Debugging Package for Motorola 68K CISC CPUs User's Manual

(Part 1 of 2)

68KBUG1/D3

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Preface

The *Debugging Package for Motorola 68K CISC CPUs User's Manual* provides general information for the onboard firmware package for all Motorola 68000 CISC CPU and MPU VMEmodule boards.

This document is bound in two parts. Part 1 (68KBUG1/D3, this volume) contains the Table of Contents and Chapters 1 through 3. Part 2 (68KBUG2/D3) contains Chapters 4 and 5, Appendices A through I, and the Index.

This manual is intended for anyone who wants to design OEM systems, supply additional capability to an existing compatible system, or work in a lab environment for experimental purposes.

The following firmware packages and boards are covered in this manual:

MVME162	162Bug
MVME172	172Bug
MVME166	166Bug
MVME167	167Bug
MVME176	176Bug
MVME177	177Bug

The firmware packages are referred to as *16XBug* in this manual. The boards are referred to as *MVME16X*.

This manual describes the debugger, the debugger command set, the one-line assembler/disassembler, and system calls. These functional elements are common to all firmware packages.

Installation, start-up, diagnostics tests, and environmental parameters are described in the diagnostic manuals for each of the firmware packages.

A basic knowledge of computers and digital logic is assumed.

Related Documentation

The following publications are applicable to Motorola 68K CISC CPU debugging packages and may provide additional helpful information. If not shipped with this product, they may be purchased by contacting your local Motorola sales office. Non-Motorola documents may be obtained from the sources listed following the table.

Document Title	Motorola Publication Number
M68040 Microprocessors User's Manual	M68040UM/AD
M68060 Microprocessors User's Manual	M68060UM/AD
MVME050 System Controller Module User's Manual	MVME050/D
MVME162 Programmer's Reference Guide	MVME162PG/D
MVME162FX Programmer's Reference Guide	MVME162LXPG/D
MVME162LX Programmer's Reference Guide	V162FXA/PG
MVME172 Programmer's Reference Guide	VME172A/PG
Single Board Computers Programmer's Reference Guide	VMESBCA1/PG and VMESBCA2/PG
162BugDiagnostics User's Manual	V162DIAA/UM
167Bug Debugging Package User's Manual	MVME167BUG/D
172Bug Diagnostics User's Manual	V172DIAA/UM
177Bug Diagnostics User's Manual	V177DIAA/UM
MVME320B VMEbus Disk Controller Module User's Manual	MVME320B/D
MVME323 ESDI Disk Controller User's Manual	MVME323/D
MVME327A VMEbus to SCSI Bus Adapter and MVME717 Transition Module User's Manual	MVME327A/D
MVME327A Firmware User's Manual	MVME327AFW/D
MVME328 VMEbus Dual SCSI Host Adapter User's Manual	MVME328/D
MVME335 Serial and Parallel I/O Module User's Manual	MVME335/D
MVME350 Streaming Tape Controller VMEmodule User's Manual	MVME350/D
MVME350 IPC Firmware User's Guide	MVME350FW/D
MVME374 Multi-Protocol Ethernet Interface Module User's Manual	MVME374/D
MVME376 Ethernet Communication Controller User's Manual	MVME376/D

Note Although not shown in the above list, each Motorola Computer Group manual publication number is suffixed with the revision level of the document, such as “2” (the second revision of a manual); a supplement bears the same number as a manual but has a suffix such as "2A1" (the first supplement to the second revision of the manual).

The following publications are available from the sources indicated.

ANSI Small Computer System Interface-2 (SCSI-2), Draft Document X3.131-198X, Revision 10c; Global Engineering Documents, P.O. Box 19539, Irvine, CA 92714.

Versatile Backplane Bus: VMEbus, ANSI/IEEE Std. 1014-1987, The Institute of Electrical and Electronics Engineers, Inc., 345 East 47th Street, New York, NY 10017 (VMEbus Specification). This is also available as *Microprocessor system bus for 1 to 4 byte data, IEC 821 BUS*, Bureau Central de la Commission Electrotechnique Internationale; 3, rue de Varembé, Geneva, Switzerland.

Manual Terminology

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:

$	hexadecimal character
%	binary number
&	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.

Data and address sizes are defined as follows:

- A *byte* is eight bits, numbered 0 through 7, with bit 0 being the least significant.
- A *word* is 16 bits, numbered 0 through 15, with bit 0 being the least significant.
- A *longword* is 32 bits, numbered 0 through 31, with bit 0 being the least significant.

Conventions

The following conventions are used in this document:

bold	is used for user input that you type just as it appears. Bold is also used for commands, options and arguments to commands, and names of programs, directories, and files.
italic	is used for names of variables to which you assign values. Italic is also used for comments in screen displays and examples.
`courier`	is used for system output (e.g., screen displays, reports), examples, and system prompts.
<**RETURN**> or <**CR**>	represents the carriage return or Enter key.
CTRL or **^**	represents the Control key. Execute control characters by pressing the **CTRL** key and the letter simultaneously, e.g., **CTRL-d**.

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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WARNING

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

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Contents

List of Figures

List of Tables

General Information 1

Introduction

16XBug is a powerful evaluation and debugging tool for systems built around the MVME16X CISC-based single-board computer and embedded controller modules. Facilities are available for loading and executing user programs under complete operator control for system evaluation.

16XBug includes commands for display and modification of memory, breakpoint and tracing capabilities, a powerful assembler/disassembler useful for patching programs, and a self-test at power-up feature which verifies the integrity of the system. Various 16XBug routines that handle I/O, data conversion, and string functions are available to user programs through the TRAP #15 system calls.

Note 167Bug is used in most examples of commands and displays given in this manual. However, the commands and displays apply to all 68K CISC debugging packages, unless otherwise noted.

Overview of M68000 Firmware

The firmware packages for the M68000-based (68K) series of boards and systems have a common genealogy. They achieve good portability and comprehensibility by being written entirely in the "C" programming language, except where forced to utilize assembler functions.

16XBug consists of three parts:

1. A command-driven user-interactive software debugger, described in Chapter 2 and hereafter referred to as "the debugger" or "16XBug".
2. A command-driven diagnostic package for the specific CPU board hardware, described in a separate board-specific debugger manual and hereafter referred to as "the diagnostics".
3. A user interface that accepts commands from the system console terminal.

When using 16XBug, you will operate out of either the debugger directory or the diagnostic directory.

- If you are in the debugger directory, the debugger prompt "`16X-Bug>`" is displayed and you have all of the debugger commands at your disposal.
- If you are in the diagnostic directory, the diagnostic prompt "`16X-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 (refer to Chapter 3), or may examine the commands in the particular directory that you are currently in by using the Help (**HE**) command (refer to Chapter 3).

Because 16XBug is command-driven, it performs its various operations in response to user commands entered at the keyboard. The flow of control in 16XBug is shown in the individual board-specific debugger manuals. When you enter a command, 16XBug executes the command and the prompt reappears. However, if you enter a command that causes execution of user target code (e.g., **"GO"**), then control may or may not return to 16XBug, depending on the outcome of the user program.

If you have used one or more of Motorola's other debugging packages, you will find the CISC 16XBug very similar. Some effort has also been made to make the interactive commands more consistent. For example, delimiters between commands and arguments may now be commas or spaces interchangeably.

16XBug Implementation

16XBug is written largely in the "C" programming language, providing 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.

16XBug is contained on EPROM, PROM, or FLASH devices, depending on which board is used. These memory devices provide either 512KB or 1MB of storage. The memory provided is larger than the space is occupied by the firmware because of the 32-bit longword-oriented MC68040 and MC68060 memory bus architecture. The executable code is checksummed at every power-on or reset firmware entry, and the result (which includes a pre-calculated checksum contained in the EPROM, PROM, and FLASH devices), is tested for an expected zero.

Note Do not modify the EPROM, PROM, and FLASH devices unless re-checksum precautions are taken.

General Installation and Start-up

Even though the 16XBug memory devices are installed on the MVME16X module, for 16XBug to operate properly with the MVME16X, follow this general set-up procedure and the details given in the board-specific debugger manual.

Caution

Inserting or removing modules while power is applied could damage module components.

1. Turn all equipment power OFF. Refer to the individual board installation manual and install/remove jumpers on headers and/or set configuration switches as required for your particular application.
2. Refer to the board installation manual and configure the jumper or switch that enables/disables the system controller function of the MVME16X.
3. Be sure that the 16XBug memory devices are installed in proper sockets on the MVME16X module. Refer to the board-specific debugger manual for details.
4. Refer to the set-up procedure for your particular chassis or system for details concerning the installation of the MVME16X.
5. Connect the terminal which is to be used as the 16XBug system console to the default debug EIA-232-D port at the proper location described in the MVME16X installation manual or the 16XBug board-specific debugger manual. 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 MVME16X ports at power-up)

   After power-up, the baud rate of the debug port can be reconfigured by using the Port Format (**PF**) command of the 16XBug debugger.

Note In order for high-baud rate serial communication between 16XBug and the terminal to work, the terminal must do some form of handshaking. If the terminal

being used does not do hardware handshaking via the CTS line, then it must do XON/XOFF handshaking. If you get garbled messages and missing characters, then you should check the terminal to make sure XON/XOFF handshaking is enabled.

6. If you want to connect devices (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 above. After power-up, this (these) port(s) can be reconfigured by programming the MVME16X serial interface chip, or by using the 16XBug **PF** command.

   Note that *some* MVME16X modules contain parallel ports. To use a parallel device, such as a printer, with such an MVME16X module, connect it to the appropriate parallel port per the installation manual for the MVME16X module. However, with *any* MVME16X, you could add a module such as the MVME335 to the system.

7. Power up the system. 16XBug executes some self-checks and displays the debugger prompt "`16X-Bug>`" (if 16XBug is in Board Mode). However, if the **ENV** command has put 16XBug in System Mode, the system performs a selftest and tries to autoboot. Refer to the **ENV** and **MENU** commands in Chapter 3, and to system operation in Appendix A.

   If the confidence test fails, the test is aborted when the first fault is encountered. If possible, an appropriate message is displayed, and control then returns to the menu.

Autoboot

Autoboot is a software routine that is contained in the 16XBug EPROM, PROM, or FLASH devices to provide an independent mechanism for booting an operating system. This Autoboot routine automatically scans for controllers and devices in a specified sequence until a valid bootable device containing a boot media is

found or the list is exhausted. If a valid bootable device is found, a boot from that device is started. The controller scanning sequence goes from the lowest controller Logical Unit Number (LUN) detected to the highest LUN detected. (Refer to Appendix E for default LUNs.)

At power-up, Autoboot is enabled, and providing the drive and controller numbers encountered are valid, the following message is displayed upon the system console:

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

Following this message there is a delay to allow you an opportunity to abort the Autoboot process if you wish. Then the actual I/O is begun: the program pointed to within the volume ID of the media specified is loaded into RAM and control passed to it. If, however, during this time you want to gain control without Autoboot, you can press the <BREAK> key or the software ABORT or RESET switches.

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

Caution

Although streaming tape can be used to autoboot, the same power supply must be connected to the streaming tape drive, controller, and the MVME16X. At power-up, the tape controller will position the streaming tape to load point where the volume ID can correctly be read and used.

If, however, the MVME16X loses power but the controller does not, and the tape happens to be at load point, the sequences of commands required (attach and rewind) cannot be given to the controller and Autoboot will not be successful.

ROMboot

This function is configured/enabled by the Environment (**ENV**) command and executed at power-up (optionally also at reset) or by the **RB** command assuming there is valid code in the EPROM, PROM, or FLASH devices (or optionally elsewhere on the module or VMEbus) to support it. If ROMboot code is installed, a user-written routine is given control (if the routine meets the format requirements). One use of ROMboot might be resetting SYSFAIL* on an unintelligent controller module. The **NORB** command disables the function.

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

1. Power must have just been applied (but the **ENV** command can change this to also respond to any reset).
2. Your routine must be located within the MVME16X ROM memory map (but the **ENV** command can change this to any other portion of the onboard memory, or even offboard VMEbus memory).
3. The ASCII string "BOOT" must be located within the specified memory range.
4. Your routine must pass a checksum test, which ensures that this routine was really intended to receive control at power-up.

To prepare a module for ROMboot, the Checksum (**CS**) command must be used. When the module is ready it can be loaded into RAM, and the checksum generated, installed, and verified with the **CS** command. (Refer to the **CS** command description and examples in Chapter 3.)

The format of the beginning of the routine is as follows:

Module Offset	Length	Contents	Description
$00	4 bytes	BOOT	ASCII string indicating possible routine; checksum must be zero, too.
$04	4 bytes	Entry Address	Longword offset from "BOOT".
$08	4 bytes	Routine Length	Longword, includes length from "BOOT" to and including checksum.
$0C	?	Routine name	ASCII string containing routine name.

When you wish to make use of ROMboot, you do not have to fill a complete memory device. Any partial amount is acceptable, as long as:

1. The identifier string "BOOT" starts on a longword (EPROM and Direct spaces) or 8KB (local RAM and VMEbus spaces) boundary.
2. The ROMboot module size (in bytes) is evenly divisible by 2.
3. The length parameter (offset $8) reflects where the checksum is, and the checksum is correct.

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

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

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

1. Search direct address for "BOOT".
2. Search complete ROM map.
3. Search local RAM, at all 8K byte boundaries starting at the beginning of local RAM.
4. Search the VMEbus map (if so selected by the **ENV** command) on all 8K byte boundaries starting at the end of the onboard RAM. VMEbus address space is searched both below (if the start address of local RAM is not located at 0) and above local RAM up to the beginning of EPROM, PROM, or FLASH memory space.

The example below performs the following:

1. Outputs a <CR><LF> sequence to the default output port.
2. Displays the date and time from the current cursor position.
3. Outputs two more <CR><LF> sequences to the default output port.
4. Returns control to 167Bug.

Sample ROMboot Routine

Module preparation including calculation of checksum:

The target code is first assembled and linked, leaving $00 in the even and odd locations destined to contain the checksum.

Load the routine into RAM (with S-records via the **LO** command, or from magnetic media using **IOP**).

Display the entire module (checksum bytes are at $00010024 and $00010025).

```
167-Bug>md 10000 :c;l
```

```
00010000  424F4F54 00000010 00000026 54455354  BOOT.......&TEST
00010010  4E4F0026 4E4F0052 4E4F0026 4E4F0026  N0.&NO.RNO.&NO.&
00010020  4E4F0063 00000000 00000000 00000000  NO.c............
```

```
167-Bug>md 10010:5;di
00010010 4E4F0026  SYSCALL     .PCRLF
00010014 4E4F0052  SYSCALL     .RTC_DSP
00010018 4E4F0026  SYSCALL     .PCRLF
0001001C 4E4F0026  SYSCALL     .PCRLF
00010020 4E4F0063  SYSCALL     .RETURN
```

Disassemble executable instructions.

```
167-Bug>cs 10000:26/2;w
 Effective address: 00010000

Effective count  : &38
Checksum: C226
```

Perform checksum on locations $10000 through $10025 (refer to the **CS** command).

```
167-Bug>m 10024;w
00010024 0000? c226.
```

Insert checksum into bytes $10024, $10025.

Again display the entire module (now with checksums).

```
167-Bug>md 10000 :c;l

00010000  424F4F54 00000010 00000026 54455354  BOOT.......&TEST
00010010  4E4F0026 4E4F0052 4E4F0026 4E4F0026  NO.&NO.RNO.&NO.&
00010020  4E4F0063 C2260000 00000000 00000000  NO.c.&..........
```

Verify the functionality of your ROMboot module by executing the **RB** command. (The "VERBOSE" option reports the progress of the search.)

```
167-Bug>rb;v

ROMboot in progress... To abort hit <BREAK>
Direct Adr: FFC00000 FFC00000: Searching for ROMboot Module at: FFC00000
ROM       : FFC00000 FFC7FFFC: Searching for ROMboot Module at: FFC7E000
Local RAM : 00000000 00FFFFFC: Searching for ROMboot Module at: 00010000
Executing ROMboot Module "TEST" at 00010000

FRI SEP 15 11:50:21.00 1989

167-Bug>
```

The ROMboot module is now ready for use.

Network Boot

Network Auto Boot is a software routine contained in the 16XBug EPROM, PROM, or FLASH devices that provides a mechanism for booting an operating system using a network (local Ethernet interface) as the boot device. The Network Auto Boot routine automatically scans for controllers and devices in a specified sequence until a valid bootable device containing a boot media is found or the list is exhausted. If a valid bootable device is found, a boot from that device is started. The controller scanning sequence goes from the lowest controller Logical Unit Number (LUN) detected to the highest LUN detected. (Refer to Appendix G for default LUNs.)

At power-up, Network Boot is enabled, and providing the drive and controller numbers encountered are valid, the following message is displayed upon the system console:

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

Following this message there is a delay to allow you to abort the Auto Boot process if you wish. Then the actual I/O is begun: the program pointed to within the volume ID of the media specified is loaded into RAM and control passed to it. If, however, during this time you want to gain control without Network Boot, you can press the <BREAK> key or the software ABORT or RESET switches.

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

Restarting the System

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

The debugger has a special feature upon a reset condition. This feature is activated by depressing the RESET and ABORT switches at the same time. This feature instructs the debugger to use the default setup/operation parameters in ROM versus your setup/operation parameters in NVRAM. This feature can be used in the event your setup/operation parameters are corrupted or do not meet a sanity check. Refer to the **ENV** command for the ROM defaults.

Reset

Pressing and releasing the MVME16X front panel RESET switch initiates a system reset. COLD and WARM reset modes are available. By default, 16XBug is in COLD mode (refer to the **RESET** command description in Chapter 3). During COLD reset, a total system initialization takes place, as if the MVME16X had just been powered up. All static variables (including disk device and controller parameters) are restored to their default states. The breakpoint table and offset registers are cleared. The target registers are invalidated. Input and output character queues are cleared. Onboard devices (timer, serial ports, etc.) are reset, and the *first* two serial ports are reconfigured to their default state.

During WARM reset, the 16XBug variables and tables are preserved, as well as the target state registers and breakpoints.

Reset must be used if the processor ever halts, or if the 16XBug environment is ever lost (vector table is destroyed, stack corrupted, etc.).

Abort

Pressing and releasing the ABORT switch on the MVME16X front panel generates a local board condition which interrupts the processor, if enabled. Whenever abort is invoked while executing a user program (running target code), a “snapshot” of the processor state is captured and stored in the target registers. The contents of the registers are displayed on the screen. Any breakpoints installed

in your code are removed and the breakpoint table remains intact. Control is returned to the debugger. Use the debugger's **RD; e** command to display the contents of the target registers after pressing ABORT when not executing a user program.

Abort is most appropriate when terminating a user program that is being debugged. Abort should be used to regain control if the program gets caught in a loop, etc. The target PC, register contents, etc., reflecting the machine state at the time the ABORT switch was pressed, help to pinpoint the malfunction.

Break

A "Break" is generated by pressing and releasing 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 your code and keeps the breakpoint table intact. Break also takes a snapshot of the machine state if the function was entered using SYSCALL. This machine state is then accessible to you for diagnostic purposes.

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

SYSFAIL* Assertion/Negation

Upon a reset/powerup condition the debugger asserts the VMEbus SYSFAIL* line (refer to the VMEbus specification). SYSFAIL* stays asserted if any of the following has occurred:

- Confidence test failure
- NVRAM checksum error
- NVRAM low battery condition
- Local memory configuration status
- Self test (if system mode) has completed with error
- MPU clock speed calculation failure

After debugger initialization is done and none of the above situations have occurred, the SYSFAIL* line is negated. This indicates to the user or VMEbus masters the state of the debugger. In a multi-computer configuration, other VMEbus masters could view the pertinent control and status registers to determine which CPU is asserting SYSFAIL*. SYSFAIL* assertion/negation is also affected by the **ENV** command. Refer to Chapter 3.

MPU Clock Speed Calculation

The clock speed of the microprocessor is calculated and checked against a user definable parameter housed in NVRAM (refer to the **CNFG** command). If the check fails, a warning message is displayed. The calculated clock speed is also checked against known clock speeds and tolerances.

Memory Requirements

The program portion of 16XBug is several hundred KB of code, consisting of download, debugger, and diagnostic packages and contained entirely in the EPROM, PROM, or FLASH devices. The exact size of this code and mapped starting location of the memory devices on the MVME16X are board-dependent and are given in the board-specific debugger manuals for each particular board series.

16XBug requires a minimum of 64KB of contiguous read/write memory to operate.

The **ENV** command controls where this block of memory is located. Regardless of where the onboard RAM is located, the first 64KB is used for 16XBug stack and static variable space and the rest is reserved as user space. Whenever the MVME16X is reset, the target PC is initialized to the address corresponding to the beginning of the user space, and the target stack pointers are initialized to addresses within the user space, with the target Interrupt Stack Pointer (ISP) set to the top of the user space.

Terminal Input/Output Control

When entering a command at the prompt, the following control codes may be entered for limited command line editing.

Note The presence of the caret (^) before a character indicates that the Control (CTRL) key must be held down while striking the character key.

^X	Cancel line	The cursor is backspaced to the beginning of the line. If the terminal port is configured with the hardcopy or TTY option (refer to **PF** command), then a carriage return and line feed is issued along with another prompt.
^H	Backspace	The cursor is moved back one position. The character at the new cursor position is erased. If the hardcopy option is selected, a "/" character is typed along with the deleted character.
<DEL>	Delete or rubout	Performs the same function as **^H**.
^D	Redisplay	The entire command line as entered so far is redisplayed on the following line.
^A	Repeat	Repeats the previous line. This happens only at the command line. The last line entered is redisplayed but not executed. The cursor is positioned at the end of the line. You may enter the line as is or you can add more characters to it. You can edit the line by backspacing and typing over old characters.

When observing output from any 16XBug command, the XON and XOFF characters which are in effect for the terminal port may be entered to control the output, if the XON/XOFF protocol is enabled

(default). These characters are initialized to **^S** and **^Q** respectively by 16XBug, but you may change them with the **PF** command. In the initialized (default) mode, operation is as follows:

^S	Wait	Console output is halted.
^Q	Resume	Console output is resumed.

Disk I/O Support

16XBug can initiate disk input/output by communicating with intelligent disk controller modules over the VMEbus. Disk support facilities built into 16XBug consist of command-level disk operations, disk I/O system calls (only via one of the TRAP #15 instructions - refer to Chapter 5) for use by user programs, and defined data structures for disk parameters.

Parameters such as the address where the module is mapped and the type and number of devices attached to the controller module are kept in tables by 16XBug. Default values for these parameters are assigned at power-up and cold-start reset, but may be altered as described in the section on default parameters, later in this chapter.

Appendix E contains a list of the controllers presently supported, as well as a list of the default configurations for each controller.

Blocks Versus Sectors

The logical block defines the unit of information for disk devices. A disk is viewed by 16XBug as a storage area divided into logical blocks. By default, the logical block size is set to 256 bytes for every block device in the system. The block size can be changed on a per device basis with the **IOT** command.

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

When a disk transfer is requested, the start and size of the transfer is specified in blocks. 16XBug translates this into an equivalent sector specification, which is then passed on to the controller to initiate the transfer. If the conversion from blocks to sectors yields a fractional sector count, an error is returned and no data is transferred.

Device Probe Function

A device probe with entry into the device descriptor table is done whenever a specified device is accessed; i.e., when system calls .DSKRD, .DSKWR, .DSKCFIG, .DSKFMT, and .DSKCTRL, and debugger commands **BH**, **BO**, **IOC**, **IOP**, **IOT**, **MAR**, and **MAW** are used.

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

Disk I/O via 16XBug Commands

These following 16XBug commands are provided for disk I/O. Detailed instructions for their use are found in Chapter 3. When a command is issued to a particular Controller Logical Unit Number (CLUN) and Device Logical Unit Number (DLUN), these LUNs are remembered by 16XBug so that the next disk command defaults to use the same controller and device.

IOI (Input/Output Inquiry)

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

IOP (Physical I/O to Disk)

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

IOT (I/O Teach)

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

IOC (I/O Control)

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

BO (Bootstrap Operating System)

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

BH (Bootstrap and Halt)

BH reads an operating system or control program from a specified device into memory, and then returns control to 16XBug. It is used as a debugging tool.

Disk I/O via 16XBug System Calls

All operations that actually access the disk are done directly or indirectly by 16XBug TRAP #15 system calls. (The command-level disk operations provide a convenient way of using these system calls without writing and executing a program.)

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

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

Refer to Chapter 5 for information on using these and other system calls.

To perform a disk operation, 16XBug must eventually present a particular disk controller module with a controller command packet which has been especially prepared for that type of controller module. (This is accomplished in the respective controller driver module.) A command packet for one type of controller module usually does not have the same format as a command packet for a different type of module. The system call facilities which do disk I/O accept a generalized (controller-independent) packet format as an argument, and translate it into a controller-specific packet, which is then sent to the specified device.

Refer to the system call descriptions in Chapter 5 for details on the format and construction of these standardized “user” packets.

The packets which a controller module expects to be given vary from controller to controller. The disk driver module for the particular hardware module (board) must take the standardized packet given to a trap function and create a new packet which is specifically tailored for the disk drive controller it is sent to. Refer to documentation on the particular controller module for the format of its packets, and for using the **IOC** command.

Default 16XBug Controller and Device Parameters

16XBug initializes the parameter tables for a default configuration of controllers and devices (refer to Appendix E). If the system needs to be configured differently than this default configuration (for example, to use a 70MB Winchester drive where the default is a 40MB Winchester drive), then these tables must be changed.

There are three ways to change the parameter tables:

- Use **BO** or **BH**. When you invoke one of these commands, the configuration area of the disk is read and the parameters corresponding to that device are rewritten according to the parameter information contained in the configuration area. (Appendix D has more information on the disk configuration area.) This is a temporary change. If a cold-start reset occurs, then the default parameter information is written back into the tables.
- Use **IOT**. You can use this command to reconfigure the parameter table manually for any controller and/or device that is different from the default. This is also a temporary change and is overwritten if a cold-start reset occurs.
- Obtain the source. You can then change the configuration files and rebuild 16XBug so that it has different defaults. Changes made to the defaults are permanent until changed again.

Disk I/O Error Codes

16XBug returns an error code if an attempted disk operation is unsuccessful. Refer to Appendix F for an explanation of disk I/O error codes.

Network I/O Support

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

The booting process is executed in two distinct phases.

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

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

Intel 82596 LAN Coprocessor Ethernet Driver

This driver manages/surrounds the Intel 82596 LAN Coprocessor. Management is in the scope of the reception of packets, the transmission of packets, receive buffer flushing, and interface initialization.

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

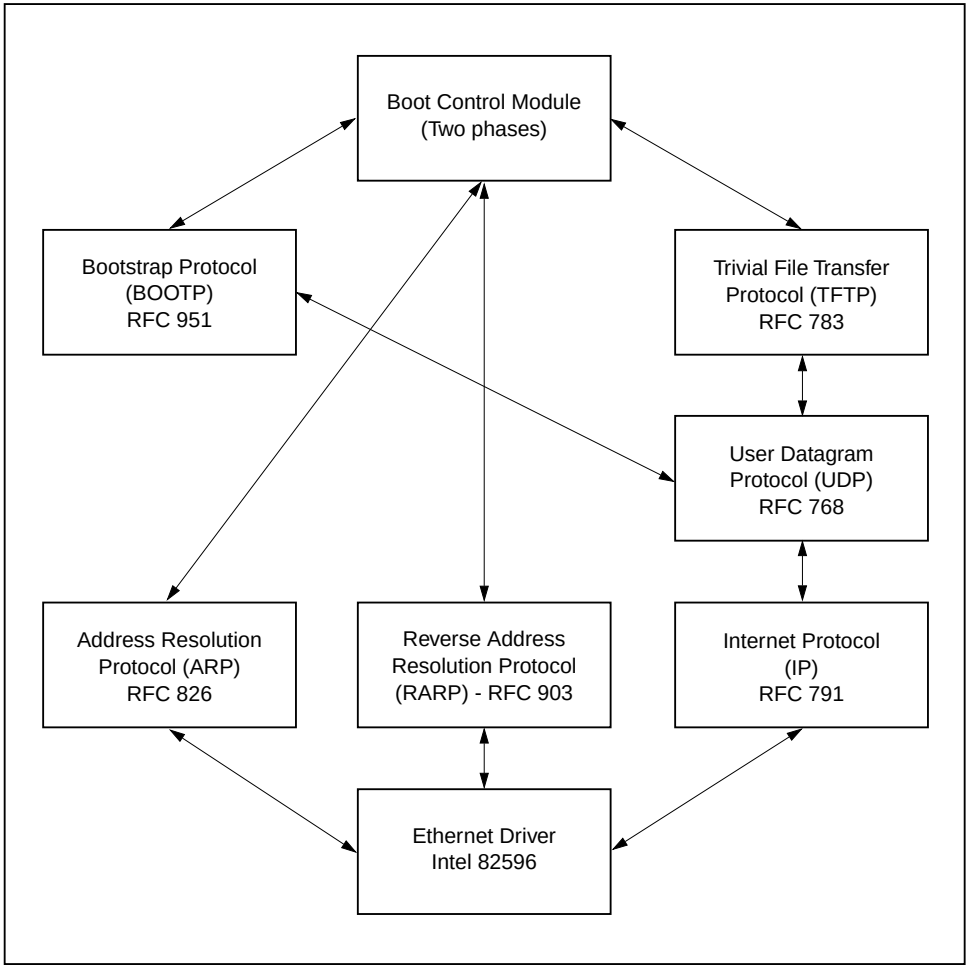


Figure 1-1. Network Boot Support Modules

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 (hence User Datagram Protocol, or 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) basically consists of an identity-less node broadcasting a "whoami" packet onto the Ethernet, and waiting for an answer. The RARP server fills an Ethernet reply packet up with the target's Internet Address and sends it.

