at the address in the target IP.

The optional *COUNT* argument (which defaults to 1) specifies the number of instructions to be traced before returning control to the debugger.

Breakpoints are monitored (but not inserted) during tracing for all trace commands. Instruction memory must be writable. In all cases, if a breakpoint with 0 count is encountered, control is returned to the debugger.

The trace functions are implemented by inserting traps in the code. Therefore, the code must be writable and uncached for tracing to be effective.

Example

The following program resides at location $30000, and breakpoint is specified at location $30014.

```
PPC1-Bug>DS 30000 <Return>
00030000 3CA00000  ADDIS       R5,R0,$0
00030004 2B040000  CMPLI       CRF6,0,R4,$0
00030008 419A0014  BC          12,26,$0003001C
0003000C 98A30000  STB         R5,$0(R3) ($00041000)
00030010 3884FFFF  ADDI        R4,R4,$FFFFFFFF
00030014 38630001  ADDI        R3,R3,$1
00030018 4BFFFFEC  B           $00030004
0003001C 4E800020  BCLR        20,0
PPC1-Bug>
```

```
PPC1-Bug>BR <Return>
BREAKPOINTS
00030014
PPC1-Bug>
```

Initialize IP and R3, R4:

```
PPC1-Bug>RM IP <Return>
IP   =0000E000 ? 30000.<Return>
PPC1-Bug>

PPC1-Bug>RM R3 <Return>
R3     =00000000 ? 41000 <Return>
R4     =00000000 ? 100. <Return>
PPC1-Bug>
```

Display target registers and trace one instruction:

```
PPC1-Bug>RD <Return>
IP     =00030000 MSR    =00003030 CR     =00000020 FPSCR  =00000000
R0     =00000000 R1     =00020000 R2     =FFF0178C R3     =00041000
R4     =00000100 R5     =00000000 R6     =00000000 R7     =00000000
R8     =00000000 R9     =00000000 R10    =00000000 R11    =00000000
R12    =00000000 R13    =00000000 R14    =00000000 R15    =00000000
R16    =00000000 R17    =00000000 R18    =00000000 R19    =00000000
R20    =00000000 R21    =00000000 R22    =00000000 R23    =00000000
R24    =00000000 R25    =00000000 R26    =00000000 R27    =00000000
R28    =00000000 R29    =00000000 R30    =00000000 R31    =00000000
SPR0   =00000000 SPR1   =00000000 SPR8   =00020014 SPR9   =00000000
00030000 3CA00000  ADDIS       R5,R0,$0
PPC1-Bug>

PPC1-Bug>T <Return>
R0     =00000000 R1     =00020000 R2     =FFF0178C R3     =00041000
R4     =00000100 R5     =00000000 R6     =00000000 R7     =00000000
R8     =00000000 R9     =00000000 R10    =00000000 R11    =00000000
R12    =00000000 R13    =00000000 R14    =00000000 R15    =00000000
R16    =00000000 R17    =00000000 R18    =00000000 R19    =00000000
R20    =00000000 R21    =00000000 R22    =00000000 R23    =00000000
R24    =00000000 R25    =00000000 R26    =00000000 R27    =00000000
R28    =00000000 R29    =00000000 R30    =00000000 R31    =00000000
SPR0   =00000000 SPR1   =00000000 SPR8   =00020014 SPR9   =00000000
00030004 2B040000  CMPLI       CRF6,0,R4,$0
PPC1-Bug>
```

Trace next instruction:

```
PPC1-Bug> <Return>
IP     =00030008 MSR    =00003030 CR     =00000040 FPSCR  =00000000
R0     =00000000 R1     =00020000 R2     =FFF0178C R3     =00041000
R4     =00000100 R5     =00000000 R6     =00000000 R7     =00000000
R8     =00000000 R9     =00000000 R10    =00000000 R11    =00000000
R12    =00000000 R13    =00000000 R14    =00000000 R15    =00000000
R16    =00000000 R17    =00000000 R18    =00000000 R19    =00000000
R20    =00000000 R21    =00000000 R22    =00000000 R23    =00000000
R24    =00000000 R25    =00000000 R26    =00000000 R27    =00000000
R28    =00000000 R29    =00000000 R30    =00000000 R31    =00000000
SPR0   =00000000 SPR1   =00000000 SPR8   =00020014 SPR9   =00000000
00030008 419A0014  BC           12,26,$0003001C
PPC1-Bug>
```

Trace the next two instructions:

```
PPC1-Bug>T 2 <Return>
IP     =0003000C MSR    =00003030 CR     =00000040 FPSCR  =00000000
R0     =00000000 R1     =00020000 R2     =FFF0178C R3     =00041000
R4     =00000100 R5     =00000000 R6     =00000000 R7     =00000000
R8     =00000000 R9     =00000000 R10    =00000000 R11    =00000000
R12    =00000000 R13    =00000000 R14    =00000000 R15    =00000000
R16    =00000000 R17    =00000000 R18    =00000000 R19    =00000000
R20    =00000000 R21    =00000000 R22    =00000000 R23    =00000000
R24    =00000000 R25    =00000000 R26    =00000000 R27    =00000000
R28    =00000000 R29    =00000000 R30    =00000000 R31    =00000000
SPR0   =00000000 SPR1   =00000000 SPR8   =00020014 SPR9   =00000000
0003000C 98A30000  STB          R5,$0(R3) ($00041000)
IP     =00030010 MSR    =00003030 CR     =00000040 FPSCR  =00000000
R0     =00000000 R1     =00020000 R2     =FFF0178C R3     =00041000
R4     =00000100 R5     =00000000 R6     =00000000 R7     =00000000
R8     =00000000 R9     =00000000 R10    =00000000 R11    =00000000
R12    =00000000 R13    =00000000 R14    =00000000 R15    =00000000
R16    =00000000 R17    =00000000 R18    =00000000 R19    =00000000
R20    =00000000 R21    =00000000 R22    =00000000 R23    =00000000
R24    =00000000 R25    =00000000 R26    =00000000 R27    =00000000
R28    =00000000 R29    =00000000 R30    =00000000 R31    =00000000
SPR0   =00000000 SPR1   =00000000 SPR8   =00020014 SPR9   =00000000
00030010 3884FFFF  ADDI         R4,R4,$FFFFFFFF
PPC1-Bug>
```

Trace the next instruction:

```
PPC1-Bug>T <Return>
At Breakpoint
IP     =00030014 MSR    =00003030 CR     =00000040 FPSCR  =00000000
R0     =00000000 R1     =00020000 R2     =FFF0178C R3     =00041000
R4     =000000FF R5     =00000000 R6     =00000000 R7     =00000000
R8     =00000000 R9     =00000000 R10    =00000000 R11    =00000000
R12    =00000000 R13    =00000000 R14    =00000000 R15    =00000000
R16    =00000000 R17    =00000000 R18    =00000000 R19    =00000000
R20    =00000000 R21    =00000000 R22    =00000000 R23    =00000000
R24    =00000000 R25    =00000000 R26    =00000000 R27    =00000000
R28    =00000000 R29    =00000000 R30    =00000000 R31    =00000000
SPR0   =00000000 SPR1   =00000000 SPR8   =00020014 SPR9   =00000000
00030014 38630001  ADDI        R3,R3,$1
PPC1-Bug>
```

Note that in the breakpoint was reached (the message `At Breakpoint` is displayed).

TA - Terminal Attach

Command Input

TA [*PORT*]

Description

The **TA** command assigns a serial port to be the console. The port specified must already be assigned (refer to *PF - Port Format NOPF - Port Detach* on page 3-183).

No prompt appears unless the selected *port* is already the console. All keyboard exchanges and displays are now made through *port*. This remains in effect until another **TA** command is issued. Upon reset, the port is initialized to the value stored in non-volatile RAM.

If no *port* is specified, **TA** restores the console to port selected at power-up. The prompt will appear at the connected terminal (port 0).

Examples

Example 1: Select port 1 (logical unit #01) as console.

```
PPC1-Bug>TA 1 <Return>
Console = [01: PPC1- “HOST”]
Update Non-Volatile RAM (Y/N)?
```

Example 2: Restore console to port specified in non-volatile RAM.

```
PPC1-Bug>TA <Return>
Console = [00: PPC1- "DEBUG"]
Update Non-Volatile RAM (Y/N)?
PPC1-Bug>
```

TIME - Display Time and Date

Command Input

TIME [**;L**]

Description

The **TIME** command displays the date and time to the console in ASCII characters.

Use the **SET** command to initialize the time-of-day clock (refer to *SET - Set Time and Date* on page 3-213).

Option **L** causes the date and time display to be updated continuously. An abort or break returns you to the debugger prompt. Use **TIME ;L** to see if the clock is running.

Example

Display the date and time:

```
PPC1-Bug>TIME <Return>
MON MAY 15 14:05:32.70 1995
PPC1-Bug>
```

TM - Transparent Mode

Command Input

TM [*PORT*] [*ESCAPE*]

Description

The **TM** command connects the current console serial port to the an other port, allowing you to communicate with a host computer. The two ports remain connected until the escape character (the character used to exit the transparent mode) is received by the console port. The escape character is not transmitted to the host, and at power-up or reset it is initialized to $01 (**CTRL- a**).

The optional *PORT* argument allows you to specify which port is the host port. If omitted, port 1 is assumed.

The ports do not have to be at the same baud rate, but the console port baud rate should be equal to or greater than the host port baud rate for reliable operation. To change the baud rate use the **PF** (Port Format) command.

The optional *ESCAPE* argument allows you to specify the character to be used as the escape character. This character may be either a Control character (e.g., **CTRL-a**), or an ASCII character. The *ESCAPE* argument can be entered in one of three formats:

***ESCAPE* Format**	**Sets escape to . . .**	**Example**
Hexadecimal	**CTRL** and the equivalent ASCII character	**$63** sets escape to **CTRL-c**.
^ and a character	**CTRL** and the character	**^c** sets escape to **CTRL-c**.
‘ and a character	the character	**‘c** sets escape to **c**.

If the port number is omitted and the *ESCAPE* argument is entered as a numeric value, precede the *ESCAPE* argument with a comma to distinguish it from a port number.

TM without any arguments displays the current escape character, which you must enter in order to return to the debugger.

Examples

Example 1: Display the escape character.

```
PPC1-Bug>TM <Return>
Escape character:  $01=^A
.
.
.
<Control-A>
PPC1-Bug>
```

Example 2: In this example, the default port of 1 is specified by the NULL *PORT* argument, and the escape character is set to **CTRL-g**.

```
PPC1-Bug>TM,,^g <Return>
Escape character: $07=^G
.
.
.
<Ctrl-g>
PPC1-Bug>
```

Example 3: In this example, $03 is specified as the port logical unit and the escape character is set to **CTRL-b**.

```
PPC1-Bug>TM 3 2 <Return>
Escape character: $02=^B
.
.
.
<Ctrl-b>
PPC1-Bug>
```

TT - Trace to Temporary Breakpoint

Command Input

TT *ADDR*

Description

The **TT** command sets a temporary breakpoint at the specified address and traces until a breakpoint with 0 count is encountered. The temporary breakpoint is then removed (**TT** is analogous to the **GT** command) and control is returned to the debugger. Tracing starts at the target IP address.

The message `At Breakpoint` is displayed when a breakpoint is reached.

Breakpoints are monitored (but not inserted) during tracing for all trace commands. Instruction memory must be writable. If a breakpoint with 0 count is encountered, control is returned to the debugger.

The trace functions are implemented by inserting traps in the code. Therefore, the code must be writable and uncached for tracing to be effective.

Example

The following program resides at location $30000, and breakpoint is specified at location $30014.

```
PPC1-Bug>DS 30000 <Return>
00030000 3CA00000  ADDIS       R5,R0,$0
00030004 2B040000  CMPLI       CRF6,0,R4,$0
00030008 419A0014  BC          12,26,$0003001C
0003000C 98A30000  STB         R5,$0(R3) ($00041000)
00030010 3884FFFF  ADDI        R4,R4,$FFFFFFFF
00030014 38630001  ADDI        R3,R3,$1
00030018 4BFFFFEC  B           $00030004
0003001C 4E800020  BCLR        20,0
PPC1-Bug>

PPC1-Bug>BR <Return>
BREAKPOINTS
00030014
PPC1-Bug>
```

Initialize IP and R3, R4:

```
PPC1-Bug>RM IP <Return>
IP   =0000E000 ? 30000.<Return>
PPC1-Bug>

PPC1-Bug>RM R3 <Return>
R3     =00000000 ? 41000 <Return>
R4     =00000000 ? 100. <Return>
PPC1-Bug>
```

Display target registers and trace to temporary breakpoint:

```
PPC1-Bug>RD <Return>
IP     =00030000 MSR    =00003030 CR     =00000020 FPSCR  =00000000
R0     =00000000 R1     =00020000 R2     =FFF0178C R3     =00041000
R4     =00000100 R5     =00000000 R6     =00000000 R7     =00000000
R8     =00000000 R9     =00000000 R10    =00000000 R11    =00000000
R12    =00000000 R13    =00000000 R14    =00000000 R15    =00000000
R16    =00000000 R17    =00000000 R18    =00000000 R19    =00000000
R20    =00000000 R21    =00000000 R22    =00000000 R23    =00000000
R24    =00000000 R25    =00000000 R26    =00000000 R27    =00000000
R28    =00000000 R29    =00000000 R30    =00000000 R31    =00000000
SPR0   =00000000 SPR1   =00000000 SPR8   =00020014 SPR9   =00000000
00030000 3CA00000  ADDIS       R5,R0,$0
PPC1-Bug>

PPC1-Bug>TT 30008 <Return>
IP     =00030004 MSR    =00003030 CR     =00000000 FPSCR  =00000000
R0     =00000000 R1     =00020000 R2     =00000000 R3     =00041000
R4     =00000100 R5     =00000000 R6     =00000000 R7     =00000000
R8     =00000000 R9     =00000000 R10    =00000000 R11    =00000000
R12    =00000000 R13    =00000000 R14    =00000000 R15    =00000000
R16    =00000000 R17    =00000000 R18    =00000000 R19    =00000000
R20    =00000000 R21    =00000000 R22    =00000000 R23    =00000000
R24    =00000000 R25    =00000000 R26    =00000000 R27    =00000000
R28    =00000000 R29    =00000000 R30    =00000000 R31    =00000000
SPR0   =00000000 SPR1   =00000000 SPR8   =00000000 SPR9   =00000000
00030004 2B040000  CMPLI       CRF6,0,R4,$0
At Breakpoint
IP     =00030008 MSR    =00003030 CR     =00000040 FPSCR  =00000000
R0     =00000000 R1     =00020000 R2     =00000000 R3     =00041000
```

```
R4     =00000100 R5     =00000000 R6     =00000000 R7     =00000000
R8     =00000000 R9     =00000000 R10    =00000000 R11    =00000000
R12    =00000000 R13    =00000000 R14    =00000000 R15    =00000000
R16    =00000000 R17    =00000000 R18    =00000000 R19    =00000000
R20    =00000000 R21    =00000000 R22    =00000000 R23    =00000000
R24    =00000000 R25    =00000000 R26    =00000000 R27    =00000000
R28    =00000000 R29    =00000000 R30    =00000000 R31    =00000000
SPR0   =00000000 SPR1   =00000000 SPR8   =00000000 SPR9   =00000000
00030008 419A0014  BC          12,26,$0003001C
PPC1-Bug>
```

VE - Verify S-Records Against Memory

Command Input

VE [*PORT*] [*ADDR*] [**;**[**X**] [**C**]] [**=***text*]

Options

C Ignore checksum. A checksum for the data contained within an S-Record is calculated as the S-Record is read in at the port. Normally, this calculated checksum is compared to the checksum contained within the S-Record and if the compare fails an error message is sent to the screen on completion of the download. If this option is selected, then the comparison is not made.

X Echo the S-records to your terminal as they are read in at the host port

Description

The **VE** command compares data to the an S-record that is in memory. This command is similar to the **LO** command, except that the data is compared to memory instead of being stored to memory.

The **VE** command accepts serial data from a host system in the form of a file of Motorola S-records and compares it to data already in the memory. If the data does not compare, then you are alerted via information sent to the terminal screen.

If *PORT* is not specified but *ADDR* is specified, insert two commas in front of ADDR. If this number is omitted, port 1 is assumed.

ADDR is an offset address which is to be added to the address contained in the address field of each record. This causes the records to be compared to memory at different locations than would normally occur. The contents of the automatic offset register are not added to the S-record addresses. (For information on S-records, refer to Appendix D)

The optional *text* argument is a command that is sent to the host before the debugger begins to look for S-records at the host port. This allows you to send a command to the host device to initiate the download. This text should *not* be delimited by any quote marks, and should begin immediately

following the equals sign, and terminate with the carriage return. If the host is operating full duplex, the string is also echoed back to the host port by the host and appears on your terminal screen.

In order to accommodate host systems that echo all received characters, the above-mentioned text string is sent to the host one character at a time and characters received from the host are read one at a time. After the entire command has been sent to the host, VE keeps looking for an **<LF>** character from the host, signifying the end of the echoed command. No data records are processed until this **<LF>** is received. If the host system does not echo characters, VE still keeps looking for an **<LF>** character before data records are processed. For this reason, it is required in situations where the host system does not echo characters, that the first record transferred by the host system be a header record. The header record is not used, but the **<LF>** after the header record serves to break VE out of the loop so that data records are processed.

During a verify operation, data from an S-record is compared to memory beginning with the address contained in the S-record address field (plus the offset address, if it was specified). If the verification fails, then the non-comparing record is set aside until the verify is complete and then it is printed out to the screen. If three non-comparing records are encountered in the course of a verify operation, then the command is aborted.

If a non-hexadecimal character is encountered within the data field of a data record, then the part of the record which had been received up to that time is printed to the screen and the PPCBug error handler is invoked to point to the faulty character.

As mentioned, if the embedded checksum of a record does not agree with the checksum calculated by PPCBug and if the checksum comparison has not been disabled via the C option, then an error condition exists. A message is output stating the address of the record (as obtained from the address field of the record), the calculated checksum, and the checksum read with the record. A copy of the record is also output. This is a fatal error and causes the command to abort.

Example

For the example, assume that the program has been compiled and linked to start at address 65040000.

```
        .file   “test.s”
#
# retrieve contents of the RTC registers
#
        .toc
T.FD:   .tc     FD.4330000080000000[tc] ,1127219200,-2147483648
        .toc
T..test:
        .tc     ..test[tc], test[ds]
T..LDATA:
        .tc     ..LDATA[tc], .LDATA
T..LRDATA:
        .tc     ..LRDATA[tc], .LRDATA
#
        .align  2
        .globl  test[ds]
        .csect  test[ds]
        .long   .test[pr], TOC[tc0], 0
        .globl  .test[pr]
        .csect  .test[pr]
.test:
        mfspr   r4,4            # load RTC upper register
        stw     r4,0(r3)        # write to caller’s buffer
        mfspr   r4,5            # load RTC lower register
        stw     r4,4(r3)        # write to caller’s buffer
        bclr    0x14,0x0        # return to the caller
FE_MOT_RESVD.test:
        .csect  [rw]
        .align  2
.LDATA:
        .csect  [rw]
        .align  2
.LRDATA:
```

Then the program is converted into an S-record file named **test.mx** as follows:

```
S325650400007C8402A6908300007C8502A6908300044E80002000000000650400006504002412
S30D650400200000000000000000069
S7056504000091
```

This file is downloaded into memory at address $40000. The program may be examined in memory using the **MD** command.

```
PPC1-Bug>MD 40000:5;DI <Return>
00040000 7C8402A6  MFSPR       R4,4
00040004 90830000  STW         R4,$0(R3) ($00041000)
00040008 7C8502A6  MFSPR       R4,5
0004000C 90830004  STW         R4,$4(R3) ($00041004)
00040010 4E800020  BCLR        20,0
PPC1-Bug>
```

Suppose you want to make sure that the program has not been destroyed in memory. The **VE** command is used to perform a verification.

```
PPC1-Bug>VE „-65000000;X=cat test.mx <Return>
cat test.mx
S325650400007C8402A6908300007C8502A6908300044E800020000000006504000065040024 12
S30D650400200000000000000069
S7056504000091
Verify passes.
PPC1-Bug>
```

The verification passes. The program stored in memory was the same as that in the S-record file that had been downloaded.

Now change the program in memory and perform the verification again.

```
PPC1-Bug>MM 40004;H <Return>
00040004 9083? 9082. <Return>
PPC1-Bug>
```

```
PPC1-Bug>VE „-65000000;X=cat test.mx <Return>
cat test.mx
S325650400007C8402A69083
S-RECORD Data Verification error:
Address       =00040005
Expected data =83
Actual data   =82
S-RECORD=
S325650400007C8402A69083
PPC1-Bug>
```

The byte which was changed in memory does not compare with the corresponding byte in the S-record.

VER - Revision/Version Display

Command Input

VER [**;E**]

Description

The **VER** command displays the various revisions and versions of the host's hardware subsystems. The command displays the revision and date of PPCBug that is running.

The **E** option displays more detail, such as PCI configuration headers for each device, which can be used for components/subsystems that may have lengthy data arrays associated with their identification. Such a data array would be displayed as a memory dump.

Refer to the appropriate device manual to translate the physical revision/version to its logical revision/version.

Examples

Example 1:

```
PPC1-Bug>VER <Return>
Debugger/Diagnostics Type/Revision.................=PPC1/x.x
Debugger/Diagnostics Revision Date.................=XX/XX/XX RMXX
MicroProcessor Version/Revision....................=0008/0201
MicroProcessor Internal Clock Speed (MHZ)..........=233
MicroProcessor External Clock Speed (MHZ)..........=67
CPU Type/System ID/CPU Subtype.....................=E0/FC/00
PCI Bus Clock Speed (MHZ)..........................=33
Local Memory Size..................................=02000000 (32MB)
L2 Cache (External)................................=NONE
L2 Cache (P0-In-Line)..............................=1MB
L2 Cache (P1-In-Line)..............................=N/A
Super I/O Device Offset/ID Revision................=02E/C0/7
PCI Bus Bridge Device ID/Revision..................=00011057/21
PCI Device (80800800) ID/Revision..................=05861106/33
PCI Function 00/0B/1 (00005900) ID/Revision.........=05711106/06
```

```
PCI Function 00/0B/2 (00005A00) ID/Revision.........=30381106/02
PCI Function 00/0B/3 (00005B00) ID/Revision.........=30401106/02
PCI Function 00/0E/0 (00007000) ID/Revision.........=00091011/20
PCI Function 00/10/0 (00008000) ID/Revision.........=00B81013/00
PCI Function 00/14/0 (0000A000) ID/Revision.........=00261011/01
PCI Function 01/0D/0 (00016800) ID/Revision.........=70789004/03
PCI Function 01/0F/0 (00017800) ID/Revision.........=00211011/02
PCI Function 02/08/0 (00024000) ID/Revision.........=00031000/02
PCI Function 02/0D/0 (00026800) ID/Revision.........=0091011/22
PPC1-Bug>
```


