EPPCBug Firmware Package User's Manual

Version 1.1

EPPCBUGA1/UM1

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Preface

The *EPPCBug Firmware Package User's Manual* provides information on the EPPCBug firmware, the start-up and boot routines, the debugger commands, the one-line assembler/disassembler, and the debugger system calls. All information contained herein is specific to Motorola's PowerPC™-based MBX Series boards.

This manual covers release 1.1 of EPPC1Bug.

Safety Summary
Safety Depends On You

The following general safety precautions must be observed during all phases of operation, service, and repair of this equipment. Failure to comply with these precautions or with specific warnings elsewhere in this manual violates safety standards of design, manufacture, and intended use of the equipment. Motorola, Inc. assumes no liability for the customer's failure to comply with these requirements.

The safety precautions listed below represent warnings of certain dangers of which Motorola is aware. You, as the user of the product, should follow these warnings and all other safety precautions necessary for the safe operation of the equipment in your operating environment.

Ground the Instrument.

To minimize shock hazard, the equipment chassis and enclosure must be connected to an electrical ground. The equipment is supplied with a three-conductor ac power cable. The power cable must be plugged into an approved three-contact electrical outlet. The power jack and mating plug of the power cable meet International Electrotechnical Commission (IEC) safety standards.

Do Not Operate in an Explosive Atmosphere.

Do not operate the equipment in the presence of flammable gases or fumes. Operation of any electrical equipment in such an environment constitutes a definite safety hazard.

Keep Away From Live Circuits.

Operating personnel must not remove equipment covers. Only Factory Authorized Service Personnel or other qualified maintenance personnel may remove equipment covers for internal subassembly or component replacement or any internal adjustment. Do not replace components with power cable connected. Under certain conditions, dangerous voltages may exist even with the power cable removed. To avoid injuries, always disconnect power and discharge circuits before touching them.

Do Not Service or Adjust Alone.

Do not attempt internal service or adjustment unless another person capable of rendering first aid and resuscitation is present.

Use Caution When Exposing or Handling the CRT.

Breakage of the Cathode-Ray Tube (CRT) causes a high-velocity scattering of glass fragments (implosion). To prevent CRT implosion, avoid rough handling or jarring of the equipment. Handling of the CRT should be done only by qualified maintenance personnel using approved safety mask and gloves.

Do Not Substitute Parts or Modify Equipment.

Because of the danger of introducing additional hazards, do not install substitute parts or perform any unauthorized modification of the equipment. Contact your local Motorola representative for service and repair to ensure that safety features are maintained.

Dangerous Procedure Warnings.

Warnings, such as the example below, precede potentially dangerous procedures throughout this manual. Instructions contained in the warnings must be followed. You should also employ all other safety precautions which you deem necessary for the operation of the equipment in your operating environment.

WARNING

Dangerous voltages, capable of causing death, are present in this equipment. Use extreme caution when handling, testing, and adjusting.

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This equipment generates, uses, and can radiate electromagnetic energy. It may cause or be susceptible to electromagnetic interference (EMI) if not installed and used in a cabinet with adequate EMI protection.

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General Information 1

Introduction

This manual is intended for anyone who designs OEM systems, supplies additional capability to an existing compatible system, or works in a lab environment for experimental purposes.

A basic knowledge of computers and digital logic is assumed. Refer to *Related Documentation* on page 1-4, of this manual for a list of documents that may provide helpful information.

Typographic Conventions

The following conventions are used in this document:

bold
: Used for 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
: Used for names of variables to which you assign values. Italic is also used for comments in screen displays and examples.

`courier`
: Used for system output such as screen displays, reports, examples, and system prompts.

RETURN
: Represents the Enter, Return, or Carriage Return <CR> 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 that you can select from (one only).

[ ]
: Encloses an optional item that may occur zero or one time.

{ }
: Encloses an optional item that may occur zero or more times.

Terminology Conventions

Throughout this manual, a convention has been maintained whereby data and address parameters are preceded by a character which specifies the numeric format as follows:

$ Dollar sign, specifies a hexadecimal character.

% Percent sign, specifies a binary number.

& Ampersand sign, specifies a decimal number.

Unless otherwise specified, all address references are in hexadecimal throughout this manual.

An asterisk (*) following the signal name for signals which are level-significant denotes that the signal is true or valid when the signal is low.

An asterisk (*) following the signal name for signals which are edge-significant denotes that the actions initiated by that signal occur on high to low transition.

In this manual, assertion and negation are used to specify forcing a signal to a particular state. In particular

- Assertion and assert refer to a signal that is active or true
- Negation and negate indicate a signal that is inactive or false

These terms are used independently of the voltage level (high or low) that they represent.

Throughout this manual, it is assumed that the MPU on the MBX is programmed to big-endian byte ordering. Any attempt to use little-endian byte ordering immediately renders the EPPCBug debugger unusable.

Related Documentation

The following publications may provide additional helpful information. If not shipped with this product, they may be purchased by contacting your local Motorola sales office.

Document Title	Motorola Publication Number
MBX Series Embedded Controller Installation and Use	MBXA/IH
MBX Series Programmer's Guide	MBXA/PG
PowerPC Microprocessor Family: The Programming Environments	MPCFPE/AD

DARPA Internet Request for Comments RFC-792

ISO-9660, Information processing - Volume and file structure of CD-ROM for information interchange, International Organization for Standardization.

System V Application Binary Interface, PowerPC Processor Supplement, Sunsoft.

Introduction to PowerPC EPPCBug Firmware

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Product Structure

The overall product structure of the PowerPC EPPCBug Firmware Package is the classic Operating System model. The devices and hardware entities are abstracted via device and hardware drivers. The user interfaces: remote, command, and programmatic, permit you to access the devices and or hardware through a set of device drivers. The kernel/monitor layer oversees all activities of the product.

The hardware and firmware initialization attachment is responsible for initialization of the hardware to enable a system boot. System boot is the primary purpose of the firmware. System boot can be viewed from loading a program for debugging purposes, to loading an operating system which completely acquires control of the hardware.

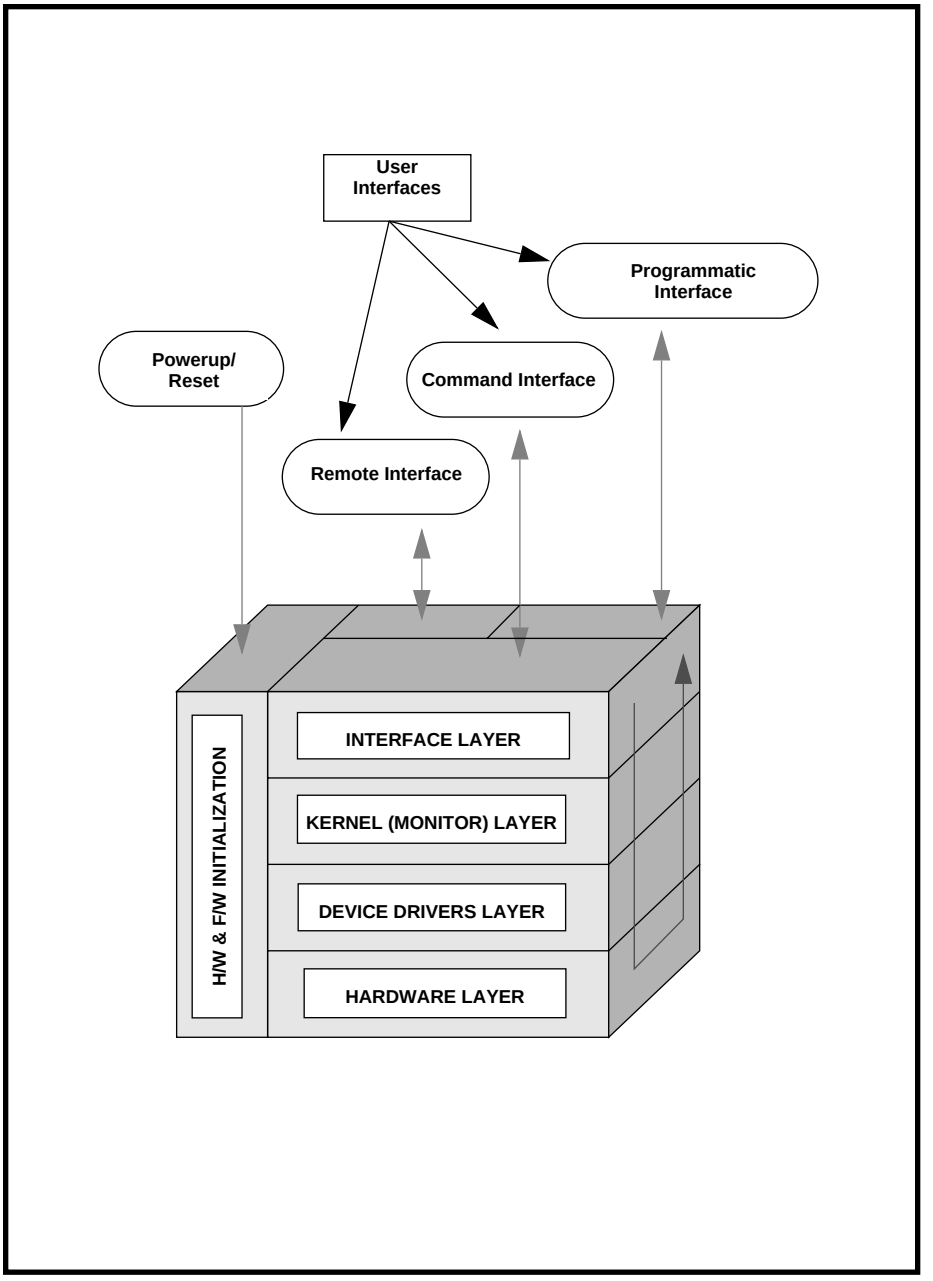

Figure 2-1. Overall Product Structure

Firmware (Debugger) Overview

The firmware for the PowerPC-based (MPC 821/860) MBX Series of board and system level products is derived from the BUG firmware currently used on all Motorola Computer Group M68000 and M88000 based CPU modules. The PowerPC firmware family provides a high degree of functionality and user friendliness, yet stresses portability and ease of maintenance. The firmware is portable and comprehensive because it is written entirely in the C programming language, except where forced to utilize assembler functions.

Description of EPPCBug

The EPPCBug package is a powerful evaluation and debugging tool for systems built around the Motorola MBX Series boards. Facilities are available for loading and executing user programs under complete operator control for system evaluation. EPPCBug includes commands for:

- Display and modification of memory
- Breakpoint and tracing capabilities
- Assembler/disassembler, useful for patching programs

Various EPPCBug routines that handle I/O, and general service functions are available to user programs through the System Call handler. The System Call handler is accessible through the system call (SC) instruction, with exception vector $00C00 (System Call Exception).

EPPCBug consists of:

A command-driven user-interactive software debugger, described in *Chapter 3* and hereafter referred to as the debugger or EPPCBug.

A user interface, which accepts commands from the system console terminal. When using EPPCBug, you operate out of either the debugger directory or the diagnostic directory.

If you are in the debugger directory, then the debugger prompt **EPPC-Bug>** is displayed and you have all of the debugger commands at your disposal.

If you are in the diagnostic directory, then the diagnostic prompt **EPPC-Diag>** is displayed and you have all of the diagnostic commands at your disposal as well as all of the debugger commands.

You may switch between directories by using the Switch Directories (**SD**) command, or examine the commands in the particular directory that you are currently in by using the Help (**HE**) command. Refer to *Chapter 4* for debugger commands.

Because EPPCBug is command-driven, it performs its various operations in response to user commands entered at the keyboard. The flow of control in EPPCBug is shown in the individual board-specific debugger manuals. When you enter a command, EPPCBug executes the command and the prompt reappears. However, if you enter a command that causes execution of user target code (for instance **GO**), then control may or may not return to EPPCBug, depending on the outcome of the user program.

Comparison with other Motorola Firmware

If you have used one or more of Motorola Computer Group's other firmware debugging packages you will find the PowerPC EPPCBug very similar, after making due allowances for the architectural differences between the microprocessor architectures. These are primarily reflected in the instruction mnemonics, register displays, addressing modes of the assembler/disassembler, and argument passing to the system calls.

Data and address sizes are defined as follows:

- A byte is eight bits, numbered 0 through 7, with bit 7 being the least significant.
- A half-word is 16 bits, numbered 0 through 15, with bit 15 being the least significant.

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

EPPCBug Implementation

As noted in the overview, EPPCBug is written largely in the C programming language, which provides benefits of portability and maintainability. Where necessary, assembler has been used in the form of separately compiled modules containing only assembler code, no mixed language modules are used.

Physically, EPPCBug is contained in one Flash ROM, providing 512Kb (128K words) of storage. The executable code is checksummed at every power-on or reset firmware entry, and the result (which includes a precalculated checksum contained in the ROM) is tested for an expected zero. Thus, you are cautioned against modification of the ROM unless rechecksum precautions are taken.

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General Installation and Startup

Even though the EPPCBug FlashROM is installed on the MBX module, for EPPCBug to operate properly with the MBX, follow this general set-up procedure and the details given in the module-specific manual.

Note, that inserting or removing components or modules while power is applied could damage module components.

1. Turn all equipment power OFF. Refer to the individual module hardware manual and install/remove jumpers on headers and/or set configuration switches as required for your particular application.
2. Be sure that the EPPCBug Flash ROM is installed in the proper socket on the MBX board. Refer to the module-specific manual for details.
3. Refer to the set-up procedure for your particular chassis or system for details concerning the installation of the MBX.
4. Connect the terminal which is to be used as the EPPCBug system console to the default debug EIA-232-D port at the proper location described in the MBX hardware manual.
5. Set up the terminal as follows:
   - Eight bits per character
   - One stop bit per character
   - Parity disabled (no parity)
   - Baud rate 9600 baud (default baud rate of MBX ports at power-up)
6. After power-up, the baud rate of the debug port can be reconfigured by using the Port Format (**PF**) command of the EPPCBug debugger.

In order for high-baud rate serial communication between EPPCBug and the terminal to work, the terminal must do some form of handshaking. If your terminal does not do hardware

handshaking via the CTS line, then it must do XON/XOFF handshaking. If you get unintelligible messages and missing characters, check the terminal to make sure XON/XOFF handshaking is enabled.

If you want to connect a device, such as a host computer system and/or a serial printer, to the other EIA-232-D port(s), connect the appropriate cables and configure the port(s) as detailed in step 5. After power-up, you can reconfigure the port by programming the MBX console interface, or by using the EPPCBug **PF** command.

7. Power up the system. EPPCBug executes some self-checks and displays the debugger prompt **EPPC-Bug>**.

Hardware Initialization

Hardware initialization occurs from the hardware power-up/reset state to some point prior to the initialization and/or setup of the product's features. Normally, this initialization is performed only once, during a reset.

The following list identifies the hardware components that are initialized following the power-up/reset.

- MPC821/860 PowerPC Core
- MPC821/860 System Interface Unit (SIU)
- MPC821/860 Memory-Controller and Memory
- Primary PCI Bus Bridge Device (QSpan)
- ISA Bus Bridge Device (Winbond SL82C565)
- Super I/O Device (SMC FDC37C93X)
- PCI Device Configuration (PCI I/O and PCI Memory Address Spaces)
- PCMCIA Module Configuration
- I/O and Memory Address Map

The hardware initialization follows a predetermined flow, due to an inherent hierarchy in the hardware.The following figure shows the flow of the hardware initialization sequence.

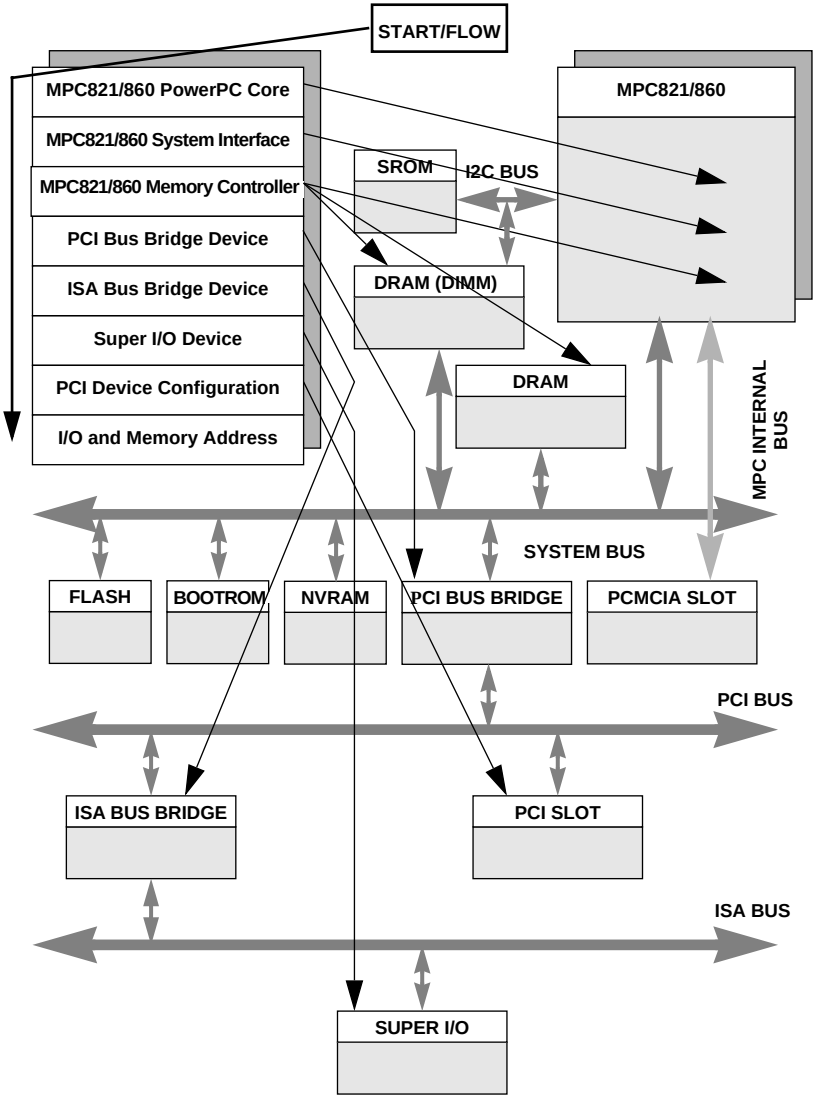

Figure 2-2. Hardware Initialization Sequence

Restarting the System

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

Reset

Powering up the MBX Series board initiates a system reset. Additionally, reset can be asserted through the utility connector. COLD and WARM reset modes are available. By default, EPPCBug is in COLD mode (refer to the RESET command description in *Chapter 4*.

During COLD reset, these system initialization processes occur, as if the MBX had just been powered up.

- All static variables are restored to their default states
- Breakpoint table and offset registers are cleared
- 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 EPPCBug variables and tables are preserved, as are the target state registers and breakpoints. Revision 1.1 of the EPPCBug does not support the WARM reset feature.

Reset must be used if the processor ever halts or if the EPPCBug environment is ever lost (vector table is destroyed, stack corrupted, etc.).

Break

To invoke a Break, press and release the BREAK key on the terminal 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.

Occasionally, 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.

Note EPPCBug 1.1 does not support ABORT.

Diagnostic Facilities

Included in the EPPCBug package is a complete set of hardware diagnostics intended for testing and troubleshooting of the MBX Series boards. In order to use the diagnostics, you must switch directories to the diagnostic directory. If you are in the debugger directory, you can switch to the diagnostic directory by entering the debugger command Switch Directories (**SD**). The **EPPC-Diag>** prompt should appear. Note that some diagnostics depend on restart defaults that are set up only in a particular restart mode.

Memory Requirements

EPPCBug requires a minimum of 128Kb of contiguous read/write memory to operate. This memory resides at the upper end of memory. This read/write memory must not be modified by a user's application. This 128Kb is used for EPPCBug stack and static variable space and the remainder is reserved as user space.

Whenever the MBX Series board is reset, the

- Target IP is initialized to the address corresponding to the beginning of the user space, and
- Target stack pointers are initialized to addresses within the user space, with the target Pseudo Stack Pointer (R1) set to the top of the user space

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I/O and Memory Address Map

The hardware source of all address decode is the eight "chip select" banks located within the MPC821/860. The firmware initializes the system's address map as follows:

Table 2-1. System Address Map - MPU View

Start	End	Size	Definition	CS	Note
00000000	00XFFFFF	4/16M	On-Board DRAM X = 3, 4M X = F, 16M	1	1, 3, 12
00X00000	0XXXXXXX	xM	DIMM Slot (Bank 0 and 1) (8/16/32/64M)	2, 3	1, 10, 11, 12
80000000	9FFFFFFF	512M	PCI/ISA I/O Space	5	2, 4, 7
A0000000	BFFFFFFF	512M	Reserved		6
C0000000	DFFFFFFF	512M	PCI/ISA Memory Space	5	2, 4, 7
E0000000	E3FFFFFF	64M	PCMCIA Memory Space	N/A	5, 13
E4000000	E7FFFFFF	64M	PCMCIA DMA Memory Space	N/A	5, 13
E8000000	EBFFFFFF	64M	PCMCIA Attribute Space	N/A	5, 13
EC000000	EFFFFFFF	64M	PCMCIA I/O Space	N/A	5, 13
F0000000	F9FFFFFF	160M	Unused		6
FA000000	FA0FFFFF	1M	NVRAM (BBRAM) (32/128/512K Internal Decode)	4	5, 7
FA100000	FA1FFFFF	1M	Status/Control Register #1/#2	4	5, 7
FA200000	FA20FFFF	64K	MPC821/860 Dual Port RAM (16K Internal Decode)	N/A	5
FA210000	FA21FFFF	64K	PCI Bus Bridge Control/Status Registers (4K Internal Decode)	6	2, 4
FA220000	FBFFFFFF	30592K	Unused		6
FC000000	FC7FFFFF	1/2/4/8 M	FLASH Memory (1/2/4/8M)	0 or 7	3, 8, 9
FC800000	FDFFFFFF	24M	Reserved		6

Table 2-1. System Address Map - MPU View

Start	End	Size	Definition	CS	Note
FE000000	FE7FFFFF	8M	Boot ROM (128/256/512K)	0 or 7	5, 8, 9
FE800000	FFFFFFFF	24M	Reserved		6

Notes

1. Dependent upon the size of memory installed (plugged into the DIMM slot), the onboard memory may or may not be located at address 00000000. If the size of the installed memory is larger than the onboard memory, then the installed memory should be located at address 00000000. When configuring the bank address registers of the MPC821/860, the base address of the bank must be a modulus of the bank size. For example, If a bank was 32Mb, it can only be located at addresses 00000000, 02000000, 04000000, 06000000.
2. The location of these address spaces are dependent upon the presence of the PCI-bus host bridge. These address spaces are programmable via the PCI-bus host bridge device (QSpan).
3. The size of these address spaces is queried from the SROM device.
4. The presence of the PCI-bus host bridge device is queried from the SROM device.
5. These address spaces are smaller than the indicated size. The actual decode is dependent upon the device. Address “wrapping” may occur.
6. Access to any reserved/unused address space either perform a machine check or return useless data.
7. These address spaces share a common chip select, the specified selection is further decoded by the appropriate address lines.

8. The actual chip select used is dependent upon the position of the Boot-ROM jumper (J-4). Chip select #0 is always utilized by the MPC821/860 as the source to the reset vector.
9. EPPCBug can be executed from either the onboard FLASH or the socketed FLASH the Boot ROM. EPPCBug configures the reset FLASH device at the lower address, and the nonreset FLASH device is configured at the higher address.
10. The DIMM is 64 data bits wide, however it can only be accessed 32 bits at a time. The 32-bit data width is a limitation of the MPC821/860. With this is mind, the DIMM can be viewed as two contiguous banks of memory (bank 0 and bank 1). The RAS0 signal is logically connected to the first chip selection and the RAS2 signal is logically connected to the second chip selection.
11. When installing DIMM modules, ensure the jumpers (J8/10/11) on the MBX Series board are configured to match the size of the DIMM being installed. The MBX board supports only 4K refresh single bank DIMM modules.
12. Both the onboard DRAM and the DIMM DRAM share/utilize the same UPM, UPMA. UPMB is used for PCI-bus resource bursting (when available).
13. PCMCIA decodes are enabled only if a PCMCIA card is present in the PCMCIA socket.

For more information on initialization values for various hardware components for the MBX Series boards, please refer to the *MBX Series Programmer's Guide*.

Terminal Input/Output Control

Information regarding command line control can be found in *Appendix D*.

Using the EPPCBug Debugger 3

How to Enter Debugger Command Lines

EPPCBug is command-driven and performs its various operations in response to commands that you enter at the keyboard. When the debugger prompt (**EPPC-Bug>**) appears on the terminal screen, the debugger is ready to accept commands.

When you enter a command, it is stored in an internal buffer. Execution begins only after you press RETURN. This allows you to correct entry errors, if needed, using the control characters described on page 3-2.

When you enter a command, the debugger executes the command and the prompt reappears. However, if the command that you enter causes execution of user target code, for example GO, then control may or may not return to the debugger, depending on what the user 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. Alternately, the user program could return to the debugger by means of the System Call Handler function **.RETURN** as described in *Chapter Running H/F 3*. For more information, refer to the descriptions in *Chapter Running H/F 3* for the GD, GO, and GT commands.

In general, a debugger command is made up of the following parts:

1. The command identifier (MD or md for the Memory Display command). Note that either uppercase or lowercase is allowed.
2. A port number if the command is set up to work with more than one port.
3. At least one intervening space before the first argument.
4. Any required arguments, as specified by command.