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

BOOTP Protocol Module

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

TFTP Protocol Module

The Trivial File Transfer Protocol (TFTP) is a simple protocol to transfer files. It is implemented on top of the Internet User Datagram Protocol (UDP or Datagram) so it may be used to move

files between machines on different networks implementing UDP. The only thing it can do is read and write files from/to a remote server.

Network Boot Control Module

The "control" capability of the Network Boot Control Module ties together all the modules (capabilities) and determines the booting sequence. The booting sequence has two phases: the first, labeled "address determination and bootfile selection", uses RARP/BOOTP and the second, labeled "file transfer", uses TFTP.

Network I/O Error Codes

16XBug returns an error code if an attempted network operation is unsuccessful. Refer to Appendix H for an explanation of network I/O error codes.

Multiprocessor Support

The MVME16X dual-port RAM feature makes the shared RAM available to remote processors as well as to the local processor. You can access it by either the MPCR or GCSR method, which are described in the next subsections. Either method can be enabled or disabled by the **ENV** command as its Remote Start Switch Method.

Multiprocessor Control Register (MPCR) Method

A remote processor can initiate program execution in the local MVME16X dual-port RAM by issuing a remote **GO** command using the Multiprocessor Control Register (MPCR). The MPCR, located at shared RAM location of $800 offset from the base address

the debugger loads it at, contains one of two longwords used to control communication between processors. Organization of the MPCR contents is:

$800	*	N/A	N/A	N/A	(MPCR)

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

- Status returned (from the monitor)
- Status set (by the bus master)

The status codes that may be returned from the monitor are:

Hex	0	(Hex 00)	Wait. Initialization not yet complete.
ASCII	E	(Hex 45)	Code pointed to by the MPAR address is executing.
ASCII	P	(Hex 50)	Program FLASH Memory. The MPAR is set to the address of the FLASH memory program control packet.
ASCII	R	(Hex 52)	Ready. The firmware monitor is watching for a change.

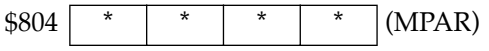
You can only program FLASH memory by the MPCR method. See the .PFLASH system call for a description of the FLASH memory program control packet structure.

The status codes that may be set by the bus master are:

ASCII	G	(Hex 47)	Use Go Direct (**GD**) logic specifying the MPAR address.
ASCII	B	(Hex 42)	Install breakpoints using the Go (**G**) logic.

The Multiprocessor Address Register (MPAR), located in shared RAM location of $804 offset from the base address the debugger loads it at, contains the second of two longwords used to control

communication between processors. The MPAR contents specify the address at which execution for the remote processor is to begin if the MPCR contains a G or B. The MPAR is organized as follows:



At power-up, the debug monitor self-test routines initialize RAM, including the memory locations used for multi-processor support ($800 through $807).

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

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

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

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

If the code being executed in dual-port RAM is to reenter the debug monitor, a TRAP #15 call using function $0063 (SYSCALL .RETURN) returns control to the monitor with a new display prompt. Note that every time the debug monitor returns to the prompt, an R is moved into the MPCR to indicate that control can be transferred once again to a specified RAM location.

GCSR Method

A remote processor can initiate program execution in the local MVME16X dual-port RAM by issuing a remote **GO** command using the VMEchip2 Global Control and Status Registers (GCSR). The remote processor places the MVME16X execution address in general purpose registers 0 and 1 (GPCSR0 and GPCSR1). The remote processor then sets bit 8 (SIG0) of the VMEchip2 LM/SIG register. This causes the MVME16X to install breakpoints and begin execution. The result is identical to the MPCR method (with status code B) described in the previous section.

The GCSR registers are accessed in the VMEbus short I/O space. Each general purpose register is two bytes wide, occurring at an even address. The general purpose register number 0 is at an offset of $8 (local bus) or $4 (VMEbus) from the start of the GCSR registers. The local bus base address for the GCSR is $FFF40100. The VMEbus base address for the GCSR depends on the group select value and the board select value programmed in the Local Control and Status Registers (LCSR) of the MVME16X. The execution address is formed by reading the GCSR general purpose registers in the following manner:

GPCSR0	Used as the upper 16 bits of the address
GPCSR1	Used as the lower 16 bits of the address

The address appears as:

GPCSR0	GPCSR1

Diagnostic Facilities

Included in the 16XBug package is a complete set of hardware diagnostics intended for testing and troubleshooting of the MVME16X. These diagnostics are completely described in each board-specific debugger or diagnostics manual (refer to the *Related Documentation* section located in the Preface).

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 diagnostic prompt ("`16X-Diag>`") should appear. Refer to the board-specific debugger manual for complete descriptions of the diagnostic routines available and instructions on how to invoke them.

Note that some diagnostics depend on restart defaults that are set up only in a particular restart mode. Refer to the documentation on a particular diagnostic for the correct mode.

Using the 16XBug Debugger 2

Entering Debugger Command Lines

16XBug is command-driven and performs its various operations in response to user commands entered at the keyboard. When the debugger prompt (`16X-Bug>`) appears on the terminal screen, then the debugger is ready to accept commands.

As the command line is entered, it is stored in an internal buffer. Execution begins only after the carriage return is entered, so that you can correct entry errors, if necessary, using the control characters described in Chapter 1.

When a command is entered, the debugger executes the command and the prompt reappears. However, if the command entered 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 TRAP #15 function ".RETURN" (described in Chapter 5). For more about this, refer to the descriptions in Chapter 3 for the **GD**, **GT**, and **GO** commands.

The Command Line

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

- The command identifier (e.g., **MD** or **md** for the Memory Display command). Note that either upper- or lowercase is allowed.
- A port number, if the command is set up to work with more than one port.
- At least one intervening space before the first argument.

- Any required arguments, as specified by the command.
- An option field, set off by a semicolon (**;**), to specify conditions other than the default conditions of the command.

The commands are shown using a modified Backus-Naur form syntax. The metasymbols used are:

boldface strings	A boldface string is a literal such as a command or a program name, and is to be typed just as it appears.
italic strings	An italic string is a "syntactic variable" and is to be replaced by one of a class of items it represents.
|	A vertical bar separating two or more items indicates that a choice is to be made; only one of the items separated by this symbol should be selected.
[ ]	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.

Command Arguments

The following command arguments are encountered in the command descriptions which follow. Additional command arguments may be used and are defined in the particular command description in which they occur.

exp	Expression (described in detail in a following section).
address	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 *address address* or by *address* : *count*.
text	An ASCII string of up to 255 characters, delimited at each end by the single quote mark (').

A delimiter is required between arguments. This may be either a space or a comma. To use the default value for an argument before specifying a subsequent argument, you must insert commas as delimiters.

exp - Expression as a Parameter

An expression (*exp*) 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 - Address as a Parameter

Many commands use *address* as a parameter. The syntax accepted by 16XBug is similar to the one accepted by the MC68040/MC68040 one-line assembler. All control addressing modes are allowed. An "*address + offset register*" mode is also provided.

Table 2-1 summarizes the address formats which are acceptable for *address* parameters in debugger command lines.

Table 2-1. Debugger Address Parameter Formats

Format	Example	Description
N	140	Absolute address+contents of automatic offset register.
N+R*n*	130+R5	Absolute address+contents of the specified offset register (not an assembler-accepted syntax).
(A*n*)	(A1)	Address register indirect (also post-increment, predecrement)
(*d*,A*n*) or *d*(A*n*)	(120,A1) 120(A1)	Address register indirect with dis- placement (two formats accepted).
(*d*,A*n*,X*n*) or *d*(A*n*,X*n*)	(&120,A1,D2) &120(A1,D2)	Address register indirect with index and displacement (two formats accepted).
([*bd*,A*n*,X*n*],*od*)	([C,A2,A3],&100)	Memory indirect preindexed.
([*bd*,A*n*],X*n*,*od*)	([12,A3],D2,&10)	Memory indirect postindexed.
For the memory indirect modes, fields can be omitted. For example, three of many permutations are as follows:		
([,A*n*],*od*)	([,A1],4)	
([*bd*])	([FC1E])	
([*bd*,,X*n*])	([8,,D2])	

Notes

N — Absolute address (any valid expression).
A*n* — Address register *n*.
X*n* — Index register *n* (A*n* or D*n*).
d — Displacement (any valid expression).
bd — Base displacement (any valid expression).
od — Outer displacement (any valid expression).
n — Register number (0 to 7).
R*n* — Offset register *n*.

Note In commands with *range* specified as *address address*, and with size option **W** or **L** chosen, data at the second (ending) address is acted on only if the second address is a proper boundary for a word or longword, respectively.

Offset Registers

Eight pseudo-registers (R0 through R7) called offset registers are used to simplify the debugging of relocatable and position-independent modules. The listing files in these types of programs usually start at an address (normally 0) that is not the one at which they are loaded, so it is harder to correlate addresses in the listing with addresses in the loaded program. The offset registers solve this problem by taking into account this difference and forcing the display of addresses in a relative address+offset format. Offset registers have adjustable ranges and may even have overlapping ranges. The range for each offset register is set by two addresses: base and top. Specifying the base and top addresses for an offset register sets its range. In the event that an address falls in two or more offset registers' ranges, the one that yields the least offset is chosen.

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

Example

A portion of the listing file of an assembled, relocatable module is shown below:

```
    1
    2                                   *
    3                                   * MOVE STRING SUBROUTINE
    4                                   *
    5   0 00000000 48E78080            MOVESTR  MOVEM.L  D0/A0,-(A7)
    6   0 00000004 4280                         CLR.L    D0
    7   0 00000006 1018                         MOVE.B   (A0)+,D0
    8   0 00000008 5340                         SUBQ.W   #1,D0
    9   0 0000000A 12D8                 LOOP    MOVE.B   (A0)+,(A1)+
   10   0 0000000C 51C8FFFC             MOVS    DBRA     D0,LOOP
   11   0 00000010 4CDF0101                     MOVEM.L  (A7)+,D0/A0
   12   0 00000014 4E75                         RTS
   13
   14                                           END
****** TOTAL ERRORS     0--
****** TOTAL WARNINGS   0--
```

The above program was loaded at address $0001327C.

The disassembled code is shown next:

```
167Bug>MD 1327C;DI
0001327C 48E78080                   MOVEM.L  D0/A0,-(A7)
00013280 4280                       CLR.L    D0
00013282 1018                       MOVE.B   (A0)+,D0
00013284 5340                       SUBQ.W   #1,D0
00013286 12D8                       MOVE.B   (A0)+,(A1)+
00013288 51C8FFFC                   DBF      D0,$13286
0001328C 4CDF0101                   MOVEM.L  (A7)+,D0/A0
00013290 4E75                       RTS
167Bug>
```

By using one of the offset registers, the disassembled code addresses can be made to match the listing file addresses as follows:

```
167Bug>OF R0
R0 =00000000 00000000? 1327C. <CR>
167Bug>MD 0+R0;DI <CR>
00000+R0 48E78080                MOVEM.L  D0/A0,-(A7)
00004+R0 4280                    CLR.L    D0
00006+R0 1018                    MOVE.B   (A0)+,D0
00008+R0 5340                    SUBQ.W   #1,D0
0000A+R0 12D8                    MOVE.B   (A0)+,(A1)+
0000C+R0 51C8FFFC                DBF      D0,$A+R0
00010+R0 4CDF0101                MOVEM.L  (A7)+,D0/A0
00014+R0 4E75                    RTS
167Bug>
```

For additional information about the offset registers, refer to the **OF** command description.

Port Numbers

Some 16XBug commands give you the option to choose the port to be used to input or output. Refer to the board installation manual for port information.

Entering and Debugging Programs

There are various ways to enter a user program into system memory for execution. One way is to create the program using the 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 4 for complete details of the 16XBug 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 (described in Appendix C) and may have been assembled or compiled on the host system. Alternately, the program may have been previously created using the 16XBug **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

MVME16X port 1. (Hardware configuration details are in the section on *Installation and Startup* in Chapter 1.) The file is downloaded from the host to MVME16X memory by the Load (**LO**) command.

Another way is by reading in the program from disk, using one of the disk commands (**BO**, **BH**, **IOP**). Once the object code has been loaded into memory, you can set breakpoints if desired and run the code or trace through it.

Yet another way is via the network, using one of the network disk commands (**NBO**, **NBH**, **NIOP**).

Calling System Utilities from User Programs

A convenient way of doing character input/output and many other useful operations has been provided so that you do not have to write these routines into the target code. You can access various 16XBug routines via one of the MC68040 and MC68060 TRAP instructions, using vector #15. Refer to Chapter 5 for details on the various TRAP #15 utilities available and how to invoke them from within a user program.

Preserving the Debugger Operating Environment

This section explains how to avoid contaminating the operating environment of the debugger. 16XBug uses certain of the MVME16X onboard resources and also offboard system memory to contain temporary variables, exception vectors, etc. If you disturb resources upon which 16XBug depends, then the debugger may function unreliably or not at all.

If your application enables translation through the Memory Management Units (MMUs), and utilizes resources of the debugger (e.g., system calls), your application must create the necessary

translation tables for the debugger to have access to its various resources. The debugger honors the enabling of the MMUs; it does not disable translation.

16XBug Vector Table and Workspace

As described in the *Memory Requirements* section in Chapter 1, 16XBug needs 64KB of read/write memory to operate. The 16XBug reserves a 1024-byte area for a user program vector table area and then allocates another 1024-byte area and builds an exception vector table for the debugger itself to use. Next, 16XBug reserves space for static variables and initializes these static variables to predefined default values. After the static variables, 16XBug allocates space for the system stack, then initializes the system stack pointer to the top of this area.

With the exception of the first 1024-byte vector table area, you must be extremely careful not to use the above-mentioned memory areas for other purposes. You should refer to the *Memory Requirements* section in Chapter 1 and to Appendix A to determine how to dictate the location of the reserved memory areas. If, for example, your program inadvertently wrote over the static variable area containing the serial communication parameters, these parameters would be lost, resulting in a loss of communication with the system console terminal. If your program corrupts the system stack, then an incorrect value may be loaded into the processor Program Counter (PC), causing a system crash.

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 16XBug

The exception vectors used by the debugger are listed below. These vectors must reside at the specified offsets in the target program's vector table for the associated debugger facilities (breakpoints, trace mode, etc) to operate.

Table 2-2. Exception Vectors Used by 16XBug

Vector Offset	Exception	16XBug Facility
$10	Illegal instruction	Breakpoints (used by **GO**, **GN**, **GT**)
$24	Trace	Trace operations (such as **T**, **TC**, **TT**)
$80-$B8	TRAP #0 - #14	Used internally
$BC	TRAP #15	System calls (refer to Chapter 5)
$NOTE	Level 7 interrupt	ABORT pushbutton
$NOTE	Level 7 interrupt	AC Fail
$DC	FP Unimplemented Data Type	Software emulation and data type conversion of floating point data.

Note This depends on what the Vector Base Register (VBR) is set to in the MCchip.

For the MVME162, the ABORT pushbutton vector offset depends on what the contents of the Vector Base Register (VBR) is set to in the MCchip. The AC Fail vector offset depends on what the contents of the Vector Base Register is set to in the VMEchip2.

When the debugger handles any exception, the target stack pointer is left pointing past the bottom of the exception stack frame created; that is, it reflects the system stack pointer values just before the exception occurred. In this way, the operation of the debugger facility (through an exception) is transparent to users.

Example

Trace one instruction using debugger.

```
167Bug>RD
PC   =00010000 SR   =2700=TR:OFF_S._7_.....  VBR  =00000000
USP  =0000DFFC MSP  =0000EFFC ISP* =0000FFFC SFC  =0=F0
DFC  =0=F0     CACR =0=........
D0   =00000000 D1   =00000000 D2   =00000000 D3   =00000000
D4   =00000000 D5   =00000000 D6   =00000000 D7   =00000000
A0   =00000000 A1   =00000000 A2   =00000000 A3   =00000000
A4   =00000000 A5   =00000000 A6   =00000000 A7   =0000FFFC
00010000 203C0000 0001    MOVE.L     #$1,D0
167Bug>T
PC   =00010006 SR   =2700=TR:OFF_S._7_.....  VBR  =00000000
USP  =0000DFFC MSP  =0000EFFC ISP* =0000FFFC SFC  =0=F0
DFC  =0=F0     CACR =0=........
D0   =00000001 D1   =00000000 D2   =00000000 D3   =00000000
D4   =00000000 D5   =00000000 D6   =00000000 D7   =00000000
A0   =00000000 A1   =00000000 A2   =00000000 A3   =00000000
A4   =00000000 A5   =00000000 A6   =00000000 A7   =0000FFFC
00010006 D280             ADD.L      D0,D1
167Bug>
```

Notice that the value of the target stack pointer register (A7) has not changed even though a trace exception has taken place. Your program may either use the exception vector table provided by 16XBug or it may create a separate exception vector table of its own. The two following sections detail these two methods.

Using the 16XBug Target Vector Table

The 16XBug initializes and maintains a vector table area for target programs. A target program is any program started by the bug, either manually with **GO** or **TR** type commands or automatically with the **BO** command. The start address of this target vector table area is the base address of the debugger memory. This address is loaded into the target-state VBR at power up and cold-start reset and can be observed by using the **RD** command to display the target-state registers immediately after power up.

The 16XBug initializes the target vector table with the debugger vectors listed in Table 2-2 and fills the other vector locations with the address of a generalized exception handler. The target program may take over as many vectors as desired by simply writing its own exception vectors into the table. If the vector locations listed in Table 2-2 are overwritten then the accompanying debugger functions are lost.

The 16XBug maintains a separate vector table for its own use. In general, you do not have to be aware of the existence of the debugger vector table. It is completely transparent and you should never make any modifications to the vectors contained in it.

Creating a New Vector Table

Your program may create a separate vector table in memory to contain its exception vectors. If this is done, the program must change the value of the VBR to point at the new vector table. In order to use the debugger facilities you can copy the proper vectors from the 16XBug vector table into the corresponding vector locations in your program vector table.

The vector for the 16XBug generalized exception handler may be copied from offset $08 (bus error vector) in the target vector table to all locations in your program vector table where a separate exception handler is not used. This provides diagnostic support in the event that your program is stopped by an unexpected exception. The generalized exception handler gives a formatted display of the target registers and identifies the type of the exception.

The following is an example of a routine which builds a separate vector table and then moves the VBR to point at it:

```
*
***  BUILDX - Build exception vector table ****
*
BUILDX  MOVEC.L  VBR,A0            Get copy of VBR.
        LEA      $10000,A1         New vectors at $10000.
        MOVE.L   $80(A0),D0        Get generalized exception vector.
        MOVE.W   $3FC,D1           Load count (all vectors).
LOOP    MOVE.L   D0,(A1,D1)        Store generalized exception vector.
        SUBQ.W   #4,D1
        BNE.B    LOOP              Initialize entire vector table.
        MOVE.L   $10(A0),$10(A1)   Copy breakpoints vector.
        MOVE.L   $24(A0),$24(A1)   Copy trace vector.
        MOVE.L   $BC(A0),$BC(A1)   Copy system call vector.
        LEA.L    COPROCC(PC),A2    Get your exception vector.
        MOVE.L   A2,$2C(A1)        Install as F-Line handler.
        MOVEC.L  A1,VBR            Change VBR to new table.
        RTS
        END
```

It may turn out that your program uses one or more of the exception vectors that are required for debugger operation. Debugger facilities may still be used, however, if your exception handler can determine when to handle the exception itself and when to pass the exception to the debugger.

When an exception occurs which you want to pass on to the debugger; i.e., **ABORT**, your exception handler must read the vector offset from the format word of the exception stack frame. This offset is added to the address of the 16XBug target program vector table (which your program saved), yielding the address of the 16XBug exception vector. The program then jumps to the address stored at this vector location, which is the address of the 16XBug exception handler.

Your program must make sure that there is an exception stack frame in the stack and that it is exactly the same as the processor would have created for the particular exception before jumping to the address of the exception handler.

The following is an example of an exception handler which can pass an exception along to the debugger:

```
*
***  EXCEPT - Exception handler  ****
*
EXCEPT  SUBQ.L   #4,A7              Save space in stack for a PC value.
        LINK     A6,#0              Frame pointer for accessing PC space.
        MOVEM.L  A0-A5/D0-D7,-(SP)  Save registers.
        :
        : decide here if your code handles exception, if so, branch...
        :
        MOVE.L   BUFVBR,A0          Pass exception to debugger; Get saved VBR.
        MOVE.W   14(A6),D0          Get the vector offset from stack frame.
        AND.W    #$0FFF,D0          Mask off the format information.
        MOVE.L   (A0,D0.W),4(A6)    Store address of debugger exc handler.
        MOVEM.L  (SP)+,A0-A5/D0-D7  Restore registers.
        UNLK     A6
        RTS                         Put addr of exc handler into PC and go.
```

Floating Point Support

The floating point unit (FPU) of the MC68040 and MC68060 microprocessors is supported in 16XBug. The **MD**, **MM**, **RM**, and **RS** commands allow display and modification of floating point data in registers and 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	Word
12345678	Longword

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.

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

2. The 68K debuggers do NOT support extended (X) display options such as extended precision format (;X) or packed decimal format (;P). If you attempt to use these formats, the debugger will return an `**** Illegal Option ****` error message.

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:

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

For more information about the floating point unit of the MC68040 and MC68060 microprocessors, refer to the appropriate microprocessor user's manual (see the *Related Documentation* section in the Preface).

Debugger Commands 3

Introduction

This chapter contains descriptions of each debugger command, with one or more examples of each. The 16XBug debugger commands are summarized in Table 3-1.

Table 3-1. Debugger Commands

Command Mnemonic	Title
AB/NOAB	Automatic Bootstrap Operating System/No Autoboot
AS	One Line Assembler
BC	Block of Memory Compare (Note 2)
BF	Block of Memory Fill (Note 2)
BH	Bootstrap Operating System and Halt
BI	Block of Memory Initialize
BM	Block of Memory Move (Note 2)
BO	Bootstrap Operating System
BR/NOBR	Breakpoint Insert/Delete
BS	Block of Memory Search (Note 2)
BV	Block of Memory Verify (Note 2)
CM/NOCM	Concurrent Mode/No Concurrent Mode
CNFG	Configure Board Information Block
CS	Checksum (Note 2)
DC	Data Conversion (Note 2)
DMA	DMA Block of Memory Move
DS	One Line Disassembler

Table 3-1. Debugger Commands (Continued)

Command Mnemonic	Title
DU	Dump S-Records
ECHO	Echo String
ENV	Set Environment to Bug/Operating System
GD	Go Direct (Ignore Breakpoints)
GN	Go to Next Instruction
GO	Go Execute User Program
GT	Go to Temporary Breakpoint
HE	Help (NOTE 2)
IOC	I/O Control for Disk
IOI	I/O Inquiry
IOP	I/O Physical (Direct Disk Access) (Note 2)
IOT	I/O Teach for Configuring Disk Controller (Note 2)
IRQM	Interrupt Request Mask
LO	Load S-Records from Host (Note 2)
MA/NOMA	Macro Define/Display/Delete
MAE	Macro Edit
MAL/NOMAL	Enable/Disable Macro Expansion Listing
MAR	Load Macros
MAW	Save Macros
MD	Memory Display (Note 2)
MENU	System Menu
MM	Memory Modify (Note 2)
MMD	Memory Map Diagnostic
MS	Memory Set (Note 2)
MW	Memory Write

Table 3-1. Debugger Commands (Continued)

Command Mnemonic	Title
NAB	Automatic Network Boot Operating System
NBH	Network Boot Operating System and Halt
NBO	Network Boot Operating System
NIOC	Network I/O Control
NIOP	Network I/O Physical (Note 2)
NIOT	Network I/O Teach (Note 2)
NPING	Network Ping
OF	Offset Registers Display/Modify
PA/NOPA	Printer Attach/Detach
PF/NOPF	Port Format/Detach (Note 2)
PFLASH	Program FLASH Memory (Note 2)
PS	Put RTC into Power Save Mode for Storage
RB/NORB	ROMboot Enable/Disable
RD	Register Display
REMOTE	Connect Remote Modem to CSO
RESET	Cold/Warm Reset
RL	Read Loop
RM	Register Modify
RS	Register Set
SD	Switch Directories
SET	Set Time and Date (Note 2)
SYM/NOSYM	Symbol Table Attach/Detach
SYMS	Symbol Table Display/Search
T	Trace
TA	Terminal Attach

Table 3-1. Debugger Commands (Continued)

Command Mnemonic	Title
TC	Trace on Change of Control Flow
TIME	Display Time and Date (Note 2)
TM	Transparent Mode (Note 2)
TT	Trace to Temporary Breakpoint
VE	Verify S-Records Against Memory (Note 2)
VER	Revision/Version Display
WL	Write Loop

Notes

1. In most examples of commands and displays given in this manual, 167Bug is used. However, the commands, displays, and system calls apply to all 68K CISC debugging packages, unless otherwise noted.
2. These commands are also part of the reduced command set contained in the BootBug PROM for boards that have a BootBug function.

Each of the individual commands is described in the following pages. The command syntax is shown using the symbols explained in Chapter 2.

In the examples shown, the symbol <**CR**> represents the carriage Return or Enter key on your terminal keyboard. Whenever this symbol appears, it means that you should enter a carriage return.

AB/NOAB - Automatic Bootstrap Operating System/No Autoboot

Command Input

AB [**;V**]
NOAB

Description

The **AB** command re-invokes the autoboot sequence.

The option field **V** (verbose) enables the autoboot sequence to display the controller and device numbers while it is scanning as well as the returned packet status.

The **NOAB** command disables the automatic boot function.

Examples

`167-Bug>`**AB**	Enables the autoboot function.
`167-Bug>`**NOAB**	Disables the autoboot function but does not change the parameters.

AS - One Line Assembler

Command Input

AS *address*

Description

This is synonymous with the **MM** *address***;DI** command. (Refer to it for details.) It provides access to the one-line assembler described in Chapter 4. Accordingly, it is not described further here.

BC - Block of Memory Compare

Command Input

BC *range address* [**; B** | **W** | **L**]

Options

B	Byte
W	Word (default)
L	Longword

Description

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

The option field **B, W,** or **L** (upper- or lowercase) defines the size of data compared, and also, 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 **L** would mean to compare 4 longwords (16 bytes).

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.

Example 1: Memory compare, nothing printed.

```
167-Bug>BC 20000 2001F 21000
Effective address: 00020000
Effective address: 0002001F
Effective address: 00021000
167-Bug>
```

Example 2: Memory compare, nothing printed.