Example 2:

```
PPC1-Bug>VER ;E <Return>
Debugger/Diagnostics Type/Revision..................=PPC1/X.X
Debugger/Diagnostics Revision Date..................=XX/XX/XX RMXX
MicroProcessor Version/Revision.....................=0008/0201
MicroProcessor Internal Clock Speed (MHZ)...........=233
MicroProcessor External Clock Speed (MHZ)...........=67
CPU Type/System ID/CPU Subtype......................=E0/FC/00
PCI Bus Clock Speed (MHZ)...........................=33
Local Memory Size...................................=02000000 (32MB)
L2 Cache (External).................................=NONE
L2 Cache (P0-In-Line)...............................=1MB
L2 Cache (P1-In-Line)...............................=N/A
Super I/O Device Offset/ID Revision.................=02E/C0/7
PCI Bus Bridge Device ID/Revision...................=48011057/01
PCI Bus Bridge Device Registers
Class: Built before Class definitions  Subclass: Non VGA device
Base+$0000 48 01 10 57 22 80 00 06 06 00 00 01 00 00 00 00 H..W"..........
Base+$0010 00 00 00 01 3C 00 00 00 00 00 00 00 00 00 00 00 ..............
Base+$0020 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 ..............
Base+$0030 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 ..............
Base+$0040 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 ..............
Base+$0050 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 ..............
Base+$0060 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 ..............
Base+$0070 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 ..............
Base+$0080 80 00 81 FE 80 00 00 F3 81 FF 81 FF 80 00 00 E3 ..............
Base+$0090 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 ..............
Base+$00A0 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 ..............
Base+$00B0 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 ..............
Base+$00C0 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 ..............
Base+$00D0 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 ..............
Base+$00E0 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 ..............
Base+$00F0 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 ..............

Press "RETURN" to continue <Return>
```

```
PCI Function 00/0B/0 (0005800) ID/Revision.........=05861106/33
Class:Bridge Device Subclass: PCI/ISA Bridge
Base+$0000  05 86 11 06 02 00 00 07 06 01 00 33 00 80 00 00  ............3.
Base+$0010  01 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 ................
Base+$0020  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 ................
Base+$0030  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 ................

Press "RETURN" to continue <Return>

PCI Function 00/0B/1 (00005900) ID/Revision.........=05711106/06
Class:Mass Storage Controller Subclass: IDE Controller
Base+$0000 05 71 11 06 02 80 00 85 01 01 8F 06 00 00 00 00  H..W...........
Base+$0010 00 00 FF F9 00 00 FF F5 00 00 FF E9 00 00 FF E5.................
Base+$0020 00 00 FF D1 00 00 00 00 00 00 00 00 00 00 00 00 ................
Base+$0030 00 00 00 00 00 00 00 00 00 00 00 00 00 00 01 0E ................

Press "RETURN" to continue <Return>

PCI Function 00/0B/2 (00005A00) ID/Revision.........=30381106/02
Class: Serial Bus Controller  Subclass: Universal Serial Bus
Base+$0000 30 38 11 06 02 00 00 05  0C 03 00 02 00 00 16 08 08.."..........
Base+$0010 00 00 00 00 00 00 00 00  00 00 00 00 00 00 00 00 ..@.............
Base+$0020 00 00 FF A1 00 00 00 00  00 00 00 00 12 34 09 25 .............4%
Base+$0030 00 00 00 00 00 00 00 00  00 00 00 00 00 00 04 0B ................

Press "RETURN" to continue <Return>

PCI Function 00/0B/3 (00005B00) ID/Revision.........=30401106/02
Class: Built before Class definitions Subclass: Non VGA device

Base+$0000 30 40 11 06 02 80 00 00  00 00 00 02 00 00 00 00 0@..............
Base+$0010 00 00 00 00 00 00 00 00  00 00 00 00 00 00 00 00 ................
Base+$0020 00 00 00 00 00 00 00 00  00 00 00 00 00 00 00 00 ................
Base+$0030 00 00 00 00 00 00 00 00  00 00 00 00 00 00 00 00 ................

Press "RETURN" to continue <Return>

PCI Function 00/0E/0 (00007000) ID/Revision.........=00091011/20
Class: Network Controller Subclass: Ethernet Controller

Base+$0000 00 09 10 11 02 80 00 07 02 00 00 20 00 00 00 00 ................
Base+$0010 3F 7F FF 81 3B FF FF 80 00 00 00 00 00 00 00 00 .?..............
Base+$0020 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 ................
Base+$0030 5D 7C 00 00 00 00 00 00 00 00 00 00 28 14 01 0A ]|..............

Press "RETURN" to continue <Return>

PCI Function 00/10/0 (00008000) ID/Revision.........=008B1013/00
Class: Display Controller Subclass:VGA-compatible Controller

Base+$0000 00 B8 10 13 02 00 00 00 03 00 00 00 00 00 00 00 ................
Base+$0010 FF 00 00 08 FF FF FF E1 00 00 00 00 00 00 00 00 ................
Base+$0020 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 ................
Base+$0030 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 05 ................

Press "RETURN" to continue <Return>
```

```
PCI Function 00/14/0 (0000A000) ID/Revision.........=00261011/01
Class: Bridge Device Subclass:PCI/PCI Bridge

Base+$0000 00 26 10 11 02 80 00 07 06 04 00 01 00 01 80 08 .&..............
Base+$0010 00 00 00 00 00 00 00 00 80 02 01 00 22 80 E1 D1 ................
Base+$0020 3B E0 3B D0 00 01 FF F1 FF FF FF FF 00 00 00 00 ................
Base+$0030 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 ................

Press "RETURN" to continue <Return>

PCI Function 00/0D/0 (00016800) ID/Revision.........=70789004/03
Class: Mass Storage Controller Subclass: SCSI Controller

Base+$0000 70 78 90 04 02 80 00 07 01 00 00 03 00 00 00 08 px..............
Base+$0010 00 00 EF 01 3B EF F0 00 00 00 00 00 00 00 00 00 ................
Base+$0020 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 ................
Base+$0030 00 00 00 00 00 00 00 00 00 00 00 00 08 08 01 FF ................

Press "RETURN" to continue <Return>

PCI Function 01/0F/0 (00017800) ID/Revision.........=00211011/02
Class: Bridge Device Subclass: PCI/PCI Bridge

Base+$0000 00 21 10 11 02 80 00 07 06 04 00 02 00 01 80 08 .!..............
Base+$0010 00 00 00 00 00 00 00 00 80 02 02 01 02 80 D0 D0 ................
Base+$0020 3B D0 3B D0 00 00 FF F0 00 00 00 00 00 00 00 00 ................
Base+$0030 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 ................

Press "RETURN" to continue <Return>

PCI Function 02/08/0 (00024000) ID/Revision.........=00031000/02
Class: Mass Storage Controller Subclass: SCSI Controller

Base+$0000 00 03 10 00 02 00 00 07 01 00 00 02 00 00 80 00 ................
Base+$0010 00 00 DF 01 3B DF FF 00 00 00 00 00 00 00 00 00 ................
Base+$0020 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 ................
Base+$0030 00 00 00 00 00 00 00 00 00 00 00 00 00 00 01 FF ................

Press "RETURN" to continue <Return>

PCI Function 02/0D/0 (00026800) ID/Revision.........=00091011/22
Class: Network Controller Subclass: Ethernet Controller

Base+$0000 00 09 10 11 02 80 00 07 02 00 00 22 00 00 00 08 ...........”...
Base+$0010 00 00 DE 81 3B DF FE 80 00 00 00 00 00 00 00 00 ................
Base+$0020 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 ................
Base+$0030 40 00 00 00 00 00 00 00 00 00 00 00 28 14 01 FF @...............

Press "RETURN" to continue <Return>

PPC1-Bug>
```

WL - Write Loop

Command Input

WL *ADDR*:*DATA*[**;B**|**H**|**W**]

Options

B	Byte
H	Half-word
W	Word

Description

The **WL** command establishes an infinite loop consisting of a processor store instruction, *DATA*, targeted to the given *ADDR* and of the given length, followed by a branch instruction back to the store. The defined *DATA* is therefore stored repeatedly into the defined location in rapid succession.

The write loop can only be terminated by an external occurrence, such as an interrupt (usually an abort), a reset from the RESET switch, or power cycle.

One-Line Assembler/ Disassembler

4

Introduction

The PPCBug one-line assembler is an interactive assembler/editor in which the source program is not saved. Each source line is translated into the proper PowerPC machine language code and is stored in memory on a line-by-line basis at the time of entry. In order to display an instruction, the machine code is disassembled, and the instruction mnemonic and operands are displayed. All valid PowerPC instructions are translated.

The assembler is effectively a subset of an operating system assembler. It has some limitations as compared with the operating system assembler, such as not allowing line numbers, pseudo ops, instruction macros, and label. However, it is a powerful tool for creating, modifying, and debugging code written in PowerPC assembly language.

PowerPC Assembly Language

The symbolic language used to code source programs for processing by the assembler is PowerPC assembly language. This language is a collection of mnemonics representing:

- Operations
  - (PowerPC machine-instruction operation codes, Directives (pseudo-ops))
  - Operators
- Special symbols

Machine-Instruction Operation Codes

Refer to *PowerPC 603 RISC Microprocessor User's Manual*, *PowerPC 604 RISC Microprocessor User's Manual*, or the *PowerPC MCP750 RISC Microprocessor User's Manual* for information on the mnemonic machine instruction operation codes.

Directives

The PPCBug one-line assembler recognizes only two mnemonic directives: to define a word constant (WORD), and system call (SYSCALL). These directives are used to define data within the program, and to make calls on PPCBug utilities. Refer to *WORD Define Constant Directive* on page 4-9 and *SYSCALL System Call Directive* on page 4-10 for further details.

Comparison with the Standard Assembler

There are several major differences between the PPCBug one-line assembler and the PowerPC Standard Assembler. The PowerPC assembler is a two-pass assembler that processes an entire program as a unit, while the PPCBug one-line assembler processes each line of a program as an individual unit. Because of this, the capabilities of the PPCBug one-line assembler are more restricted, as described below:

- Label and line numbers are not used. Labels are used to reference other lines and locations in a program. The one-line assembler has no knowledge of other lines and, therefore, cannot make the required association between a label and the label definition located on a separate line.
- Source lines are not saved. In order to read back a program after it has been entered, the machine code is disassembled and then displayed as mnemonic and operands.
- Only two directives (WORD and SYSCALL) are accepted.
- No macro operation capability is included.

- No conditional assembly is used.
- Several symbols recognized by the resident assembler are not included in the PPCBug one-line assembler character set.
- Depending on the context, the ampersand (&) has multiple meanings to the resident assembler (refer to *Addressing Modes* on page 4-8). The & is either the AND logical operator or a decimal number prefix.
- Depending on the context, the asterisk (*) has multiple meanings to the resident assembler (refer to *Addressing Modes* on page 4-8). The * is either the multiplication operator or the current value of the program counter.

Although functional differences exist between the two assemblers, the PPCBug one-line assembler is a true subset of the resident assembler. The format and syntax used with the PPCBug one-line assembler are acceptable to the resident assembler except as described above.

Source Program Coding

A source program is a sequence of source statements arranged in a logical way to perform a predetermined task. Each source statement occupies a line and must be either an executable instruction, or a WORD assembler directive. Each source statement follows a consistent source line format.

Source Line Format

Each source statement is a combination of operation and, as required, operand fields. Line numbers, labels, and comments are not used.

Operation Field

Because there is no label field, the operation field may begin in the first available column. It may also follow one or more spaces. Entries can consist of one of two categories:

- Operation codes which correspond to the MPC60*x* instruction set.

- Define Constant directive -- WORD is recognized to define a constant in a word location.

The size of the data field affected by an instruction is determined by the data size codes. Some instructions and directives can operate on more than one data size. For these operations, the data size code must be specified or a default size applicable to that instruction will be assumed. The size code need not be specified if only one data size is permitted by the operation. Refer to the *PowerPC 603 RISC Microprocessor User's Manual*, the *PowerPC 604 RISC Microprocessor User's Manual,* or the *PowerPC MPC750 RISC Microprocessor User's Manual* section on Instructions for a definition of allowable size codes.

The data size code is not permitted, however, when the instruction or directive does not have a data size attribute.

Operand Field

If present, the operand field follows the operation field and is separated from the operation field by at least one space. When two or more operand subfields appear within a statement, they must be separated by a comma.

Disassembled Source Line

The disassembled source line may not look identical to the source line entered. The disassembler makes a decision on how it interprets the numbers used. If the number is an offset from a register, it is treated as a signed hexadecimal offset. Otherwise, it is treated as a straight unsigned hexadecimal.

Mnemonics and Delimiters

The assembler recognizes all PowerPC instruction mnemonics.

Numbers are recognized as binary, octal, decimal, and hexadecimal, with hexadecimal the default case. Numbers may be represented only as integers; floating point representations are not supported. The following formats are acceptable:

Decimal	a string of decimal digits (0 through 9) preceded by an ampersand (&) For example &12334 or -&987654321
Hexadecimal	a string of hexadecimal digits (0 through 9, A through F) preceded by an optional dollar sign ($). For example, $AFE5

An ASCII string is made up of one or more ASCII characters enclosed by apostrophes (’ ’). ASCII strings are right-justified and zero-filled (if necessary), whether stored or used as immediate operands.

The following register mnemonics are recognized/referenced by the assembler/disassembler:

Pseudo-Registers:

Z0-Z7	User Offset Registers - These are only recognized during the assembly/disassembly of target addresses (branch instructions).

Main Processor Registers:

R0-R31	General Purpose Registers
FR0-FR31	Floating Point Unit Data Registers
CRB0-CRB31	Condition Register Bit Field (CR/FPSCR)
CRF0-CRF7	Condition Register Field (FPSCR)

Note that the processor registers that are not listed here are still accessible, but instead of the register being denoted by a name, it is denoted by a number with a specific instruction mnemonic.

Instructions

The following is a list of the instruction fields and their default number bases:

CRBA	Decimal
CRBB	Decimal
BD	Signed Hexadecimal
CRFD	Decimal
CRFS	Decimal
BI	Decimal
BO	Decimal
CRBD	Decimal
D	Signed Hexadecimal
DS	Signed Hexadecimal
FM	Hexadecimal
FRA	Decimal
FRB	Decimal
FRC	Decimal
FRS	Decimal
FRD	Decimal
CRM	Hexadecimal
L	Decimal
LI	Signed Hexadecimal
MB	Decimal
ME	Decimal
NB	Decimal
RA	Decimal
RB	Decimal
RS	Decimal

RD	Decimal
SH	Decimal
SIMM	Signed Hexadecimal
SPR	Decimal
TO	Decimal
IMM	Decimal
UIMM	Hexadecimal

The assembly/disassembly format of the instruction mnemonics and operands follow the syntax specified in the *PowerPC 603 RISC Microprocessor User's Manual* or *PowerPC 604 RISC Microprocessor User's Manual*. The required fields are in boldface type, and the variable fields are not, fields being one or more characters in length.

Character Set

The character set recognized by the PPCBug one-line assembler is a subset of ASCII, and these are listed as follows:

Letters A through Z (uppercase and lowercase)

Integers 0 through 9

Arithmetic operators: + - * / << >> ! & % ^

Parentheses ( )

Characters used as special prefixes:

dollar sign ($) specifies a hexadecimal number

ampersand (&) specifies a decimal number

at sign (@) specifies an octal number

percent sign(%) specifies a binary number

apostrophe (‘) specifies an ASCII literal character string

Separating characters:

space

comma (,)

period (.)

slash (/)

dash (-)

* (asterisk); indicates the current instruction pointer value

Addressing Modes

Effective address modes, combined with operation codes, define the particular function to be performed by a given instruction. Effective addressing and data organization are described in detail in the section on *Addressing Modes and Instruction Set* in the *PowerPC 603 RISC Microprocessor User's Manual* or *PowerPC 604 RISC Microprocessor User's Manual.*

You may use an expression in any numeric field of these addressing modes. The assembler has a built-in expression evaluator. It supports the following operand types:

Binary numbers	%10
Octal numbers	@765 . . 0
Decimal numbers	&987 . . 0
Hexadecimal numbers	$FED . . 0
String literals	'foo'
Offset registers	Z0 - Z7
Instruction pointer	*

Allowed operators are:

Addition	+ (plus)
Subtraction	- (minus)
Multiply	* (asterisk)
Divide	/ (slash)
Shift left	<< (left angle brackets)

Shift right	>> (right angle brackets)
Bitwise OR	! (exclamation mark)
Bitwise AND	& (ampersand)
Modulus	% (percent)
Exponential	^ (circumflex)
One's Complement	~ (tilde)

The order of evaluation is strictly left to right with no precedence granted to some operators over others. The only exception to this is when you force the order of precedence through the use of parenthesis.

The order of parsing algebraic expressions is:

OPERAND OPERATOR OPERAND OPERATOR...

with a possible left or right parenthesis.

The parsing order allows the assembler to properly interpret characters. For example, the "*" which represents both multiply and instruction pointer, is interpreted as:

***	IP * IP
+	IP + IP
2**	2 * IP
*&&16	IP AND &16

WORD Define Constant Directive

The format for the WORD directive is:

WORD 32-bit-operand

The function of this directive is to define a constant in memory. The WORD directive can have only one operand (32-bit value) which can contain the actual value (decimal, hexadecimal, or ASCII). Alternatively, the operand can be an expression which can be assigned a numeric value by the assembler. An ASCII string is recognized when characters are enclosed inside single quotes (' '). Each character (seven bits) is assigned

to a byte of memory, with the eighth bit (MSB) always equal to zero. If only one byte is entered, the byte is right justified. Any number of ASCII characters may be entered for each WORD directive, and the characters are right justified, but truncation occurs after four characters.

An ASCII string which contains spaces may not be used as an argument to the WORD directive, even if the string is enclosed inside single quotes. In this case, the **mm** command may be used in place of the assembler's WORD directive. Note that to use **mm**, the one-line assembler must be exited.

The following example illustrates the Assembler Error which will occur if the user attempts to enter a string containing spaces using the WORD directive. Following the error is an example of the use of the **mm** command to put the string into memory instead.

```
PPC1-Bug>as 80000
```

user enters **WORD 'abcd'**, *which works fine*

```
00080000 61626364  ORI         R2,R11,$6364
```

user enters **WORD 'ab d'**, *which is invalid*

```
00080004 00000000  WORD        $00000000? WORD 'ab d'
Assembler Error: Operand Conversion
```

exit the one-line assembler

```
00080004 00000000  WORD        $00000000? .
```

use **mm** *command instead*

```
PPC1-Bug>mm 80004
00080004 00000000? 'ab d'
00080008 00000000? .
```

verify this using **md** *command*

```
PPC1-Bug>md 80000:4
00080000  61626364 61622064 00000000 00000000  abcdab d........
```

SYSCALL System Call Directive

The function of this directive is to aid you in making the appropriate system call entry to the debugger system call routines. The format for this directive is:

SYSCALL <.ROUTINE>

This is assembled as:

```
ADDI R10,R0,$XXXX
SC
```

Where *$XXXX* is the 16-bit code for the system call routine.

Refer to Chapter 5, *System Calls*, for information on the system call routines.

Entering and Modifying Source Programs

User programs are entered into the memory using the one-line assembler/disassembler. The program is entered in assembly language statements on a line-by-line basis. The source code is not saved as it is converted immediately to machine code upon entry. This imposes several restrictions on the type of source line that can be entered.

Symbols and labels, other than the defined instruction mnemonics, are not allowed. The assembler has no means to store the associated values of the symbols and labels in lookup tables. This forces the programmer to use memory addresses and to enter data directly rather than use labels.

Also, editing is accomplished by retyping the entire new source line. Lines can be added or deleted by moving a block of memory data to free up or delete the appropriate number of locations (refer to the **BM** command in Chapter 3, *Debugger Commands*).

Invoking the Assembler/Disassembler

Use either the **MM** command or the **AS** command for program entry and modification.

MM *ADDR* **;DI**

or

AS *ADDR*

When either the **MM** or **AS** command is used, the memory contents at the specified location are disassembled and displayed. A new or modified line can be entered if desired. The disassembled line can be a PowerPC

instruction or a WORD directive. If the disassembler recognizes a valid form of some instruction, the instruction will be returned; if not (random data occurs), the WORD $XXXXXXXX (always hexadecimal) is returned. Because the disassembler gives precedence to instructions, a word of data that corresponds to a valid instruction will be returned as the instruction.

Entering a Source Line

A new source line is entered immediately following the disassembled line, using the format discussed in the section on Source Line Format:

```
PPC1-Bug>AS 20000 <CR>
00020000 3C600004  ADDIS       R3,R0,$4? ORI R3,R0,4 <CR>
```

When the carriage return is entered terminating the line, the old source line is erased from the terminal screen, the new line is assembled and displayed, and the next instruction in memory is disassembled and displayed.

```
00020000 60030004  ORI         R3,R0,$4
00020004 60631000  ORI         R4,R4,$1000? <Return>
```

If a printer is being used, port 0 should be reconfigured as the printer port (hardcopy mode) for proper operation (refer to the **PF** command in Chapter 3). In this case, the above example would look as follows:

```
PPC1-Bug>AS 20000 <Return>
00020000 3C600004  ADDIS       R3,R0,$4? ORI R3,R0,4 <Return>
00020000 60030004  ORI         R3,R0,$4
00020004 60631000  ORI         R4,R4,$1000? <CR>
```

Another program line can now be entered. Program entry continues in like manner until all lines have been entered.

Enter a period to exit either the **MM** or **AS** command.

If an error is encountered during assembly of the new line, an error message will be displayed. The location being accessed is redisplayed.

```
PPC1-Bug>AS 30000 <CR>
00030000 3CA00000  ADDIS       R5,R0,$0? ORU R5,R0,1 <Return>
Assembler Error: Unknown Mnemonic
00030000 3CA00000  ADDIS       R5,R0,$0?
```

Entering Branch Operands

In the case of forward branches, the absolute address of the destination may not be known as the program is being entered. You may temporarily enter an asterisk (*****) for branch to self in order to reserve space. After the actual address is discovered, the line containing the branch instruction can be re-entered using the correct value.

Branch operands are interpreted as signed hexadecimal numbers.

Assembler Output/Program Listings

Obtain a listing of the program with either the **MD** command or **DS** command.

MD *ADDR*[**:***COUNT* | *ADDR*] **;DI**

or

DS *ADDR*[**:***COUNT* | *ADDR*]

Both MD and DS commands require the starting address to be entered in the command line. When the MD command is invoked with the **DI** option, the number of instructions disassembled and displayed is equal to the line count. The line count parameter is optional and defaults to the eight instructions displayed.

To obtain a hardcopy listing of a program, use the **PA** (Printer Attach) command to activate the printer port, and then use **MD** to display the listing on the terminal and print it on the printer.

Note again, that the listing may not correspond exactly to the program as entered. As discussed in the section on the Disassembled Source Line, the disassembler displays in signed hexadecimal any number it interprets as an offset from a register; all other numbers are displayed in unsigned hexadecimal.

Assembler Error Messages

The following is a list of the assembler error messages:

```
An Operand has a Length of Zero

Unknown Mnemonic

Excessive Operand(s)

Missing Operand(s)

Operand Type Not Found

Operand Prefix

Operand Address Misalignment

Operand Displacement

Operand Sign Extension

Operand Data Field Overflow

Operand Conversion
```

System Calls 5

Introduction

This chapter describes the PPCBug System Call handler, which allows system calls from user programs. The system calls can be used to access selected functional routines contained within the debugger, including input and output routines. The System Call handler may also be used to transfer control to the debugger at the end of a user program (refer to *.RETURN* in this section for more information).

In the descriptions of some input and output functions, reference is made to the default input port or the default output port. After power-up or reset, the default input and output port is initialized to be port 0 (the debug port). The defaults may be changed, however, using the .REDIR_I and .REDIR_O functions.

Invoking System Calls

The System Call handler is accessible through the **SC** (system call) instruction, with exception vector $00C00 (System Call Exception).

To invoke a system call from a user program, insert the following code into the source program. The code corresponding to the particular system routine is specified in register R10. Parameters are passed and returned in registers R3 to R*n*, where *n* is less than 10.

ADDI R10,R0,$*XXXX*

SC

$*XXXX* is the 16-bit code for the system call routine, and **SC** is the system call instruction (system call to the debugger). Register R10 is set to $0000*XXXX*.

Refer to Chapter 4, *One-Line Assembler/ Disassembler* for information on using the SYSCALL system call instruction in the One-line Assembler.

String Formats for I/O

Within the context of the System Call handler there are two formats for strings:

Pointer/Pointer Format	The string is defined by a pointer to the first character and a pointer to the last character + 1.
Pointer/Count Format	The string is defined by a pointer to a count byte, which contains the count of characters in the string, followed by the string itself.

A line is defined as a string followed by a carriage return and a line feed (**<CR><LF>**).

System Call Routines

The system call routines are described in this chapter, in order by the 16-bit hex code. Table 5-1 list the routines in code order; Table 5-2 lists them in alphabetical order.

On entry to firmware system call routines, the machine state is saved so that a subsequent abort or break condition allows you to resume if you wish.

Table 5-1. System Call Routines -- Hex Code Order

Code	Routine	Description
$0000	.INCHR	Input character
$0001	.INSTAT	Input serial port status
$0002	.INLN	Input line (pointer/pointer format)
$0003	.READSTR	Input string (pointer/count format)
$0004	.READLN	Input line (pointer/count format)
$0005	.CHKBRK	Check for break
$0010	.DSKRD	Disk read

Table 5-1. System Call Routines -- Hex Code Order (Continued)

Code	Routine	Description
$0011	.DSKWR	Disk write
$0012	.DSKCFIG	Disk configure
$0014	.DSKFMT	Disk format
$0015	.DSKCTRL	Disk control
$0018	.NETRD	Read/get from host
$0019	.NETWR	Write/send to host
$001A	.NETCFIG	Configure network parameters
$001B	.NETFOPN	Open file for reading
$001C	.NETFRD	Retrieve specified file blocks
$001D	.NETCTRL	Implement special control functions
$0020	.OUTCHR	Output character
$0021	.OUTSTR	Output string (pointer/pointer format)
$0022	.OUTLN	Output line (pointer/pointer format)
$0023	.WRITE	Output string (pointer/count format)
$0024	.WRITELN	Output line (pointer/count format)
$0025	.WRITDLN	Output line with data (pointer/count format)
$0026	.PCRLF	Output carriage return and line feed
$0027	.ERASLN	Erase line
$0028	.WRITD	Output string with data (pointer/count format)
$0029	.SNDBRK	Send break
$0043	.DELAY	Timer delay function
$0050	.RTC_TM	Time initialization for RTC
$0051	.RTC_DT	Date initialization for RTC
$0052	.RTC_DSP	Display RTC time and date
$0053	.RTC_RD	Read the RTC Registers
$0060	.REDIR	Redirect I/O of a System Call function
$0061	.REDIR_I	Redirect input
$0062	.REDIR_O	Redirect output
$0063	.RETURN	Return to PPCBug

Table 5-1. System Call Routines -- Hex Code Order (Continued)

Code	Routine	Description
$0064	.BINDEC	Convert binary to Binary Coded Decimal (BCD)
$0067	.CHANGEV	Parse value
$0068	.STRCMP	Compare two strings (pointer/count format)
$0069	.MULU32	Multiply two 32-bit unsigned integers
$006A	.DIVU32	Divide two 32-bit unsigned integers
$006B	.CHK_SUM	Generate checksum
$0070	.BRD_ID	Return pointer to board ID packet
$0071	.ENVIRON	Access boot environment parameters
$0073	.PFLASH	Program FLASH memory
$0074	.DIAGFCN	Diagnostic function(s)
$0090	.SIOPEPS	Retrieve SCSI pointers
$0100	.FORKMPU	Fork MPU
$0101	.FORKMPUR	Fork Idle MPU with Register Set
$0110	.IDLEMPU	Idle MPU
$0120	.IOINQ	Port Inquire
$0124	.IOINFORM	Port Inform
$0128	.IOCONFIG	Port Configure
$012C	.IODELETE	Port Delete
$0130	.SYMBOLTA	Attach Symbol Table
$0131	.SYMBOLTD	Detach Symbol Table

Table 5-2. System Call Routines -- Alphabetical Order

Routine	Code	Description
.BINDEC	$0064	Convert binary to Binary Coded Decimal (BCD)
.BRD_ID	$0070	Return pointer to board ID packet
.CHANGEV	$0067	Parse value
.CHK_SUM	$006B	Generate checksum
.CHKBRK	$0005	Check for break

Table 5-2. System Call Routines -- Alphabetical Order

Routine	Code	Description
.DELAY	$0043	Timer delay function
.DIAGFCN	$0074	Diagnostic function(s)
.DIVU32	$006A	Divide two 32-bit unsigned integers
.DSKCFIG	$0012	Disk configure
.DSKCTRL	$0015	Disk control
.DSKFMT	$0014	Disk format
.DSKRD	$0010	Disk read
.DSKWR	$0011	Disk write
.ENVIRON	$0071	Access boot environment parameters
.ERASLN	$0027	Erase line
.FORKMPU	$0100	Fork MPU
.FORKMPUR	$0101	Fork Idle MPU with Register Set
.IDLEMPU	$0110	Idle MPU
.INCHR	$0000	Input character
.INLN	$0002	Input line (pointer/pointer format)
.INSTAT	$0001	Input serial port status
.IOCONFIG	$0128	Port Configure
.IODELETE	$012C	Port Delete
.IOINFORM	$0124	Port Inform
.IOINQ	$0120	Port Inquire
.MULU32	$0069	Multiply two 32-bit unsigned integers
.NETCFIG	$001A	Configure network parameters
.NETCTRL	$001D	Implement special control functions
.NETFOPN	$001B	Open file for reading
.NETFRD	$001C	Retrieve specified file blocks
.NETRD	$0018	Read/get from host
.NETWR	$0019	Write/send to host
.OUTCHR	$0020	Output character
.OUTLN	$0022	Output line (pointer/pointer format)

Table 5-2. System Call Routines -- Alphabetical Order

Routine	Code	Description
.OUTSTR	$0021	Output string (pointer/pointer format)
.PCRLF	$0026	Output carriage return and line feed
.PFLASH	$0073	Program FLASH memory
.READLN	$0004	Input line (pointer/count format)
.READSTR	$0003	Input string (pointer/count format)
.REDIR	$0060	Redirect I/O of a System Call function
.REDIR_I	$0061	Redirect input
.REDIR_O	$0062	Redirect output
.RETURN	$0063	Return to PPCBug
.RTC_DSP	$0052	Display RTC time and date
.RTC_DT	$0051	Date initialization for RTC
.RTC_RD	$0053	Read the RTC Registers
.RTC_TM	$0050	Time initialization for RTC
.SIOPEPS	$0090	Retrieve SCSI pointers
.SNDBRK	$0029	Send break
.STRCMP	$0068	Compare two strings (pointer/count format)
.SYMBOLTA	$0130	Attach Symbol Table
.SYMBOLTD	$0131	Detach Symbol Table
.WRITD	$0028	Output string with data (pointer/count format)
.WRITDLN	$0025	Output line with data (pointer/count format)
.WRITE	$0023	Output string (pointer/count format)
.WRITELN	$0024	Output line (pointer/count format)

.INCHR

Name

.INCHR - Input character routine

Code

$0000

Description

.INCHR reads a character from the default input port. The character is returned in the LSB of R03.

