MULTI: Debugging Command Reference

Green Hills Software
30 West Sola Street
Santa Barbara, California 93101
USA
Tel: 805-965-6044
Fax: 805-965-6343
www.ghs.com

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Preface

Contents

This preface discusses the purpose of the manual, the MULTI documentation set, and typographical conventions used.

About This Book

The *MULTI: Debugging Command Reference* book provides information about using Debugger commands, and it provides a comprehensive listing of Debugger commands. It is divided into the following chapters:

- *Chapter 1: Using Debugger Commands* describes the conventions used to document the Debugger commands and explains some common concepts and procedures related to using Debugger commands. See Chapter 1, “Using Debugger Commands” on page 1.
- Remaining chapters document all commands that can be entered into the Debugger command pane. Most of these commands correspond to actions that can be performed from the graphical user interface, as described in Parts I through VI of the *MULTI: Debugging* book. The last chapter documents deprecated Debugger commands and the commands that have superseded them. See Chapter 2, “General Debugger Command Reference” on page 15.

Note

New or updated information may have become available while this book was in production. For additional material that was not available at press time, or for revisions that may have become necessary since this book was printed, please check your installation directory for release notes, **README** files, and other supplementary documentation.

The MULTI 6 Document Set

The primary documentation for using MULTI is provided in the following books:

- *MULTI: Getting Started* — Provides an introduction to the MULTI Integrated Development Environment and leads you through a simple tutorial.
- *MULTI: Licensing* — Describes how to obtain, install, and administer MULTI licenses.
- *MULTI: Managing Projects and Configuring the IDE* — Describes how to create and manage projects and how to configure the MULTI IDE.
- *MULTI: Building Applications* — Describes how to use the compiler driver and the tools that compile, assemble, and link your code. Also describes the Green Hills implementation of supported high-level languages.
- *MULTI: Configuring Connections* — Describes how to configure connections to your target.
- *MULTI: Debugging* — Describes how to set up your target debugging interface for use with MULTI and how to use the MULTI Debugger and associated tools.
- *MULTI: Debugging Command Reference* — Explains how to use Debugger commands and provides a comprehensive reference of Debugger commands.
- *MULTI: Scripting* — Describes how to create MULTI scripts. Also contains information about the MULTI-Python integration.

For a comprehensive list of the books provided with your MULTI installation, see the **Help → Manuals** menu accessible from most MULTI windows.

Most books are available in the following formats:

- A printed book (select books are not available in print).
- Online help, accessible from most MULTI windows via the **Help → Manuals** menu.
- An electronic PDF, available in the **manuals** subdirectory of your IDE or Compiler installation.

Conventions Used in the MULTI Document Set

All Green Hills documentation assumes that you have a working knowledge of your host operating system and its conventions, including its command line and graphical user interface (GUI) modes.

Green Hills documentation uses a variety of notational conventions to present information and describe procedures. These conventions are described below.

Convention	Indication	Example
bold type	Filename or pathname	**C:\MyProjects**
	Command	**setup** command
	Option	**-G** option
	Window title	The **Breakpoints** window
	Menu name or menu choice	The **File** menu
	Field name	**Working Directory:**
	Button name	The **Browse** button
italic type	Replaceable text	**-o *filename***
	A new term	A task may be called a *process* or a *thread*
	A book title	*MULTI: Debugging*
`monospace` type	Text you should enter as presented	Type `help` *`command_name`*
	A word or words used in a command or example	The **wait** [-global] command blocks command processing, where `-global` blocks command processing for all MULTI processes.
	Source code	`int a = 3;`
	Input/output	`> print Test` `Test`
	A function	`GHS_System()`
ellipsis (...) (in command line instructions)	The preceding argument or option can be repeated zero or more times.	**debugbutton** [*name*]...

Convention	Indication	Example
greater than sign (>)	Represents a prompt. Your actual prompt may be a different symbol or string. The > prompt helps to distinguish input from output in examples of screen displays.	`> print Test` `Test`
pipe (|) (in command line instructions)	One (and only one) of the parameters or options separated by the pipe or pipes should be specified.	**call** *proc* | *expr*
square brackets ([ ]) (in command line instructions)	Optional argument, command, option, and so on. You can either include or omit the enclosed elements. The square brackets should not appear in your actual command.	`.macro` *`name`* `[`*`list`*`]`

The following command description demonstrates the use of some of these typographical conventions.

gxyz [-*option*]... *filename*

The formatting of this command indicates that:

- The command **gxyz** should be entered as shown.
- The option *`-option`* should either be replaced with one or more appropriate options or be omitted.
- The word *`filename`* should be replaced with the actual filename of an appropriate file.

The square brackets and the ellipsis should not appear in the actual command you enter.

Chapter 1

Using Debugger Commands

Contents

This chapter describes the conventions used to document the Debugger commands and explains some common concepts and procedures related to using Debugger commands. The remainder of this manual describes all of the MULTI Debugger commands. For a description of the command pane, the area of the main Debugger window in which you enter Debugger commands, and shortcuts that can be used in the command pane, see “The Command Pane” in Chapter 2, “The Main Debugger Window” in the *MULTI: Debugging* book.

Availability of Debugger Commands

All of the Debugger commands can be executed from the Debugger command pane. Many of these commands can also be invoked using Debugger menus, buttons, hot keys, or mouse bindings, as noted in the description for each command.

Some Debugger commands are not available in non-GUI mode. These commands are labeled *GUI only*. If a command is not marked *GUI only*, it is available in both GUI and non-GUI mode. For more information about GUI and non-GUI modes, see “Starting the Debugger in GUI Mode” in Chapter 1, “Introduction” in the *MULTI: Debugging* book and “Starting the Debugger in Non-GUI Mode (Linux/Solaris only)” in Chapter 1, “Introduction” in the *MULTI: Debugging* book.

A few Debugger commands are available only on Linux/Solaris or while debugging Linux/Solaris-like targets, and are labeled *Linux/Solaris only*.

For a full explanation of other notational and usage conventions pertaining to the Debugger commands, see “Debugger Command Conventions” on page 3.

Getting Help Information about Debugger Commands

The MULTI Debugger provides two commands that display help about Debugger commands:

- `help` *`command`* — Opens the Help Viewer on documentation for the specified command.
- `usage` *`command`* — Prints the basic syntax of the specified command to the command pane.

For more information about these and other help commands, see Chapter 9, "Help and Information Command Reference" on page 109.

Finding Debugger Commands in This Book

The following chapters provide comprehensive documentation of all of the commands available for use in the command pane of the MULTI Debugger. The commands are grouped by function.

If you are looking for information about a specific command, consult the index for the specific location of the relevant documentation. For an alphabetical list of all Debugger commands, see the entry **commands** in the index.

For general information about using Debugger commands, and for an explanation of the conventions used in the command syntax and descriptions, see "Debugger Command Conventions" on page 3. For a description of the command pane, the area of the main Debugger window in which you enter Debugger commands, and shortcuts that can be used in the command pane, see "The Command Pane" in Chapter 2, "The Main Debugger Window" in the *MULTI: Debugging* book.

Debugger Command Conventions

The following table describes symbols, placeholders, and concepts that are related to Debugger commands and that are used in the following chapters.

%bp_ID	Some Debugger commands accept one or more ***%bp_ID*** arguments, where `bp_ID` is the breakpoint identification number assigned to a breakpoint by MULTI when the breakpoint is created. For more information, see "Breakpoint IDs and Labels" on page 10. Breakpoint IDs in the form ***%bp_ID*** can be used to specify a single breakpoint, a breakpoint range, or a breakpoint list related to the execution of a specific command. For more information, see "Breakpoint Ranges and Lists" on page 11.

%bp_label	The **b** commands for setting breakpoints (for example, **b**, **bi**, **bif**, and **bx**) accept ***%bp_label*** as an argument, where *`bp_label`* is the user-specified name for the breakpoint. *`bp_label`* should not contain spaces or special characters.
	
	The following example sets a breakpoint labeled `foo` on line 24 of procedure `main`:
	
	`> b %foo main#24`
	
	After a breakpoint has been created with a breakpoint label, other commands (such as **B**, **e**, **d**, and **tog**) can use the breakpoint labels to refer to that specific breakpoint. For example:
	
	`> d %foo`
	
	removes the breakpoint labeled `foo`.
	
	Breakpoint labels can also be used to specify breakpoint lists and ranges. For more information, see "Breakpoint Ranges and Lists" on page 11.

@bp_count	The **b** commands for setting breakpoints (for example, **b** and **bx**) accept ***@bp_count*** as an argument, where *`bp_count`* is an integer. When a breakpoint's count is greater than 1, your process skips the breakpoint, and the count is decremented by 1. When the count reaches 1, the breakpoint stops your process in accordance with the breakpoint's other attributes. In this way, a breakpoint with a count can be used to stop your process less frequently and reproduce complex software conditions. Breakpoints with counts are especially useful for debugging inner loops.
@continue_count	The **c** and **cb** commands use the ***@continue_count*** argument to specify how many breakpoints the Debugger will pass before stopping. For example, if ***continue_count*** is 4, the Debugger skips over the next 3 breakpoints and stops the process at the fourth breakpoint. **Note:** Only breakpoints that stop program execution are counted. A conditional breakpoint whose condition is false or a breakpoint whose commands resume a process are not counted. For more information, see "Continue Commands" on page 148.

{*commands*}	Curly braces indicate a command list, where ***commands*** can be either a single command or a list of commands with the syntax: ***command; command; ...*** Some Debugger commands, such as certain breakpoint commands, accept command lists that specify other commands to be performed at specific times. For more information, see "Using Command Lists in Debugger Commands" on page 12.
address_expression	In the documentation describing the syntax for Debugger commands, ***address_expression*** is a placeholder for an expression referring to a specific location within your program. The Debugger accepts a variety of address expressions. For examples of common address expression formats, see "Using Address Expressions in Debugger Commands" on page 5.
GUI only	The label **GUI only** indicates that a command is not available in non-GUI mode. For more information about GUI and non-GUI modes, see "Starting the Debugger in GUI Mode" in Chapter 1, "Introduction" in the *MULTI: Debugging* book and "Starting the Debugger in Non-GUI Mode (Linux/Solaris only)" in Chapter 1, "Introduction" in the *MULTI: Debugging* book.
Linux/Solaris only	The label **Linux/Solaris only** indicates that the command is only available on Linux/Solaris or while debugging Linux/Solaris-like target systems.
stacklevel_	A number followed by an underscore refers to the specified level of the call stack. For example, if the procedure `main()` calls `foo()`, which calls `bar()`, which calls `hum()`, and in the Debugger you are currently debugging `hum()`, the following command: `> e 2_` changes the current viewing location to `foo()`, because `foo()` is at frame 2 in the current call stack.