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

Example 3: Create a mismatch.

```
167-Bug>MM 2100F;B
0002100F 21? 0.
167-Bug>

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

Mismatches are printed out.

BF - Block of Memory Fill

Command Input

BF *range data* [*increment*] [**; B | W | L**]

Arguments

data and *increment* are both expression parameters.

Options

B	Byte
W	Word (default)
L	Longword

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 that you enter is right-justified in either a byte, word, or longword field (as specified by the option selected).

If the user-entered data 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 an increment was specified).

If the user-entered increment does not fit into the data field size, then leading bits are truncated to make it fit. If truncation occurs, then a message is printed stating the increment which was actually used.

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.

Example 1

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

```
167-Bug>BF 20000,2001F 4E71 <CR>
Effective address: 00020000
Effective address: 0002001F
167-Bug>MD 20000:18;W <CR>
00020000 4E71 4E71 4E71 4E71  4E71 4E71 4E71
4E71   NqNqNqNqNqNqNqNq
00020010 4E71 4E71 4E71 4E71  4E71 4E71 4E71
4E71   NqNqNqNqNqNqNqNq
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.

```
167-Bug>BF 20000:10 4E71 ;B <CR>
Effective address: 00020000
Effective count : &16
Data = $71
167-Bug>MD 20000:18 <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   ................
```

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.

```
167-Bug>BF 20000,20006 12345678 ;L <CR>
Effective address: 00020000
Effective address: 00020003
167-Bug>MD 20000:18 <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 longword pattern would not fit evenly in the given range. Only one longword 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.

```
167-Bug>BF 20000:18 0 1 ;W<CR>
Effective address: 00020000
Effective count : &48
167-Bug>MD 20000:18 <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   ................
```

BH - Bootstrap Operating System and Halt

Command Input

BH [*controllerLUN*] [*deviceLUN*] [*string*]

Arguments

controllerLUN	is the Logical Unit Number (LUN) of the controller to which the following device is attached. Defaults to LUN 0.
deviceLUN	is the LUN of the device from which to boot. Defaults to LUN 0.
string	is a string that is passed to the operating system or control program loaded. Its syntax and use is completely defined by the loaded program.

Description

BH is used to load an operating system or control program from disk into memory. This command works in exactly the same way as the **BO** command, except that control is not given to the loaded program. After the registers are initialized, control is returned to the 16XBug debugger and the prompt reappears on the terminal screen. Because control is retained by 16XBug, all the 16XBug facilities are available for debugging the loaded program if necessary.

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

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

Example 1:

167-Bug>**bh 4,1 <CR>** Boot and halt from Controller LUN 4, Device LUN 0.

```
Booting from: VME350, Controller 4, Drive 0
Loading: Operating System

Volume: V/68

IPL loaded at: $00010000
167-Bug>
```

Example 2

167-Bug>**bh 4,0,test167 <CR>** Boot and halt from Controller LUN 4, Device LUN 0, and pass the string "test167" to the loaded program.

```
Booting from: VME350, Controller 4, Drive 0
Loading: test167

Volume: V/68

IPL loaded at: $00010000
167-Bug>
```

Refer to the **BO** command description for more detailed information about what happens during bootstrap loading.

BI - Block of Memory Initialize

Command Input

BI *range* [**;B** | **W** | **L**]

Options

B Byte
W Word (default)
L Longword

Description

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

The limits of the block of memory to be initialized may be specified using a *range*. The option field specifies the data size in which memory is initialized if *range* is specified using a *count*. The option also specifies the size of data element to which the *count* refers. The length option is valid only when a *count* is entered.

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.

Example 1

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

Example 2

Assume system memory from $0 to $000FFFFF.

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

BM - Block of Memory Move

Command Input

BM *range address* [**; B | W | L**]

Options

B	Byte
W	Word (default)
L	Longword

Description

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

The option field is only allowed when *range* is specified using a *count*. In this case, the **B, W,** or **L** 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 8 bytes) to the new location. If an option field is specified without a *count* in the *range*, an error results.

Example 1

Assume memory from 20000 to 2000F is clear.

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

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

167-Bug>MD 20000:10 <CR>
00020000 5448 4953 2049 5320  4120 5445 5354 2121   THIS IS A TEST!!
00020010 0000 0000 0000 0000  0000 0000 0000 0000   ................
167-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.

```
167-Bug>MD 20000 2000A;DI
00020000   D480       ADD.L    D0,D2
00020002   E2A2       ASR.L    D1,D2
00020004   2602       MOVE.L   D2,D3
00020006   4E4F0021   SYSCALL  .OUTSTR
0002000A   4E71       NOP
167-Bug>
```

Now suppose you would like to insert a NOP between the ADD.L instruction and the ASR.L instruction. You could Block Move the object code down two bytes to make room for the NOP.

```
167-Bug>BM 20002 2000B 20004
Effective address: 00020002
Effective address: 0002000B
Effective address: 00020004
167-Bug>MD 20000 2000C;DI
00020000   D480       ADD.L    D0,D2
00020002   E2A2       ASR.L    D1,D2
00020004   E2A2       ASR.L    D1,D2
00020006   2602       MOVE.L   D2,D3
00020008   4E4F0021   SYSCALL  .OUTSTR
0002000C   4E71       NOP
167-Bug>
```

Now you simply need to enter the NOP at address $20002.

```
167-Bug>MM 20002;DI
00020002   E2A2       ASR.L    D1,D2 ? NOP
00020002   4E71       NOP
00020004   E2A2       ASR.L    D1,D2 ? .
167-Bug>
```

```
167-Bug>MD 20000 2000C;DI
00020000   D480       ADD.L    D0,D2
00020002   4E71       NOP
```

```
00020004   E2A2       ASR.L    D1,D2
00020006   2602       MOVE.L   D2,D3
00020008   4E4F0021   SYSCALL  .OUTSTR
0002000C   4E71       NOP
167-Bug>
```

BO - Bootstrap Operating System

Command Input

BO [*controllerLUN*] [*deviceLUN*] [*string*]

Arguments

controllerLUN	is the Logical Unit Number (LUN) of the controller to which the following device is attached. Defaults to LUN 0.
deviceLUN	is the LUN of the device from which to boot. Defaults to LUN 0.
string	is a string that is passed to the operating system or control program loaded. Its syntax and use is completely defined by the loaded program.

Description

BO is used to load an operating system or control program from disk into memory and give control to it. Where to find the program and where in memory to load it is contained in block 0 of the Device LUN specified. (Refer to Appendix D.) The device configuration information is located in block 1 (Appendix D). The device and controller configurations used when **BO** is initiated can be examined and changed via the I/O Teach (**IOT**) command.

Upon the retrieval of the device configuration information (located in block #1 of the device), the boot process will examine the **ENV** flag parameter "Ignore CFGA Block on a Hard Disk Boot". Depending on the state of the flag, the boot process will either reconfigure the device or not. If the flag is set to "Y", the reconfiguration process will not be done .

In older devices (e.g., ESDI, ST506, Winchester), the reconfiguration of the hard disk drive was necessary. With all the Motorola-tested SCSI hard disk drives, this reconfiguration is not necessary.

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

The device probe mechanism utilizes the SCSI commands "Inquiry" and "Mode Sense". If the specified controller is non-SCSI, the probe simply returns a status of "device present and unknown". The device probe makes an entry into the device descriptor table with the pertinent data.

After an entry has been made, the next time a probe is done it simply returns with "device present" status (pointer to the device descriptor).

The following sequence of events occurs when **BO** is invoked:

1. Block 0 of the Controller LUN and Device LUN specified is read into memory.
2. Locations $F8 (248) through $FF (255) of block 0 are checked to contain the string "**MOTOROLA**". If it is not found, the boot sequence aborts and displays an error message: Bad VID Block.
3. The following information is extracted from block 0:

   $90 (144) - $93 (147): Configuration area starting block.
   $94 (148) : Configuration area length in blocks.

   If any of the above two fields is zero, the present controller configuration is retained; otherwise the first block of the configuration area is read and the controller reconfigured.
4. The program is read from disk into memory. The following locations from block 0 contain the necessary information to initiate this transfer:

   $14 (20) - $17 (23) : Block number of first sector to load from disk.
   $18 (24) - $19 (25) : Number of blocks to load from disk.
   $1E (30) - $21 (33) : Starting memory location to load.
5. The first eight locations of the loaded program must contain a "pseudo reset vector", which is loaded into the target registers:

0-3: Initial value for target system stack pointer.
4-7: Initial value for target PC. If less than load address+8, then it represents a displacement that, when added to the starting load address, yields the initial value for the target PC.

6. Other target registers are initialized with certain arguments. The resultant target state is shown below:

   PC = Entry point of loaded program (loaded from "pseudo reset vector").
   SR = $2700.
   D0 = Device LUN.
   D1 = Controller LUN.
   D4 = 'IPLx', with x = $0C ($49504C0C)
   The ASCII string 'IPL' indicates that this is the Initial Program Load sequence; the code $0C indicates TRAP #15 support with stack parameter passing and TRAP #15 disk support.
   A0 = Address of Disk Controller.
   A1 = Entry point of loaded program.
   A2 = Address of Media Configuration Block. Zero if no configuration loaded.
   A5 = Start of string (after command parameters).
   A6 = End of string + 1 (if no string was entered A5=A6).
   A7 = Initial stack pointer (loaded from "pseudo reset vector").

7. Control is given to the loaded program. Note that the arguments passed to the target program, as for example, the string pointers, may be used or ignored by the target program.

Examples

`167-Bug>`**BO <CR>**	Boot from Controller LUN 0, Device LUN 0.
`167-Bug>`**BO 3 <CR**	Boot from Controller LUN 3, Device LUN 0.
`167-Bug>`**BO , 3 <CR>**	Boot from Controller LUN 0, Device LUN 3.

167-Bug>**BO 8 0,test <CR>**	Boot from Controller LUN 8, Device LUN 0, and pass the string "test" to the booted program.

BR - Breakpoint Insert/Delete

Command Input

BR [*address*[*:count*]]
NOBR [*address*]

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 16XBug. 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 16XBug.

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

Example

```
167-Bug>BR 14000,14200  14700:&12 <CR>Set some  breakpoints.

BREAKPOINTS
00014000        00014200
00014700:C

167-Bug>NOBR 14200 <CR>                 Delete one breakpoint.

BREAKPOINTS
00014000        00014700:C
```

167-Bug>**NOBR <CR>** Delete all breakpoints.

```
BREAKPOINTS
167-Bug>
```

BS - Block of Memory Search

Command Input

BS *range text* [**;B | W | L**]

or

BS *range data* [*mask*] [**;B | W | L** [**,N**][**,V**]]

Arguments

text An ASCII text string that is matched against a range of memory.

data A data pattern that is matched against a range of memory.

mask A string that indicates which bit positions in data to compare to memory (a 1 is compared, a 0 is not). The default is all 1s.

Options

B Byte
W Word
L Longword
N Non-aligned
V Verify

Description

The block search 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, words, or longwords. 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 you either enter a size in the option field or it is assumed (the assumption is word). The size entered in the option field also dictates whether the *count* field in *range* refers to bytes, words, or longwords. 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, words, or longwords (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**" (non-aligned) option has been selected, then the data is searched for on a byte-by-byte basis, rather than by words or longwords, regardless of the size of *data*. This is useful if a word (or longword) pattern is being searched for, but is not expected to lie on a word (or longword) 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 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 non-contiguous 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:...........
```

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

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

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

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

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.

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

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

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

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

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

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

```
167-Bug>bs 30000,3002F 3d34 <CR>
Effective address: 00030000
Effective address: 0003002F
-not found-
```

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

```
167-Bug>bs 30000,3002F 3d34 ;n <CR>
Effective address: 00030000
Effective address: 0003002F
0003000F|3D34
```

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.

```
167-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
```

Mode 3, on a different block of memory, *mask* option, scan for words with low nibble non-0: two locations failed to verify.

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

BV - Block of Memory Verify

Command Input

BV ***range*** *data* [*increment*] [**;B** | **W** | **L**]

Arguments

data and *increment* are both expression parameters

Options

B	Byte
W	Word (default)
L	Longword

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. You may accomplish a decrementing pattern by entering a negative increment. The data you enter is right-justified in either a byte, word, or longword field (as specified by the option selected).

If the user-entered data or increment (if specified) does 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 stored, then data is stored 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.

Example 1

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

```
167-Bug>MD 20000:18 <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

167-Bug>BV 20000 2001F 4E71 <CR>      Default size is word.
Effective address: 00020000
Effective address: 0002001F
167-Bug                               Verify successful, nothing printed.
```

Example 2

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

```
167-Bug>MD 20000:18 <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{

167-Bug>BV 20000:30 0;B <CR>

Effective address: 00020000
Effective count : &48                 Mismatches are printed out.
0002002A|4A 0002002B|FB 0002002C|4A 0002002D|FB 0002002E|4A 0002002F|FB

167-Bug>
```

Example 3

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

```
167-Bug>MD 20000:18 <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   ................

167-Bug>BV 20000:18 0 1 <CR>          Default size is word.
```

```
Effective address: 00020000
Effective count : &48
00020012|FFFF
167-Bug
```

word)

Mismatches are printed out.

CM - Concurrent Mode

Command Input

CM [[*port*] [*id-string*] [*baud*] [*phone-number*]] | [**;A**] | [**;H**]

Arguments

port	Everyting output to the system console is also echoed to this port.
id-string	The device (i.e. modem) with which communications is established before the concurrent mode session is activated. If no identifier string is specified, **CM** will use an identifier string of **"DUMB"** by default. The identifier string must be one that is supported, by using the choices displayed. If the identifier string is not found in the supported list, **CM** displays an error message.
baud	The baud rate specified must be one of those supported by the bug. (Refer to the **PF** command.) The baud rate also must be supported by the device specified (identifier string). If no rate is specified, **CM** uses the default baud rate associated with the device. This is also displayed along with the supported devices. If the baud rate is not supported, **CM** displays an error message.
phone number	This field is a string of any alphanumeric characters. This string is passed directly to the device driver if needed. In the case of modems, this string is added to the dial recognition string. If the phone number field is not specified, a dial-in condition is assumed (wait for call).

When specifying arguments, if there is any previous argument field which is not specified, it must be separated using delimiters.

Options

A Lists all supported devices.

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

Description

This command activates a mode in which everything that appears on the system console terminal is also echoed to the specified port as specified by the command line argument (*port* field). The specified port is also checked for inbound characters as well. These are also echoed to the system console terminal. If no port is specified, **CM** uses port 1 by default.

If the port number specified is not currently assigned, **CM** displays an error message.

The port in which concurrency is to take place must already be configured. The baud rate need not be specified because the port is reconfigured prior to activation. The preconfiguration of the port is done by using the **PF** (Port Format) command.

Examples

To list all supported devices (*id-string* field) by the bug, do the following:

```
167-Bug>cm;a
Concurrent Devices Supported
Device Name (ID-STRING)      Default Baud
DUMB                         9600
UDS2662                      1200
UDS2980                      1200
UDS3382                      1200

167-Bug>cm
Concurrent Mode Active
```

(*port* = 1, default)
(*id-string* = DUMB, default)
(*baud* = 9600, default for "DUMB")
(*phone-number* = null)

```
167-Bug>cm,,uds2662,,16024383020
Concurrent Mode Active
```

(*port* = 1, default because of null argument)
(*id-string* = uds2662 modem)
(*baud* = 1200, default for "uds2662")
(phone-number = 16024383020)

```
167-Bug>cm,,uds2662,,16024383020
Concurrent Mode Active
167-Bug>cm,,uds2662,,16024383020
Concurrent Mode Already Active
167-Bug>
```

(Error, concurrent mode already active)

```
167-Bug>cm 2 uds2980 1200 18007777777
```

(*port* = 2)
(*id-string* = uds2980 modem)
(*baud* = 1200)
(*phone-number* = 18007777777)

```
167-Bug>cm 2,,dumb
Concurrent Mode Setup Failure
167-Bug>
```

(Error in establishing communications with port/device)

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

NOCM - No Concurrent Mode

Command Input

NOCM

Description

This command terminates concurrent mode which was activated by the Concurrent Mode (**CM**) command. Depending on the device and the port specified with the **CM** command, the communication link is appropriately closed.

Examples

```
167-Bug>nocm
Concurrent Mode Terminated
167-Bug>
```

```
167-Bug>nocm
Concurrent Mode Not Active
167-Bug>
```

(Error, concurrent mode was not active)

```
167-Bug>nocm
Concurrent Mode Terminated With Failure
167-Bug>
```

(Error, closing communications link)

CNFG - Configure Board Information Block

Command Input

CNFG [;[I][M]]

Options

I Initialize the unused area of the board information block to 0.

M Modify the board information block.

Description

This command is used to display and configure the board information block. This block is resident within the Non-Volatile RAM (NVRAM). The board information block contains various elements detailing specific operation pa- rameters of the hardware. The **CNFG** command does *not* describe the elements and their use. The board information block contents are checksummed for validation purposes. This checksum is the last element of the block.

Refer to the board-specific MVME16X hardware manual for the actual location of the board information block. The MVME16X hardware manual may also describe the elements within the board information block, and list the size and logical offset of each element. Refer to the board-specific MVME16X debugger manual for the actual data structure for the **CNFG** command.

Example

Display the current contents of the board information block:

```
167-Bug>cnfg
Board (PWA) Serial Number = "000000061050"
Board Identifier          = "MVME167-03      "
Artwork (PWA) Identifier  = "01-W3826B03A    "
MPU Clock Speed           = "2500"
```

```
Ethernet Address          = 08003E20A867
Local SCSI Identifier     = "07"
167-Bug>
```


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

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

Example

```
167-Bug>cnfg
WARNING: Board Information Block Checksum Error
Board (PWA) Serial Number = "???????????"
Board Identifier          = "????????????????"
Artwork (PWA) Identifier  = "????????????????"
MPU Clock Speed           = "????"
Ethernet Address          = 000000000000
Local SCSI Identifier     = "??"
167-Bug>
```

Modification is permitted by using the **M** option of the command.

Example

```
167-Bug>cnfg;m
WARNING: Board Information Block Checksum Error
Board (PWA) Serial Number = "???????????"? 000000061050
Board Identifier          = "????????????????"? MVME167-03
Artwork (PWA) Identifier  = "????????????????"? 01-W3826B03A
MPU Clock Speed           = "????"? 2500
Ethernet Address          = 000000000000? 08003E20A867
Local SCSI Identifier     = "??"? 07
```

```
Update Non-Volatile RAM (Y/N)? y
167-Bug>
```

At the end of the modification session, you are prompted for the update to Non-Volatile RAM (NVRAM). A `Y` response must be made for the update to occur; any other response terminates the update (disregards all changes). The update also recalculates the checksum.

Caution

Be cautious when modifying parameters. Some of these parameters are set up by the factory, and correct board operation relies upon these parameters.

Once modification/update is complete, you can now display the current contents as described earlier.

Example

```
167-Bug>cnfg
Board (PWA) Serial Number = "000000061050"
Board Identifier          = "MVME167-03      "
Artwork (PWA) Identifier  = "01-W3826B03A    "
MPU Clock Speed           = "2500"
Ethernet Address          = 08003E20A867
Local SCSI Identifier     = "07"
167-Bug>
```

CS - Checksum

Command Input

CS *range* [**;B** | **W** | **L**]

Options

B Byte
W Word (default)
L Longword

The option field serves both as a data size identifier and scale factor if a *count* is specified as part of the *range*.

Description

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

1. At powerup, 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.

2. Following a valid power-up test, 16XBug examines the ROM map space for code that needs to be executed. This feature (ROMboot) makes use of the checksum routine to verify that a routine in memory is really there to be executed at powerup. For more information, refer to the *ROMboot* section in Chapter 1, which describes the format of the routine to be executed and the interface provided upon entry.

This command is provided as an aid in preparing routines for the ROMboot feature. Because ROMboot does checksum validation as part of its screening process, you need access to the same routine in the preparation of EPROM/ROM routines.

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:

1. The checksum variable is set to zero.
2. Each data element is added to the checksum; if a carry is generated, a one is added to the checksum variable.
3. This process is repeated for each data element until the ending address is reached.

Examples

```
167-Bug>cs 1000 2000 <CR>
Effective address: 00001000
Effective address: 00001FFF
Checksum: 3E87
```
Default size is word.

```
167-Bug>cs 1000 2000;l <CR>
Effective address: 00001000
Effective address: 00001FFF
Checksum: A79B3E15
```
Size is set to longword.

```
167-Bug>cs FF800000:400;b <CR>
Effective address: FF800000
Effective count: &1024
Checksum: A8
```
Size is set to byte. count is in hexadecimal.

```
167-Bug>cs FF800000:400 <CR>
Effective address: FF800000
Effective count: &2048
Checksum: CE57
```
Default size is word, count is in hexadecimal.

DC - Data Conversion

Command Input

DC *exp* | *addess* [**;**[**B**][**O**][**A**]]

Options

B Displays the output in binary.

O Displays the output in octal.

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

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 (i.e., if the most significant bit of the 32-bit internal representation of the number is set), then both the signed and unsigned interpretations are displayed.

Examples

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

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

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

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

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

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

167-Bug>dc 1+2;b
DATA BIR: 33222222222211111111110000000000
NUMBER>>: 10987654321098765432109876543210
BINARY  : 00000000000000000000000000000011
167-Bug>dc 1+2;bo
DATA BIR: 33222222222211111111110000000000
NUMBER>>: 10987654321098765432109876543210
BINARY  : 00000000000000000000000000000011
OCTAL   : 00000000003

167-Bug>dc 1+2;boa
DATA BIR: 33222222222211111111110000000000
NUMBER>>: 10987654321098765432109876543210
BINARY  : 00000000000000000000000000000011
OCTAL   : 00000000003
ASCII   : ETX
```

The subsequent examples assume A0=00030000 and the following data resides in memory:

```
00030000 1111 1111 2222 2222 3333 3333 4444 4444   ....""""3333DDDD

167-Bug>DC (A0) <CR>
       00030000 = $30000 = &196608
167-Bug>

167-Bug>DC ([,A0]) <CR>
       11111111 = $11111111 = &286331153
167-Bug>

167-Bug>DC (4,A0) <CR>
       00030004 = $30004 = &196612
167-Bug>

167-Bug>DC ([4,A0]) <CR>
       22222222 = $22222222 = &572662306
167-Bug>
```

DMA - DMA Block of Memory Move

Command Input

DMA *range address vdir am block* **[;B | W | L]** .

Description

This command utilizes the hardware capability of Direct Memory Access (DMA). This command is used to move blocks of data from the local bus to the VMEbus, or from the VMEbus to the local bus. Refer to the board-specific MVME16X hardware manual for a detailed description of this hardware feature. You can *not* DMA from the local bus to the local bus, or from the VMEbus to the VMEbus.

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

Arguments

vdir Specifies the direction of the transfer. When *vdir* equals zero, the transfer occurs from the local bus to the VMEbus; when *vdir* equals one, the transfer occurs from the VMEbus to the local bus.

am Specifies the VMEbus address modifier of the transfer. Refer to the VMEbus specification (listed in Chapter 1) for the complete list of address modifiers. The VMEbus transfer address must also support transfers with the selected address modifier. Refer to the applicable hardware manuals for the target boards.

block Specifies the block transfer mode of the transfer. This argument can have the values of zero to three, described as follows:

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

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

Options

B Byte
W Word (default)
L Longword

The option field is only allowed when *range* is specified using a *count*. In this case, the **B**, **W**, or **L** defines the size of the data that the *count* is referring to. For example, a *count* of four with an option of **L** means to move four longwords (or 16 bytes) to the new location. If an option field is specified without a *count* in the *range*, an error results.

Example 1

The following local memory block has the contents of:

```
167-Bug>md 10000:40;l
```

```
00010000  00000001 00020003 00040005 00060007  ................
00010010  00080009 000A000B 000C000D 000E000F  ................
00010020  00100011 00120013 00140015 00160017  ................
00010030  00180019 001A001B 001C001D 001E001F  ................
00010040  00200021 00220023 00240025 00260027  . .!."#.$.%.&.'
00010050  00280029 002A002B 002C002D 002E002F  .(.).*.+.,.-.../
00010060  00300031 00320033 00340035 00360037  .0.1.2.3.4.5.6.7
00010070  00380039 003A003B 003C003D 003E003F  .8.9.:.;.<.=.>.?
00010080  00400041 00420043 00440045 00460047  .@.A.B.C.D.E.F.G
00010090  00480049 004A004B 004C004D 004E004F  .H.I.J.K.L.M.N.O
000100A0  00500051 00520053 00540055 00560057  .P.Q.R.S.T.U.V.W
000100B0  00580059 005A005B 005C005D 005E005F  .X.Y.Z.[..].^._
000100C0  00600061 00620063 00640065 00660067  .`.a.b.c.d.e.f.g
000100D0  00680069 006A006B 006C006D 006E006F  .h.i.j.k.l.m.n.o
000100E0  00700071 00720073 00740075 00760077  .p.q.r.s.t.u.v.w
000100F0  00780079 007A007B 007C007D 007E007F  .x.y.z.{.|.}.~..
167-Bug>
```

167-Bug>**dma 10000:40 3000000 0 d 0;l**

```
Effective address: 00010000
Effective count  : &256
Effective address: 03000000
DMA Completion Status =00000001
167-Bug>
```

In this example, the DMA command was requested to move (DMA) 256 bytes of data from local address $10000 to the VMEbus address $3000000, the address modifier was $D (Extended Supervisory Data Access), and the block transfer was disabled.

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

The destination memory (VMEbus) now looks like this:

167-Bug>**md 3000000:40;l**

```
03000000  00000001 00020003 00040005 00060007  ................
03000010  00080009 000A000B 000C000D 000E000F  ................
03000020  00100011 00120013 00140015 00160017  ................
03000030  00180019 001A001B 001C001D 001E001F  ................
03000040  00200021 00220023 00240025 00260027  . .!."#.$.%.&.'
03000050  00280029 002A002B 002C002D 002E002F  .(.).*.+.,.-.../
03000060  00300031 00320033 00340035 00360037  .0.1.2.3.4.5.6.7
03000070  00380039 003A003B 003C003D 003E003F  .8.9.:.;.<.=.>.?
03000080  00400041 00420043 00440045 00460047  .@.A.B.C.D.E.F.G
03000090  00480049 004A004B 004C004D 004E004F  .H.I.J.K.L.M.N.O
030000A0  00500051 00520053 00540055 00560057  .P.Q.R.S.T.U.V.W
030000B0  00580059 005A005B 005C005D 005E005F  .X.Y.Z.[..].^._
030000C0  00600061 00620063 00640065 00660067  .`.a.b.c.d.e.f.g
030000D0  00680069 006A006B 006C006D 006E006F  .h.i.j.k.l.m.n.o
030000E0  00700071 00720073 00740075 00760077  .p.q.r.s.t.u.v.w
030000F0  00780079 007A007B 007C007D 007E007F  .x.y.z.{.|.}.~..
167-Bug>
```

Example 2

The following VMEbus memory block has the contents of:

```
167-Bug>md 3000000:40;l

03000000  FFFFFFFE FFFDFFFC FFFBFFFA FFF9FFF8  ................
03000010  FFF7FFF6 FFF5FFF4 FFF3FFF2 FFF1FFF0  ................
03000020  FFEFFFEE FFEDFFEC FFEBFFEA FFE9FFE8  ................
03000030  FFE7FFE6 FFE5FFE4 FFE3FFE2 FFE1FFE0  ................
03000040  FFDFFFDE FFDDFFDC FFDBFFDA FFD9FFD8  ................
03000050  FFD7FFD6 FFD5FFD4 FFD3FFD2 FFD1FFD0  ................
03000060  FFCFFFCE FFCDFFCC FFCBFFCA FFC9FFC8  ................
03000070  FFC7FFC6 FFC5FFC4 FFC3FFC2 FFC1FFC0  ................
03000080  FFBFFFBE FFBDFFBC FFBBFFBA FFB9FFB8  ................
03000090  FFB7FFB6 FFB5FFB4 FFB3FFB2 FFB1FFB0  ................
030000A0  FFAFFFAE FFADFFAC FFABFFAA FFA9FFA8  ................
030000B0  FFA7FFA6 FFA5FFA4 FFA3FFA2 FFA1FFA0  ................
030000C0  FF9FFF9E FF9DFF9C FF9BFF9A FF99FF98  ................
030000D0  FF97FF96 FF95FF94 FF93FF92 FF91FF90  ................
030000E0  FF8FFF8E FF8DFF8C FF8BFF8A FF89FF88  ................
030000F0  FF87FF86 FF85FF84 FF83FF82 FF81FF80  ................
167-Bug>
```

```
167-Bug>dma 3000000 3000100 10000 1 e 0
Effective address: 03000000
Effective address: 030000FF
Effective address: 00010000
DMA Completion Status =00000001
167-Bug>
```

In this example, the DMA command was requested to move (DMA) 256 bytes of data from VMEbus address $3000000 to the local address $10000, the address modifier was $E (Extended Supervisory Program Access), and the block transfer was disabled.

The destination memory (local) now looks like this:

```
167-Bug>md 10000:40;l

00010000  FFFFFFFE FFFDFFFC FFFBFFFA FFF9FFF8  ................
00010010  FFF7FFF6 FFF5FFF4 FFF3FFF2 FFF1FFF0  ................
00010020  FFEFFFEE FFEDFFEC FFEBFFEA FFE9FFE8  ................
00010030  FFE7FFE6 FFE5FFE4 FFE3FFE2 FFE1FFE0  ................
00010040  FFDFFFDE FFDDFFDC FFDBFFDA FFD9FFD8  ................
00010050  FFD7FFD6 FFD5FFD4 FFD3FFD2 FFD1FFD0  ................
00010060  FFCFFFCE FFCDFFCC FFCBFFCA FFC9FFC8  ................
00010070  FFC7FFC6 FFC5FFC4 FFC3FFC2 FFC1FFC0  ................
00010080  FFBFFFBE FFBDFFBC FFBBFFBA FFB9FFB8  ................
00010090  FFB7FFB6 FFB5FFB4 FFB3FFB2 FFB1FFB0  ................
000100A0  FFAFFFAE FFADFFAC FFABFFAA FFA9FFA8  ................
000100B0  FFA7FFA6 FFA5FFA4 FFA3FFA2 FFA1FFA0  ................
000100C0  FF9FFF9E FF9DFF9C FF9BFF9A FF99FF98  ................
000100D0  FF97FF96 FF95FF94 FF93FF92 FF91FF90  ................
000100E0  FF8FFF8E FF8DFF8C FF8BFF8A FF89FF88  ................
000100F0  FF87FF86 FF85FF84 FF83FF82 FF81FF80  ................
167-Bug>
```

Example 3

In the following example, an attempt was made to DMA to non-existent VMEbus memory. The command displays the DMA controller status register and the DMA controller counter registers. Refer to the *MVME166/MVME167/MVME187 Single Board Computers Programmer's Reference Guide* for the description of these registers.