Entry Conditions

None

Exit Conditions Different From Entry

R03: bits 7 through 0 contain the character returned
R03: bits 31 through 8 are zero.

.INSTAT

Name

.INSTAT - Input serial port status routine

Code

$0001

Description

.INSTAT is used to see if there are characters in the default input port buffer. R03 is set to indicate the result of the operation.

Entry Conditions

No arguments required

Exit Conditions Different From Entry

R03: Bit 3 (ne) = 1; Bit 2 (eq) = 0 if the receiver buffer is not empty.
R03: Bit 3 (ne) = 0; Bit 2 (eq) = 1 if the receiver buffer is empty.

.INLN

Name

.INLN - Input line routine

Code

$0002

Description

.INLN is used to read a line from the default input port. The buffer size should be at least 256 bytes.

Entry Conditions

R03: 32-bit address of string buffer

Exit Conditions Different From Entry

R03: Address of last character in the string+1

Note A line is a string of characters terminated by a **<CR>**. The maximum allowed size is 254 characters. The terminating **<CR>** is not considered part of the string, but it is returned in the buffer, that is, the returned pointer points to it. The control characters described in the section *Control Characters* in Chapter 2 are in effect.

.READSTR

Name

.READSTR - Read string into variable-length buffer

Code

$0003

Description

.READSTR is used to read a string of characters from the default input port into a buffer. On entry, the first byte in the buffer indicates the maximum number of characters that can be placed in the buffer. The buffer size should at least be equal to that number+2. The maximum number of characters that can be placed in a buffer is 254 characters. On exit, the count byte indicates the number of characters in the buffer. Input terminates when a **<CR>** is received. A null character appears in the buffer, although it is not included in the string count. All printable characters are echoed to the default output port. The **<CR>** is not echoed. Some control character processing is done:

^G	Bell	Echoed
^X	Cancel line	Line is erased
^H	Backspace	Last character is erased
<DEL>	Same as backspace	Last character is erased
<LF>	Line Feed	Echoed
<CR>	Carriage Return	Terminates input

All other control characters are ignored

Entry Conditions

R03: 32-bit address of input buffer

Exit Conditions Different From Entry

The count byte contains the number of bytes in the buffer.

Note This routine allows the caller to dictate the maximum length of input to be less than 254 characters. If more characters are entered, then the buffer input is truncated. Use the control characters described in *Disk I/O Support* for more details.

.READLN

Name

.READLN - Read line to fixed-length buffer

Code

$0004

Description

.READLN is used to read a string of characters from the default input port. Characters are echoed to the default output port. A string consists of a count byte followed by the characters read from the input. The count byte indicates the number of characters in the input string, excluding the **<CR><LF>** sequence. A string may be up to 254 characters.

Entry Conditions

R03: 32-bit address of input buffer

Exit Conditions Different From Entry

The first byte in the buffer indicates the string length.

Note The caller must allocate 256 bytes for a buffer. Input may be up to 254 characters. A **<CR><LF>** sequence is sent to default output following echo of input. The control characters described in the section *Control Characters* in Chapter 2 are in effect.

.CHKBRK

Name

.CHKBRK - Check for break

Code

$0005

Description

.CHKBRK alters R03 according to a break status being detected at the default input port.

Entry Conditions

No arguments required

Exit Conditions Different From Entry

R03: Bit 3 (ne) = 1; Bit 2 (eq) = 0 if break status is not detected.
R03: Bit 3 (ne) = 0; Bit 2 (eq) = 1 if break status is detected.

.DSKRD
.DSKWR

Name

.DSKRD - Disk read routine

.DSKWR - Disk write routine

Codes

\$0010

\$0011

Description

These routines are used to read and write blocks of data from/to the specified disk or tape device. Information about the data transfer is passed in a command packet which has been built somewhere in memory. (The user program must first manually prepare the packet.) The address of the packet is passed as an argument to the routine. The same command packet format is used for .DSKRD and .DSKWR. It is eight half-words in length and is arranged as follows:

	F E D C B A 9 8	7 6 5 4 3 2 1 0
\$00	Controller LUN	Device LUN
\$02	Status Half-Word	
\$04	Memory Address	Most Significant Half-Word
\$06		Least Significant Half-Word
\$08	Block Number (Disk) or	Most Significant Half-Word
\$0A	File Number (Tape)	Least Significant Half-Word
\$0C	Number of Blocks	
\$0E	Flag Byte	Address Modifier

Field descriptions:

Controller LUN	Logical Unit Number (LUN) of controller to use
Device LUN	Logical Unit Number (LUN) of device to use
Status Half-Word	This status half-word reflects the result of the operation. It is zero if the command completed without errors. Refer to Appendix F for meanings of returned error codes.
Memory Address	Address of buffer in memory. On a disk read, data is written starting at this address. On a disk write, data is read starting at this address.
Block Number	For disk devices, this is the block number where the transfer starts. On a disk read, data is read starting at this block. On a disk write, data is written starting at this block.
File Number	For streaming tape devices, this is the file number where the transfer starts. This field is used if the IFN bit in the Flag Byte is cleared (refer to the Flag Byte description below). On a disk read, data is read starting at this file. On a disk write, data is written starting at this file.
Number of Blocks	The number of blocks to read from the disk (**.DSKRD**) or to write to the disk (**.DSKWR**). For streaming tape devices, the actual number of blocks transferred is returned in this field.
Flag Byte	The flag byte is used to specify variations of the same command, and to receive special status information. Bits 0 through 3 are used as command bits, and bits 4 through 7 are used as status bits. For disk devices, this field must be set to zero. For streaming tape devices, the following bits are defined: Bit 7 Filemark flag. If 1, a filemark was detected at the end of the last operation. Bit 1 Ignore File Number (IFN) flag. If 0, the file number field is used to position the tape before any reads or writes are done. If 1, the file number field is ignored, and reads or writes start at the present tape position.

Bit 0	End of File flag. If 0, reads or writes are done until the specified block count is exhausted. If 1, reads are done until the count is exhausted or until a filemark is found. If 1, writes are terminated with a filemark.
Address Modifier	VMEbus address modifier to use while transferring data. If zero, a default value is selected by the debugger. If nonzero, the specified value is used.

Entry Conditions

R03: 32-bit address of command packet

Exit Conditions Different From Entry

Status half-word of command packet is updated. Data is written into memory as a result of .DSKRD routine. Data is written to disk as a result of .DSKWR routine.

R03: Bit 3 (ne) = 1; Bit 2 (eq) = 0 if errors.
R03: Bit 3 (ne) = 0; Bit 2 (eq) = 1 if no errors.

.DSKCFIG

Name

.DSKCFIG - disk configure routine

Code

$0012

Description

This routine allows you to change the configuration of the specified device. It effectively performs the **IOT** command under program control. Refer to Table E-2 for information on formatting floppy disks.

All the required parameters are passed in a command packet which has been built somewhere in memory. The address of the packet is passed as an argument to the routine. Refer to *Command Packet on page 5-17*.

Entry Conditions

R03: 32-bit address of command packet

Exit Conditions Different From Entry

Status half-word of command packet is updated. The device configuration is changed.

R03: Bit 3 (ne) = 1; Bit 2 (eq) = 0 if errors.
R03: Bit 3 (ne) = 0; Bit 2 (eq) = 1 if no errors.

Command Packet

The command packet format is as follows:

	F E D C B A 9 8	7 6 5 4 3 2 1 0
$00	Controller LUN	Device LUN
$02	Status Half-Word	
$04	Memory Address	Most Significant Half-Word
$06		Least Significant Half-Word
$08	0	

	F E D C B A 9 8	7 6 5 4 3 2 1 0
$00	Controller LUN	Device LUN
$02	Status Half-Word	
$04	Memory Address	Most Significant Half-Word
$06		Least Significant Half-Word
$0A	0	
$0C	0	
$0E	0	Address Modifier

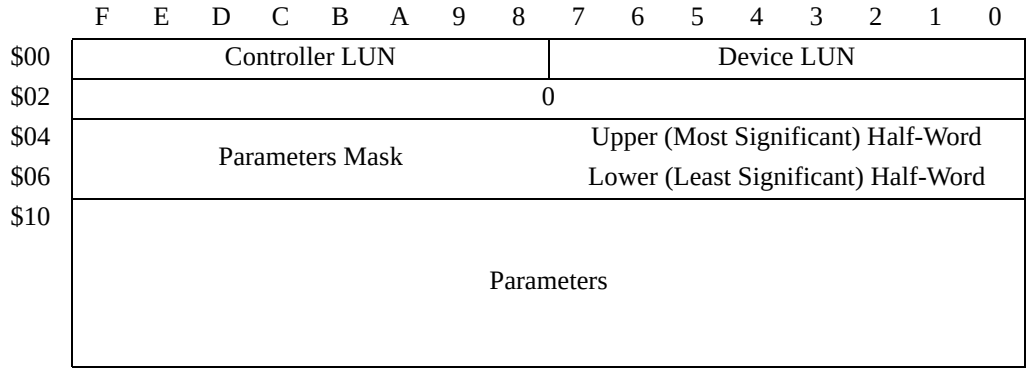
Field descriptions:

Controller LUN	Logical Unit Number (LUN) of controller to use
Device LUN	Logical Unit Number (LUN) of device to use
Status Half-Word	This status half-word reflects the result of the operation. It is zero if the command completed without errors. Refer to Appendix F for meanings of returned error codes.
Memory Address	Contains a pointer to a Device Descriptor Packet that contains the configuration information to be changed
Address Modifier	VMEbus address modifier to use while transferring data. If zero, a default value is selected by the debugger. If nonzero, the specified value is used.

Device Descriptor Packet

The Device Descriptor Packet is as follows:

	F E D C B A 9 8	7 6 5 4 3 2 1 0
$00	Controller LUN	Device LUN
$02	0	
$04	Parameters Mask	Upper (Most Significant) Half-Word
$06		Lower (Least Significant) Half-Word
$08	Attributes Mask	Upper (Most Significant) Half-Word
$0A		Lower (Least Significant) Half-Word
$0C	Attributes Flags	Upper (Most Significant) Half-Word
$0E		Lower (Least Significant) Half-Word



Most of the fields in the Device Descriptor Packet are equivalent to the fields defined in the Configuration Area block (CFGA). In the field descriptions following, reference is made to the equivalent field in the CFGA whenever possible. For additional information on these fields, refer to tables in *Configuration Area Block CFGA Fields* on page 5-22.

Controller LUN	Same as in command packet
Device LUN	Same as in command packet
Parameters Mask	Equivalent to the IOSPRM and IOSEPRM fields, with the lower half-word equivalent to IOSPRM, and the upper half-word equivalent to IOSEPRM
Attributes Mask	Equivalent to the IOSATM and IOSEATM fields, with the lower half-word equivalent to IOSATM, and the upper half-word equivalent to IOSEATM
Attributes Flags	Equivalent to the IOSATW and IOSEATW fields, with the lower half-word equivalent to IOSATW, and the upper half-word equivalent to IOSEATW
Parameters	The parameters used for device reconfiguration are specified in this area. Most parameters have an *exact* CFGA equivalent.

The Disk Packet Parameters are shown in the following table. The parameters that do not have an exact equivalent CFGA field are indicated with an asterisk (*).

Table 5-3. Disk Packet Parameters

Parameter	Offset (Bytes)	Length (Bytes)	CFGA Equivalent	Description
P_DDS*	$10	1	N/A	Device descriptor size. For internal use only, this field does not have an equivalent CFGA field. It should be set to 0.
P_DSR	$11	1	IOSSR	Step rate (encoded). Refer to the IOSSR field in Table 5-8 for step rate code values.
P_DSS*	$12	1	IOSPSM	Sector size, encoded as follows (IOSPSM is a two-byte field containing the actual sector size): $00 128 bytes $01 256 bytes $02 512 bytes $03 1024 bytes $04-$FF Reserved encodings
P_DBS*	$13	1	IOSREC	Record (Block) size, encoded as follows (IOSREC is a two-byte field containing the actual block size): $00 128 bytes $01 256 bytes $02 512 bytes $03 1024 bytes
P_DST*	$14	2	IOSSPT	Sectors per track; P_DST is a two byte field, IOSSPT is a one-byte field.
P_DIF	$16	1	IOSILV	Interleave factor
P_DSO	$17	1	IOSSOF	Spiral offset
P_DSH*	$18	1	IOSSHD	Starting head; This field is equivalent to the lower byte of IOSSHD.
P_DNH	$19	1	IOSHDS	Number of heads

Table 5-3. Disk Packet Parameters

Parameter	Offset (Bytes)	Length (Bytes)	CFGA Equivalent	Description
P_DNCYL	$1A	2	IOSTRK	Number of cylinders
P_DPCYL	$1C	2	IOSPCOM	Precompensation cylinder
P_DRWCYL	$1E	2	IOSRWCC	Reduced write current cylinder
P_DECCB	$20	2	IOSECC	ECC data burst length
P_DGAP1	$22	1	IOSGPB1	Gap 1 size
P_DGAP2	$23	1	IOSGPB2	Gap 2 size
P_DGAP3	$24	1	IOSGPB3	Gap 3 size
P_DGAP4	$25	1	IOSGPB4	Gap 4 size
P_DSSC	$26	1	IOSSSC	Spare sectors count
P_DRUNIT	$27	1	IOSRUNIT	Reserved area units
P_DRCALT	$28	2	IOSRSVC1	Reserved count 1 (for alternate mapping area)
P_DRCCTR	$2A	2	IOSRSVC2	Reserved count 2 (for controller)

Configuration Area Block CFGA Fields

Attribute Mask -- IOSATM and IOSEATM

The IOSATM field bits are defined in the following table: A 1 in a particular bit position indicates that the corresponding attribute from the attributes (or extended attributes) word should be used to update the configuration. A 0 in a bit position indicates that the current attribute should be retained.

Table 5-4. IOSATM Fields (CFGA)

Label	Bit Position	Description
IOADDEN	0	Data density
IOATDEN	1	Track density
IOADSIDE	2	Single/double sided
IOAFRMT	3	Floppy disk format
IOARDISC	4	Disk type
IOADDEND	5	Drive data density
IOATDEND	6	Drive track density
IOARIBS	7	Embedded servo drive seek
IOADPCOM	8	Post-read/pre-write precompensation
IOASIZE	9	Floppy disk size
IOATKZD	13	Track zero data density

All IOSEATM bits are undefined and should be set to 0.

Parameter Mask -- IOSPRM and IOSEPRM

The IOSPRM and IOSEPRM bits are defined in the following tables. A 1 in a particular bit position indicates that the corresponding parameter from the configuration area (CFGA) should be used to update the device configuration. A 0 in a bit position indicates that the parameter value in the current configuration will be retained.

Table 5-5. IOSPRM Fields (CFGA)

Label	Bit Position	Description
IOSRECB	0	Operating system block size
IOSSPTB	4	Sectors per track
IOSHDSB	5	Number of heads
IOSTRKB	6	Number of cylinders
IOSILVB	7	Interleave factor
IOSSOFB	8	Spiral offset
IOSPSMB	9	Physical sector size
IOSSHDB	10	Starting head number
IOSPCOMB	12	Precompensation cylinder number
IOSSRB	14	Step rate code
IOSRWCCB	15	Reduced write current cylinder number and ECC data burst length

Table 5-6. IOSEPRM Fields (CFGA)

Label	Bit Position	Description
IOAGPB1	0	Gap byte 1
IOAGPB2	1	Gap byte 2
IOAGPB3	2	Gap byte 3
IOAGPB4	3	Gap byte 4
IOASSC	4	Spare sector count
IOARUNIT	5	Reserved area units
IOARVC1	6	Reserved count 1
IOARVC2	7	Reserved count 2

Attribute Word -- IOSATW and IOSEATW

IOSATW contains various flags that specify characteristics of the media and drive, which are defined in the following table. All unused bits must be set to 0. All IOSEATW bits are undefined and should be set to 0.

Table 5-7. IOSATW Fields (CFGA)

Bit Number	Description	
Bit 0	Data density:	0 = Single density (FM encoding) 1 = Double density (MFM encoding)
Bit 1	Track density:	0 = Single density (48 TPI) 1 = Double density (96 TPI)
Bit 2	Number of sides:	0 = Single sided floppy 1 = Double sided floppy
Bit 3	Floppy disk format: (sector numbering)	0 = Motorola format 1 to *n* on side 0 *n*+1 to 2*n* on side 1 1 = Standard IBM format 1 to *n* on both sides
Bit 4	Disk type:	0 = Floppy disk 1 = Hard disk
Bit 5	Drive data density:	0 = Single density (FM encoding) 1 = Double density (MFM encoding)
Bit 6	Drive track density:	0 = Single density 1 = Double density
Bit 8	Post-read/pre-write precompensation:	0 = Pre-write 1 = Post-read
Bit 9	Floppy disk size:	0 = 3 1/2 and 5 1/4 inch floppy 1 = 8-inch floppy
Bit 13	Track zero density:	0 = Single density (FM encoding) 1 = Same as remaining tracks

Table 5-8. CFGA Fields

<table>
<tr><th></th><th>Parameter</th><th>Description</th></tr>
<tr><td>IOSREC</td><td>Record (Block) size</td><td>Number of bytes per record (block). Must be an integer multiple of the physical sector size.</td></tr>
<tr><td>IOSSPT</td><td>Sectors per track</td><td>Number of sectors per track.</td></tr>
<tr><td>IOSHDS</td><td>Number of heads</td><td>Number of recording surfaces for the specified device.</td></tr>
<tr><td>IOSTRK</td><td>Number of cylinders</td><td>Number of cylinders on the media.</td></tr>
<tr><td>IOSILV</td><td>Interleave factor</td><td>This field specifies how the sectors are formatted on a track. Normally, consecutive sectors in a track are numbered sequentially in increments of 1 (interleave factor of 1). The interleave factor controls the physical separation of logically sequential sectors. This physical separation gives the host time to prepare to read the next logical sector without requiring the loss of an entire disk revolution.</td></tr>
<tr><td>IOSPSM</td><td>Physical sector size</td><td>Actual number of bytes per sector on media.</td></tr>
<tr><td>IOSSOF</td><td>Spiral offset</td><td>Used to displace the logical start of a track from the physical start of a track. The displacement is equal to the spiral offset times the head number, assuming that the first head is 0. This displacement is used to give the controller time for a head switch when crossing tracks.</td></tr>
<tr><td>IOSSHD</td><td>Starting head number</td><td>The first head number for the device.</td></tr>
<tr><td>IOSPCOM</td><td>Precompensation cylinder</td><td>The cylinder on which precompensation begins.</td></tr>
<tr><td>IOSSR</td><td>Step</td><td>The rate at which the read/write heads can be moved when seeking a track on the disk. The encoding is as follows:
<table>
<tr><th>Step Rate Code</th><th>Winchester Hard Disks</th><th>3-1/2 Inch/ 5-1/4 Inch Floppy</th><th>8-Inch Floppy</th></tr>
<tr><td>$00</td><td>0 msec</td><td>12 msec</td><td>6 msec</td></tr>
<tr><td>$01</td><td>6 msec</td><td>6 msec</td><td>3 msec</td></tr>
<tr><td>$02</td><td>10 msec</td><td>12 msec</td><td>6 msec</td></tr>
<tr><td>$03</td><td>15 msec</td><td>20 msec</td><td>10 msec</td></tr>
<tr><td>$04</td><td>20 msec</td><td>30 msec</td><td>15 msec</td></tr>
</table></td></tr>
<tr><td>IOSRWCC</td><td>Reduced write current cylinder</td><td>The cylinder number at which the write current should be reduced when writing to the drive. This parameter is normally specified by the drive manufacturer.</td></tr>
</table>

Table 5-8. CFGA Fields

	Parameter	Description
IOSECC	ECC data burst length	The number of bits to correct for an ECC error when supported by the disk controller.
IOSGPB1	Gap byte 1	The number of words of zeros that are written before the header field in each sector during format.
IOSGPB2	Gap byte 2	The number of words of zeros that are written between the header and data fields during format and write commands.
IOSGPB3	Gap byte 3	The number of words of zeros that are written after the data fields during format commands.
IOSGPB4	Gap byte 4	The number of words of zeros that are written after the last sector of a track and before the index pulse.
IOSSSC	Spare sectors count	The number of sectors per track allocated as spare sectors. These sectors are only used as replacements for bad sectors on the disk.
IOSRUNIT	Reserved area units	The unit of measurement used for IOSRSVC1 and IOSRSVC2. If zero, the units are in tracks; if 1, the units are in cylinders.
IOSRSVC1	Reserved count 1	The number of tracks (IOSRUNIT = 0), or the number of cylinders (IOSRUNIT = 1) reserved for the alternate mapping area on the disk.
IOSRSVC2	Reserved count 2	The number of tracks (IOSRUNIT = 0), or the number of cylinders (IOSRUNIT = 1) reserved for use by the controller.

.DSKFMT

Name

.DSKFMT - Disk format routine

Code

$0014

Description

This routine allows you to send a format command to the specified device. The parameters required for the command are passed in a command packet which has been built somewhere in memory. The address of the packet is passed as an argument to the routine. The format of the packet is as follows:

	F E D C B A 9 8	7 6 5 4 3 2 1 0
$00	Controller LUN	Device LUN
$02	Status Half-Word	
$04	Memory Address	Most Significant Half-Word
$06		Least Significant Half-Word
$08	Disk Block Number	Most Significant Half-Word
$0A		Least Significant Half-Word
$0C	0	
$0E	Flag Byte	Address Modifier

Field descriptions:

Controller LUN	Logical Unit Number (LUN) of controller to use
Device LUN	Logical Unit Number of device to use
Status Half-Word	This status half-word reflects the result of the operation. It is zero if the command completed without errors. Refer to Appendix F for meanings of returned error codes.

Memory Address	Address of buffer in memory. On disk read, data is written starting at this address. On disk write, data is read starting at this address. On disk format, this field does not apply.
Block Number	For disk devices, when doing a format track, the track that contains this block number is formatted. This field is ignored for streaming tape devices.
Flag Byte	Contains additional information. Bit 0 is interpreted as follows for disk devices: If 0, it indicates a Format Track operation. The track that contains the specified block is formatted. If 1, it indicates a Format Disk operation. All the tracks on the disk are formatted. For streaming tapes, bit 0 is interpreted as follows: If 0, it selects a Retension Tape operation. This rewinds the tape to BOT, advances the tape without interruptions to EOT, and then rewinds it back to BOT. Tape retension is recommended by cartridge tape suppliers before writing or reading data when a cartridge has been subjected to a change in environment or a physical shock, has been stored for a prolonged period of time or at extreme temperature, or has been previously used in a start/stop mode. If 1, it selects an Erase Tape operation. This completely clears the tape of previous data and at the same time retensions the tape.
Address Modifier	VMEbus address modifier to use while transferring data. If zero, a default value is selected by the debugger. If nonzero, the specified value is used.