Using Address Expressions in Debugger Commands

In the documentation describing the syntax for Debugger commands, *`address_expression`* is a placeholder for an expression referring to a specific location within your program. Note that address expressions differ from standard expressions, which are discussed in Chapter 14, "Using Expressions, Variables, and Procedure Calls" in the *MULTI: Debugging* book.

The following table provides example address expressions, which are specified here in conjunction with the **e** command. The **e** command navigates to the location indicated by the given address expression (see “e” on page 133).

Note

When the *`address_expression`* refers to a line number, the meaning of the expression varies depending on whether the configuration option **procRelativeLines** is on (procedure-relative mode) or off (file-relative mode). For more information about specifying line numbers, see “Specifying Line Numbers” on page 7.

Command	Effect
`e 10`	Procedure-relative mode: Examines line number 10 in the current procedure. File-relative mode: Examines line number 10 in the current file.
`e +10` or `-10`	Examines ten lines after or before the current position, respectively.
`e 0x1234`	Examines the line at address `0x1234`.
`e proc2`	Examines procedure `proc2`.
`e proc2#4`	Procedure-relative mode: Examines line 4 of procedure `proc2`. File-relative mode: Examines line 4 of the file containing `proc2`, if that line exists within `proc2`.
`e "file3.c"#4`	Examines line 4 of file **file3.c**.
`e "file3.c"#proc2`	Examines procedure `proc2` in file **file3.c**.
`e "file3.c"#proc2#4`	Procedure-relative mode: Examines line 4 of procedure `proc2` in file **file3.c**. File-relative mode: Examines line 4 of the file **file3.c**, if that line exists within `proc2`.
`e (foo)`	Examines the address that is the value of the standard expression `foo`.
`e global_variable`	Examines the source location where `global_variable` is defined.
`e ($retadr( ))`	Examines the return address (exit point) of the current procedure.

Command	Effect
`e 1b`	Examines the location of the breakpoint with ID = 1.
`e %`*`bp_label`*	Examines the location of the breakpoint labeled *`bp_label`*.
`e 2_`	Examines stack level 2.
`e "file3.c"#proc2##label4`	Examines C Label `label4` in procedure `proc2` in file **file3.c**.
`e proc2##label4`	Examines C Label `label4` in procedure `proc2`.
`e ##label4`	Examines C Label `label4` in the current procedure.
`e *`	Examines the procedure list (wildcard search).
`e $`*`register_name`*	Examines the address stored in the register *`register_name`*.
`e $`*`system_variable`*	Examines the address stored in the system variable *`system_variable`*.

For information about the way MULTI resolves names in address expressions, see "Name Resolution" on page 8.

Specifying Line Numbers

The MULTI Debugger has two modes for interpreting line numbers: procedure-relative mode and file-relative mode. By default, the Debugger uses procedure-relative mode and interprets line numbers relative to a procedure rather than to a file. To change from one mode to another, toggle the option **Use procedure relative line numbers (vs. file relative)**, which appears on the **Debugger** tab of the **Options** window. (From the command pane, use the syntax `configure procRelativeLines on | off`.)

The following examples demonstrate how the same command will examine different lines, depending on whether the Debugger is configured for procedure-relative or file-relative mode.

Command	Effect in Procedure-Relative Mode	Effect in File-Relative Mode
`e proc3#4`	Examines the source code at line 4 of procedure `proc3`.	Examines the source code at line 4 of file containing procedure `proc3`. (The line must exist within `proc3`.)

Command	Effect in Procedure-Relative Mode	Effect in File-Relative Mode
`e 4`	Examines the source code at line number 4 in the current procedure.	Examines the source code at line number 4 in the current file.
`e #4`	Examines the source code at line number 4 in the current file.	Examines the source code at line number 4 in the current procedure.

Name Resolution

When resolving names in address expressions, MULTI attempts to match the name with a function, a global variable, or a program section. If attempting to match the name with a function, MULTI generally searches fully qualified function names first, then base names.

In C, the base name of a function and the fully qualified name are the same. In C++, the fully qualified name consists of the function's name and argument type(s), while the base name consists of the name only. Some examples follow.

```
int ex1(int arg1);
```

- Base name in C — `ex1`
- Fully qualified name in C — `ex1`
- Base name in C++ — `ex1`
- Fully qualified name in C++ — `ex1(int)`

```
int ex2();
```

- Base name in C — `ex2`
- Fully qualified name in C — `ex2`
- Base name in C++ — `ex2`
- Fully qualified name in C++ — `ex2()`

```
int ex3(int arg1, float arg2, short arg3, char * arg4);
```

- Base name in C — `ex3`
- Fully qualified name in C — `ex3`
- Base name in C++ — `ex3`

- Fully qualified name in C++ — `ex3(int, float, short, char *)`

Names in standard address expressions are resolved as follows.

If you specified a file in the address expression, MULTI attempts, in the order indicated below, to match the name with:

1. The fully qualified name of a function in the specified file
2. The base name of a function in the specified file
3. A global variable in the specified file

If you did not specify a file in the address expression, MULTI attempts, in the order indicated below, to match the name with:

1. The fully qualified name of a static function in the current file
2. The fully qualified name of a non-static function in any file
3. An unresolved link symbol (generally a function name in a library that is not yet loaded)
4. In C — The name of any function (including static functions) in the program

   In C++ — The base name of any function in any class/namespace in the program (If the name in the expression is prefixed with `::`, MULTI searches only the global namespace for a match. If the name in the expression is fully qualified, MULTI uses the given qualifications in its search.)

   If MULTI finds more than one matching result, you may be asked to choose one.
5. Any global variable (only if the name in the expression is *not* followed by `#`)
6. A section name on the target (only if the name in the expression is *not* followed by `#`)

Identifying Breakpoints in Debugger Commands

You can use breakpoint IDs, breakpoint labels, breakpoint ranges, and breakpoint lists to specify breakpoints in Debugger commands.

Breakpoint IDs and Labels

MULTI automatically assigns a *breakpoint ID* number to each breakpoint when it is created. Breakpoints are numbered sequentially in the order in which they were created, without respect to their location. To see a list of breakpoints by breakpoint ID, use the **B** command. (For a full description of the information printed about each breakpoint when this command is executed, see "B" on page 40.)

The breakpoint ID provides a way to refer to specific breakpoints. Some Debugger commands accept one or more ***%bp_ID*** arguments, where `bp_ID` is the breakpoint ID number. Breakpoint IDs in the form ***%bp_ID*** can also be used to specify a range of breakpoints or a list of breakpoints, as described in "Breakpoint Ranges and Lists" on page 11.

You can also specify a *breakpoint label* when you create a new breakpoint. Most of the **b** commands for setting breakpoints (for example, **b**, **bi**, **bif**, and **bx**) accept ***%bp_label*** as an argument to specify a name for a new breakpoint. `bp_label` should not contain spaces or special characters.

The following example sets a breakpoint labeled `foo` on line 24 of procedure `main`:

```
> b %foo main#24
```

After a breakpoint has been created with a breakpoint label, other commands (such as **B**, **e**, **d**, and **tog**) can use the breakpoint label to refer to that specific breakpoint. For example:

```
> d %foo
```

removes the breakpoint labeled `foo`. For information about the **B**, **d**, and **tog** commands, see "Breakpoint Commands" on page 37. For information about the **e** command, see "Navigation Commands" on page 132.

To add a label after a breakpoint is created, use the **Software Breakpoint Editor**. For more information, see "Creating and Editing Software Breakpoints" in Chapter

8, “Executing and Controlling Your Program from the Debugger” in the *MULTI: Debugging* book.

Like breakpoint IDs, breakpoint labels can also be used to specify breakpoint ranges and breakpoint lists, as described in the next section.

Breakpoint Ranges and Lists

A *breakpoint range* has the format:

%bp_ID_or_bp_label_1*:*%bp_ID_or_bp_label_2

and refers to all of the breakpoints with breakpoint IDs between the IDs for the breakpoints referred to by *`bp_ID_or_bp_label_1`* and *`bp_ID_or_bp_label_2`*, inclusive. For example, `%3:%6` refers to the four breakpoints with breakpoint IDs 3, 4, 5, and 6. You can specify breakpoint labels in a breakpoint range. These will be converted to the corresponding numerical ID in order to establish the range. The breakpoint ID of the second breakpoint in the range must be greater than or equal to the breakpoint ID of the first breakpoint in the range.

A *breakpoint list* is a comma-separated list of breakpoint IDs, breakpoint labels, and/or breakpoint ranges. You can include one or more breakpoint ranges in a breakpoint list. For example, the breakpoint list `%3,%6:%8` refers to the four breakpoints with identification numbers 3, 6, 7, and 8.

Some breakpoint commands, such as the **B** and **d** commands, can take breakpoint lists as arguments. For example:

Command	Effect
`d %foo,%bar,%gamma`	Removes the breakpoints labeled `foo`, `bar`, and `gamma`.
`d %foo:%gamma`	Removes the breakpoints with breakpoint IDs in the range between the breakpoint ID of breakpoint labeled `foo` and the breakpoint ID of the breakpoint labeled `gamma`. The breakpoint ID of the second breakpoint in the range must be greater than or equal to the ID of the first breakpoint in the range.
`d %1,%4:%7`	Removes the breakpoints with ID numbers 1, 4, 5, 6, and 7.

For more information about breakpoint IDs and breakpoint labels, see “Breakpoint IDs and Labels” on page 10. For information about the **B** and **d** commands, see “Breakpoint Commands” on page 37.

Command Syntax

Using Command Lists in Debugger Commands

Some Debugger commands, such as certain breakpoint commands and conditional execution commands, can contain a list of other commands to be performed when certain conditions are met. Such commands are specified in a *command list*, which is indicated by curly braces (**{ }**). A command list can contain either a single command or a list of commands with the syntax: **{ *command1*; *command2*; ...}**.

A command list can span multiple lines. That is, after the initial curly brace (**{**), which must be included on the first line, you can continue to enter commands on separate lines until you end the list with a closing curly brace (**}**).

For example, a valid **if** command can be written to span multiple lines as follows:

```
if ($test == 0) {
    mprintf("Invalid value\n");
} else {
mprintf("Valid value\n");
}
```

The following **if** command, which also spans multiple lines, uses invalid syntax (the curly braces begin new lines):

```
if ($test == 0)
{
    mprintf("Invalid value\n");
} else
{
    mprintf("Valid value\n");
}
```

Curly braces may contain other pairs of curly braces, as long as they are all paired and closed correctly. For example, the following command will set a breakpoint that checks the value of some global variables.

```
MULTI> b {
continued> mprintf("Fly = %d\n", fly);
continued> if (bar<9) {resume} else {echo Error: bar too high}
continued> }
```

When the breakpoint is hit, the Debugger will first print:

```
Fly =
```

followed by the decimal value of the variable `fly`. Then, if the value of the variable `bar` is less than nine, the process will continue to run. Otherwise, the Debugger will print:

```
Error: bar too high
```

and the process will remain stopped at the breakpoint.