5. An option field, set off by a semicolon (;) to specify conditions other than the default conditions of the command.

6. The metasymbols used in the command syntax are:

boldface strings	A boldface string is a literal such as a command or a program name. Type it just as it appears.
italic strings	An italic string is a "syntactic variable". Replace it with one of a class of items it represents.
|	A vertical bar separating two or more items indicates that a choice is to be made. Choose only one of the items separated by this symbol.
[ ]	Square brackets enclose an item that is optional. The item may appear zero or one time.
{ }	Braces enclose an optional symbol that may occur zero or more times.

Control Characters

Some commands, such as **ENV**, **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.
=	Reopen the same field register, or memory location.
.	Terminate the command, and return to `EPPC-Bug>` prompt

You may use the following control characters for limited editing while entering commands at the `EPPC-Bug>` prompt. Additional command line history and editing control characters are described in *Appendix D*.

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**.

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 EPPC-Bug are:

CTRL-s	Wait: halt console output (XON)
CTRL-q	Resume console output (XOFF).

Syntactic Variables

The following syntactic variables are encountered in the command descriptions which follow. In addition, other syntactic variables may be used and are defined in the particular command description in which they occur.

DEL	Delimiter; either a comma or a space.
EXP	Expression (described in detail in a following section).
ADDR	Address (described in detail in a following section).
COUNT	Count; the syntax is the same as for *EXP*.
RANGE	A range of memory addresses which may be specified either by *ADDR* DEL ADDR or by *ADDR* : *COUNT*.
TEXT	An ASCII string of up to 255 characters, delimited at each end by the single quote mark (').

Expression as a Parameter

An expression can be one or more numeric values separated by the arithmetic operators: plus (+), minus (-), multiplied by (*), divided by (/), logical AND (&), shift left (<<), or 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	Examples
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 (In 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 (In Hexadecimal)	Notes
FF0011	FF0011	
45+99	DE	
&45+&99	90	
@35+@67+@10	5C	
%10011110+%1001	A7	
88<<4	880	shift left
AA&F0	A0	logical AND

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

Address as a Parameter

Many commands use ADDR as a parameter. The syntax accepted by EPPCBug is similar to the one accepted by the PowerPC one-line assembler. All control addressing modes are allowed. An "address + offset register" mode is also provided.

Address Formats

Addresses are entered as a hexadecimal number. For instance, 20000 would correspond to address $00020000. The address, or starting address of a range, can be qualified by a suffix of the form ^S, ^s, ^U, or ^u where S or s defines Supervisor address space, and U or u defines user address space. The default, when the qualifier is not specified, is Supervisor.

Note EPPCBUG 1.1 does not support the address space qualifier.

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

An alternate form of address is Rn, which tells the bug to use the address contained in MPU Register Rn, where n=0 through 31 (0, 1, ..., or 31).

Hence ADDR:= Hexadecimal Number{[^S] | [^s] | [^U] | [^u]} | Rn

In commands with RANGE specified as ADDR DEL ADDR, and with size option H or W chosen, data at the second (ending) address is acted on only if the second address is a proper boundary for a half-word or word, respectively. 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. This makes it 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. 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.

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

Port Numbers

Some EPPCBug commands give you the option to choose the port to be used to input or output. Valid port numbers which may be used for these commands are:

EPPCBug Port Numbers

PORT0	SMC Port 1. Sometimes known as the console port. It is used for interactive user input/output by default.
PORT1	SMC Port 2. Sometimes known as the host port. This is the default for downloading, uploading and transparent modes.

How to Enter and Debug Programs

There are various ways to enter a user program into system memory for execution. One way is to create the program using the Memory Modify (MM) command with the assembler/disassembler option. You enter 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 Running H/F 3* for complete details of the EPPCBug Assembler/Disassembler.

Another way to enter a program is to download an object file from a host system. The program must be in S-record format and may have been assembled or compiled on the host system. Alternately, the program may have been previously created using the EPPCBug MM command as outlined above and stored to the host using the Dump (DU) command. A communication link must exist between the host system and the MBX serial port. Refer to the Installation guide for the MBX Series boards. The file is downloaded from the host to MBX memory by the Load (LO) command.

Additionally, the PL command allows programs to be loaded from network or mass storage I/O devices.

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

Call System Utilities from User Programs

A convenient way of doing character input/output and many other useful operations has been provided so you do not have to write these routines into the target code. You have access to various EPPCBug routines via the System Call Handler. Refer to *Chapter Running H/F 3* for details on the various utilities available and how to invoke them from within a user program.

Preserve the Debugger Operating Environment

This section explains how to avoid contaminating the operating environment of the debugger. EPPCBug uses certain MBX onboard resources and also offboard system memory to contain temporary variables, exception vectors, etc. If you disturb resources upon which EPPCBug depends, then the debugger may function unreliably or not at all.

If your application enables translation through the Memory Management Unit (MMU), and utilizes resources of the debugger (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/disable translation.

EPPCBug Vector Table and Workspace

The debugger and diagnostic firmware resides in EPROM. The last 128Kb of RAM are also used by the debugger for storage of the vector table, executable code, variables, and stack.

Hardware Functions

The only hardware resources used by the debugger are the EIA-232-D ports, which are initialized to interface to the debug terminal. If these ports are reprogrammed, the terminal characteristics must be modified to suit, or the ports should be restored to the debugger-set characteristics prior to reinvoking the debugger.

Exception Vectors Used by EPPCBug

These 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. Note that revision 1.1 of the EPPCBug this feature is not supported.
00D00	Used for instruction tracing.	
Run Mode		

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

MPU/CPU Registers

Certain MPU/CPU registers must be preserved for their specific uses.

MPU Register SPR272

MPU register SPR272 is reserved for use by the debugger. If SPR272 is to be used by the user program, it must be restored prior to utilizing debugger resources (system calls) and or returning control to the debugger.

MPU Registers SPR273-SPR275

These MPU registers are utilized by debugger as scratch registers.

Context Switching

Context switching is viewed as switching from the debugger state to the user (target) state, or vice a versa. This switching occurs upon the invocation of debugger commands GD, GN, GO, GT, T, and TT, 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:

R0-R31	General Purpose Registers
SPRns	Special Purpose Registers (SPR1, SPR8, SPR9, SPR18, SPR19, SPR22, SPR26, SPR27, SPR268, PSR269, SPR272, SPR273, SPR274, SPR275, SPR284, SPR285,SPR286)
IP	Instruction Pointer (copy of SPR26)
MSR	Machine State Register (copy of SPR27)
CR	Condition Register

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

R0-R31	General Purpose Registers
SPR26	Restored from IP Register Image
SPR27	Restored from MSR Register Image
SPRns	Special Purpose Registers (SPR1, SPR8, SPR9, SPR275)
CR	Condition Register

Floating Point Support

For EPPCBug, the commands MD and MM have been extended to allow display and modification of floating point data in memory. Floating point instructions can be assembled/disassembled with the DI option of the MD and MM commands.

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

Integer Data Types

12	Byte
1234	Half-Word
12345678	Word

Floating Point Data Types

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

When entering data in single or double precision format, the following rules must be observed:

1. The sign field is the first field and is a binary field.
2. The exponent field is the second field and is a hexadecimal field.

3. The mantissa field is the last field and is a hexadecimal field.
4. 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).
5. Each field must be separated from adjacent fields by an underscore.
6. All the digit positions in the sign and exponent fields must be present.

Single Precision Real

This 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

This 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.

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

Scientific Notation

This 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

Debugger Commands 4

Command Descriptions

This chapter contains descriptions of each debugger command, with one or more examples of each.The EPPCBug debugger commands are summarized in the following table.

Table 4-1. Debugger Commands

Command Mnemonic	Title
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/NOBR	Breakpoint Insert/Delete
BS	Block of Memory Search
BV	Block of Memory Verify
CS	Checksum a Block of Data
CSAR	PCI Configuration Space READ Access
CSAW	PCI Configuration Space WRITE Access
DC	Data Conversion
DS	One Line Disassembler
DTT	Display Temperature
DU	Dump S-Records
ECHO	Echo String
ENV	Edit Environment
GD	Go Direct (Ignore Breakpoints)
GN	Go to Next Instruction
GO	Go Execute User Program
GT	Go to Temporary Breakpoint
HBD	History Buffer Display
HBX	History Buffer Entry-Execute

Table 4-1. Debugger Commands

Command Mnemonic	Title
HE	Help
I2C	I2C Device Read/Write
IOC	I/O Control for Disk
IOI	I/O Inquiry
IOP	I/O Physical to Disk
IOT	I/O "Teach" for Configuring Disk Controller
LO	Load S-Records from Host
MA/NOMA	Macro Define/Display/Delete
MAE	Macro Edit
MAL/NOMAL	Enable/Disable Macro Expansion Listing
MD/MDS	Memory Display
MM	Memory Modify
MMAP	MPC8xx Memory Map Display
MMD	Memory Map Diagnostic
MS	Memory Set
MW	Memory Write
NIOC	Network I/O Control
NIOP	Network I/O Physical
NIOT	I/O "Teach" for Configuring Network Controller
NPING	Network Ping
OF	Offset Registers Display/Modify
PA/NOPA	Printer Attach/Detach
PF/NOPF	Port Format/Detach
PFLASH	Program FLASH Memory
PL	Program Load
PLH	Program Load and Halt
RD	Register Display
RESET	Cold/Warm Reset
RL	Read Loop
RM	Register Modify
RS	Register Set
SD	Switch Directories
SET	Set Time and Date

Table 4-1. Debugger Commands

Command Mnemonic	Title
SYM/NOSYM	Symbol Table Attach/Detach
SYMS	Symbol Table Display/Search
T	Trace
TA	Terminal Attach
TIME	Display Time and Date
TM	Transparent Mode
TT	Trace to Temporary Breakpoint
UPM	MPC8xx User Programmable Memory (UPM) Display/Read/Write
VE	Verify S-Records Against Memory
VER	Revision/Version Display
VPD	VPD (Vital Product Data) Display
WL	Write Loop

Each of the individual commands is described in the following pages.The command syntax is shown using the symbols explained in *Chapter Running H/F 3*.

In the examples shown, the symbol <CR> represents the RETURN key on your terminal keyboard.Whenever this symbol appears, it means that you should enter a RETURN.

AS - One Line Assembler

Command Input

AS ADDR

Description

This is synonymous with the MM ADDR;DI command. Refer to *MM - Memory Modify* on page 4-89 for details. It provides access to the one-line assembler described in *Chapter Running H/F 3*. Accordingly, it is not described further here.

BC - Block of Memory Compare

Command Input

BC RANGE DEL 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 B, H, or W (upper or lower case) defines the size of data compared, and if RANGE is specified using a count, defines the size of data element to which the count refers. 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.

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:

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

Memory compare, nothing printed.

Example 2:

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


Memory compare, nothing printed.

Example 3:

```
EPPC-Bug>MM 2100F;B <CR>
0002100F 21? 0. <CR>
EPPC-Bug>
```

Create a mismatch.

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

Mismatches are printed out.

BF - Block of Memory Fill

Command Input

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

where data and increment are both expression parameters.

Options

(length of data field):

B Byte
H Half-word
W Word

Description

The BF command fills the specified range of memory with a data pattern. 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 option selected). The default field length is W (word).

If data you entered 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 data pattern which was actually written (or initially written if you specified an increment).

If the increment you entered 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.

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:

Assume memory from $20000 through $2002F is clear.

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

EPPC-Bug>MD 20000:18;H <CR>
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   ................
```

Because no option was specified, the length of the data field defaulted to word.

Example 2:

Assume memory from $20000 through $2002F is clear.

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

EPPC-Bug>MD 20000:18;H <CR>
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   ................
EPPC-Bug>
```

The specified data did not fit into the specified data field size. The data was truncated and the "Data = " message was output.

Example 3:

Assume memory from $20000 through $2002F is clear.

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

```
EPPC-Bug>MD 20000:18;H <CR>
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   ................
```

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

Example 4:

Assume memory from $20000 through $2002F is clear.

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

EPPC-Bug>MD 20000:18;H <CR>
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   ................
EPPC-Bug>
```

BI - Block of Memory Initialize

Command Input

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

Options

B Byte
H Half-word
W Word

Description

The BI command may be used to initialize parity for a block of memory. The BI command is nondestructive. 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 entered. 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:

```
EPPC-Bug>BI 0:10000;B <CR>
Effective address: 00000000
```

```
Effective count  : &65536
EPPC-Bug>
```

Example 2:

Assume system memory from $0 to $000FFFFF.

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

BM - Block of Memory Move

Command Input

BM *RANGE DEL 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 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 default data type is Word.

Examples

Example 1:

Assume memory from 20000 to 2000F is clear.

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

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

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

Example 2:

This utility is very useful for patching assembly code in memory. Suppose you had a short program in memory at address 20000.

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

Now, you would like to insert an ANDC between the OR instruction and the ADD instruction. You should Block Move the object code down four bytes to make room for the ANDC.

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

EPPC-Bug>MD 20000 20014;DI <CR>
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
EPPC-Bug>
```

Now you need to simply enter the ANDC at address 20008.

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

EPPC-Bug>MD 20000 20014;DI <CR>
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
EPPC-Bug>
```

BR - Breakpoint Insert/Delete

Command Input

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

Description

The BR command allows you to set 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 EPPCBug. 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 field 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 that a breakpoint with zero count is found, a breakpoint handler routine prints the CPU state on the screen and control is returned to EPPCBug.

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 <RETURN> is entered, then all entries are deleted from the breakpoint table and the empty table is displayed.

Examples

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

Set some breakpoints.

```
EPPC-Bug>NOBR 1E200 <CR>
BREAKPOINTS
0001E000        0001E700:C
EPPC-Bug>
```

Delete specified breakpoint.

```
EPPC-Bug>NOBR <CR>
BREAKPOINTS
EPPC-Bug>
```

Delete all breakpoints.

BS - Block of Memory Search

Command Input

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

or

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

Options

B Byte
H Half-word
W Word

Description

The BS command searches the specified range of memory for a match with a user-entered data pattern. This command has three modes, as described below.

Mode 1 - Literal String Search
In this mode, a search is carried out for the ASCII equivalent of the literal string you entered. This mode is assumed if the single quote (') indicating the beginning of a TEXT field is encountered following RANGE. The size as specified in the option field tells 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.

Mode 2 - Data Search
In this mode, you enter a data pattern as part of the command line and either enter a size in the option field or it will be is assumed (the assumption is word). The size entered in the option field also dictates whether the COUNT field in RANGE refers to bytes, half-words, or words. The following actions occur during a data search:

1. The user-entered data pattern 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 the user-entered data. Comparison is made only on those bits at bit positions corresponding to a "1" in the mask. If no mask is specified, then a default mask of all ones is used (all bits are compared). The size of the mask is taken to be the same size as the data. The default data size is word.

3. If the N (nonaligned) option has been selected, then the 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.

4. 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.

Mode 3 - Data Verification

If the V (verify) option has been selected, then displaying of addresses and data is done only when the memory contents do NOT match the user-specified pattern. Otherwise this mode is identical to the Mode 2.

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 noncontiguous memory with this command without causing a Bus Error.

Examples

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:...........
```

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

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

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

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

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

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.

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

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

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

Mode 2, using RANGE with count: count is displayed in decimal bytes, and the data pattern is found and displayed.

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

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

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

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

```
EPPC-Bug>BS 30000:30 60,F0;B <CR>
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
EPPC-Bug>
```

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.

```
EPPC-Bug>BS 3000 1FFFF 0000 000F;WH <CR>
Effective address: 00003000
Effective address: 0001FFFF
0000C000|E501   0001E224|A30E
```

```
EPPC-Bug>
```

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

BV - Block of Memory Verify

Command Input

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

Where data and increment are both expression parameters.

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 Word.

If the user-entered data or increment (if specified) do not fit into the data field size, then leading bits are truncated to make them fit. If truncation occurs, then a message is printed stating the data pattern and, if applicable, the increment value actually used.

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:

Assume memory from $20000 to $2002F is as indicated.

```
EPPC-Bug>MD 20000:18;H <CR>
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
EPPC-Bug>

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

In this example the default data element size is word, and the block verify was successful (nothing printed).

Example 2:

Assume memory from $20000 to $2002F is as indicated.

```
EPPC-Bug>MD 20000:18;H <CR>
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{
EPPC-Bug>

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

Mismatches are printed out.

Example 3:

Assume memory from $20000 to $2002F is as indicated.

```
EPPC-Bug>MD 20000:18;H <CR>
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  ................
EPPC-Bug>

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

Size is half-word, mismatches are printed out.

CS - Checksum a Block of Data

Command Input

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

Options

B Byte
H Half-word
W Word

Description

The Checksum command provides access to the same checksum routine used by the power-up self-test firmware. This routine is used in two ways within the firmware monitor.

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.

At power-up, the power-up confidence test is executed. One of the items verified is the checksum contained in the firmware monitor EPROM. If for any reason the contents of the EPROM were to change from the factory version, the checksum test is designed to detect the change and inform you of the failure.

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

The CS command is used to calculate/verify the contents of a block of memory.

The algorithm used to calculate the checksum is as follows:

- The checksum variable is set to zero.

- 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.

Examples:

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

Default size is word.

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

Size is set to half-word.

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

Size is set to byte, count is in hexadecimal.

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

Default size is word, count is in hexadecimal.

CSAR - PCI Configuration Space READ Access

Command Input

CSAR [*Bus-NO*] [*Device-NO*] [*Function-NO*] [*OFFSET*] [**;B | H | W**]

Options

B Byte
H Half-word
W Word (default)

Description

The CSAR command reads the PCI configuration space of the device specified by the BUS-NUMBER, DEVICE-NUMBER, and FUNCTION-NUMBER. The register to be read is specified by its OFFSET into the PCI configuration space.

Example

Reads 32-bit PCI configuration register @ offset 0 from device function 0 on PCI bus #0.

```
EPPC-Bug>csar 0 13 0 0;w<cr>
Read Data =056510AD
EPPC-Bug>
```

CSAW - PCI Configuration Space WRITE Access

Command Input

CSAW [*B-NO*] [*D-NO*] [*F-NO*] [*OFFSET*] [*WRITE-DATA*] [**;B | H | W**]

Options

B Byte
H Half-word
W Word (default)

Description

The CSAW command writes to the PCI configuration space of the device specified by the BUS-NUMBER, DEVICE-NUMBER, and FUNCTION-NUMBER. The register to be written to is specified by its OFFSET into the PCI configuration space. The value to be written is specified by DATA.

Note CSAW does not do a read verify of the data written to the device. If the device does not accept the written data, no notice is given to the user.

Example

Writes a zero byte to register offset 0x3c on device 0x13, function 0 on PCI bus #0.

```
EPPC-Bug>csaw 0 13 0 3c 0;b<cr>
EPPC-Bug>
```

DC - Data Conversion

Command Input

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

Options

B Binary
O Octal
A ASCII

Description

The DC command is used to simplify 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 (for instance, 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.

The B option displays the output in binary; the O option displays the output in octal; and the A option displays the ASCII character equal to the value. (If the value is greater than $7F, the A option displays "NA".)

Examples

```
EPPC-Bug>DC 10 <CR>
         00000010 = $10 = &16
EPPC-Bug>

EPPC-Bug>DC &10-&20 <CR>
SIGNED  : FFFFFFF6 = -$A = -&10
UNSIGNED: FFFFFFF6 = $FFFFFFF6 = &4294967286
EPPC-Bug>

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

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

EPPC-Bug>DC 55&F <CR>
         00000005 = $5 = &5
EPPC-Bug>

EPPC-Bug>DC 55>>1 <CR>
         0000002A = $2A = &42
EPPC-Bug>

EPPC-Bug>DC 1+2;B <CR>
DATA BIT: 33222222222211111111110000000000
NUMBER>>: 10987654321098765432109876543210
BINARY  : 00000000000000000000000000000011
EPPC-Bug>

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

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

The subsequent examples assume R2=00030000 and the following data resides in memory:

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

EPPC-Bug>DC R2 <CR>
         00030000 = $30000 = &196608
EPPC-Bug>
```

DS - One Line Disassembler

Command Input

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

Description

This is synonymous with the MD ADDR;DI command and provides access to the disassembler. Refer to *MD - Memory Display* on page 4-85 for information.

DTT - Display Temperature

Command Input

DTT

Description

This command reads and displays the temperature registered by the DS1621 Digital Thermometer and thermostat chip. The temperature is displayed in both Celsius and Fahrenheit formats.

Example

```
EPPC-Bug>dtt<cr>
Temperature =33C/91F
EPPC-Bug>
```

DU - Dump S-Records

Command Input

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

Options

B Byte
H Half-word
W Word (default)

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.

The option field is allowed only if a count was entered as part of the range, and defines the units of the count (bytes, half-words, or words). The default data type is byte.

TEXT For text that is incorporated into the header (S0) record of the block of records that will be dumped.

ADDR Allows 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. *Chapter Running H/F 3* has additional information on S-records.

OFFSET Allows you to specify an optional offset in the field. 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 loads back into memory at a different location than the location from which it was dumped. The default offset is zero.

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.

```
EPPC-Bug>DU ,,20000 2002F <CR>
Effective address: 00020000
Effective address: 0002002F
EPPC-Bug>
```

Example 2:

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

```
EPPC-Bug>DU 0 30000:&10 <CR>
Effective address: 00030000
Effective count : &10
S0030000FC
S20E0300002602544553546608 4E4F7B
S9030000FC
EPPC-Bug>
```

Example 3:

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

```
EPPC-Bug>DU ,,20000 2002F 'TEST' 2000A <CR>
Effective address: 00020000
Effective address: 0002002F
EPPC-Bug>
```

ECHO - Echo String

Command Input

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

Description

The ECHO command displays strings to any configured port. A hexadecimal number must have two digits before it is displayed. The hexadecimal number allows printing of new lines, carriage returns, etc. ASCII strings can be entered by enclosing them in single quotes ('). To include a quote as part of a string, two consecutive quotes should be entered.

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

Examples

Example 1:

```
EPPC-Bug>ECHO ,,'quick brown fox jumps over the lazy dog' 0A <CR>
quick brown fox jumps over the lazy dog
EPPC-Bug>
```

In this example, the ASCII string was displayed to the current console port. The port number was separated by delimiters, but was not specified. This directs the ECHO command to use the current console port.

Example 2:

```
EPPC-Bug>ECHO 1 'this is a test' 07 <CR>
EPPC-Bug>
```

In this example, the ASCII string and a BELL character were sent to port #1.

Example 3:

```
EPPC-Bug>ECHO 3 'this will not work' <CR>
Logical unit $02 unassigned
```

```
EPPC-Bug>
```

An error message results in this example because the selected port is not configured.

Example 4:

```
EPPC-Bug>ECHO ,, 'This is "EPPCBug"' <CR>
This is "EPPCBug"
EPPC-Bug>
```

This example handles a string with quotes.

ENV - Edit Environment

Command Input

ENV [;[**D**]]

The ENV command allows you to view and configure all EPPCBug operational parameters that are kept in NonVolatile 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 EPPCBug uses a parameter from NVRAM, the NVRAM contents are first tested by checksum to ensure the integrity of the NVRAM contents. In the instance of NVRAM checksum failure, certain default values are assumed.

The debugger operational parameters, that are kept in NVRAM, are not initialized automatically on power-up/warm reset. You must 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 are loaded into NVRAM
- 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 RETURN. To leave the field unaltered, press RETURN 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 ENV command, and return control to the debugger

ENV Command Parameters

The following prompts appear with the default field values:

Probe System for Supported I/O Controllers [Y/N] = Y?

Y) Access the appropriate system buses (PCIbus, local MPU bus) to determine the presence of supported controllers.

N) Do not access the system buses to determine the presence of supported controllers.

Local SCSI Bus Reset on Debugger Setup [Y/N] = N?

Y) Reset the Local SCSI bus on debugger set-up.
N) Do not reset the Local SCSI bus on debugger set-up (default).

PCI Interrupts Route Control Registers (PIRQ0/1/2/3) = 0A0B0E0F?

Specifies the values to use for the PIRQ routing registers in the PCI-ISA bridge. This parameter defines the mapping of PCI interrupts to the ISA interrupt controller within the ISA bridge.

Firmware Command Buffer Offset = 000002C8?

Specifies the offset within NVRAM where firmware looks for the startup command buffer.

Upon startup, if BUG commands are present in the startup command buffer, they will be executed as though a user was present and entering the commands from the keyboard.

If the startup buffer begins with a NULL character, the firmware does not attempt to execute commands from the buffer. In this case, control simply goes to the command line prompt.

Firmware Command Buffer Size = 00000200?

Specifies the size of the startup command buffer.

Firmware Command Buffer Delay = 5000?

Defines the number of milliseconds to wait before firmware begins executing the startup commands in the startup command buffer. During this delay, you may press any key to prevent the execution of the startup command buffer.

The default value of this parameter causes a startup delay of 5 seconds.

Program Intermediate Load Address = 00200000?

This parameter defines the address of memory where the PL command initially loads the program image. Once the image is loaded at the intermediate load address, its contents are evaluated and repositioned in memory as appropriate for the load image type (ELF, ROMBOOT or binary)

Binary Program Load Address = 00080000?

This parameter defines the address where binary images are moved to for execution. Binary images are images that are neither ELF or ROMBOOT images. This parameter does not affect the load address for either ELF or ROMBOOT images.

Binary Program Execution Offset = 00000100?

This parameter defines the offset from the Binary Program Load Address that you use to establish the initial instruction pointer value for binary images. This parameter does not affect the initial instruction pointer for either ELF or ROMBOOT images.

Primary Network Controller LUN = 20?
Primary Network Device LUN = 00?

Together, these parameters define the network device which is to be considered the primary network controller in the system. The networking parameters for the primary network controller are saved within the primary network controller NVRAM area.

Firmware Command Buffer:
['NULL' terminates entry]?

The Firmware Command Buffer contents contain the BUG commands which are executed upon firmware startup. BUG commands you will place into the command buffer should be typed just as you enter the commands from the command line.

The string 'NULL' on a new line terminates the command line entries.

All BUG commands except for the following may be used within the command buffer:

DU
ECHO
LO
PA
TA
VE

Execution of a BUG commands file via PL.

Note

Interactive editing of the startup commands buffer is not supported. If changes are needed to an existing set of startup commands, a new set of commands with changes must be reentered.

GD - Go Direct (Ignore Breakpoints)

Command Input

GD [*ADDR*]

Description

GD is used to start target code execution. If an address is specified, it is placed in the target IP. Execution starts at the target IP address. As opposed to GO, breakpoints are not inserted.

Once execution of the target code has begun, control may be returned to EPPCBug by various conditions:

- The ABORT or RESET switch on the debugger host was pressed.
- An unexpected exception occurred.

Examples

The following program resides at $20000.