Entry Conditions

R03: 32-bit address of command packet

Exit Conditions Different From Entry

Status half-word of command packet is updated.

R03: Bit 3 (ne) = 1; Bit 2 (eq) = 0 if errors.
R03: Bit 3 (ne) = 0; Bit 2 (eq) = 1 if no errors.

.DSKCTRL

Name

.DSKCTRL - Disk control routine

Code

$0015

Description

This routine is used to implement any special device control routines that cannot be accommodated easily with any of the other disk routines. At the present, the only defined routine is SEND packet, which allows you to send a packet in the specified format of the controller. The required parameters are passed in a command packet which has been built somewhere in memory. The address of the packet is passed as an argument to the routine.

The packet is as follows:

	F E D C B A 9 8	7 6 5 4 3 2 1 0
$00	Controller LUN	Device LUN
$02	Status Half-Word	
$04	Memory Address	Most Significant Half-Word
$06		Least Significant Half-Word
$08	0	
$0A	0	
$0C	0	
$0E	0	Address Modifier

Field descriptions:

Controller LUN	Logical Unit Number (LUN) of controller to use.
Device LUN	Logical Unit Number of device to use

Status Half-Word	This status half-word reflects the result of the operation. It is zero if the command completed without errors. Refer to Appendix F for meanings of returned error codes.
Memory Address	Contains a pointer to the controller packet to send. Note that the controller packet to send (as opposed to the command packet) is controller and device dependent. Information about this packet should be found in the user's manual for the controller and device being accessed.
Address Modifier	VMEbus address modifier to use while transferring data. If zero, a default value is selected by the debugger. If nonzero, the specified value is used.

Entry Conditions

R03: 32-bit address of command packet

Exit Conditions Different From Entry

Status half-word of command packet is updated. Additional side effects depend on the packet sent to the controller.

R03: Bit 3 (ne) = 1; Bit 2 (eq) = 0 if errors.
R03: Bit 3 (ne) = 0; Bit 2 (eq) = 1 if no errors.

.NETRD
.NETWR

Name

.NETRD - Read/get from host

.NETWR - Write/put to host

Code

\$0018/\$0019

Description

This routine is used to get files from the destination host over the specified network interface. The .NETWR system call is used to send files to the host. Information about the file transfer is passed in a command packet which has been built in memory. (The user program must first manually prepare the packet.) The address of the packet is passed as an argument to the routine. These routines basically behave the same as the **NIOP** command, but under program control. All packets must be word-aligned. The format of the packet structure, NIOPCALL, is shown below:

	F E D C B A 9 8	7 6 5 4 3 2 1 0
\$00	Controller LUN	Device LUN
\$02	Status Word	
\$04	Data Transfer Address	Most Significant Word
\$06		Least Significant Word
\$08	Maximum Length of Transfer	Most Significant Word
\$0A		Least Significant Word
\$0C	Byte Offset	Most Significant Word
\$0E		Least Significant Word
\$10	Transfer Time in Seconds (Status)	Most Significant Word
\$12		Least Significant Word
\$14	Transfer Byte Count (Status)	Most Significant Word
\$16		Least Significant Word
\$18	Boot Filename String	\$40(&64) Bytes
\$56		

Field descriptions:

Controller LUN	Logical Unit Number (LUN) of controller to use
Device LUN	Logical Unit Number of device to use
Status Word	This status word reflects the result of the operation. It is zero if the command completed without errors. Refer to Appendix H for meanings of returned error codes.
Data Transfer Address	Address of buffer in memory. On a read, data is read to (received to) starting at this address. On a write, data is written (sent) starting at this address.
Length of Transfer	The number of bytes from the data transfer address to transfer. A length of 0 specifies to transfer the entire file on a read. On a write the length must be set to the number of bytes to transfer.
Byte Offset	The offset into the file on a read. This permits users to wind into a file.
Transfer Time	The number of seconds that elapsed for the period of the data transfer. This field is status only and will be updated only on a successful data transfer.
Transfer Byte Count	This field is status only and will be updated only on a successful data transfer. If the length of transfer field is set to a non-zero value on a read and the desired file is smaller than the desired length, the length will be written to the actual number of bytes transferred, up to the desired length.
Boot Filename String	The name of the file to load/store. On a write the file must exist on the host system and also be writable (write permission). The filename string must be null terminated. The maximum length of the string is 64 bytes inclusive of the null terminator.

.NETCFIG

Name

.NETCFIG - Configure network parameters

Code

$001A

Description

This routine allows you to change the configuration parameters of the specified network interface. The .NETCFIG system call effectively performs a **NIOT** command under program control. All the required parameters are passed in a command packet which has been built in memory.

The address of the packet is passed as an argument to the routine. This packet contains the memory address (pointer) of the configuration parameters to/with you wish to update/change. The packet also contains a control flag field; this control flag specifies the configuration operation: read, write, or write to NVRAM. All packets must be word-aligned. The format for the packet structure, NIOTCALL, is shown below:

	F E D C B A 9 8	7 6 5 4 3 2 1 0
$00	Controller LUN	Device LUN
$02	Status Word	
$04	Network Configuration Parameters Pointer	Most Significant Word
$06		Least Significant Word
$08	Device Configuration Parameters Pointer	Most Significant Word
$0A		Least Significant Word
$0C	Control Flag	Most Significant Word
$0E		Least Significant Word

Field descriptions:

Controller LUN	Logical Unit Number (LUN) of controller to use
Device LUN	Logical Unit Number of device to use

Status Word	This status word reflects the result of the operation. It is zero if the command completed without errors. Refer to Appendix H for meanings of returned error codes.
Network Configuration Parameters Pointer	The location in memory of the network configuration parameters.
Device Configuration Parameters Pointer	The location in memory of the device configuration parameters. To date no device configuration parameters are used or needed.
Control Flag	The configuration parameters operation: read, write, or write to NVRAM. The control flag bit definitions are as follows: 0 Read configuration parameters. Pointer specifies destination. 1 Write (update) configuration parameters. Pointer specifies source. 2 Write (update) configuration parameters in NVRAM. Pointer specifies source.

The Network Configuration Parameters structure has the following format:

	F E D C B A 9 8 7 6 5 4 3 2 1 0	
$00	Packet Version/Identifier	Most Significant Word
$02		Least Significant Word
$04	Node Control Memory Address	Most Significant Word
$06		Least Significant Word
$08	Boot File Load Address	Most Significant Word
$0A		Least Significant Word
$0C	Boot File Execution Address	Most Significant Word
$0E		Least Significant Word
$10	Boot File Execution Delay	Most Significant Word
$12		Least Significant Word
$14	Boot File Length	Most Significant Word
$16		Least Significant Word

	F E D C B A 9 8 7 6 5 4 3 2 1 0	
$18	Boot File Byte Offset	Most Significant Word
$1A		Least Significant Word
$1C	Trace Buffer Address (TXD/RXD)	Most Significant Word
$1E		Least Significant Word
$20	Client IP Address	Most Significant Word
$22		Least Significant Word
$24	Server IP Address	Most Significant Word
$26		Least Significant Word
$28	Subnet IP Address Mask	Most Significant Word
$2A		Least Significant Word
$2C	Broadcast IP Address Mask	Most Significant Word
$2E		Least Significant Word
$30	Gateway IP Address	Most Significant Word
$32		Least Significant Word
$34	BOOTP/RARP Retry	TFTP/ARP Retry
$36	BOOTP/RARP Control	Update Control
$38	Boot Filename String	$40(&64) Bytes
$76		
$78	Argument Filename String	$40(&64) Bytes
$B6		

Field descriptions:

Node Control Memory Address	The starting address of the necessary memory needed for the transmit and receive buffers. 256KB are needed for the specified Ethernet driver (transmit/receive buffers).
Client IP Address	The IP address of the client. The firmware is considered to be the client.
Server IP Address	The IP address of the server. The firmware is considered to be the server.

Subnet IP Address Mask	The subnet IP address mask. This mask is used to determine if the server and client are resident on the same network. If they are not, the gateway IP address is used as the intermediate target (server).
Broadcast IP Address	The broadcast IP address that the firmware utilizes when an IP broadcast needs to be performed.
Gateway IP Address	The gateway IP address. The gateway address would be necessary if the server and the client do not reside on the same network. The gateway IP address would be used as the intermediate target (server).
Boot File Name	The name of the boot file to load. Once the file is loaded, control is passed to the loaded file (program). To specify a null filename, the string 'NULL' must be used. This resets the filename buffer to a null character string.
Argument File Name	The name of the argument file. This file may be used by the booted file (program) for an additional file load. To specify a null filename, the string 'NULL' must be used. This resets the filename buffer to a null character string.
Boot File Load Address	The load address of the boot file.
Boot File Execution Address	The execution address of the boot file.
Boot File Execution Delay	The delay, in seconds, before control is passed to the loaded file (program).
Boot File Length	The number of bytes from the data transfer address to transfer. A length of 0 specifies to transfer the entire file on a read. On a write the length must be set to the number of bytes to transfer.
Boot File Offset	The offset into the file on a read. This permits users to wind into a file.
BOOTP/RARP Request Retry	The number of the number of retries that should be attempted prior to giving up. A retry value of zero specifies always to retry (not give up).

TFTP/ARP Request Retry	The number of retries that should be attempted prior to giving up. A retry value of zero specifies always to retry (not give up).
Trace Character Buffer Address	The starting address of memory in which to place the trace characters. The receive/transmit packet tracing is disabled by default (value of 0). Any non-zero value enables tracing. Tracing would only be used in a debug environment and normally should be disabled. Care should be exercised when enabling this feature; you should ensure adequate memory exists. The following characters are defined for tracing: ? Unknown & Unsupported Ethernet type * Unsupported IP type % Unsupported UDP type $ Unsupported BOOTP type [BOOTP request] BOOTP reply + Unsupported ARP type (ARP request) ARP reply - Unsupported RARP type { RARP request } RARP reply ^ Unsupported TFTPtype \ TFTP read request / TFTP write request < TFTP acknowledgment > TFTP data | TFTP error

	, Unsupported ICMP type
	: ICMP echo request
	; ICMP echo reply
BOOTP/RARP Request Control	The BOOT/RARP request control during the boot process. Control can be set either to always (A) or to when needed (W). When control is set to always, the BOOTP/RARP request is always sent, and the accompanying reply always expected. When control is set to when needed, the BOOTP/RARP request is sent if needed (i.e., IP addresses of 0, null boot file name).
BOOTP/RARP Replay Update Control	The updating of the configuration parameters following a BOOTP/RARP reply. Receipt of a BOOTP/RARP reply would only be in lieu of a request being sent.

.NETFOPN

Name

.NETFOPN - Open file for reading

Code

$001B

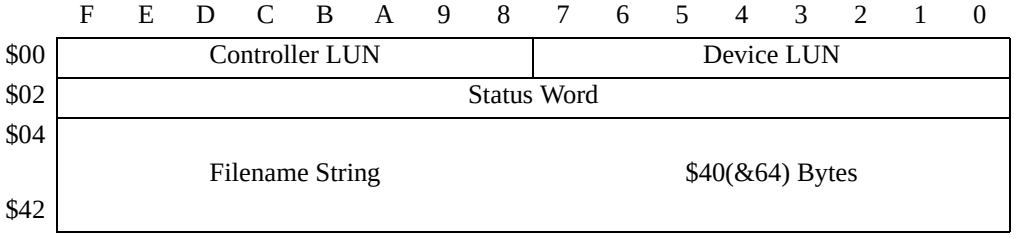
5

Description

This routine allows the user to open a file for reading. The firmware basically transmits a TFTP Read Request for the specified file and returns to the user. It is your responsibility to retrieve the forthcoming file blocks; you would use the .NETFRD system call to do this. You must also perform the file block retrievals in a timely fashion, else the TFTP server will time-out.

Information about the file open/request is passed in a command packet which has been built in memory. (The user program must first manually prepare the packet.) The address of the packet is passed as an argument to the routine. All packets must be word-aligned.

The format of the packet structure, NFILEOPEN, is shown below:



Field descriptions:

Controller LUN	Logical Unit Number (LUN) of controller to use
Device LUN	Logical Unit Number of device to use
Status Word	This status word reflects the result of the operation. It is zero if the command completed without errors. Refer to Appendix H for meanings of returned error codes.
Filename String	The name of the file to load. The filename string must be null terminated. The maximum length of the string is 64 bytes, inclusive of the null terminator.

.NETFRD

Name

.NETFRD - Retrieve specified file blocks

Code

$001C

Description

This routine allows you to retrieve the specified file blocks. You would use this routine multiple times to retrieve the entire file. Prior to using this routine a .NETFOPN system call must have been performed. For each file block retrieved the firmware will transmit a TFTP ACK packet to acknowledge the receipt of data. The end of data will be signified when the number of bytes transferred is smaller than the block size. The block size is set at 512 bytes (TFTP convention). For each .NETFRD system call performed, you must update (increment by one) the block number field of the command packet. Initially the block number is one.

Information about the file block is passed in a command packet which has been built in memory. (The user program must first manually prepare the packet.) The address of the packet is passed as an argument to the routine. All packets must be word-aligned. The format of the packet structure, NFILEREAD, is shown below:

	F E D C B A 9 8	7 6 5 4 3 2 1 0
$00	Controller LUN	Device LUN
$02	Status Word	
$04	Data Transfer Address	Most Significant Word
$06		Least Significant Word
$08	Transfer Byte Count	
$0A	Block Number	
$0C	Data Packet (File Block) Timeout	Most Significant Word
$0E		Least Significant Word

Field descriptions:

Controller LUN	Logical Unit Number (LUN) of controller to use
Device LUN	Logical Unit Number of device to use
Status Word	This status word reflects the result of the operation. It is zero if the command completed without errors. Refer to Appendix H for meanings of returned error codes.
Data Transfer Address	Address of buffer in memory to which to transfer the file block.
Transfer Byte Count	This field is status only and will be updated only on a successful data transfer. The size of each file block is 512 bytes unless it is the last block of the file (0 to 511 bytes).
Block Count	The next expected block number to be received.
Data Packet Timeout	The number of seconds to wait before giving up control to the caller.

.NETCTRL

Name

.NETCTRL - Implement special control routines

Code

$001D

Description

This routine is used to implement any special control routines that cannot be accommodated easily with any of the other network routines. At the present, the only defined packet is SEND packet, which allows you to send a packet in the specified format to the specified network interface driver. The required parameters are passed in a command packet which has been built somewhere in memory.

The address of the packet is passed as an argument to the routine. This routine effectively performs an **NIOC** command, but under program control. All packets must be word-aligned. The format of the packet structure, NIOCCALL, is shown below:

	F E D C B A 9 8	7 6 5 4 3 2 1 0
$00	Controller LUN	Device LUN
$02	Status Word	
$04	Command Identifier	Most Significant Word
$06		Least Significant Word
$08	Memory Address (Data Transfers)	Most Significant Word
$0A		Least Significant Word
$0C	Number of Bytes (Data Transfers)	Most Significant Word
$0E		Least Significant Word
$10	Status/Control Flags	Most Significant Word
$12		Least Significant Word

Field descriptions:

Controller LUN	Logical Unit Number (LUN) of controller to use
Device LUN	Logical Unit Number of device to use
Status Word	This status word reflects the result of the operation. It is zero if the command completed without errors. Refer to Appendix H for meanings of returned error codes.
Command Identifier	The command operation type. The command types (identifiers) are as follows: 0 Initialize device/channel/node 1 Get hardware (Ethernet) address (network node) 2 Transmit (put) data packet 3 Receive (get) data packet 4 Flush receiver and receive buffers 5 Reset device/channel/node Rules on commands: The initialization (type 0) of the device/channel/node must always be performed first. If you have booted or initiated some other network I/O command, the initialization would already have been done. The flush receiver and receive buffer (type 4) would be used if, for example, the current receive data is not longer needed, or to provide a known buffer state prior to initiating data transfers. The reset device/channel/node (type 5) would be used if another operating system (node driver) needs to be in control of the device/channel/node. Basically, put the device/channel/node to a known state.
Memory Address	The memory address in which the data transfer operation (types 1, 2, and 3) would take place from/to.
Number of Bytes	The number of bytes of the data transfer.

Status/Control Flags	This parameter specifies control and status flags as needed by the operation types. Bit #16 - Receive data transferred to user's memory.

.OUTCHR

Name

.OUTCHR - Output character routine

Code

$0020

Description

This routine outputs a character to the default output port.

Entry Conditions

R03: Bits 7 through 0: Character (byte)

Exit Conditions Different From Entry

Character is sent to the default I/O port.

.OUTSTR
.OUTLN

Names

.OUTSTR - Output string to default output port

.OUTLN - Output string with a **<CR><LF>** sequence

Codes

$0021

$0022

Description

.OUTSTR outputs a string of characters to the default output port.

.OUTLN outputs a string of characters followed by a **<CR><LF>** sequence.

Entry Conditions

R03: Address of first character

R04: Address of last character+1

Exit Conditions Different From Entry

None

.WRITE
.WRITELN

Names

.WRITE - Output string without a **<CR>** or **<LF>**

.WRITELN - Output string with a **<CR><LF>** sequence

Codes

$0023

$0024

Description

These output routines are designed to output strings formatted with a count byte followed by the characters of the string. The user passes the starting address of the string. The output goes to the default output port.

Entry Conditions

R03: Address of string

Exit Conditions Different From Entry

None

Note The string must be formatted such that the first byte (the byte pointed to by the passed address) contains the count (in bytes) of the string. There is no special character at the end of the string as a delimiter.

.PCRLF

Name

.PCRLF - Print a **<CR><LF>** sequence

Code

$0026

Description

.PCRLF sends a **<CR><LF>** sequence to the default output port.

Entry Conditions

No arguments required.

Exit Conditions Different From Entry

None

.ERASLN

Name

.ERASLN - Erase Line

Code

$0027

Description

.ERASLN is used to erase the line at the present cursor position. If a printer is used (hardcopy mode), a **<CR><LF>** sequence is issued instead.

Entry Conditions

No arguments required.

Exit Conditions Different From Entry

The cursor is positioned at the beginning of a blank line.

.WRITD
.WRITDLN

Names

.WRITD - Output string with data

.WRITDLN - Output string with data and a **<CR><LF>** sequence

Codes

$0028

$0025

Description

These trap routines take advantage of the monitor I/O routine which outputs a user string containing embedded variable fields. The user passes the starting address of the string and the address of a data list containing the data which is inserted into the string. The output goes to the default output port.

Entry Conditions

R03: Address of string

R04: Data list pointer. A separate data list arranged as follows:

Data list pointer	Data for 1st variable in string
	Data for next variable
	Data for next variable

Exit Conditions Different From Entry

None

Notes

1. The string must be formatted such that the first byte (the byte pointed to by the passed address) contains the count (in bytes) of the string (including the data field specifiers, described in Note 2 below).

2. Any data fields within the string must be represented as follows:

   |*radix*,*fieldwidth*[**Z**]|

   where:

   radix is the hexadecimal value for the base in which the data will be displayed (for example, A is base 10, and 10 is base 16.)

   fieldwidth is the hexadecimal value for the number of characters this data is to occupy in the output.

   The data is right justified, and left-most characters are removed to make the data fit. The **Z** is included if it is desired to suppress leading zeros in output. The vertical bars (|) are required characters.

3. All data is to be placed in the data list as 32-bit words. Each time a data field is encountered in the user string, a word is read from the data list to be displayed.

4. The data list is not destroyed by this routine.

.SNDBRK

Name

.SNDBRK - Send break

Code

$0029

Description

.SNDBRK is used to send a break to the default output port.

Entry Conditions

No arguments required

Exit Conditions Different From Entry

The current default output port has sent break.

.DELAY

Name

.DELAY - Timer delay routine

Code

$0043

Description

.DELAY is used to generate accurate timing delays that are independent of the processor frequency and instruction execution rate. This routine uses the onboard timer for operation. You specify the desired delay count in milliseconds. The .DELAY system call returns to the caller after the specified delay count is exhausted.

Entry Conditions

R03: Delay time in milliseconds (word)

Exit Conditions Different From Entry

None

.RTC_TM

Name

.RTC_TM - Time initialization for RTC

Code

$0050

Description

.RTC_TM initializes Real-Time Clock with the time that is located in a user-specified buffer.

The data input format can be either ASCII or unpacked BCD. The order of the data in the buffer is:



HH	Hours
MM	Minutes
SS	Seconds
s	Sign of calibration factor (+ or -)
cc	Value of calibration factor

Entry Conditions

R03: Time initialization buffer (address)

Exit Conditions Different From Entry

None

.RTC_DT

Name

.RTC_DT - Date initialization

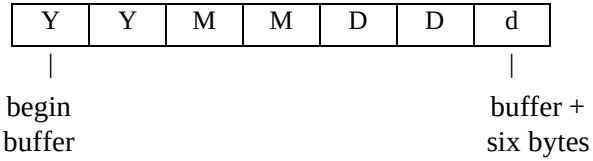
Code

$0051

Description

.RTC_DT initializes Real-Time Clock with the date that is located in a user-specified buffer.

The data input format can be either ASCII or unpacked BCD. The order of the data in the buffer is:



YY	Year
MM	Month
DD	Day of month
d	Day of week (1 = Sunday)

Entry Conditions

R03: Date initialization buffer (address)

Exit Conditions Different From Entry

None

.RTC_DSP

Name

.RTC_DSP - Display time from RTC

Code

$0052

Description

.RTC_DSP displays the date and time on the console from the current cursor position. The format is as follows:

DAY MONTH DD, YYYY hh:mm:ss.s

DAY	Day
MONTH	Month
DD	Day of month
YYYY	Year
hh	Hour
mm	Minute
ss.s	Second (to nearest tenth)

Entry Conditions

No arguments required

Exit Conditions Different From Entry

The cursor is left at the end of the string.

.RTC_RD

Name

.RTC_RD - Read the RTC registers

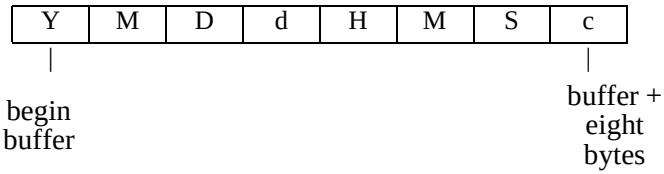
Code

$0053

Description

.RTC_RD is used to read the Real-Time Clock registers. The data returned is in packed BCD.

The order of the data in the buffer is:



Y	Year (2 nibbles packed BCD)
M	Month (2 nibbles packed BCD)
D	Day of month (2 nibbles packed BCD)
d	Day of week (2 nibbles packed BCD)
H	Hour of 24 hour clock (2 nibbles packed BCD)
M	Minute (2 nibbles packed BCD)
S	Seconds (2 nibbles packed BCD)
c	Calibration factor (MS nibble = 0 negative, 1 positive, LS nibble = value)

Entry Conditions

R03: Buffer address where RTC data is to be returned

Exit Conditions Different From Entry

Buffer now contains date and time in packed BCD format.

.REDIR

Name

.REDIR - Redirect I/O routine

Code

$0060

Description

.REDIR is used to select an I/O port and at the same time invoke a particular I/O routine. The invoked I/O routine reads or writes to the selected port.

Entry Conditions

R03: Port
R04: I/O routine to call
R05: R03 as required by the invoked System Call routine
R06: R04 as required by the invoked System Call routine
R07: R05 as required by the invoked System Call routine
R08: R06 as required by the invoked System Call routine

Exit Conditions Different From Entry

R03: May be changed by I/O routine

.REDIR_I
.REDIR_O

Name

.REDIR_I - Redirect input

.REDIR_O - Redirect output

Codes

$0061

$0062

Description

The .REDIR_I and .REDIR_O system calls are used to change the default port number of the input and output ports, respectively. This is a permanent change, that is, it remains in effect until a new .REDIR command is issued.

Entry Conditions

R03: Port Number (word)

Exit Conditions Different From Entry

R03: Is set to $FFFFFFFF if invalid port number was specified, otherwise PPCBug console input (output) is redirected to the specified port number.

.RETURN

Name

.RETURN - Return to PPCBug

Code

$0063

Description

.RETURN is used to return control to PPCBug from the target program in an orderly manner. First, any breakpoints inserted in the target code are removed. Then, the target state is saved in the register image area. Finally, the routine returns to PPCBug.

Entry Conditions

No arguments required.

Exit Conditions Different From Entry

Control is returned to PPCBug.

Note .RETURN must be used only by code that was started using PPCBug.

.BINDEC

Name

.BINDEC - Calculate the Binary Coded Decimal (BCD) equivalent of the binary number specified

Code

$0064

Description

.BINDEC takes a 32-bit unsigned binary number and changes it to an equivalent BCD number.

Entry Conditions

R03: Argument: Hex number

Exit Conditions Different From Entry

R03: Bits 31 through 8: Zero
R03: Bits 7 through 0: Decimal number (two most significant DIGITS)
R04: Decimal number (next eight DIGITS)

.CHANGEV

Name

.CHANGEV - Parse value, assign to variable

Code

$0067

Description

Attempt to parse value in user-specified buffer. If user's buffer is empty, prompt user for new value, otherwise update integer offset into buffer to skip value. Display new value and assign to variable unless user's input is an empty string.

Entry Conditions

R03: Address of 32-bit offset into user's buffer
R04: Address of user's buffer (pointer/count format string)
R05: Address of 32-bit integer variable to change
R06: Address of string to use in prompting and displaying value

Exit Conditions Different From Entry

None.