```
167-Bug>dma 0:1000 4000000 0 d 0;b
Effective address: 00000000
Effective count  : &4096
Effective address: 04000000
DMA Completion Status =00000002
DMA Byte Counter              =00000FC0
DMA Local Bus Address Counter =00000040
DMA VMEbus Address Counter    =04000004
167-Bug>
```

DS - One Line Disassembler

Command Input

DS *address [:count | address*]

Description

This is synonymous with the **MD** *address***;DI** command (refer to it), and provides access to the disassembler. Accordingly, it is not described further here.

DU - Dump S-Records

Command Input

DU [*port*] *range* [*text*] [*address*] [*offset*] [**;B** | **W** | **L**]

Description

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

Arguments

port — The port to which the S-records are sent.

text — Text that will be incorporated into the header (S0) record of the block of records that will be dumped.

address — Entry address for code contained in the block of records. This address is incorporated into the address field of the block termination record. If no entry address is entered, then the address field of the termination record will consist of zeros. The termination record will be an S7, S8, or S9 record, depending on the address entered. Appendix C has additional information on S-records.

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

Caution

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.

Options

B Byte (default)

W Word

L Longword

The option field is allowed only if a *count* was entered as part of the *range*, and defines the units of the *count* (bytes, words, or longwords).

Example 1

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

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

Example 2

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

```
167-Bug>DU 0 30000:&10 <CR>
Effective address: 00030000
Effective count : &10
S0030000FC
S20E0300002602544553546608 4E4F7B
S9030000FC
167-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.

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

ECHO - Echo String

Command Input

ECHO [*port*] {*hexadecimal_number*} {'***string***'}

Arguments

port	Port where string will be echoed.
hexadecimal_number	The *hexadecimal_number* allows printing of new lines, carriage returns, etcetera. It must have two digits before it is displayed.
string	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.

Description

The **ECHO** command allows you to display strings to any configured port.

Example 1

```
167-Bug>echo ,,'quick brown fox jumps over the lazy dog' 0a
quick brown fox jumps over the lazy dog

167-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

```
167-Bug>echo 1 'this is a test' 07
```

```
167-Bug>
```

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

Example 3

```
167-Bug>echo 2 'this will not work'
Logical unit $02 unassigned
167-Bug>
```

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

Example 4

```
167-Bug>echo ,, 'This is "167BUG"'
This is '167BUG'
167-Bug>
```

This example handles a string with quotes.

ENV - Set Environment to Bug/Operating System

Command Input

ENV [;[**D**]]

Option

D Load ROM defaults into NVRAM.

Description

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

Any time the Bug 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 BBRAM checksum failure, certain default values are assumed. Refer to your board-specific debugger manual for examples of the parameters and their default values.

The bug operational parameters (which are kept in NVRAM) are not initialized automatically on power up/warm reset. It is up to the Bug user to invoke the **ENV** command. Once the **ENV** command is invoked and executed without error, Bug 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/powerup condition.

If the **ENV** command is invoked with no options on the command line, you are prompted to configure all operational parameters. If the **ENV** command is invoked with the option **D**, ROM defaults will be loaded into NVRAM.

Programming the VMEbus to Local Bus Map Decoders

The VMEbus slave map decoders allow a VMEbus master to view a block of the local bus (usually memory) through a VMEbus window. The following procedure can be used with the **ENV** command to configure the VMEbus to Local Bus (slave) map decoders. This is not the only procedure that can be used to program the map decoders.

1. Determine the local base address (for onboard DRAM memory this is the Base Address of Local Memory) and size of the memory block to be viewed through the VMEbus window. The following restrictions must be considered when defining the local bus address of the block and the block size.

   The map decoder logic performs address translation by replacing a portion of the VMEbus address with an address from the address translation register. Therefore, translation is performed in increments of the block size and the block size must be a power of 2 and located on a power of 2 boundary. For example, a 32MB block cannot be addressed on a 4MB boundary. However, any 4MB block of the 32MB memory can be addressed on any 4MB boundary.

   Also note that if the block size is not a power of 2, then rounding up to a power of 2 boundary is necessary. For example, a 12MB block must be accessed at 0, 16MB, 32MB, etc.

2. Set the Slave Address Translation Address Register parameter with the LOCAL base address of the block.

3. Set the Slave Address Translation Select Register parameter with the 2's complement of the block size.

4. Set the Slave Starting Address Register parameter with the starting address of the VMEbus window.

5. Set the Slave Ending Address Register parameter with the ending address of the VMEbus window.

Note The VMEbus window size may be any number of 64KB blocks up to the block size.

6. If the VMEbus window is entirely below the 16MB boundary, enable A24 and/or A32 addressing. If the VMEbus window is entirely above the 16MB boundary, enable only A32 addressing. If the VMEbus window spans the 16MB boundary, enable A32 addressing. If access is required to the portion below the 16MB boundary using A24 addressing, the second map decoder should be programmed to provide A24 access to the portion of the VMEbus window below the 16MB boundary.

   Set the Slave Control parameter to $01EF to enable A32 addressing, $01DF to enable A24 addressing, and to $01FF to enable both A32 and A24 addressing.

Configuring ENV Parameters

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

Go Direct (Ignore Breakpoints)

Command Input

GD [*address*]

Description

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

Once execution of the target code has begun, control may be returned to 16XBug by various conditions:

1. User pressed the ABORT or RESET switches on the MVME16X front panel.
2. An unexpected exception occurred.
3. By execution of the .RETURN TRAP #15 function.

Example

The following program resides at $10000.

```
167-Bug>md 10000:4;di
00010000 2200          MOVE.L  D0,D1
00010002 2401          MOVE.L  D1,D2
00010004 2601          MOVE.L  D1,D3
00010006 60F8          BRA.B   $10000
```

Set breakpoint at $10004:

```
167-Bug>br 10004 <CR>
BREAKPOINTS
00010004
```

Initialize D0 and start target program:

```
167-Bug>rm D0 <CR>
D0   =00000000? 52a9c. <CR>
```

```
167-Bug>gd 10000
Effective address: 00010000
```

To exit target code, press ABORT pushbutton.
Note that the breakpoint was not taken.

```
Exception: Abort
PC   =00010004 SR   =2700=TR:OFF_S._7_.....  VBR  =00000000
USP  =00010000 MSP  =0000EFFC ISP* =0000FFFC SFC  =0=F0
DFC  =0=F0     CACR =0=........
D0   =00052A9C D1   =00052A9C D2   =00052A9C D3   =00052A9C
D4   =00000000 D5   =00000000 D6   =00000000 D7   =00000000
A0   =00000000 A1   =00000000 A2   =00000000 A3   =00000000
A4   =00000000 A5   =00000000 A6   =00000000 A7   =0000FFFC
00010004 2601               MOVE.L      D1,D3
167-Bug>
```

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

Example

The following section of code resides at address $10000.

```
167-Bug>md 10000:5;di <CR>
00010000 4280          CLR.L    D0
00010002 2200          MOVE.L   D0,D1
00010004 61FF0000 FFFA BSR.L    $20000
0001000A 2602          MOVE.L   D2,D3
0001000C 4E4F0063      SYSCALL  .RETURN
```

The following simple routine resides at address $20000.

```
167-Bug>md 20000:2;di <CR>
00020000 2401          MOVE.L  D1,D2
00020002 5242          ADDQ.W  #$1,D2
00020004 4E75          RTS
```

Execute up to the BSR instruction.

```
167-Bug>rm pc <CR>
PC = 00010010? 10000. <CR>
167-Bug>gt 10004 <CR>
Effective address: 00010004
```

```
Effective address: 00010000
At breakpoint
PC   =00010004 SR   =2704=TR:OFF_S._7_..Z..  VBR  =00000000
USP  =00010000 MSP  =0000EFFC ISP* =0000FFFC SFC  =0=F0
DFC  =0=F0     CACR =0=........
D0   =00000000 D1   =00000000 D2   =00000000 D3   =00000000
D4   =00000000 D5   =00000000 D6   =00000000 D7   =00000000
A0   =00000000 A1   =00000000 A2   =00000000 A3   =00000000
A4   =00000000 A5   =00000000 A6   =00000000 A7   =0000FFFC
00010004 61FF0000 FFFA      BSR.L       $20000
167-Bug>
```

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

```
167-Bug>gn <CR>
Effective address: 0001000A
Effective address: 00010004
At breakpoint
PC   =0001000A SR   =2700=TR:OFF_S._7_.....  VBR  =00000000
USP  =00010000 MSP  =0000EFFC ISP* =0000FFFC SFC  =0=F0
DFC  =0=F0     CACR =0=D........
D0   =00000004 D1   =00000000 D2   =00000001 D3   =00000000
D4   =00000000 D5   =00000000 D6   =00000000 D7   =00000000
A0   =00000000 A1   =00000000 A2   =00000000 A3   =00000000
A4   =00000000 A5   =00000000 A6   =00000000 A7   =0000FFFC
0001000A 2602               MOVE.L      D2,D3
167-Bug>
```

GO - Go Execute User Program

Command Input

GO [*address*]

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 PC. Execution starts at the target PC address.

The sequence of events is as follows:

1. First, if an address is specified, it is loaded in the target PC.
2. Then, if a breakpoint is set at the target PC address, the instruction at the target PC is traced (executed in trace mode).
3. Next, all breakpoints are inserted in the target code.
4. Finally, target code execution resumes at the target PC address.

At this point control may be returned to 16XBug by various conditions:

1. A breakpoint with 0 count was found.
2. User pressed the ABORT or RESET switches on the MVME16X front panel.
3. An unexpected exception occurred.
4. By execution of the .RETURN TRAP #15 function.

Example

The following program resides at $10000.

```
167-Bug>md 10000;di
00010000 2200          MOVE.L  D0,D1
00010002 4282          CLR.L   D2
00010004 D401          ADD.B   D1,D2
00010006 E289          LSR.L   #$1,D1
00010008 66FA          BNE.B   $10004
0001000A E20A          LSR.B   #$1,D2
0001000C 55C2          SCS.B   D2
0001000E 60FE          BRA.B   $1000E
167-Bug>
```

Initialize D0, set breakpoints, and start target program:

```
167-Bug>rm D0 <CR>
D0  =00000000? 52a9c. <CR>
167-Bug>br 10000 1000E
BREAKPOINTS
00010000              0001000E
167-Bug>go 10000
Effective address: 00010000
At breakpoint
PC   =0001000E SR   =2711=TR:OFF_S._7_X...C  VBR  =00000000
USP  =00010000 MSP  =0000EFFC ISP* =0000FFFC SFC  =0=F0
DFC  =0=F0     CACR =0=........
D0   =00052A9C D1   =00000000 D2   =000000FF D3   =00000000
D4   =00000000 D5   =00000000 D6   =00000000 D7   =00000000
A0   =00000000 A1   =00000000 A2   =00000000 A3   =00000000
A4   =00000000 A5   =00000000 A6   =00000000 A7   =0000FFFC
0001000E 60FE              BRA.B       $1000E
167-Bug>
```

Note that in this case breakpoints are inserted after tracing the first instruction, therefore the first breakpoint is not taken.

Continue target program execution.

```
167-Bug>g <CR>
Effective address: 0001000E
At breakpoint
PC   =0001000E SR   =2711=TR:OFF_S._7_X...C  VBR  =00000000
USP  =00010000 MSP  =0000EFFC ISP* =0000FFFC SFC  =0=F0
DFC  =0=F0     CACR =0=........
```

```
D0   =00052A9C D1   =00000000 D2   =000000FF D3   =00000000
D4   =00000000 D5   =00000000 D6   =00000000 D7   =00000000
A0   =00000000 A1   =00000000 A2   =00000000 A3   =00000000
A4   =00000000 A5   =00000000 A6   =00000000 A7   =0000FFFC
0001000E 60FE               BRA.B       $1000E
167-Bug>
```

Remove breakpoints and restart the target code.

```
167-Bug>nobr
BREAKPOINTS
167-Bug>go 10000
Effective address: 00010000
```

To exit target code, press the ABORT pushbutton.

```
Exception: Abort
PC   =0001000E SR   =2711=TR:OFF_S._7_X...C  VBR  =00000000
USP  =00010000 MSP  =0000EFFC ISP* =0000FFFC SFC  =0=F0
DFC  =0=F0     CACR =0=........
D0   =00052A9C D1   =00000000 D2   =000000FF D3   =00000000
D4   =00000000 D5   =00000000 D6   =00000000 D7   =00000000
A0   =00000000 A1   =00000000 A2   =00000000 A3   =00000000
A4   =00000000 A5   =00000000 A6   =00000000 A7   =0000FFFC
0001000E 60FE               BRA.B       $1000E
167-Bug>
```

GO - Go to Temporary Breakpoint

Command Input

GT *address*

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 PC 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 16XBug by various conditions:

1. A breakpoint with count 0 was found.
2. User pressed the ABORT or RESET switches on the MVME16X front panel.
3. An unexpected exception occurred.
4. By execution of the .RETURN TRAP #15 function.

Example

The following program resides at $10000.

```
167-Bug>MD 00010000;DI
00010000 2200          MOVE.L  D0,D1
00010002 4282          CLR.L   D2
00010004 D401          ADD.B   D1,D2
00010006 E289          LSR.L   #$1,D1
00010008 66FA          BNE.B   $10004
0001000A E20A          LSR.B   #$1,D2
0001000C 55C2          SCS.B   D2
0001000E 60FE          BRA.B   $1000E
167-Bug>
```

Initialize D0 and set a breakpoint:

```
167-Bug>rm D0 <CR>
D0  =00000000? 52a9c. <CR>
167-Bug>BR 1000E
BREAKPOINTS
0001000E
167-Bug>
```

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

```
167-Bug>rm pc <CR>
PC   =00010010? 10000. <CR>
167-Bug>GT 1000c
Effective address: 0001000C
Effective address: 00010000
At breakpoint
PC   =0001000C SR   =2708=TR:OFF_S._7_.N...  VBR  =00000000
USP  =00010000 MSP  =0000EFFC ISP* =0000FFFC SFC  =0=F0
DFC  =0=F0     CACR =0=........
D0   =00052A9C D1   =00052A9C D2   =00000017 D3   =00000000
D4   =00000000 D5   =00000000 D6   =00000000 D7   =00000000
A0   =00000000 A1   =00000000 A2   =00000000 A3   =00000000
A4   =00000000 A5   =00000000 A6   =00000000 A7   =0000FFFC
0001000C 55C2               SCS.B       D2
167-Bug>
```

Set another temporary breakpoint at $10004 and continue the target program execution:

```
167-Bug>GT 10004
Effective address: 00010004
Effective address: 0001000C
At breakpoint
PC   =0001000E SR   =2711=TR:OFF_S._7_X...C  VBR  =00000000
USP  =00010000 MSP  =0000EFFC ISP* =0000FFFC SFC  =0=F0
DFC  =0=F0     CACR =0=........
D0   =00052A9C D1   =00000029 D2   =000000FF D3   =00000000
D4   =00000000 D5   =00000000 D6   =00000000 D7   =00000000
A0   =00000000 A1   =00000000 A2   =00000000 A3   =00000000
```

```
A4   =00000000 A5   =00000000 A6   =00000000 A7   =0000FFFC
0001000E 60FE               BRA.B       $1000E
167-Bug>
```

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

HE - Help

Command Input

HE [*command*]

Description

HE is the 16XBug help facility. **HE <CR>** displays the command names of all available commands along with their appropriate titles. **HE** *command* displays the command name, syntax and title for only that particular command. The syntax displayed may include the word <DEL> indicating required delimiters.

Examples

```
167-Bug>he
AB       Automatic Bootstrap Operating System
AS       Assembler
BC       Block of Memory Compare
BF       Block of Memory Fill
BH       Bootstrap Operating System and Halt
BI       Block of Memory Initialize
BM       Block of Memory Move
BO       Bootstrap Operating System
BS       Block of Memory Search
BR       Breakpoint Insert
BV       Block of Memory Verify
CM       Concurrent Mode
CNFG     Configure Board Information Block
CS       Checksum a Block of Data
DC       Data Conversion and Expression Evaluation
DMA      DMA Block of Memory Move
DS       Disassembler
DU       Dump S-Records
ECHO     Echo String
ENV      Set Environment to Bug/Operating System
G        "Alias" for "GO" Command
GD       Go Direct (Ignore Breakpoints)
Press "RETURN" to continue
```

```
GN       Go to Next Instruction
GO       Go Execute User Program
GT       Go to Temporary Breakpoint
HE       Help on Command(s)
IOC      I/O Control for Disk
IOI      I/O Inquiry
IOP      I/O Physical to Disk
IOT      I/O "Teach" for Configuring Disk Controller
IRQM     Interrupt Request Mask
LO       Load S-Records from Host
M        "Alias" for "MM" Command
MA       Macro Define/Display
MAE      Macro Edit
MAL      Enable Macro Expansion Listing
MAR      Macro Load
MAW      Macro Save
MD       Memory Display
MDS      Memory Display
MENU     System Menu
MM       Memory Modify
MMD      Memory Map Diagnostic
MS       Memory Set
Press "RETURN" to continue

MW       Memory Write
NAB      Network Automatic Bootstrap Operating System
NBH      Network Bootstrap Operating System and Halt
NBO      Network Bootstrap Operating System
NIOC     Network I/O Control
NIOP     Network I/O Physical
NIOT     I/O "Teach" for Configuring Network Controller
NOAB     No Auto Boot NOBR     Breakpoint Delete
NOCM     No Concurrent Mode
NOMA     Macro Delete
NOMAL    Disable Macro Expansion Listing
NOPA     Printer Detach
NOPF     Port Detach
NORB     No ROM Boot
NOSYM    Detach Symbol Table
NPING    Network Ping
OF       Offset Registers Display/Modify
PA       Printer Attach
PF       Port Format
PFLASH   Program FLASH Memory
PS       Put RTC Into Power Save Mode for Storage
RB       ROM Bootstrap Operating System
Press "RETURN" to continue
```

```
RD        Register Display
REMOTE    Connect the Remote Modem to CSO
RESET     Cold/Warm Reset
RL        Read Loop
RM        Register Modify
RS        Register Set
SD        Switch Directories
SET       Set Time and Date
SFLASH    Swap FLASH Memory
SYM       Attach Symbol Table
SYMS      Display Symbol Table
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
VE        Verify S-Records Against Memory
VER       Revision/Version Display
RWL       Write Loop
167-Bug>
```

```
167-Bug>HE TT
Trace to Temporary Breakpoint:
TT <ADDR>
167-Bug>
```

IOC - I/O Control for Disk

Command Input

IOC

Description

The **IOC** command allows you to send 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 user's manual for the disk controller module. (Refer to the *Related Documentation* section in Chapter 1.)

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

When invoked, this command prompts for the controller and drive required. The default Controller LUN (CLUN) and Device LUN (DLUN) when **IOC** is invoked are those most recently specified for **IOP**, **IOT**, or a previous invocation of **IOC**. An address where the controller command is located is also prompted for.

The same special characters used by the Memory Modify (**MM**) command to access the next successive memory location (**v** or **V**), a previous field (**^**), reopen the same location (**=**), or exit (**.**), can be used with **IOC**.

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

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

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

Example

Send the packet at $10000 to an MVME320 controller module configured as CLUN #0. Specify an operation to the hard disk which is at DLUN #1.

```
167-Bug>IOC <CR>
Controller LUN  =00? <CR>
Device LUN      =00? 1 <CR>
Packet address  =000012BC? 10000 <CR>

00010000 0219 1500 1001 0002   0100 3D00 3000 0000  .........=.0...
00010010 0000 0000 0300 0000   0000 0200 03         .................

Send Packet (Y/N)? Y <CR>
167-Bug>
```

IOI - I/O Inquiry

Command Input

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

Options

C Specifies to clear the Device Descriptor Table.

L Specifies to list the Device Descriptor Table.

Description

IOI is used to inquire for all of the possible attached devices. This command (no options specified) will probe 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 type devices), the command will display the inquiry data along with the CLUN, DLUN, controller type, device address, device type, and the removable media attribute. If a device does not support "inquiry" data the message of "<None>" will be displayed.

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

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

Example 1

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

```
167-Bug>IOI

I/O Inquiry Status:
CLUN   DLUN   CNTRL-TYPE  DADDR  DTYPE   RM   Inquiry-Data
0      30     VME167      3      $00     N    MICROP 1578-15MB1036511 AS0C
2      10     VME327      1      $00     N    MAXTOR LXT-340S 6.57
2      30     VME327      3      $01     Y    ARCHIVE Python 25501-XXX 3.43
2      50     VME327      5      $01     Y    EXABYTE EXB-8200 4.25
2      60     VME327      6      $00     Y    TEAC FC-1 JHF 01 RV E
2      80     VME327      0      $00     Y    <None>
2      81     VME327      1      $00     Y    <None>
167-Bug>
```

Example 2

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

```
167-Bug>IOI;L

I/O Inquiry Device Descriptor Table Status:
CLUN   DLUN   CNTRL-TYPE   CNTRL-Address    RM      Device-Type
0      30     VME167       $FFF47000        N       $00/Direct-Access
2      30     VME327       $FFFFA600        Y       $01/Sequential-Access
167-Bug>
```

Example 3

:Clear the device descriptor table.

```
167-Bug>IOI;C
167-Bug>
```

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

IOP - I/O Physical (Direct Disk Access)

Command Input

IOP

Description

The **IOP** command allows you to read, write, or format any of the supported disk or tape devices. When invoked, this command goes into an interactive mode, prompting you for all the parameters necessary to carry out the command. You may change the displayed value by typing a new value followed by a carriage return <CR>; or may simply enter <CR>, which leaves the field unchanged.

The same special characters used by the Memory Modify (**MM**) command to access the next successive memory location (**v** or **V**), previous field (^), reopen the same location (=), or exit (**.**), can be used with **IOP**.

After **IOP** has prompted you for the last parameter, the selected function is executed. The disk SYSCALL functions (trap routines), as described in Chapter 5, are used by **IOP** to access the specified disk or tape.

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 non-SCSI, the probe simply returns a status of "device present and unknown". The device probe makes an entry into the device descriptor table with the pertinent data. After an entry has been made, the next time a probe is done it simply returns with "device present" status (pointer to the device descriptor).

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 information that you are prompted for is as follows:

```
Controller LUN   =00?
```

The Logical Unit Number (LUN) of the controller to access is specified in this field.

```
Device LUN       =00?
```

The LUN of the device to access is specified in this field.

```
Read/Write/Format =R?
```

In this field, you specify the desired function by entering a one-character mnemonic as follows:

1. **R** for read. This reads blocks of data from the selected device into memory.
2. **W** for write. This writes blocks of data from memory to the selected device.
3. **F** for format. This formats the selected device. For disk devices, either a track or the whole disk can be selected by a subsequent field. This option only applies to SCSI Direct Access devices (type $00). When the format operation is selected, the `Flag Byte` prompt is displayed. A flag byte of $08 specifies to ignore the grown defect list when formatting. A flag byte of $00 specifies not to ignore the grown defect list when formatting.

```
Memory Address   =00003000?
```

This field selects 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?
```

This parameter specifies 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?
```

This field specifies the number of data blocks to be transferred on a read or write operation.

```
Address Modifier   =00?
```

This field contains the VMEbus address modifier to use for Direct Memory Access (DMA) data transfers by the selected controller. If zero is specified, a valid default value is selected by the driver. If a nonzero value is specified, then it is used by the driver for data transfers.

```
Track/Disk     =T (T/D)?
```

This field specifies whether a disk track or the entire disk is formatted when the format operation is selected.

Caution

68KBug does NOT support formatting on SCSI drives; if `T` is selected on SCSI drives, the entire disk would be formatted.

```
File Number    =0000?
```

For streaming tape devices, this field specifies the starting file number to access.

```
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. At the present, only streaming tape devices use this field. 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 — This bit is used for 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.

Refer also to the `Read/Write/Format` prompt.

```
Retension/Erase   =R (R/E)?
```

For streaming tape devices, this field indicates whether a retension of the tape or an erase should be done when a format operation is scheduled.

Retension: This rewinds the tape to BOT, advances the tape without interruptions to EOT, and then rewinds it back to BOT. Tape retension is recommended by cartridge tape suppliers before writing or reading data when a cartridge has been subjected to a change in environment or a physical shock, has been stored for a prolonged period of time or at extreme temperature, or has been previously used in a start/stop mode.

Erase This completely clears the tape of previous data and at the same time retensions the tape.

After all the required parameters are entered, the disk access is initiated. If an error occurs, an error status word is displayed. Refer to Appendix F for an explanation of returned error status codes.

Example

Read 25 blocks starting at block 370 from device 2 of controller 0 into memory beginning at address $50000.

```
167-Bug>IOP <CR>
Controller LUN   =00? <CR>
Device LUN       =00? 2 <CR>
```

```
Read/Write/Format=R? <CR>
Memory  Address  =00003000? 50000 <CR>
Starting Block   =00000000? &370 <CR>
Number of Blocks =0002? &25 <CR>
Address Modifier =00? <CR>
167-Bug>
```

Example 2

Write 14 blocks starting at memory location $7000 to file 6 of device 0, controller 4. Append a filemark at the end of the file.

```
167-Bug>IOP <CR>
Controller LUN   =00? 4 <CR>
Device LUN       =02? 0 <CR>
Read/Write/Format=R? W <CR>
Memory  Address  =00050000? 7000 <CR>
File Number      =00000172? 6 <CR>
Number of Blocks =0019? e <CR>
Flag Byte        =00? %01 <CR>
Address Modifier =00? <CR>
167-Bug>
```

Example 3

Format the specified device with the option **not** to ignore the grown defect list.

```
167-Bug>IOP
Controller LUN =00?
Device LUN =00?
Read/Write/Format =f
Starting Block =00000000?
Track/Disk (T/D) =D?
Flag Byte =00?
Address Modifier =00?
167-Diag>
```

Example 4

Format the specified device **with** the option to ignore the grown defect list.

```
167-Bug>IOP
Controller LUN =00?
Device LUN =00?
Read/Write/Format =f
Starting Block =00000000?
Track/Disk (T/D) =D?
Flag Byte =00? 8
Address Modifier =00?
167-Diag>
```

IOT - I/O Teach for Configuring Disk Controller

Command Input

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

Options

A (All) instructs **IOT** to list all the disk controllers which are currently supported in 16XBug. SCSI-type controllers are identified with an asterisk (*).