Continuing Commands onto Subsequent Lines

To issue a command that spans multiple lines:

- End every line but the last with a backslash (`\`), or
- Use an open curly brace (`{`) as documented in "Using Command Lists in Debugger Commands" on page 12.

Including Comments in Debugger Commands

You can use C or C++ style comments in Debugger commands. For example:

```
> echo foo /* This is a C style comment */
foo
> echo bar // This is a C++ style comment
bar
```

These comments will be stripped out and ignored during command processing.

Note

C-style comments `/* */` are allowed to span lines.

Terminating Commands

All MULTI Debugger commands are assumed to be terminated by a new line or by a semicolon (`;`) unless the new line or semicolon occurs inside a command list (denoted by `{}`) or the new line is preceded by a backslash (\). See “Using Command Lists in Debugger Commands” on page 12.

Default Search Path for Files Specified in Commands

MULTI maintains a search path that it uses when locating user-specified filenames on the file system. The search path always contains the current directory (**.**) as its final entry. To change this search path, do one of the following:

- Use the **source** command (see “source” on page 80).
- Use the **-I** command line option to MULTI. For more information, see “Using the Command Line” in Chapter 1, “Introduction” in the *MULTI: Debugging* book.
- From the main Debugger menu, choose **View** → **Source Path**.

MULTI uses the default search path when locating the following types of files:

- Source files
- Script files
- Object files

If a Debugger command uses the default search path, it will be indicated in its description.

Chapter 2

General Debugger Command Reference

Contents

The commands in this chapter allow you to perform common Debugger operations such as attaching to and detaching from a program, debugging a new program, blocking command processing, and closing the Debugger or the MULTI IDE. For information about using the Debugger, see the *MULTI: Debugging* book.

General Debugger Commands

The following list provides a brief description of each general Debugger command. For a command's arguments and for more information, see the page referenced.

- **asm** — Assembles the given assembly instruction into machine code and prints this machine code (see “asm” on page 17).
- **attach** — Attaches to a process running on an RTOS (see “attach” on page 18).
- **caches** — Enables or disables the use of the memory cache and the assembly cache (see “caches” on page 19).
- **call** — Prints the value of the given procedure or expression (see “call” on page 19).
- **dbnew** — Allows you to debug a different program (see “dbnew” on page 19).
- **debug** — Replaces the current program with the given program (see “debug” on page 20).
- **detach** — Detaches the Debugger from the program it is currently debugging (see “detach” on page 20).
- **loadsym** — Loads additional debug symbols from the given file and merges them into the symbol table (see “loadsym” on page 21).
- **mev** — Requests the MULTI EventAnalyzer to perform the given operation (see “mev” on page 22).
- **monitor** — Saves the command list `commands` to send to the Debugger every time the process stops (see “monitor” on page 23).
- **mrv** — Launches or closes the MULTI ResourceAnalyzer (see “mrv” on page 23).
- **multibar** — Starts the Launcher (see “multibar” on page 24).
- **new** — Adds the given program to the target list and loads it in the Debugger window (see “new” on page 24).

- **output** — Redirects output normally sent to the Debugger into a file or to standard output (see “output” on page 25).
- **P** — Sends commands to processes and/or lists information about processes (see “P” on page 27).
- **q** — Prompts the user to quit MULTI (see “q” on page 28).
- **quit** — Closes the current Debugger window and exits MULTI if this is the last window (see “quit” on page 29).
- **quitall** — Exits MULTI (see “quitall” on page 30).
- **restore** — Restores the state of the Debugger from the specified file (see “restore” on page 30).
- **save** — Saves the state of the Debugger (see “save” on page 31).
- **unloadsym** — Unloads from the symbol table all the debugging symbols for the specified file (see “unloadsym” on page 31).
- **wait** — Blocks command processing (see “wait” on page 31).

asm

asm [-replace *addr* [-force | -f]] [-opt "*options*"] *inst*

Select targets only

Assembles the given assembly instruction `inst` into the machine code it represents and prints this machine code. (If this feature is not supported for the current target, an error message will be printed instead). This command takes the following arguments:

- `-replace addr` — Replaces the instruction at address `addr` with the assembled version of `inst` (if the assembling is successful). Note that this may fail if the instruction assembled has a different length than the instruction at address `addr`; see `-force` to avoid this.
- `-force` | `-f` — Only valid when `-replace` is used. This forces the replacement to proceed even if the instruction assembled has a different length than the instruction at address `addr`.
- `-opt "options"` — Assembles `inst` with the indicated assembler options. See the documentation for your target's assembler for more information about possible options.

attach

attach [-addressSpace *name*] *process_id*|*process_name* [-halt|-nohalt] [-exec *executable*]

GUI only

Attaches to a process running on an RTOS, adds a new target list entry for the process, and loads the process in the Debugger window. Attaching to threads advertised by hardware targets is a deprecated use of this command.

You can use this command for native Linux/Solaris debugging. Note that unless you are logged in as `root`, you can only debug your own native processes.

Available options are:

- `-addressSpace` *`name`* — Specifies where the task (or process) is from on the INTEGRITY operating system. If *`name`* contains a space or other special characters, it should be enclosed in double quotation marks.
- *`process_id`* — Specifies the numeric ID of a task as displayed in the run-mode Task Manager, freeze-mode **OSA Explorer**, or native **Process Viewer** window.
- *`process_name`* — Specifies the name of a task as displayed in the run-mode Task Manager or freeze-mode **OSA Explorer** window. If *`process_name`* contains a space or other special characters, it should be enclosed in double quotation marks.
- `-halt` and `-nohalt` — Specify whether or not to halt the process on the target when the process is attached. If `-halt` or `-nohalt` is not specified, the behavior depends on the corresponding debug server's setting. Note that `-nohalt` is only supported with embedded debugging.
- `-exec` *`executable`* — Specifies the process's executable name. If no executable is specified, MULTI tries to find the executable name for the process and asks you to select one if it fails to do so.

The **detach** command detaches from a process (see “detach” on page 20).

Corresponds to: **File → Attach to Process**

caches

caches [on | off]

GUI only

Enables or disables the use of both the memory cache (`_CACHE`) and the assembly cache (`_ASMCACHE`). For example, `caches on` is equivalent to `_CACHE = 1; _ASMCACHE = 1`. For more information about `_CACHE` and `_ASMCACHE`, see "System Variables" in Chapter 14, "Using Expressions, Variables, and Procedure Calls" in the *MULTI: Debugging* book.

call

call *proc* | *expr*

Prints the value of the procedure *`proc`* or the expression *`expr`*. This command allows you to call:

- a procedure with the same name as a MULTI command or
- an expression that contains one or more variables with the same name as a MULTI command

This command does not use MULTI commands when resolving the name of the given procedure or expression.

dbnew

dbnew [c | n]

GUI only

Allows you to debug a different program. The **dbnew** command prompts you to select a new executable to debug. The selected executable is added to the target list and loaded into the Debugger window, replacing the previous program. If `c` is specified, the previous program is removed from the target list. If `n` is specified, the previous program is not removed from the target list and its status is unaffected. If you run this command without arguments, it has the same effect as `dbnew n`. See also "debug" on page 20.

Corresponds to: **File → Debug Program as New Entry**

debug

debug [*program_name*] [*core_file*]

Replaces your current program with a new program to debug given by `program_name`. If no new program is given, the current program's name is used. This command will have no effect unless the current process has executed. All monitors and monitor windows are deleted and any child processes of the current program are also killed.

The optional `core_file` argument applies only to Linux/Solaris. If `core_file` is specified, the Debugger will display the location of the program counter recorded in the core file. Otherwise, the Debugger will display the main routine. For more information, see “Core File Debugging (Linux/Solaris only)” in Chapter 7, “Preparing Your Target” in the *MULTI: Debugging* book.

The named files will be located using the default search path. See “Default Search Path for Files Specified in Commands” on page 14.

Corresponds to: 

Corresponds to: **File → Debug Program**

detach

detach [-run|-norun] [pr=*num*]

In run mode, detaches the Debugger from the current process and selects the next program in the target list. In a native environment, the entry for the current process is removed from the target list, but the debug server remains connected. All breakpoints are removed before detaching. See also “attach” on page 18.

- `-run` and `-norun` — Specify whether or not to resume the process on the target when the process is detached. If you do not specify one of these options, the behavior depends on the debug server, which usually resumes the process. (Note that the **detach** command may halt a currently running process before resuming it. This behavior depends on the debug server.)

- `pr=`*`num`* — Specifies that the process you want to detach from is placed in the Debugger's internal process slot number *`num`*. If no process slot is specified, the process on which the command is executed is detached.

Corresponds to: **File → Detach from Process**

loadsym

loadsym *filename* [*text_offset* [*data_offset*]]

Loads additional debug symbols from the file specified by *`filename`* and merges them into the symbol table. *`filename`* is searched for using the default search path (see “Default Search Path for Files Specified in Commands” on page 14). If the optional text and data offset values are supplied, the text and data addresses are offset by the given values.

You can use this command in target environments where new code, typically position-independent code, is loaded to the target at run time. For example:

```
> loadsym a.out 0x20000
```

This command loads symbol information into the Debugger, but does not affect the target. You can load additional symbol information for a module during a debugging session.

Warning

Do not use this command to specify the primary executable that you want to debug. Instead, use the **debug** command followed by the **prepare_target** command (see “debug” on page 20 and “prepare_target” on page 228). For example, if you connect to a target on which your program is already loaded, first select **Direct hardware access** for the core that is running the program, and then issue the following commands:

```
> debug my_program
> prepare_target -verify=none
```

See also “unloadsym” on page 31.

mev

mev -close [*data_file*]

mev [-title *title_string*] [-noreload] [-raisewindow] *data_file*

mev [-title *title_string*] -newwindow [*data_file*]

mev [-oid *object_id*] -time *position_to_scroll_to* [-raisewindow] [*data_file*]

Requests the MULTI EventAnalyzer to perform the given operation, where:

- `-close [`*`data_file`*`]` — Closes the EventAnalyzer window displaying the data file *`data_file`*. If *`data_file`* is not specified, all EventAnalyzer windows are closed.
- *`data_file`* — Displays the specified data file, *`data_file`*, in an EventAnalyzer window. The following options can be placed before the *`data_file`* argument.
  - `-title` *`title_string`* — Specifies the title for the EventAnalyzer window displaying *`data_file`*.
  - `-noreload` — Indicates that the specified data file should not be reloaded if it is already being displayed in an EventAnalyzer window.
  - `-raisewindow` — Raises the existing EventAnalyzer window displaying the specified data file to the top.
  - `-newwindow` — Opens a new EventAnalyzer window to display the specified data file. If you do not specify a data file, an empty EventAnalyzer opens. No more than one empty EventAnalyzer can be displayed at a time.
- `-time` *`position_to_scroll_to`* — Scrolls the EventAnalyzer window to the time specified by *`position_to_scroll_to`*. The following arguments can also be used with the `-time` option.
  - `-oid` *`object_id`* — Specifies the object ID, *`object_id`*, for the EventAnalyzer window to scroll to. This option should come before `-time`.
  - `-raisewindow` — Raises a previously launched EventAnalyzer window to the top.
  - *`data_file`* — Specifies which data file to display in the EventAnalyzer and scroll in. If no data file is specified, all EventAnalyzer windows are scrolled to the specified time on the specified object, if applicable.

monitor

monitor [0 | {*commands*} | *num* [{*commands*}]]

GUI only

Saves the command list `commands` to send to the Debugger every time the process stops. An unlimited number of monitors can be active at any time.