.STRCMP

Name

.STRCMP - Compare two strings (pointer/count)

Code

$0068

Description

Comparison for equality is made and Boolean flags are returned to caller.

Entry Conditions

R03: Address of string 1
R04: Address of string 2

Exit Conditions Different From Entry

R03: Bit 3 (ne) = 1; Bit 2 (eq) = 0, if strings are not equal.
R03: Bit 3 (ne) = 0; Bit 2 (eq) = 1, if strings are equal.

.MULU32

Name

.MULU32 - Unsigned 32-bit x 32-bit multiply

Code

$0069

Description

Two 32-bit unsigned integers are multiplied and the product is returned as a 32-bit unsigned integer. No overflow checking is performed.

Entry Conditions

R03: 32-bit multiplier
R04: 32-bit multiplicand

Exit Condition Different From Entry

R03: 32-bit product (result from multiplication)

.DIVU32

Name

.DIVU32 - Unsigned 32-bit x 32-bit divide

Code

$006A

Description

Unsigned division is performed on two 32-bit integers and the quotient is returned as a 32-bit unsigned integer. The case of division by zero is handled by returning the maximum unsigned value $FFFFFFFF.

Entry Conditions

R03: 32-bit divisor (value to divide by)
R04: 32-bit dividend (value to divide)

Exit Condition Different From Entry

R03: 32-bit quotient (result from division)

.CHK_SUM

Name

.CHK_SUM - Generate checksum for address range

Code

$006B

Description

This routine generates a checksum for an address range that is passed in as arguments.

Entry Conditions

R03: Beginning address
R04: Ending address + 1
R05: Scale indicator. Values are:

0 Default setting (WORD)
1 BYTE
2 HALF-WORD
4 WORD

Exit Conditions Different From Entry

R03: Checksum

Notes 1. If a Bus Error results from this routine, then the debugger bus error exception handler is invoked and the calling routine is also aborted.

2. The calling routine must insure that the beginning and ending addresses are on word boundaries or the integrity of the checksum cannot be guaranteed.

.BRD_ID

Name

.BRD_ID - Return pointer to board ID packet

Code

$0070

Description

This routine returns a pointer in R03 to the board identification packet. The packet is built at initialization time and contains information about the PowerPC board and peripherals it supports.

The format of the board identification packet is shown below:

	31 24	23 16	15 8	7 0
$00	Eye Catcher			
$04	Rev.	Month	Day	Year
$08	Packet Size		Reserved	
$0C	Board Number		Board Suffix	
$10	Options (such as coprocessor)		Family	CPU
$14	Controller LUN		Device LUN	
$18	Device Type		Device Number	
$1C	Option-2			

Field descriptions:

Eye Catcher	Word containing ASCII string “BDID”
Rev.	Byte containing PPCBug revision (in BCD)
Month, Day, Year	Three Bytes containing date (in BCD) the PPCBug code was frozen
Packet Size	Half-Word containing the size of the packet
Reserved	Reserved for future use

Board Number	Half-Word containing the board number (in BCD)
Board Suffix	Half-Word containing the ASCII board suffix (e.g. XT, A, 20)
Options:	
bits 0-3	Four bits containing CPU type:
	CPU = 1; MPC620
	CPU = 1; MPC601
	CPU = 2; MPC602
	CPU = 3; MPC603
	CPU = 4; MPC604
bits 4-6	Three bits containing the Family type:
	Fam = 2; MPC600 family
bits 7-31	The remaining bits define various board specific options:
	Bit 7 set = FPC present
	Bit 8 set = MMU present
	Bit 9 set = MMB present
Controller LUN	The Logical Unit Number for the boot device controller (refer to Appendices E and G)
Device LUN	The Logical Unit Number for the boot device (refer to Appendices E and G)
Device Type	The device type of the boot device (refer to the following table)
Option-2	Reserved for future use (zero in this implementation)

Refer to Appendix G for data on supported network controllers.

Device Type	Device
00	Direct-Access Device (e.g., magnetic disk)
01	Sequential-Access Device (e.g., magnetic tape)
02	Printer Device
03	Processor Device
04	Write-Once Read-Multiple Device (e.g., some optical devices)
05	CD-ROM Device
06	Scanner Device
07	Optical Memory Device (e.g., some optical devices)
08	Medium Changer Device (e.g., jukeboxes)
09	Communications Device

Entry Conditions

None

Exit Conditions Different From Entry

R03: Address (word) Starting address of ID packet

.ENVIRON

Name

.ENVIRON - Read/write environment parameters

Code

$0071

Description

The purpose of the TRAP is to allow a user program access to certain debugger environmental parameters. These parameters include default boot devices and start-up configurations.

Entry Conditions

R03: Parameter storage buffer
R04: Size of the storage buffer
R05: Operation type:

0	Size in bytes of the information the debugger will pass
1	Update the NVRAM with environmental parameters passed
2	The debugger will update your parameter storage buffer with environmental information from the NVRAM.

Exit Conditions Different From Entry

For operations 1 & 2

R03:

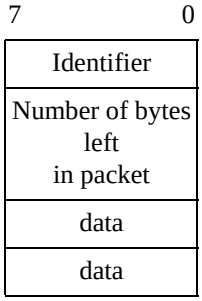
0	No errors encountered, operation completed
1	Debugger has more data than the passed buffer could hold.
	Partial data transferred:
1	Checksum error occurred during the write update (write only)

For operation 0

R03: The number of bytes required to store the debugger information.

Description Of Parameter Packets

The data contained in the parameter storage area is organized as a set of data packets. Each data packet has the following structure:



Supported packets and formats:

0 End of the list (End Record)

0

0

1 PPCBug Start-Up Parameters

1

$6

System or debugger environment flag

Field service menu flag

Remote start method flag

Probe system for controllers flag

Negate SYSFAIL always flag

Reset local SCSI on board reset flag

2 Disk Auto Boot Information

2

$15

Disk Auto Boot Enable

Disk Auto Boot at power-up only

Disk Auto Boot Controller Logical Unit Number

Disk Auto Boot Device Logical Unit Number

Disk Auto Boot Abort Delay

Disk Auto Boot String to be passed to load program ($10 bytes in length)

3 ROM Boot Information

3

$C

ROM Boot Enable

ROM Boot at power-up only

ROM Boot from VME bus

ROM Boot Abort Delay

ROM Boot Starting Address (4 bytes in length)

ROM Boot Ending Address (4 bytes in length)

4 NetBoot Information

4

$9

NetBoot Enable

NetBoot at power up only

NetBoot Controller Logical Unit Number

NetBoot Device Logical Unit Number

NetBoot Abort Delay

NetBoot parameter pointer (4 bytes in length)

5 Memory Size Information

5

$9

Memory Size Enable ($4E or $59)

Memory Size Starting Address (4 bytes)

Memory Size Ending Address (4 bytes)

For an explanation of each entry and definition of options, refer to the **ENV** command.

The debugger will return all parameter packets on a read. During a write you may return only the packets that need to be updated; however, the packet may not be returned out of order.

During an update, entries that have specific values will be verified. If an entry is in error, that parameter will be unchanged.

.PFLASH Function

Name

.PFLASH - Program Flash memory

Code

$0073

Description

The purpose of this TRAP is to program Flash memory under program control. The address of the packet is passed as an argument to the function. The address of the packet is passed in the longword memory location pointed to by the current stack pointer. The packet contains the necessary arguments/data to program the Flash memory.

Entry Conditions

R03 ==> Address: Starting address of control packet *word*

Exit Conditions Different From Entry

None

Format of Flash Memory Control Packet

The Flash Memory Control Packet must be word (32 bit) aligned.

	31 **24**	**23** **16**	**15** **8**	**7** **0**
$00	Status Word		Control Word	
$04	Source Starting Address			
$08	Number of Bytes to Program			
$0C	Destination Starting Address			
$10	Instruction Execution Address			

Field descriptions:

Control/Status Word	Specifies control and status of the various phases of the Flash memory programming. This parameter has two 16-bit parts: bits #31 to #16 specify status and bits #15 to #0 specify control.
Source Starting Address	Specifies the source starting address of the data with which to program the Flash memory. Word (32-bit) address alignment is required for this parameter.
Number of Bytes to Program	Specifies the number of bytes of the source data (or the number bytes to program the Flash memory with). Word (32-bit) address alignment is required for this parameter.
Destination Starting Address	Specifies the starting address of the Flash memory to program the source data with. Word (32-bit) address alignment is required for this parameter.
Instruction Execution Address	Specifies the instruction execution address to be executed upon completion of the Flash memory programming. This parameter must meet the syntax of the reset vector of the applicable MPU architecture of the host product. This parameter is qualified with a control bit in the control/status word; execution will only occur when the control bit is set and no errors occur during programming/verification. This non-execution on error can be invalidated by yet another control bit in the control/status word.

The next table describes the definitions of the control and status bits in the Control/Status Word field.

Type	Bit Position	Definition
Control	0	Execution address valid.
Control	1	Execute address on error as well.
Control	2	Execute local reset.
Control	3	Execute local reset on error as well.
Control	4	Non-verbose, no display messages. (NOTE)
Control	5-15	Unused, Reserved
Status	16	Error of some type, see remaining status bits.
Status	17	Address/Range alignment error.
Status	18	Flash Memory address range error.
Status	19	Flash Memory erase error.
Status	20	Flash Memory write error.
Status	21	Verification (read after write) error.
Status	22	Time-Out during erase operation.
Status	23	Time-Out during byte write operation.
Status	24	Unexpected manufacturer identifier read from the device.
Status	25	Unexpected device identifier read from the device.
Status	26	Unable to initialize the Flash device to zero.
Status	27-29	Unused, Reserved
Status	30	Flash Memory program control driver downloaded.
Status	31	No return possible to caller.

Note: When programming the Flash device in which the Flash memory is executing, bit 4 will have no effect. All programming operations that involve the Flash device in which the Flash memory is executing will be NON-VERBOSE.

.DIAGFCN

Name

.DIAGFCN - Diagnostic routine

Code

$0074

Description

.DIAGFCN is a system-call-like routine, for the diagnostics. This system call provides the debugger and external software (operating systems) with a single-point-of-entry to information maintained by the firmware diagnostics.

The .DIAGFCN system call requires a single argument, which is a pointer to a **diagfcn** struct. This struct contains an 'unsigned int' which is the number of the diagnostic routine being requested, and a pointer to arguments for the routine to be executed:

```
unsigned int DIAGFCN number to execute
char * pointer to function arguments
```

This system call implements four diagnostic functions:

01: .CHKFCN (check function)

02: .TESTSTAT (output test status report)

03: .MEMSTAT (memory status)

04: .ST_NMLIST (selftest name list)

01: .CHKFCN (check function)

The purpose of this function is to determine whether a given **diagfcn** is present in this revision of firmware. The argument pointer in the **diagfcn** struct simply points to an unsigned int variable, containing the **diagfcn** number to test for. If it exists, the syscall will return zero.

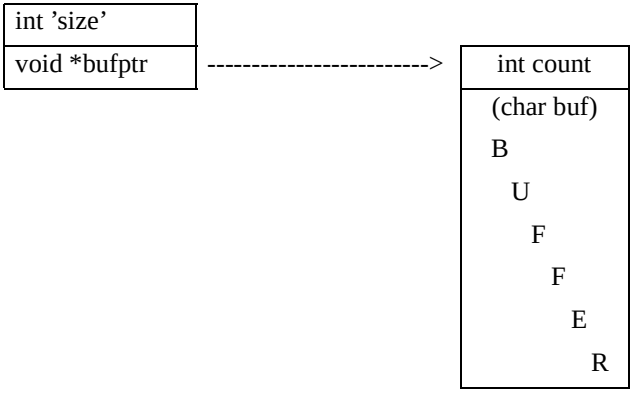
02: .TESTSTAT (output test status report)

This **diagcfn** call allows access to selftest diagnostic results. The calling function must supply the **diagcfn** call with a pointer to two arguments (a structure containing two members):

```
struct ts_bufps
{
unsigned int size;
void *bufptr;
}
```


'bufptr' points to a buffer in memory, where the first 'sizeof(int)' bytes are reserved for an integer 'count' variable, and the rest of the buffer is reserved as a 'char' array for ASCII string data:

```
struct ts_bufs
{
unsigned int count;
unsigned char buf[1];}
```



The calling function typically first makes a call with the 'size' set to 'sizeof(int)', and 'bufptr' pointing to a section of R/W memory, 'size' bytes long. This causes the TESTSTAT function to calculate how large a buffer will be required to contain the test status report. The calculated value, plus 'sizeof(int)', will be returned in the location pointed to by 'bufptr'.

The caller will then typically allocate the number of bytes of memory requested for the report, and call the TESTSTAT function again. This time, the ‘size’ passed in should be at least as large as the count returned by the previous call to TESTSTAT. This function will then recalculate the memory required, compare that to the amount of memory supplied, and either return an error if insufficient buffer space has been allocated, or generate the report and append it to the count at the location pointed to by ‘bufptr’.

The test result strings placed in the buffer will have the format:

DEL Dir_Name DEL Test_Name DEL Description DEL F|P|B|M|N|E|? 0

Where *DEL* is a delimiter, either a semi-colon or a space

0 is a zero

F if the test has ever failed since the last reset

P if the test has executed to completion without failure

B if the test has been bypassed since the last reset

M if the test has been masked by the operator

N if the test has not been executed since the last reset

E if the test is an ‘eval’ type, and is normally not executed.

? if an invalid test index is generated internal to the debugger. This should *never* occur.

The N and E status is stored for each test at diag init time (on reset), depending on whether the test is of type T_TEST (a ‘regular’ test) or T_EVAL (a test that is only run manually). This is the only time these values will be stored for a test. All other status types destructively overwrite this initial value.

The M status will be saved for a test, whenever the test is executed, if masking has been enabled for this test. It will only overwrite an N status (and not an E).

The B status indicates a test has decided not to run, due to some configuration limitation (an example would be when the MCECC tests report bypassed on a CPU that only contains parity-type RAM). The B status will overwrite the M, N, and E status.

The P status will only ever be saved, if the previous status for the test was B, M, N, or E. A P status will never overwrite an F status. If a test is aborted before completion, the previous status will remain, even if the test was passing up to the point of the abort.

The F status will overwrite all other values, and will never be changed without a reset.

These status strings are appended together in the buffer supplied by the caller. The initial delimiter character of each test result string should be read by the calling function, and used as the character to search for, when looking for separation between ‘words’ of the result. Each single test result string could have a different delimiter. The 0 following each result string indicates the start of the next result.

A hex dump of report data might look like:

```
100  00000204  (‘count’)
104  5F 72 61 6D 5F 71 75 69  6B 5F 51 75 69 63 6B 20  _ram_quik_Quick
114  57 72 69 74 65 2F 52 65  61 64 5F 4E 00 5F 72 61  Write/Read_N._ra
124  6D 5F 61 6C 74 73 5F 41  6C 74 65 72 6E 61 74 69  m_alts_Alternati
134  6E 67 20 4F 6E 65 73 2F  5A 65 72 6F 65 73 5F 4E  ng Ones/Zeroes_N
144  00 5F 72 61 6D 5F 70 61  74 73 5F 50 61 74 74 65  ._ram_pats_Patte
154  72 6E 73 5F 4E 00 5F 72  61 6D 5F 61 64 72 5F 41  rns_N._ram_adr_A
164  64 64 72 65 73 73 61 62  69 6C 69 74 79 5F 4E 00  ddressability_N.
174  5F 72 61 6D 5F 63 6F 64  65 5F 43 6F 64 65 20 45  _ram_code_Code E
. . .
```

This function will return an integer status. 0 (zero) is returned upon success. A result of `-1` is returned if an error in the system call function occurred:

```
if ( 0 <= size < 4 )
   return -1;

if ( size == 4 )
   write ‘count’ to ‘bufptr’ location in RAM
   return 0;

if ( 4 < size < count )
   write ‘count’ to ‘bufptr’ location in RAM
   return -1;

if ( count <= size )
   write ‘count’ to ‘bufptr’ location in RAM
   write status report to ‘bufptr + sizeof(int)’ in RAM
   return 0;
```

The result is returned in R03

03: .MEMSTAT (memory status)

This function implements a report mechanism for main memory diagnostics. This report is always of a fixed size, and can therefore be called by higher level software that can not dynamically allocate buffer space.

This function reports combined status for each of certain test directories. This list includes RAM, MCECC, MEMC1, MEMC2, and ECC.

In the case of RAM tests, they cover a range of memory, and typically contain nothing that is board-specific.

The MCECC and ECC tests do contain board-specific code, and will cover segments of memory, rather than a single range. In this case, these tests will likely appear in the report multiple times, once for each segment of memory.

Since the test is only ever run once, over all segments, the status result will be identical for all reported instances. If one of the segments covered does not contain an ECC type of memory board, the results will contain a zero address range (beginning address = ending address).

The MEMC1 and MEMC2 tests are on a per-board basis. These tests are intended for the parity memory board, but contain one or more tests that are also appropriate for the MCECC memory board. Each test covers one segment of memory on the board under test.

This report may return:

N	not executed
B	bypassed
P	passed
F	failed

1. Walk down through the diag directory, looking for test groups that match our list.

2. When a match is found, walk down through the tests, ignore any functions that are not of the type T_TEST, check the status for each test (using the test index to look in the diagctl teststat array).

3. Create an overall status for the test group **P**, **F**, **N**, or **B**:

   P Passed, which is returned when all of the T_TEST type functions in the test group have posted a 'passed' status. Any test in the group posting other than 'passed' will cause a different status to be returned.

   F Failed, which is returned if any test of type T_TEST in the test group has posted a 'failed' status

   N Not Executed, which is returned if any test in the group of type T_TEST was not executed. If any of the tests posted a 'failed' status, F is returned.

   B Bypassed, which is returned if all of the T_TYPE functions in the test group have posted a `bypassed` status

The upper address bound and lower address bound passed back to the caller, should be initialized to the values of the Memory Size Ending Address and the Memory Size Starting Address from NVRAM. These values to be returned should be overridden by any test configuration parameters (CF params) that might exist for the applicable test. A function will be inserted in each of the memory test groups that can be called and will return the upper and lower bounds.

The argument pointer in the diagfcn struct points to the report buffer. This buffer is 452 bytes long, and has the structure:

	unsigned int	number of valid entries
Entry 1	unsigned int	upper address bound
	unsigned int	lower address bound
	unsigned int	combined test status (P|F|N|B)
	char[16]	test group name (NULL terminated)
Entry 2	unsigned int	upper address bound
	unsigned int	lower address bound
	unsigned int	combined test status (P|F|N|B)
	char[16]	test group name (NULL terminated)

	unsigned int	number of valid entries
	.	
	.	
	.	
Entry 16	unsigned int	upper address bound
	unsigned int	lower address bound
	unsigned int	combined test status (P|F|N|B)
	char[16]	test group name (NULL terminated)

MEMSTAT will return a zero from the system call if there were no errors.

04: .ST_NMLIST (selftest name list)

This function will walk through the selftest directory structure, and generate a report consisting of test and group names that are present.

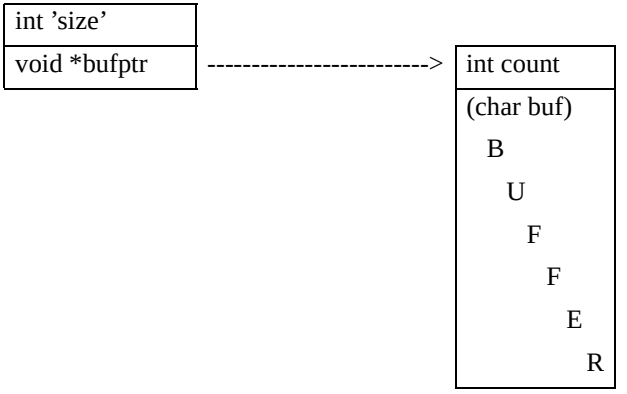
The report contains test group name, as well as the specific test name. Format of the list is the same as that for the .TESTSTAT diag syscall.

Each string in the list begins with the separator (unique delimiter character) that is to be used in the current line. The test group name comes next, followed by a separator. Next is the test name, followed by a NULL (\0). For example, #ram#pats<0>.

The caller must provide a pointer to a structure when calling this function. The structure first contains an 'int' (4 bytes) giving the size of an available buffer to be used for output from this function. This 'int' is immediately followed by the address (4 bytes) of the start of the buffer.

If this function is called with the 'size' set to 'sizeof(int)' (4), then this function will return a single integer (4 bytes) in the buffer, containing the size of buffer needed to contain the list and the size. To get the list, the function needs to be called with a buffer 'size' at least as large as is reported in the first call. Anything smaller will result in a non-zero return status, and the list will not be generated.

The caller should place the structure pointer in processor register R03. An integer result will be returned, in place of the pointer passed in to this function. A zero (0) result indicates success, non-zero indicates failure.



Entry Conditions

R03 contains the diagfcn struct address.

Exit Conditions Different From Entry

An integer status to the higher level is returned in R03.

Examples

Example 1: .CHKFCN

```
PPC1-Bug>MM 10100;DI <Return>
00010100 59200074  SYSCALL .DIAGFCN <Return>
00010108 59200063  SYSCALL .RETURN <Return>

PPC1-Bug>RM R02 (pointer to DIAGFCN struct)
R03 =00000000? 20000 . <Return>

PPC1-Bug>MM 20000 <Return>
00020000 00000000? 1 <Return> (DIAGFCN #1, .CHKFCN)
00020004 00000000? 20008 <Return>  (pointer to variable arguments)
00020008 00000000? 3 . <Return>  (DIAGFCN # to verify)

PPC1-Bug>GO 10100 <Return> (check for the existence of DIAGFCN)
Effective address: 00010100

PPC1-Bug>RM R02 <Return> (0=FCN AVAIL)
R03 =00000000? . <Return>
```

Example 2: .TESTSTAT

```
PPC1-Bug>MM 10100;DI <Return>
00010100 59200074 SYSCALL .DIAGFCN <Return>
00010108 59200063 SYSCALL .RETURN <Return>

PPC1-Bug>RM R02 <Return> (pointer to DIAGFCN struct)
R03 =00000000? 20000 . <Return>

PPC1-Bug>MM 20000 <Return>
00020000 00000000? 2 <Return>  (DIAGFCN #2, .TESTSTAT)
00020004 00000000? 20008 <Return>  (pointer to variable arguments)
00020008 00000000? 4 <Return>  (size of buffer)
0002000c 00000000? 20100 . <Return>  (pointer to buffer)

PPC1-Bug>BF 20100:800 FFFFFFFF <Return>
Effective address: 00020100
Effective count : &8192

PPC1-Bug>GO 10100 <Return> (get buffer size needed for report)
Effective address: 00010100

PPC1-Bug>RM R02 <Return> (check return status, 0=OK)
R03 =00000000? . <Return>

PPC1-Bug>MM 20100 <Return>
00020100 000013B5? . <Return>  (need '13B5' bytes for report)

PPC1-Bug>RM R02 <Return> (pointer to DIAGFCN struct)
R03 =00000000? 20000 . <Return>

PPC1-Bug>MM 20008 <Return> (size of buffer)
00020008 00000000? 13B5 . <Return>

PPC1-Bug>BF 20100:800 FFFFFFFF <Return>
Effective address: 00020100
Effective count : &8192

PPC1-Bug>GO 10100 <Return> (generate a report)
Effective address: 00010100

PPC1-Bug>RM R02 <Return> (check return status, 0=OK)
R03 =00000000? . <Return>
```

```
PPC1-Bug>MD 20104  <Return> (display report)
00020104 2372616D 23717569 6B235175 69636B20 #ram#quik#Quick
00020114 57726974 652F5265 6164234E 00237261 Write/Read#N.#ra
00020124 6D23616C 74732341 6C746572 6E617469 m#alts#Alternati
00020134 6E67204F 6E65732F 5A65726F 6573234E ng Ones/Zeroes#N
00020144 00237261 6D237061 74732350 61747465 .#ram#pats#Patte
00020154 726E7323 4E002372 616D2361 64722341 rns#N.#ram#adr#A
00020164 64647265 73736162 696C6974 79234E00 ddressability#N.
00020174 2372616D 23636F64 6523436F 64652045 #ram#code#Code E
```

Example 3: .MEMSTAT

```
PPC1-Bug>MM 10100;DI <Return>
00010100 59200074 SYSCALL .DIAGFCN <Return>
00010108 59200063 SYSCALL .RETURN <Return>

PPC1-Bug>RM R02 <Return> (pointer to DIAGFCN struct)
R03 =00000000? 20000 . <Return>

PPC1-Bug>MM 20000 <Return>
00020000 00000000? 3 <Return>  (DIAGFCN #3, .MEMSTAT)
00020004 00000000? 20100 . <Return>  (pointer to arguments -- output buffer)

PPC1-Bug>BF 20100:100 FFFFFFFF <Return>
Effective address: 00020100
Effective count : &1024

PPC1-Bug>GO 10100 <Return> (output the RAM test status report)
Effective address: 00010100

PPC1-Bug>RM R02 <Return> (check return status, 0=OK)
R03 =00000000? . <Return>
```

PPC1-Bug>**MD 20100:40** <**Return**> (display report)

```
00020100 00000005 00000000 00000000 0000004E ..............N
00020110 72616D00 00000000 00000000 00000000 ram.............
00020120 00000000 00000000 0000004E 6D636563 ...........Nmcec
00020130 63000000 00000000 00000000 00000000 c...............
00020140 00000000 0000004E 6D636563 63000000 .......Nmcecc...
00020150 00000000 00000000 00000000 00000000 ................
00020160 0000004E 6D656D63 31000000 00000000 ...Nmemc1.......
00020170 00000000 00000000 00000000 0000004E ..............N
00020180 6D656D63 32000000 00000000 00000000 memc2...........
00020190 00000000 00000000 00000000 00000000 ................
000201A0 00000000 00000000 00000000 00000000 ................
000201B0 00000000 00000000 00000000 00000000 ................
000201C0 00000000 00000000 00000000 00000000 ................
000201D0 00000000 00000000 00000000 00000000 ................
000201E0 00000000 00000000 00000000 00000000 ................
000201F0 00000000 00000000 00000000 00000000 ................
```


Example 4: .ST_NMLIST

PPC1-Bug>**MM 10100;DI** <**Return**>
00010100 59200074 **SYSCALL .DIAGFCN** <**Return**>
00010108 59200063 **SYSCALL .RETURN** <**Return**>

PPC1-Bug>**RM R02** <**Return**> (pointer to DIAGFCN struct)
R03 =00000000? **20000 .** <**Return**>

PPC1-Bug>**MM 20000** <**Return**>
00020000 00000000? **4** <**Return**> (DIAGFCN #4, .ST_NMLIST)
00020004 00000000? **20008** <**Return**> (pointer to variable arguments)
00020008 00000000? **4** <**Return**> (size of buffer)
0002000C 00000000? **20100 .** <**Return**> (pointer to buffer)

PPC1-Bug>**BF 20100:800 FFFFFFFF** <**Return**>
Effective address: 00020100
Effective count : &8192

PPC1-Bug>**GO 10100** <**Return**> (get buffer size needed for report)
Effective address: 00010100

PPC1-Bug>**RM R02** <**Return**> (check return status, 0=OK)
R03 =00000000? **.** <**Return**>

PPC1-Bug>**MM 20100** <**Return**>
00020100 00000AFE? **.** <**Return**> (need 'AFE' bytes for report)

PPC1-Bug>**RM R02** <**Return**> (pointer to DIAGFCN struct)
R03 =00000000? **20000.** <**Return**>

PPC1-Bug>**MM 20008** <**Return**> (size of buffer)
00020008 00000000? **AFE .** <**Return**>

PPC1-Bug>**BF 20100:800 FFFFFFFF** <**Return**>
Effective address: 00020100
Effective count : &8192

PPC1-Bug>**GO 10100** <**Return**> (generate a report)
Effective address: 00010100

PPC1-Bug>**RM R02** <**Return**> (check return status, 0=OK)
R03 =00000000? .<**Return**>

PPC1-Bug>**MD 20104** <**Return**> (display report)

```
00020104 2372616D 23717569 6B002372 616D2361 #ram#quik.#ram#a
00020114 6C747300 2372616D 23706174 73002372 lts.#ram#pats.#r
00020124 616D2361 64720023 72616D23 636F6465 am#adr.#ram#code
00020134 00237261 6D237065 726D0023 72616D23 .#ram#perm.#ram#
00020144 726E646D 00237261 6D236274 6F670023 rndm.#ram#btog.#
00020154 72616D23 70656400 2372616D 23726566 ram#ped.#ram#ref
.
.
.
00020BE4 23636368 62797000 23636D6D 756D7075 #cchbyp.#cmmumpu
00020BF4 33236363 68636F64 6500FFFF FFFFFFFF 3#cchcode.......
```

.SIOPEPS

Name

.SIOPEPS - Retrieve SCSI pointers

Code

$0090

Description

The purpose of this TRAP is to allow a user program to access the SCSI I/O Processor package contained in the PPCBug ROMs. This TRAP returns a list of pointers and table sizes that the user program uses to move the SCSI I/O Processor package from ROM to RAM. The SIOP package cannot be executed by a user program without being moved and edited. For instructions on how to move and edit the SIOP package, refer to the documentation for the SCSI I/O controller (refer to Appendix A, *Related Documentation*).