```
EPPC-Bug>DS 20000:10 <CR>
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
EPPC-Bug>
```

Set breakpoint at $1003C:

```
EPPC-Bug>BR 20028 <CR>
BREAKPOINTS
00020028
EPPC-Bug>
```

Initialize R7 and start target the program:

```
EPPC-Bug>RM R7 <CR>
R7     =00000000 ? FFFFFFFF. <CR>
EPPC-Bug>

EPPC-Bug>GD 20000 <CR>
Effective address: 00020000
```

Note that the breakpoint was not taken.

GN - Go to Next Instruction

Command Input

GN

Description

GN sets a temporary breakpoint at the address of the next instruction, that is, the one following the current instruction, and then starts target code execution. After setting the temporary breakpoint, the sequence of events is similar to that of the GO command.

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

Examples

The following section of code resides at address $20000.

```
EPPC-Bug>DS 20000:6 <CR>
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)
EPPC-Bug>
```

The following simple routine resides at address $30000.

```
EPPC-Bug>DS 30000 <CR>
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
EPPC-Bug>
```

Execute up to the BL instruction.

```
EPPC-Bug>RM IP <CR>
IP     =00020020 ? 20000. <CR>
EPPC-Bug>
EPPC-Bug>GT 20010 <CR>
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
EPPC-Bug>
```

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

```
EPPC-Bug>GN <CR>
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)
EPPC-Bug>
```

GO - Go Execute User Program

Command Input

GO [*ADDR*]

Description

The GO command (alternate form G) is used to initiate 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 EPPCBug by various conditions:

- A breakpoint with 0 count was found.
- The ABORT or RESET switch on the debugger host was pressed.
- An unexpected exception occurred.

Examples

The following program resides at $30000.

```
EPPC-Bug>DS 30000 <CR>
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
EPPC-Bug>
```

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

```
EPPC-Bug>RM R3 <CR>
R3     =000410FE? 68000 <CR>
R4     =00000000? 34. <CR>
EPPC-Bug>
EPPC-Bug>BR 30018 3001C <CR>
BREAKPOINTS
00030018              0003001C
EPPC-Bug>
EPPC-Bug>GO 30000 <CR>
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
EPPC-Bug>
```

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

```
EPPC-Bug>NOBR * <CR>
BREAKPOINTS
0003001C
EPPC-Bug>
```

Continue target program execution.

```
EPPC-Bug>G <CR>
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
EPPC-Bug>
```

Remove breakpoints and restart the target code.

```
EPPC-Bug>NOBR <CR>
BREAKPOINTS
EPPC-Bug>

EPPC-Bug>GO 30000 <CR>
Effective address: 00030000
```

The outcome is dependent on the loaded application.

GT - Go to Temporary Breakpoint

GT *ADDR*

Description

GT allows you to set a temporary breakpoint and then start 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 0 count 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 EPPCBug by various conditions:

- A breakpoint with count 0 was found.
- The ABORT or RESET switch on the debugger host was pressed.
- An unexpected exception occurred.

Examples

The following program resides at $20000 and $30000.

```
EPPC-Bug>DS 20000:7 <CR>
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
EPPC-Bug>

EPPC-Bug>DS 30000:8 <CR>
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
EPPC-Bug>
```

Set a breakpoint:

```
EPPC-Bug>BR 20014 <CR>
BREAKPOINTS
00020014
EPPC-Bug>
```

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

```
EPPC-Bug>RM IP <CR>
IP   =00020010 ? 20000. <CR>
EPPC-Bug>


EPPC-Bug>GT 20010 <CR>
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
EPPC-Bug>
```

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

```
EPPC-Bug>GT 20000 <CR>
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)
EPPC-Bug>
```

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

HBD - History Buffer Display

Command Input

HBD [*N-Entries*]

Description

The MBX board keeps track of the last 128 commands entered by the user since power-up. The HBD command allows you to retrieve a listing of these commands.

The number of entries to display is optional. If present, it limits the number of commands displayed.

Examples

```
EPPC-Bug>ioi<cr>
I/O Inquiry Status:
CLUN  DLUN  CNTRL-TYPE  DADDR  DTYPE  RM  Inquiry-Data
EPPC-Bug>hbd<cr>
  1 ioi
  2 hbd
EPPC-Bug>
```

HBX - History Buffer Entry-Execute

Command Input

HBX *N-Entry*

Description

As noted under the HBD command, the MBX board keeps track of the last 128 commands entered since power-up. You can run any previous command by running HBX with the entry number that you want to execute. Refer to *Appendix D* for additional history buffer features.

Examples

```
EPPC-Bug>ioi<cr>
I/O Inquiry Status:
CLUN  DLUN  CNTRL-TYPE  DADDR  DTYPE  RM  Inquiry-Data
EPPC-Bug>hbd<cr>
  1 ioi
  2 hbd
EPPC-Bug>hbx 1<cr>
EPPC-Bug>ioi
I/O Inquiry Status:
CLUN  DLUN  CNTRL-TYPE  DADDR  DTYPE  RM  Inquiry-Data
EPPC-Bug>
```

HE - Help

Command Input

HE [*COMMAND*]

Description

HE is the EPPCBug help facility. HE <RETURN> displays the command names of all available commands along with their appropriate titles. Note that the actual display output is dependent upon the host CPU functionality and version of the resident debugger.

HE *COMMAND* displays only the command name, title, and syntax for that particular command.

Examples

```
EPPC-Bug>HE <CR>
AS       Assembler
BC       Block of Memory Compare
BF       Block of Memory Fill
BI       Block of Memory Initialize
BM       Block of Memory Move
BS       Block of Memory Search
BR       Breakpoint Insert
BV       Block of Memory Verify
CS       Checksum a Block of Data
CSAR     PCI Configuration Space READ Access
CSAW     PCI Configuration Space WRITE Access
DC       Data Conversion and Expression Evaluation
DS       Disassembler
DTT      Display Temperature
DU       Dump S-Records
ECHO     Echo String
ENV      Edit Environment
G        "Alias" for "GO" Command
GD       Go Direct (Ignore Breakpoints)
GN       Go to Next Instruction
GO       Go Execute User Program
Press "RETURN" to continue
```

```
GT        Go to Temporary Breakpoint
HBD       History Buffer Display
HBX       History Buffer Entry-Execute
HE        Help on Command(s)
I2C       I2C Device Read/Write
IOC       I/O Control for Disk
IOI       I/O Inquiry
IOP       I/O Physical to Disk
IOT       I/O "Teach" for Configuring Disk Controller
LO        Load S-Records from Host
M         "Alias" for "MM" Command
MA        Macro Define/Display
MAE       Macro Edit
MAL       Enable Macro Expansion Listing
MD        Memory Display
MDS       Memory Display
MM        Memory Modify
MMAP      MPC8xx Memory Map Display
MMD       Memory Map Diagnostic
MS        Memory Set
MW        Memory Write
Press "RETURN" to continue
NIOC      Network I/O Control
NIOP      Network I/O Physical
NIOT      I/O "Teach" for Configuring Network Controller
NOBR      Breakpoint Delete
NOMA      Macro Delete
NOMAL     Disable Macro Expansion Listing
NOPA      Printer Detach
NOPF      Port Detach
NOSYM     Detach Symbol Table
NPING     Network Ping
OF        Offset Registers Display/Modify
PA        Printer Attach
PF        Port Format
PFLASH    Program FLASH Memory
RD        Register Display
RESET     Cold/Warm Reset
RL        Read Loop
RM        Register Modify
RS        Register Set
SD        Switch Directories
```

```
SET      Set Time and Date
SYM      Attach Symbol Table
SYMS     Display Symbol Table
Press "RETURN" to continue
T        Trace
TA       Terminal Attach
TC       Trace on Change of Flow Control
TIME     Display Time and Date
TM       Transparent Mode
TT       Trace to Temporary Breakpoint
UPM      MPC8xx User Programmable Memory (UPM) Display/Read/Write
VE       Verify S-Records Against Memory
VER      Revision/Version Display
VPD      VPD (Vital Product Data) Display
WL       Write Loop
EPPC-Bug>

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

I2C - I2C Device Read/Write

Command Input

I2C <*DADDR*><*DEL*><*XADDR*><*DEL*><*XBYTES*>**;D | P"** }

4

Arguments

DADDR The I2C bus address of the device of interest

XADDR The memory address of the data to be read from or written to the device.

XBYTES The number of bytes which are to be read or written to the device

Options

D Read the I2C device.
P Write the I2C device.

Description

The I2C command provides access to devices on the I2C bus.

Caution

The contents of the VPD SROM and DIMM information SROMs contains data which is crucial to the correct operation of the board. The I2C command does not provide any sanity or error checking of data written to these devices. The user should take care in modifying the contents of the VPD SROM or DIMM SROMs or the board may be rendered inoperable.

Examples

To read the contents of the VPD SROM (I2C bus address 0xA4) into address 0x100000:

```
EPPC-Bug>i2c a4 100000 100;d
EPPC-Bug>mds 100000
00100000  4D4F544F 524F4C41 01000103 4D425802  MOTOROLA....MBX.
00100010  0C30312D 57333236 39463035 41030732  .01-W3269F05A..2
00100020  37313839 34340410 00000000 00000000  718944..........
00100030  00000000 00000000 0504017D 78400604  ...........}x@..
00100040  017D7840 07040000 80000806 08003E20  .}x@.........> 
00100050  0002FFFF FFFFFFFF FFFFFFFF FFFFFFFF  ................
00100060  FFFFFFFF FFFFFFFF FFFFFFFF FFFFFFFF  ................
00100070  FFFFFFFF FFFFFFFF FFFFFFFF FFFFFFFF  ................
00100080  FFFFFFFF FFFFFFFF FFFFFFFF FFFFFFFF  ................
00100090  FFFFFFFF FFFFFFFF FFFFFFFF FFFFFFFF  ................
001000A0  FFFFFFFF FFFFFFFF FFFFFFFF FFFFFFFF  ................
001000B0  FFFFFFFF FFFFFFFF FFFFFFFF FFFFFFFF  ................
001000C0  FFFFFFFF FFFFFFFF FFFFFFFF FFFFFFFF  ................
001000D0  FFFFFFFF FFFFFFFF FFFFFFFF FFFFFFFF  ................
001000E0  FFFFFFFF FFFFFFFF FFFFFFFF FFFFFFFF  ................
001000F0  FFFFFFFF FFFFFFFF FFFFFFFF FFFFFFFF  ................
00100100  00000000 00000000 00000000 00000000  ................
```

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 *Related Documentation* on page 1-4.

Use this command 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 RETURN. To leave the field unaltered, press RETURN 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.
=	Reopen 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 PL 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 nonSCSI, 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).

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 displays 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> is 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.

With the variety 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 RAM. This is done only if the device is present. You may view the system's device names by performing the following operations.

1. Use the D option for mass storage devices, when probing, to display the device names of the attached devices. These device names are per the IBM firmware and the IBM AIX naming conventions.
2. Use the N option to view the device names of mass storage devices which are currently configured (or have been accessed via a boot (PL), or via an I/O operation (IOP)).

IOP - I/O Physical to Disk

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 RETURN. To leave the field unchanged, press RETURN 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.
=	Reopen the same field
.	Terminate the IOP command, and return control to the debugger

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 commands Inquiry and Mode Sense. If the specified controller is nonSCSI, 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 (EPPCBug> 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 =00004000?

The starting address for the 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.

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 *Disk Status Codes* on page E-1 for an explanation of returned error status codes.

IOT - I/O “Teach” for Configuring Disk Controller

Command Input

IOT [;[A | F | H | T]]

4

Options

A List all the disk controllers which are supported by EPPCBug. SCSI controllers are identified with an asterisk (*).

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 EPPCBug 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 EPPCBug 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 PL commands, and also any user program that uses the system call disk functions.

Refer to *Appendix* for information on floppy disk formats.

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 *Floppy Drive Configuration Parameters* on page B-3 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 PL 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 RETURN. To leave the field unaltered, press RETURN 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.

= Reopen 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 (magnetic disk)
$01	Sequential-access (magnetic tape)
$02	Printer
$03	Processor
$04	Write-once (some optical disks)
$05	CD-ROM
$06	Scanner
$07	Optical Memory (some optical disks)
$08	Medium Changer (jukeboxes)
$09	Communications
$0A, $0B	Graphic Arts Pre-Press
$0C-$1E	Reserved
$1F	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:

Removable Media = N (Y/N)

This value should be set to Y if the media is removable (floppy, CDROM) otherwise set the value to N.

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 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.

LO - Load S-Records from Host

Command Input

LO [*n*] [*ADDR*] **[;[X][C][T]]** [*=text*]

Description

This 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.

Downloading S-records can be at any baud rate supported by both the bug and the host system. If the X option is specified, ensure 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.

n Allows you to specify which port is to be used for the downloading. If the port number is not specified but the ADDR option is specified, LO must be separated from ADDR by two commas. If this number is omitted, port 1 is assumed.

ADDR Allows you to enter 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 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.

=text Is sent to the host before EPPCBug 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. The text should NOT be delimited by any kind of quote marks. Text is understood to begin immediately following the equals sign and terminates by pressing 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, LO keeps looking for a <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 other options (more than one may be used) have the following effects:

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. This option echoes the S-records to your terminal as they are read in at the host port.

T Obsolete. The T option has no effect on the operation of LO.

The S-record format (refer to *Chapter Running H/F 3*) 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 G or GO instead of G addr or GO addr to execute the code that was downloaded.

If a nonhexadecimal 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 EPPCBug 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 EPPCBug 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.

Examples

Suppose a host system was used to create this 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:
```

Assume that the program has been compiled and linked to start at address 65040000. Then the program was converted into an S-record file named "test.mx" as follows:

```
S325650400007C8402A6908300007C8502A6908300044E80002000000000650400006504002412
S30D650400200000000000000000069
S7056504000091
```

Load this file into memory for execution at address $40000 as follows:

```
EPPC-Bug>TM <CR>
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 a RETURN-A character sequence. At this point control will return to the EPPCBug prompt.)

```
.
EPPC-Bug>
EPPC-Bug>LO ,,-65000000 ;X=cat test.mx <CR>
cat test.mx
S325650400007C8402A6908300007C8502A6908300044E80002000000000650400006504002412
S30D650400200000000000000069
S7056504000091
EPPC-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 a SYSTEM V command line that caused the file to be copied by SYSTEM V to the port which is connected with the debugger host's host port.

```
EPPC-Bug>DS 40000,40014 <CR>
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
EPPC-Bug>
```

The target IP now contains the entry point of the code in memory ($40000).

```
EPPC-Bug>RD <CR>
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
EPPC-Bug>
```

MA/NOMA - Macro Define/Display/Delete

Command Input

MA [*NAME* | **;L**]
NOMA [*NAME*]

4

Description

The NAME can be any combination of 1-8 alphanumeric characters.

The MA command defines a complex command consisting of any number of debugger primitive commands with optional parameter specifications.

Use the NOMA command to delete either a single macro or all macros.

Entering MA without specifying a macro name causes the debugger to list all currently defined macros and their definitions.

When MA is invoked with the name of a currently defined macro, that macro definition is displayed.

Line numbers are shown when displaying macro definitions to facilitate editing via 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=**, enter a debugger command, and press RETURN. Commands entered are not checked for syntax until the macro is invoked. To exit the macro definition mode, enter only a RETURN (null line) in response to the prompt. If the macro contains errors, it can either be deleted and redefined or it can be edited with the MAE command. A macro containing no primitive debugger commands (i.e., no definition) is not accepted.

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 10 (0 to 9) arguments are permitted. 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 "\0" characters. Similarly, the second argument would be used whenever the sequence "\1" occurred.

For instance, entering ARGUE 3000 1 ;B on the debugger command line would invoke the

> macro named *ARGUE* with the text strings *3000*, *1*, and **;B** replacing "\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, then once a macro is invoked, it is automatically reinvoked 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 macro “ABC”.

```
EPPC-Bug>MA ABC <CR>
M=MD 3000 <CR>
M=GO \0 <CR>
M= <CR>
EPPC-Bug>
```

Example 2:

Define macro "DIS".

```
EPPC-Bug>MA DIS <CR>
M=MD \0:17;DI <CR>
M= <CR>
EPPC-Bug>
```

Example 3:

List all currently defined macros.

```
EPPC-Bug>MA <CR>
MACRO ABC
010 MD 3000
020 GO \0
MACRO DIS
010 MD \0:17;DI
EPPC-Bug>
```

Example 4:

List definition of macro "ABC".

```
EPPC-Bug>MA ABC <CR>
MACRO ABC
010 MD 3000
020 GO \0
EPPC-Bug>
```

Example 5:

Delete macro "DIS".

```
EPPC-Bug>NOMA DIS <CR>
EPPC-Bug>
```

Example 6:

Define macro "ASM".

```
EPPC-Bug>MA ASM <CR>
M=MM \0;DI <CR>
M= <CR>
EPPC-Bug>
```

Example 7:

List all currently defined macros.

```
EPPC-Bug>MA <CR>
MACRO ABC
010 MD 3000
020 GO \0
MACRO ASM
010 MM \0;DI
EPPC-Bug>
```

Example 8:

Delete all defined macros.

```
EPPC-Bug>NOMA <CR>
EPPC-Bug>
```

Example 9:

List all currently defined macros.

```
EPPC-Bug>MA <CR>
NO MACROS DEFINED
EPPC-Bug>
```

MAE - Macro Edit

Command Input

MAE *NAME LINE #* [*STRING*]

Options

NAME Any combination of 1-8 alphanumeric characters.

LINE # The line number (1-999) of the macro to be replaced or inserted.

STRING The character line to be inserted or replaced.

Description

The MAE command modifies the macro named in the command line. MAE is line-oriented and supports the following actions: insertion, deletion, and replacement.

To insert a line, specify a line number between the numbers of the lines that the new line is to be inserted between. The text of the new line to insert must also be specified on the command line following the line number.

To replace a line, specify its line number and enter the replacement text after the line number on the command line.

A line is deleted if its line number is specified and the replacement line is omitted.

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. NOMA must be used to remove a macro. To define new macros, use MA; the MAE command operates only on previously defined 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

List definition of macro “ABC”. Add a line to macro “ABC”. Replace line #010 from macro “ABC”. Remove the specified line from the macro “ABC”.

```
EPPC-Bug>MA ABC <CR>
MACRO ABC
010 MD 3000
020 GO \0
EPPC-Bug>

EPPC-Bug>MAE ABC 15 RD <CR>
MACRO ABC
010 MD 3000
020 RD
030 GO \0
EPPC-Bug>

EPPC-Bug>MAE ABC 10 MD 10+Z0 <CR>
MACRO ABC
010 MD 10+Z0
020 RD
030 GO \0
EPPC-Bug>

EPPC-Bug>MAE ABC 30 <CR>
MACRO ABC
010 MD 10+Z0
020 RD
EPPC-Bug>
```

MAL/NOMAL - Enable/Disable Macro Expansion Listing

Command Input

MAL
NOMAL

Description

The MAL command lets you 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.

Use the NOMAL command to suppress the listing of the macro lines during execution.

Using MAL and NOMAL is a convenience for you and in no way interacts with the function of the macros.

MD - Memory Display

Command Input

MD[S] *ADDR*[:*COUNT* | *DEL 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

This command displays 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 DI option enables the Resident MC88100 disassembler, and is identical to the DS command. No other option is allowed if DI is selected. later, only.

The optional count argument in the MD command specifies the number of data items to be displayed (or the number of disassembled instructions to display if the disassembly option is selected) defaulting to 8 if none is entered. The default count is changed to 128 if the S (sector) modifier is used. Pressing RETURN at the prompt immediately after the command has completed causes the command to re-execute and displays an equal number of data items or lines beginning at the next address.

Examples

Example 1:

```
EPPC-Bug>MD 22000;H <CR>
00022000  2800 1942 2900 1942  2800 1842 2900 2846  (..B)..B(..B).(F
EPPC-Bug> <CR>
00022010  FC20 0050 ED07 9F61  FF00 000A E860 F060  | .Pm..a....h'p'
EPPC-Bug>
```

Example 2:

Assume the following microprocessor register state: R5=00023627

```
EPPC-Bug>MD R5:&19;B <CR>
00022000  2800 1942 2900 1942  2800 1842 2900 2846  (..B)..B(..B).(F
EPPC-Bug> <CR>
00022010  FC20 0050 ED07 9F61  FF00 000A E860 F060  | .Pm..a....h'p'
EPPC-Bug>
```

Example 3:

```
EPPC-Bug>MD 30000;DI <CR>
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
EPPC-Bug>
```

Example 4:

```
EPPC-Bug>MD 20000;D <CR>
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
EPPC-Bug>
```

Example 5:

```
EPPC-Bug>MD 10000;S <CR>
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
EPPC-Bug>
```

Example 6:

```
EPPC-Bug>MDS 30000 <CR>
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  ................
EPPC-Bug>
```


Example 7:

```
EPPC-Bug>MDS 30000;B <CR>
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  ................
EPPC-Bug>
```

Example 8:

```
EPPC-Bug>MDS 30000;H <CR>
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  ................
EPPC-Bug>
```

MM - Memory Modify

Command Input

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

Description

Use MM to examine and change memory locations. MM accepts the both integer and floating point data types. The default data type is word.

The MM command (alternate form M) reads and displays the contents of memory at the specified address and prompts you with a question mark ("?"). You may enter new data for the memory location, followed by a RETURN, or may simply enter RETURN which leaves the contents unaltered. That memory location is closed and the next location is opened.

You may also enter one of several special characters, either at the prompt or after writing new data, which change what happens when the carriage return is entered. These special characters are as follows:

“V” or “v” The next successive memory location is opened. This is the default. It is in effect whenever MM is invoked and remains in effect until changed by entering one of the other special characters.

"^" MM backs up and opens the previous memory location.

"=" MM reopens the same memory location (this is useful for examining I/O registers or memory locations that are changing over time).

"." Terminates MM command. Control returns to EPPCBug.

The N option of the MM command disables the read portion of the command. The A option forces alternate location accesses only.

Examples

Example 1:

Access location $20000, modify memory, modify and backup, and modify memory and exit.

```
EPPC-Bug>MM 20000;H <CR>
00020000 1234? <CR>
00020002 5678? 4321 <CR>
00020004 9ABC? 8765^ <CR>
00020002 4321? <CR>
00020000 1234? ABCD. <CR>
EPPC-Bug>
```

E**xample 2**:

Word access to location $20004 with alternate location access option enabled, modify and reopen location, and exit memory modify.

```
EPPC-Bug>MM 10004;WA <CR>
00020004 CD432187? <CR>
0002000C 00068010? 68010+10= <CR>
0002000C 00068020? <CR>
0002000C 00068020? . <CR>
EPPC-Bug>
```

The DI option enables the one-line assembler/disassembler. All other options are invalid if DI is selected. 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:

1. Press RETURN. This closes the present location and continues with disassembly of next instruction.
2. Enter a new source instruction followed by RETURN. This invokes the assembler, which assembles the instruction and generates a "listing file" of one instruction.
3. Enter .RETURN. This closes the present location and exits the MM command.

If a new source line is entered, the present line is erased and replaced by the new source line entered. In the hardcopy 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.

For additional information about the assembler, refer to *Chapter Running H/F 3*.

Example 3:

Assemble a new source line.

```
EPPC-Bug>MM 40000;DI <CR>
00040000 00000000  WORD        $00000000? ADDIS R10,R0,1000 <CR>
00040000 3D401000  ADDIS       R10,R0,$1000
00040004 00000000  WORD        $00000000? ORI R10,R10,FFFF <CR>
00040004 614AFFFF  ORI         R10,R10,$FFFF
00040008 00000000  WORD        $00000000? . <CR>
EPPC-Bug>
```

Example 4:

New source line with error.

```
EPPC-Bug>MM 40008;DI <CR>
00040008 00000000  WORD        $00000000? FOO R20,R0,10 <CR>
Assembler Error: Unknown Mnemonic

00040008 00000000  WORD        $00000000? ORI R20,R0,10 <CR>
00040008 60140010  ORI         R20,R0,$10
0004000C 00000000  WORD        $00000000? . <CR>
EPPC-Bug>
```

Example 5:

Step to next location and exit MM.

```
EPPC-Bug>MM 40000;DI <CR>
00040000 3D401000  ADDIS       R10,R0,$1000? <CR>
00040004 614AFFFF  ORI         R10,R10,$FFFF? . <CR>
EPPC-Bug>
```

Example 6:

Double precision floating point numbers.