F (Force) allows you to 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 (Help) instructs **IOT** to list all the disk controllers which are currently available to the system. SCSI-type controllers are identified by an asterisk (*). For example,

```
167-Bug>IOT;H <CR>
  Disk Controllers Available
Lun   Type    Address    # dev
 0   VME320  $FFFFB000     4
 4   VME350  $FFFF5000     1
167-Bug>
```

T (Teach) probes the system for I/O controllers. This option basically invokes the **IOI** command with no options.

Description

The **IOT** command allows you to "teach" a new disk configuration to 16XBug for use by the TRAP #15 disk functions. **IOT** lets you modify the controller and device descriptor tables used by the TRAP #15 functions for disk access. Note that because the 16XBug commands that access the disk use the TRAP #15 disk functions, changes in the descriptor tables affect all those commands. These commands include **IOP**, **BO**, **BH**, and also any user program that uses the TRAP #15 disk functions.

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.

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 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).

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 on the console for you to examine. You may change the displayed value by entering a new value or may leave it unchanged by typing only a carriage return.

The same special characters used by the Memory Modify (**MM**) command to access the next successive memory location (**v** or **V**), a previous field (^), reopen the same location (=), or exit (**.**), can be used with **IOT**. All numerical values are interpreted as hexadecimal numbers. Decimal values may be entered by preceding the number with an "**&**".

The first two items of information for which you are prompted are the Controller LUN and Device LUN (LUN = Logical Unit Number). These two LUNs specify one particular drive out of many that may be present in the system.

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.

Next you are prompted for Device Type and asked whether you have Removable Media. Device type codes may be any of the following, although currently only the $00, $01, and $05 are supported by the I/O controller drivers:

$00	Direct-access (e.g., magnetic disk)
$01	Sequential-access (e.g., magnetic tape)
$02	Printer
$03	Processor
$04	Write-once (e.g., some optical disks)
$05	CD-ROM
$06	Scanner
$07	Optical Memory (e.g., some optical disks)
$08	Medium Changer (e.g., jukeboxes)
$09	Communications
$0A-$0B	Graphic Arts Pre-Press
$0C-$1E	Reserved
$0F	Unknown or no device type

After these first prompts have been displayed, **IOT** begins displaying the values in the attribute fields, allowing you to enter changes if you wish.

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. You are prompted as follows:

```
Sector Size:
0- 128 1- 256 2- 512
3-1024 4-2048 5-4096 =01 (0-5)?
```

The physical sector size specifies 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 block size defines 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 the following relationship holds true:

(block size)(number of blocks)/(physical sector size)* must be an integer.

```
Sectors/Track          =0020?
```

This field specifies the number of data sectors per track, and is a function of the device being accessed and the sector size specified.

```
Starting Head          =10?
```

This field specifies 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?
```

This field specifies the number of heads on the drive.

```
Number of Cylinders    =0337?
```

This field specifies the number of cylinders on the device. For floppy disks, the number of cylinders depends on the media size and the track density. General values for 5-1/4 inch floppy disks are shown below:

48 TPI - 40 cylinders
96 TPI - 80 cylinders

```
Precomp. Cylinder      =0000?
```

This field specifies 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?
```

This field specifies 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?
```

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.

```
Spiral Offset         =00?
```

The spiral offset controls the number of sectors that the first sector of each track is offset from the index pulse. This is used to reduce latency when crossing track boundaries.

```
ECC Data Burst Length =0000?
```

This field defines the number of bits to correct for an ECC error when supported by the disk controller.

```
Step  Rate  Code      =00?
```

The step rate is an encoded field used to specify 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 (Hexadecimal)	Winchester Hard Disks	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)?
```

Single (FM) or double (MFM) data density should be specified by typing **S** or **D**, respectively.

```
Single/Double TRACK Density =D (S/D)?
```

Used to define the density across a recording surface. This usually relates to the number of tracks per inch as follows:

48 TPI = Single Track Density
96 TPI = Double Track Density

```
Single/Equal_in_all Track zero density =S (S/E)?
```

This flag specifies whether the data density of track 0 is a single density or equal to the density of the remaining tracks. For the "Equal_in_all" case, the Single/Double data density flag indicates the density of track 0.

```
Slow/Fast Data Rate   =S (S/F)?
```

This flag selects the data rate for floppy disk devices as follows:

S = 250 kHz data rate
F = 500 kHz data rate

```
Gap 1                 =07?
```

This field contains the number of words of zeros that are written before the header field in each sector during format.

```
Gap 2                 =08?
```

This field contains the number of words of zeros that are written between the header and data fields during format and write commands.

```
Gap 3                 =00?
```

This field contains the number of words of zeros that are written after the data fields during format commands.

```
Gap  4                =00?
```

This field contains 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?
```

This field contains the number of sectors per track allocated as spare sectors. These sectors are only used as replacements for bad sectors on the disk.

Example 1

Examine the default parameters of a 5-1/4 inch floppy disk.

```
167-Bug>IOT <CR>
Controller LUN       =00? <CR>
Device LUN           =00? 2 <CR>
Device Type [00-1F]  =00? <CR>
Removable Media =Y (Y/N)? <CR>
Sector Size:
0- 128 1- 256 2- 512
3-1024 4-2048 5-4096 =01 (0-5)? <CR>
Block Size:
0- 128 1- 256 2- 512
3-1024 4-2048 5-4096 =01 (0-5)? <CR>
Sectors/track        =0010? <CR>
Number of heads      =02? <CR>
Number of cylinders  =0050? <CR>
Precomp. Cylinder    =0028? <CR>
Step  Rate  Code     =00?  <CR>
Single/Double TRACK density=D (S/D)?  <CR>
Single/Double  DATA  density    =D  (S/D)?  <CR>
Single/Equal_in_all  Track  zero density =S (S/E)? <CR>
Slow/Fast Data Rate  =S (S/F)? <CR>
167-Bug>
```

Example 2

Change from a 40MB Winchester to a 70MB Winchester. Note that reconfiguration such as this is only necessary when you wish to read or write a disk which is different than the default using the **IOP** command. Reconfiguration is normally done automatically by the **BO** or **BH** command when booting from a disk which is different from the default.)

```
167-Bug>IOT <CR>
Controller LUN       =00? <CR>
Device LUN           =00? 1 <CR>
Device Type [00-1F]  =00? <CR>
Removable Media =N (Y/N)? <CR>
Sector Size:
0- 128 1- 256 2- 512
3-1024 4-2048 5-4096 =01 (0-5)? <CR>
Block Size:
0- 128 1- 256 2- 512
3-1024 4-2048 5-4096 =01 (0-5)? <CR>
Sectors/track        =0020? <CR>
Starting head        =00? <CR>
Number of heads      =06? 8 <CR>
Number of cylinders  =033E? 400 <CR>
Precomp. Cylinder    =0000? 401 <CR>
Reduced Write Current Cylinder=0000? <CR>
Interleave factor    =01? 0B <CR>
Spiral Offset        =00? <CR>
ECC Data Burst Length=0000? 000B <CR>
167-Bug>
```

Example 3

Change from a WREN IV drive to a WREN III drive.

```
167-Bug>IOT
Controller LUN       =02?
Device LUN           =00? 20
Device Type [00-1F]  =00? <CR>
Removable Media =N (Y/N)? <CR>
Sector Size:
0- 128 1- 256 2- 512
3-1024 4-2048 5-4096 =02 (0-5)?
Block Size:
0- 128 1- 256 2- 512
3-1024 4-2048 5-4096 =01 (0-5)?
Sectors/Track        =002E? 23
Starting Head        =00?
Number of Heads      =09?
Number of Cylinders  =0584? 3c7
```

```
Precomp. Cylinder    =0000?
Reduced Write Current Cylinder=0000?
Interleave Factor    =00?
Spiral Offset        =00?
ECC Data Burst Length=0000?
Step Rate Code       =00?
Spare Sectors Count  =00?
Reserved Area Units:Tracks/Cylinders =T (T/C)?
Tracks Reserved for Alternates =0000?
167-Bug>
```

IRQM - Interrupt Request Mask

Command Input

IRQM [*mask*]

Description

This command displays the current value stored in the MVME16X Interrupt Enable Register, when the *mask* portion of the command is not present.

To change the current value in the Interrupt Enable Register, include the new 32-bit *mask* value in the command string. This value is installed, and is only in effect until the next system reset occurs, at which time the value reverts back to that value saved with the **ENV** command (Debugger Interrupt Request Mask).

LO - Load S-Records from Host

Command Input

LO [*port*] [*address*] [**;X | C | T**] [*=text*]

Arguments

port The optional port number allows you to specify which port is to be used for the downloading. If the port number is not specified but the *address* option is specified, **LO** must be separated from *address* by two commas. If this number is omitted, port 1 is assumed.

address The optional *address* field 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.

Options

More than one option may be used.

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 TRAP #15 code. This option causes **LO** to set the target register D4 ='**LO** '*x*, with *x* =$01 ($4C4F2001). The ASCII string **'LO '** indicates that this is the **LO** command; the code $01 indicates TRAP #15 support with stack parameter/result passing and TRAP #15 disk support. This code can be used by the downloaded program to select the appropriate calling convention when invoking debugger functions, because some Motorola debuggers use conventions different from 16XBug, and they set a different code in D4.

=text The optional *text* field, entered after the equals sign (=), is sent to the `host` before 16XBug begins to look for S-records at the host port. This allows you to send a command to the host device to initiate the download. This text should NOT be delimited by any kind of quote marks. Text is understood to begin immediately following the equals sign and terminate with the carriage return. If the host is operating full duplex, the string is also echoed back to the host port by the host and appears on your terminal screen.

Description

This command is used when data in the form of a file of Motorola S-records is to be downloaded from a host system to the MVME16X. The **LO** command accepts serial data from the host and loads it into memory.

Note Downloading of S-records can be at any baud rate supported by both the bug and the host system. If the X option is specified, take care that the baud rate of the host system is less than or equal to the baud rate of the console. If there are any problems loading S-records, reduce the baud rate of the host.

In order to accommodate host systems that echo all received characters, the above-mentioned text string is sent to the host one character at a time and characters received from the host are read

one at a time. After the entire command has been sent to the host, **LO** keeps looking for a <**LF**> character from the host, signifying the end of the echoed command. No data records are processed until this <**LF**> is received. If the host system does not echo characters, **LO** still keeps looking for a <**LF**> character before data records are processed. For this reason, it is required in situations where the host system does not echo characters, that the first record transferred by the host system be a header record. The header record is not used but the <**LF**> after the header record serves to break **LO** out of the loop so that data records are processed.

The S-record format (refer to Appendix C) 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 PC. Thus, after a download, you need only enter **G** or **GO** instead of **G** *address* or **GO** *address* to execute the code that was downloaded.

If a non-hex 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 16XBug 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 16XBug 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:

```
#  disptime.s - display time and date
msg: byte 5,'T,'i,'m,'e,'=
          text
disptime:
          pea     msg
          trap    &15
          short   0x23      # syscall .write
          trap    &15
          short   0x52      # syscall .rtc_dsp
          trap    &15
          short   0x26      # syscall .pcrlf
          trap    &15
          short   0x63      # syscall .return
```

Assume that the program has been compiled and linked to start at address $10000. Then this program was converted into an S-record file named `Disptime.mx` as follows:

```
S00B000044697370746965B5
S21C0100004879000100184E4F00234E4F00524E4F00264E4F00634E71D7
S20C0100180554696D653D000009
S9030000FC
```

Load this file into MVME16X module memory for execution at address $40000 as follows:

`167-Bug>`**TM**	Go into transparent mode to establish communication with the host.
`Escape character: $01= ^A`	
`  ''`	
`<CR>`	Press Return or Enter key to get login prompt.
`  ''`	
`(login)`	You must log onto the host and enter the proper directory to access the file Disptime.mx.
`  ''`	
`  ''`	
`= <^A>`	Enter escape character (CTRL A) to return to the 16XBug prompt.

```
167-Bug>LO,,30000 ;X=cat Disptime.mx <CR>
cat Disptime.mx
S00B000044697370746965D65B5
S21C0100004879000100184E4F00234E4F00524E4F00264E4F00634E71D7
S20C0100180554696D653D000009
S9030000FC
167-Bug>
```

The S-records are echoed to the terminal because of the **X** option.

The offset address of 30000 was added to the addresses of the records in Disptime.mx and caused the program to be loaded to memory starting at $40000. The *text* `cat Disptime.mx` is a SYSTEM V/68 command line that caused the file to be copied by SYSTEM V/68 to the port which is connected with the MVME167 host port.

```
167-Bug>DS 40000,40016 <CR>
00040000 4E790001 0018          PEA.L       ($10018).L
00040006 4E4F0023               SYSCALL     .WRITE
0004000A 4E4F0052               SYSCALL     .RTC_DSP
0004000E 4E4F0026               SYSCALL     .PCRLF
00040012 4E4F0063               SYSCALL     .RETURN
167-Bug>MD 40018;b <CR>
00040018 05 54 69 6D 65 3D 00 00                .Time=..
```

MA/NOMA - Macro Define/Display/Delete

Command Input

MA [*name* **; L**]
NOMA [*name*]

Argument

name A currently defined macro; can be any combination of 1-8 alphanumeric characters.

When **MA** is invoked with the name of a currently defined macro, that macro definition is displayed. Entering **MA** without specifying a macro name causes the debugger to list all currently defined macros and their definitions.

Option

L The **;L** option toggles the loop continuous macro mode. In this mode, once a macro is invoked, it is automatically re-invoked for continuous operation.

Description

The **MA** command allows you to define a complex command consisting of any number of debugger primitive commands with optional parameter specifications.

The **NOMA** command is used to delete either a single macro or all macros.

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, including a carriage return. Commands entered are not checked for syntax until the macro is invoked. To exit the macro definition mode, enter only a carriage 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 you are returned to the debugger command prompt. This also happens if the string entered would cause the string pool to overflow. The string pool has a capacity of 511 characters. The only way to add or expand macros when the string pool is full is either to delete or edit macro(s).

Debugger commands contained in macros may reference arguments supplied at invocation time. Arguments are denoted in macro definitions by embedding a back slash "\" followed by a numeral. Up to ten arguments are permitted. 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.

Thus, 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.

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

```
167-Bug> MA ABC                    Define macro ABC.
M=MD 3000
M=GO \0
M= <CR>
167-Bug>
```

```
167-Bug> MA DIS                    Define macro DIS.
M=MD \0:17;DI
M= <CR>
167-Bug>

167-Bug> MA                        List macro definitions.
MACRO ABC
010 MD 3000
020 GO \0
MACRO DIS
010 MD \0:17;DI
167-Bug>

167-Bug> MA ABC                    List definition of macro ABC.
MACRO ABC
010 MD 3000
020 GO \0
167-Bug>

167-Bug> NOMA DIS                  Delete macro DIS.
167-Bug>

167-Bug> MA ASM                    Define macro ASM.
M=MM \0;DI
M= <CR>
167-Bug>

167-Bug> MA                        List all macros.
MACRO ABC
010 MD 3000
020 GO \0
MACRO ASM
010 MM \0;DI
167-Bug>

167-Bug> NOMA                      Delete all macros.
167-Bug>

167-Bug> MA                        List all macros.
NO MACROS DEFINED
167-Bug>
```

MAE - Macro Edit

Command Input

MAE *name line#* [*string*]

Arguments

name	Any combination of 1-8 alphanumeric characters.
line#	Line number in range 1-999.
string	Replacement line to be inserted.

The **MAE** command permits modification of 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 be inserted 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

```
167-Bug> MA ABC                    List definition of macro ABC.
MACRO ABC
010 MD 3000
020 GO \0
167-Bug>

167-Bug> MAE ABC 15 RD             Add a line to macro ABC.
MACRO ABC
010 MD 3000
020 RD                             This line was inserted.
030 GO \0
167-Bug>

167-Bug> MAE ABC 10 MD 10+R0       Replace line 10.
MACRO ABC
010 MD 10+R0                       This line was overwritten.
020 RD
030 GO \0
167-Bug>

167-Bug> MAE ABC 30                Delete line 30.
MACRO ABC
010 MD 10+R0
020 RD
167-Bug>
```

MAL/NOMAL - Enable/Disable Macro Expansion Listing

Command Input

MAL
NOMAL

Description

The **MAL** command allows you to view expanded macro lines as they are executed. This is especially useful when errors result, as the line that caused the error appears on the display.

The **NOMAL** command is used to suppress the listing of the macro lines during execution.

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

MAW/MAR - Save/Load Macros

Command Input

MAW [*controllerLUN*] [[*deviceLUN*] [*block#*]]
MAR [*controllerLUN*] [[*deviceLUN* [*block#*]]

Arguments

controllerLUN	is the logical unit number of the controller to which the following device is attached. Initially defaults to LUN 0.
deviceLUN	is the logical unit number of the device to save/load macros to/from. Initially defaults to LUN 0.
block#	is the number of the block on the above device that is the first block of the macro list. Initially defaults to block 2.

The **MAW** command allows you to save the currently defined macros to disk/tape. A message is printed listing the block number, Controller LUN, and Device LUN before any writes are made. This message is followed by a prompt `(OK to proceed (y/n)?)`. You may then decline to save the macros by typing the letter **N** (uppercase or lowercase). Typing the letter **Y** (uppercase or lowercase) permits **MAW** to proceed to write the macros out to disk/tape. The list is saved as a series of strings and may take up to three blocks. If no macros are currently defined, no writes are done to disk/tape and `NO MACRO DEFINED` is displayed.

The **MAR** command allows you to load macros that have previously been saved by **MAW**. Care should be taken to avoid attempting to load macros from a location on the disk/tape other than that written to by the **MAW** command. While **MAR** checks for invalid macro names and other anomalies, the results of such a mistake are unpredictable.

Note MAR discards all currently defined macros before loading from disk/tape.

Defaults change each time **MAR** and **MAW** are invoked. When either has been used, the default controller, device, and block numbers are set to those used for that command. If macros were loaded from controller 0, device 2, block 8 via command **MAR**, the defaults for a later invocation of **MAW** or **MAR** would be controller 0, device 2, and block 8.

Errors encountered during I/O are reported along with the 16-bit status word returned by the I/O routines.

Examples

Assume that controller 0, device 2 is accessible.

```
167-Bug> MAR 0,2,3
167-Bug>
```
Load macros from block 3.

```
167-Bug> MA
MACRO ABC
010 MD 3000
020 GO \0
167-Bug>
```
List macros.

```
167-Bug> MA ASM
M=MM \0;DI
M= <CR>
167-Bug>
```
Define macro ASM.

```
167-Bug> MA
MACRO ABC
010 MD 3000
020 GO \0
MACRO ASM
010 M=MM \0;DI
167-Bug>
```
List all macros.

```
167-Bug> MAW ,,8
```
Save macros to block 8, previous device.

```
Saving to:  VME320, Controller 0, Drive 2, Block/File Number 8
Number of Logical Blocks = 2
OK to proceed (y/N)? Y <CR>
167-Bug>
```

MD, MDS - Memory Display

Command Input

MD[**S**] *address* [**:***count* | *address*][**; [B | W | L | S | D | DI]]**

Arguments

count 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.

Options

Integer Data Types		Floating Point Data Types	
B	Byte	**S**	Single Precision
W	Word (default)	**D**	Double Precision
L	Longword		

DI Enables the resident MC68040 and MC68060 one-line disassembler, and is identical to the **DS** command. No other option is allowed if **DI** is selected.

Description

This command is used to display the contents of multiple memory locations all at once. **MD** accepts Integer and Floating Point data types. For the integer data types, the data is always displayed in hexadecimal along with its ASCII representation.

To re-execute the command, enter only <CR> at the prompt immediately after the command has completed. The command displays an equal number of data items or lines beginning at the next address.

Example 1

```
167-Bug>md 12000 <CR>
```

```
00012000 2800  1942  2900  1942   2800  1842  2900  2846  (..B)..B(..B).(F
167-Bug> <CR>
00012010 FC20  0050  ED07  9F61   FF00  000A  E860  F060  | .Pm..a....h'p'
```


Example 2

Assume the following processor state: A2=00013500 and D5=53F00127.

```
167-Bug>md (A2,D5):&19;b <CR>

00013627 4F 82 00 C5 9B 10 33 7A  DF 01 6C 3D 4B 50 0F 0F  O..E..3z_.l=KP..
00013637 31 AB 80                                         1+.
167-Bug>
```

Example 3

Disassemble eight instructions, starting at $10000.

```
167-Bug>MD 10000;di
00010000 F2104C00                FMOVE.P (A0),FP0
00010004 5440                    ADDQ.W  #$2,D0
00010006 4850                    PEA.L   (A0)
00010008 00D00000                CMP2.B  (A0),D0
0001000C 4299                    CLR.L   (A1)+
0001000E 28330160 00D2           MOVE.L  ($D2.W,A3,ZD0.W*1),D4
00010014 BA84                    CMP.L   D4,D5
00010016 6710                    BEQ.B   $10028
167-Bug>
```

Example 4

To display eight double precision floating point numbers at location $20000, enter the following command line:

```
167-Bug>MD 20000;d
00020000 0_3F6_44C1D0F047FC2= 2.4777000000000002_E-0003
00020008 0_423_DAEFF04800000= 1.2749000000000000_E+0011
00020010 0_000_0000000000000= 0.0000000000000000_E+0000
00020018 0_403_0000000000000= 1.6000000000000000_E+0001
00020020 0_3FF_0000000000000= 1.0000000000000000_E+0000
00020028 0_000_00000FFFFFFFF= 2.1219957904712067_E+0314
00020030 0_44D_FDE9F10A8D361= 6.0200000000000000_E+0023
00020038 0_3C0_79CA10C924223= 1.5999999999999999_E+0019
167-Bug>
```

Example 5

```
167-Bug>md 10000;s
00010000 0_A4_194155= 1.6455652147200000_E+0011
00010004 0_27_3BFC7C= 4.7454405384196168_E-0027
00010008 1_E8_005800=-4.0673757930760459_E+0031
0001000C 1_80_00D2A5=-2.0128567218780518_E+0000
00010010 0_56_3BFF25= 6.6789829960070541_E-0013
00010014 1_70_031E80=-3.1261239200830460_E-0005
00010018 0_8F_497EC3= 1.0316552343750000_E+0005
0001001C 0_80_22A8D5= 2.5415546894073486_E+0000
167-Bug>
```

MENU - System Menu

Command Input

MENU

Description

When 16XBug is in "system" mode, you can toggle back and forth between the menu and Bug by typing a **3** response to the Enter Menu #: prompt when the menu is displayed. Entering the Bug and then typing **MENU** in response to the 16X-Bug (or 16X-Diag) prompt returns you to the system menu.

For details on use of the menu features, refer to Appendix A, *System Mode Operation*.

Example

The following is an example of command line entries and their definitions.

```
167-Bug>MENU

1      Continue System Start Up
2      Select Alternate Boot Device
3      Go to System Debugger
4      Initiate Service Call
5      Display System Test Errors
6      Dump Memory to Tape
Enter Menu #:
```

MM - Memory Modify

Command Input

MM *address*[**;**[[**B** | **W** | **L** | **S** | **D**][**A**][**N**]] | [**DI**]]

Options

Integer Data Types		Floating Point Data Types	
B	Byte	**S**	Single Precision
W	Word (default)	**D**	Double Precision
L	Longword		

Other Options

N Disable the read portion of the command.

A Force alternate locations only.

DI Enable the one-line assembler/disassembler. All other options are invalid if this option is selected.

Description

This command is used to examine and change memory locations. **MM** accepts Integer and Floating Point data types:

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 <CR>, or simply enter <CR>, 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** re-opens 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 16XBug.

When the one-line assembler/disassembler is enabled, the contents of the specified memory location are disassembled and displayed and you are prompted with a question mark ("?") for input. At this point, you have three options:

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

If a new source line is entered (choice 2 above), 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 4.

Example 1

167-Bug>**mm 10000 <CR>**	Access location 10000.
00010000 1234? **<CR>**	
00010002 5678? **4321 <CR>**	Modify memory.

```
00010004 9ABC? 8765^ <CR>     Modify memory and backup.
00010002 4321? <CR>
00010000 1234? abcd. <CR>     Modify memory and exit.
```

Example 2

```
167-Bug>mm 10004;la <CR>      Longword access to location 10004.
00010004 CD432187? <CR>       Alternate location accesses).
0001000C 00068030? 68030+10= <CR> Modify and reopen location.
0001000C 00068040? <CR>
0001000C 00068040? . <CR>     Exit MM.
```

Example 3

Assemble a new source line.

```
167-Bug>MM 1000C;DI
0001000C 46FC2400             MOVE.W  $2400,SR ? divs.w -(A2),D2
0001000C 85E2                 DIVS.W  -(A2),D2
0001000E 2400                 MOVE.L  D0,D2 ? <CR>
167-Bug>
```

Example 4

New source line with error.

```
00010008 4E7AD801             MOVEC.L VBR,A5 ? bchg #$12,9(A5,D6))
00010008                      BCHG    #$12,9(A5,D6))
-----------------------------------------------^
*** Unknown Field ***
00010008 4E7AD801             MOVEC.L VBR, A5 ? <CR>
167-Bug>
```

Example 5

Step to next location and exit **MM**.

```
167-Bug>M 1000C;di
FFE1000C 000000FF             OR.B    #255,D0 ? <CR>
FFE10010 20C9                 MOVE.L  A1,(A0)+ ? .
167-Bug>
```

Example 6

Double precision floating point numbers.

```
167-Bug> mm 10000;d
00010000 3.140000000000001_E+87? 1.2
00010008 -5.8508426708663386_E+250? 2
00010010 1.9999900000000014_E-100? 4.357e+10
00010018 6.7777778899999985_E+37? 2.765e-99
00010020 9.8762300000000015_E+10? -4.876e-34
00010028 1.00008764231_E-2? -1.023e101
00010030 4.5789000000000044_E-99? 1_7ff_ffffffffffff.
167-Bug>md 10000:7;d
00010000 0_3FF_3333333333333= 1.2000000000000000_E+0000
00010008 0_400_0000000000000= 2.0000000000000000_E+0000
00010010 0_422_449F2E0FFFFFF= 4.3569999999999992_E+0010
00010018 0_2B7_830E4EB15EA1B= 2.7650000000000032_E-0099
00010020 1_390_4410D74F66DA5=-4.8760000000000030_E-0034
00010028 1_54E_762B1924BFDD5=-1.0230000000000001_E+0101
00010030 1_7FF_FFFFFFFFFFFF=-0.FFFFFFFFFFFF000_E-0FFF
167-Bug>
```

MMD - Memory Map Diagnostic

Command Input

MMD *range increment* [**;B** | **W** | **L**]

Options

B	Byte
W	Word (default)
L	Longword

Description

This command is used to find and display ranges of addresses that are readable. This is done by reading memory locations within the *range*. If a successful transaction to a location is completed, that address is included in a found range, else in a not-found range. The transaction (a read) is done with the data type specified on the command line.

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, i.e., 1x for byte, 2x for word, and 4x for longword.

Example 1

Looks for any memory between $0 and $10000000 with an increment of $10000 by bytes. It reports that only $1000000 (16MB) of memory was found.

```
167-Bug>mmd 0 10000000 10000;b
Effective address: 00000000
Effective address: 10000000
$00000000-$00FF0000 PRESENT
$01000000-$0FFF0000 NOT-PRESENT
```

Example 2

Looks for any memory between $FFFF0000 and $FFFFFFFF with an increment of $1 by half-words.