Entry Conditions

None

Exit Conditions Different From Entry

R03: Pointer to the SIOP pointer and size table.

Description of SIOP Pointer and Size Table Packet

Format for packet containing SIOP pointers and table sizes. All entries are 4 bytes in length.

`siop_init`	Initialization routine entry
`siop_cmd`	Command entry point entry
`siop_int`	Interrupt handler entry
`sdt_tinit`	SIOP debug trace initialization entry
`sdt_alloc`	SIOP debug trace memory allocation entry
`relocation`	Pointer to the relocation table for NCR scripts

`script_ptr`	Pointer to the NCR scripts index pointer array
`script_ptr_sz`	Size of the NCR scripts index pointer array
`script_array_sz`	Size of the scripts array

.FORKMPU Function

Note This is a PPCBug system call for MVME4600 series or Dual Processor MTX motherboards.

Name

.FORKMPU - Fork MPU (Multiple MPU Configuration)

Code

$0100

Description

.FORKMPU allows you to Fork (execute target code) on an MPU that is idle. The MPU register R1 is set to the user stack space. Interrupts are also disabled at the processor MSR register.

Entry Conditions

R03 ==> MPU number (i.e., 0-1)
R04 ==> Instruction Pointer of target code

Exit Conditions Different from Entry

R03 ==> 0, successful fork
-1, processor not idle
-2, null or not word-aligned IP
-3, invalid processor number
R04 ==> No change

.FORKMPUR Function

Note This is a PPCBug system call for MVME4600 or dual processor MTX motherboards.

Name

.FORKMPUR - Fork Idle MPU with Register Set

5

Code

$0101

Description

This routine loads the user register set into the specified MPU (load and go). This command is analogous to the BUG command **FORKWR**. Refer to Chapter 3 for the command description. Read only registers are not restored but are present in the list.

The format of the register set is shown below:

	31 24	23 16	15 8	7 0
$000	GPR00			
$004	GPR01			
$008	GPR02			
$00C	GPR03			
$010	GPR04			
$014	GPR05			
$018	GPR06			
$01C	GPR07			
$020	GPR08			
$024	GPR09			
$028	GPR10			
$02C	GPR11			
$030	GPR12			
$034	GPR13			
$038	GPR14			
$03C	GPR15			
$040	GPR16			
$044	GPR17			
$048	GPR18			
$04C	GPR19			
$050	GPR20			
$054	GPR21			

	31 24	23 16	15 8	7 0
$058	GPR22			
$05C	GPR23			
$060	GPR24			
$064	GPR25			
$068	GPR26			
$06C	GPR27			
$070	GPR28			
$074	GPR29			
$078	GPR30			
$07C	GPR31			
$080	FPR00			
$088	FPR01			
$090	FPR02			
$098	FPR03			
$0A0	FPR04			
$0A8	FPR05			
$0B0	FPR06			
$0B8	FPR07			
$0C0	FPR08			
$0C8	FPR09			
$0D0	FPR10			
$0D8	FPR11			
$0E0	FPR12			
$0E8	FPR13			
$0F0	FPR14			
$0F8	FPR15			
$100	FPR16			
$108	FPR17			
$110	FPR18			
$118	FPR19			
$120	FPR20			
$128	FPR21			
$130	FPR22			
$138	FPR23			
$140	FPR24			
$148	FPR25			
$150	FPR26			
$158	FPR27			
$160	FPR28			
$168	FPR29			
$170	FPR30			
$178	FPR31			
$180	SR00			
$184	SR01			
$188	SR02			
$18C	SR03			
$190	SR04			
$194	SR05			

	31 24	23 16	15 8	7 0
$198		SR06		
$19C		SR07		
$1A0		SR08		
$1A4		SR09		
$1A8		SR10		
$1AC		SR11		
$1B0		SR12		
$1B4		SR13		
$1B8		SR14		
$1BC		SR15		
$1C0		SPR00		
$1C4		SPR01		
$1C8		SPR04		
$1CC		SPR05		
$1D0		SPR06		
$1D4		SPR08		
$1D8		SPR09		
$1DC		SPR18		
$1E0		SPR19		
$1E4		SPR20		
$1E8		SPR21		
$1EC		SPR22		
$1F0		SPR25		
$1F4		SPR26		
$1F8		SPR27		
$1FC		SPR268		
$200		SPR269		
$204		SPR272		
$208		SPR273		
$20C		SPR274		
$210		SPR275		
$214		SPR282		
$218		SPR283		
$21C		SPR285		
$220		SPR287		
$224		SPR528		
$228		SPR529		
$22C		SPR530		
$230		SPR531		
$234		SPR532		
$238		SPR533		
$23C		SPR534		
$240		SPR535		
$244		SPR536		
$248		SPR537		
$24C		SPR538		
$250		SPR539		
$254		SPR540		
$258		SPR541		

	31 24	23 16	15 8	7 0
$25C	SPR542			
$260	SPR543			
$264	SPR936			
$268	SPR937			
$26C	SPR938			
$270	SPR939			
$274	SPR940			
$278	SPR941			
$27C	SPR942			
$280	SPR952			
$284	SPR953			
$288	SPR954			
$28C	SPR955			
$290	SPR956			
$294	SPR957			
$298	SPR958			
$29C	SPR976			
$2A0	SPR977			
$2A4	SPR978			
$2A8	SPR979			
$2AC	SPR980			
$2B0	SPR981			
$2B4	SPR982			
$2B8	SPR984			
$2BC	SPR986			
$2C0	SPR987			
$2C4	SPR990			
$2C8	SPR991			
$2CC	SPR1008			
$2D0	SPR1009			
$2D4	SPR1010			
$2D8	SPR1013			
$2DC	SPR1017			
$2E0	SPR1019			
$2E4	SPR1020			
$2E8	SPR1021			
$2EC	SPR1022			
$2F0	SPR1023			
$2F4	IP			
$2F8	MSR			
$2FC	CR			
$300	FPSCR			
$304	CPUIEN			

Field descriptions:

GPR00 to GPR31	general purpose registers
FPR00 to FPR31	floating point registers
SR00 to SR15	segment registers
SPR0 to SPR1023	special purpose registers
IP	instruction pointer
MSR	machine state register
CR	Condition register
FPSCR	floating point status and control register
CPUIEN	CPU interrupt enable

Refer to the microprocessor and CPU user manuals for a detailed description for each of these registers.

Entry Conditions

R03 ==> MPU number (i.e., 0 - 1)
R04 ==> Address (word) Starting address of register set

Exit Conditions Different from Entry

R03 ==> $00000000 - fork was successful
$FFFFFFFF - processor is not idle
$FFFFFFFE - invalid instruction pointer
$FFFFFFFD - invalid processor number

.IDLEMPU Function

Name

.IDLEMPU - Idle MPU (Multiple MPU Configuration)

Code

$0110

Description

.IDLEMPU is used to idle the processor executing this system call.

Entry Conditions

R03 ==> MPU number (i.e., 0-1)

Exit Conditions Different From Entry

R03==>0, idle successful
-1, processor already idle
-2, all other processors are idle
-3, invalid processor number

.IOINQ

Name

.IOINQ - Port Inquire

Code

$0120

Description

Writes the Port Control Structure at the user-specified address. The Port Control Structure contains I/O Port Concurrent Mode and Port Control information about the named port.

Entry Conditions

R0: Pointer to Port Control Structure as defined below. The Port Number, Board Name Pointer, and I/O Control Structure Pointer members of the Port Control Structure must be USER initialized before calling **.IOINQ**.

Exit Conditions Different From Entry

R03: Pointer to Port Control Structure, or R03: NULL (Port not recognized error). The Port Control Structure will be modified as described above.

Port Control Structure

The Port Control Structure is of the form:

	31 24	23 16	15 8	7 0
$00	Port Number			
$04	Board Name Pointer			
$08	Channel			
$0C	Device Address			
$10	Concurrent Mode			
$14	Modem ID			
$18	I/O Control Structure Pointer			

	31 24	23 16	15 8	7 0
$1C	Error Code			
$20	Reserved			
$24	Reserved			
$28	Reserved			

Field descriptions:

Port Number — The Port Number as used here is analogous to the port number as required by the **PF** (Port Format) command. Port Numbers are assigned as follows:

$FFFFFFFE	Concurrent Port
$FFFFFFFF	System Console
$0 - $1F	Other currently assigned port

Board Name Pointer — A pointer to a null ($00) terminated ASCII string which is the name of the target device. The maximum length of this string is 20 bytes. The device name as used here is analogous to the device name as required by the **PF** command. The following devices are supported:

VKIO
PC16550
Z85C230
PC87303

Channel — On multi-port devices, this value specifies which port of the device is being referenced. Zero inclusive port numbering is assumed, i.e., Port A is Channel Number 0.

Device Address — Base address of the I/O Device

Concurrent Mode — Nonzero Value flags concurrent mode operation of this port. Zero flags normal operation for this port.

Modem ID — Modem identification code for the modem associated with this port. The Modem ID code is ONLY valid if Concurrent Mode Operation is true for this port. The following modems are currently supported:

Modem ID	Modem Type
1	Non-intelligent modem
2	Terminal - Refer to the *Using the Service Call* section in Appendix B.
3	UDS 2662
4	UDS 2980
5	UDS 3382
6	MVME733EXT
7	MVME733F

I/O Control Structure Pointer — A pointer to the port parameter/configuration table. See *I/O Control Structure* on page 5-103.

Error Code — Contains error code, if any. The following error codes are defined:

1	PF Error; couldn't format the Port with the user's parameters
2	Port Number not recognized - the PPCBug does not have a definition for the given Port Number
3	Synchronization Error - can't turn on Concurrent Mode (Concurrent Mode already on)
4	PPCBug has no definition for the Port Number specified
5	Port Number not in range of -2 to $1F
6	No info available on CM port because CM not active
7	All legal Port Numbers are currently in use
8	All device driver Control Structures are currently in use - can't define any more Port Numbers.
9	Synchronization Error - cannot turn off CM. CM is already off.

10 Contradictory Request. CM port number specified but user's CM flag is clear and no PPCBug port is currently operating in CM.

11 Illegal Port number for .IODELETE trap call

12 Alias for Error #11

13 .IODELETE is not allowed to delete this port (PPCBug default port(s)).

14 Alias for Error #8

15 Alias for Error #7

16 Unknown modem type. Returned Port Number is valid, but CM is NOT set.

Reserved — These locations are set to zero on return to the caller.

I/O Control Structure

The I/O Control Structure is of the form:

	31 24	23 16	15 8	7 0
$00	ctrlbits			
$04	baud			
$08	00	00	00	protocol
$0C	00	00	00	sync1
$10	00	00	00	sync2
$14	00	00	00	xonchar
$18	00	00	00	xoffchar

Field descriptions:

ctrlbits — The bits of this 32-bit wide integer are defined as high true flags with the following meanings:

Bit 00 odd parity

Bit 01 even parity

Bit 028 bit character word

Bit 037 bit character word

	Bit 046	bit character word
	Bit 055	bit character word
	Bit 062	stop bits
	Bit 071	stop bit
	Bit 08	data terminal equipment
	Bit 09	data computer equipment
	Bit 10	cts control
	Bit 11	rts control
	Bit 12	xon/xoff control
	Bit 13	hard copy flag
baud	Baud rate value for this port	
protocol	A single ASCII character representing the desired communications protocol. The following characters are defined by the PPCBug.	
	A	Async
	M	Mono
	B	Bisync
	G	Gen
	S	SDLC
	H	HDLC

Note Only the asynchronous protocol is supported by PPCBug.

sync1	8 bit value to be used as the sync1 character in the synchronous communication protocols
sync2	8 bit value to be used as the sync2 character in the synchronous communication protocols
xonchar	Software flow (on) control character
xoffchar	Software flow (off) control character

.IOINFORM

Name

.IOINFORM - Port Inform

Code

$0124

Description

This trap will inform the PPCBug about change in I/O Port operation. The PPCBug updates its internal I/O control structures and writes Error Code and (possibly) Port Number in your Port Control Structure.

If you wish to inform the PPCBug that you are turning on Concurrent Mode, you must set the Concurrent Mode field of the Port Control Structure. It is permissible to use a Port number of -2 when turning on Concurrent Mode. The PPCBug will return a valid Port Number for your future reference.

If you wish to inform the PPCBug that you are turning off Concurrent Mode operation, you must use a Port Number that has been returned by the .IOINQ or .IOINFORM system calls.

Entry Conditions

R03: Pointer to the Port Control Structure.

All members of the Port Control Structure, except Error Code and Reserved, as well as the Board Name String and I/O Control Structure must be user initialized before calling .IOINFORM.

Exit Conditions Different From Entry

R03: Pointer to the Port Control Structure, or
R03: NULL (Port not recognized error).

The Port Control Structure will be modified as described above.

Port Control Structure

The Port Control Structure is of the form:

	31 24	23 16	15 8	7 0
$00	Port Number			
$04	Board Name Pointer			
$08	Channel			
$0C	Device Address			
$10	Concurrent Mode			
$14	Modem ID			
$18	I/O Control Structure Pointer			
$1C	Error Code			
$20	Reserved			
$24	Reserved			
$28	Reserved			

.IOCONFIG

Name

.IOCONFIG - Port Configure

Code

$0128

Description

This trap will instruct the PPCBug to access the I/O device to change port operation and to update its internal I/O Control structures. The PPCBug writes ERROR CODE and (possibly) PORT NUMBER in your Port Control Structure.

If you wish to inform the PPCBug that you are turning on Concurrent Mode, you must set the Concurrent Mode field of the Port Control Structure. It is permissible to use a Port number of -2 when turning on Concurrent Mode. The PPCBug will return a valid Port Number for your future reference.

If you wish to inform the PPCBug that you are turning off Concurrent Mode operation, you must use a PORT NUMBER that has been returned by the .IOINQ or .IOINFORM system calls.

Entry Conditions

R03: Pointer to Port Control Structure.

All members of the Port Control Structure, except Error Code and Reserved, as well as the Board Name String and I/O Control Structure must be user initialized before calling .IOCONFIG.

Exit Conditions Different From Entry

R03: Pointer to Port Control Structure as defined above, or
R03: NULL (Port not recognized error).

The Port Control Structure will be modified as described above.

.IODELETE

Name

.IODELETE - Port Delete

Code

$012C

Description

Causes the PPCBug to delete the named I/O port from its internal port list. The routine of this call is analogous to the PPCBug **NOPF** command. Note that .IODELETE cannot delete the Concurrent port. You must first use the .IOINFORM trap and then you may delete the port.

Entry Conditions

R03: Pointer to Port Control Structure as defined above.

The Port Number member of the Port Control Structure must be USER initialized before calling .IODELETE. The Board Name Pointer, Channel, Device Address, Concurrent Flag, Modem ID, and, I/O Control Pointer members of the Port Control Structure are not used by this trap.

Exit Conditions Different From Entry

R03: Pointer to Port Control Structure as defined above, or
R03: NULL (Port not recognized error).

The Port Control Structure Error Code field will be written with an error code if any errors occurred.

Port Control Structure

The Port Control Structure is of the form:

	31 24	23 16	15 8	7 0
$00	Port Number			
$04	Board Name Pointer			
$08	Channel			
$0C	Device Address			
$10	Concurrent Mode			
$14	Modem ID			
$18	I/O Control Structure Pointer			
$1C	Error Code			
$20	Reserved			
$24	Reserved			
$28	Reserved			

.SYMBOLTA

Name

.SYMBOLTA - Attach Symbol Table

Code

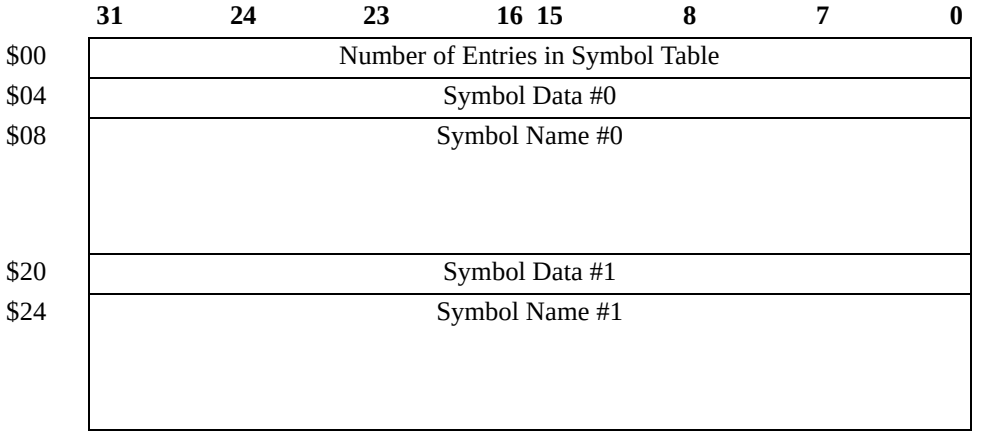
$0130

5

Description

This routine attaches a symbol table to the debugger. Once a symbol table has been attached, all displays of physical addresses are first looked up in the symbol table to see if the address is in range of any of the symbols (symbol data). If the address is in range, it is displayed with the corresponding symbol name and offset (if any) from the symbol base address (symbol data). In addition to the display, any command line input that supports an address as an argument can now take a symbol name for the address argument. The address argument is first looked up in the symbol table to see if it matches any of the addresses (symbol data) before conversion takes place. This command is analogous to the debugger command **SYM**. Refer to Chapter 3 for the command description.

The format of the symbol table is shown below:



Field descriptions:

Number of Entries in Symbol Table	The number of entries in table
Symbol Data	32-bit hexadecimal value. The symbol data fields must be ascending in value (sorted numerically). Upon execution of the system call, the debugger performs a sanity check on the symbol table with the above rules. The symbol table is not attached if the check fails.
Symbol Name	A string of printable characters; may be null ($00) terminated

Entry Conditions

R03: Address (word) Starting address of symbol table

Exit Conditions Different From Entry

R03: Bit 3 (ne) = 1; Bit 2 (eq) = 0 if errors (sanity check failed)
R03: Bit 3 (ne) = 0; Bit 2 (eq) = 1 if no errors

.SYMBOLTD

Name

.SYMBOLTD - Detach Symbol Table

Code

$0131

Description

This routine detaches a symbol table from the debugger. This command is analogous to the debugger command **NOSYM**. Refer to Chapter 3 for the command description.

Entry Conditions

None

Exit Conditions Different From Entry

None

Related Documentation A

Motorola Computer Group Documents

The Motorola publications listed below are referenced in this manual. You can obtain paper or electronic copies of Motorola Computer Group publications by:

- Contacting your local Motorola sales office
- Visiting Motorola Computer Group's World Wide Web literature site, http://www.motorola.com/computer/literature

Table A-1. Motorola Computer Group Documents

Document Title	Publication Number
MCP750 CompactPCI Single Board Computer Installation and Use*	MCP750A/IH
MCP750 CompactPCI Single Board Computer Programmer's Reference Guide	MCP750A/PG
MCPN750 CompactPCI Single Board Computer Installation and Use	MCPN750A/IH
MCP750 CompactPCI Single Board Computer Programmer's Reference Guide	MCPN750A/PG
MVME2100 Series Single Board Computer Installation and Use	V2100A/IH
MVME2100 Series Single Board Computer Programmer's Reference Guide	V2100A/PG
MVME2400 Series VME Processor Module Installation and Use	V2400A/IH
MVME2400 Series VME Processor Module Programmer's Reference Guide	V2400A/PG
MVME2600 Series Single Board Computer Installation and Use	V2600A/IH
MVME2600 Series Single Board Computer Programmer's Reference Guide	V2600A/PG
MVME2700 Series VME Processor Module Installation and Use	V2700A/IH
MVME2700 Series VME Processor Module Programmer's Reference Guide	V2700A/PG
MVME3600 Series Single Board Computer Installation and Use	V3600A/IH
MVME4600 Series VME Processor Module Installation and Use	V4600A/IH

Table A-1. Motorola Computer Group Documents (Continued)

Document Title	Publication Number
MVME3600/4600 Series VME Processor Modules Programmer's Reference Guide	V3600A/PG
MVME2300 VME Processor Modules Installation and Use	V2300A/IH
MVME2300 VME Processor Modules Programmer's Reference Guide	V2300A/PG
MVME2400 VME Processor Modules Installation and Use	V2400A/IH
MVME2300 VME Processor Modules Programmer's Reference Guide	V2400A/PG
MTX Embedded ATX Motherboard Installation and Use	MTXA/IH
MTX Embedded ATX Motherboard Programmer's Reference Guide	MTXA/PG
PMCSpan PMC Adapter Carrier Module Installation and Use	PMCSPANA/IH
PPCBug Diagnostics Manual	PPCDIAA/UM
TMCP700 Transition Module Installation and Use	TMCP700A/IH
TMCPN710 Transition Module Installation and Use	TMCPN710A/IH
MVME712M Transition Module and P2 Adapter Board Installation and Use	VME712MA/IH
MVME761 Transition Module Installation and Use	VME761A/IH

Microprocessor and Controller Documents

For additional information, refer to the following table for manufacturers' data sheets or user's manuals. As an additional help, a source for the listed document is also provided. Please note that in many cases, the information is preliminary and the revision levels of the documents are subject to change without notice. .