```
EPPC-Bug>MM 20000;D <CR>
00020000 3.140000000000001_E+87? 1.2 <CR>
00020008 -5.8508426708663386_E+250? 2 <CR>
00020010 1.9999900000000014_E-100? 4.357E+10 <CR>
00020018 6.7777778899999985_E+37? 2.765E-99 <CR>
00020020 9.8762300000000015_E+10? -4.876E-34 <CR>
00020028 1.00008764231_E-2? -1.023E101 <CR>
00020030 4.5789000000000044_E-99? 1_7FF_FFFFFFFFFFFF. <CR>
EPPC-Bug>


EPPC-Bug>MD 20000:7;D <CR>
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
EPPC-Bug>
```

MMAP - Memory Map Display

Command Input

MMAP

Description

MMAP displays information about the memory map of the MPC8xx as configured by EPPCBug

Examples

```
EPPC-Bug>mmap<cr>
IMMR =FA200000

MPC8xx Address Decode:
S-ADDR    E-ADDR    CS  PS  PE  WP  MS    BI  V  DESCRIPTION
FE000000  FE7FFFFF  0   32  N   N   GPCM  Y   Y  FLASH Memory
00000000  00FFFFFF  1   32  N   N   UPMA  N   Y  Local DRAM Memory
00000000  FFFFFFFF  2    0  N   N   UPMA  N   N  DIMM Memory - Bank #0
00000000  FFFFFFFF  3    0  N   N   UPMA  N   N  DIMM Memory - Bank #1
FA000000  FA1FFFFF  4    8  N   N   GPCM  Y   Y  NVRAM & BCSR
80000000  DFFFFFFF  5   32  N   N   GPCM  Y   Y  PCI I/O & Memory
FA210000  FA21FFFF  6   32  N   N   GPCM  Y   Y  QSpan Registers
FC000000  FC7FFFFF  7    8  N   N   GPCM  Y   Y  Boot ROM

Press "RETURN" to continue
MPC8xx PCMCIA Interface Decode:
S-ADDR    E-ADDR    W  PS  ID  WP  V  DESCRIPTION
E0000000  E3FFFFFF  0  16  A   N   N  Common Memory Space
00000000  00000000  1   8  A   N   N  Common Memory Space
00000000  00000000  2   8  A   N   N  Common Memory Space
00000000  00000000  3   8  A   N   N  Common Memory Space
00000000  00000000  4   8  A   N   N  Attribute Memory Space
00000000  00000000  5   8  A   N   N  Reserved
00000000  00000000  6   8  A   N   N  Common Memory Space
00000000  00000000  7   8  A   N   N  Common Memory Space

Press "RETURN" to continue
DRAM Memory Usage:
S-ADDR    E-ADDR    DESCRIPTION
```

```
00000000  00003FFF  Vector Table
00004000  00FBCFFF  Available to User
00FBD000  00FFFFFF  F/W Monitor
```

MMD - Memory Map Diagnostic

Command Input

MMD *RANGE DEL INCREMENT*[**;B | H | W**]

Options

B Byte
H Half-word
W Word

Description

Use this command 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. After the transaction is complete, increment is added to the old transaction address to form the next transaction address. The increment will be scaled by the data type, for example, 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 (8Mb) of memory was found.

```
EPPC-Bug>MMD 0 10000000 10000;B <CR>
Effective address: 00000000
Effective address: 10000000
$00000000-$007F0000 PRESENT
$00800000-$0FFF0000 NOT-PRESENT
EPPC-Bug>
```

Example 2:

Look for any memory between $10000000 and $FFFFFFFF with an increment of $40000 by bytes.

```
EPPC-Bug>MMD 10000000 FFFFFFFF 40000;B <CR>
Effective address: 10000000
Effective address: FFFFFFFF
$10000000-$7FFC0000 NOT-PRESENT
$80000000-$9FFC0000 PRESENT
$A0000000-$FFEC0000 NOT-PRESENT
$FFF00000-$FFFC0000 PRESENT
EPPC-Bug>
```

MS - Memory Set

Command Input

MS *ADDR* {*Hexadecimal number*} {'*string*'}

Description

Memory Set is used to write data to memory starting at the specified address. Hexadecimal numbers are not assumed to be of a particular size, so they 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.

ASCII strings can be entered by enclosing them in single quotes ('). To include a quote as part of a string, two consecutive quotes should be entered.

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

Examples

Assume that memory is initially cleared:

```
EPPC-Bug>MS 25000 0123456789ABCDEF 'This is "EPPCBug"' 23456 <CR>
EPPC-Bug>

EPPC-Bug>MD 25000:20;B
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
"EPPCBug"#E`.....
EPPC-Bug>
```

MW - Memory Write

Command Input

MW *ADDR DATA* [**;B | H | W**]

Options

B Byte
H Half-word
W Word

Description

The MW command writes a specific data pattern to a specific location. No verify (read) is performed. You also can specify the data width.

The default data width is word.

Examples

Example 1:

```
EPPC-Bug>MW 1E000 55AA55AA <CR>
Effective address: 0001E000
Effective data   : 55AA55AA
EPPC-Bug>
EPPC-Bug>MD 1E000 <CR>
0001E000  55AA55AA 00000000 00000000 00000000  U.U.............
0001E010  00000000 00000000 00000000 00000000  ................
EPPC-Bug>
```

Example 2:

```
EPPC-Bug>MW 1E000 77;B
Effective address: 0001E000
Effective data   : 77
EPPC-Bug>
EPPC-Bug>MW 1E000 <CR>
0001E000  77AA55AA 00000000 00000000 00000000  w.U.............
0001E010  00000000 00000000 00000000 00000000  ................
```

```
EPPC-Bug>
```

Example 3:

```
EPPC-Bug>MW 1E002 33CC;H <CR>
Effective address: 0001E002
Effective data   : 33CC
EPPC-Bug>

EPPC-Bug>MD 1E000 <CR>
0001E000  77AA33CC 00000000 00000000 00000000  w.3.............
0001E010  00000000 00000000 00000000 00000000  ................
EPPC-Bug>
```

NIOC - Network I/O Control

Command Input

NIOC

4

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 C*.

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 pressing RETURN. To leave the field unaltered, press RETURN 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
=	Reopen 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.

NIOP - Network I/O Physical

Command Input

NIOP

4

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 RETURN. To leave the field unaltered, press RETURN 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

= Reopen 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 - I/O "Teach" for Configuring Network Controller* on page 4-105 for a description of the parameters.

Note that winding (indexing) into a file is possible on a read (get), but there is a drawback in this feature due to the nature of TFTP, the entire file is transferred across the network. 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.

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.

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.

NIOT - I/O “Teach” for Configuring Network Controller

Command Input

NIOT [;[A | H]]

Options

A Display the Network Controllers/Nodes that are supported by this version of the firmware.

H Display all Network Controllers/Nodes that are present in the system. The display also includes the Protocol (Internet) and Hardware (Ethernet) addresses.

Description

Use the NIOT command to set-up (“teach”) a new network configuration on the debugger for use by the .NIO_xxx system calls. NIOT lets you modify the controller and device descriptor tables used by the .NIO_xxx 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, PL, PLH, and also any user program that uses the .NIO_xxx 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 is done only if the device is present. You may view the system's device names by the performing the following operations.

- 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 pressing RETURN. To leave the field unaltered, press RETURN without typing a new value.
- You may also enter a special character, either at the prompt or after typing new data, to scroll 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
=	Reopen the same field
.	Terminate the NIOT command, and return control to the debugger

You are 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).

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.

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 nonzero value enables tracing. Tracing would only be used in a debug environment and normally should be disabled. Care should be taken 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 (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.

NPING - Network Ping

Command Input

NPING [*CLUN*] [*DLUN*] [*Source IP*] [*Destination IP*] [*N-Packets*]

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 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.

OF - Offset Registers Display/Modify

Command Input

OF [Zn[;A]]

Command Use

OF — Display all offset registers. An asterisk indicates which register is the automatic register.

OF Z*n* — Display/modify Z*n*. You can scroll through the register in a way similar to that used by the MM command.

OF Z*n*;A — Display/modify Z*n* and set it as the automatic register. The automatic register is one that is automatically added to each absolute address argument of every command except if an offset register is explicitly added. An asterisk indicates which register is the automatic register.

Range entry

Ranges may be entered in three formats: base address alone, base and top as a pair of addresses, and base address followed by byte count. Control characters "^ used. Their function is identical to that in Register Modify (RM) and Memory Modify (MM) commands.

Range syntax

[base address [del top address]] [^ | V | = | .] or [base address [':' byte count]] [^ | V | = | .]

Description

Use this command 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.

- Base is the absolute least address that is used for the range declared by the offset register.
- Top address is the absolute greatest address that is used.

When entering the base and top, you may use either an address/address format or an address/count format. If a count is specified, it refers to bytes. If the top address is omitted from the range, then a count of 1MB is assumed. The top address must equal or exceed the base address. Wrap-around is not permitted.

Offset Register Rules

1. At power-up and cold start reset, Z7 is the automatic register.
2. At power-up and cold start reset, all offset registers have both base and top addresses preset to 0. This effectively disables them.
3. Z7 always has both base and top addresses set to 0, it cannot be changed.
4. Any offset register can be set as the automatic register.
5. The automatic register is always added to every absolute address argument of every EPPCBug command where there is not an offset register explicitly called out.
6. There is always an automatic register. To disable the effect of the automatic register, set Z7 as the automatic register. Note that this is the default condition.

Examples

Display offset registers.

```
EPPC-Bug>OF <CR>
Z0 =00000000 00000000  Z1 = 00000000 00000000
Z2 =00000000 00000000  Z3 = 00000000 00000000
Z4 =00000000 00000000  Z5 = 00000000 00000000
Z6 =00000000 00000000  Z7*= 00000000 00000000
EPPC-Bug>
```

Modify some offset registers.

```
EPPC-Bug>OF Z0 <CR>
Z0 =00000000 00000000? 20000 200FF <CR>
Z1 =00000000 00000000? 25000:200^
Z0 =00020000 000200FF? . <CR>
EPPC-Bug>
```

Look at location $20000.

```
EPPC-Bug>M 20000;DI <CR>
00000+Z0 3C600004  ADDIS       R3,R0,$4? . <CR>
EPPC-Bug>

EPPC-Bug>M Z0;DI <CR>
00000+Z0 3C600004  ADDIS       R3,R0,$4? . <CR>
EPPC-Bug>
```

Set Z0 as the automatic register.

```
EPPC-Bug>OF Z0;A <CR>
Z0*=00020000 000200FF? . <CR>
EPPC-Bug>
```

To look at location $20000.

```
EPPC-Bug>M 0;DI <CR>
00000+Z0 3C600004  ADDIS       R3,R0,$4? . <CR>
EPPC-Bug>
```

To look at location 0, override the automatic offset.

```
EPPC-Bug>M 0+Z7;DI <CR>
00000000 7FB143A6  MTSPR       273,R29? . <CR>
EPPC-Bug>
```

PA/NOPA - Printer Attach/Detach

Command Input

PA [*n*]
NOPA [*n*]

Description

These two commands either attach or detach a printer to the parallel/serial port that you specify. PA is used to attach and NOPA is used to detach.

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 any port, but NOPA detaches all attached ports.

The specified 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 number specified 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. This is done using the Port Format (PF) command, see page page 4-117. This is done by executing the following sequence prior to **PA** *n*.

Examples

```
EPPC-Bug>PF 3 <CR>
Logical unit $03 unassigned
Name of board? FDC37C672-lpt <CR>
Name of port? LPT1 <CR>
Port base address = $800003BC? <CR>
OK to proceed (y/n)? Y <CR>
EPPC-Bug>
```

For further details, refer to *PF /NOPF - Port Format/Detach* on page 4-117.

Example 1:

Attach logical unit $03.

```
EPPC-Bug>PA 3 <CR>
EPPC-Bug>
```

Example 2:

Display current attached printers.

```
EPPC-Bug>PA <CR>
Printer $03 attached
EPPC-Bug>
```

Example 3:

Detach device at logical unit $03.

```
EPPC-Bug>NOPA 3 <CR>
Printer $03 detached
EPPC-Bug>
```

Example 4:

Detach all possible attached printers.

```
EPPC-Bug>NOPA <CR>
EPPC-Bug>
```

PF /NOPF - Port Format/Detach

Command Input

PF [*PORT*]
NOPF [*PORT*]

Description

Use this command to examine and change the serial input/output environment. PF may be used to display a list of the current port assignments, configure a port that is already assigned, or assign and configure a new port. Configuration is done interactively, much like modifying registers or memory (RM and MM commands). An interlock is provided prior to configuring the hardware -- you must explicitly direct PF to proceed.

The serial ports that are labeled

- DEBUG (LUN 0)
- HOST" (LUN 1)
- Console" (LUN dependent, "DEBUG" LUN by default)

by the debugger are special in that you can remove (NOPF) them.

Any changes remain in effect until a reset operation occurs, or another PF execution. The reset operation, via the debugger, sets the serial ports that are labeled DEBUG (LUN 0, port 0) and HOST (LUN 1, port 1) to the default parameters. Refer to *General Installation and Startup* on page 2-6 for details on terminal setup.

Note Only nine ports may be assigned at any given time. Port numbers must be in the range 0 to $1F.

Listing Current Port Assignments

PF lists the names of the module (board) and port for each assigned port number (LUN) when the command is invoked with the port number omitted.

Examples

```
EPPC-Bug>PF <CR>
Current port assignments:  (LUN: Device name, Port name)
00: MPC8xx-SMC
01: MPC8xx-SMC
02: Memory
EPPC-Bug>
```

Configuring a Port

The primary use of PF is changing baud rates, stop bits, etc. This may be accomplished for assigned ports by invoking the command with the desired port number. Assigning and configuring may be accomplished consecutively. Refer to *Assigning a New Port* in this section.

When PF is invoked with the number of a previously assigned port, the interactive mode is entered immediately. To exit from the interactive mode, enter a period by itself or following a new value/setting. While in the interactive mode, the following rules apply:

Only listed values are accepted when a list is shown. The sole exception is that upper- or lowercase may be interchangeably used when a list is shown. Case takes on meaning when the letter itself is used, such as XON character value.

^ Control characters are accepted by hexadecimal value or by a letter preceded by a caret (Control-A (CTRL A) would be "^A"). The caret, when entered by itself or following a value, causes Port Format to issue the previous prompt after each entry.

v or V — Either upper- or lowercase "v" causes Port Format to resume prompting in the original order (Baud Rate, then Parity Type, etc.).

= — Entering an equal sign by itself or when following a value causes PF to issue the same prompt again. This is supported to be consistent with the operation of other debugger commands. To resume prompting in either normal or reverse order, enter the letter "v" or a caret "^ respectively.

. — Entering a period by itself or following a value causes Port Format to exit from the interactive mode and issue the `OK to proceed (y/n)?` prompt.

RETURN — Pressing RETURN without entering a value preserves the current value and causes the next prompt to be displayed.

Examples

Example 1:

Change the number of stop bits to 2.

```
EPPC-Bug>PF 1 <CR>
Baud rate [110,300,600,1200,2400,4800,9600,19200] = 9600? <CR>
Even, Odd, or No Parity [E,O,N] = N? <CR>
Character width [5,6,7,8] = 8? <CR>
Stop Bits [1,2] = 1? 2 <CR>
Auto Xmit enable on CTS* [Y,N] = N? . <CR>
OK to proceed (y/n)? Y <CR>
EPPC-Bug>
```

Parameters Configurable by Port Format

Port base address:

Upon assigning a port, the option is provided to set the base address. This is useful for support of modules with adjustable base addressing. Entering no value selects the default base address shown.

Baud rate:

You may choose from the following: 110, 300, 600, 1200, 2400, 4800, 9600, 19200. IF A NUMBER BASE IS NOT SPECIFIED, THE DEFAULT IS DECIMAL, NOT HEXADECIMAL.

Parity type:

Parity choice may be:

E even
O odd
N disabled

Character width:

You may select 5-, 6-, 7-, or 8-bit characters.

Number of stop bits:

Only 1 and 2 stop bits are supported.

Automatic software handshake:

Current drivers have the capability of responding to XON/XOFF characters sent to the debugger ports. Receiving an XOFF causes a driver to cease transmission until an XON character is received.

Software handshake character values:

The values used by a port for XON and XOFF may be redefined to be any 8-bit value. ASCII control characters or hexadecimal values are accepted.

Assigning a New Port

PF supports a set of drivers for a number of different modules and the ports on each. To assign one of these to a previously unassigned port number, invoke the command with that number. A message is then printed to indicate that the port is unassigned and a prompt is issued to request the name of the module. Pressing the RETURN key on the console at this point causes PF to list the currently supported modules and ports. Once the name of the module

(board) has been entered, a prompt is issued for the name of the port. After the port name has been entered, Port Format attempts to supply a default configuration for the new port.

Once a valid port has been specified, default parameters are supplied. The base address of this new port is one of these default parameters. Before entering the interactive configuration mode, you are allowed to change the port base address. Press the RETURN key to retain the base address shown.

If the configuration of the new port is not fixed, then the interactive configuration mode is entered. Refer to the section above regarding configuring assigned ports. If the new port does have a fixed configuration, then Port Format issues the `OK to proceed (y/n)?` prompt immediately.

PF does not initialize any hardware until you have responded with the letter "Y" to prompt `OK to proceed (y/n)?`. Pressing the BREAK key any time prior to this step or responding with the letter "N" at the prompt leaves the port unassigned. This is only true of ports not previously assigned.

NOPF Port Detach

The NOPF command, NOPF n, unassigns the port whose number is "n". Only one port may be unassigned at a time. Invoking the command without a port number, NOPF, does not unassign any ports.

PFLASH - Program FLASH Memory

Command Input

PFLASH [*RANGE*] [*DSADDR*] [*IEADDR*] **[;[B | H | W][[A | R] | [X]]]**

Arguments

RANGE	Source starting and ending address of the binary image used to program the flash memory.
DSADDR	Destination starting address of the FLASH memory to program the binary image to.
IEADDR	Instruction execution address (i.e., PC/IP). This address points to a reset vector for MPC60x architecture.

Options

B Byte
H Half-word
W Word

R Allow the automatic reset (local) of the hardware on 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 on 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

Description

The PFLASH command loads an application or program into FLASH memory. The command line arguments are checked (for instance, 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.

The element size is determined by the size (B, W, or L) option. The default is 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 (MBX) 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 is 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
```

PL - Program Load

Command Input

When used with disk devices, PL has the following format:

PL[*H*] *CLUN DLUN FNAME* [*PARTITION*] [*STRING*]

When used with network devices, PL has the following format:

PL[*H*] *CLUN DLUN* [*FNAME*] [*SERVERIP*] [*CLIENTIP*] [*GATEWAY*] [*STRING*]

Arguments:

CLUN Controller Logical Unit of the device to be downloaded from.

DLUN Device logical Unit number of the device to be downloaded from.

Note: CLUN & DLUN assignments can be found in *Device Interface Identifiers (CLUN/DLUN Pairs)* on page B-1.

FNAME Specifies the name of the file to be downloaded from. This argument is mandatory for disk devices and specifies the pathname of the file to be loaded (such as \bindir\myprog.elf). FNAME may be omitted when downloading from network devices. If omitted, FNAME is determined via a BOOTP lookup or via NVRAM parameters set by NIOT.

When used with disk IO devices, PL requires the disk device to contain an IBM PC FAT file system. FNAME specifies the path to the file within that file system.

PARTITION
Specifies the partition number on the disk which contains the FAT file system of interest. PARTITION is optional and if omitted, defaults to 0.

SERVERIP
Specifies the Internet address of the network host which contains the file to be downloaded.

CLIENTIP
Specifies the Internet address that EPPCBug is to use for the board to be downloaded into.

GATEWAY
Specifies the Internet address which EPPCBug will use to forward requests through in the case that SERVERIP and CLIENTIP are not on the same network

STRING
An optional parameter. If STRING is specified on the command line, EPPCBug will pass a pointer to this string in R4 to the program.

Description

PL provides support for loading and invoking programs from IO devices. Depending on the type of IO device being accessed, the PL command can take one of several formats:

PL downloads and invokes the program image specified by FNAME via the device specified by the CLUN, DLUN pair. Likewise, PLH also downloads the image but instead of invoking the program, halts at the BUG command prompt to allow interactive debugging of the program image to occur.

When used with network IO devices, PL 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 *NIOT - I/O "Teach" for Configuring Network Controller* on page 4-105.

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.

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:

R1 Stack pointer (points to top of free memory).

R3 Pointer to board information structure.

R4 Pointer to STRING argument (null terminated) from command line.

To effect an autoboot, the firmware startup command buffer can be loaded with a "PL *xxx*" command. Refer to *ENV - Edit Environment* on page 4-37.

Examples

Example 1

```
EPPC-Bug>plh 20 0 /usr/tmp/ta.bin
Network Booting from: MPC860, Controller 20, Device 0
Loading: /usr/tmp/ta.bin

Client IP Address      = 144.191.24.105
Server IP Address      = 144.191.24.252
Gateway IP Address     = 144.191.17.252
Subnet IP Address Mask = 255.255.255.0
Boot File Name         = /usr/tmp/ta.bin
Argument File Name     =

Bytes Received =&524288, Bytes Loaded =&524288
Bytes/Second   =&65536, Elapsed Time =8 Second(s)
IP     =00100000 MSR    =00003000 CR     =00000000
R0     =00000000 R1     =003B9000 R2     =00000000 R3     =003F4228
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
SPR1   =00000000 SPR8   =00000000 SPR9   =00000000
00100000 4F424D44  WORD        $4F424D44
EPPC-Bug>
```

Example 2

```
EPPC-Bug>plh 20 0 /usr/tmp/ta.bin 144.191.24.252 144.191.24.105
144.191.24.252 elvislives <CR>
Network Booting from: MPC860, Controller 20, Device 0
Loading: /usr/tmp/ta.bin

Client IP Address      = 144.191.24.105
Server IP Address      = 144.191.24.252
Gateway IP Address     = 144.191.24.252
Subnet IP Address Mask = 255.255.255.0
Boot File Name         = /usr/tmp/ta.bin
Argument File Name     = elvislives
```

```
Bytes Received =&524288, Bytes Loaded =&524288
Bytes/Second   =&131072, Elapsed Time =4 Second(s)
IP     =00100000 MSR    =00003000 CR     =00000000
R0     =00000000 R1     =003B9000 R2     =00000000 R3     =003F4228
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
SPR1   =00000000 SPR8   =00000000 SPR9   =00000000
00100000 4F424D44  WORD        $4F424D44
EPPC-Bug>
```

RD - Register Display

Command Input

RD [{[**+**|**-**|**=**][<*DNAME*>][**/**]}{[**+**|**-**|**=**][<*REG1*>[-<*REG2*>]][**/**]}][**;E**]

Arguments

"+" A qualifier indicating that a device or register range is to be added.

"-" A qualifier indicating that a device or register range is to be removed, except when used between two register names. In this case, it indicates a register range.

"=" A qualifier indicating that a device or register range is to be set. This character followed by DEF restores the register mask to select those registers originally displayed.

DNAME
A device name or DEF. This is used to quickly enable or disable all the registers of a device, or functional grouping.

Description

Use the RD command to display the target state, that is, the register state associated with the target program. Refer to *GO - Go Execute User Program* on page 4-45. The instruction pointed to by the target IP is disassembled and displayed also. Internally, a register mask specifies which registers are displayed when RD RETURN is executed.

At reset time, this mask is set to display the 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, which is reduced particularly when Floating Point Unit (FPU) registers are displayed.

The available device/functional group names are:

MPU	Microprocessor Unit
DEF	Default RD List
"/"	Is a required delimiter between device names and register ranges.
REG1	Is the first register in a range of registers.
REG2	Is the last register in a range of registers.
"E"	Selects 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 EPPCBug command caused an exception. These registers are not accessible using other debugger commands.

Observe the following notes when specifying any arguments in the command line:

1. The qualifier is applied to the next register range only.
2. If no qualifier is specified, a "+" qualifier is assumed, even for DEF.
3. All device names should appear before any register names.
4. The command line arguments are parsed from left to right, with each field being processed after parsing; thus the sequence in which qualifiers and registers are organized has an impact on the resultant register mask.
5. When specifying a register range, REG1 and REG2 do not have to be of the same class.
6. The register mask used by RD is also used by all exception handler routines, including the trace and breakpoint exception handlers.

For all modules, the MPU registers in ordering sequence are:

IP	Instruction Pointer
MSR	Machine State Register
CR	Condition Codes Register
R0-R31	General Purpose (32)
SPR1-SPR287	Special Purpose Registers (17)

Total: 52 Registers.

Examples

Example 1:

Default display - MPU subset (also called out by DEF):

```
EPPC-Bug>RD <CR>
IP     =00040010 MSR    =00003030 CR     =00000020
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
EPPC-Bug>
```

Example 2:

Change the mask to display all MPU registers.

```
EPPC-Bug>RD +MPU <CR>
IP     =00040010 MSR    =00003030 CR     =00000020
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
SPR1   =00000000 SPR8   =00000000 SPR9   =00000000 SPR18   =00000000
SPR19  =00000000 SPR22 =00000000 SPR26  =00000000 SPR27  =00000000
SPR268 =00000000 SPR269 =00000000 SPR272 =00000000 SPR273 =00000000
SPR274 =00000000 SPR275 =003E6210 SPR284 =00000000 SPR285 =00000000
SPR287 =00000000

00040010 4E800020  BCLR        20,0
EPPC-Bug>
```

Afterwards, every time RD <RETURN> is typed, all MPU registers are displayed.

To change the mask and disable the display of MPU registers, type:

```
EPPC-Bug>RD -MPU <CR>
00040010 4E800020  BCLR        20,0
EPPC-Bug>
```

Example 3:

Remove R10-R21 and R29 from the previous display.

```
EPPC-Bug>RD -R10-R21/-R29 <CR>
IP     =00040010 MSR    =00003030 CR     =00000020
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
00040010 4E800020  BCLR        20,0
EPPC-Bug>
```

Example 4:

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.)

```
EPPC-Bug>RD =R2/R31 <CR>
R2     =FFF0178C R31    =00000000
00040010 4E800020  BCLR        20,0
EPPC-Bug>
```

Example 5:

Restore the display to the original set.

```
EPPC-Bug>RD =DEF <CR>
IP     =00040010 MSR    =00003030 CR    =00000020
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
EPPC-Bug>
```

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.