```
167-Bug>mmd ffff0000 ffffffff 1
Effective address: FFFF0000
Effective address: FFFFFFFF
$FFFF0000-$FFFF07FE NOT-PRESENT
$FFFF0800-$FFFF09FE PRESENT
$FFFF0A00-$FFFF0FFE NOT-PRESENT
$FFFF1000-$FFFF117E PRESENT
$FFFF1180-$FFFF2FFE NOT-PRESENT
$FFFF3000-$FFFF30FE PRESENT
$FFFF3100-$FFFF35FE NOT-PRESENT
$FFFF3600-$FFFF36FE PRESENT
$FFFF3700-$FFFF37FE NOT-PRESENT
$FFFF3800-$FFFF38FE PRESENT
$FFFF3900-$FFFF4FFE NOT-PRESENT
$FFFF5000-$FFFF501E PRESENT
$FFFF5020-$FFFF9FFE NOT-PRESENT
$FFFFA000-$FFFFA1FE PRESENT
$FFFFA200-$FFFFA80E NOT-PRESENT
$FFFFA810-$FFFFA81E PRESENT
$FFFFA820-$FFFFAA0E NOT-PRESENT
$FFFFAA10-$FFFFAA1E PRESENT
$FFFFAA20-$FFFFBE0E NOT-PRESENT
$FFFFBE10      PRESENT
$FFFFBE12-$FFFFFFFE NOT-PRESENT
```

MS - Memory Set

Command Input

MS *address* {*hexadecimal_number*} {'*string*'}

Arguments

hexadecimal_number	Hexadecimal value to be written to memory. 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.
string	An ASCII string to be written to memory. 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.

Description

Memory Set is used to write data to memory starting at the specified address.

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

Example

Assume that memory is initially cleared:

```
167-Bug>ms 25000 0123456789abcDEF 'This is ''167Bug'' 23456 <CR>
167-Bug>md 25000:20;b <CR>

00025000 0123 4567 89AB CDEF  5468 6973 2069 7320    #Eg.+MoThis is
00025010 2731 3637 4275 6727  2345 6000 0000 0000    '167Bug'#E`.....

167-Bug>
```

MW - Memory Write

MW *address data* **[;B | W | L]**

Options

B Byte

W Word (default)

L Longword

Description

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

Example 1

```
167-Bug>mw e000 55aa55aa;l
Effective address: 0000E000
Effective data   : 55AA55AA
167-Bug>md e000;l

0000E000  55AA55AA 00000000 00000000 00000000  U.U.............
0000E010  00000000 00000000 00000000 00000000  ................
167-Bug>
```

Example 2

```
167-Bug>mw e000 77;b
Effective address: 0000E000
Effective data   : 77
167-Bug>md e000;l

0000E000  77AA55AA 00000000 00000000 00000000  w.U.............
0000E010  00000000 00000000 00000000 00000000  ................
167-Bug>
```

Example 3

```
167-Bug>mw e002 33cc
Effective address: 0000E002
Effective data   : 33CC
167-Bug>md e000;l

0000E000  77AA33CC 00000000 00000000 00000000  w.3.............
0000E010  00000000 00000000 00000000 00000000  ................
167-Bug>
```

NAB - Automatic Network Boot Operating System

Command Input

NAB

Description

The NAB command re-invokes the network automatic boot feature. This command simply invokes the **NBO** command with the specified parameters saved in NVRAM for the specified network interface. This invocation occurs at system startup and can be specified at either power-up or at any reset condition.

NBH - Network Boot Operating System and Halt

Command Input

NBH [*controllerLUN*] [*deviceLUN*] [*clientIPaddress*] [*serverIPaddress*] [*string*]

Arguments

controllerLUN	This is the Logical Unit Number (LUN) of the controller to which the following device is attached. It defaults to LUN 0.
deviceLUN	This is the LUN of the device to boot from. It defaults to LUN 0.
clientIPaddress	This is the Internet Protocol Address of the client, basically my/source IP address. It defaults to an IP address of 0 (see the **NIOT** command).
serverIPaddress	This is the Internet Protocol Address of the server, basically the destination IP address. It defaults to an IP address of 0 (see the **NIOT** command).
string	This is a string of characters. Up to 2 strings may be specified, usually the name of the file to boot and an optional string (string #2). String #2, if specified, is passed to the booted file. To specify string #2, a delimiter must be used to differentiate from string #1 (boot filename). Both character strings default to a null character string (see the **NIOT** command).

Description

NBH is used to load an operating system or control program from the server into memory and halt (no control is given to it). This command functions in exactly the same way as the **NBO** command, except that control is not given to the loaded program. After the registers are initialized, control is returned to the debugger monitor and the prompt reappears on the terminal screen. Because control is retained by the debugger, all of the debugger's facilities are available for debugging the loaded program if necessary.

The device and controller configuration parameters used when **NBH** is initiated can be examined via the Network I/O Teach (**NIOT**) command.

Note that certain arguments will be passed (through MPU registers) to the loaded program. See the **NBO** command description for examples and further explanation.

NBO - Network Boot Operating System

Command Input

NBO [*controllerLUN*][*deviceLUN*] [*clientIPaddress*] [*serverIPaddress*] [*string*]

Arguments

controllerLUN	This is the Logical Unit Number (LUN) of the controller to which the following device is attached. It defaults to LUN 0.
deviceLUN	This is the LUN of the device from which to boot. It defaults to LUN 0.
clientIPaddress	This is the Internet Protocol Address of the client, basically my/source IP address. It defaults to an IP address of 0 (see the **NIOT** command).
serverIPaddress	This is the Internet Protocol Address of the server, basically the destination IP address. It defaults to an IP address of 0 (see the **NIOT** command).
string	This is a string of characters. Up to 2 strings may be specified, usually the name of the file to boot and a optional string (string #2). String #2, if specified, is passed to the booted file. To specify string #2 a delimiter must be used to differentiate from string #1 (boot filename). Both character strings default to a null character string (see the **NIOT** command).

Description

NBO is used to load an operating system or control program from the server into memory and give control to it (execute). The load and execution address of the file is specified via the configuration parameters. The device and controller configuration parameters used when **NBO** is initiated can be examined via the Network I/O Teach (**NIOT**) command.

NBO uses primarily the BOOTP, RARP, and TFTP protocols to load the boot file. Refer to the DARPA Internet Request for Comments RFC-951, RFC-903, and RFC-783, respectively, for the description of

these protocols. You may skip the BOOTP phase (address determination and bootfile selection) by specifying the IP addresses (server and client) and the boot filename; the booting process would then start with the TFTP phase (file transfer) of the boot sequence.

IP addresses of "0" are special in that these addresses 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 (see the **NIOT** command).

Prior to the TFTP phase an ARP request is transmitted for the hardware address (Ethernet) of the server.

At selected times (when prompted or a time-out condition exists), the booting process can be aborted by pressing the <BREAK> key on the console keyboard or by pressing the <ABORT> switch on the front panel.

Note that certain arguments are passed (through MPU registers) to the loaded program; the following is a list of the MPU registers and their contents:

MC68000.A0 = Base Address of Controller/Device
MC68000.A1 = Entry Point of Loaded Program
MC68000.A2 = Boot Information Packet (IP Addresses) Pointer

MC68000.A3 = String Pointer to Optional Argument Start
MC68000.A4 = String Pointer to Optional Argument End
MC68000.A5 = String Pointer to Loaded Filename Start
MC68000.A6 = String Pointer to Loaded Filename End
MC68000.D0 = Device LUN
MC68000.D1 = Controller LUN
MC68000.D2 = Automatic Booting: Bit #0 = 1, else Bit #0 = 0

Note that the Controller LUN and Device LUN for the network interface are 0 and 0 on the MVME166, MVME167, MVME176 and MVME177 boards. See the **NIOT;H** command invocation.

Example 1

Boot from controller LUN 0, device LUN 0, with default client address of 144.191.17.34, server IP address of 144.191.17.21, and bootfile **/tftpboot/load167**:

```
167-Bug>NBO 0 0 144.191.17.34 144.191.17.21 /tftpboot/load167
  . . .
```

Example 2

Boot from controller LUN 0, device LUN 0, with default client IP address, server IP address 144.191.17.21, and the default bootfile:

```
167-Bug>NBO 0 0,,144.191.17.21
      . . .
```

NBO uses primarily the BOOTP and TFTP protocols to load the boot file. Refer to the DARPA Internet Request for Comments RFC-951 and RFC-783, respectively, for the description of these protocols. You may skip the BOOTP phase (address determination and bootfile selection) by specifying the IP addresses (server and client) and the boot filename; the booting process would then start with the TFTP phase (file transfer) of the boot sequence.

Example 3

Invoke **NBO** with no arguments:

```
167-Bug>NBO
Network Booting from: VME167, Controller 0, Device 0
Loading: Operating System
Client IP Address          = 144.191.24.10
Server IP Address          = 144.191.11.81
Gateway IP Address         = 144.191.24.254
Subnet IP Address Mask     = 144.191.24.254
Boot File Name             =
/riscy/fwdb/NETLOADER/nbldexp/M68K/nbld.out
Argument File Name         =

Network Boot File load in progress... To abort hit <BREAK>

Bytes Received =&8912, Bytes Loaded =&8912
Bytes/Second =&2970, Elapsed Time =3 Second(s)
      ...
```

In this example no arguments were specified. Depending on the interface's configuration parameters, the display of various IP addresses and the boot file name signifies that the BOOTP phase was successful. The booting process now halts and waits about 5 seconds for you to abort. If you do not abort, a carriage return and line feed are printed to signify the entrance into the TFTP phase of the boot process. Once this phase is started, you cannot abort (by pressing the <BREAK> key) unless a time-out condition arises. When the boot

file is loaded into the user memory, the statistics of the TFTP phase (file transfer) are displayed. The boot process continues with loading of the MPU registers and execution of the loaded file.

Whenever an error occurs, the booting process is terminated and the error code is displayed. The error codes are listed in Appendix H.

NIOC - Network I/O Control

Command Input

NIOC

Description

The **NIOC** command allows you to send command packets directly to the network (initially only Ethernet) 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, see below), as well as some control (command identifiers 0, 1, 4, and 5, see 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 packet structure is defined in the "C" header file listed in Appendix I. 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 (e.g., Ethernet) address (network node)
2	Transmit (put) data packet
3	Receive (get) data packet
4	Flush receiver and receive buffers
5	Reset device/channel/node

The initialization (type 0) of the device/channel/node must always be performed first. If you have booted or initiated some other network I/O command, the initialization would already have been done.

The flush receiver and receive buffer (type 4) would be used if, for example, the current receive data is no longer needed, or to provide a known buffer state prior to initiating data transfers.

The reset device/channel/node (type 5) would be used if another operating system (node driver) needs to be control of the device/channel/node. Basically, put the device/channel/ node to a known state.

Whenever an error occurs, the initiated I/O control process is terminated and the appropriate error code is displayed. The error codes are listed in Appendix H.

Example 1

Initialize (type 0) the device/channel/node.

```
167-Bug>NIOC
Controller LUN                  =00?
Device LUN                      =00?
Packet Address                  =00006454?
00006454 0000 0000 0000 0000 0000 0000 0000 0000
................
00006464 0000 0000                                      ....
Send Packet (Y/N)                =N? y
167-Bug>
```

Example 2

Retrieve the hardware address of the specified network interface (type 1). Note that the transfer byte count is set to zero; this specifies all possible data associated with the address retrieval. This also holds true for the reception of data packets.

```
167-Bug>NIOC

Controller LUN                  =00?
Device LUN                      =00?
Packet Address                  =00006454?
00006454 0000 0000 0000 0001 0000 E000 0000 0000        ................
00006464 0000 0000        ....
```

```
Send Packet (Y/N)          =N? y
167-Bug>
```

(View the address data retrieval.)

```
167-Bug>MD E000:6;B
0000E000 08 00 3E 21 0F CC        ..>!..
167-Bug>
```

Example 3

View the packet to transmit, ARP Request.

```
167-Bug>MD E000:&21

0000E000 FFFF FFFF FFFF 0800 3E21 0FCC 0806 0001        ........>!......
0000E010 0800 0604 0001 0800 3E21 0FCC 90BF 0B2C        ........>!.....,
0000E020 FFFF FFFF FFFF 8610 1112        ..........
167-Bug>

167-Bug>NIOC

Controller LUN                 =00?
Device LUN                     =00?
Packet Address                 =00006454?
00006454 0000 0000 0000 0002 0000 E000 0000 002A        ................
00006464 0000 0000        ....

Send Packet (Y/N)   =N? y
167-Bug>
```

The above example illustrates the transmission (type 2) of a packet (ARP Request). The transfer byte count specifies how many bytes are to be transmitted. If the transfer byte count is below the minimum transmit byte count for the specified interface, the driver rounds to the minimum and places it into your packet. However, the specified network interface driver does not round down to the maximum if the transfer byte count exceeds the maximum. You must ensure packet integrity (e.g., source and destination addresses) for the specified network interface; the driver does not insert any data.

Example 4

```
167-Bug>NIOC
```

```
Controller LUN                  =00?
Device LUN                      =00?
Packet Address                  =00006454?
00006454 0000 0000 0000 0003 0000 E000 0000 0000        ................
00006464 0000 0000                                      ....
```



```
Send Packet (Y/N)               =N? y
167-Bug>
```

(View packet status.)

```
167-Bug>NIOC
Controller LUN                  =00?
Device LUN                      =00?
Packet Address                  =00006454?
00006454 0000 0000 0000 0003 0000 E000 0000 0222        ................
00006464 0001 0000                                      ....

Send Packet (Y/N)               =N? n 167-Bug>
```

(View the receive packet.)

```
167-Bug>MD E000:222;B
0000E000 FF FF FF FF FF FF 08 00 3E 20 C8 0A 08 00 45 00    .......> ....E.
0000E010 02 14 00 00 00 00 40 11 25 5E 90 BF 18 FE 90 BF    ......@.%^......
0000E020 18 FF 02 08 02 08 02 00 55 34 02 01 00 00 00 02    ........U4......
0000E030 00 00 C0 13 01 00 00 00 00 00 00 00 00 00 00 00    ................
0000E040 00 03 00 02 00 00 90 BF 82 00 00 00 00 00 00 00    ................
0000E050 00 00 00 00 00 03 00 02 00 00 C0 13 02 00 00 00    ................
0000E060 00 00 00 00 00 00 00 00 00 04 00 02 00 00 90 BF    ................
0000E070 63 00 00 00 00 00 00 00 00 00 00 00 00 02 00 02    c...............
0000E080 00 00 90 BF 83 00 00 00 00 00 00 00 00 00 00 00    ................
0000E090 00 04 00 02 00 00 90 BF 03 00 00 00 00 00 00 00    ................
0000E0A0 00 00 00 00 00 03 00 02 00 00 90 BF 84 00 00 00    ................
0000E0B0 00 00 00 00 00 00 00 00 00 04 00 02 00 00 90 BF    ................
0000E0C0 04 00 00 00 00 00 00 00 00 00 00 00 03 00 02       ................
0000E0D0 00 00 90 BF 85 00 00 00 00 00 00 00 00 00 00 00    ................
0000E0E0 00 04 00 02 00 00 90 BF 06 00 00 00 00 00 00 00    ................
0000E0F0 00 00 00 00 00 03 00 02 00 00 90 BF 86 00 00 00    ................
0000E100 00 00 00 00 00 00 00 00 00 04 00 02 00 00 90 BF    ................
0000E110 E6 00 00 00 00 00 00 00 00 00 00 00 00 02 00 02    ................
0000E120 00 00 90 BF 87 00 00 00 00 00 00 00 00 00 00 00    ................
0000E130 00 04 00 02 00 00 90 BF C7 00 00 00 00 00 00 00    ................
0000E140 00 00 00 00 00 02 00 02 00 00 90 BF 88 00 00 00    ................
0000E150 00 00 00 00 00 00 00 00 00 04 00 02 00 00 90 BF    ................
0000E160 28 00 00 00 00 00 00 00 00 00 00 00 00 02 00 02    (...............
0000E170 00 00 DE 01 08 00 00 00 00 00 00 00 00 00 00 00    ................
0000E180 00 02 00 02 00 00 90 BF 08 00 00 00 00 00 00 00    ................
```

```
0000E190 00 00 00 00 00 04 00 02 00 00 90 BF E8 00 00 00    ................
0000E1A0 00 00 00 00 00 00 00 00 00 02 00 02 00 00 90 BF    ................
0000E1B0 89 00 00 00 00 00 00 00 00 00 00 00 00 04 00 02    ................
0000E1C0 00 00 90 BF 29 00 00 00 00 00 00 00 00 00 00 00    ....)...........
0000E1D0 00 04 00 02 00 00 90 BF AA 00 00 00 00 00 00 00    ................
0000E1E0 00 00 00 00 00 04 00 02 00 00 90 BF 8A 00 00 00    ................
0000E1F0 00 00 00 00 00 00 00 00 00 04 00 02 00 00 90 BF    ................
0000E200 0A 00 00 00 00 00 00 00 00 00 00 00 00 03 00 02    ................
0000E210 00 00 90 BF AB 00 00 00 00 00 00 00 00 00 00 00    ................
0000E220 00 04                                              ..
```

The above example illustrates the reception of data (type 3). The driver does not block (waits for incoming data). The control/status word field signifies whether or not data has been received. Currently only one status bit is specified, bit 16, the receipt of data. This bit is cleared if no data is present. It is set if receive data is present. The transfer byte count is also set to the number of bytes associated with this receive data packet. This field is only valid when bit 16 is set.

Example 5

Flush the receiver and receive buffers (type 4).

```
167-Bug>NIOC

Controller LUN                  =00?
Device LUN                      =00?
Packet Address                  =00006454?
00006454 0000 0000 0000 0004 0000 0000 0000 0000        ................
00006464 0000 0000                                      ....

Send Packet (Y/N)                =N? y
167-Bug>
```

This entry point is useful when the interface has not been accessed for some time and you do not want receive data. The Network I/O commands (i.e., **NAB**, **NBH**, **NBO**, **NIOP**, and **NPING**) use this feature prior to any Network I/O transactions.

NIOP - Network I/O Physical

Command Input

NIOP

Description

The **NIOP** command allows you to get/put files from/to the supported network (initially only Ethernet) 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.

Example 1

Read a file into memory.

```
167-Bug>NIOP
Controller LUN   =00?
Device LUN       =00?
Get/Put          =G?
File Name        =?/riscy/fwdb/NETLOADER/nbldexp/M68K/nbld.out
Memory Address   =0000E000? 10000
Length           =00000000?
Byte Offset      =00000000?
Bytes Received =&8912, Bytes Loaded =&8912
Bytes/Second =&8912, Elapsed Time =1 Second(s)
167-Bug>
```

The above example illustrates the reading (or getting) of the file **/riscy/fwdb/NETLOADER/nbldexp/M68K/nbld.out** from the specified server (see the **NIOT** command) into memory at address 00010000. The length field of 0 signifies to load the entire file. The load (get) of a file can be truncated to a desired length by specifying the desired length (non-zero). The byte offset field can be used to wind (index) into a file (only used on file reads, gets).

Upon successful transfer of the specified file, the command displays the TFTP session statistics.

The **NIOP** command utilizes the necessary configuration parameters (see the **NIOT** command) to perform the TFTP file transfer.

Note that winding (indexing) into a file is possible on a read (get), there is a drawback in this feature due to the nature of TFTP, the entire file is transferred across the network. But only the desired section of the file is written to the user memory.

Refer to the DARPA Internet Request for Comments RFC-783 for the description of the TFTP protocol.

Prior to the TFTP session an ARP request is transmitted for the hardware address (Ethernet) 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.

NIOT - Network I/O Teach (Configuration)

Command Input

NIOT [;[**H**]|[**A**]]

Options

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

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

Description

The **NIOT** command allows you to "teach" a new network configuration to the debugger for use by the .NETxxx system calls. **NIOT** lets you modify the controller and device descriptor tables used by the .NETxxx system calls for network access. Note that because the debugger commands that access the network use the same interface as the system calls, changes in the descriptor tables affect all those commands. These commands include **NIOP**, **NBO**, **NBH**, and also any user program that uses the .NETxxx system calls.

As stated in the description of the **IOT** command, each controller/device LUN combination has its own descriptor table; this table houses configuration and run-time parameters. If the specified network interface has been specified to Network Automatic Boot, then any changes made by this command is saved in NVRAM (you are prompted).

The following is a list of the prompts for the parameters that are accessible via the **NIOT** command. A retry value of "0" is interpreted as no maximum, always retry.

```
Node Control Memory Address=FFE10000?
```

This parameter specifies the starting address of the necessary memory needed for the transmit and receive buffers. Currently 65,536 bytes are needed for the MVME166/167/176/177 Ethernet driver (transmit/receive buffers).

```
Client IP Address          =144.191.24.10?
```

This parameter specifies the IP address of the client. The firmware is considered the client.

```
Server IP Address          =144.191.11.81?
```

This parameter specifies 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?
```

This parameter specifies 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?
```

This parameter specifies the broadcast IP address that the firmware utilizes when a IP broadcast needs to be performed.

```
Gateway IP Address         =144.191.24.254?
```

This parameter specifies 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)       =?
```

This parameter specifies 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)   =?
```

This parameter specifies the name of the argument file. This file may be used by the booted file (program) for an additional file load. To specify a null filename, the string "NULL" must be used; this resets the filename buffer to a null character string.

```
Boot File Load Address     =001F0000?
Boot File Execution Address=001F0000
```

These parameters specify the load and execution addresses of the boot file.

```
Boot File Execution Delay  =00000000?
```

This parameter specifies a delay value in seconds before control is passed to the loaded file (program).

```
Boot File Length           =00000000?
Boot File Byte Offset      =00000000?
```

These parameters behave the same as the "Length" and "Offset" parameters associated with the **NIOP** command.

```
BOOTP/RARP Request Retry   =00?
TFTP/ARP Request Retry     =00?
```

These parameters specify 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?
```

This parameter specifies the starting address of memory in which to place the trace characters. The receive/transmit packet tracing are disabled by default (value of 0). Any non-zero value enables tracing. Tracing would only be used in a debug environment and normally should be disabled. Care should be exercised when enabling this feature; you need to ensure that adequate memory exists. The following characters are defined for tracing:

```
?       Unknown
&       Unsupported ETHERNET Type
*       Unsupported IP Type
%       Unsupported UDP Type
$       Unsupported BOOTP Type
```

```
[       BOOTP Request
]       BOOTP Reply
+       Unsupported ARP Type
(       ARP Request
)       ARP Reply
-       Unsupported RARP Type
{       RARP Request
}       RARP Reply
^       Unsupported TFTP Type
\       TFTP Read Request
/       TFTP Write Request
<       TFTP Acknowledgment
>       TFTP Data
|       TFTP Error
,       Unsupported ICMP Type
:       ICMP Echo Request
;       ICMP Echo Reply
```

```
BOOTP/RARP Request Control: Always/When-Needed (A/W)  =W
```

This parameter specifies the BOOTP/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 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 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.

Example 1

Invoke **NIOT** with no options. This shows the interactive session for the various configuration parameters.

```
167-Bug>NIOT
Controller LUN          =00?
Device LUN              =00?
Node Control Memory Address =FFE10000?
Client IP Address              =144.191.24.10?
Server IP Address              =144.191.11.81?
Subnet IP Address Mask         =255.255.255.0?
Broadcast IP Address           =255.255.255.255?
Gateway IP Address             =144.191.24.254?
Boot File Name ("NULL" for None)            =?
Argument File Name ("NULL" for None)        =?
Boot File Load Address         =001F0000?
Boot File Execution Address    =001F0000?
Boot File Execution Delay      =00000000?
Boot File Length               =00000000?
Boot File Byte Offset          =00000000?
BOOTP/RARP Request Retry       =00?
TFTP/ARP Request Retry         =00?
Trace Character Buffer Address =00000000?
BOOTP/RARP Request Control: Always/When-Needed (A/W)  =W?
BOOTP/RARP Reply Update Control: Yes/No (Y/N)         =Y?
167-Bug>
```

Example 2

Display the Network Controllers/Nodes that are present in the system.

```
167-Bug>NIOT;H
Network Controllers/Nodes Available
CLUN    DLUN    Name    Address        P-Address/H-Address
0       0       VME167  $FFF46000      44.191.24.10/08003E210FCC
167-Bug>
```

Example 3

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

```
167-Bug>NIOT;A
Network Controllers/Nodes Supported
CLUN    DLUN    Name    Address
0       0       VME167  $FFF46000
2       0       VME376  $FFFF1200
3       0       VME376  $FFFF1400
4       0       VME376  $FFFF1600
5       0       VME376  $FFFF5400
6       0       VME376  $FFFF5600
7       0       VME376  $FFFFA400
167-Bug>
```

Caution

If you use the **NIOT** debugger command, the network interface configuration parameters need to be saved/retained in the NVRAM (Non-volatile RAM), also known as Battery Backed-Up RAM (BBRAM), somewhere in the address range $FFFC0000 through $FFFC0FFF (for 68K boards). The **NIOT** parameters do not exceed 128 bytes in size.

The location for these parameters is determined by a setting of the **ENV** (Set Environment to Bug/Operating System) debugger command. For a 68K board (such as the MVME167), change the Network Auto Boot Configuration Parameters Pointer (NVRAM) from its default of 00000000. If you have used the exact same space for your own program information or commands, they will be overwritten and lost.

NPING - Network Ping

Command Input

NPING *controllerLUN deviceLUN sourceIP destinationIP [N-packets]*

Arguments

controllerLUN	This is the Logical Unit Number (LUN) of the controller to which the following device is attached.
deviceLUN	This is the LUN of the device.
sourceIP	This is the Internet Protocol Address of the Source (initiator, ECHO_REQUEST).
destinationIP	This is the Internet Protocol Address of the Destination (target, ECHO_RESPONSE).
N-packets	This is the number of packets to send. It defaults to infinity.

Description

The **NPING** command allows you to probe 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 PING session is terminated and the appropriate error code is displayed. The error codes are listed in Appendix H. The receive packet is checked for checksum and data integrity.

Prior to the PING session an ARP request is transmitted for the hardware address (Ethernet) 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.

Example 1

Transmit/receive 0x10 (16) ping packets. Once the ping session is complete, the command displays the statisticsof the session.

```
167-Bug>NPING 0 0 144.191.24.10 144.191.24.254 10
Source IP Address                              = 144.191.24.10
Destination IP Address                         = 144.191.24.254
Number of Packets Transmitted =16, Packets Lost =0, Packet Size
=128
167-Bug>
```

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.

Example 2

This example illustrates the indefinite transmission/reception of packets.

```
167-Bug>NPING 0 0 144.191.24.10 144.191.24.254
Source IP Address                              = 144.191.24.10
Destination IP Address                         = 144.191.24.254
```

(<BREAK> key pressed)

```
Number of Packets Transmitted =1955, Packets Lost =0, Packet Size
=128
167-Bug>
```

OF - Offset Registers Display/Modify

Command Input

OF [R*n*[;A]]

Description

OF allows you to access and change pseudo-registers called offset registers. These registers are used to simplify the debugging of relocatable and position-independent modules.

There are eight offset registers R0-R7, but only R0-R6 can be changed. R7 always has both base and top addresses set to 0. This allows the automatic register function to be effectively disabled by setting R7 as the automatic register.

Each offset register has two values: base and top. The base is the absolute least address that is used for the range declared by the offset register. The top address is the absolute greatest address that is used. 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.

Command Usage

OF	To display all offset registers. An asterisk indicates which register is the automatic register.
OF R*n*	To display/modify **R*n***. You can scroll through the register in a way similar to that used by the **MM** command.
OF R*n*;A	To display/modify **R*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 "**^**", "**v**", "**V**", "**=**", and "**.**" may be used. Their function is identical to that in Register Modify (**RM**) and Memory Modify (**MM**) commands.
Range syntax	[*base address* [*top address*]] [**^** | **v** | **=** | **.**] or [*base address* [**':'** *byte count*]] [**^** | **v** | **=** | **.**]

Offset Register Rules

1. At power-up and cold start reset, R7 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. R7 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 16XBug command where there is not an offset register explicitly called out.
6. There is always an automatic register. A convenient way to disable the effect of the automatic register is by setting R7 as the automatic register. Note that this is the default condition.