This command has five forms:

- **monitor** — Lists all of the monitors in order.
- **monitor** `num` — Deletes monitor number `num`. This does not renumber the current monitors. Thus, if you have four monitors and delete number `3`, the remaining three will be numbered `1`, `2`, `4`, creating an "empty slot" where `3` was formerly located.
- **monitor** `{commands}` — Inserts a monitor with the given command list in the first available empty slot.
- **monitor** `num {commands}` — Puts a monitor with the given command list in the `num` slot. It replaces any existing monitor in that position.
- **monitor** `0` — (The number zero.) Deletes all monitors.

See also "window" on page 278. For information about command lists, see "Using Command Lists in Debugger Commands" on page 12.

mrv

mrv [-title *string*] [-log *log_filename*] [-timeout *seconds*] [-port *port_num*] *target*

mrv -close [[-port *port_num*] *target*]

GUI only

Launches or closes the MULTI ResourceAnalyzer. The first format of the command launches the ResourceAnalyzer and the second format closes it.

Available options are:

- `-title` *`string`* — Specifies the string that appears in the title bar of the MULTI ResourceAnalyzer.
- `-log` *`log_filename`* — Specifies that messages from the target should be logged to *`log_filename`*.
- `-timeout` *`seconds`* — Specifies the timeout period (in seconds) for connecting to the target. If not specified, the host's default value is used.
- `-port` *`port_num`* — Specifies the port to connect to on *`target`*. If you do not specify a port, MULTI uses the default port used by the INTEGRITY target.
- *`target`* — Specifies the target you want to connect to.
- `-close [[-port` *`port_num`*`]` *`target`*`]` — Disconnects the MULTI ResourceAnalyzer from *`port_num`* on *`target`*. If you do not specify a port, MULTI disconnects from the default port used by the INTEGRITY target. If you do not specify *`target`*, the connection for the current ResourceAnalyzer is closed.

multibar

multibar

Starts the Launcher.

Corresponds to: **Tools → Launcher**

new

new [[-alias *component_alias*]... [-bind *component_alias*]... *program_name* [pr=*num*] [*core_file*]]

GUI only

Adds the program *`program_name`* to the target list and loads the program in the Debugger window. Available options are:

- `-alias` *`component_alias`* — Adds the alias *`component_alias`* for the Debugger component *`program_name`* so that you can route commands to the component (see “route” on page 181). To list components and their aliases, use the **components** command (see “components” on page 97).

- `-bind` *`component_alias`* — Associates the program *`program_name`* with the CPU and connection represented by the given Debugger component. This argument is only supported if there is no pre-existing association between the connection and another executable. See also “Associating Your Executable with a Connection” in Chapter 7, “Preparing Your Target” in the *MULTI: Debugging* book.
- *`program_name`* — Adds the program *`program_name`* to the target list and loads the program in the Debugger window.
- `pr=`*`num`* — Specifies that the program *`program_name`* be placed in MULTI's internal program slot numbered *`num`*. If *`num`* is not specified, MULTI uses the first empty slot. If *`num`* is specified and that program slot is in use, the target list entry for that slot is reused to debug the new program. To see which program slots are in use, issue the **P** command (see “P” on page 27).
- *`core_file`* (Linux/Solaris only) — Specifies a core file for the program *`program_name`*. For more information, see “Core File Debugging (Linux/Solaris only)” in Chapter 7, “Preparing Your Target” in the *MULTI: Debugging* book.

If no arguments are specified, MULTI adds another instance of the current program to the target list and loads the program in the Debugger window.

output

output [-show] -server|-io|-multi [-prefix *prefix_string*|-noprefix] [-append] [-copytopane yes|no] [*filename*|-normal]

Redirects output normally sent to the Debugger into a file or to standard output. You may optionally copy the redirected output to the Debugger.

When a string is redirected to a file or to standard output, a prefix is automatically printed before the text in order to distinguish it from different sources. You can change or disable the prefix with the `-prefix` or `-noprefix` options, respectively.

The options are:

- `-show` — Displays the current output settings.

- `-server` — Sets the destination for output normally sent to the target pane of the Debugger window (see “The Target Pane” in Chapter 2, “The Main Debugger Window” in the *MULTI: Debugging* book).
- `-io` — Sets the destination for output normally sent to the I/O pane of the Debugger window (see “The I/O Pane” in Chapter 2, “The Main Debugger Window” in the *MULTI: Debugging* book).

Note

Because I/O is handled by the underlying operating system in a native environment, you cannot use the **output** command to redirect output from a native process. On Linux/Solaris, the output is displayed in the terminal from which the Debugger was launched.

- `-multi` — Sets the destination for output normally sent to the command pane of the Debugger window (see “The Command Pane” in Chapter 2, “The Main Debugger Window” in the *MULTI: Debugging* book).
- `-prefix` — Specifies the prefix string that is printed before the output.
- `-noprefix` — Indicates that no prefix is printed before the output.
- `-append` — Appends output to preexisting text in the specified destination file. If you do not specify this option, the output overwrites any preexisting text.
- `-copytopane yes` — Copies redirected output to the MULTI Debugger pane (target, I/O, or command) that serves as the default destination for the output source (see the description of the `-normal` option below). This is the default behavior.
- `-copytopane no` — Does not copy redirected output to a MULTI Debugger pane.
- *`filename`* — Specifies the destination file for an output source.
- `-normal` — Resets the destination for the specified output source to its default destination, as listed below:
  - Debug server output is sent to the MULTI target pane.
  - Output from the process being debugged is sent to the MULTI I/O pane. (This does not apply if you are debugging in a native environment. See the description of `-io` earlier in this section.)

- ○ MULTI output is sent to the MULTI command pane.

If neither a filename nor the `-normal` option is specified, the output source is redirected to standard output.

Note

On Windows, MULTI Debugger output that is redirected to `stdout` via the **output** command is not usually visible unless you redirect `stdout`. For example, when launching the Debugger from the command line, you could redirect the Debugger's `stdout` to a file named **myout.txt**:

```
multi a.out > myout.txt
```

P

P [[pr=*num*] *subcommands*]

Sends *subcommands* to a process and then lists information about the process, or, if issued with no arguments, lists information (including process slot numbers) about all processes.

This command is used exclusively for multiprocess debugging, and most of the subcommands are used exclusively for native debugging.

If specified, the commands *subcommands* are sent to the process *num*, where *num* is MULTI's internal slot number for the process. For example, the command `P pr=1 b` toggles the state of the `b` flag in the process with slot number `1`. If no process slot number is specified, the process currently being debugged is used. In either case, this command lists information about the process after sending *subcommands* to it.

Valid *subcommand* values for native debugging are:

- `b` — Toggles the flag causing breakpoint inheritance after forking. If the flag is set, children of the current process inherit all breakpoints set at the time of the fork.
- `c` — Toggles the flag causing children to be debugged. If the flag is set, children of the current process are added to the list of processes under control of MULTI.

- `e` — Toggles the flag causing children to stop upon execution of the `exec()` system call. If the flag is set, this acts as if a breakpoint were encountered at the first instruction of routine `main()` in the exec'd program.
- `f` — Toggles the flag causing children to stop upon execution of the `fork()` system call. If the flag is set, this acts as if a breakpoint were encountered immediately following the fork.
- `i` — Toggles the flag that makes the child process inherit its settings from the parent. This will only have an effect if the `c` flag is also set.

After a `fork()` or `exec()` of a process, MULTI prints a message indicating that this has happened.

Valid *`subcommand`* values for native or embedded debugging are:

- `h` — Toggles the flag causing MULTI to halt a task when it is attached.
- `r` — Toggles the flag causing MULTI to resume a task when it is detached.

Valid *`subcommand`* values for INTEGRITY run-mode debugging are:

- `d` — Toggles the flag causing MULTI to debug a newly created task on target.
- `t` — Toggles the flag causing the target to stop a newly created task.

The following *`subcommand`* is deprecated in this version and remains for compatibility. The **signal** command should be used instead (see “signal” on page 166).

- `s` *`num`* (Linux/Solaris only) — Sends signal *`num`* to the current process.

q

q

Non-GUI only

Prompts the user to quit MULTI. This command works only in non-GUI mode. When prompted, your choices are as follows.

- `n` — Cancels the quit request. This is the default choice.

- `s` — Saves breakpoints and the directory list to the file named **multistate**, and then exits MULTI.
- `y` — Exits MULTI.

quit

quit [all] [this] [ask | confirm | auto | force] [window | entry]

Closes the current Debugger window or removes the current target list entry. If this is the last entry, the Debugger exits. If you do not specify any arguments and a process has started, MULTI prompts you to kill the process or, if the target allows, detaches the Debugger from the process and lets it run. If you do not specify any arguments and no process has started, the Debugger closes without prompting you.

You can specify one of the following arguments to modify the behavior of this command:

- `all` — Is equivalent to the **quitall** command except that MULTI prompts you before killing an active process or, if the target allows, detaches the Debugger from the process and lets the process run (see "quitall" on page 30).
- `this` — Closes the current target list entry. MULTI prompts you first.
- `ask` — Uses the **promptQuitDebugger** configuration option to determine whether or not to prompt you before quitting the Debugger. The default setting is to prompt only if a process has started. See "The More Debugger Options Dialog" in Chapter 8, "Configuration Options" in the *MULTI: Managing Projects and Configuring the IDE* book.
- `confirm` — Always prompts you before quitting the Debugger.
- `auto` — Quits the current Debugger window. If a process has started, MULTI prompts you to kill the process or, if the target allows, detaches the Debugger from the process and lets it run. If no process has started, MULTI closes the Debugger without prompting you.
- `force` — Closes the current Debugger window and kills the current process without prompting.
- `window` — Closes the current Debugger window, but does not detach from or terminate any process unless the current Debugger window is the only one remaining. If the current Debugger window is the only one remaining, MULTI detaches from run-mode processes and terminates non-run-mode processes

when it closes the window. This option corresponds to and **File → Close Debugger Window**.