Examples

Set to “warm” start.

```
EPPC-Bug>RESET<cr>
Cold/Warm Reset [C,W]              = C? C<cr>
Execute Local SCSI Bus Reset [Y,N] = N? Y<cr>
Execute MPC8xx Reset [Y,N]         = N? Y<cr>

Copyright Motorola Inc. 1988-1997, All Rights Reserved

MBXC Debugger/Diagnostics Release Version 0.3 - 05/01/97
COLD Start

Local Memory Found =01000000 (&16777216)

MPU Clock Speed =25Mhz

EPPC-Bug>
```

Dependent on the environment configuration, control may passed to a various boot control command, self-test, the system mode menu, or the debugger prompt.

RL - Read Loop

Command Input

RL *ADDR*[**;B | H | W**]

Options

B Byte
H Half-word
W Word

Description

RL establishes an infinite loop consisting of a processor load instruction that is:

- targeted to the given address, and
- of the given length (the default data size is word), then
- followed by a branch instruction back to the load

As a result, 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 RESET switch, or power cycle.

RM - Register Modify

Command Input

RM [*REG*]

Description

RM allows you to display and change the target registers. It works in essentially the same way as the MM command, and the same special characters are used to control the display/change session. Refer to *MM - Memory Modify* on page 4-89.

REG is the mnemonic for the particular register, the same as is displayed. If REG is not used, all the registers are displayed in sequence.

Examples

Example 1:

Modify register R5 and exit.

```
EPPC-Bug>RM R5 <CR>
R5     =12345678? ABCDEF. <CR>
EPPC-Bug>
```

Example 2:

```
EPPC-Bug>RM <CR>
IP     =00040010? <CR>
MSR    =00003030? <CR>
CR     =00000020? <CR>
R0     =00000000? <CR>
R1     =00020000? <CR>
R2     =FFF0178C? <CR>
R3     =00041000? <CR>
R4     =22EDB280? <CR>
R5     =00000000? <CR>
R6     =00000000? <CR>
R7     =00000000? <CR>
R8     =00000000? <CR>
R9     =00000000? <CR>
R10    =00000000? <CR>
```

```
R11    =00000000? <CR>
R12    =00000000? <CR>
R13    =00000000? <CR>
R14    =00000000? <CR>
R15    =00000000? <CR>
R16    =00000000? <CR>
R17    =00000000? <CR>
R18    =00000000? <CR>
R19    =00000000? <CR>
R20    =00000000? <CR>
R21    =00000000? <CR>
R22    =00000000? <CR>
R23    =00000000? <CR>
R24    =00000000? <CR>
R25    =00000000? <CR>
R26    =00000000? <CR>
R27    =00000000? <CR>
R28    =00000000? <CR>
R29    =00000000? <CR>
R30    =00000000? <CR>
R31    =00000000? <CR>
SPR1   =00000000? <CR>
SPR8   =00020014? <CR>
SPR9   =00000000? <CR>
SPR18  =40000000? <CR>
SPR19  =FFEC0000? <CR>
SPR22  =16A30500? <CR>
SPR25  =00000000? <CR>
SPR26  =00040010? <CR>
SPR27  =00083030? <CR>
SPR268 =00000000? <CR>
SPR269 =00000000? <CR>
SPR272 =00004210? <CR>
SPR273 =00000000? <CR>
SPR274 =00000000? <CR>
SPR275 =00000000? <CR>
SPR284 =00083030? <CR>
SPR285 =00083030? <CR>
SPR287 =00000000? <CR>
IP     =00040010? <CR>
MSR    =00003030? . <CR>
EPPC-Bug>
```

RS - Register Set

Command Input

RS *REG* [*DEL EXP* | *DEL ADDR*]

4

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 mnemonic for the particular register.

Examples

Example 1:

Change register R5.

```
EPPC-Bug>RS R5 12345678 <CR>
R5      =12345678
EPPC-Bug>
```

Example 2:

Examine register R5.

```
EPPC-Bug>RS R5 <CR>
R5      =12345678
EPPC-Bug>
```

SD - Switch Directories

Command Input

SD

Description

Use SD to change from the debugger directory to the diagnostic directory or from the diagnostic directory to the debugger directory.

The commands in the current directory (the directory that you are in at the particular time) may be listed using the Help (HE) command.

The directories are structured so that the debugger commands are available from either directory, but the diagnostic commands are only available from the diagnostic directory.

Examples

Example 1:

Switch from debugger directory to diagnostic directory.
The prompt indicates what is the current directory:

- Bug= Debugger
- Diag=Diagnostics

```
EPPC-Bug>SD <CR>
EPPC-Diag>
```

Example 2:

```
EPPC-Diag>SD <CR>
EPPC-Bug>
```

SET - Set Time and Date

Command Input

SET *mmddyyhhmm*

4

Description

The SET command starts the RTC and sets the time as two digits each of month, day, year, hour, and minutes. Hours should be in military (24-hour) form. The parameter is validated to ensure that it corresponds to a legal date and time. If it is valid, the time-of-day clock is updated to correspond, and a formatted date and time message is displayed as a check. If still incorrect, the SET command may be repeated.

To display the current date and time of day, refer to *TIME - Display Time and Date* on page 4-154.

Examples

Example 1:

SET a date and time of May 11, 1993 2:05 PM.

```
EPPC-Bug>SET 0511931405 <CR>
TUE MAY 11 14:05:00.00 1993
EPPC-Bug>
```

SYM - Symbol Table Attach

Command Input

SYM [*ADDR*]

Description

Use the SYM command to attach a symbol table to the BUG. 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 Running H/F 3* for the description of the system call.

The address argument, ADDR, to this command tells the BUG 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 format of the symbol table is shown below:

Offset	Field Description
$00	Number of entries in symbol table (32 bit word)
$04	Next Symbol Offset #0 (32 bit word)
$08	Symbol Data - Entry #0 (24 bytes)
$0C	Symbol Name - Entry #0 (variable length ascii)
$XX	Next Symbol Offset #1 (32 bit word)

$XX+4 Symbol Data - Entry #1 (32 bit word)

$XX+8 Symbol Name - Entry #1 (variable length ascii)

- The *Number of Entries in Symbol Table* field governs the size of the symbol table
- *Symbol Links* are offsets from the beginning of the Symbol table to the next Symbol table location.
- The *Symbol Data* field must be word-aligned.
  The symbol data fields must be ascending in value (sorted numerically).
- The *Symbol Name* field must consist only of printable characters (ASCII codes $21 through $7E).
  The symbol name must be terminated with a null ($00) character.

Upon execution of the command, the BUG performs a sanity check on the symbol table with the above rules. The symbol table is not attached if the check fails.

Examples

Example 1:

Attach symbol table at address $0001E000

```
EPPC-Bug>SYM 1E000 <CR>
EPPC-Bug>
```

Example 2:

```
EPPC-Bug>MD 0 <CR>
_ldchar+$0000  00010203 04050607 08090A0B 0C0D0E0F  ................
_ldchar+$0010  10111213 14151617 18191A1B 1C1D1E1F  ................
EPPC-Bug>
```

Example 3:

```
EPPC-Bug>MD _ldchar <CR>
_ldchar+$0000  00010203 04050607 08090A0B 0C0D0E0F  ................
_ldchar+$0010  10111213 14151617 18191A1B 1C1D1E1F  ................
EPPC-Bug>
```

Example 4:

```
EPPC-Bug>MD _ldchar+4 <CR>
_ldchar+$0004  04050607 08090A0B 0C0D0E0F 10111213  ................
_ldchar+$0014  14151617 18191A1B 1C1D1E1F 20212223  ............ !"#
EPPC-Bug>
```

Example 5:

```
EPPC-Bug>BF _ldchar:8 0 <CR>
Effective address: _ldchar+$0000
Effective count  : &32
EPPC-Bug>MD _ldchar <CR>
_ldchar+$0000  00000000 00000000 00000000 00000000  ................
_ldchar+$0010  00000000 00000000 00000000 00000000  ................
EPPC-Bug>
```

NOSYM - Symbol Table Detach

Command Input

NOSYM

Description

The NOSYM command allows you to detach a symbol table from the BUG.

This command is analogous to the system call .SYMBOLTD. Refer to *Chapter Running H/F 3* for the description of the system call.

Example

Detach symbol table.

```
EPPC-Bug>NOSYM <CR>
EPPC-Bug>
```

SYMS - Symbol Table Display/Search

Command Input

SYMS [*symbol-name*] | [**;S**]

Description

Use the SYMS command to

- Display the attached symbol table
- Search the attached symbol table for a particular symbol name
- Search the attached symbol table for a set of symbols
- Display the attached symbol table in lexicographic (ascending ASCII) order (by using the S option)

A symbol table must be attached for this command to execute. Refer to *SYM - Symbol Table Attach* on page 4-143.

Examples

Example 1:

Display attached symbol table.

```
EPPC-Bug>SYMS <CR>
_stchar                 00001020
_ldchar                 000028A0
_sizmemory              00004930
EPPC-Bug>
```

Example 2:

Search attached symbol table for specified symbol.

```
EPPC-Bug>SYMS _ldchar <CR>
_ldchar                 000028A0
-Bug>
```

Example 3:

Search attached symbol table for all symbols starting with "_s".

```
EPPC-Bug>SYMS _s <CR>
_stchar                 00001020
_sizmemory              00004930
EPPC-Bug>
```


Example 4:

Display attached symbol table in lexicographical order.

```
EPPC-Bug>SYMS;S <CR>
_ldchar                 000028A0
_sizmemory              00004930
_stchar                 00001020
EPPC-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 field (which defaults to 1 if none entered) specifies the number of instructions to be traced before returning control to EPPCBug.

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 EPPCBug.

The trace functions are implemented by inserting traps in the code. Therefore, the code must be writable and uncached for tracing to be effective.

Examples

The following program resides at location $30000, and breakpoint is specified at location $30014.

```
EPPC-Bug>DS 30000 <CR>
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
EPPC-Bug>
EPPC-Bug>BR <CR>
BREAKPOINTS
00030014
EPPC-Bug>
```

Initialize IP and R3, R4:

```
EPPC-Bug>RM IP <CR>
IP   =0000E000 ? 30000.<CR>
EPPC-Bug>

EPPC-Bug>RM R3 <CR>
R3     =00000000 ? 41000 <CR>
R4     =00000000 ? 100. <CR>
EPPC-Bug>
```

Display target registers and trace one instruction:

```
EPPC-Bug>RD <CR>
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
EPPC-Bug>

EPPC-Bug>T <CR>
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
EPPC-Bug>
```

Trace next instruction:

```
EPPC-Bug> <CR>
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
EPPC-Bug>
```

Trace the next two instructions:

```
EPPC-Bug>T 2 <CR>
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
EPPC-Bug>
```

Trace the next instruction:

```
EPPC-Bug>T <CR>
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
EPPC-Bug>
```

Notice that in the last example that the breakpoint was reached (the message `At Breakpoint`).

TA - Terminal Attach

Command Input

TA [*PORT*]

Description

Use the TA command to assign any serial port to be the console. The port specified must already be assigned. Refer to *PF /NOPF - Port Format/Detach* on page 4-117.

Examples

Example 1:

Select port 1 (logical unit #01) as console. Console changed to port 1 and no prompt appears, unless port 1 was already the console. All keyboard exchanges and displays are now made through port 1. This remains in effect until either another TA command has been issued or the reset switch was depressed.

```
EPPC-Bug>TA 1 <CR>
Console = [01: MPC601EVM- “HOST”]
```

Example 2:

Restore console to port selected at power-up. The prompt will appear at the connected terminal (port 0).

```
EPPC-Bug>TA <CR>
Console = [00: MPC601EVM- "DEBUG"]
EPPC-Bug>
```

TIME - Display Time and Date

Command Input

TIME [;L]

Description

This command presents the date and time in ASCII characters to the console.

To initialize the time-of-day clock, refer to *SET - Set Time and Date* on page 4-142.

Option L simply recalls the command. The data and time is displayed on the same line, continuously updated. An abort or break returns you to the monitor.

Example

Display a date and time of May 11, 1985 2:05:32.7:

```
EPPC-Bug>TIME <CR>
MON MAY 11 14:05:32.70 1985
EPPC-Bug>
```

TM-Transparent Mode

Command Input

TM [*n*] *[ESCAPE*]

Description

TM essentially connects the current console serial port and the port specified in the command (default is host port) together, which allows you to communicate with a host computer. A message displayed by TM shows the current escape character, for example, the character used to exit the transparent mode. The two ports remain "connected" until the escape character 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=^A (Control A).

The optional port number *n* 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 Port Format (PF) command.

The optional escape argument allows you to specify the character to be used as the exit character. This can be entered in three different formats:

$03 Set escape character to ^C
^C Set escape character to ^C
‘c Set escape character 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.

Examples

Example 1:

```
EPPC-Bug>TM <CR>
Escape character:  $01=^A
.
.
.
<Control-A>
EPPC-Bug>
```

Example 2:

In this example, the default port of 1 was specified by the NULL argument field, and an escape character of CTRL-G was specified.

```
EPPC-Bug>TM,,^g <CR>
Escape character: $07=^G
.
.
.
<Control-G>
EPPC-Bug>
```

Example 3:

In this example the port logical unit of $03 was specified, and an escape character of CTRL-B was specified.

```
EPPC-Bug>TM 3 2 <CR>
Escape character: $02=^B
.
.
.
<Control-B>
EPPC-Bug>
```

TT-Trace to Temporary Breakpoint

Command Input

TT *ADDR*

Description

TT 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 EPPCBug. Tracing starts at the target IP address.

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 EPPCBug.

The trace functions are implemented by inserting traps in the code. Therefore, the code must be writable and uncached for tracing to be effective.

Examples

The following program resides at location $30000, and breakpoint is specified at location $30014.

```
EPPC-Bug>DS 30000 <CR>
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
EPPC-Bug>

EPPC-Bug>BR <CR>
BREAKPOINTS
00030014
```

```
EPPC-Bug>
```

Initialize IP and R3, R4:

```
EPPC-Bug>RM IP <CR>
IP   =0000E000 ? 30000.<CR>
EPPC-Bug>

EPPC-Bug>RM R3 <CR>
R3     =00000000 ? 41000 <CR>
R4     =00000000 ? 100. <CR>
EPPC-Bug>
```

Display target registers and trace to temporary breakpoint:

```
EPPC-Bug>RD <CR>
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
EPPC-Bug>

EPPC-Bug>TT 30008 <CR>
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
EPPC-Bug>
```

Notice that in the last example that the temporary breakpoint was reached (the message `At Breakpoint`).

UPM - MPC8xx User Programmable Machine (UPM) Display/Read/Write

Command Input

UPM [*A* | *B*] [*ADDR*]**;**[**R**|**W**]]

Arguments

The first argument to the command specifies which UPM is to be affected. The MPC8xx has two UPM machines designated as 'A' and 'B'

ADDR	Specifies the area of memory where the UPM values are to be read into or written from. If ADDR is missing, the values are not stored in memory but are instead displayed on the console
;R	Specifies that the UPM is to be read
;W	Specifies that the UPM values are to be written to

Description

Use the UPM command to display and modify the user-program machine (UPM) contents in the MPC8xx.

Note UPM contents define the timing used by the MPC8xx to access DRAM. The UPM command allows you to modify the UPM settings to values which do not meet the DRAM timing requirements. This may cause the board to 'hang' until it's reset. UPM contents should not normally be modified by users.

Example

```
EPPC-Bug>upm a<cr>
UPM A Contents (MAMR =0C821000):
Read Single Beat Cycle
00 CFFFE004 0FFFE404 08AF2C04 03AF2C08
```

```
04 FFFFEC07 FFFFEC07 FFFFEC07 FFFFEC07
Read Burst Cycle
08 CFFFE004 0FFFE404 08AF2C04 03AF2C08
0C 08AF2C04 03AF2C08 08AF2C04 03AF2C08
10 08AF2C04 03AF2C08 FFFFEC07 FFFFEC07
14 FFFFEC07 FFFFEC07 FFFFEC07 FFFFEC07
Write Single Beat Cycle
18 CFFFE004 0FFFA404 08FF2C00 33FF6C0F
1C FFFFEC07 FFFFEC07 FFFFEC07 FFFFEC07
Write Burst Cycle
20 CFFFE004 0FFFA404 08FF2C00 03FF2C0C
24 08FF2C00 03FF2C0C 08FF2C00 03FF2C0C
28 08FF2C00 33FF6C0F FFFFEC07 FFFFEC07
2C FFFFEC07 FFFFEC07 FFFFEC07 FFFFEC07
Periodic Timer Expired
30 C0FFEC04 07FFEC04 3FFFEC07 FFFFEC07
34 FFFFEC07 FFFFEC07 FFFFEC07 FFFFEC07
38 FFFFEC07 FFFFEC07 FFFFEC07 FFFFEC07
Exception
3C FFFFEC07 FFFFEC07 FFFFEC07 FFFFEC07
EPPC-Bug>
```

VE - Verify S-Records Against Memory

Command Input

VE [*n*] [*ADDR*] [**;**[**X**][**C**]] [*=text*]

4

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. Echoes the S-records to your terminal as they are read in at the host port.

Arguments

n — Allows you to specify which port is to be used for the downloading. It is optional. If the port number is not specified but the ADDR option is specified, VE must be separated from ADDR by two commas. If this number is omitted, port 1 is assumed.

ADDR — An offset address that is added to the address contained in the address field of each record. It is optional. 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 *Chapter Running H/F 3*.

=text — Sent to the host before EPPCBug begins to look for S-records at the host port. This option allows you to send a command to the host device to initiate the download. Text should NOT be delimited by any kind of quote marks. Text is understood to begin immediately

following the equals sign and terminate with by pressing 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.

Description

This command is identical to the LO command with the exception that data is not stored to memory but merely compared to the contents of memory.

The VE command accepts serial data from a host system in Motorola S-record file format 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.

In order to accommodate host systems that echo all received characters, the 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 noncomparing record is set aside until the verify is complete and then it is printed out to the screen. If three noncomparing records are encountered in the course of a verify operation, then the command is aborted.

If a nonhexadecimal 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 EPPCBug 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 EPPCBug 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.

Examples

Sample test 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:
```

Assume that the program has been compiled and linked to start at address 65040000. Then the program was converted into an S-record file named "test.mx" as follows:

```
S325650400007C8402A6908300007C8502A6908300044E80002000000000650400006504002412
S30D650400200000000000000000069
S7056504000091
```

This file was downloaded into memory at address $40000. The program may be examined in memory using the Memory Display (MD) command.

```
EPPC-Bug>MD 40000:5;DI <CR>
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
EPPC-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.

```
EPPC-Bug>VE ,,-65000000;X=cat test.mx <CR>
cat test.mx
S325650400007C8402A6908300007C8502A6908300044E80002000000000650400006504002412
S30D650400200000000000000000069
S7056504000091
Verify passes.
EPPC-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.

```
EPPC-Bug>M 40004;H <CR>
00040004 9083? 9082. <CR>
EPPC-Bug>

EPPC-Bug>VE ,,-65000000;X=cat test.mx <CR>
cat test.mx
S3256504000007C8402A69083
S-RECORD Data Verification error:
Address       =00040005
Expected data =83
Actual data   =82
S-RECORD=
S3256504000007C8402A69083

EPPC-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 EPPCBug that is running and hardware revision information.

The *E* option displays more detail, 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.

Examples

Example 1:

```
EPPC-Bug>ver<cr>
Debugger/Diagnostics Type/Revision.................=MBXC/0.3
Debugger/Diagnostics Revision Date.................=05/01/97
MicroProcessor Version/Revision....................=0050/0000
MicroProcessor Internal Clock Speed (MHZ)..........=25
MicroProcessor External Clock Speed (MHZ)..........=25
Communication Processor Module (CPM) Part/Mask.....=00/12
Internal Memory Map Pointer........................=FA200000
Local Memory Size..................................=01000000 (16MB)
EPPC-Bug>
```

Example 2:

```
EPPC-Bug>ver;e
Debugger/Diagnostics Type/Revision.................=MBXC/0.3
Debugger/Diagnostics Revision Date.................=05/01/97
MicroProcessor Version/Revision....................=0050/0000
MicroProcessor Internal Clock Speed (MHZ)..........=25
MicroProcessor External Clock Speed (MHZ)..........=25
Communication Processor Module (CPM) Part/Mask.....=00/12
```

```
Internal Memory Map Pointer.......................=FA200000
Local Memory Size.................................=00400000 (4MB)
PCI Device (00009800) ID/Revision.................=056510AD/04
Class: Bridge Device  Subclass: PCI/ISA Bridge
Base+$0000  05 65 10 AD 02 00 00 07  06 01 00 04 00 80 00 00  .e..............
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  ................

PCI Device (00009900) ID/Revision.................=010510AD/05
Class: Mass Storage Controller  Subclass: IDE Controller
Base+$0000  01 05 10 AD 02 80 00 05  01 01 8F 05 00 80 00 08  ................
Base+$0010  01 00 00 21 01 00 00 31  01 00 00 29 01 00 00 35  ...!...1...)...5
Base+$0020  01 00 00 01 01 00 00 11  00 00 00 00 00 00 00 00  ................
Base+$0030  00 00 00 00 00 00 00 00  00 00 00 00 28 02 01 0E  ............(...

EPPC-Bug>
```

VPD - (Vital Product Data) Display

Command Input

VPD

Description

The VPD command displays the information about the board that is stored in the VPD SROM on the board. Refer to *Appendix* .

Example

```
EPPC-Bug>vpd<cr>
Product Identifier            : MBX
Manufacturing Assembly Number : 01-W3269F05A
Serial Number                 : 2677405
Product Configuration Options : 00000000000000000000000000000000
Internal Clock Speed (Hertz)  : 017D7840 (&25000000)
External Clock Speed (Hertz)  : 017D7840 (&25000000)
Reference Clock Speed (Hertz) : 00008000 (&32768)
Ethernet Address              : 08003E229470
EPPC-Bug>
```

WL - Write Loop

Command Input

WL *ADDR:DATA*[**;B** | **H** | **W**]

Options

B Byte
H Half-word
W Word

Description

WL establishes an infinite loop consisting of a processor store instruction:

- targeted to the given address
- of the given length
- followed by a branch instruction back to the store

The defined data is then stored repeatedly into the defined location in rapid succession.

The write loop can only be terminated by an external occurrence, such as an abort, reset, a reset, or power cycle.

One-Line Assembler/Disassembler 5

Overview

Included as part of the debugger is an assembler/disassembler utility. The 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 an effective subset of an operating system assembler. It has some limitations as compared with the operating system assembler, for instance, it does not allow line numbers, pseudo ops, instruction macros, and labels. However, it is a powerful tool for creating, modifying, and debugging code written in PowerPC assembly.

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:

1 Operations (PowerPC machine-instruction operation codes, Directives (pseudo-ops))

2 Operators

3 Special symbols

Machine-Instruction Operation Codes

Machine instruction supported by the assembler/disassembler are described in the *PowerPC Microprocessor Family: The Programming Environments*. Reference this manual for any question concerning operation codes.

Directives

Normally, assembly language can contain mnemonic directives which specify auxiliary actions to be performed by the assembler.

The EPPCBug assembler recognizes only two directives

- Define a word constant (WORD)
- System call (SYSCALL).

These directives are used to define data within the program, and to make calls on EPPCBug utilities. Refer to *The WORD Define Constant Directive* on page 5-12 and *The SYSCALL System Call Directive* on page 5-12 respectively for further details.

Comparison with PowerPC Standard Assembler

There are several major differences between the EPPCBug assembler and the PowerPC Standard Assembler.

- The resident assembler is a two-pass assembler that processes an entire program as a unit
- The EPPCBug assembler processes each line of a program as an individual unit

Due mainly to this basic functional difference, the capabilities of the EPPCBug assembler are more restricted:

1. 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.
2. 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.
3. Only two directives (WORD and SYSCALL) are accepted.
4. No macro operation capability is included.
5. No conditional assembly is used.
6. Several symbols recognized by the resident assembler are not included in the EPPCBug assembler character set. These symbols include > and <. Two other symbols, the ampersand (&) and the asterisk (*), have multiple meanings to the resident assembler. Depending on the context, refer to *Addressing Modes* on page 5-10, the ampersand can be either the AND logical operator, or a decimal number prefix, while the asterisk can be either the multiplication operator, or the current value of the program counter.

Although functional differences exist between the two assemblers, the one-line assembler is a true subset of the resident assembler. The format and syntax used with the EPPCBug 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.

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:

1. Operation codes which correspond to the PowerPC instruction set.
2. 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 is assumed. The size code need not be specified if only one data size

is permitted by the operation. Refer to the *PowerPC Microprocessor Family: The Programming Environments* for a definition of allowable size codes.

The data size code is not permitted 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 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
- Hexadecimal (default)

Numbers may be represented only as integers. Floating point representations are not supported.

Decimal Is a string of decimal digits (0 through 9) preceded by an ampersand (&). Examples are:

&12334
&987654321

Hexadecimal
Is a string of hexadecimal digits (0 through 9, A through F) preceded by an optional dollar sign ($). An example is:

$AFE5

One or more ASCII characters enclosed by apostrophes (' ') constitute an ASCII string. ASCII strings are right-justified and zero-filled (if necessary), whether stored or used as immediate operands.

The following register mnemonics are recognized and/or 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.

The following instruction fields are listed to denote the default number base for the specified field:

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 as specified in the *PowerPC Microprocessor Family: The Programming Environments*. The required fields are in boldface type and the variable fields are not. Fields are one or more characters in length.

Character Set

The character set recognized by the EPPCBug assembler is a subset of ASCII, and are listed as follows:

1. The letters A through Z (uppercase and lowercase)
2. The integers 0 through 9
3. Arithmetic operators: + - * / << >> ! & % ^
4. Parentheses ( )
5. Characters used as special prefixes:

   $ (dollar sign) specifies a hexadecimal number

   & (ampersand) specifies a decimal number

   @ (commercial at sign) specifies an octal number

   % (percent sign) specifies a binary number

   ' (apostrophe) specifies an ASCII literal character string
6. Five separating characters:

   Space

   , (comma)

   . (period)

   / (slash)

   - (dash)
7. The character * (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*, of the *PowerPC Microprocessor Family: The Programming Environments*.

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.

Possible points of confusion:

1. You should keep in mind that where a number is intended and it could be confused with a register, it must be differentiated in some way.
2. With the use of "*" to represent both multiply and instruction pointer, how does the assembler know when to use which definition?

For parsing algebraic expressions, the order of parsing is:

```
OPERAND OPERATOR OPERAND OPERATOR...
```

with a possible left or right parenthesis.

Given the above order, the assembler can distinguish by placement which definition to use. For example:

*** equals IP * IP

+ equals IP + IP

2** equals 2 * IP

*&&16 equals IP AND &16

The 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.

The SYSCALL System Call Directive

The function of this directive is to aid you in making the appropriate TRAP entry to EPPCBug functions as defined in *Chapter Running H/F 3*. The format for this directive is:

SYSCALL .SOMEFUNCTION

This is assembled as:

```
ADDI   R10,R0,$XXXX
SC
```

Where $XXXX is a 16 bit number specifying the function to perform.

Refer to *Chapter Running H/F 3* for a complete listing of all the System Call functions provided.

How To Enter and Modify 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.
- 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 Block Move (**BM**) command).

Invoke the Assembler/Disassembler

The assembler/disassembler is invoked using the **;DI** option of the Memory Modify (**MM**) and Memory Display (**MD**) commands:

MM ADDR ;DI

or

AS ADDR

and

MD[S] ADDR[:COUNT | ADDR];DI

or

DS ADDR[:COUNT | ADDR]

The MM (;DI option), or interchangeably the **AS** command, is used for program entry and modification. When this 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 an PowerPC instruction or a WORD directive. If the disassembler recognizes a valid form of some instruction, the instruction will be returned. If not recognized (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.

Enter a Source Line

A new source line is entered immediately following the disassembled line, using the format discussed in *Source Line Format* on page 5-4:

```
EPPC-Bug>AS 20000 <CR>
00020000 3C600004  ADDIS       R3,R0,$4? ORI R3,R0,4 <CR>
```

When RETURN is entered and terminates 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? <CR>
```

Another program line can now be entered. Program entry continues in this manner until all lines have been entered. A period is used to exit the MM or AS command.