Table A-2. Microprocessor and Controller Documents

Document Title and Source	Publication Number
PowerPC 603™ RISC Microprocessor Technical Summary Literature Distribution Center for Motorola Telephone: (800) 441-2447 FAX: (602) 994-6430 or (303) 675-2150 E-mail: ldcformotorola@hibbertco.com	MPC603/D
PowerPC 603™ RISC Microprocessor User's Manual Literature Distribution Center for Motorola Telephone: (800) 441-2447 FAX: (602) 994-6430 or (303) 675-2150 E-mail: ldcformotorola@hibbertco.com OR IBM Microelectronics Mail Stop A25/862-1 PowerPC Marketing 1000 River Street Essex Junction, Vermont 05452-4299 Telephone: 1-800-PowerPC Telephone: 1-800-769-3772 FAX: 1-800-POWERfax FAX: 1-800-769-3732	MPC603UM/AD MPR603UMU-01
MPC750™ RISC Microprocessor User's Manual Motorola Literature Distribution Center Telephone: (800) 441-2447 or (303) 675-2140 FAX: (303) 675-2150 E-mail: ldcformotorola@hibbertco.com INTERNET: http://motorola.com/sps INTERNET: http://www.mot.com/PowerPC	MPC750UM/AD

Table A-2. Microprocessor and Controller Documents (Continued)

Document Title and Source	Publication Number
PowerPC 604™ RISC Microprocessor User's Manual Literature Distribution Center for Motorola Telephone: (800) 441-2447 FAX: (602) 994-6430 or (303) 675-2150 E-mail: ldcformotorola@hibbertco.com OR IBM Microelectronics Mail Stop A25/862-1 PowerPC Marketing 1000 River Street Essex Junction, Vermont 05452-4299 Telephone: 1-800-PowerPC Telephone: 1-800-769-3772 FAX: 1-800-POWERfax FAX: 1-800-769-3732	MPC604UM/AD MPR604UMU-01
PowerPC™ Microprocessor Family: The Programming Environments Motorola Literature Distribution Center Telephone: (800) 441-2447 FAX: (602) 994-6430 or (303) 675-2150 E-mail: ldcformotorola@hibbertco.com OR IBM Microelectronics Mail Stop A25/862-1 PowerPC Marketing 1000 River Street Essex Junction, Vermont 05452-4299 Telephone: 1-800-PowerPC Telephone: 1-800-769-3772 FAX: 1-800-POWERfax FAX: 1-800-769-3732	MPCFPE/AD MPRPPCFPE-01
MPC2604GA Integrated Secondary Cache for PowerPC Microprocessors Data Sheets Literature Distribution Center for Motorola Telephone: (800) 441-2447 FAX: (602) 994-6430 or (303) 675-2150 E-mail: ldcformotorola@hibbertco.com	MPC2604GA

Table A-2. Microprocessor and Controller Documents (Continued)

Document Title and Source	Publication Number
Alpine™ VGA Family - CL-GD543X/'4X Technical Reference Manual Fourth Edition Cirrus Logic, Inc. (or nearest Sales Office) 3100 West Warren Avenue Fremont, California 94538-6423 Telephone: (510) 623-8300 FAX: (510) 226-2180	385439
DECchip 21040 Ethernet LAN Controller for PCI Hardware Reference Manual Digital Equipment Corporation Maynard, Massachusetts DECchip Information Line Telephone (United States and Canada): 1-800-332-2717 TTY (United States only): 1-800-332-2515 Telephone (outside North America): +1-508-568-6868	EC-N0752-72
DECchip 21140 PCI Fast Ethernet LAN Controller Hardware Reference Manual Digital Equipment Corporation Maynard, Massachusetts DECchip Information Line Telephone (United States and Canada): 1-800-332-2717 TTY (United States only): 1-800-332-2515 Telephone (outside North America): +1-508-568-6868	EC-QC0CA-TE
PC87303VUL (Super I/O™ Sidewinder Lite) Floppy Disk Controller, Keyboard Controller, Real-Time Clock, Dual UARTs, IEEE 1284 Parallel Port, and IDE Interface National Semiconductor Corporation Customer Support Center (or nearest Sales Office) 2900 Semiconductor Drive P.O. Box 58090 Santa Clara, California 95052-8090 Telephone: 1-800-272-9959	PC87303VUL

Table A-2. Microprocessor and Controller Documents (Continued)

Document Title and Source	Publication Number
PC87307VUL (Super I/O™ Enhanced Sidewinder Lite) Floppy Disk Controller,, Keyboard Controller, Real-Time Clock, Dual UARTs, IEEE 1284 Parallel Port, and IDE Interface National Semiconductor Corporation Customer Support Center (or nearest Sales Office) 2900 Semiconductor Drive P.O. Box 58090 Santa Clara, California 95052-8090 Telephone: 1-800-272-9959	PC87307VUL
PC87308VUL (Super I/O™ Enhanced Sidewinder Lite) Floppy Disk Controller, Keyboard Controller, Real-Time Clock, Dual UARTs, IEEE 1284 Parallel Port, and IDE Interface National Semiconductor Corporation Customer Support Center (or nearest Sales Office) 2900 Semiconductor Drive P.O. Box 58090 Santa Clara, California 95052-8090 Telephone: 1-800-272-9959	PC87308VUL
PC16550 UART National Semiconductor Corporation Customer Support Center (or nearest Sales Office) 2900 Semiconductor Drive P.O. Box 58090 Santa Clara, California 95052-8090 Telephone: 1-800-272-9959	PC16550DV
MK48T559 Address/Data Multiplexer 8K x 8 TIMEKEEPER™ SRAM Data Sheet SGS-Thomson Microelectronics Group Faxback (Document-on-Demand) system Carrollton, TX Telephone: (972) 4667-7788	M48T559

Table A-2. Microprocessor and Controller Documents (Continued)

Document Title and Source	Publication Number
SYM 53CXX (was NCR 53C8XX) Family PCI-SCSI I/O Processors Programming Guide Symbios Logic Inc. 1731 Technology Drive, suite 600 San Jose, CA95110 Telephone: (408) 441-1080 Hotline: 1-800-334-5454	T72961II
SCC (Serial Communications Controller) User's Manual (for Z85230 and other Zilog parts) Zilog, Inc. 210 East Hacienda Ave., mail stop C1-0 Campbell, California 95008-6600 Telephone: (408) 370-8016 FAX: (408) 370-8056	DC-8293-02
AMD-645™ Peripheral Bus Controller Data Sheet Advanced Micro Devices, Inc. or VT82C586B PIPC PCI Integrated Peripheral Controller PC97 Compliant PCI-to-ISA Bridge with ACPI, Distributed DMA, Plug and Play, Master Mode PCI-IDE Controller with Ultra DMA-33 USB Controller, Keyboard Controller, and RTC VIA Technologies, Inc. 5020 Brandin Court Fremont, CA 94538 Telephone: (510) 683-3300 FAX: (510) 683-3301	21095A/O VT82C586B
Digital Semiconductor 21154 PCI-to-PCI Bridge Data Sheet Digital Equipment Corporation Maynard, MA Telephone (United States and Canada): 1-800-332-2717 Telephone (Outside North America): +1-508-628-4760	EC-R24JA-TE

Table A-2. Microprocessor and Controller Documents (Continued)

Document Title and Source	Publication Number
Z8536 CIO Counter/Timer and Parallel I/O Unit Product Specification and User's Manual (in Z8000® Family of Products Data Book) Zilog, Inc. 210 East Hacienda Ave., mail stop C1-0 Campbell, California 95008-6600 Telephone: (408) 370-8016 FAX: (408) 370-8056	DC-8319-00
W83C553 Enhanced System I/O Controller with PCI Arbiter (PIB) Winbond Electronics Corporation Winbond Systems Laboratory 2730 Orchard Parkway San Jose, CA 95134 Telephone: 1-408-943-6666 FAX: 1-408-943-6668	W83C553
Universe User Manual Tundra Semiconductor Corporation 603 March Road Kanata, ON K2K 2M5, Canada Telephone: 1-800-267-7231 Telephone: (613) 592-1320 OR 695 High Glen Drive San Jose, California 95133, USA Telephone: (408) 258-3600 FAX: (408) 258-3659	Universe (Part Number 9000000.MD303.01)

Related Specifications

For additional information, refer to the following table for related specifications. As an additional help, a source for the listed document is also provided. Please note that in many cases, the information is preliminary and the revision levels of the documents are subject to change without notice.

Table A-3. Related Specifications

Document Title and Source	Publication Number
ANSI Small Computer System Interface-2 (SCSI-2), Draft Document Global Engineering Documents 15 Inverness Way East Englewood, CO 80112-5704 Telephone: 1-800-854-7179 Telephone: (303) 792-2181	X3.131.1990
Compact PCI Specification PCI Industrial Manufacturers Group (PICMG) 401 Edgewater Pl, Suite 500 Wakefield, MA 01880 Telephone: 781-246-9318 Fax: 781-224-1239	CPCI Rev. 2.1 Dated 9/2/97

Table A-3. Related Specifications (Continued)

Document Title and Source	Publication Number
VME64 Specification VITA (VMEbus International Trade Association) 7825 E. Gelding Drive, Suite 104 Scottsdale, Arizona 85260-3415 Telephone: (602) 951-8866 FAX: (602) 951-0720 **NOTE:** An earlier version of this specification is available as:	ANSI/VITA 1-1994
Versatile Backplane Bus: VMEbus Institute of Electrical and Electronics Engineers, Inc. Publication and Sales Department 345 East 47th Street New York, New York 10017-21633 Telephone: 1-800-678-4333 OR Microprocessor system bus for 1 to 4 byte data Bureau Central de la Commission Electrotechnique Internationale 3, rue de Varembé Geneva, Switzerland	ANSI/IEEE Standard 1014-1987 IEC 821 BUS
IEEE - Common Mezzanine Card Specification (CMC) Institute of Electrical and Electronics Engineers, Inc. Publication and Sales Department 345 East 47th Street New York, New York 10017-21633 Telephone: 1-800-678-4333	P1386 Draft 2.0
IEEE - PCI Mezzanine Card Specification (PMC) Institute of Electrical and Electronics Engineers, Inc. Publication and Sales Department 345 East 47th Street New York, New York 10017-21633 Telephone: 1-800-678-4333	P1386.1 Draft 2.0

Table A-3. Related Specifications (Continued)

Document Title and Source	Publication Number
Bidirectional Parallel Port Interface Specification Institute of Electrical and Electronics Engineers, Inc. Publication and Sales Department 345 East 47th Street New York, New York 10017-21633 Telephone: 1-800-678-4333	IEEE Standard 1284
Peripheral Component Interconnect (PCI) Local Bus Specification, Revision 2.1 PCI Special Interest Group 2575 NE Kathryn St. #17 Hillsboro, OR 97124 Telephone: (800) 433-5177 (inside the U.S.) or (503) 693-6232 (outside the U.S.) FAX: (503) 693-8344	PCI Local Bus Specification
PowerPC Reference Platform (PRP) Specification, Third Edition, Version 1.0, Volumes I and II International Business Machines Corporation Power Personal Systems Architecture 11400 Burnet Rd. Austin, TX 78758-3493 Document/Specification Ordering Telephone: 1-800-PowerPC Telephone: 1-800-769-3772 Telephone: 708-296-9332	MPR-PPC-RPU-02
ATX Specification Version 2.01 created by Intel Corporation available on the World Wide Web through Teleport Internet Services at URL http://www.teleport.com/~atx/index.htm	
IEEE Standard for Local Area Networks: Carrier Sense Multiple Access with Collision Detection (CSMA/CD) Access Method and Physical Layer Specifications Institute of Electrical and Electronics Engineers, Inc. Publication and Sales Department 345 East 47th Street New York, New York 10017-21633 Telephone: 1-800-678-4333	IEEE 802.3

Table A-3. Related Specifications (Continued)

Document Title and Source	Publication Number
Information Technology - Local and Metropolitan Networks - Part 3: Carrier Sense Multiple Access with Collision Detection (CSMA/CD) Access Method and Physical Layer Specifications Global Engineering Documents 15 Inverness Way East Englewood, CO 80112-5704 Telephone: 1-800-854-7179 Telephone: (303) 792-2181 *(This document can also be obtained through the national standards body of member countries.)*	ISO/IEC 8802-3
Interface Between Data Terminal Equipment and Data Circuit-Terminating Equipment Employing Serial Binary Data Interchange (EIA-232-D) Electronic Industries Association Engineering Department 2001 Eye Street, N.W. Washington, D.C. 20006	ANSI/EIA-232-D Standard

System Menu B

Introduction

Enter the **MENU** command at either the PPCx-Bug> or PPCx-Diag> prompt to display the System Menu, which is shown below.

```
1) Continue System Start Up
2) Select Alternate Boot Device
3) Go to System Debugger
4) Initiate Service Call
5) Display System Test Errors
6) Dump Memory to Tape
```

Menu Items

Continue System Start-up

Enter **1** to continue the system start-up and boot sequence. The system self-tests, followed by the boot routine, either NVRAM Boot List Boot, Auto Boot, ROMboot, or Network Auto Boot. The boot routine, and the boot device, are selectable in the **ENV** command. Refer to Chapter 3 for information on setting the **ENV** command parameters.

If the self-test fails to complete correctly, it may display an error message. Refer to Appendix C for explanations of these error messages. Refer to the *PPCBug Diagnostics Manual* for explanations of some of the self-tests and test error messages.

Select Alternate Boot Device

Enter **2** to receive the following prompts for entering an alternate boot device:

```
*Enter Alternate Boot Device:
Controller:
Drive      :
File       :".
```

The devices supported by the PPCBug are listed in Appendix E. After entry of a selected device and a carriage return, the menu is redisplayed for another selection (normally `Continue System Start Up`).

Go to System Diagnostics

Enter **3** to go to the PPCBug diagnostics directory. You may return to the System Menu by entering the **MENU** command at the `PPCx-Diag>` prompt.

Initiate Service Call

Enter **4** to initiate a service call.

This function is normally used to complete a connection to a service center which can then use the concurrent mode (the concurrent operation of a modem connected terminal and the system console) to assist a customer with a problem.

Refer to *Using the Service Call Function* on page B-5 for details on this menu item.

Display System Test Errors

Enter **5** to display any errors accumulated by the extended confidence test suite when last run. This can be a useful field service tool.

Dump Memory to Tape

Enter **6** to save an image of memory on to tape for later analysis. The output of tape dump is two or more files on the user-specified controller and device. The first file (File 0) contains information about the Tape Dump Utility that created the tape, certain hardware specific information, and, an array of Tape Dump File Map Entries.

Other files (files 1 through *n*) written by the Tape Dump Utility are simply image(s) of memory at the time the Tape Dump Utility was invoked.

This implementation of the Tape Dump Utility allows you to define multiple blocks of memory, each block written as a separate file on the tape. The Tape Dump File Map Entries in File 0 describe the address ranges of system memory that each tape file contains.

The File Zero Structure is of the form:

```
struct fil0 {
  char magic[4];              /* magic number */
  char who_do[4];             /* who made dump (Bug or OS) */
  int file0sz;                /* File zero size */
  int complete;               /* tape dump completed flag */
  int Trev;                   /* Revision of this structure */
  struct brdid bd_info;       /* Board Identification Packet */
  struct tddir tdir[MAXFILES]; /* Tape Dump File Map Entries */
};
```

The Board Identification/Information structure (**brdid**) is identical to the Board ID packet returned by the System Call **.BRD_ID**.

The constant FZS_REV is the File Zero Structure revision in Binary Coded Decimal (BCD) representation. FZS_REV is defined as $110 (that is, rev. 1.10). Member Trev is set to FZS_REV.

The constant MAXFILES determines the maximum number of Tape Dump File Map Entries in the File 0 Structure Template and, congruently, the maximum number of memory blocks that can define and dump. MAXFILES is defined as 20.

The Tape Dump File Map Entry structure is of the form:

```
struct tddir {
  unsigned int fileno;              /* file number */
  unsigned int saddr;              /* memory starting address */
  unsigned int eaddr;               /* memory ending address */
};
```

The first member of the Tape Dump File Map Entry structure is File Number (**fileno**). The normal range of values for **fileno** is from 1 to MAXFILES. The value $FFFFFFFF in **fileno** flags an invalid and unused File Map Entry.

Tape Dump Example:

```
1) Continue System Start Up
2) Select Alternate Boot Device
3) Go to System Debugger
4) Initiate Service Call
5) Display System Test Errors
6) Dump Memory to Tape
Enter Menu #: 6<Return>

Do you wish to dump memory (N/Y)? <Return>
Controller LUN = 04, Device LUN = 00.
Change DLUN and/or CLUN (Y/N)? <Return>
Define memory blocks to be dumped.
File Number:1
Starting Address   = 00000000? <Return>
Ending Address + 1 = 01000000? 10000<Return>
Define another memory block  (Y/N)? Y<Return>
File Number:2
Starting Address   = 80000 <Return>
Ending Address + 1 = 100000 <Return>
Define another memory block  (Y/N)? <Return>

The following memory blocks have been defined:
File: 1  Start: 00000000  End: 00010000
File: 2  Start: 00080000  End: 00100000

Insert tape..Do you want to continue (N/Y)? <Return>
Rewind command executing

Erase Tape (Y/N)? <Return>

Retension Tape (Y/N)? <Return>
Writing file # 0
Writing file # 1
Writing file # 2

Dump finished. You may remove tape.

1) Continue System Start Up
2) Select Alternate Boot Device
3) Go to System Debugger
4) Initiate Service Call
5) Display System Test Errors
6) Dump Memory to Tape
Enter Menu #:
```

Using the Service Call Function

Operation

The service call function displays a series of interactive prompts. Any question requiring a **Y** or **N** answer defaults to **N** if only **Return** is entered.

First, the system asks the modem type:

```
Modem Type:
 0) Terminal -            -                        9600
 1) Manual   -            -                        1200
 2) Internal -            UDS-2122662              1200
 3) Internal MVME712A/AM  UDS-V.22b                2400
 4) Internal MVME714M     UDS-V.22b                2400
 5) External MVME733EXT   UDS-V.32/V.42b,FasTalk   9600
 6) Internal MVME733F     UDS-V.32/V.42b           9600
Your Selection (2)? 0
```

Select **0** (Terminal) to connect any ASCII terminal in place of a modem via a null modem or equivalent cable. This is useful in certain trouble-shooting applications for providing a slave terminal without the necessity of dialing through a modem. Refer to *Terminal Connection* on page B-10.

Select **1** (Manual) connects directly to the modem in an ASCII terminal mode, allowing any nonstandard protocol modem to be used. Refer to *Manual Connection* on page B-9.

”UDS” signifies an internal modem that is compatible with the UDS modem protocol.

When an option is selected, the system asks:

```
Do you want to change the baud rate from 1200 (Y/N)?
```

If you answer **Y** (the default is **N**), the system prompts:

```
Baud rate [300, 1200, 2400, 4800, 9600] 1200?
```

Enter a baud rate from the and press Return. If you do not enter a value, the baud rate remains as previously set.

The system then asks:

```
Is the modem already connected to customer service (Y/N)?
```

When a connection has been made to a customer service center (or any other remote device), hang up does not automatically occur; it is an operation that you initiate. If a system reset has occurred, for instance, a hang up does not take place, and connection to customer service is still in effect. In this case, it is not necessary or desirable to attempt to reconnect on a connection that is already in effect.

When an answer is entered, the system responds:

```
Enter System ID Number:
```

This number is typically assigned to your system by customer service. The customer service computer may do a check to assure the validity of this number for login purposes.

The system responds with:

```
Wait for an incoming Call or Dial Out (W/D)?
```

Enter **W** to wait for the other computer to dial in to complete the connection. Enter **D** for dialing out yourself. If **D** is selected, the system asks:

```
UDS Modem:

(T) = Tone Dialing (Default), (P) = Pulse Dialing
(=) = Pause and Search for a Dial Tone
(,) = Wait 2 Seconds
```

The system then asks:

```
Enter phone number:
```

Enter the number, including area code if required. Do not use any separators except for a comma (,) or equal sign (=) if required to search for a dial tone (depending on which modem protocol was selected), such as when dialing out of a location having an internal switchboard. Additionally, preface the number with one of the dialing selections. The dialing selection can also be changed within the number being dialed if necessary if an internal dialing system takes a different dialing mode than the external world switched network. When connection has been made, the system reports:

```
Service Call in progress - Connected
```

The remote system can now send either the **MESS** (Message Control) to send a message, or the **RCC** (Request for Concurrent Console) to enter the concurrent mode.

Sending Messages

Use the **MESS** command to send a message from the customer service center to the console of the calling system. The message is a string of data no more than 80 bytes in length terminated with a carriage return. The ROM code moves the string to the console followed by a carriage return and a line feed.

This command can be used to send messages to the operator (such as “Please stand by”) to give an indication of activity while various processes are taking place at the customer service center. Many of these message commands may be sent while in the command mode.

Concurrent Mode

In concurrent mode, all input from either the port, the console, or the remote, is taken simultaneously. All output is sent to both ports concurrently. Use the **RCC** command to request concurrent console. A prompt is displayed. If the operator enters **Y**, a single character **y** is sent to the customer service system, followed by the console menu as displayed on the operators console. If the operator enters **N**, the single character **f** is sent to the customer service system and the call is terminated.

Either the console or the remote console may terminate the concurrent mode at any time by typing **CTRL-a**. The phone line is hung up by the PPC ROM code and a message is displayed indicating the end of the concurrent mode.

The most likely command sequence at this point is a message command to indicate connection to the remote system, followed by a request for concurrent mode operation. When these are received, the user system asks:

```
Concurrent mode (Y/N)?
```

Enter **Y** to enter concurrent mode. The system then presents the information:

```
Select Menu Item #8 to exit Concurrent Mode
```

The menu is redisplayed and concurrent mode is in effect. Any normal system operation can now be initiated at either the local or remote connected terminal, including system reboot.

```
1) Continue System Start Up
2) Select Alternate Boot Device
3) Go to System Debugger
4) Initiate Service Call
5) Display System Test Errors
6) Dump Memory to Tape
7) Start Conversation Mode
8) Exit Concurrent Mode
```

Two new entries, `Start Conversation Mode` and `Exit Concurrent Mode`, appear in the menu during concurrent mode.

Conversation mode allows either party to initiate a direct conversation mode between the remote system terminal and the local terminal.

The conversation mode can be selected and used at any time, though the prompt line is not displayed in normal operation.

Terminating the Conversation and Concurrent Modes

To exit the conversation mode, but remain in concurrent mode, press **Return**, type a period (**.**) and press Return again.

To exit the conversation mode as well as to terminate the concurrent mode and hang up the modem, type **Ctrl-a**.

The system then redisplays the selection menu for further operator action.

You may terminate the concurrent connection by selecting menu item **4** (Initiate Service Call) while a call is underway. The system asks:

```
Do you wish to disconnect the remote link (Y/N)?
```

If you answer **N**, the system gives the option of returning to (or entering) the conversation mode:

```
Do you wish the conversation mode (Y/N)?
```

Enter **Y** to return to conversation mode. Enter **N** to redisplay the menu.

The system responds with the following series of messages if the disconnect option is chosen:

```
Wait for concurrent mode to terminate

Hanging up the Modem

Concurrent Mode Terminated
```

The last message is followed by the system menu without the `Start Conversation Mode` and `Exit Concurrent Mode` selections.

Manual Connection

Enter Manual mode by selecting Manual as the modem type.

A manual modem connection allows use of modems that have a defined ASCII command set but do not adhere to any of the standard protocols supported.

When manual modem control is attempted, the user terminal is in effect connected directly to the modem for control purposes. This is called transparent mode. When in transparent mode, you must take responsibility for modem control, and for informing the system of when connection has taken place.

If manual mode selection is made in response to the `Is the modem already connected` prompt, the following dialog takes place:

Manual mode displays all prompts as in system mode, through the `Enter System ID Number`. After the ID number has been entered, the system prompts:

```
Manually call CSO and when you are Connected,
exit the Transparent Mode

Escape character: $01=^A
```

Enter the dial command for the modem (such as **atdt**). Enter **Ctrl-a** when connection is made or if for any reason a connection cannot be made. Because the system has no knowledge of the status of the system when transparent mode is exited, it asks:

```
Did you make the connection (Y/N)?
```

If you answer **Y** to the question, the system then continues with a normal dialog with the remote system, which would be for the remote system to send the banner message followed by a request for concurrent mode operation (the concurrent operation of a modem connected terminal and the system console). If **N** is the response, the system asks:

```
Terminate CSO conversation (Y/N)?
```

Enter **Y** to re-enter transparent mode and prompt:

```
Manually hang up the modem and when you are done,
exit the transparent mode
Escape character: $01 = ^A
```

The system is now in normal operation, and the menu is redisplayed.

Terminal Connection

Enter Terminal mode by selecting Terminal as the modem type.

Operation with the terminal mode is similar to system mode, except that after the `Baud rate` prompt, the system automatically enters concurrent mode. Additionally, exiting concurrent mode does not give prompts and messages referring to the hang up sequence. All other system operation is the same as other modes of connection.

PPCBug Messages C

Introduction

This section lists the PPCBug messages.

Refer to the *PPCBug Diagnostics User's Manual* for error messages displayed while running various diagnostics commands.