- `entry` — Removes the currently selected entry from the target list. In run mode, MULTI detaches from the process. If you are not debugging in run mode, MULTI terminates the process. If the entry is the only remaining entry in the target list, all Debugger windows close and the Debugger exits. This option corresponds to **File → Close Entry**.

quitall

quitall

Causes MULTI to exit. This closes all of MULTI's windows. If you have edits that have not been saved, you will be given the chance to save them before exiting. The Debugger does not prompt you before killing active processes.

Corresponds to: **File → Exit All**

restore

restore [*filename*]

GUI only

Restores the state of the Debugger from the file *`filename`*, or from the file **multistate** if *`filename`* is not specified. This file must have been created with the **save** command (see “save” on page 31). If you were connected to a debug server when you issued the **save** command and are not currently connected to the server, this command also reconnects you to that debug server.

MULTI searches for *`filename`* using the default search path. See “Default Search Path for Files Specified in Commands” on page 14.

Note

This command may not be able to restore group breakpoints.

Corresponds to: **Config → State → Restore State**

save

save [*filename*]

Saves the state of the Debugger. This writes out breakpoints and source directories as set by the **source** command (see “source” on page 80), and the current target connection, if any, to the file `filename` or to the file **multistate** if no filename is specified on the command line. This file may later be used by the **restore** command to restore the state of the Debugger (see “restore” on page 30). (Note that this command may not be able to restore group breakpoints.)

Corresponds to: **Config → State → Save State**

unloadsym

unloadsym *filename*

Unloads from the symbol table all of the debugging symbols for the file `filename`.

You can use this command with the **loadsym** command to load debugging information for a stripped executable at run time (see “loadsym” on page 21).

For example:

```
> debug a.out.stripped
> loadsym a.out.debug
> unloadsym a.out.stripped
```

The filename will be searched for using the default search path. See “Default Search Path for Files Specified in Commands” on page 14.

wait

wait [-global] [-time *milliseconds*] [-lastWindow] [-search] [-stop] [[-not] -multiStatus *status_name_or_value*] [-py [-all | -cmd | -pane]] [[-show | -goaway] [*optional_arguments*] -taskName *task_name* | -taskid *task_id*] [-runmode_partner]

Blocks command processing. While command processing is blocked, MULTI cannot accept new commands. However, it can still refresh its windows and handle target events. To abort the **wait** command, press the **Esc** key.

The available arguments are:

- `-global` — Blocks command processing for all MULTI processes in the same MULTI session. If you do not specify `-global`, only the current process is blocked. This argument may be used in conjunction with any other argument.
- `-time` *`milliseconds`* — Blocks command processing for *`milliseconds`*. If used in conjunction with another argument, *`milliseconds`* represents the maximum period of time that command processing is blocked, whether or not the action specified by the second argument has occurred.
- `-lastwindow` — Blocks command processing until the last GUI window is fully displayed.
- `-search` — Blocks command processing until the search in progress (if any) has finished.
- `-stop` — Blocks command processing until the current process halts. This is the default behavior if you do not specify any argument to the **wait** command. It is also a special case of the `-multiStatus` syntax, described next.
- `[-not] -multiStatus` *`status_name_or_value`* — Blocks command processing until the MULTI process enters the specified status or until it exits the specified status. The status name/value possibilities follow.
  - `Nil/1`
  - `Stopped/2`
  - `Running/3`
  - `Dying/4`
  - `Fork/5`
  - `Exec/6`
  - `Continue/7`
  - `Zombie/8`
  - `targetFrozen`

  The status name `targetFrozen` indicates the target's system halted status. The other names are normal statuses for MULTI processes, and the numeric values are MULTI-internal values. For information about accessing the current process status, see the `_STATE` variable in “System Variables” in Chapter 14, "Using Expressions, Variables, and Procedure Calls" in the *MULTI: Debugging* book.

- `-py` — Blocks command processing until pending Python statements complete. Use the following optional arguments to specify the source of the pending Python statements. If you do not specify one of the following arguments, `-all` is the default behavior.

  Optional arguments to `-py` are:

  - `-all` — Indicates that the Python statements may come from any source. This is the default.
  - `-cmd` — Indicates that the Python statements come from the **python** or **py** Debugger command. For information about these commands, see "python, py" on page 201.
  - `-pane` — Indicates that the Python statements come from the Debugger's Python pane.

- `-show` and `-goaway` — Blocks command processing until the specified object appears in the Task Manager window or until the specified object disappears from the Task Manager window. Use the following optional and required arguments to specify an object. If you give an object but do not enter `-show` or `-goaway`, `-show` is the default behavior.

  `optional_arguments` to `-show|-goaway` are:

  - `-taskStack` — Specifies that stack information for the task *`task_name`* or *`task_id`* is the object. When used with `-show`, this will block command processing until the specified task has stack information. This option is not generally useful with `-goaway`.
  - `-taskStatus` *`status | integer_value`* — Specifies that the status *`status`* for the task *`task_name`* or *`task_id`* is the object. Examples of *`status`* are `running`, `pended`, and `suspended`. If *`status`* contains a space, you must enclose it with quotation marks. The integer value corresponds to the status. If you do not know the integer value, use the string *`status`*.
  - `-addressSpace` *`address_space_name`* — Specifies that the task *`task_name`* or *`task_id`* located in the address space *`address_space_name`* is the object.

One of the following arguments to `-show` or `-goaway` is required:

  - `-taskName` *`task_name`* — Specifies that the task *`task_name`* is the object. If used in conjunction with an *`optional_argument`*, *`task_name`* may be a modifier. For example, if you type `wait -show -taskStack -taskName foo`, MULTI blocks command processing until stack information for the task **foo** appears in the Task Manager window.
  - `-taskid` *`task_id`* — Specifies that the task *`task_id`* is the object. If used in conjunction with an *`optional_argument`*, *`task_id`* may be a modifier.

- `-runmode_partner` — Blocks command processing until the freeze-mode connection's run-mode partner has been created and initialized. See "Automatically Establishing Run-Mode Connections" in Chapter 4, "INDRT2 (rtserv2) Connections" in the *MULTI: Debugging* book.

For more information about the Task Manager window, see Chapter 25, "Run-Mode Debugging" in the *MULTI: Debugging* book.

The **wait** command can be useful when scripting test cases or in a situation like the following. Suppose you are debugging in run-mode and want to attach to a task named **My Task** when it appears in the Task Manager window. You can enter:

```
> wait -taskname "My Task"; attach "My Task"
```

Chapter 3

Breakpoint Command Reference

Contents

The Debugger provides a variety of commands for setting and removing breakpoints. These breakpoint commands each have a similar syntax, since all breakpoints have similar attributes.

Every breakpoint must be associated with an address. Most of the breakpoint commands take an optional address expression that specifies the location of the breakpoint. (For more information about the *`address_expression`* argument, see "Using Address Expressions in Debugger Commands" on page 5.) If an address is not specified, the current line is used. In GUI mode, the current line is indicated by the blue arrow.

A breakpoint can also have a breakpoint count, which causes it to be skipped a specified number of times before it stops the process. The breakpoint count is decremented by 1 each time the breakpoint is skipped. When the breakpoint count reaches 1, the breakpoint stops the process (and continues to stop the process every subsequent time it is reached). To set a breakpoint count, add the argument ***@bp_count*** before the command list. For example, the following command sets a breakpoint with a count of 4:

```
> b @4
```

In this example, the breakpoint will be hit the fourth time the line of code is executed, and will continue to be hit every subsequent time that line is executed.

In all of the two letter breakpoint commands, if the second character is uppercase (for example **bU**), the breakpoint is temporary.

All breakpoint commands that contain the argument **{*commands*}** can take a list of commands. The commands in the list are executed when the breakpoint is hit. See "Using Command Lists in Debugger Commands" on page 12 for more information.)

The commands in this chapter allow you to set, edit, and remove breakpoints. (For information about setting breakpoints using the GUI, see "Using Breakpoints and Tracepoints" in Chapter 8, "Executing and Controlling Your Program from the Debugger" in the *MULTI: Debugging* book.)

Breakpoint Commands

The following list provides a brief description of each breakpoint command. For a command's arguments and for more information, see the page referenced.

- **b** — Sets a breakpoint at the specified location (see “b” on page 38).
- **B** — Lists information about breakpoints (see “B” on page 40).
- **bA** — Sets a temporary breakpoint (see “bA” on page 41).
- **bi**, **bI** — Sets a permanent or temporary breakpoint at the specified location, where the Debugger resolves procedure names to the beginning of the procedure's stack setup code (see “bi, bI” on page 41).
- **bif** — Sets a conditional breakpoint that will stop the process if the given condition evaluates to true (see “bif” on page 42).
- **bpload** — Loads breakpoints from the specified file (see “bpload” on page 42).
- **bpsave** — Saves breakpoints to the specified file (see “bpsave” on page 43).
- **bpview**, **breakpoints** — Opens the **Breakpoints** window (see“bpview, breakpoints” on page 43).
- **bt** — Displays a message every time the specified procedure is entered or exits (see “bt” on page 44).
- **bu**, **bU** — Sets a permanent or temporary up-level breakpoint (see “bu, bU” on page 44).
- **bx**, **bX** — Sets a permanent or temporary breakpoint at the exit point of a function (see “bx, bX” on page 45).
- **d** — Deletes the software breakpoint at the specified address expression or with the given label (see “d” on page 46).
- **D** — Deletes software breakpoints (see “D” on page 47).
- **dz** — Allows you to restore, view, or permanently remove previously deleted breakpoints (see “dz” on page 48).
- **edithwbp** — Opens a dialog box that you can use to edit the hardware breakpoint at the current source line (see “edithwbp” on page 49).
- **editswbp** — Opens a dialog box that you can use to edit the software breakpoint at the current source line (see “editswbp” on page 50).