If an error is encountered during assembly of the new line, an error message is displayed. The location being accessed is redisplayed:

```
EPPC-Bug>AS 30000 <CR>
00030000 3CA00000  ADDIS       R5,R0,$0? ORU R5,R0,1 <CR>
Assembler Error: Unknown Mnemonic

00030000 3CA00000  ADDIS       R5,R0,$0?
```

How to Enter 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 "*" for branch to self in order to reserve space. After the actual address is discovered, the line containing the branch instruction can be reentered using the correct value.

Branch operands are interpreted as signed hexadecimal numbers.

Assembler Output/Program Listings

A listing of the program is obtained using the Memory Display (**MD**) command with the **;DI** option, or interchangeably the **DS** command. The MD command requires both the starting address and the line count to be entered in the command line. When the ;DI option is invoked, the number of instructions disassembled and displayed is equal to the line count. The DS command also operates with a starting address and an ending address.

Note that the listing may not correspond exactly to the program as entered. As discussed in *Disassembled Source Line* on page 5-5, 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 all possible 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

Program Loading 6

Overview

EPPCBug supports loading of user programs from a variety of interfaces. Program loading, into read/write memory, can be viewed as the system's boot process. The boot process is responsible for calling the appropriate driver (as specified by the interface identifier) to load the specified Initial Program Load (IPL) and to pass control to the just-loaded IPL (execute it). The IPL format (program load) is restricted to a finite set of file formats. Program loading is supported from the following interface types:

- Network (Ethernet)
- Mass Storage (SCSI, FDC, EIDE, IDE)
- Serial (Asynchronous - SCC, SMC, SuperI/O)
- PCMCIA (ROM/FLASH-Memory Cards)
- FLASH Memory (On-Board)

Note EPPCBug 1.1 supports only local network and local (nonplug-in card) disk (floppy/EIDE hard disk) storage loading. S-Records are only supported via the LO command. Additional interface support will be added in future EPPCBug releases.

Program Load Features

The program-load feature recognizes a finite list of file formats. In addition, file recognition is also dependent upon the program-load interface utilized. The following file formats are supported:

- Motorola Serial Records (S-Records)
- Executable Linker Format (ELF, PowerPC Version)
- Binary
- Command(s) Processor
- Motorola ROM Boot

The firmware-supported serial-interfaces only support the program loading of S-Records. It is recommended you use the following file naming conventions:

Table 6-1. File Naming Conventions

File Format/Type	File Suffix
Motorola Serial Records (S-Records)	.mx
Executable Linker Format (ELF, PowerPC Version)	.elf
Binary	.bin
Command(s) Processor	.cop
Motorola ROM Boot	.rom

Each interface is uniquely identified by a logical unit number (LUN). More specifically, each interface is identified with a LUN pair (CLUN/DLUN). Refer to the appropriate section of this specification for the definition of the actual LUNs.

To aid the boot process the following global configuration variables are specified/utilized:

Default Load Address Point (LAP)

This address specifies the load point for program-load file formats *binary* and *command(s) processor*. Binary file formats do not indicate the memory load address of the program load. LAP defines the load point for binary images.

Default Execution Address Point (EAO)

This address specifies the execution point offset from LAP for the program-load file format *binary*. Binary format does not indicate the execution address of the program load.

Default Intermediate Load Address Point (ILAP)

This address specifies the load point in which the intermediate program-load takes place. A region of read/write memory is needed to first load the program. Once loaded, the firmware determines the program load format, and moves (to the "linked" address") the program accordingly.

LAP, EAO, and ILAP are tunable via the ENV command.

Additional Program Load Interfaces

Program loading is dependent upon the interface and device types. The follow table lists these dependencies.

Table 6-2. Program Load Dependencies

Interface Type	Device Type	File System Type	Supported File Types	Notes
Mass Storage	Direct-Access Rigid Geometry (HDISK)	DOS Partition Table with 16-Bit FAT	PowerPC ELF (.elf) Motorola S-Records (.mx) Binary (.bin) Command(s) Processor (.cop) Motorola ROM Boot (.rom)	
	Direct Access Non-Rigid Geometry (Floppy)	12-Bit FAT	PowerPC ELF (.elf) Motorola S-Records (.mx) Binary (.bin) Command(s) Processor (.cop) Motorola ROM Boot (.rom)	
	Read-Only-Memory (CDROM)	ISO 9660	PowerPC ELF (.elf) Motorola S-Records (.mx) Binary (.bin) Command(s) Processor (.cop) Motorola ROM Boot (.rom)	
Network (Ethernet)		(Transparent to firmware)	PowerPC ELF (.elf) Motorola S-Records (.mx) Binary (.bin) Command(s) Processor (.cop) Motorola ROM Boot (.rom)	
PCMCIA (ROM/FLASH-Memory Cards)	Read-Only-Memory (ROMDISK)	DOS Partition Table with either 12-Bit or 16-Bit FAT	PowerPC ELF (.elf) Motorola S-Records (.mx) Binary (.bin) Command(s) Processor (.cop) Motorola ROM Boot (.rom)	
FLASH Memory (On-Board)	Read-Only-Memory (ROMDISK)	DOS Partition Table with either 12-Bit or 16-Bit FAT	PowerPC ELF (.elf) Motorola S-Records (.mx) Binary (.bin) Command(s) Processor (.cop) Motorola ROM Boot (.rom)	
Serial	N/A	(Transparent to firmware)	Motorola S-Records (.mx)	

Command Line Syntax

Command Line Syntax is covered under the PL/PLH entry in Chapter Running H/F 3.

Automatic Program Load (AutoBoot)

The automatic program-load is accomplished by initializing the command buffer located in NVRAM with the desired command(s) to execute. The command buffer syntax is the same syntax that you would use if you manually entered in the command at the firmware command-line.

If an autoboot is needed, the PL command with the appropriate arguments should be placed in the command buffer.

Network

The actual standard network booting sequence was standardized by Sun Microsystems. Sun's booting process is executed in two distinct phases.

- The first phase allows the diskless remote node to discover its network identity 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.

The following support functions (modules) are added to meet the overall network boot function. These functions basically describe the internal view (software versus hardware) of the necessary support required. Following the module title, a brief description of the module's purpose is given.

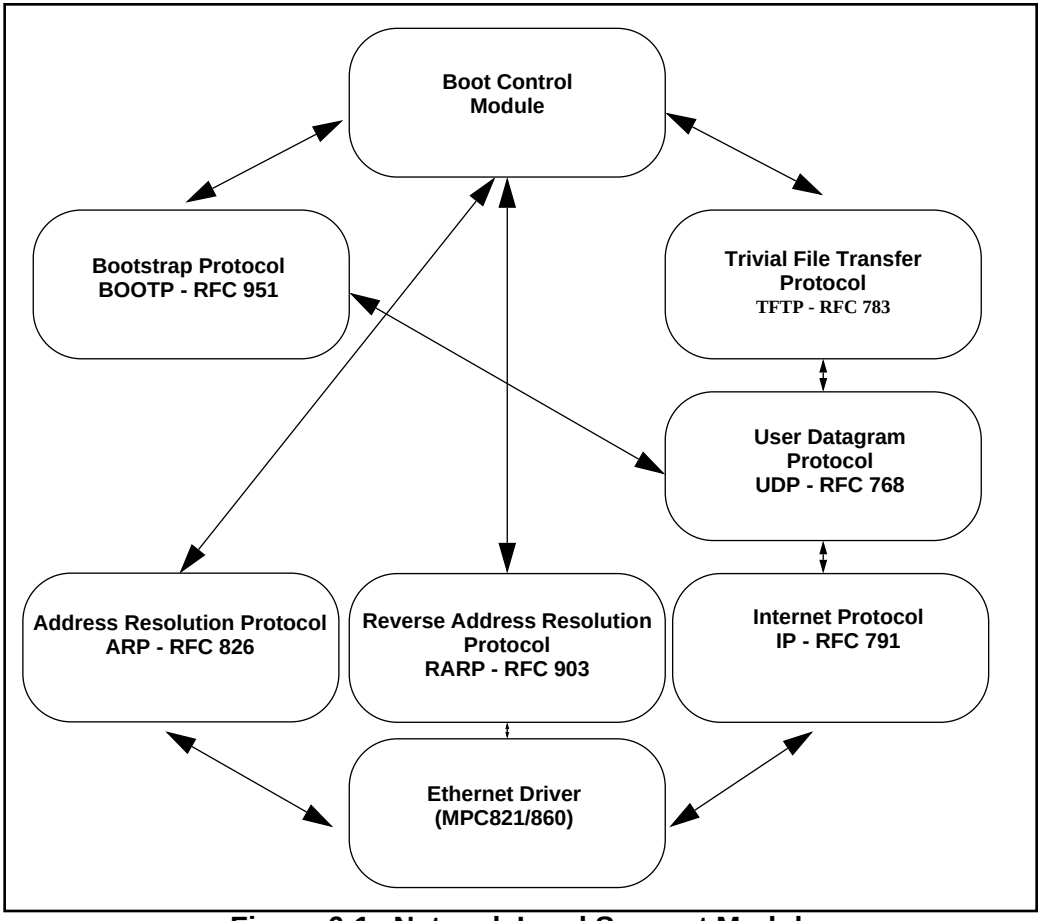


Figure 6-1. Network Load Support Modules

UDP/IP Protocol Modules

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

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

RARP/ARP Protocol Modules

The Reverse Address Resolution Protocol (RARP) consists of a node without identity that broadcasts a "whoami" packet onto the Ethernet, and waits for an answer. The RARP server fills an Ethernet reply packet with the target's Internet Address and returns the information packet to the node.

The Address Resolution Protocol (ARP) provides a method of converting protocol addresses (IP addresses) to local area network addresses such as Ethernet addresses.

The implementation of the RARP protocol module was necessary to support older systems which do not support the BOOTP protocol.

BOOTP Protocol Module

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

TFTP Protocol Module

TFTP (Trivial File Transfer Protocol) 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. Its only function is to read and write files from/to a remote server.

Network Boot Control Module

This "control" capability 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 phase is labeled *address determination and bootfile selection* and utilizes the RARP/BOOTP capability.
- The second phase is labeled *file transfer* and utilizes the TFTP capability.

Figure 6-1 on page 6-6 shows a graphic representation of these support functions (modules), including their capabilities and dependencies.

Mass Storage

Typically, program loading from mass storage devices is the most common method of booting. Please reference Table 6-2 for the complete list of the supported mass storage device types. The supported device types are the more common industry standard program-load types.

Mass storage devices, in which a desired program-load must take place from, are formatted with a file system. The entire mass storage device does not need to be formatted with the file system, only enough of one to achieve program loading of a desired set of files.

Serial (SCC, SCM, SuperI/O)

As stated previously, program loading from the supported serial interfaces are constrained to utilizing S-Records. Please refer to Table 6-2 which describes the format of S-Records.

PCMCIA (ATA/ROM/FLASH-Memory Cards)

Program loading from PC cards of this type behaves the same as program loading from a hard-disk mass storage device type. The nonvolatile memory contains the supported file system.

FLASH Memory

Program loading from the on-board FLASH memory may be accomplished as program-loading from a FLASH memory card (PCMCIA), or from the more direct approach, ROM boot.

ROM Boot

ROM Boot is a mechanism for a program load to occur from a user-defined area of a nonvolatile memory storage area (ROM, FLASH, NVRAM). Perform a ROM Boot by placing a GO command with the appropriate ROM/NVRAM execution address into the command start-up buffer.

Disk File System (FAT)

The DOS operating system uses the file allocation table (FAT) to manage the disk's data area. The FAT indicates to DOS which portions of the disk belong to each file.

Utilization of the FAT file-system for initial program loading permits more than one program-load (boot) file to exist per mass storage device. It should also be noted than the entire mass storage device does not need to contain the FAT file-system, just enough to contain the desired number of program-load files is required.

File Formats

CDROM File System (ISO9660)

Conforms to the following document: *ISO-9660, Information processing - Volume and file structure of CD-ROM for information interchange*, published by International Organization for Standardization.

PowerPC ELF

Conforms to the following document: *System V Application Binary Interface, PowerPC Processor Supplement*, Sunsoft.

S-Records

The file format for S-Records can be found in Chapter Running H/F 3.

Command(s) Processor

The file format is identical to the command buffer, as located in NVRAM, with one exception. The first line (terminated with a RETURN character) of the file contains the string, `This is an EPPC-Bug command(s) processor file.` The text string must be in the case shown in this example.

The individual commands are terminated with a RETURN and the list of commands are terminated with a null or EOT character. These commands have the same syntax as if they were executed from the firmware command-line interface.

Motorola ROM Boot

The following table specifies the layout of this file format.

Table 6-3. File Format - Motorola ROM Boot

Offset	Length	Contents	Description
000	4	BOOT (0x424F4F54)	ASCII string indicating possible routine; the checksum must be valid (match the expected checksum).
004	4	Entry Address	32-bit word offset into image to begin execution.
008	4	Module Length	32-bit word indicating the size of the module; this includes the length from the "BOOT" field to and including the two-byte checksum field.
00C	(variable)	Module Name	ASCII string containing the module name.

The `Module Name` field is followed by the user-defined code and data fields. Following the user-defined fields a 2-byte checksum must be present.

The following algorithm can be used to generate the required 2-byte checksum.

```
unsigned int
cs16(addr, cnt)
unsigned int addr;
unsigned int cnt;
{
  unsigned short *lptr;
  unsigned int x;
  unsigned short y, isum, sum;
  for (lptr = (unsigned short *)addr, x = sum = 0; x < cnt; x++) {
              y = *lptr++;
              isum = sum + y;
```

```
                if ((isum < y) || (isum < sum))
                                isum += 1;
                sum = isum;
}
    return (sum);
}
```


Register State at Program Load Time

The following table lists the state of the MPU registers at program-load time.

Table 6-4. MPU Registers at Program-Load Time

Register	Description of Contents
R0	Undefined
R1	Stack pointer (points to the high end of free memory)
R2	Undefined
R3	Pointer to Board Information Block
R4	Pointer to optional Argument-String (NULL terminated)
R5 - R31	Undefined
MSR	Interrupts Masked, MMU translation disabled.

EPPCBug System Calls 7

Overview

This chapter describes the EPPCBug System Call handler. The System Call handler allows system calls from user programs which are used to access selected functional routines contained within the debugger, including input and output routines. You can also use the System Call handler to transfer control to the debugger at the end of a user program.

How to Invoke 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 to the system call via a pointer in R3. Parameters are returned from the system call via a pointer in R4.

```
ADDI R10,R0,$XXXX
SC
```

$XXXX is the 16-bit code for the system call routine, and SC is the system call instruction.

In the following example, the .CIO_PUTS system call is used to display ‘abcd’ on the current console device.

```
EPPC-Bug>mw 10000 ‘abcd’<cr>
Effective address: 00010000
Effective data   : 61626364
EPPC-Bug>mw 10004 0a0d0000<cr>
Effective address: 00010004
Effective data   : 00000000
EPPC-Bug>mm 20000<cr>
```

```
00020000 00000000? 0<cr>
00020004 00000000? 0<cr>
00020008 00000000? 10000<cr>
0002000C 00000000? .<cr>
EPPC-Bug>mm 30000;di<cr>
00030000 3C600002  ADDIS       R3,R0,$2<cr>
00030004 3C800004  ADDIS       R4,R0,$4<cr>
00030008 39400201 SYSCALL     .CIO_PUTS<cr>
00030010 39400F00 SYSCALL     .RETURN<cr>
00030018 00000000  WORD       $00000000? .<cr>
EPPC-Bug>
```

7

Input/Output Argument pointers

If a system call requires input arguments, the caller builds a packet containing the argument values and passes a pointer to this packet in register R3. The input argument packet must be aligned on a 4-byte address boundary. The required content of the input argument packet is described for each system call. Some system calls reserve additional space in the input argument packet. To ensure compatibility with future revisions of the EPPCBug system call interface, input arguments marked as reserved should be initialized as described in the system call descriptions.

All system calls except .RETURN return output arguments (at least a completion status) to the caller. The caller must allocate an area in memory sufficiently large to contain the output arguments and passes a pointer to this memory in register R4. The output argument packet must be aligned on a 4 byte address boundary. In all cases, the first 32 bit word in the output argument packet is the system call completion status. This status word has the following meaning:

A value of zero indicates the system call completed without an error.

0x100 indicates the system call number (i.e. the value passed in R10) is not a valid system call number.

0x200 indicates an invalid or unsupported device was specified in the CLUN/DLUN fields of the input argument packet.

0x300 indicates that one or more of the addresses passed to the system call are misaligned or invalid.

0x400 indicates a device or interface error occurred. In this case more detailed error status values will be made available in additional locations in the output argument packet.

Some system calls reserve additional space in the output argument packet. The caller must allocate space for all output arguments described for the system calls - even those marked as reserved.

CLUN/DLUN Use by System Calls

Many of the System calls require a CLUN/DLUN pair be passed as part of the system call input arguments. CLUN/DLUN definitions can be found in Appendix B of this manual.

Some system calls support additional special case CLUN/DLUNs. For example, the character IO system calls (CIO_*) accept a CLUN/DLUN pair of 0/0 as meaning the current BUG console I/O device. Individual system call man pages describe any special case treatment of CLUN/DLUN pairs.

System Call Routines

The system call routines are described in order by the 16-bit hex code.

When you enter 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 7-1. System Calls

System Calls Sorted By Type and ID		
Character IO System Calls		
.CIO_READ	0200	Read (receive) character(s) from the specified serial I/O device.
.CIO_WRIT	0201	Write (transmit) character(s) to the specified serial I/O device. This call is also capable of a sending a break character.
.CIO_STAT	0202	Retrieve status of the specified serial I/O device. Empty/full status on read/write queues. Break condition status.
.CIO_CNFG	0203	Configure/query the specified serial I/O device's operating parameters (baud rate, character-word size).
.CIO_PUTS	0204	Transmit the NULL terminated string (variable in length) to the specified serial I/O device. The NULL character is not transmitted.
.CIO_GETS	0205	Receive string (variable number of characters) until a RETURN character is received. The RETURN is replaced with a NULL character in the caller's buffer.
MASS IO System Calls		
.MSIO_READ	0300	Read N blocks from the specified mass storage I/O device.
.MSIO_WRIT.	0301	Write N blocks to the specified mass storage I/O device.
.MSIO_CNFG	0302	Configure/query the specified mass storage I/O device.
MSIO_CTRL	0303	Implement special control functions with the specified mass storage I/O device.
.MSIO_FRMT	0304	Format the specified mass storage I/O device.
NETWORKING IO System Calls		

Table 7-1. System Calls

System Calls Sorted By Type and ID		
.NIO_READ	0400	Read file (TFTP Read) from the specified file server through the specified network I/O device.
.NIO_WRIT	0401	Write file (TFTP Write) to the specified file server through the specified network I/O device.
.NIO_CNFG	0402	Configure/query the specified network I/O device.
.NIO_CTRL	0403	Implement special control functions with the specified network I/O device.
Real Time Clock System Calls		
.RTC_READ	0500	Read the RTC registers (logical operation).
.RTC_WRIT	0501	Write the RTC registers (logical operation).
Flash Memory System Calls		
.FM_WRIT	0600	Write (program) the FLASH memory array.
Debugging Support System Calls		
.SYMBOLTA	0700	Attach symbol table, enable symbol table lookup.
.SYMBOLTD	0701	Detach symbol table, disable symbol table lookup.
Miscellaneous System Calls		
.RETURN	0F00	Return control back to the F/W.
.DELAY	0F01	Delay for a number of time units.
.BRDINFO	0F02	Retrieve board information block.
.SCREV	0F03	Retrieve system call interface version

.CIO_READ

Code: 0200

Description

.CIO_READ reads bytes from the specified serial device into the buffer specified by the caller.

.CIO_READ does not translate received characters. Characters are placed into the buffer exactly as received. (No CR to LF or other canonical processing is provided.)

.CIO_READ does not wait for all requested characters to be received before returning. It reads characters from the input device into the buffer until no more characters are available (or the number of bytes requested is read).

Entry Conditions

R3 points to the input parameter block:

Offset	Description
0x0	CLUN of device (0 selects current input device)
0x4	DLUN of device (0 selects current input device)
0x8	Pointer to input buffer
0xC	Number of bytes requested
0x10	Reserved (must be 0)

Note EPPCBug 1.1 supports only CLUN and DLUN of 0.

R4 points to the output parameter block:

Offset	Description
0x0	System call return status
0x4	Number of bytes actually received

Exit Conditions

System call return status has been updated with either zero (no error) or a nonzero error code listing.

The user-specified buffer has been written with the data bytes received. The output parameter block indicates the number of bytes actually received. The number of bytes received may be less than the requested number (or even zero if no characters were available).

.CIO_WRIT

Code: 0201

Description

.CIO_WRIT writes bytes to the specified serial device from the buffer specified by the caller.

.CIO_WRIT does not translate transmitted characters. Characters are sent to the device exactly as they exist in the buffer. No CR to LF or other canonical processing is provided.

.CIO_WRIT does not wait for all requested characters to be sent before returning. It writes characters to the output device from the buffer until the device transmitter indicates it cannot accept another character (or the number of bytes requested is sent).

.CIO_WRIT may be used to send a break condition to the output device as well

Entry Conditions

R3 points to the input parameter block:

Offset	Description
0x0	CLUN of device (0 selects current output device)
0x4	DLUN of device (0 selects current output device)
0x8	Pointer to data buffer (or -1 to cause a break to be sent)
0xC	Number of bytes to be sent
0x10	Reserved (must be 0)

Note EPPCBug 1.1 supports only CLUN and DLUN of 0.

R4 points to the output parameter block:

Offset	Description
0x0	System call return status
0x4	Number of bytes actually sent

Exit Conditions

System call return status has been updated with either zero (no error) or a nonzero error code listing.

If the data buffer pointer location contained -1, then a break was sent to the port. Otherwise the data bytes pointed to by the buffer pointer were sent to the port.

The number of bytes actually sent indicates the number of bytes actually sent to the device. The number of bytes actually sent may be less than the number requested (or even zero if the device could not accept any characters).

.CIO_STAT

Code: 0202

Description

.CIO_STAT returns status flags which indicate the state of the device transmit, receive and line status.

Entry Conditions

R3 points to the input parameter block:

Offset	Description
0x0	CLUN of device (0 selects current output device)
0x4	DLUN of device (0 selects current output device)

Note EPPCBug 1.1 supports only CLUN and DLUN of 0.

R4 points to the output parameter block:

Offset	Description
0x0	System call return status
0x4	Input data ready flag (nonzero true)
0x8	Output channel ready (nonzero true)
0xC	Break received flag (nonzero true)
0x10	Modem line status

Exit Conditions

System call return status has been updated with either zero (no error) or a nonzero error code listing.

Input data ready flag indicates whether or not at least one character is available for reading. A nonzero flag indicates data is available.

Output channel empty indicates whether or not the transmitter section of the device can accept at least one more character.

Break received flag indicates whether or not a break was detected on the serial line.

Modem control status indicates the state of the modem control inputs at this serial port:

Bit 31 is true if DCD is asserted to the serial interface chip.

Bit 30 is true if CTS is asserted to the serial interface chip.

Note that not all serial ports have a predefined DCD or CTS pin. In those cases where EPPCBug cannot determine the actual state of the modem control bit, a false (0) value for that line is returned to the caller.