Examples

Display offset registers.

```
167-Bug>OF <CR>
R0 =00000000 00000000  R1 = 00000000 00000000
R2 =00000000 00000000  R3 = 00000000 00000000
R4 =00000000 00000000  R5 = 00000000 00000000
R6 =00000000 00000000  R7*= 00000000 00000000
```

Modify some offset registers.

```
167-Bug>OF R0 <CR>
R0 =00000000 00000000? 20000 200FF <CR>
R1 =00000000 00000000? 25000:200^
R0 =00020000 000200FF? .<CR>
```

Look at location $20000.

```
167-Bug>M 20000;DI <CR>
00000+R0   00000000  ORI.B #$0,D0? .<CR>
167-Bug>M R0;DI <CR>
00000+R0   00000000  ORI.B #$0,D0? .<CR>
167-Bug>
```

Set R0 as the automatic register.

```
167-Bug>OF R0;A <CR>
R0*=00020000 000200FF? .<CR>
```

To look at location $20000.

```
167-Bug>M 0;DI <CR>
00000+R0   00000000  ORI.B #$0,D0? .<CR>
167-Bug>
```

To look at location 0, override the automatic offset.

```
167-Bug>M 0+R7;DI <CR>
00000000   FF80      DC.W  $FF80?.<CR>
167-Bug>
```

PA/NOPA - Printer Attach/Detach

Command Input

PA [*port*]
NOPA [*port*]

Description

These two commands "attach" or "detach" a printer to the user-specified *port*. 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. **PA** is used to attach, **NOPA** is used to detach. If no port is specified, **PA** does not attach any port, but **NOPA** detaches all attached ports.

If the port number specified is not currently assigned, **PA** displays an unassigned message. If **NOPA** is attempted on a port that is not currently attached, an unassigned message is displayed.

The port being attached must already be configured. This is done using the Port Format (**PF**) command. This is done by executing the following sequence prior to "**PA** *port*".

```
167-Bug>PF 3 <CR>
Logical unit $03 unassigned
Name of board? VME167 <CR>
Name of port? PTR <CR>
Port base address = $FFF45000? <CR>
OK to proceed (y/n)? Y <CR>
167-Bug>
```

For further details, refer to the **PF** command.

Examples

Console Display	Printer Output
167-Bug>**PA 7 <CR>**	
(Attaching port 7)	*(Printer now attached)*

```
167-Bug>HE NOPA <CR>
NOPA   Printer detach
167-Bug>NOPA <CR>
```

(Detach all attached printers)

```
167-Bug>NOPA <CR>
No printer attached
167-Bug>
```

```
167-Bug>HE NOPA
NOPA Printer detach
167-Bug>NOPA
```

(Printer now detached)

PF/NOPF - Port Format/Detach

Command Input

PF [*port*]
NOPF [*port*]

Description

Port Format (**PF**) allows you 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), and "Console" (LUN dependent, "DEBUG" LUN by default) by the debugger are special in that the configuration parameters of these ports are saved/retained in Battery Backed Up RAM (BBRAM), also known as Non-Volatile RAM (NVRAM). These configuration parameters remain in effect through power-up or any reset. The "DEBUG" and "HOST" LUNs are local serial ports, 0 and 1 respectively. If the "Console" port of the debugger is moved (refer to the **TA** command) from the default "Console" port ("DEBUG" LUN) to some other port, the retention of the "DEBUG" port configuration parameters are lost and the "Console" port configuration parameters take its place in NVRAM.

Note The Reset and Abort options sets the serial ports that are labeled "DEBUG" (LUN 0, port 0) and "HOST" (LUN 1, port 1) by the debugger to the default parameters. (Refer to the *Installation and Startup* section in Chapter 1 for details on terminal setup.)

Any time the "DEBUG" (LUN 0), "HOST" (LUN 1), or "Console" (LUN dependent) ports are addressed and an input/change has been made, you are prompted to update (save the changes) the configuration parameters (for the specified port) in NVRAM.

Note On any MVME16X module, only nine ports may be assigned at any given time. Port numbers must be in the range 0 to $1F.

Listing Current Port Assignments

Port Format 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.

Example

```
167-Bug>pf
Current port assignments:  (Port #: Board name, Port name)
[00: VME167- "DEBUG"] [01: VME167- "HOST"]
Console = [00: VME167- "DEBUG"]
167-Bug>
```

Configuring a Port

The primary use of Port Format 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 the section on *Assigning a New Port*.

Note If you configure channels for baud rates greater than and equal to 19,200 baud, note that the debugger can not sustain input and/or output at these speeds.

When Port Format 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 (i.e., 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 uppercase or lowercase "**v**" causes Port Format to resume prompting in the original order (i.e., 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.
<CR>	Pressing return without entering a value preserves the current value and causes the next prompt to be displayed.

Example 1

```
167-Bug>PF 1 <CR>
Baud rate [110,300,600,1200,2400,4800,9600,19200,38400] = 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>          New value entered.
```

The next response is to demonstrate reversing the order of prompting.

```
Auto Xmit enable on CTS* [Y,N] = N? ^ <CR>
Stop Bits [1,2] = 2? . <CR>          Value acceptable, exit
                                     interactive mode.
OK to proceed (y/n)? Y <CR>          A carriage return is required.

Update Non-Volatile RAM (Y/N)? y
167-Bug>
```

Example 2

```
167-Bug>pf 1

Baud Rate [110,300,600,1200,2400,4800,9600,19200,38400] = 1200? .

OK to proceed (y/n)? y

Update Non-Volatile RAM (Y/N)? y
167-Bug>
```

Example 3

You may not want to save the changes permanently (NVRAM update), but make a temporary change:

```
167-Bug>pf 1

Baud Rate [110,300,600,1200,2400,4800,9600,19200,38400] = 1200? .

OK to proceed (y/n)? y

Update Non-Volatile RAM (Y/N)? n
WARNING: No Update(s) made to Non-Volatile RAM
167-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	38400

Note If a number base is not specified, the default is decimal, not hexadecimal.

Parity type:

Parity may be on of the following

Even (choice E)
Odd (choice O)
None (disabled) (choice N)

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

Port Format 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 (such as VME16X, VME050, etc.). 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. Pressing the RETURN key on the console retains 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.

Port Format does not initialize any hardware until you have responded with the letter "**Y**" to prompt `"OK to proceed (y/n)?"`. Pressing the BREAK key on the console 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.

Example

Assigning port 3 to the MVME335 printer port.

```
167-Bug>PF 3 <CR>
Logical unit $03 unassigned
Name of board? <CR>          Cause PF to list supported modules
                             (boards), ports.
Boards and ports supported:
VME167:  DEBUG,HOST,HOST1,HOST2,PTR
VME050:  1,2,PTR
VME335:  1,2,3,4,PTR
Name of board? VME335 <CR>Uppercase or lowercase accepted.
Name of port? PTR <CR>
Port base address = $FFFF3600? <CR>
```

(*Interactive mode not entered because hardware has fixed configuration).*

```
OK to proceed (y/n)? Y <CR>
167-Bug>
```

NOPF Port Detach

The **NOPF** command, "**NOPF** *port*", unassigns the port whose number is "*port*". 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 *ssaddr seaddr dsaddr* [*ieaddr*] [**;** [**A** | **R**] [**X**]]

or

PFLASH *ssaddr:count dsaddr* [*ieaddr*] [**;** [**B** | **W** | **L**] [**A** | **R**] [**X**]]

Arguments

ssaddr Source starting address of the binary image to program the FLASH memory with.

seaddr Source ending address of the binary image to program the FLASH memory with.

dsaddr Destination starting address of the FLASH memory to program the binary image to. On the MVME176/177, this may be relative offset into the FLASH memory array or the physical address that will apply when the entire FLASH is mapped.

count The number of elements to program. The element size is dependent on the size option (i.e., B | W | L). The default element size is Byte.

ieaddr Instruction execution address (i.e., PC/IP). This address points to a reset vector for MC68000 architectures.

Options

B | W | L These size options, Byte, Word, and Longword, can only be used when the *count* argument is specified, that is, with the ":" operator.

R | A These options allow the automatic reset (local) of the hardware if the hardware supports it upon completion of programming. The **R** option specifies resetting only

when the programming of the FLASH Memory is completed error free. The **A** option specifies always resetting upon completion of the programming.

X — This option directs the FLASH Memory driver to always execute the passed execution address, even on error. This option is valid only when you specify the instruction execution address.

The PFLASH command is available on 162Bug, 166Bug, 176Bug, and 177Bug. The PFLASH command is used to program (load) the FLASH memory with the desired application or program. The given command line arguments are checked; for example, 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 next table lists the address and range alignment requirements for 68K products that support FLASH memory.

Table 3-2. FLASH Memory Address and Range Alignment

Product	Alignment
MVME162	1-byte multiple
MVME172	1-byte multiple
MVME166	4-byte multiple
MVME176	4-byte multiple
MVME177	4-byte multiple

If the programming agent is the debugger and it is resident in the FLASH memory, it automatically relocates the FLASH memory driver to RAM. The downloaded driver uses the board's system fail LED and NVRAM to communicate programming errors. This hardware notification of a FLASH memory programming error is

only necessary if you are reprogramming the programming agent's text and data space. Otherwise, errors are communicated by means of the programming terminal (serial I/O).

Upon error free completion of the FLASH memory programming, control is passed back to the monitor. If the instruction execution address argument is specified, control will be passed to this address. If the programming agent is reprogrammed and the instruction execution address argument is not specified, control remains within the FLASH memory driver (do nothing, wait for reset).

PFLASH reports the current physical address and the absolute block number for each operation in progress: erasing, programming, and verifying. On 176Bug and 177Bug, the messages displayed may not appear to be based on the same destination starting address that was entered. This happens because the **PFLASH** command needs to switch the portion of the FLASH that is visible in order to program it. If switching is required, the map will be restored to the condition that existed before **PFLASH** was entered.

The PFLASH command also resides in the MVME166 BootBug product. The FLASH memory driver does not have to be downloaded to the BootBug product, and all errors are displayed on the programming terminal (serial I/O).

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
```

Example

This example illustrates programming FLASH memory that is outside the range (application area) of the product debugger. It gives you a last chance prompt to make sure this is what you want to do.

```
162-Bug>PFLASH 10000:80000 FF880000
Source Starting/Ending Addresses          =00010000/0008FFFF
Destination Starting/Ending Addresses     =FF880000/FF8FFFFF
Number of Effective Bytes                 =00080000 (&524288)

Program FLASH Memory (Y/N)? Y
FLASH Memory Programming Complete
162-Bug>
```

PS - Put RTC into Power Save Mode for Storage

Command Input

PS

Description

The **PS** command is used to turn off the oscillator in the RTC chip, MK48Txx. The MVME16X module is shipped with the RTC oscillator stopped to minimize current drain from the onchip battery. Normal cold-start of the MVME16X with the 16XBug EPROMs installed gives the RTC a "kick start" to begin oscillation. To disable the RTC, you must enter "**PS**".

The **SET** command restarts the clock. Refer to the **SET** command for further information.

Example

```
167-Bug>PS
(Clock is in Battery Save Mode)
167-Bug>
```

RB/NORB - ROMboot Enable/Disable

Command Input

RB[**;V**]
NORB

Option

V Enables verbose mode operation as shown in the example below.

Description

The **RB** command invokes the search for and booting from a routine nominally encoded in on-board memory devices on the MVME16X. However, the routine can be in other memory locations, as detailed in the **ENV** command description elsewhere in this manual. Refer also to the ROMboot function description and example in Chapter 1.

NORB disables the search for a ROMboot routine, but does not change the options chosen.

The default condition is with the ROMboot function disabled.

Examples

The following two examples assume the existence of a valid ROMboot module at $10000.

```
167-Bug>rb

ROMboot in progress... To abort hit <BREAK>
FRI SEP 15 11:50:21.00 1989
167-Bug>

167-Bug>rb;v

ROMboot in progress... To abort hit <BREAK>

Direct Adr: FFC00000 FFC00000: Searching for ROMboot Module at: FFC00000
ROM       : FFC00000 FFC7FFFC: Searching for ROMboot Module at: FFC7E000
Local RAM : 00000000 00FFFFFC: Searching for ROMboot Module at: 00010000
Executing ROMboot Module "TEST" at 00010000
```

```
FRI SEP 15 11:50:21.00 1989
167-Bug>
```

NORB disables the ROMboot function but does not change any options chosen under **RB**.

Example

```
167-Bug> NORB
ROM boot disabled
167-Bug>
```

RD - Register Display

Command Input

RD {[**+**|**-**|**=**][*dname*][**/**]} {[**+**|**-**|**=**][*reg1*[**-***reg2*]][**/**]} [**;E**]

Arguments

+	is a qualifier indicating that a device or register range is to be added.
-	is 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.
=	is 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	is a device name, or **DEF**. This is used to quickly enable or disable all the registers of a device, or a functional grouping. The available device/functional-group names are: MPU Microprocessor Unit DEF Default **RD** List FPC Floating Point Unit MMU Memory Management Unit CPU Board Registers
/	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 167Bug command caused an exception. These registers are not accessible using other debugger commands.

Description

The **RD** command is used to display the target state, that is, the register state associated with the target program (refer to the **GO** command). The instruction pointed to by the target PC is disassembled and displayed also. Internally, a register mask specifies which registers are displayed when **RD <CR>** is executed. At reset time, this mask is set to display the MPU 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 registers of the Floating Point Unit (FPC) or Memory Management Unit (MMU) are displayed.

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.

Ordering Sequence of MPU, DEF, FPC, and MMU Registers

MPU Registers

MC68040: The MPU registers in ordering sequence are:

Number and Type	Mnemonic
9 System Registers	PC, SR, USP, MSP, ISP, VBR, SFC, DFC, CACR
8 Data Registers	D0 - D7
8 Address Registers	A0 - A7

Total: 25 Registers.

MC68060: The MPU registers in ordering sequence are:

Number and Type	Mnemonic
10 System Registers	PC, SR, VBR, SSP, USP, SFC, DFC, CACR, PCR, BUSCR
8 Data Registers	D0 - D7
8 Address Registers	A0 - A7

Total: 26 Registers.

DEF Registers

MC68040, MC68060: The DEF registers in ordering sequence are:

Number and Type	Mnemonic
10 System Registers	PC, SR, VBR, SSP, USP, SFC, DFC, CACR, PCR, BUSCR
8 Data Registers	D0 - D7
8 Address Registers	A0 - A7

Total: 26 Registers.

FPC Registers

MC68040, MC68060: The FPC registers in ordering sequence are:

Number and Type	Mnemonic
3 System Registers	FPCR, FPSR, FPIAR
8 Data Registers	FP0 - FP7

Total: 11 Registers.

MMU Registers

MC68040: The MMU registers in ordering sequence are:

Number and Type	Mnemonic
7 Address Translation Control	URP, SRP, TC, DTT0, DTT1, ITT0, TT1
1 Control/Status	MMUSR

Total: 8 Registers.

MC68060: The MMU registers in ordering sequence are:

Number and Type	Mnemonic
7 Address Translation Control	URP, SRP, TC, DTT0, DTT1, ITT0, TT

Total: 7 Registers.

Ordering Sequence of CPU Registers

The next subsections provide system-specific information about the ordering sequence of CPU registers.

MVME166/167/176/177 Registers

For the MVME166/167/176/177, the CPU registers in ordering sequence are:

Mnemonic	Name of Register
IPL	Interrupt Priority Level Register
IMLR	Interrupt Mask Level Register
MMIEN	Master Masters Interrupt Enable Register
VIEN	VME2 Chip Interrupt Enable Register

VIST	VME2 Chip Interrupt Status Register
PIEN	PCC2 Chip Interrupt Enable Register
PIST	PCC2 Chip Interrupt Status Register

Total: 7 Registers.

MVME162/MVME172 Registers

For the MVME162 and MVME172, the CPU registers in ordering sequence are:

Mnemonic	Name of Register
IPLR	Interrupt Priority Level Register (MVME172 only)
MMIEN	Master Masters Interrupt Enable Register
VIEN	VME2 Chip Interrupt Enable Register
VIST	VME2 Chip Interrupt Status Register
PIEN	Peripheral/Memory Controller Chip (MCC) Interrupt Enable Register
PIST	Peripheral/Memory Controller Chip (MCC) Interrupt Status Register

Total: 5 Registers.

MMIEN, PIEN, and PIST Registers

The MMIEN, PIEN, and PIST registers are composite registers. Their contents comprise bits from more than one register. The next subsections provide system-specific information about the MMIEN, PIEN and PIST registers.

MVME166/167/176/177 Registers

The MMIEN register comprises all of the master interrupt enables on the CPU.

Bit #0	VME2 Chip Master Interrupt Enable
Bit #1	PCC2 Chip Master Interrupt Enable

The PIEN register comprises all of the interrupt enable bits within the PCC2 chip.

Bit #0	Printer Port-BSY Interrupt Enable Bit
Bit #1	Printer Port-PE Interrupt Enable Bit
Bit #2	Printer Port-SELECT Interrupt Enable Bit
Bit #3	Printer Port-FAULT Interrupt Enable Bit
Bit #4	Printer Port-ACK Interrupt Enable Bit
Bit #5	SCSI Interrupt Enable Bit
Bit #6	LANC Error Interrupt Enable Bit
Bit #7	LANC Interrupt Enable Bit
Bit #8	Tick Timer #2 Interrupt Enable Bit
Bit #9	Tick Timer #1 Interrupt Enable Bit
Bit #10	GPIO Interrupt Enable Bit
Bit #11	Serial Modem Interrupt Enable Bit
Bit #12	Serial Receive Interrupt Enable Bit
Bit #13	Serial Transmit Interrupt Enable Bit

The PIST register comprises all of the interrupt status bits within the PCC2 chip. This software register is read only.

Bit #0	Printer Port-BSY Status Bit
Bit #1	Printer Port-PE Status Bit
Bit #2	Printer Port-SELECT Status Bit
Bit #3	Printer Port-FAULT Status Bit
Bit #4	Printer Port-ACK Status Bit
Bit #5	SCSI Status Bit
Bit #6	LANC Error Status Bit
Bit #7	LANC Status Bit
Bit #8	Tick Timer #2 Status Bit
Bit #9	Tick Timer #1 Status Bit
Bit #10	GPIO Status Bit
Bit #11	Serial Modem Status Bit
Bit #12	Serial Receive Status Bit
Bit #13	Serial Transmit Status Bit

MVME162/MVME172 Registers

The MMIEN register comprises all of the master interrupt enables on the CPU.

Bit #0	VME2 Chip Master Interrupt Enable
Bit #1	MC Chip Master Interrupt Enable

The PIEN register comprises all of the interrupt source enable bits within the MCC and the IPIC chips. This register is 32 bits wide and all bits that are not defined here are reserved and unused.

Bit #3	MCC, Tick Timer #4
Bit #4	MCC, Tick Timer #3
Bit #5	MCC, SCSI
Bit #6	MCC, LANC Error
Bit #7	MCC, LANC Normal
Bit #8	MCC, Tick Timer #2
Bit #9	MCC, Tick Timer #1
Bit #11	MCC, Parity Error
Bit #13	MCC, SCC
Bit #14	MCC, ABORT Switch
Bit #16	IPIC, Industry Pack A Interrupt 0
Bit #17	IPIC, Industry Pack A Interrupt 1
Bit #18	IPIC, Industry Pack B Interrupt 0
Bit #19	IPIC, Industry Pack B Interrupt 1

The PIST register comprises all of the interrupt status bits within the PCC2 chip. This software register is read only.

Bit #0	Printer Port-BSY Status Bit
Bit #1	Printer Port-PE Status Bit
Bit #2	Printer Port-SELECT Status Bit
Bit #3	Printer Port-FAULT Status Bit
Bit #4	Printer Port-ACK Status Bit
Bit #5	SCSI Status Bit
Bit #6	LANC Error Status Bit
Bit #7	LANC Status Bit
Bit #8	Tick Timer #2 Status Bit
Bit #9	Tick Timer #1 Status Bit
Bit #10	GPIO Status Bit
Bit #11	Serial Modem Status Bit
Bit #12	Serial Receive Status Bit
Bit #13	Serial Transmit Status Bit

Example 1

Default display - MPU registers only:

```
167-Bug>RD
PC  =00008000 SR  =2700=TR:OFF_S._7_..... VBR =00000000
USP =0000DFFC MSP =0000EFFC ISP*=0000FFFC SFC =0=F0
DFC =0=F0     CACR=0=........
D0  =00000000 D1  =00000000 D2  =00000000 D3  =00000000
D4  =00000000 D5  =00000000 D6  =00000000 D7  =00000000
A0  =00000000 A1  =00000000 A2  =00000000 A3  =00000000
A4  =00000000 A5  =00000000 A6  =00000000 A7  =00004000
00008000 00000000        ORI.B       #$0,D0
167-Bug>
```

Notes 1. An asterisk (*) following a stack pointer name indicates that it is the active stack pointer.

2. The status register includes a mnemonic portion to help in reading it:

Trace Bits:	0	0	TR:OFF	Trace off
	0	1	TR:CHG	Trace on change of flow
	1	0	TR:ALL	Trace all states
	1	1	TR:INV	Invalid mode

S, M Bits:	The bit name appears (S,M) if the respective bit is set, otherwise a "." indicates that it is cleared.
Interrupt Mask:	A number from 0 to 7 indicates the current processor priority level.
Condition Codes:	The bit name appears (X,N,Z,V,C) if the respective bit is set, otherwise a "." indicates that it it cleared.

3. The source and destination function code registers (SFC, DFC) include a two character mnemonic:

Function Code	Mnemonic	Description
0	F0	Undefined
1	UD	User Data
2	UP	User Program
3	F3	Undefined
4	F4	Undefined
5	SD	Supervisor Data
6	SP	Supervisor Program
7	CS	CPU Space

4. The Cache Control Register (CACR) shows mnemonics for two bits: enable and freeze. The bit name (E, F) appears if the respective bit is set, otherwise a "." indicates that it is cleared.

Example 2

Set the display to D6 and A3 only.

```
167-Bug>RD =D6/A3 <CR>
D6  =00000000 A3  =00000000
00003000 4AFC             ILLEGAL
167-Bug>
```

This sequence sets the display to D6 only, then adds register A3 to the display.

Example 3

Restore all the MPU registers.

```
167-Bug>RD +MPU
PC  =00008000 SR  =2700=TR:OFF_S._7_..... VBR =00000000
USP =0000DFFC MSP =0000EFFC ISP*=0000FFFC SFC =0=F0
DFC =0=F0     CACR=0=........
D0  =00000000 D1  =00000000 D2  =00000000 D3  =00000000
D4  =00000000 D5  =00000000 D6  =00000000 D7  =00000000
A0  =00000000 A1  =00000000 A2  =00000000 A3  =00000000
```

```
A4  =00000000 A5  =00000000 A6  =00000000 A7  =0000FFFC
00008000 00000000        ORI.B       #$0,D0
167-Bug>
```

Note that an equivalent command would have been **RD PC-A7** or **RD=DEF**.

Example 4

Add all the FPC registers.

```
167-Bug>RD +FPC
PC  =00008000 SR  =2700=TR:OFF_S._7_..... VBR =00000000
USP =0000DFFC MSP =0000EFFC ISP*=0000FFFC SFC =0=F0
DFC =0=F0     CACR=0=........
D0  =00000000 D1  =00000000 D2  =00000000 D3  =00000000
D4  =00000000 D5  =00000000 D6  =00000000 D7  =00000000
A0  =00000000 A1  =00000000 A2  =00000000 A3  =00000000
A4  =00000000 A5  =00000000 A6  =00000000 A7  =0000FFFC
FPCR=00000000 FPSR=00000000-(CC=....   )  FPIAR=00000000
FP0 =0_0000_0000000000000000= 0.0000000000000000_E+0000
FP1 =0_0000_0000000000000000= 0.0000000000000000_E+0000
FP2 =0_0000_0000000000000000= 0.0000000000000000_E+0000
FP3 =0_0000_0000000000000000= 0.0000000000000000_E+0000
FP4 =0_0000_0000000000000000= 0.0000000000000000_E+0000
FP5 =0_0000_0000000000000000= 0.0000000000000000_E+0000
FP6 =0_0000_0000000000000000= 0.0000000000000000_E+0000
FP7 =0_0000_0000000000000000= 0.0000000000000000_E+0000
00008000 00000000        ORI.B       #$0,D0
167-Bug>
```

The floating point data registers are always displayed in extended precision and in scientific notation format. The floating point status register display includes a mnemonic portion for the condition codes. The bit name appears (N, X, I, NAN) if the respective bit is set, otherwise a "." indicates that it is cleared.

Example 5

Display only the MMU registers.

```
167-Bug>RD =MMU
URP  =00000000  SRP  =00000000  TC   =00000000  DTT0 =00000000
DTT1 =00000000  ITT0 =00000000  ITT1 =00000000
MMUSR=00000000= .....CW.....
00008000 00000000        ORI.B       #$0,D0
167-Bug>
```

The MMUSR register above includes a mnemonic portion. The bits are:

B	Bus Error
G	Global
U1	User Page Attribute 1
U0	User Page Attribute 0
S	Supervisor Only
CM	Cache Mode (2 bits) CW,CC,IN or IS
M	Modified
W	Write Protected
T	Transparent Translation Register Hit
R	Resident

Example 6

Remove D3 through D5 and A2, and add FPSR and FP0, starting with the default display.

```
167-Bug>RD -D3-D5/-A2/FP0/FPSR <CR>
PC  =00008000 SR  =2700=TR:OFF_S._7_..... VBR =00000000
USP =0000DFFC MSP =0000EFFC ISP*=0000FFFC SFC =0=F0
DFC =0=F0     CACR=0=........
D0  =00000000 D1  =00000000 D2  =00000000 D6  =00000000
D7  =00000000 A0  =00000000 A1  =00000000 A3  =00000000
A4  =00000000 A5  =00000000 A6  =00000000 A7  =0000FFFC
FPSR=00000000-(CC=....   )
FP0 =0_0000_0000000000000000= 0.0000000000000000_E+0000
00008000 00000000        ORI.B       #$0,D0
167-Bug>
```

Note that if the current register display had differed from the default, the same results could be acquired by entering:

RD=DEF/-D3-D5/-A2/FP0/FPSR <CR>

REMOTE - Connect Remote Modem to CSO

Command Input

REMOTE

Description

The **REMOTE** command duplicates the remote operation modem functions available from the "system" mode menu command, entry number 4 (see *Initiate Service Call* in Appendix A). It is only accessible when the 16XBug is in "system" mode. Refer to the **MENU** command and to Appendix A for details on remote operation.

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 MVME16X front panel.

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.

Note If the MVME16X is the system controller, pressing the RESET switch resets all the modules in the system, including disk controllers like the MVME320 or MVME327A. This may cause the disk controller configuration to be out of phase with respect to the disk configuration tables in memory.

Example

```
167-Bug> RESET <CR>
Cold/Warm Reset [C,W] = C? W <CR>      Set to warm start.
167-Bug>
```

Press the RESET switch, actually forcing a warm start.

```
Copyright Motorola Inc. 1990, 1991, All Rights Reserved
MVME167 Debugger/Diagnostics Release Version 2.8  04/04/91
WARM Start
```


If the board is in system mode (refer to Appendix A), the diagnostics run a short self-test, then the system menu comes up. You can select the debugger. Then the 167-Diag> prompt comes up. Using the Switch Directories (**SD**) command gets you to the debugger itself.

```
167-Bug>
```

RL - Read Loop

Command Input

RL *address* [**;**[**B** | **W** | **L**]]

Options

B Byte

W Word (default)

L Longword

RL establishes an infinite loop consisting of a processor load instruction targeted to the given address and of the given length, followed by a branch instruction back to the load. Hence the address is accessed repeatedly in rapid succession.

The read loop can only be terminated by an external occurrence, such as an interrupt (usually an ABORT), a RESET from the RESET switch, or power cycle.

RM - Register Modify

Command Input

RM [*reg*]

Arguments

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.

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 the **MM** command).

Example 1

```
167-Bug>RM D5
D5   =12345678? ABCDEF^   Modify register and back up.
D4   =00000000? 3000.     Modify register and exit.
167-Bug>
```

Example 2

```
167-Bug>RM SFC

SFC  =7=CS    ? 1=        Modify register and reopen.
SFC  =1=UD    ? .         Exit.
167-Bug>
```

The **RM** command is also used to modify the registers of the floating point unit.