- **hardbrk** — Lists, deletes, or sets hardware breakpoints (see “hardbrk” on page 50).
- **rominithbp** — Sets or removes the post-initialization hardware breakpoint used in ROM and ROM-to-RAM copy debugging (see “rominithbp” on page 54).
- **sb** — Sets target-specific breakpoints (see “sb” on page 55).
- **setbrk** — Sets a new breakpoint or removes an existing breakpoint at the current line or at the current address (see “setbrk” on page 57).
- **sethbp** — Sets a hardware execute breakpoint at the current location in your program code (see “sethbp” on page 57).
- **stopif** — Sets a conditional breakpoint at the line number specified (see “stopif” on page 58).
- **stopifi** — Sets a conditional breakpoint on the machine instruction at the specified address (see “stopifi” on page 59).
- **tog** — Toggles the active status of the given address expression or breakpoints (see “tog” on page 59).
- **Tog** — Toggles the active status of all breakpoints (see “Tog” on page 60).
- **watchpoint** — Sets a watchpoint on the address indicated, which causes the process to halt when the address is written to (see “watchpoint” on page 61).

b

b [%*bp_label*] [@*bp_count*] [&] [/s] [/off] [/type_gt [@*task_group*] [/trigger @*task_group*]] [*address_expression*] [{*commands*}]

Sets a breakpoint at the specified location, where:

- `%bp_label` — Specifies a breakpoint label (see “Breakpoint IDs and Labels” on page 10).
- `@bp_count` — Specifies a breakpoint count (see “Debugger Command Conventions” on page 3).
- `&` — Causes the breakpoint to beep when it is hit.
- `/s` — Suppresses messages when the breakpoint is hit.

- `/off` — Inactivates the breakpoint. This allows you to set a breakpoint on a running target without halting the target.
- `/type_gt [@task_group]` — Sets a group breakpoint for the specified task group. Any task in the task group can hit the breakpoint. If `@task_group` is not present, MULTI uses a temporary group that contains only the task itself to create the group breakpoint. If `task_group` contains spaces, enclose it with double quotation marks. The `{commands}` and `/type_gt [@task_group]` arguments are mutually exclusive. The breakpoint count (`@bp_count`) of group breakpoints must be `1` (default). See "Setting Breakpoints for Task Groups" in Chapter 25, "Run-Mode Debugging" in the *MULTI: Debugging* book.
- `/trigger @task_group` — Specifies the task group that stops when a group breakpoint is hit. All tasks in the task group stop along with the task that hits the breakpoint. If `task_group` contains spaces, enclose it with double quotation marks. See "Setting Breakpoints for Task Groups" in Chapter 25, "Run-Mode Debugging" in the *MULTI: Debugging* book.

  This option is only applicable if `/type_gt` is specified.
- `address_expression` — Specifies an address (see "Using Address Expressions in Debugger Commands" on page 5). In GUI mode, if `address_expression` is ambiguous, the **b** command opens a dialog box listing all procedures that match the wildcard pattern `address_expression`. You can pick some, all, or none of the procedures listed. For more information about the dialog box, see "Procedure Ambiguities and the Browse Dialog Box" in Chapter 12, "Browsing Program Elements" in the *MULTI: Debugging* book. If you do not specify an address expression, the breakpoint is set at the location of the blue current line pointer (➡).
- `{commands}` — Specifies a list of commands to be performed (see "Using Command Lists in Debugger Commands" on page 12). The `/type_gt [@task_group]` and `{commands}` arguments are mutually exclusive.

The options you specify determine what breakpoint marker is displayed on the left side of the source pane. See "Breakdots, Breakpoint Markers, and Tracepoint Markers" in Chapter 8, "Executing and Controlling Your Program from the Debugger" in the *MULTI: Debugging* book.

If a procedure name is specified (for example with the command `b Fly`), the breakpoint is not set at the first machine instruction of the procedure, but rather at the first machine instruction after the procedure's stack setup code, if any exists.

This ensures that the arguments and local variables of a procedure are read correctly when you stop in that procedure. (See “The Call Stack Window and Procedure Prologues and Epilogues” in Chapter 18, “Using Other View Windows” in the *MULTI: Debugging* book.) For information about stopping at the first machine instruction of a procedure, see “bi, bI” on page 41.

B

B [*address_expression* | *breakpoint_list*]

Lists information about breakpoints. The information is listed in the following order:

`ID bp_label location address count: flags commands`

If no argument is specified, this command lists information about all breakpoints. You can also specify an address or a list of breakpoints. For more information, see “Using Address Expressions in Debugger Commands” on page 5 and “Breakpoint Ranges and Lists” on page 11.

Example:

```
> b main#5
> b %my_bp_name main#6 { print "Here I am"; }
> b main#7 { print "main#7" }
> tog main#5
> B
0               main#5: 0x10204 count: 1 (inactive)
1 my_bp_name  main#6: 0x01220 count: 1 <{ print "Here I am"; }>
2               main#7: 0x1022c count: 1 <{ print "main#7" }>
> B %my_bp_name:%2
1 my_bp_name   main#6: 0x10220 count: 1 <{ print "Here I am"; }>
2               main#7: 0x1022c count: 1 <{ print "main#7" }>
```

Note

Entering the **l b** (lowercase `L` lowercase `B`) command is the same as entering **B** in the command pane (see “l” on page 102).

Note

You can list information about deleted breakpoints by using the **dz -list** command (see “dz” on page 48).

bA

bA [%*bp_label*] [@*bp_count*] [&] [/s] [*address_expression*] [{*commands*}]

Sets a temporary breakpoint using many of the same options as the **b** command (see “b” on page 38). A temporary breakpoint is automatically removed when it is hit.

bi, bI

bi [%*bp_label*] [@*bp_count*] [*address_expression*] [{*commands*}]

bI [%*bp_label*] [@*bp_count*] [*address_expression*] [{*commands*}]

(The second command contains an uppercase `i`.)

Sets a breakpoint at the specified location. (The **bI** command sets a temporary breakpoint; the **bi** command sets a permanent breakpoint.)

- `%bp_label` — Specifies a breakpoint label (see “Breakpoint IDs and Labels” on page 10).
- `@bp_count` — Specifies a breakpoint count (see “Debugger Command Conventions” on page 3).
- `address_expression` — Specifies a location (see “Using Address Expressions in Debugger Commands” on page 5). If a procedure name is specified, the breakpoint is set on the first instruction of the procedure's stack setup code (if any). Otherwise it is set on the first instruction of the procedure.
- `{commands}` — Specifies a list of commands to be performed (see “Using Command Lists in Debugger Commands” on page 12).

bif

bif [%*bp_label*] [@*bp_count*] *address_expression condition*

Sets a conditional breakpoint that will stop the process if `condition` evaluates to true.

- `%bp_label` — Specifies a breakpoint label (see “Breakpoint IDs and Labels” on page 10).
- `@bp_count` — Specifies a breakpoint count (see “Debugger Command Conventions” on page 3).
- `address_expression` — See “Using Address Expressions in Debugger Commands” on page 5.
- `condition` — Expression in the current language.

For example:

```
> bif funcname {i != 0}
Stop if i != 0 set at 0x20e6b8.
```

will stop the process when the function `funcname` is entered, if the variable `i` is nonzero.

See also “stopif” on page 58.

bpload

bpload *filename*

Loads breakpoints from `filename`, where `filename` is a file created with **bpsave** (see “bpsave” on page 43).

You can also use the **Load** button in the **Breakpoints** window to achieve the same results.

Note

This command and button may not be able to correctly load group breakpoints.

bpsave

bpsave *filename* [*breakpoint_list*]

Saves `breakpoint_list` to `filename`. If `breakpoint_list` is not specified, all breakpoints are saved. The breakpoints are generally preserved in the form `file#proc#line` to provide maximal portability between debugging sessions.

For example, after a debugging session, you can issue the following command:

```
> bpsave brkpts.lst
```

This saves the breakpoints to the file **brkpts.lst**. (You can also use the **Save** button in the **Breakpoints** window to achieve the same results.)

Later, when you restart the Debugger, you can issue the following command:

```
> bpload brkpts.lst
```

This restores the breakpoints from the previous debugging session.

See also “bpload” on page 42.

bpview, breakpoints

bpview

breakpoints

GUI only

Opens the **Breakpoints** window, which you can use to add, change, or delete software breakpoints, hardware breakpoints, and tracepoints. See “Viewing Breakpoint and Tracepoint Information” in Chapter 8, “Executing and Controlling Your Program from the Debugger” in the *MULTI: Debugging* book.

Corresponds to: 

Corresponds to: **View** → **Breakpoints**

bt

bt [@*bp_count*] *proc_name*

Displays a message every time the specified procedure is entered or exits, where:

- `@bp_count` — Specifies a breakpoint count (see "Debugger Command Conventions" on page 3).
- `proc_name` — Specifies a procedure name.

The displayed message states whether the procedure is entered or exited. The message printed on exit also provides the return value of the specified procedure.

Note

This command may produce unexpected behavior if your compiler optimization settings result in `proc_name` having multiple exit points or if the exit point cannot be found.

bu, bU

bu [@*bp_count*] [*stacklevel*] [{*commands*}]

bU [@*bp_count*] [*stacklevel*] [{*commands*}]

Sets an up-level breakpoint. The breakpoint is permanent if you use **bu** and temporary if you use **bU**.

- `@bp_count` — Specifies a breakpoint count (see "Debugger Command Conventions" on page 3).
- `stacklevel` — Call stack trace level.
- `{commands}` — See "Using Command Lists in Debugger Commands" on page 12.

The breakpoint is set immediately after the return to the level specified by `stacklevel`. The `stacklevel` is specified with a numeric value without an underscore (for example, `5`; see Chapter 5, “Call Stack Command Reference” on page 67). If `stacklevel` is not specified, the breakpoint is set one level up from the current procedure. For example, a way to recover after accidentally single-stepping into a procedure is:

```
> bU; c
```

to set a temporary, up-level breakpoint and continue.

The **bu** and **bU** commands rely on the Debugger's ability to generate a partial stack trace. They may not work correctly (for example, they may set a breakpoint at the wrong address) if the stack trace obtained by the Debugger is incorrect. For restrictions on tracing the call stack, see “Viewing Call Stacks” in Chapter 18, “Using Other View Windows” in the *MULTI: Debugging* book.

See also “cu, cU” on page 161.

bx, bX

bx [%*bp_label*] [@*bp_count*] [*address_expression*] [{*commands*}]

bX [%*bp_label*] [@*bp_count*] [*address_expression*] [{*commands*}]

Sets a breakpoint at the exit point of a function. The breakpoint is permanent if you use **bx** and temporary if you use **bX**.

- `%bp_label` — Specifies a breakpoint label (see “Breakpoint IDs and Labels” on page 10).
- `@bp_count` — Specifies a breakpoint count (see “Debugger Command Conventions” on page 3).
- `address_expression` — If a call stack level is specified in the address expression, this command sets a breakpoint at the exit point of the function at the specified stack level. See Chapter 5, “Call Stack Command Reference” on page 67. If a procedure name is specified as the address expression, this command sets a breakpoint at the exit point of the procedure. For more information about address expressions, see “Using Address Expressions in Debugger Commands” on page 5.