.CIO_CNFG

Code: 0203

Description

.CIO_CNFG provides a means of reading the current serial port configuration and changing it.

Entry Conditions

R3 points to the input parameter block:

Offset	Description
0x0	CLUN of device (0 selects current output device)
0x4	DLUN of device (0 selects current output device)
0x8	Current configuration pointer
0xC	New configuration pointer

Note EPPCBug 1.1 supports only CLUN and DLUN of 0.

Configuration pointers point to a structure with the following entries:

Offset	Description
0x0	Baud rate
0x4	Control bits
0x8	Reserved (must be 0)

Control bits are as follows:

Bit #	If Set, Selects
0*	Odd parity
1*	Even parity
2	8 bit character
3	7 bit character

Bit #	If Set, Selects
4	6 bit character
5	5 bit character
6	2 stop bits
7	1 stop bit
*__Note:__ Bit 0 and bit 1 cannot be set at the same time.	

R4 points to the output parameter block:

Offset	Description
0x0	System call return status

Exit Conditions

System call return status has been updated with either zero (no error) or a nonzero error code listing.

If the current configuration pointer entry in the input parameter block is nonzero, then the current port settings (prior to any change) are saved at the area specified by the pointer.

If the new configuration pointer entry in the input parameter block is nonzero, then the port has been modified to operate at the settings described by the area pointed to by the pointer.

.CIO_PUTS

Code: 0204

Description

.CIO_PUTS outputs a string of characters to the specified port. The string must be NULL terminated.

.CIO_PUTS waits until the entire string has been written to the output device before returning.

.CIO_PUTS does not translate transmitted characters. Characters are sent to the device exactly as they exist in the buffer. No CR to LF or other canonical processing is provided.

Entry Conditions

R3 points to the input parameter block:

Offset	Description
0x0	CLUN of device (0 selects current output device)
0x4	DLUN of device (0 selects current output device)
0x8	Pointer to string to be sent

Note EPPCBug 1.1 supports only CLUN and DLUN of 0.

R4 points to the output parameter block:

Offset	Description
0x0	System call return status

Exit Conditions

System call return status has been updated with either zero (no error) or a nonzero error code listing.

.CIO_GETS

Code: 0205

Description

.CIO_GETS is used to read a string of characters from the specified device into a buffer. Input terminates when a RETURN is received.

.CIO_GETS does not write the terminating RETURN into the buffer but instead terminates the string with a NULL character. Up until the terminating RETURN is received, you may edit and correct input characters using the line editing features of the BUG.

Entry Conditions

R3 points to the input parameter block:

Offset	Description
0x0	CLUN of device (0 selects current output device)
0x4	DLUN of device (0 selects current output device)
0x8	Pointer to input buffer
0xC	Maximum number of bytes in buffer

Note EPPCBug 1.1 supports only CLUN and DLUN of 0.

R4 points to the output parameter block:

Offset	Description
0x0	System call return status
0x4	Number of bytes actually received (not including terminating NULL)

Exit Conditions

System call return status has been updated with either zero (no error) or a nonzero error code listing.

The memory pointed to by the input buffer pointer contains the received string.

.MSIO_READ and .MSIO_WRIT

Code: 0300 (MSIO_READ)

Code: 0301 (MSIO_WRIT)

Description

.MSIO_READ reads blocks from the specified mass storage device. .MSIO_WRIT writes blocks to the specified mass storage device.

Entry Conditions

R3 points to the input parameter block:

Offset	Description
0x0	CLUN of device to use
0x4	DLUN of device to use
0x8	Pointer to data buffer to read data into or write data from.
0xC	Number of blocks requested
0x10	Block Number (disk devices) or File Number (tape devices). 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. On a disk read, data is read starting at this block. For streaming tape devices, this is the file number where the transfer starts. This field is used if the IFN bit in the Flags is cleared (refer to the Flags description below).
0x14	Flags. This field must be zero for disk devices. For tapes: Bit 30: 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 31: 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.
0x18	Reserved. (must be 0)

R4 points to the output parameter block:

Offset	Description
0x0	System call return status
0x4	Device specific error code. If the system call failed due to an error at the device interface level, additional device specific error status will be returned in this location. Appendix E provides disk/tape status error codes
0x8	Number of blocks read
0xC	EOF status (tape devices only) If non-zero, a filemark was detected at the end of the last operation.

Exit Conditions

System call return status has been updated with either zero (no error) or a nonzero error code listing.

The output parameter block contains the number of blocks actually read. This may be less than the number requested in some cases

The output parameter block contains a flag indicating whether and EOF mark was detected during the read. This flag is only valid when using MSIO_READ with a streaming tape device.

.MSIO_CNFG

Code: 0302

Description

.MSIO_CNFG configures the specified mass storage device. It effectively performs the IOT command under program control. MSIO_CNFG also allows the caller to retrieve the current configuration of the mass storage device.

Entry Conditions

R3 points to the input parameter block:

Offset	Description
0x0	CLUN of device
0x4	DLUN of device
0x8	Current configuration pointer
0xC	New configuration pointer

R4 points to the output parameter block:

Offset	Description
0x0	System call return status
0x4	Device specific error code. If the system call failed due to an error at the device interface level, additional device specific error status will be returned in this location. Appendix E provides disk/tape status error codes
0x8	Reserved
0xC	Reserved

Exit Conditions

System call return status has been updated with either zero (no error) or a nonzero error code listing.

If the current configuration pointer entry in the input parameter block is nonzero, then the current port settings (prior to any change) are saved at the area specified by the pointer.

If the new configuration pointer entry in the input parameter block: is nonzero, then the port has been modified to operate at the settings described by the area pointed to by the pointer.

The configuration pointers point to a command packet with the following layout:

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
$10	Parameters	

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 7-22.

Controller LUN	Same as in input argument packet
Device LUN	Same as in input argument 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 7-2. 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 7-7 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

Table 7-2. Disk Packet Parameters

Parameter	Offset (Bytes)	Length (Bytes)	CFGA Equivalent	Description
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
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 zero in a bit position indicates that the current attribute should be retained.

Table 7-3. 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 zero in a bit position indicates that the parameter value in the current configuration will be retained.

Table 7-4. 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 7-5. 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 zero. All IOSEATW bits are undefined and should be set to zero.

Table 7-6. IOSATW Fields

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 7-7. CFGA Fields

	Parameter	Description
IOSREC	Record (Block) size	Number of bytes per record (block). Must be an integer multiple of the physical sector size.
IOSSPT	Sectors per track	Number of sectors per track.
IOSHDS	Number of heads	Number of recording surfaces for the specified device.
IOSTRK	Number of cylinders	Number of cylinders on the media.
IOSILV	Interleave factor	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.
IOSPSM	Physical sector size	Actual number of bytes per sector on media.
IOSSOF	Spiral offset	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.
IOSSHD	Starting head number	The first head number for the device.
IOSPCOM	Precompensation cylinder	The cylinder on which precompensation begins.

Table 7-7. CFGA Fields

	Parameter	Description
IOSSR	Step	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** / **Winchester Hard Disks** / **3-1/2 Inch/ 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
IOSRWCC	Reduced write current cylinder	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.
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.

.MSIO_CTRL

Code: 0303

Description

.MSIO_CTRL is used to implement any special device control routines that cannot be accommodated easily with any of the other disk routines. Right now, 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 was built somewhere in memory. The address of the packet is passed as an argument to the routine.

Note that the controller packet to send is controller and device dependent. Information about this packet should be found in the user's manual for the controller and device being accessed.

Entry Conditions

R3 points to the input parameter block:

Offset	Description
0x0	CLUN of device
0x4	DLUN of device
0x8	Pointer to controller packet

R4 points to the output parameter block:

Offset	Description
0x0	System call return status
0x4	Device specific error code. If the system call failed due to an error at the device interface level, additional device specific error status will be returned in this location. Refer to Appendix E.
0x8	Reserved
0xC	Reserved

Exit Conditions

System call return status has been updated with either zero (no error) or a nonzero error code listing.

.MSIO_FRMT

Description Code: 0304

Description

.MSIO_FRMT allows you to send a format command to the specified device.

Entry Conditions

R3 points to the input parameter block:

Offset	Description
0x0	CLUN of device
0x4	DLUN of device
0x8	Reserved (must be 0)
0xC	Reserved (must be 0)
0x10	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.
0x14	Flags Contains additional information. Bit zero 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 zero 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. If 1, it selects an Erase Tape operation. This completely clears the tape of previous data and at the same time retensions the tape.

R4 points to the output parameter block:

Offset	Description
0x0	System call return status
0x4	Device specific error code. If the system call failed due to an error at the device interface level, additional device specific error status will be returned in this location. Appendix E provides disk/tape status error codes
0x8	Reserved
0xC	Reserved

Exit Conditions

System call return status has been updated with either zero (no error) or a nonzero error code listing.

.NIO_READ and .NIO_WRIT

Code: 0400 (.NIO_READ)

Code: 0401 (.NIO_WRIT)

Description

.NIO_READ is used to get files from the destination host over the specified network interface.The.NIO_WRIT system call is used to send files to the host.

Entry Conditions

R3 points to the input parameter block:

Offset	Description
0x0	CLUN of device
0x4	DLUN of device
0x8	Data Transfer Address
0xC	The number of bytes from the data transfer address to transfer. A length of zero specifies to transfer the entire file on a read. On a write the length must be set to the number of bytes to transfer.
0x10	Byte offset into the file.
0x14	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.

R4 points to the output parameter block:

Offset	Description
0x0	System call return status
0x4	Device specific error code. If the system call failed due to an error at the device interface level, additional device specific error status will be returned in this location.
0x8	Number of bytes actually received

Exit Conditions

System call return status has been updated with either zero (no error) or a nonzero error code listing.

.NIO_CNFG

Code: 0402

Description

.NIO_CNFG allows you to change and/or query the configuration parameters of the specified network interface. The .NIO_CNFG 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.

Entry Conditions

R3 points to the input parameter block:

Offset	Description
0x0	CLUN of device
0x4	DLUN of device
0x8	Current configuration pointer
0xC	Reserved (must be 0)
0x10	New configuration pointer
0x14	Reserved (must be 0)
0x18	Reserved (must be 0)

R4 points to the output parameter block:

Offset	Description
0x0	System call return status
0x4	Device specific error code. If the system call failed due to an error at the device interface level, additional device specific error status will be returned in this location.
0x8	Reserved

Exit Conditions

System call return status has been updated with either zero (no error) or a nonzero error code listing.

If the current configuration pointer entry in the input parameter block is nonzero, then the current port settings (prior to any change) are saved at the area specified by the pointer.

If the new configuration pointer entry in the input parameter block is nonzero, then the port has been modified to operate at the settings described by the area pointed to by the pointer.

The configuration pointers point to a command packet with the following layout:

	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	Reserved	Most Significant Word
$0A		Least Significant Word
$0C	Reserved	Most Significant Word
$0E		Least Significant Word
$10	Reserved	Most Significant Word
$12		Least Significant Word
$14	Boot File Length	Most Significant Word
$16		Least Significant Word
$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

	F E D C B A 9 8 7 6 5 4 3 2 1 0	
$2C $2E	Broadcast IP Address Mask	Most Significant Word Least Significant Word
$30 $32	Gateway IP Address	Most Significant Word Least Significant Word
$34	BOOTP/RARP Retry	TFTP/ARP Retry
$36	BOOTP/RARP Control	Update Control
$38 $76	Boot Filename String	$40(&64) Bytes
$78 $B6	Argument Filename String	$40(&64) Bytes

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.
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 Length	The number of bytes from the data transfer address to transfer. A length of zero 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 nonzero 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.

.NIO_CTRL

Code: 0403

Description

.NIO_CTRL 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 the 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.

Entry Conditions

R3 points to the input parameter block:

Offset	Description
0x0	CLUN of device
0x4	DLUN of device
0x8	Command
0xC	Memory address
0x10	Number of bytes
0x14	Reserved

R4 points to the output parameter block:

Offset	Description
0x0	System call return status
0x4	Device specific error code. If the system call failed due to an error at the device interface level, additional device specific error status will be returned in this location.
0x8	Reserved

Exit Conditions

System call return status has been updated with either zero (no error) or a nonzero error code listing.

.RTC_READ

Code: 0500

Description

.RTC_READ is used to read the Real-Time Clock registers. The data returned is in packed BCD.

Entry Conditions

R3 points to the input parameter block:

Offset	Description
0x0	Pointer to rtc data buffer

R4 points to the output parameter block:

Offset	Description
0x0	System call return status

Exit Conditions

System call return status has been updated with either zero (no error) or a nonzero error code listing.

The rtc data buffer has been filled with the following:

Offset	Description
0x0	Year (2 nibbles packed BCD)
0x1	Month (2 nibbles packed BCD)
0x2	Day of month (2 nibbles packed BCD)
0x3	Day of week (2 nibbles packed BCD)
0x4	Hour of 24 hour clock (2 nibbles packed BCD)
0x5	Minute (2 nibbles packed BCD)
0x6	Seconds (2 nibbles packed BCD)
0x7	Reserved

.RTC_WRIT

Code: 0501

Description

.RTC_WRIT initializes Real-Time Clock with the time that is located in a user-specified buffer.

Entry Conditions

R3 points to the input parameter block:

Offset	Description
0x0	Pointer to RTC data

Pointer to RTC data points at a structure with the following elements:

Offset	Description
0x0	Year (2 nibbles packed BCD)
0x1	Month (2 nibbles packed BCD)
0x2	Day of month (2 nibbles packed BCD)
0x3	Day of week (2 nibbles packed BCD)
0x4	Hour of 24 hour clock (2 nibbles packed BCD)
0x5	Minute (2 nibbles packed BCD)
0x6	Seconds (2 nibbles packed BCD)
0x7	Reserved (must be 0)

R4 points to the output parameter block:

Offset	Description
0x0	System call return status

Exit Conditions

System call return status has been updated with either zero (no error) or a nonzero error code listing.

.FM_WRIT

Code: 0600

Description

.FM_WRIT is used to program flash memory.

Entry Conditions

R3 points to the input parameter block:

Offset	Description
0x0	Reserved (must be 0)
0x4	Reserved (must be 0)
0x8	Control word. Contains bit flags with the following meaning: Bit 0 Execution address valid. Bit 1 Execute address on error as well. Bit 2 Execute local reset. Bit 3 Execute local reset on error as well. Bit 4 Non-verbose, no display messages.
0xC	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.
0x10	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.
0x14	Specifies the starting address of the FLASH memory to program the source data with. Word (32-bit) address alignment is required for this parameter.
0x18	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 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 word.
0x1C	Reserved (must be 0)

Offset	Description
0x20	Reserved (must be 0)

R4 points to the output parameter block:

Offset	Description
0x0	System call return status
0x4	Flash programming status. Meanings of bits within this are: Bit 0 Error of some type, see remaining status bits. Bit 1 Address/Range alignment error. Bit 2 FLASH Memory address range error. Bit 3 FLASH Memory erase error. Bit 4 FLASH Memory write error. Bit 5 Verification (read after write) error. Bit 6 Time-Out during erase operation. Bit 7 Time-Out during byte write operation. Bit 8 Unexpected manufacturer identifier read from the device. Bit 9 Unexpected device identifier read from the device. Bit 10 Unable to initialize the FLASH device to zero. Bit 14 FLASH Memory program control driver downloaded. Bit 15 No return possible to caller.

Exit Conditions

System call return status has been updated with either zero (no error) or a nonzero error code listing.

.SYMBOLTA

Code: 0700

Description

.SYMBOLTA attaches a symbol table to the debugger. When a symbol table is 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 displays 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 Running H/F 3* for the command description.

Entry Conditions

R3 points to the input parameter block:

Offset	Description
0x0	Starting address of symbol table.

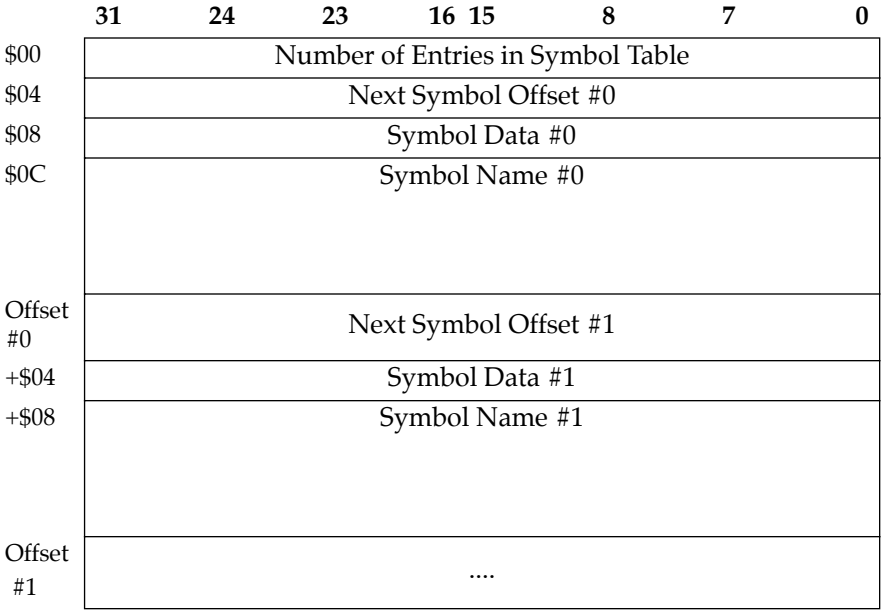
R4 points to the output parameter block:

Offset	Description
0x0	System call return status

Exit Conditions

System call return status has been updated with either zero (no error) or a nonzero error code listing.

The format of the symbol table is as shown:



Field descriptions:

Number of Entries in Symbol Table	**The number of entries in table**
Next Symbol Offset	Offset from the beginning of the symbol table to the next symbol table entry
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; must be null ($00) terminated

.SYMBOLTD

Code: 0701

Description

.SYMBOLTD detaches a symbol table from the debugger. This command is analogous to the debugger command NOSYM. Refer to *Chapter Running H/F 3* for the command description.

Entry Conditions

This system call requires no input parameters.

R4 points to the output parameter block:

Offset	Description
0x0	System call return status

Exit Conditions

System call return status has been updated with either zero (no error) or a nonzero error code listing.

.RETURN

Code: 0F00

Description

.RETURN is used to return control to EPPCBug 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 EPPCBug.

Entry Conditions

None. This system call requires no input parameters and furnishes no output parameters.

Exit Conditions

Control is passed to EPPCBug and does not return to caller.

.DELAY

Code: 0F01

Description

.DELAY does nothing and then returns to the calling program after the specified number of milliseconds.

Entry Conditions

R3 points to the input parameter block:

Offset	Description
0x0	Number of milliseconds to delay
0x4	Reserved (Must be 0)

R4 points to the output parameter block:

Offset	Description
0x0	System call return status

Exit Conditions

System call return status has been updated with either zero (no error) or a nonzero error code listing.

.BRDINFO

Code: 0F02

Description

.BRDINFO returns a pointer to the board information packet. The packet is built at initialization time and contains information about the PowerPC board and peripherals it supports.

Entry Conditions

R3 points to the input parameter block:

Offset	Description
0x0	Pointer to board info buffer

R4 points to the output parameter block:

Offset	Description
0x0	System call return status

Exit Conditions

System call return status has been updated with either zero (no error) or a nonzero error code listing.

The user input argument packet has been filled with a pointer to the board information structure.

The board information structure format is shown below:

Offset	Description
0x0	Word containing ASCII string "BDID"
0x4	Size of this structure
0x8	Revision of this structure
0xC	EPPCBug Rev. Month Day Year
0x10	Start address of local DRAM
0x14	Ending address of local DRAM
0x18	Processor internal frequency (in Hz)

Offset	Description
0x1C	Processor external BUS frequency (in Hz)
0x20	Boot device CLUN
0x24	Boot device DLUN

.SCREV

Code: 0F03

Description

.SCREV returns a value which describes which revision of the system call interface the firmware adheres to. Initially, the revision number will be 1. As new system calls are added or program visible changes are made to the system call interface, the revision number will be updated to allow programs to dynamically determine which features of the system call interface are available.

Entry Conditions

R4 points to the output parameter block:

Offset	Description
0x0	System call return status
0x4	System call interface revision number

Exit Conditions

System call return status has been updated with either zero (no error) or a nonzero error code listing.

S-Record Output Format 8

The S-record format for output modules specifically supports the encoding of programs or data files in a printable format for transportation between computer systems. The transportation process can then be visually monitored and the S-records can be more easily edited.

S-Record Content

When you view S-records, they appear as character strings made of several fields which identify the record type, record length, memory address, code/data, and checksum. Each byte of binary data is encoded as a two-character hexadecimal number:

- The first character representing the high-order 4 bits
- The second the low-order 4 bits of the byte

The five fields which comprise an S-record are shown below:

Type	Record Length	Address	Code/Data	Checksum

Where the fields are composed as follows:

Table 8-1. S-Record Composition

Field	Printable Characters	Contents
Type	2	S-record type -- S0, S1, etc.
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	0-2n	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 8-1. S-Record Composition

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 CR/LF/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 makes up the header record. The address field is normally zeroes.

S1 A record containing code/data and the 2-byte address at which the code/data is to reside.

S2 A record containing code/data and the 3-byte address at which the code/data is to reside.

S3 A record containing code/data and the 4-byte 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.

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.

Creation of S-Records

S-record-format programs may be produced by:

- Several dump utilities
- Debuggers
- The operating system resident linkage editor
- 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

Shown below is a typical S-record-format module, as printed or displayed:

```
S00A00006765745F7274630D
S2240400007C8402A6908300007C8502A6908300044E80002000000000000400000004002442
S20C040020000000000000000CF
S804040000F7
```

The module consists of one S0 record, two S3 records, and one S8 record.

The first S0 record is explained as follows:

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

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

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 an 6-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 an 6-byte address.

0C Hexadecimal 0C (decimal 12), indicating that 12 character pairs, representing 12 bytes of binary data, follow.

040020 Eight-character 6-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:

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 (ASCII in this example) representation of the binary bits which are actually transmitted. For example, the first S0 record above is sent as:

```
TYPE/LENGTH/ADDRESS/CODE-DATA/CHECKSUM
S  0/ 0  A/ 0  0  0  0/ 6  7  6  5  7  4  5  F  7  2  7  4  6  3/ 0  D
38 30/30 41/30 30 30 30/36 37 36 35 37 34 35 46 37 32 37 34 36 33/30 44
```

Note that the slash character is not included in the record, but used for clarity.

Vital Product Data

A

Overview

Typically, Vital Product Data (VPD) consists of data that is pertinent to board configuration and operation. An example of such data would be:

- Assigned Ethernet address
- Board serial number (used for licensing and field-service purposes)
- Processor internal/external clock frequencies
- Processor type, local memory configuration, etc.

Software Notes

The serial EEPROM can be viewed virtually as two separate and distinct serial EEPROMs, each being 256-bytes in size.

- The first 256-byte portion contains the product's VPD and the I2C device address is 0xA4
- The second 256-byte portion contains the local memory configuration (the DIMM serial presence detect data) and the I2C device address is 0xA6.

This distinction between the two portions allows for the same configuration software (DIMM serial presence detect data probe) to be utilized for both the local DRAM and the optional (socketed) DIMM module.

VPD Data Format

The VPD data format consists mainly of formatted data packets. Each packet starts with an identifier byte, followed by a data-field length byte.

- The data-field length byte indicates the size of the following data (the packet data field).
- The format of the data field is dependent upon the type of packet (the packet identifier).
- The data-field length byte can also be used to determine where the next packet starts, and where the current packet ends.
- The last packet of the VPD data is followed by the termination packet identifier, this indicates the end of initialized VPD data.
- The packets can be in any order, however, no hole or gaps can exist between packets.

The VPD EEPROM always starts with the eye-catcher and size fields. These fields can be used to determine the integrity of the VPD EEPROM. In addition, an optional EEPROM CRC packet may be specified to further the confidence of VPD data integrity.

Data packets can be added to the VPD EEPROM contents. These packets must adhere to the previously stated format. A range of packet identifiers are reserved for use by the customer. Addition of user packets is discouraged.

Examples of possible user-defined packets:

1. LCD Panel Type, such as Sharp-LM32K07, Hitachi-LMC7211URFR, ALPS-LRUBJ904XB)
2. Size of the installed BBRAM (in bytes)

VPD Data Definitions

The following table describes and lists the current assigned packet identifiers

Table A-1. VPD Packet Types

Identifier	Size	Description	Data Type	Notes
00	N/A	Guaranteed Illegal	N/A	
01	Variable	Product Identifier (“MBX”)	ASCII	1
02	Variable	Factory Assembly Number (“01-W3269F01B”)	ASCII	1
03	Variable	Serial Number (“2718944”)	ASCII	1
04	10	Product Configuration Options Data The data contained within this packet shall contain data which further describes board configuration (header population, I/O routing, etc.). Its exact contents is dependent upon the product configuration/type. A table found later in this document further describes this packet.	Binary	
05	04	MPU Internal Clock Frequency in Hertz.	Integer (4-byte)	3
06	04	MPU External Clock Frequency in Hertz. This is also considered the local processor bus frequency.	Integer (4-byte)	3
07	04	Reference Clock Frequency in Hertz	Integer (4-byte)	3
08	06	Ethernet Address (e.g., 08003E20002)	Binary	2, 4
09	Variable	MPU Type (801, 821, 823, 860, 860DC, 860DE, 860DH, 860EN, 860MH, etc.)	ASCII	1
0A	4	EEPROM CRC This packet is optional. This packet would be utilized in environments where CRC protection is required. When computing the CRC this field (i.e., 4 bytes) is set to zero.	Integer (4-byte)	3

Table A-1. VPD Packet Types

Identifier	Size	Description	Data Type	Notes
0B	9	FLASH Memory Configuration A table found later in this document further describes this packet.	Binary	
0D-BF		Reserved		
C0-FE		User Defined An example of an user defined could be the type of LCD panel connected in an MPC821 based application.		
FF	N/A	Termination Packet (follows the last initialized data packet)	N/A	

Notes

1. The data size is variable. Its actual size is dependent upon the product configuration or type.
2. This packet may be omitted if the Ethernet interface is nonexistent.
3. Integer values are formatted and stored in big-endian byte ordering.
4. This packet may contain an additional byte following the address data. This additional byte indicates the Ethernet interface instance number. This additional byte would be specified in applications where the host product supports multiple Ethernet interfaces. For each Ethernet interface present, the instance number would be incremented by one starting with zero.