Example 3

```
167-Bug>RM FPSR
FPSR =00000000-(CC=....  ) ? F000000
FPIAR=00000000 ? <CR>
```

```
FP0 =0_7FFF_FFFFFFFFFFFFFFFF= 0.FFFFFFFFFFFFFFFF_E-0FFF?0_1234_5
FP1 =0_7FFF_FFFFFFFFFFFFFFFF= 0.FFFFFFFFFFFFFFFF_E-0FFF?1.25E3
FP2 =0_7FFF_FFFFFFFFFFFFFFFF= 0.FFFFFFFFFFFFFFFF_E-0FFF?1_7F_3FF
FP3 =0_7FFF_FFFFFFFFFFFFFFFF= 0.FFFFFFFFFFFFFFFF_E-0FFF?1100_9261_3
FP4 =0_7FFF_FFFFFFFFFFFFFFFF= 0.FFFFFFFFFFFFFFFF_E-0FFF?&564
FP5 =0_7FFF_FFFFFFFFFFFFFFFF= 0.FFFFFFFFFFFFFFFF_E-0FFF?0_5FF_F0AB
FP6 =0_7FFF_FFFFFFFFFFFFFFFF= 0.FFFFFFFFFFFFFFFF_E-0FFF?3.1415
FP7 =0_7FFF_FFFFFFFFFFFFFFF= 0.FFFFFFFFFFFFFFF_E-0FFF?-2.74638369E-36.

167-Bug>
```

```
167-Bug>RD +FPC
PC  =00008000 SR  =2700=TR:OFF_S._7_..... VBR =00000000
USP =0000DFFC MSP =0000EFFC ISP*=0000FFFC SFC =0=F0
DFC =0=F0     CACR=0=........
D0  =00000000 D1  =00000000 D2  =00000000 D3  =00000000
D4  =00000000 D5  =00000000 D6  =00000000 D7  =00000000
A0  =00000000 A1  =00000000 A2  =00000000 A3  =00000000
A4  =00000000 A5  =00000000 A6  =00000000 A7  =00004000
FPCR =00000000 FPSR =0F000000-(CC=NZI[NAN])  FPIAR=00000000
FP0  =0_1234_5000000000000000= 6.6258385370745493_E-3530
FP1  =0_4009_9C40000000000000= 1.2500000000000000_E+0003
FP2  =1_3FFF_BFF0000000000000=-1.4995117187500000_E+0000
FP3  =1_3C9D_BCEECF12D061BED9=-3.0000000000000000_E-0261
FP4  =0_4008_8D00000000000000= 5.6400000000000000_E+0002
FP5  =0_41FF_F855800000000000= 2.6012612226385672_E+0154
FP6  =0_4000_C90E5604189374BC= 3.1415000000000000_E+0000
FP7  =1_3F88_E9A2F0B8D678C318=-2.7463836900000000_E-0036
00008000 00000000        ORI.B       #$0,D0
167-Bug>
```

The **RM** command is also used to modify the memory management unit registers.

Example 4

```
167-Bug>RM URP
URP  =00000000?<CR>
SRP  =00000000?<CR>
TC   =00000000?87654321
DTT0 =00000000?<CR>
DTT1 =00000000?<CR>
```

```
ITT0 =00000000?<CR>
ITT1 =00000000?<CR>
MMUSR=00000000= .....CW.....? .

167-Bug>RD +MMU
PC  =00008000 SR  =2700=TR:OFF_S._7_..... VBR =00000000
USP =0000DFFC MSP =0000EFFC ISP*=0000FFFC SFC =0=F0
DFC =0=F0     CACR=0=........
D0  =00000000 D1  =00000000 D2  =00000000 D3  =00000000
D4  =00000000 D5  =00000000 D6  =00000000 D7  =00000000
A0  =00000000 A1  =00000000 A2  =00000000 A3  =00000000
A4  =00000000 A5  =00000000 A6  =00000000 A7  =0000FFFC
URP  =00000000  SRP  =00000000  TC   =87654321  DTT0 =00000000
DTT1 =00000000  ITT0 =00000000  ITT1 =00000000
MMUSR=00000000= .....CW.....
00008000 00000000        ORI.B       #$0,D0
167-Bug>
```

RS - Register Set

Command Input

RS *reg* [*exp* | *address*]

Argument

reg The mnemonic for the particular register.

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.

Example 1

```
167-Bug>RS D0 12345678        Change D0.
D0  =12345678
167-Bug>
```

Example 2

```
167-Bug>RS D0                 Examine D0.
D0  =12345678
167-Bug>
```

Example 3

The RS command is also used to change the data in the floating point unit registers.

```
167-Bug>rs fp0 3.89e10;d

FP0   =0_422_21D3DCA000000= 3.8900000000000000_E+0010
167-Bug>
```

SD - Switch Directories

Command Input

SD

Description

This command is used 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 way the directories are structured, the debugger commands are available from either directory but the diagnostic commands are only available from the diagnostic directory.

Example 1

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

You have changed from the debugger directory to the diagnostic directory, as can be seen by the "167-Diag>" prompt.

Example

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

You are now back in the debugger directory.

SET - Set Time and Date

Command Input

SET *mmddyyhhmm*

or

SET *n*;**C**

Option

C Calibrate (not available on all CPUs).

Description

The **SET** command accepts a composite inter parameter formatted as 2 digits each of month, day, year, hour, and minutes. Hours should be in Military (24-hr.) form. The parameter is validated to ensure that it corresponds to a legal date and time, and if valid, the time-of-day clock is updated to correspond, and a formatted date and time message is displayed as a check. If still incorrect, the **SET** command may be repeated.

To display the current date and time of day, refer to the **TIME** command.

The option **C** allows expert users to calibrate the Real Time of Day Clock on CPU products that support calibration. The following products use the MK48Txx family of Real Time Clocks. These clocks can be adjusted with a value of +/-31.

MVME162
MVME172
MVME166
MVME167
MVME176
MVME177

Refer to the appropriate MK48Txx manual for timing and adjustment information.

Example 1

Set a date and time of May 11, 1995 2:05 PM.

```
167-Bug>SET 0511951405<CR>
MON MAY 11 14:05:00.00 1995
167-Bug>
```

Example 2

Set "no calibration".

```
167-Bug>set 0;c
Current Calibration =   0
167-Bug>
```

Example 3

Set calibration to +25.

```
167-Bug>set 25;c
Current Calibration =   25
167-Bug>
```

Example 4

Set calibration to -25.

```
167-Bug>set -25;c
Current Calibration =  -25
167-Bug>
```

SFLASH - Switch FLASH

Command Input

SFLASH ;[L | U]

Options

The **L** and **U** options specify which half of FL.ASH appears:

L Switch to the lower half of FLASH.

U Switch to the upper half of FLASH.

If no option is entered, **SFLASH** changes from the current half to the other half. A message is displayed to indicate the change.

Description

The **SFLASH** command is available on 176Bug and 177Bug only. **SFLASH** switches the half of the FLASH array that appears in the visible address space. This command assists the user in accessing the 4MB FLASH memory array. The **SFLASH** command is valid only when jumper J8 (MVME177) or jumper J3 (MVME176) is installed.

SYM - Symbol Table Attach

Command Input

SYM [*address*]

Argument

address This argument tells the bug where the symbol table begins in memory.

Description

The **SYM** command allows you 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 th+e address is in range of any of the symbols (symbol data). If the address is in range, it is displayed with the corresponding symbol name and offset (if any) from the symbol's base address (symbol data). In addition to the display, any command line input that supports an address as an argument can now take a symbol name for the address argument. The address argument is first looked up in the symbol table to see if it matches any of the addresses (symbol data) before conversion takes place.

It is your responsibility to load the symbol table into memory. This command is analogous to the system call **.SYMBOLTA**. Refer to Chapter 5 for the description of the system call.

The default address of the symbol table is your default program counter. The symbol table must be word-aligned. The format of the symbol table is shown on the following page:.

The Number of Entries in Symbol Table field governs the size of the symbol table. The Symbol Data field must be longword-aligned and the Symbol Name field must consist only of printable characters (ASCII codes $21 through $7E). The symbol name may be terminated with a null ($00) character. The symbol data fields must be ascending in value (sorted numerically).

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.

BITS	31 — 24	23 — 16	15 — 8	7 — 0
$00	Number of Entries in Symbol Table			
$04	Symbol Data #0			
$08	Symbol Name #0			
$20	Symbol Data #1			
$24	Symbol Name #1			

Example 1

```
167-Bug>sym e000
167-Bug>
```

Attach symbol table at address $0000E000.

Example 2

```
167-Bug>md 0 ;l

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

Example 3

```
167-Bug>md _ldchar ;l
```

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


Example 4

```
167-Bug>md _ldchar+4 ;l

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

Example 5

```
167-Bug>bf _ldchar:8 0 ;l
Effective address: _ldchar+$0000
Effective count  : &32
167-Bug>md _ldchar ;l

_ldchar+$0000  00000000 00000000 00000000 00000000  ................
_ldchar+$0010  00000000 00000000 00000000 00000000  ................
167-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 5 for the description of the System Call.

Example

```
167-Bug>nosymDetach symbol table.
167-Bug>
```

SYMS - Symbol Table Display/Search

Command Input

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

Description

The **SYMS** command allows you 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 , or 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 the **SYM** command description.

Example 1

```
167-Bug>syms                    Display attached symbol table.
_stchar         00001020
_ldchar         000028A0
_sizmemory      00004930
167-Bug>
```

Example 2:

```
167-Bug>syms _ldchar            Search attached symbol table for
_ldchar         000028A0        symbol.
167-Bug>
```

Example 3

```
167-Bug>syms _s                 Search attached symbol table for
_stchar         00001020        set of symbols.
_sizmemory      00004930
167-Bug>
```

Example 4

```
167-Bug>syms;s
_ldchar         000028A0
_sizmemory      00004930
_stchar         00001020
167-Bug>
```

Display attached symbol in lexicographic order.

T - Trace

Command Input

T [*count*]

Description

The **T** command allows execution of one instruction at a time, displaying the target state after execution. **T** starts tracing at the address in the target PC. The optional count field (which defaults to 1 if none entered) specifies the number of instructions to be traced before returning control to 16XBug.

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 16XBug.

The trace functions are implemented with the trace bits (T0, T1) in the MC68040 status register, and in the T-bit in the MC68060 status register. These bits should not be modified while using the trace commands.

Example

The following program resides at location $10000.

```
167-Bug>MD 10000;DI
00010000 2200                MOVE.L   D0,D1
00010002 4282                CLR.L    D2
00010004 D401                ADD.B    D1,D2
00010006 E289                LSR.L    #$1,D1
00010008 66FA                BNE.B    $10004
0001000A E20A                LSR.B    #$1,D2
0001000C 55C2                SCS.B    D2
0001000E 60FE                BRA.B    $1000E
167-Bug>
```

Initialize PC and D0:

```
167-Bug>rm pc <CR>
PC   =00008000 ? 10000. <CR>
167-Bug>rm D0 <CR>
D0   =00000000 ? 8F41C. <CR>
167-Bug>
```

Display target registers and trace one instruction:

```
167-Bug>RD
PC   =00010000 SR   =2700=TR:OFF_S._7_..... VBR  =00000000
USP  =0000DFFC MSP  =0000EFFC ISP* =0000FFFC SFC  =0=F0
DFC  =0=F0     CACR =0=........
D0   =0008F41C D1   =00000000 D2   =00000000 D3   =00000000
D4   =00000000 D5   =00000000 D6   =00000000 D7   =00000000
A0   =00000000 A1   =00000000 A2   =00000000 A3   =00000000
A4   =00000000 A5   =00000000 A6   =00000000 A7   =0000FFFC
00010000 2200               MOVE.L      D0,D1
167-Bug>

167-Bug>T
PC   =00010002 SR   =2700=TR:OFF_S._7_..... VBR  =00000000
USP  =0000DFFC MSP  =0000EFFC ISP* =0000FFFC SFC  =0=F0
DFC  =0=F0     CACR =0=........
D0   =0008F41C D1   =0008F41C D2   =00000000 D3   =00000000
D4   =00000000 D5   =00000000 D6   =00000000 D7   =00000000
A0   =00000000 A1   =00000000 A2   =00000000 A3   =00000000
A4   =00000000 A5   =00000000 A6   =00000000 A7   =0000FFFC
00010002 4282               CLR.L       D2
167-Bug>
```

Trace next instruction:

```
167-Bug><CR>
PC   =00010004 SR   =2704=TR:OFF_S._7_..Z.. VBR  =00000000
USP  =0000DFFC MSP  =0000EFFC ISP* =0000FFFC SFC  =0=F0
DFC  =0=F0     CACR =0=........
D0   =0008F41C D1   =0008F41C D2   =00000000 D3   =00000000
D4   =00000000 D5   =00000000 D6   =00000000 D7   =00000000
A0   =00000000 A1   =00000000 A2   =00000000 A3   =00000000
```

```
A4   =00000000 A5   =00000000 A6   =00000000 A7   =0000FFFC
00010004 4D01               ADD.B       D1,D2
167-Bug>
```


Trace the next two instructions:

```
167-Bug>T2
PC   =00010006 SR   =2700=TR:OFF_S._7_.....  VBR  =00000000
USP  =0000DFFC MSP  =0000EFFC ISP* =0000FFFC SFC  =0=F0
DFC  =0=F0     CACR =0=........
D0   =0008F41C D1   =0008F41C D2   =0000001C D3   =00000000
D4   =00000000 D5   =00000000 D6   =00000000 D7   =00000000
A0   =00000000 A1   =00000000 A2   =00000000 A3   =00000000
A4   =00000000 A5   =00000000 A6   =00000000 A7   =0000FFFC
00010006 E289               LSR.L       #$1,D1
PC   =00010008 SR   =2700=TR:OFF_S._7_.....  VBR  =00000000
USP  =0000DFFC MSP  =0000EFFC ISP* =0000FFFC SFC  =0=F0
DFC  =0=F0     CACR =0=........
D0   =0008F41C D1   =00047A0E D2   =0000001C D3   =00000000
D4   =00000000 D5   =00000000 D6   =00000000 D7   =00000000
A0   =00000000 A1   =00000000 A2   =00000000 A3   =00000000
A4   =00000000 A5   =00000000 A6   =00000000 A7   =0000FFFC
00010008 66FA               BNE.B       $10004
167-Bug>
```

TA - Terminal Attach

Command Input

TA [*port*]

Description

Terminal Attach allows you to assign any serial port to be the console. The port specified must already be assigned (refer to the Port Format (**PF**) command).

Any serial port selected as the console port is saved/retained in Battery Backed Up RAM (BBRAM), also known as Non-Volatile RAM (NVRAM). This console remains in effect through power-up or any reset.

Note The Reset and Abort option returns the console port to the default port ("DEBUG" port, LUN 0).

Any time the console port is moved, you are prompted to update the NVRAM with the new port configuration parameters.

Example 1

Select port 2 (logical unit #02) as console.

```
167-Bug>TA 2 <CR>
Console = [02: VME167- "HOST1"]

Non-Volatile RAM (Y/N)? y
```

Console changes to port 2 and no prompt appears, unless port 2 was already the console. All key-Update board exchanges and displays are now made through port 2. This remains in effect (through power-up or reset)until either another **TA** command has been issued or the reset and abort option has been invoked.

Example 2

Restore console to port selected at power-up.

```
167-Bug>TA <CR>                    Prompt now appears at
Console = [00: VME167- "DEBUG"]    terminal connected to port 0.

Update Non-Volatile RAM (Y/N)? y
```

Example 3

```
167-Bug>ta 1
Console = [01: VME167- "HOST"]

Update Non-Volatile RAM (Y/N)? y
```

Example 4

You may not want to save/retain the console change permanently (NVRAM update), but make a temporary change:

```
167-Bug>ta 1
Console = [01: VME167- "HOST"]

Update Non-Volatile RAM (Y/N)? n
```

TC - Trace on Change of Control Flow

Command Input

TC [*count*]

Description

The **TC** command starts execution at the address in the target PC and begins tracing upon the detection of an instruction that causes a change of control flow, such as JSR, BSR, RTS, etc. This means that execution is in real time until a change of flow instruction is encountered. The optional count field (which defaults to 1 if none entered) specifies the number of change of flow instructions to be traced before returning control to 16XBug.

Breakpoints are monitored (but not inserted) during tracing for all trace commands, which allows the use of breakpoints in ROM or write protected memory. Note that the **TC** command recognizes a breakpoint only if it is at a change of flow instruction. In all cases, if a breakpoint with 0 *count* is encountered, control is returned to 16XBug.

The trace functions are implemented with the trace bits (T0, T1) in the MC68040 status register, and in the T-bit in the MC68060 status register. These bits should not be modified while using the trace commands.

Example

The following program resides at location $10000.

```
167-Bug>MD 10000;DI
00010000 2200                    MOVE.L      D0,D1
00010002 4282                    CLR.L       D2
00010004 D401                    ADD.B       D1,D2
00010006 E289                    LSR.L       #$1,D1
00010008 66FA                    BNE.B       $10004
0001000A E20A                    LSR.B       #$1,D2
```

```
0001000C 55C2                    SCS.B       D2
0001000E 60FE                    BRA.B       $1000E
167-Bug>
```


Initialize PC and D0:

```
167-Bug>rm pc <CR>
PC   =00008000 ? 10000. <CR>
167-Bug>rm D0 <CR>
D0   =00000000 ? 8F41C. <CR>
167-Bug>
```

Trace on change of flow:

```
167-Bug>TC
00010008 66FA               BNE.B       $10004
PC   =00010004 SR   =2700=TR:OFF_S._7_.....  VBR  =00000000
USP  =0000DFFC MSP  =0000EFFC ISP* =0000FFFC SFC  =0=F0
DFC  =0=F0     CACR =0=........
D0   =0008F41C D1   =00047A0E D2   =0000001C D3   =00000000
D4   =00000000 D5   =00000000 D6   =00000000 D7   =00000000
A0   =00000000 A1   =00000000 A2   =00000000 A3   =00000000
A4   =00000000 A5   =00000000 A6   =00000000 A7   =0000FFFC
00010004 4D01               ADD.B   D1,D2
167-Bug>
```

Note that the above display also shows the change of flow instruction.

TIME - Display Time and Date

Command Input

TIME [;[**C** | **L** | **O**]]

Options

All the following options are exclusive:

C Displays the current calibration settings of the Real Time of Day Clock on CPU products that support calibration (refer to the **SET** command).

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

O Puts the real-time clock into an on-shelf mode (clock not running).

Description

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

To initialize the time-of-day clock, refer to the **SET** command.

Example 1

A date and time of May 11, 1985 2:05:32.7 would be displayed as:

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

Example 2

No calibration is set.

```
167-Bug>time;c
Current Calibration =   0
167-Bug>
```

Example 3

Calibration is set to +25.

```
167-Bug>time;c
Current Calibration =   25
167-Bug>
```

Example 4

Calibration is set to -25.

```
167-Bug>time;c
Current Calibration =  -25
167-Bug>
```

TM - Transparent Mode

Command Input

TM [*port*] [*escape*]

Arguments

port The optional port number allows you to specify which port is the "host" port. If omitted, port 1 is assumed.

escape 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:

ASCII code	:	$03	Set escape character to ^C
control character	:	^C	Set escape character to ^C
ASCII character	:	'c	Set escape character to c

Description

TM essentially connects the current console serial port and the port specified in the command (default is the host port) together, allowing you to communicate with a host computer. A message displayed by **TM** shows the current escape character, i.e., 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**.

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.

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.

Example 1

```
167-Bug>TM <CR>                    Enter TM.
Escape character:  $01=^A          Exit code is always displayed.
<^A>
```

Example 2:

```
167-Bug>TM ^g <CR>                 Enter TM and set the escape
Escape character:  $07=^G          character to ^G (CTRL G).
<^G>
167-Bug>
```

TT - Trace to Temporary Breakpoint

Command Input

TT *address*

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 16XBug. Tracing starts at the target PC 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 16XBug.

The trace functions are implemented with the trace bits (T0, T1) in the MC68040 status register, and in the T-bit in the MC68060 status register. These bits should not be modified while using the trace commands.

Example

The following program resides at location $10000.

```
167-Bug>MD 10000;DI
00010000 2200                    MOVE.L      D0,D1
00010002 4282                    CLR.L       D2
00010004 D401                    ADD.B       D1,D2
00010006 E289                    LSR.L       #$1,D1
00010008 66FA                    BNE.B       $10004
0001000A E20A                    LSR.B       #$1,D2
0001000C 55C2                    SCS.B       D2
0001000E 60FE                    BRA.B       $1000E
167-Bug>
```

Initialize PC and D0:

```
167-Bug>rm pc <CR>
PC   =00008000 ? 10000. <CR>
167-Bug>rm D0 <CR>
D0   =00000000 ? 8F41C. <CR>
167-Bug>
```

Display target registers and trace to temporary breakpoint:

```
167-Bug>rd
PC   =00010000 SR   =2700=TR:OFF_S._7_.....  VBR  =00000000
USP  =0000DFFC MSP  =0000EFFC ISP* =0000FFFC SFC  =0=F0
DFC  =0=F0     CACR =0=........
D0   =0008F41C D1   =00000000 D2   =00000000 D3   =00000000
D4   =00000000 D5   =00000000 D6   =00000000 D7   =00000000
A0   =00000000 A1   =00000000 A2   =00000000 A3   =00000000
A4   =00000000 A5   =00000000 A6   =00000000 A7   =0000FFFC
00010000 2200               MOVE.L      D0,D1
167-Bug>

167-Bug>tt 10008
PC   =00010002 SR   =2700=TR:OFF_S._7_.....  VBR  =00000000
USP  =0000DFFC MSP  =0000EFFC ISP* =0000FFFC SFC  =0=F0
DFC  =0=F0     CACR =0=........
D0   =0008F41C D1   =0008F41C D2   =00000000 D3   =00000000
D4   =00000000 D5   =00000000 D6   =00000000 D7   =00000000
A0   =00000000 A1   =00000000 A2   =00000000 A3   =00000000
A4   =00000000 A5   =00000000 A6   =00000000 A7   =0000FFFC
00010002 4282               CLR.L       D2
PC   =00010004 SR   =2704=TR:OFF_S._7_..Z..  VBR  =00000000
USP  =0000DFFC MSP  =0000EFFC ISP* =0000FFFC SFC  =0=F0
DFC  =0=F0     CACR =0=........
D0   =0008F41C D1   =0008F41C D2   =00000000 D3   =00000000
D4   =00000000 D5   =00000000 D6   =00000000 D7   =00000000
A0   =00000000 A1   =00000000 A2   =00000000 A3   =00000000
A4   =00000000 A5   =00000000 A6   =00000000 A7   =0000FFFC
00010004 D401               ADD.B       D1,D2
PC   =00010006 SR   =2700=TR:OFF_S._7_.....  VBR  =00000000
USP  =0000DFFC MSP  =0000EFFC ISP* =0000FFFC SFC  =0=F0
DFC  =0=F0     CACR =0=........
D0   =0008F41C D1   =0008F41C D2   =0000001C D3   =00000000
```

```
D4   =00000000 D5   =00000000 D6   =00000000 D7   =00000000
A0   =00000000 A1   =00000000 A2   =00000000 A3   =00000000
A4   =00000000 A5   =00000000 A6   =00000000 A7   =0000FFFC
00010006 E289               LSR.L       #$1,D1
At Breakpoint
PC   =00010008 SR   =2700=TR:OFF_S._7_.....  VBR  =00000000
USP  =0000DFFC MSP  =0000EFFC ISP* =0000FFFC SFC  =0=F0
DFC  =0=F0     CACR =0=........
D0   =0008F41C D1   =0008F41C D2   =0000001C D3   =00000000
D4   =00000000 D5   =00000000 D6   =00000000 D7   =00000000
A0   =00000000 A1   =00000000 A2   =00000000 A3   =00000000
A4   =00000000 A5   =00000000 A6   =00000000 A7   =0000FFFC
00010008 66FA               BNE.B       $10004
167-Bug>
```

VE - Verify S-Records Against Memory

Command Input

VE [*port*] [*address*] [**;[X][C]**] [**=** *text*]

Arguments

port — The optional port number "*port*" allows you to specify which port is to be used for the downloading. If the port number is not specified but the *address* option is specified, **VE** must be separated from *address* by two commas. If this number is omitted, port 1 is assumed.

address — The optional *address* field 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 compared to memory at different locations than would normally occur. The contents of the automatic offset register are not added to the S-record addresses. (For information on S-records, refer to Appendix C.)

text — The optional text field, entered after the equals sign (=), is sent to the host before 16XBug begins to look for S-records at the host port. This allows you to send a command to the host device to initiate the download. This text should NOT be delimited by any kind of quote marks. Text is understood to begin immediately following the equals sign and terminate with the carriage return. If the host is operating full duplex, the string is also echoed back to the host port by the host and appears on your terminal screen.

Options

More than one may be used:

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.

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 the form of a file of Motorola S-records and compares it to data already in the MVME16X 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 above-mentioned text string is sent to the host one character at a time and characters received from the host are read one at a time. After the entire command has been sent to the host, **VE** keeps looking for an <LF> character from the host, signifying the end of the echoed command. No data records are processed until this <LF> is received. If the host system does not echo characters, **VE** still keeps looking for an <LF> character before data records are processed. For this reason, in situations where the host system does not echo characters, it is required that the first record transferred by the host system be a header record. The header record is not used, but the <LF> after the header record serves to break **VE** out of the loop so that data records are processed.

During a verify operation, data from an S-record is compared to memory beginning with the address contained in the S-record address field (plus the offset address, if it was specified). If the verification fails, then the non-comparing record is set aside until

the verify is complete and then it is printed out to the screen. If three non-comparing records are encountered in the course of a verify operation, then the command is aborted.

If a non-hex 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 16XBug 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 16XBug 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

This short program was developed on a host system.

```
1                       *  Test Program.
2                       *
3    65040000                         ORG          $65040000
4
5    65040000 7001                    MOVEQ.L      #1,D0
6    65040002 D088                    ADD.L        A0,D0
7    65040004 4A00                    TST.B        D0
8    65040006 4E75                    RTS
9                                     END
******  TOTAL ERRORS     0--
******  TOTAL WARNINGS   0--
```

Then this program was compiled and converted into an S-Record file named TEST.MX as follows:

```
S00F000054455354533353372020010 15E
S30D650400007001D0884A004E75B3
S7056504000091
```

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

```
167-Bug>MD 40000:4;DI
00040000 7001                    MOVEQ.L     #1,D0
00040002 D088                    ADD.L       A0,D0
00040004 4A00                    TST.B       D0
00040006 4E75                    RTS
167-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.

```
167-Bug>VE -65000000 ;x=copy TEST.MX,#
S00F000054455354533353372020010 15E
S30D650400007001D0884A004E75B3
S7056504000091
Verify passes.
167-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.

```
167-Bug>M 40002
00040002 D088 ? D089 .
167-Bug>VE -65000000 ;x=copy TEST.MX,#
S00F000054455354533353372020010 15E
S30D650400007001D0884A004E75B3
S7056504000091
```

The following record(s) did not verify .....

```
S30D65040000------88--------B3
167-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**]]

Option

E Used for components/subsystems that may have lengthy data arrays associated with the identification of it. The data array would be displayed as a memory dump (see the **MD** command).

Description

This command is used to display the various revisions and versions of the host's hardware subsystems. The minimal display will always display the revision and date of the Debugger/Diagnostics firmware package. The various subsystems can be viewed as components that are interrogative in nature.

The appropriate hardware/data manual would need to be consulted to translate the physical revision/version to its logical revision/version.

Example

```
167-Bug>VER
Debugger/Diagnostics Type/Revision.................=MVME167/1.5
Debugger/Diagnostics Revision Date.................=08/24/92 (IR01
MicroProcessor Type/Speed.........................=MC68040/25Mhz
Memory Controller #1 ID/Revision...................=80/01
Memory Configuration #1............................=00
Memory Controller #2 ID/Revision...................=Not-Present
Peripheral Controller ID/Revision..................=20/00
VMEbus Controller ID/Revision......................=10/00
LAN Coprocessor I82596 ROM Signature...............=6C335394
SCSI Coprocessor NCR53C710 Revision................=00
Serial Coprocessor CL-CD2401 Revision..............=07
167-Bug>
```

WL - Write Loop

Input Command

WL *address*:*data*;[**B** | **W** | **L**]

Options

B Byte

W Word

L Longword

Description

WL establishes an infinite loop consisting of a processor store instruction targeted to the given address and of the given length, followed by a branch instruction back to the store. The defined *data* is therefore stored repeatedly into the defined location in rapid succession.

The write loop can only be terminated by an external occurrence, such as an interrupt (usually an ABORT), a RESET from the RESET switch, or power cycle.

Index

C

D

INDEX

E

F

G

H

I

J

L

M

T