- `{commands}` — The specified *`commands`* are executed when the breakpoint is hit. For more information, see "Using Command Lists in Debugger Commands" on page 12.

If no arguments are specified, this command sets a breakpoint at the exit point of the current function. The exit point is where all returns from this function will go through.

The following are two examples of this command:

```
> bx foo
```

```
> bx "foo.c"#a_routine
```

The first command sets a breakpoint at the exit point of procedure `foo`. The second command sets a breakpoint at the exit point of the procedure `a_routine`, which is located in file **foo.c**.

Note

This command may produce unexpected behavior if your compiler optimization settings result in the function having multiple exit points or if the exit point cannot be found.

d

d [[/force] *address_expression* | *breakpoint_list* | %*bp_label*]

Deletes one or more software breakpoints at the specified *`address_expression`*, in the specified *`breakpoint_list`*, or with the specified *`bp_label`*, where:

- `/force` — Removes all software breakpoints that match *`address_expression`*.
- *`address_expression`* — Specifies the address (see "Using Address Expressions in Debugger Commands" on page 5). In GUI mode, if *`address_expression`* is ambiguous and `/force` is not specified, the **d** command opens a dialog box listing all software breakpoints in procedures that match the wildcard pattern *`address_expression`*. You can delete some, all, or none of the software breakpoints listed.

- `breakpoint_list` — Specifies a list of software breakpoints. For more information, see “Breakpoint Ranges and Lists” on page 11.
- `%bp_label` — Specifies a software breakpoint label (see “Breakpoint IDs and Labels” on page 10).

If no arguments are given, all software breakpoints at the current line are removed.

This command removes software breakpoints and all of their associated attributes. If you want to temporarily disable a breakpoint without deleting it, use the **tog** command (see “tog” on page 59).

D

D

Deletes software breakpoints:

- If the OSA master process is selected in the target list — Deletes all normal software breakpoints (except group breakpoints) in the master process. For more information, see “Working with Freeze-Mode Breakpoints” in Chapter 26, “Freeze-Mode Debugging and OS-Awareness” in the *MULTI: Debugging* book.
- If a run-mode AddressSpace is selected in the target list and you are using INTEGRITY 10 or later — Deletes all any-task breakpoints in the AddressSpace.
- If a task is selected in the target list — Deletes all task-specific software breakpoints in the task.

Corresponds to: **Debug → Remove All Breakpoints**

dz

dz [soft | hard | sobp] [*bp_ID_list*]

dz -gui [soft | hard | sobp]

dz -line [list] soft | hard

dz -list [all] [soft | hard | sobp]

dz -clear [soft | hard | sobp] [*bp_ID_list*]

The first format of the **dz** command restores breakpoints deleted in the last breakpoint deletion operation or, if `bp_ID_list` is specified, the breakpoints whose IDs are listed.

The second format of the **dz** command opens the **Breakpoints Restore** window, which allows you to view and restore deleted breakpoints.

The third format of this command restores breakpoints deleted from the current line's last breakpoint deletion operation, or, if `list` is specified, it lists the breakpoints that were last deleted from the current line.

The fourth format prints a list of breakpoints that have been deleted and that can be restored.

The fifth format removes breakpoints permanently.

The following options can be used with the **dz** command:

- `-gui` — Opens the **Breakpoints Restore** window, from which you can view and restore deleted breakpoints. If specified in conjunction with `soft`, `hard`, or `sobp`, the window opens on the **Software** tab (the default), the **Hardware** tab, or the **Shared Object** tab, respectively. For information about the **Breakpoints Restore** window, see “The Breakpoints Restore Window” in Chapter 8, “Executing and Controlling Your Program from the Debugger” in the *MULTI: Debugging* book.
- `-line` — Restores the software or hardware breakpoint(s) last deleted from the line where the current line pointer (➡) is located, or, if specified in conjunction with `list`, lists the software or hardware breakpoint(s) last deleted from the line where the current line pointer is located but does not restore them.

- `-list` and `list` — Prints a list of breakpoints that have been deleted and that can be restored. If specified in conjunction with the `all` option, all restorable, deleted breakpoints are printed to the command pane. Otherwise, only those removed in the last deletion operation are printed to the command pane.
- `-clear` — Permanently removes all applicable breakpoints. For example, if specified in conjunction with the `soft` option, all previously deleted software breakpoints (not only those deleted in the last deletion operation) are permanently deleted and can no longer be restored. This option is useful if you want to remove one or more breakpoints from the list of deleted breakpoints (see the `-list` and `list` options).
- `soft` — Applies the specified operation only to software breakpoints.
- `hard` — Applies the specified operation only to hardware breakpoints.
- `sobp` — Applies the specified operation only to shared object breakpoints.
- `all` — Applies the specified operation to all deleted breakpoints, not just to those from the last breakpoint deletion operation.
- *`bp_ID_list`* — Applies the specified operation only to those deleted breakpoints whose ID numbers are contained in this space-delimited list. When you run the **dz -list** command, the breakpoint ID numbers of deleted breakpoints precede the breakpoint descriptions. For more information about breakpoint IDs, see “Breakpoint IDs and Labels” on page 10.

edithwbp

edithwbp

GUI only

Opens a dialog box that you can use to edit the hardware breakpoint at the current source line. If no hardware breakpoint is set at the current line (as indicated by the blue context arrow), you can use the dialog box to create a new hardware breakpoint. If hardware breakpoints are not supported on the currently connected target, you will not be able to set the breakpoint. See “Creating and Editing Hardware Breakpoints” in Chapter 8, “Executing and Controlling Your Program from the Debugger” in the *MULTI: Debugging* book.

editswbp

editswbp

GUI only

Opens a dialog box that you can use to edit the software breakpoint at the current source line. If no software breakpoint is set at the current line (as indicated by the blue context arrow), you can use the dialog box to create a new software breakpoint. See “Creating and Editing Software Breakpoints” in Chapter 8, “Executing and Controlling Your Program from the Debugger” in the *MULTI: Debugging* book.

hardbrk

hardbrk [global]

hardbrk [global] delete= *num* | *

hardbrk [enabled | disabled] [rolling] [read] [write] [execute] [mask=*mask*] [data=*data_value* [dmask=*data_mask*]] [vm] [global] [--] *expr* [:*size*] [{*commands*}]

The first format of the **hardbrk** command lists all currently set hardware breakpoints, or, if `global` is specified, it lists all any-task hardware breakpoints. Each breakpoint listed is allocated an identifying number.

The second format of the **hardbrk** command deletes one or more hardware breakpoints.

The third format of the **hardbrk** command sets a hardware breakpoint. If no slots remain on the target for a new hardware breakpoint, MULTI first disables an existing hardware breakpoint that was set with the rolling attribute (if any), and then it sets the hardware breakpoint. If no rolling hardware breakpoints are set on the target and no slots are available, a hardware breakpoint is not set.

All formats of this command require that you pass the options in the order they are presented above.

Note

Hardware breakpoints are implemented through direct hardware support. Only a limited number of hardware breakpoints (usually fewer than four) may be set on targets that support them. If you are using a run-mode connection to debug INTEGRITY, and hardware breakpoint resources are unavailable when you try to set a hardware breakpoint, a virtual memory breakpoint is set instead. For information about the limitations of virtual memory breakpoints, see the description of the `vm` option below.

Note

Even targets that allow you to set hardware breakpoints may not support all the breakpoint capabilities described here; neither do all targets support the precise semantics described. For information about how your target handles hardware breakpoints if you are using a Green Hills Probe or SuperTrace Probe, see the documentation about target-specific hardware breakpoint support in the *Green Hills Debug Probes User's Guide*. For more information about hardware breakpoints, see “Working with Hardware Breakpoints” in Chapter 8, “Executing and Controlling Your Program from the Debugger” in the *MULTI: Debugging* book.

Note

MULTI removes all hardware breakpoints when detaching from a process.

The following options can be used with this command:

- `global` — On supported operating systems, specifies that the breakpoint is an any-task hardware breakpoint. Normally, a hardware breakpoint can only be hit by the task in which it is set. An any-task hardware breakpoint, on the other hand, can be hit by any task in the address space in which it is set.

  If this option is the only one specified (that is, `hardbrk global`), it lists all any-task hardware breakpoints.

  If this option is passed before the `delete` option, it deletes the any-task hardware breakpoint(s) specified by *`num`* or `*`.

  The `global` option is supported if you are using a run-mode connection to debug INTEGRITY (version 10 or later) or VxWorks.
- `delete=`*`num`*`|*` — Deletes the hardware breakpoint numbered *`num`* or, if you specify `*`, deletes all hardware breakpoints. (To list the number associated with each hardware breakpoint, enter **hardbrk** with no arguments.)

- `enabled` and `disabled` — Specify that the hardware breakpoint should initially be enabled or disabled. A disabled hardware breakpoint does not consume any target resources. These options are mutually exclusive. The default is `enabled`.
- `rolling` — Indicates that the hardware breakpoint can be automatically disabled to open a slot when you want to set a new hardware breakpoint in the future.
- Any combination of the following attributes may be specified:
  - `read` — Causes the break to occur when reading from the given address.
  - `write` — Causes the break to occur when writing to the given address.
  - `execute` — Causes the break to occur if the instruction stored at the given address is executed.

  The default attribute for an address in a `text` section is `execute`. The defaults for `data` and other sections are `read` and `write`. Often the break only occurs after the read or write.

  One advantage of a `read` or `write` hardware breakpoint (also known as a data hardware breakpoint) is that you can set it on a specific memory location. When that location is accessed, the process will be halted, regardless of what instruction the process is executing.
- `mask=`*`mask`* — Specifies that the hardware breakpoint will be hit if the bitwise AND of the mask and the address about to be accessed is equal to the bitwise AND of the mask and the breakpoint address (*`expr`*). For example, you can use this feature to stop on accesses to every 16th byte in an array by providing a mask of `0x0000000F`. By default, *`mask`* is defined as `0xFFFFFFFF`.
- `data=`*`data_value`* — Specifies that the hardware breakpoint will be hit if the value located at the given address and *`data_value`* (when masked with `dmask=`*`data_mask`*, if specified) are equal.
- `dmask=`*`data_mask`* — Specifies that the hardware breakpoint will be hit if the bitwise AND of the data mask and the value located at the given address is equal to the bitwise AND of the data mask and the data value specified with `data=`*`data_value`*.
- `vm` — Instructs INTEGRITY to use a virtual memory breakpoint to simulate the hardware breakpoint. Because virtual memory breakpoints do not use any target-specific hardware breakpoint resources (INTEGRITY implements the

mechanism instead), they are useful when the target lacks such resources. However, depending on access patterns, virtual memory breakpoints may significantly impact performance. The `vm` option is only supported if you are using a run-mode connection to debug INTEGRITY (version 10 or later) tasks in virtual AddressSpaces.