Product Configuration Options Data

The product configuration options data packet consists of a binary bit field. The first bit of the first byte is bit 0 (PowerPC bit numbering). An option is said to be present when the assigned bit is a one. The following table(s) further describe the product configuration options VPD data packet.

Table A-2. MBX Product Configuration Options Data

Bit Number	Bit Mnemonic	Bit Description
0	PCO_BBRAM	Battery-Backed RAM (BBRAM) and Socket
1	PCO_BOOTROM	Boot ROM and Socket (i.e., socketed FLASH)
2	PCO_KAPWR	Keep Alive Power Source (Lithium Battery) and Control Circuit
3	PCO_ENET_TP	Ethernet Twisted Pair (TP) Connector (RJ45)
4	PCO_ENET_AUI	Ethernet Attachment Unit Interface (AUI) Header
5	PCO_PCMCIA	PCMCIA Socket
6	PCO_DIMM	DIMM Module Socket
7	PCO_DTT	Digital Thermometer and Thermostat (DTT) Device
8	PCO_LCD	Liquid Crystal Display (LCD) Header
9	PCO_PCI	PCI-Bus Bridge Device (QSpan) and ISA-Bus Bridge Device (Winbond)
10	PCO_PCIO	PC I/O (COM1, COM2, FDC, LPT, KYBD/Mouse)
11	PCO_EIDE	Enhanced IDE (EIDE) Header
12	PCO_FDC	Floppy Disk Controller (FDC) Header
13	PCO_LPT_8XX	Parallel Port Header via MPC8xx
14	PCO_LPT_PCIO	Parallel Port Header via PC I/O
15-127		Reserved for future configuration options

FLASH Memory Configuration Data

The FLASH memory configuration data packet consists of byte fields which indicate the size/organization/type of the FLASH memory array. The following table(s) further describe the FLASH memory configuration VPD data packet.

Table A-3. FLASH Memory Configuration Data

Byte Offset	Field Size (Bytes)	Field Mnemonic	Field Description
00	2	FMC_MID	Manufacturer's Identifier
02	2	FMC_DID	Manufacturer's Device Identifier
04	1	FMC_DDW	Device Data Width (8-bits, 16-bits)
05	1	FMC_NOD	Number of Devices Present
06	1	FMC_NOC	Number of Columns
07	1	FMC_CW	Column Width in Bits This will always be a multiple of the device's data width.
08	1	FMC_WEDW	Write/Erase Data Width The FLASH memory devices must be programmed in parallel when the write/erase data width exceeds the device's data width.

EEPROM Example

The following hexadecimal/ASCII dump illustrates an example EEPROM contents.

```
000  4D 4F 54 4F 52 4F 4C 41  01 00 01 03 4D 42 58 02  MOTOROLA....MBX.
010  0C 30 31 2D 57 33 32 36  39 46 30 31 42 03 07 32  .01-W3269F01B..2
020  37 31 38 39 34 34 04 10  00 00 00 00 00 00 00 00  718944..........
030  00 00 00 00 00 00 00 00  05 04 02 62 5A 00 06 04  ...........}x@..
040  02 62 5A 00 07 04 00 00  80 00 08 06 08 00 3E 20  .}x@..........>
050  00 02 09 05 38 36 30 45  4E 0A 04 00 00 00 00 0B  ....860EN.......
060  09 00 01 00 A4 08 04 04  08 08 FF FF FF FF FF FF  ................
070  FF FF FF FF FF FF FF FF  FF FF FF FF FF FF FF FF  ................
080  FF FF FF FF FF FF FF FF  FF FF FF FF FF FF FF FF  ................
090  FF FF FF FF FF FF FF FF  FF FF FF FF FF FF FF FF  ................
0A0  FF FF FF FF FF FF FF FF  FF FF FF FF FF FF FF FF  ................
```

```
0B0  FF FF FF FF FF FF FF FF  FF FF FF FF FF FF FF FF  ................
0C0  FF FF FF FF FF FF FF FF  FF FF FF FF FF FF FF FF  ................
0D0  FF FF FF FF FF FF FF FF  FF FF FF FF FF FF FF FF  ................
0E0  FF FF FF FF FF FF FF FF  FF FF FF FF FF FF FF FF  ................
0F0  FF FF FF FF FF FF FF FF  FF FF FF FF FF FF FF FF  ................
100  80 08 02 0A 0A 01 20 00  01 3C 0F 00 00 10 00 00  ...... ..<......
110  00 00 00 00 00 00 00 00  00 00 00 00 00 00 00 00  ................
120  00 00 00 00 00 00 00 00  00 00 00 00 00 00 00 00  ................
130  00 00 00 00 00 00 00 00  00 00 00 00 00 00 00 00  ................
140  00 00 00 00 00 00 00 00  00 00 00 00 00 00 00 00  ................
150  00 00 00 00 00 00 00 00  00 00 00 00 00 00 00 00  ................
160  00 00 00 00 00 00 00 00  00 00 00 00 00 00 00 00  ................
170  00 00 00 00 00 00 00 00  00 00 00 00 00 00 00 00  ................
180  00 00 00 00 00 00 00 00  00 00 00 00 00 00 00 00  ................
190  00 00 00 00 00 00 00 00  00 00 00 00 00 00 00 00  ................
1A0  00 00 00 00 00 00 00 00  00 00 00 00 00 00 00 00  ................
1B0  00 00 00 00 00 00 00 00  00 00 00 00 00 00 00 00  ................
1C0  00 00 00 00 00 00 00 00  00 00 00 00 00 00 00 00  ................
1D0  00 00 00 00 00 00 00 00  00 00 00 00 00 00 00 00  ................
1E0  00 00 00 00 00 00 00 00  00 00 00 00 00 00 00 00  ................
1F0  00 00 00 00 00 00 00 00  00 00 00 00 00 00 00 00  ................
```

The optional DIMM module socket does not support all available DIMM modules. Please consult the MBX's hardware user's manual for the supported DIMM modules.

C Header Files

The following C header/source files are listed to aid software engineering.

VPD.H

```
/*
 * Module name: %M%
 * Description:
 *             Vital Product Data (VPD) Header Module
 * SCCS identification: %I%
 * Branch: %B%
 * Sequence: %S%
 * Date newest applied delta was created (MM/DD/YY): %G%
 * Time newest applied delta was created (HH:MM:SS): %U%
 * SCCS file name %F%
 * Fully qualified SCCS file name:
 *             %P%
 * Copyright:
 *             (C) COPYRIGHT MOTOROLA, INC. 1996
 *             ALL RIGHTS RESERVED
 * Notes:
 * History:
 * Date                          Who
 *
 * 10/24/96                      Rob Baxter
 * Initial release.
 *
 */


#define VPD_EEPROM_SIZE          256     /* EEPROM size in bytes */

/*
 * packet tuple identifiers
 *
 * 0x0D - 0xBF                   reserved
 * 0xC0 - 0xFE                   user defined
 */

#define VPD_PID_GI               0x00    /* guaranteed illegal */
#define VPD_PID_PID              0x01    /* product identifier (ASCII) */
#define VPD_PID_FAN              0x02    /* factory assembly-number (ASCII) */
```

```
#define VPD_PID_SN              0x03    /* serial-number (ASCII) */
#define VPD_PID_PCO             0x04    /* product configuration options(binary) */
#define VPD_PID_ICS             0x05    /* internal clock speed in HZ (integer) */
#define VPD_PID_ECS             0x06    /* external clock speed in HZ (integer) */
#define VPD_PID_RCS             0x07    /* reference clock speed in HZ(integer) */
#define VPD_PID_EA              0x08    /* ethernet address (binary) */
#define VPD_PID_MT              0x09    /* microprocessor type (ASCII) */
#define VPD_PID_CRC             0x0A    /* EEPROM CRC (integer) */
#define VPD_PID_FMC             0x0B    /* FLASH memory configuration (binary) */
#define VPD_PID_VLSI            0x0C    /* VLSI revisions/versions (binary) */
#define VPD_PID_TERM            0xFF    /* termination */

/*
 * VPD structure (format)
 */

#define VPD_EYE_SIZE            8       /* eyecatcher size */

typedef struct vpd_header {
   UCHAR eyecatcher[VPD_EYE_SIZE];      /* eyecatcher - "MOTOROLA" */
   USHORT size;                         /* size of EEPROM */
} VPD_HEADER;

#define VPD_DATA_SIZE           (VPD_EEPROM_SIZE-sizeof(VPD_HEADER))

typedef struct vpd {
   VPD_HEADER header;                   /* header */
   UCHAR packets[VPD_DATA_SIZE];        /* data */
} VPD;

/*
 * packet tuple structure (format)
 */

typedef struct vpd_packet {
   UCHAR identifier;            /* identifier (PIDs above) */
   UCHAR size;                  /* size of the following data area */
   UCHAR data[1];               /* data (size is dependent upon PID) */
} VPD_PACKET;

/*
 * MBX product configuration options bit definitions
 *
 * Notes:
 *            1. The bit numbering is reversed in perspective with the C compiler.
```

```
 */

#define PCO_BBRAM                (1<<0)  /* battery-backed RAM (BBRAM) and socket */
#define PCO_BOOTROM              (1<<1)  /* boot ROM and socket (i.e., socketed
        FLASH) */
#define PCO_KAPWR                (1<<2)  /* keep alive power source (lithium battey)
        and control circuit */
#define PCO_ENET_TP              (1<<3)  /* ethernet twisted pair (TP) connector
        (RJ45) */
#define PCO_ENET_AUI             (1<<4)  /* ethernet attachment unit interface (AUI)
        header */
#define PCO_PCMCIA               (1<<5)  /* PCMCIA socket */
#define PCO_DIMM                 (1<<6)  /* DIMM module socket */
#define PCO_DTT                  (1<<7)  /* digital thermometer and thermostat (DTT)
        device */
#define PCO_LCD                  (1<<8)  /* liquid crystal display (LCD) device */
#define PCO_PCI                  (1<<9)  /* PCI-Bus bridge device (QSpan) and ISA-Bus
        bridge device (Winbond) */
#define PCO_PCIO                 (1<<10) /* PC I/O (COM1, COM2, FDC, LPT,
        Keyboard/Mouse) */
#define PCO_EIDE                 (1<<11) /* enhanced IDE (EIDE) header */
#define PCO_FDC                  (1<<12) /* floppy disk controller (FDC) header */
#define PCO_LPT_8XX              (1<<13) /* parallel port header via MPC8xx */
#define PCO_LPT_PCIO             (1<<14) /* parallel port header via PC I/O */

/*
 * FLASH memory configuration packet data
 */

typedef struct vpd_fmc {
   USHORT mid;                   /* manufacturer's idenitfier */
   USHORT did;                   /* manufacturer's device idenitfier */
   UCHAR ddw;                    /* device data width (e.g., 8-bits, 16-bits) */
   UCHAR nod;                    /* number of devices present */
   UCHAR noc;                    /* number of columns */
   UCHAR cw;                     /* column width in bits */
   UCHAR wedw;                   /* write/erase data width */
} VPD_FMC;
```

DIMM.H

```
/*
 * Module name: %M%
 * Description:
 *             Serial Presence Detect Definitions Module
```

```
 * SCCS identification: %I%
 * Branch: %B%
 * Sequence: %S%
 * Date newest applied delta was created (MM/DD/YY): %G%
 * Time newest applied delta was created (HH:MM:SS): %U%
 * SCCS file name %F%
 * Fully qualified SCCS file name:
 *            %P%
 * Copyright:
 *            (C) COPYRIGHT MOTOROLA, INC. 1996
 *            ALL RIGHTS RESERVED
 * Notes:
 *            1. All data was taken from an IBM application note titled
 *               "Serial Presence Detect Definitions".
 * History:
 * Date                          Who
 *
 * 10/24/96    Rob Baxter
 * Initial release.
 *
 */


/*
 * serial PD byte assignment address map (256 byte EEPROM)
 */

typedef struct dimm {
   UCHAR n_bytes;               /* 00 number of bytes written/used */
   UCHAR t_bytes;               /* 01 total number of bytes in serial PD device */
   UCHAR fmt;                   /* 02 fundamental memory type (FPM/EDO/SDRAM) */
   UCHAR n_row;                 /* 03 number of rows */
   UCHAR n_col;                 /* 04 number of columns */
   UCHAR n_banks;               /* 05 number of banks */
   UCHAR data_w_lo;             /* 06 data width */
   UCHAR data_w_hi;             /* 07 data width */
   UCHAR ifl;                   /* 08 interface levels */
   UCHAR a_ras;                 /* 09 RAS access */
   UCHAR a_cas;                 /* 0A CAS access */
   UCHAR ct;                    /* 0B configuration type (non-parity/parity/ECC) */
   UCHAR refresh_rt;            /* 0C refresh rate/type */
   UCHAR p_dram_o;              /* 0D primary DRAM organization */
   UCHAR s_dram_o;              /* 0E secondary DRAM organization (parity/ECC-
        checkbits) */
   UCHAR reserved[17];          /* 0F reserved fields for future offerings */
```

```
    UCHAR ss_info[32];          /* 20 superset information (may be used in the
         future) */
    UCHAR m_info[64];           /* 40 manufacturer information (optional) */
    UCHAR unused[128];          /* 80 unused storage locations */
} DIMM;

/*
 * memory type definitions
 */

#define DIMM_MT_FPM             1       /* standard FPM (fast page mode) DRAM */
#define DIMM_MT_EDO             2       /* EDO (extended data out) */
#define DIMM_MT_PN              3       /* pipelined nibble */
#define DIMM_MT_SDRAM           4       /* SDRAM (synchronous DRAM) */

/*
 * row addresses definitions
 */

#define DIMM_RA_RDNDNT          (1<<7)  /* redundant addressing */
#define DIMM_RA_MASK            0x7f    /* number of row addresses mask */

/*
 * module interface levels definitions
 */

#define DIMM_IFL_TTL            0       /* TTL/5V tolerant */
#define DIMM_IFL_LVTTL          1       /* LVTTL (not 5V tolerant) */
#define DIMM_IFL_HSTL15         2       /* HSTL 1.5 */
#define DIMM_IFL_SSTL33         3       /* SSTL 3.3 */
#define DIMM_IFL_SSTL25         4       /* SSTL 2.5 */

/*
 * DIMM configuration type definitions
 */

#define DIMM_CT_NONE            0       /* none */
#define DIMM_CT_PARITY          1       /* parity */
#define DIMM_CT_ECC             2       /* ECC */

/*
 * row addresses definitions
 */

#define DIMM_RRT_SR             (1<<7)  /* self refresh flag */
#define DIMM_RRT_MASK           0x7f    /* refresh rate mask */
```

```
#define DIMM_RRT_NRML              0x00    /* normal (15.625us) */
#define DIMM_RRT_R_3_9             0x01    /* reduced .25x (3.9us) */
#define DIMM_RRT_R_7_8             0x02    /* reduced .5x (7.8us) */
#define DIMM_RRT_E_31_3            0x03    /* extended 2x (31.3us) */
#define DIMM_RRT_E_62_5            0x04    /* extended 4x (62.5us) */
#define DIMM_RRT_E_125             0x05    /* extended 8x (125us) */
```

SROM_CRC.C

```
/*
 * srom_crc - generate CRC data for the passed buffer
 * description:
 *            This function's purpose is to generate the CRC for the
 *            passed buffer.
 * call:
 *            argument #1 = buffer pointer
 *            argument #2 = number of elements
 * return:
 *            CRC data
 */

unsigned int
srom_crc(elements_p, elements_n)
register unsigned char *elements_p;        /* buffer pointer */
register unsigned int elements_n;          /* number of elements */
{
   register unsigned int crc;
   register unsigned int crc_flipped;
   register unsigned char cbyte;
   register unsigned int index, dbit, msb;

   crc = 0xffffffff;
   for (index = 0; index < elements_n; index++) {
      cbyte = *elements_p++;

      for (dbit = 0; dbit < 8; dbit++) {
               msb = (crc >> 31) & 1;
               crc <<= 1;

               if (msb ^ (cbyte & 1)) {
                  crc ^= 0x04c11db6;
                  crc |= 1;
               }

               cbyte >>= 1;
```

```
            }
        }

        crc_flipped = 0;
        for (index = 0; index < 32; index++) {
            crc_flipped <<= 1;
            dbit = crc & 1;
            crc >>= 1;
            crc_flipped += dbit;
        }

        crc = crc_flipped ^ 0xffffffff;

        return (crc & 0xffff);
    }
```

Device Interface Identifiers (CLUN/DLUN Pairs)

Device and device drivers are accessed by means of an interface/device identifier. These identifiers are known as the Controller-Logical-Unit and the Device-Logical-Unit Numbers (CLUN/DLUN). The following table lists the product's logical unit numbering.

Table B-1. Device Interface/Device Identifiers (CLUN/DLUN)

Device Interface Class	CLUN	DLUN	Interface (Controller)	Specific Device
Serial	00	00	Firmware Console	SMCI (by default)
	01	00	MPC821/860	SCC1
		01		SCC2
		02	MPC860	SCC3
		03		SCC4
		04	MPC821/860	SMC1
		05		SMC2
	08	00	FDC37C67X	COM1
		01		COM2
	09	00	PCMCIA	Motorola Montana 33.6 modem
Parallel	10	00	MPC821/860	PIP (SMC2, SPI, TDM)
	11	00	FDC37C67X	LPT
Ethernet	20	00	MPC821/860	SCC1
	21	00	PCI DEC21040 DEC21140	
FLASH	40	00	Hosted	
		01	PCMCIA	TBD

Table B-1. Device Interface/Device Identifiers (CLUN/DLUN)

Device Interface Class	CLUN	DLUN	Interface (Controller)	Specific Device
Mass Storage	80	00	W83C553F	EIDE #1 (Master)
		01		EIDE #2 (Slave)
	81	00	FDC37C67X	FDC
		01		IDE #1 (Master)
		02		IDE #2 (Slave)
	82	00	PCI SYMBIOS 810/825/875 ADAPTEC 2940/2940W	ID0
		10		ID1
		20		ID2
		30		ID3
		40		ID4
		50		ID5
		60		ID6
		70		ID7 (SCSI Host)
		80		ID8
		90		ID9
		A0		ID10
		B0		ID11
		C0		ID12
		D0		ID13
		E0		ID14
		F0		ID15
	83	00	PCMCIA	IDE

Even though the table lists all possible CLUN/DLUN combinations, not all of these devices are available and are dependent upon the hardware product being used.

Floppy Drive Configuration Parameters

The following table lists the parameters used for configuring floppy disk drives with the IOT command and the .MSIO_CNFG system call.

Notes

1. All numerical parameters are in hexadecimal unless otherwise noted
2. PS2 is the default format for EPPCBug.

Table B-2. Floppy Drive 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
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

Table B-2. Floppy Drive Parameters

Configuration Parameter	Floppy Types and Formats					
	PCXT8	PCXT9	PCXT9_3	PCAT	PS2	SHD
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

Network Communication Status Codes

C

EPPCBug supports the SCC1 channel for use as the network controller on the MBX board. Future releases of EPPCBug will add support for PC104+ based network controllers.

There are two types of network communication status codes:

- Controller independent
- Controller(MPC8xx/PC104+ card) dependent

The controller-independent status codes are independent of the specified network interface. These errors are normally some type of operator error. The controller-dependent status 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. Bits 8 through 15 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 codes are returned by driver, and are placed in the controller dependent field of the command packet status word. All status codes must be nonzero, a code of $00 signifies no error.

Table C-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

Table C-1. Controller-Independent Status Codes

Code	Description
$07	NVRAM write failure
$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 C-2. MPC8xx Controller-Dependent Status Codes

Code	Description
01	256KB buffer not 16 byte aligned
02	Shared memory buffer limit exceeded (software)
03	Invalid data length (MIN <= LNGTH <= MAX)
10	Transmitter unknown error (debug)
11	Transmitter late-collision error
12	Transmitter retransmission-limit error
13	Transmitter underrun error
14	Transmitter carrier-sense-lost error
15	Transmitter timeout error
18	Receiver frame-length-violation error
19	Receiver nonoctet-aligned-frame error
1A	Receiver short-frame error
1B	receiver CRC error
1C	Receiver overrun error
1D	Receiver collision error

History Buffer D

Overview

The history buffer stores all the input and output of the firmware. This I/O is from the perspective of the user interface. The history buffer is split into two buffers which are stored in read/write memory. One buffer is for the user interface input, and the other for the user interface output.

The input buffer is further divided into two buffers, one for command-line input, and the other for user-dialogue input, such as query and response type commands.

Entries within the input buffer shall be terminated with a NULL character.

History Buffer Commands

The input history buffers have the ability to be recalled and edited. The editing process conforms to a subset of UNIX vi editor, as used on an UNIX command-line. The following table describes and lists the supported commands. Note that command modifiers and multiple-key-commands are not permitted (e.g., 10cl, 7l, 3dw, 2b). All commands are restricted to a single key.

Table D-1. History Input Buffer Recall/Edit

Key Sequence	Hexadecimal Code	Description	Edit Mode
Backspace	0x08	Move the cursor one position to the left (back a character).	Command
Control-H	0x08	Move the cursor one position to the left (back a character).	Command
Backspace	0x08	Erases the previous just-inserted character.	Insert

Table D-1. History Input Buffer Recall/Edit

Key Sequence	Hexadecimal Code	Description	Edit Mode
Control-H	0x08	Erases the previous just-inserted character.	Insert
Enter	0x0D	Finishes editing of the line and submits the entire visible line to the firmware monitor regardless of the current cursor position.	Command Insert
Escape	0x1B	Terminate the character insertion/modification and exits the insert mode (enter the command mode).	Insert
Space-Bar	0x20	Move the cursor one position to the right (forward a character).	Command
$	0x24	Move the cursor to the last character in the line.	Command
.	0x2E	Repeat the last change/edit/insert command.	Command
0	0x30	Move the cursor to the first character in the line.	Command
A	0x41	Move the cursor to one character past line end and enter the insert mode.	Command
B	0x42	From the current cursor position, move the cursor back a blank-delimited word, and position the cursor to the first character in this word.	Command
C	0x43	From the current cursor position, delete the remainder of the line and enter the insert mode.	Command

Table D-1. History Input Buffer Recall/Edit

Key Sequence	Hexadecimal Code	Description	Edit Mode
D	0x44	From the current cursor position, delete the remainder of the line.	Command
E	0x45	From the current cursor position, move the cursor forward a blank-delimited word, and position the cursor to the last character in this word.	Command
P	0x50	Put back the last deleted text to the character position prior to the current cursor position.	Command
R	0x52	At the current cursor position, enter the insert mode and start replacing characters. Note, the characters are not inserted, but replace the ones that are beneath them.	Command
U	0x55	Undo all changes made to the current line (restore the line to original contents).	Command
W	0x57	From the current cursor position, move the cursor forward a blank-delimited word, and position the cursor to the first character in this word.	Command
X	0x58	Delete the character prior to the current cursor position and position the cursor 1 character to the left.	Command
a	0x61	Move the cursor one position to the right and enter the insert mode.	Command

Table D-1. History Input Buffer Recall/Edit

Key Sequence	Hexadecimal Code	Description	Edit Mode
b	0x62	From the current cursor position, move the cursor back a word, and position the cursor to the first character in this word.	Command
e	0x65	From the current cursor position, move the cursor forward a word, and position the cursor to the last character in this word.	Command
h	0x68	Move the cursor one position to the left (back a character).	Command
i	0x69	At the current cursor position, enter the insert mode. All text shall be inserted prior to the starting cursor position.	Command
j	0x6A	Copy the next input buffer entry into the edit buffer.	Command
k	0x6B	Copy the previous input buffer entry into the edit buffer.	Command
l	0x6C	Move the cursor one position to the right (forward a character).	Command
p	0x70	Put back the last deleted text to the character position following the current cursor position.	Command

Table D-1. History Input Buffer Recall/Edit

Key Sequence	Hexadecimal Code	Description	Edit Mode
r	0x72	At the current cursor position, replace the character. This command enters the inert mode for one character duration and returns to the command mode.	Command
s	0x73	At the current cursor position, delete the character and enter the insert mode.	Command
u	0x75	Undo the last change to the current line.	Command
w	0x77	From the current cursor position, move the cursor forward a word, and position the cursor to the first character in this word.	Command
x	0x78	Delete the character at the current cursor position.	Command
~	0x7E	At the current cursor position, invert the alpha-character's case (if possible) and move the cursor one position to the right.	Command
Delete	0x7F	Move the cursor one position to the left (back a character).	Command
Delete	0x7F	Erases the previous just-inserted character.	Insert

Disk Status Codes

E

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:

15 8	7 0
Controller-Independent	Controller-Dependent

Because of the nature of the SCSI Host Adapter, additional status may be returned. The format of the additional error status is as follows:

15 8	7 0
SCSI Command	Sense Key

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.

Table E-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

Table E-1. Controller-Independent Status Codes (Continued)

Code	Description
$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 or NCR53C825) status. Table E-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 nonzero, 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 E-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
$08	Data underrun - Not enough data
$09	Clock faster than 75 MHz
$0A	Bad Clock parameter - ASCII clock value Zero or NonASCII
$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

Table E-2. SCSI Firmware Status Codes (Continued)

Code	Description
$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

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