Error Messages

Table C-1. Debugger Error Messages

Debugger Error Message	Meaning
`Bad VID Block`	String 'MOTOROLA' is not found while booting, and boot sequence aborts
`Concurrent Mode Already Active`	System is already active in concurrent mode in **CM** command
`Concurrent Mode Not Active`	Error message when trying to deactivate an inactive system in **NOCM** command
`Concurrent Mode Setup Failure`	Error in establishing communications with port/device in **CM** command)
`Concurrent Mode Terminated With Failure`	Error closing communications link in **NOCM** command
`Error Status: xxx`	Disk communication error status word when **IOP** command, or .DSKRD or .DSKWR system call, are unsuccessful. *xxx* is the error code. Refer to Appendix F for details.
`*** Illegal argument ***`	Improper argument in known command
`*** Illegal Option ***`	Improper option in **MM** command
`Invalid command`	Unknown command
`*** Invalid LUN ***`	Invalid controller and device selected in **IOP** or **IOT** commands
`*** Invalid Range ***`	Invalid range entered in **BC**, **BF**, **BI**, **BM**, **BS**, or **DU** commands
`*** Missing Argument ***`	Necessary argument was not entered
`NON-EXISTENT MNEMONIC`	Entry error in **MM** command with **DI** option
`NON-EXISTENT OPERAND`	Entry error in **MM** command with **DI** option
`part of S-record data`	Non-hex character is encountered in data field in **LO** or **VE** commands
`RAM FAIL AT $`*nnnnnnnn*	Parity is not correct at address $*nnnnnnnn* during a **BI** command

Table C-1. Debugger Error Messages (Continued)

Debugger Error Message	Meaning
`STRING POOL FULL, LAST LINE DISCARDED`	String pool size (511 characters) is exceeded during **MA** command
`The following record(s) did not verify` `S . . . . . ZZ . . . . . CS`	Match not found in the **LO** or **VE** commands. *ZZ* is the non-matching byte and *CS* is the non-matching checksum.
`Verify passes`	Successful **VE** command

Other Messages

Table C-2. Other Messages

Message	Meaning
`PPC1-Bug>`	Debugger prompt
`PPC1-Diag>`	Diagnostic prompt
`At Breakpoint`	Program has stopped at breakpoint
`Autoboot in progress... To Abort hit <BREAK>`	Autoboot has begun
`--Break Detected--`	BREAK key on console has stopped operation
`COLD Start`	Vectors have been initialized
`Concurrent Mode Active`	The specified port echoes the system console terminal after **CM** command
`Data = $nn`	*nn* is truncated data cut to fit data field size during **BF** or **BV** commands
`Effective address: nnnnnnnn`	Data location (**BC**, **BF**, **BI**, **BM**, **BS**, **BV**, and **DU** commands); Location of program execution (**GD**, **GN**, **GO**, and **GT** commands)
`Effective count: &nnn`	Number of data patterns acted on during **BC**, **BF**, **BI**, **BS**, or **BV** commands; or the number of bytes moved during **DU** command
`Enter Menu #:`	Enter a System Menu option.

C

Table C-2. Other Messages (Continued)

Message	Meaning
`Escape character: $HH=AA`	Exit code from transparent mode, in hex (*HH*) and ASCII (*AA*) during **TM** command
`Initial data = $XX, increment = $YY`	Data was truncated to fit the field length selected in the **BF** or **BV** commands. *XX* is starting data and *YY* is truncated increment.
`-last match extends over range boundary-`	String found in **BS** command ends outside specified range
`Logical unit $XX unassigned`	Port number referenced in **PA** or **PF** command is unassigned. $*XX* is the port LUN.
`M=`	Prompt for macro definitions during **MA** command
`NO MACROS DEFINED`	No macros have been defined (when using **MA** command to list available macros)
`No printer attached`	No printer was attached prior to running the **NOPA** command
`-not found-`	String not found in **BS** command
`OK to proceed (y/n)?`	Interlock prompt before writing macros in the **MAW** command or before configuring port in **PF** command.
`Press “RETURN” to continue`	More lines of output are available in the **BS** and **HE** commands
`WARM Start`	Vectors have not been initialized

S-Record Format

D

Introduction

The S-record format for output modules was devised for the purpose of encoding programs or data files in a printable format for transfer between computer systems. The transfer process can thus be visually monitored and the S-records can be edited more easily.

S-Record Content

When viewed by the user, S-records are essentially character strings made of five fields: the record type, record length, memory address, code/data, and checksum. Each byte of binary data is encoded as a 2-character hexadecimal number: the first character representing the high-order 4 bits, and the second the low-order 4 bits of the byte.

The contents of the S-record field are:

Table D-1. S-Record Fields

Field	Printable Characters	Contents
Type	2	S-record type, such as S0 or S1
Record Length	2	The count of the character pairs in the record, excluding the type and record length
Address	4, 6, or 8	The 2-, 3-, or 4-byte address at which the data field is to be loaded into memory
Code/Data	0-*n*	From 0 to *n* bytes of executable code, memory-loadable data, or descriptive information. For compatibility with teletypewriters, some programs may limit the number of bytes to as few as 28 (56 printable characters in the S-record).

Table D-1. S-Record Fields (Continued)

Field	Printable Characters	Contents
Checksum	2	The least significant byte of the one's complement of the sum of the values represented by the pairs of characters making up the record length, address, and the code/data fields

Each record may be terminated with a carriage return, line feed, or null. Additionally, an s-record may have an initial field to accommodate other data such as line numbers generated by some time-sharing system.

Accuracy of transmission is ensured by the record length (byte count) and checksum fields.

S-Record Types

Eight types of S-records have been defined to accommodate the several needs of the encoding, transportation, and decoding functions. The various Motorola upload, download, and other record transportation control programs, as well as cross-assemblers, linkers, and other file-creating or debugging programs, utilize only those S-records which serve the purpose of the program. For specific information on which S-records are supported by a particular program, the user's manual for that program must be consulted.

An S-record-format module may contain S-records of the following types:

S0 The header record for each block of S-records. The code/data field may contain any descriptive information identifying the following block of S-records. Under the operating system, a resident linker command can be used to designate module name, version number, revision number, and description information which will make up the header record. The address field is normally zeroes.

S1 A record containing code/data and the 2-byte (16-bit) address at which the code/data is to reside

S2 A record containing code/data and the 3-byte (24-bit) address at which the code/data is to reside

S3 A record containing code/data and the 4-byte (32-bit) address at which the code/data is to reside

S5 A record containing the number of S1, S2, and S3 records transmitted in a particular block. This count appears in the address field. There is no code/data field.

S7 A termination record for a block of S3 records. The address field may optionally contain the 4-byte address of the instruction to which control is to be passed. There is no code/data field.

S8 A termination record for a block of S2 records. The address field may optionally contain the 3-byte address of the instruction to which control is to be passed. There is no code/data field.

S9 A termination record for a block of S1 records. The address field may optionally contain the 2-byte address of the instruction to which control is to be passed. Under the operating system, a resident linker command can be used to specify this address. If not specified, the first entry point specification encountered in the object module input will be used. There is no code/data field.

Note The upper bytes are assumed to be zero in addresses that are smaller than 4 bytes (32 bits).

Only one termination record is used for each block of S-records. S7 and S8 records are usually used only when control is to be passed to a 3- or 4-byte address. Normally, only one header record is used, although it is possible for multiple header records to occur.

Creating S-Records

S-record-format programs may be created with the **DU** command. You may also use dump utilities, debuggers, the operating system resident linkage editor, or several cross-assemblers or cross-linkers. On the

operating system, a build utility allows an executable load module to be built from S-records, and has a counterpart utility which allows an S-record file to be created from a load module.

Several programs are available for downloading a file in S-record format from a host system to an 8-bit, 16-bit, or 32-bit microprocessor-based system.

Example

A typical S-record-format module, as printed or displayed, is shown below:

```
S00A00006765745F7274630D
S2240400007C8402A6908300007C8502A6908300044E80002000000000006504000006504002442
S20C040020000000000000000CF
S804040000F7
```

The module consists of one S0 record, two S3 records, and one S8 record.

The S0 record is explained as follows:

S0	S-record type S0, indicating that it is a header record for this block of S-records
0A	Hexadecimal 0A (decimal 10), indicating that 10 character pairs (or ASCII bytes) follow
0000	Four-character 2-byte address field; hexadecimal address 0000 (the address field is not used by the debugger, the debugger ignores this record)
6765745F727463	Module name in ASCII, get_rtc
0D	The checksum of this header record

The first S2 record is explained as follows:

S2	S-record type S2, indicating that it is a code/data record to be loaded/verified at a 3-byte address
24	Hexadecimal 24 (decimal 36), indicating that 36 character pairs, representing 36 bytes of binary data, follow

040000 — Six-character 3-byte address field; hexadecimal address 00040000, where the code/data which follows is to be loaded

7C8402...040024 — The next 32 character pairs of the first S2 record are the ASCII bytes of the actual program code/data. In this assembly language example, the hexadecimal opcodes of the program are written in the sequence in the code/data fields of the S2 records:

Address	Opcode	Instruction
00040000	7C8402A6	MFSPR R4,4
00040004	90830000	STW R4,$0(R3) ($00000000)
00040008	7C8502A6	MFSPR R4,5
0004000C	90830004	STW R4,$4(R3) ($00000004)
00040010	4E800020	BCLR 20,0
00040014	00000000	WORD $00000000
00040018	65040000	ORIS R4,R8,$0
0004001C	65040024	ORIS R4,R8,$24
00040020	00000000	WORD $00000000
00040024	00000000	WORD $00000000

42 — The checksum of this S2 record.

The second S2 record is explained as follows:

S2 — S-record type S2, indicating that it is a code/data record to be loaded/verified at a 3-byte address.

0C — Hexadecimal 0C (decimal 12), indicating that 12 character pairs, representing 12 bytes of binary data, follow.

040020 — Six-character 3-byte address field; hexadecimal address 00040020, where the code/data which follows is to be loaded.

0000000000000000	The next 8 character pairs of the second S2 record are the ASCII bytes of the actual program code/data.
CF	The checksum of this S2 record.

The S8 record is explained as follows:

D

S8	S-record type S8, indicating that it is a termination record
04	Hexadecimal 04, indicating that four character pairs (4 bytes) follow
040000	The address field, indicating the address of the instruction to which control may be passed (program entry point)
F7	The checksum of this S8 record

Each printable character in an S-record is encoded in a hexadecimal representation of the binary bits which are actually transmitted. Below is the example S0 record, as sent in hexadecimal, with an ascii representation:

T	**L**	**A**	**C/D**	**Ch**
S 0	0 A	0 0 0 0	6 7 6 5 7 4 5 F 7 2 7 4 6 3	0 D
5930	3041	30303030	36373635373435463732373436 33	3044

Disk and Tape Controllers

E

Disk and Tape Support

PPCBug supports the disk and tape controller devices listed in Table E-1. The controller addresses listed are the base addresses for each controller. The controller can be addressed by the CLUN during the **PBOOT** or **IOP** commands, or during system calls .DSKRD or .DSKWR.

Table E-1. Disk and Tape Controllers Supported

CLUN	Controller	Controller Address	Number of Devices
1	PC8477	$800003F0	1
2	PC87303IDE	$800001F0	2
x	NCR53C810	Any PCI**	*
x	NCR53C825	Any PCI**	*
x	NCR53C875	Any PCI**	*
x	SL82C105	Any PCI**	4
x	PBC-EIDEF1	Any PCI**	4

Notes * Varies, depending on the user's SCSI setup.

** These PCI addresses for your disk and tape controllers can vary depending on your board and your particular setup. See the "iot" command for further details on displaying the PCI address for specific devices.

Floppy Drive Configuration Parameters

The following table lists the parameters used for configuring floppy disk drives with the **IOT** command and the .DSKCFIG system call.

Table E-2. Floppy Drive Configuration Parameters

Configuration Parameter	Floppy Types and Formats					
	PCXT8	PCXT9	PCXT9_3	PCAT	PS2	SHD
Sector Size 0- 128 1- 256 2- 512 3-1024 4-2048 5-4096 =	2	2	2	2	2	2
Block Size: 0- 128 1- 256 2- 512 3-1024 4-2048 5-4096 =	1	1	1	1	1	1
Sectors/Track	8	9	9	F	12	24
Number of Heads =	2	2	2	2	2	2
Number of Cylinders =	28	28	50	50	50	50
Precomp. Cylinder =	28	28	50	50	50	50
Reduced Write Current Cylinder =	28	28	50	50	50	50

Table E-2. Floppy Drive Configuration Parameters

Configuration Parameter	Floppy Types and Formats					
	PCXT8	PCXT9	PCXT9_3	PCAT	PS2	SHD
Step Rate Code =	0	0	0	0	0	0
Single/Double DATA Density =	D	D	D	D	D	D
Single/Double TRACK Density =	D	D	D	D	D	D
Single/Equal_in_all Track Zero Density =	E	E	E	E	E	E
Slow/Fast Data Rate =	S	S	S	F	F	F
Other Characteristics						
Number of Physical Sectors	0280	02D0	05A0	0960	0B40	1680
Number of Logical Blocks (in hundreds)	0500	05A0	0B40	12C0	1680	2D00
Number of Bytes (decimal)	327680	368460	737280	1228800	1474560	2949120
Media Size/Density	5.25/DD	5.25/DD	3.5/DD	5.25/HD	3.5/HD	3.5/ED

Note

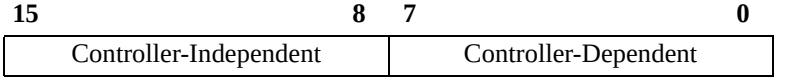
1. All numerical parameters are in hexadecimal unless otherwise noted.
2. PS2 is the default format for PPCBug.
3. The SHD format is supported effective with PPC1Bug version 1.2.

Disk Status Codes

F

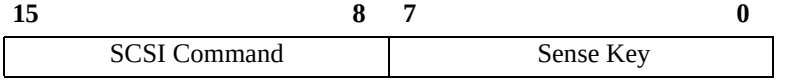
Introduction

The status word returned by the disk system call routine flags an error condition if it is nonzero. The most significant byte of the status word reflects controller independent errors, and they are generated by the disk trap routines. The least significant byte reflects controller dependent errors, and they are generated by the controller. The status word is shown below:



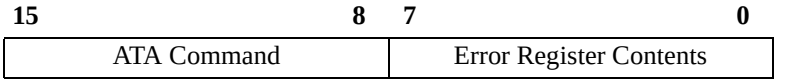
Because of the nature of the SCSI and IDE/EIDE Host Adapters, additional status may be returned. The format of the additional error status is as follows:

SCSI



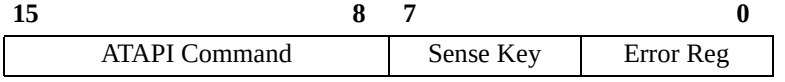
The SCSI command is a byte that identifies the command that was issued in which the Sense Key was returned. The Sense Key is a byte that is returned in Request Sense Data buffer (byte number two). Refer to the ANSI X3T9.2 SCSI Specification.

ATA (Hard Disks/CD-ROM Drives)

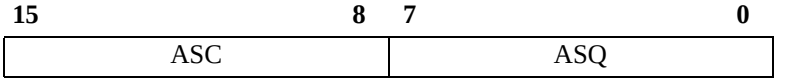


The ATA command is the byte that identifies the command creating the error condition reported in the error register. For the definition of the error register contents, refer to the AT Attachment Interface with Extensions (ATA-2) specification (X3T10-948D).

ATAPI (CD-ROM Drives)



For ATAPI devices, the upper byte reflects the command causing the failure reported in the Sense Key/Error Reg byte. If the sense key (bits 4 through 7) contains a nonzero value, then two more bytes containing additional sense data is returned as follows:



For the definition of the error register contents, sense key data, ASC, and ASQ, refer to the ATA Packet Interface for CD-ROMs specification (SFF-8020i).

Controller-Independent Status Codes

The definitions for the controller-independent errors are defined in Table F-1, shown below.

Table F-1. Controller-Independent Status Codes

Code	Description
$00	No error detected
$01	Invalid controller type
$02	Controller descriptor not found
$03	Device descriptor not found
$04	Controller already attached
$05	Descriptor table not found
$06	Invalid command packet
$07	Invalid address for transfer
$08	Block conversion error
$09	Invalid parameter in configuration
$0A	Transfer data count mismatch error
$0B	Invalid status received in command packet
$0C	Command aborted via break

SCSI Firmware Status Codes

The SCSI firmware returns codes for the SCSI Bus status and the SCSI I/O Processor (NCR53C810, NCR53C825, or NCR53C875) status. Table F-2 lists the codes and a description of each.

The debugger returns a single word (16 bits) for an error code. The upper byte is Controller-Independent, and is assigned by the debugger. The lower byte is Controller-Dependent. It is formed by selecting one of two bytes of error information returned by the firmware, either the SIOP) Status or the SCSI Bus Status.

If the SCSI Bus Status byte returned by the firmware is non-zero, this byte is returned as the Controller-Dependent code, and the SIOP Status byte is thrown away. If the SCSI Bus Status is zero, the SIOP Status byte is returned.

Therefore, there is dual use of the Controller-Dependent error code byte for error code bytes $02, $04, $08, $10, $14, and $18. For example, if the Controller-Dependent value returned by the debugger is $02, this code could have two possible meanings:

SCSI Bus Status:	Check Condition
SIOP Status:	Command aborted - SCSI bus reset

Table F-2. SCSI Firmware Status Codes

Code	Description
SCSI Bus Status	
$00	Good completion
$02	Check condition
$04	Condition met good
$08	Busy
$10	Intermediate good
$14	Intermediate condition met good
$18	Reservation conflict
$22	Command terminated
$28	Queue full
SIOP Status	
$00	Good status
$01	No operation bits were set
$02	Cmd aborted - SCSI bus reset
$03	Cmd aborted - bus device reset message
$04	Cmd aborted - abort message
$05	Cmd aborted - abort tag message
$06	Cmd aborted - clear queue message
$07	Data overflow - Too much data

Table F-2. SCSI Firmware Status Codes (Continued)

Code	Description
$08	Data underrun - Not enough data
$09	Clock faster than 75 MHz
$0A	Bad Clock parameter - ASCII clock value Zero or Non-ASCII
$0B	Queue depth too large (> 255)
$0C	Selection timeout
$0D	Reselection timeout
$0E	Bus error during a data phase
$0F	Bus error during a non-data phase
$10	Illegal NCR script instruction
$11	Command aborted - unexpected disconnect
$12	Command aborted - unexpected phase change
$13	SCSI bus hung during command
$14	Data phase not expected by user
$15	Data phase was in wrong direction
$16	Incorrect phase following select
$17	Incorrect phase following message-out
$18	Incorrect phase following data
$19	Incorrect phase following command
$1A	Incorrect phase following status
$1B	Incorrect phase following rptr message
$1C	Incorrect phase following sdptr message
$1D	No identify message after re-selection
$1E	SIOP failed during script patching
$1F	SIOP not attached to SCSI bus

ATA/ATAPI Firmware Status Codes

Note The marketing terms IDE and EIDE are often used when describing the ATA and ATAPI interface and protocol. The underlying technologies behind these are defined by the ATA and ATAPI standards proposed by the Accredited Standards Committee (ASC) and the Small Form Factor Committee (SFFC) respectively. ATA falls under the X3T10 umbrella of the ASC, while the proposed ATAPI specification is described by the SFF-8020 document set forth by the SFFC. SFFC has also proposed a number of other ATA-related documents. This PPCBug user's manual uses either the IDE/EIDE or the ATA/ATAPI nomenclature, as seems appropriate.

The debugger returns a single 16-bit word for an error code unless additional status is available. For ATA commands, the additional status comprises one 16-bit word; for ATAPI, up to two 16-bit works are returned.

The first 16-bit word contains the ATA/ATAPI command and the contents of the error register. In response to ATAPI commands, it also contains the sense key code. For non-zero sense key values, an additional 16-bit word is returned, concatenated to the second 16-bit word. This third status word indicates the ASC and ASQ values returned by the device in response to an ATAPI packet command.

Below is a list of controller dependent error codes and a short description of each for the IDE and EIDE controllers. For definition of the error register and the sense codes, refer to the appropriate ATA and/or ATAPI documents:

ATA - AT Attachment Interface with Extensions (ATA-2)
-X3T10-948D
ATAPI - ATA Packet Interface for CD-ROMs
- SFF-8020i.

Table F-3. ATA/ATAPI Controller-Dependent Errors

Code	Description
$00	Good Status
$01	Error Register contents valid
$02	Index error (vendor specific)
$04	Correctable data error
$08	Data transfer failure (Data Request from device missing)
$10	Bit 4 error (vendor specific)
$20	Device fault
$40	Device not ready
$80	Device busy (command/data transfer in progress)
$F1	Controller initialization failure
$F2	Invalid parameter
$F3	Sector size not supported
$F4	Command not supported
$F7	Data Overflow
$F8	Controller Configuration Error

Establishing Network Connections with PPCBug

G

The procedure below can be used to establish a network connection using standard PPCBug commands from a PowerPC board with a compatible network connectivity device.

1. **Ensure the RTC (Real Time Clock) is functioning** (**Note**: An RTC is not available on all boards. Boards without an RTC emulate a clock.).

   Network operations (and ROM boots) will fail if the board's RTC is not running. Boards are shipped from Motorola with the RTC in powersave mode to conserve battery life. The battery is switched ON or OFF by means of the **PS** or **SET** commands. To determine if the RTC is turned ON issue the **TIME** command. If Bug responds with the message `the RTC clock is not ticking` the board is in powersave mode. Turn on the clock by issuing the **TIME** command as described in this manual. The command format is:

   SET mmddyyhhmm

   Once running, the RTC will operate continuously until a **PS** command is issued.

2. **Configure the board's IP addressibility using the NIOT command**.

   Refer to the section in this manual dealing with the NIOT command for a complete explanation of this command.

   The board's defaults (set by **ENV:d**) are adequate for all options except:

   Client IP address: set to the IP address assigned to the PowerPC board.

   Server IP address: set to the IP address from which the code is to be loaded. **Note**: the server must be running a TFTP daemon.

   Subnet IP address mask: set if the server IP and client IP addresses are on different networks.

Gateway IP address: set if a gateway will be required to traverse the network.

Boot file name: use to select the boot file location if use of **NBO** is planned.

Parameters for the default controller are saved in NVRAM at the value specified in the ENV parameter *Network Auto Boot Configuration Parameters Offset (NVRAM).* If this value is invalid **NIOT** will respond with an error message and not save the values entered. The default value set by **ENV;d** is adequate.

3. **Verify network connectivity using the NPING command**.

   Network connectivity can now be verified using the **NPING** command. Note: PPCBug does not respond to a network ping; consequently, **NPING**s can only be sent from a device with PPCBug to a device without PPCBug.

   The format of the **NPING** command is:

   NPING *ControllerLUN DeviceLUN SourceIP DestinationIP Number_of_packets*

   Thus to ping a host at `172.27.197.64` with a board at `172.27.14.92` the command would be:

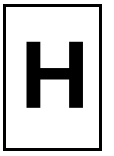
   ```
   NPING 0 0 172.27.14.92 172.27.197.64 1
   ```

   As the number of packets to be sent defaults to infinity (in other words, until the user hits the BREAK key) specifying a reasonable limit is desirable. **NPING** is not quick so be patient. When control returns to the user **NPING** will print the results in terms of *Number of Packets Transmitted, Number of Packets Lost,* and *Packet Size.* Note that **NPING** returns the number of packets lost, not the number received. A successful connection is when this value is zero.

4. **TFTP load code using the NIOP command or network boot using the NBO command**.

   Errors returned can be decoded using the tables in Appendix H, *Network Communication Status Codes,* in this manual.

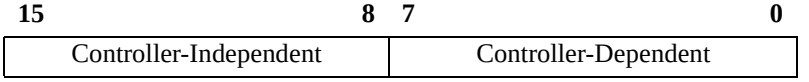
Network Communication Status Codes



There are two types of network communication status codes, controller independent and controller (DEC21040, DEC21140, DEC21143, or Intel 82559/ER) dependent.

The controller independent error codes are independent of the specified network interface. These errors are normally some type of operator error. The controller dependent error codes relate directly to the specified network interface. These errors occur at the driver level out to and including the network.

The status word returned by the network system call routine flags an error condition if it is nonzero. The most significant byte of the status word reflects controller independent errors, and they are generated by the network trap routines. The least significant byte reflects controller dependent errors, and they are generated by the controller. The status word is shown below:



The error codes are returned by driver, and will be placed in the controller dependent field of the command packet status word. All error codes must be non-zero, an error code of $00 signifies no error.

Table H-1. Controller-Independent Status Codes

Code	Description
$01	Invalid controller logical unit number
$02	Invalid device logical unit number
$03	Invalid command identifier
$04	Clock (RTC) is not running
$05	TFTP retry count exceeded
$06	BOOTP retry count exceeded
$07	NVRAM write failure

Table H-1. Controller-Independent Status Codes (Continued)

Code	Description
$08	Illegal IPL load address
$09	User abort, break key depressed
$0A	Time-out expired
$81	TFTP, File not found
$82	TFTP, Access violation
$83	TFTP, Disk full or allocation exceeded
$84	TFTP, Illegal TFTP operation
$85	TFTP, Unknown transfer ID
$86	TFTP, File already exists
$87	TFTP, No such user

Table H-2. DEC21040/21140/21143 Controller Status Codes

Code	Description
$01	Buffer not 16 byte aligned
$02	Shared memory buffer limit exceeded (software)
$03	Invalid data length (MIN <= LNGTH <= MAX)
$04	Initialization aborted
$05	transmit data aborted
$06	PCI base address not found
$07	No Ethernet port available on base-board
$10	System error
$11	Transmitter babble error
$12	Transmitter excessive collisions
$13	Transmitter process stopped
$14	Transmitter underflow error
$15	Transmitter late collision error
$16	Transmitter loss of carrier
$17	Transmitter 10baseT link fail error
$18	Transmitter no carrier

Table H-2. DEC21040/21140/21143 Controller Status Codes (Continued)

Code	Description
$19	Transmitter timeout on PHY
$20	Receiver CRC error
$21	Receiver overflow error
$22	Receiver framing error
$23	Receiver last descriptor flag not set
$24	Receiver frame damaged by collision
$25	Receiver runt frame received
$28	Transmitter time out during a normal transmit
$29	Transmitter time out during a port setup
$30	SROM corrupt

Table H-3. Intel 82559/ER Controller Status Codes

Code	Description
$01	EEPROM read error
$02	EEPROM checksum error
$03	Unable to allocate PORT test memory
$04	Port self-test failed
$05	CU command execution error
$06	Illegal CU action command requested
$10	Requested TX exceeds transmit buffer size
$20	RX TCO packet processed
$21	RX Individual Address mismatch
$22	RX no Individual Address match
$23	RX invalid header TYPE value
$24	RX indeterminate error

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