- `--` — Indicates the end of the options applied to the hardware breakpoint, and signals that the following item is the address expression where the hardware breakpoint should be located. For example:

  ```
  hardbrk write -- data
  ```

  sets a hardware breakpoint on writes on the variable named `data`. This option is useful if the expression shares the name of a **hardbrk** option.
- *`expr`*`[:`*`size`*`]` — Specifies the location of the breakpoint and can be a memory address, variable, or pointer name. Specifying a size forces the breakpoint to cover an explicit number of bytes. Sizes available vary by target and may be limited to `1`, `2`, and `4` bytes or to power-of-2 bytes. A size of `1`, `2`, `4`, or `8` bytes may also limit the memory accesses that hit the hardware breakpoint to accesses of the same length (for example, size `2` stops on a write of a `short`, but not a `char` or `int`). The default size is one byte for memory locations, and the size of the object for variables.
- `{`*`commands`*`}` — Executes the list of *`commands`* each time the hardware breakpoint is hit. For information about setting such lists of commands, see "Using Command Lists in Debugger Commands" on page 12.

When a hardware breakpoint is reached, MULTI displays a message that shows the breakpoint number and whether the break occurred on a read, write, or execute. For example:

```
Stopped by hardware break on execute (main#12)
```

If the target system cannot support the requested breakpoint, an error message appears.

Example uses of the **hardbrk** command follow.

To delete hardware breakpoint number two:

```
> hardbrk delete=2
```

To delete all hardware breakpoints:

```
> hardbrk delete=*
```

To stop on any read from variable `val`:

```
> hardbrk read val
```

To stop on any read or write to locations `0x10000` to `0x1000f`:

```
> hardbrk mask=0xfffffff0 0x10000
```

To stop on any write to the first sixteen bytes pointed to by `string`:

```
> hardbrk write *string:16
```

To print `accessed variable val` in the command window any time the variable `val` is accessed, and then resume the process:

```
> hardbrk val {echo "accessed variable val"; resume}
```

To stop when the instruction at address `0x100ff` is executed:

```
> hardbrk execute 0x100ff
```

rominithbp

rominithbp -setup [location] | -finish | -remove

Sets or removes the post-initialization hardware breakpoint used in ROM and ROM-to-RAM copy debugging. This hardware breakpoint is used to signal to MULTI that ROM initialization is complete. For ROM-only programs, this breakpoint triggers the `-after rominit` Debugger hook (see "Hook Commands" on page 196). For ROM-to-RAM copy programs, this breakpoint also indicates that the program has been copied into RAM and that any ROM restrictions on debugging are no longer necessary. When the post-initialization hardware breakpoint is hit, MULTI performs all post-initialization actions and then resumes the target.

Available options are:

- `-setup [`*`location`*`]` — Sets the post-initialization hardware breakpoint at the specified location (if any). If you do not specify a location and if the application is ROM-run, MULTI sets the breakpoint at the first source line of `main()`. If the application is ROM-copy, MULTI sets the breakpoint at `__ghs_after_romcopy`, which defaults to one of the first instructions in RAM.
- `-finish` — Immediately performs all post-initialization actions (such as triggering the `-after rominit` Debugger hook, setting software breakpoints, etc.).
- `-remove` — Removes the post-initialization hardware breakpoint.

sb

sb *task action* [%*bp_label*] [@*bp_count*] [&] [/off] [*address_expression*] [{*commands*}]

Sets target-specific breakpoints, where:

- *`task`* — Specifies which task(s) in the system the breakpoint is set on. The *`task`* argument is required and must be replaced by exactly one of the following letters:
  - `a` — Any task in the current address space.
  - `d` — Any attached task in the current address space.
  - `t` — The current task.
  - `u` — Any unattached task in the current address space.

  Only the `a` and `t` options are supported with INTEGRITY.
- *`action`* — Specifies what action is taken when the breakpoint is hit. The *`action`* argument is required and must be replaced by exactly one of the following letters:
  - `e` — Stops every actor.
  - `n` — Notifies you.
  - `s` — Stops the system.

  - `t` — Stops the task that hit the breakpoint.

  Only the `t` option is supported with INTEGRITY.

  Note

  The *`task`* and *`action`* arguments should not be separated by a space.

- `%`*`bp_label`* — Specifies a breakpoint label (see "Breakpoint IDs and Labels" on page 10).
- `@`*`bp_count`* — Specifies a breakpoint count (see "Debugger Command Conventions" on page 3).
- `&` — Causes the breakpoint to beep when it is hit.
- `/off` — Inactivates the breakpoint. This allows you to set a breakpoint on a running target without halting the target.
- *`address_expression`* — Specifies an address (see "Using Address Expressions in Debugger Commands" on page 5).
- `{`*`commands`*`}` — Specifies a list of commands to be performed (see "Using Command Lists in Debugger Commands" on page 12).

Example uses of the **sb** command follow.

```
> sb tt foo#12
```

Sets a breakpoint at line 12 of the function `foo`. The breakpoint is triggered by the current task and stops the current task (this is equivalent to a standard breakpoint).

```
> sb at bar#12
```

Sets a breakpoint at line 12 of the function `bar`. The breakpoint is triggered by any task in the address space and stops the task that hit it.

setbrk

setbrk

GUI only

Sets a new breakpoint or removes an existing breakpoint at the current line (pointed to by the current line pointer) or at the current address. The current address exists only in GUI mode and specifies the line where the mouse was last clicked in an interlaced text/assembly view.

This command is very useful when bound to a mouse button (see “Customizing Keys and Mouse Behavior” in Chapter 7, “Configuring and Customizing MULTI” in the *MULTI: Managing Projects and Configuring the IDE* book).

As an alternative to using this command, you can click the breakdot to the left of the line to set or remove a breakpoint.

The **setbrk** command is different from the **tog** command, which you can use to toggle the status of an existing breakpoint (see “tog” on page 59).

The **setbrk 0** command has been replaced by “runtohere” on page 151.

sethbp

sethbp [enabled | disabled] [rolling] [{*commands*}]

Sets a hardware execute breakpoint at the current location in your program code. The hardware breakpoint will have the size of the instruction it is set on, an address at the current code location, and an access type of `execute`. Hardware breakpoints are implemented through direct hardware support and are only available on some targets. MULTI removes all hardware breakpoints when detaching from a process.

If no slots remain on the target for this hardware breakpoint, MULTI will first disable one of the existing hardware breakpoints that was set with the `rolling` attribute and then set the hardware breakpoint. If no rolling hardware breakpoints are set on the target and no slots are available, this hardware breakpoint will not be set.

The following optional arguments can be used with this command:

- `rolling` — Indicates that this hardware breakpoint may be disabled automatically to open a slot when you want to set a new hardware breakpoint in the future.
- `disabled` — Indicates that this hardware breakpoint is initially disabled and will consume no target resources.
- `enabled` — Indicates that this hardware breakpoint is initially enabled and will operate normally. If neither the disabled or enabled attribute is specified, this is the default.
- `{`*`commands`*`}` — Specifies one or more commands that will be executed when this hardware breakpoint is hit. See “Using Command Lists in Debugger Commands” on page 12.

stopif

stopif [*file_relative_line_number*] *condition*

Sets a conditional breakpoint at the line number specified. If no line number is specified, the current line number is used. (For more information, see “Specifying Line Numbers” on page 7 and “Using Address Expressions in Debugger Commands” on page 5.) The *`condition`* must be an expression in the current language. When the process reaches the breakpoint, it will halt if *`condition`* evaluates to true; otherwise it will continue. For example, the following command stops the Debugger at line 20, if `y` is equal to five:

```
> stopif 20 y==5
```

If you omit the line number, avoid expressions that begin with a number; otherwise the expression will be parsed incorrectly. For example, the following should not be done:

```
> stopif 5==y /*INCORRECT*/
```

In this example, the Debugger will try to set a breakpoint on line 5 with the condition `(==y)`, which will fail. To properly set this breakpoint, enclose the expression in parentheses, as follows.

```
> stopif (5==y) /*CORRECT*/
```

MULTI will do limited syntax checking to make sure that the *`condition`* is a valid expression.

See also "bif" on page 42.

stopifi

stopifi [*address*] *condition*

Sets a conditional breakpoint on the machine instruction at the specified address. If *`address`* is not specified, the current machine instruction is used. The current machine instruction is set when the target halts at a new location or when you display a location using the `/i` or `/I` expression format. (For information about expression formats, see "Expression Formats" in Chapter 14, "Using Expressions, Variables, and Procedure Calls" in the *MULTI: Debugging* book.)

If issued with an address, this command is identical to the **stopif** command, except that the breakpoint is placed on the instruction at the specified address rather than on the specified line (see "stopif" on page 58).

tog

tog [q] [on | off | tog] hbp [[global] *hbp_id* | *]

tog [/force] [q] [on | off | tog] [b] [*address_expression* | *breakpoint_list* | *]

Toggles the active status of the specified breakpoint(s), where:

- `q` — Silent mode. Only error messages are printed.
- `on` — Activates all breakpoints matching the *`address_expression`* or *`breakpoint_list`*.
- `off` — Deactivates all breakpoints matching the *`address_expression`* or *`breakpoint_list`*.
- `tog` — Toggles the active status of all breakpoints matching the *`address_expression`* or *`breakpoint_list`*. This is the default if neither `on` nor `off` is specified.
- `hbp` — Toggles the status of a hardware breakpoint.

- `global` — Indicates that the hardware breakpoint specified by *`hbp_id`* is an any-task hardware breakpoint.
- *`hbp_id`* — Numeric identifier of a hardware breakpoint.
- `*` — Use this to toggle all of the hardware or software breakpoints (hardware if `hbp` is specified; software, otherwise).
- `/force` — Forces all breakpoints matching the *`address_expression`* to be toggled.
- `b` — Toggles the status of a breakpoint. This is the default if `hbp` is not specified.
- *`address_expression`* — The address expression that identifies a breakpoint to toggle. See "Using Address Expressions in Debugger Commands" on page 5.
- *`breakpoint_list`* — A list of breakpoints to toggle. For more information, see "Breakpoint Ranges and Lists" on page 11.

Only existing breakpoints can be modified with this command. If there are none, an error message is displayed.

Tog

Tog [q] [on | off | tog]

Toggles the status of all software breakpoints. If no arguments are specified, `tog` is assumed.

- `q` — Silent mode. Only error messages are printed.
- `on` — Makes all software breakpoints active.
- `off` — Makes all software breakpoints inactive.
- `tog` — Toggles the active status of all software breakpoints.

This command is equivalent to:

tog /force [q] [on | off | tog] *

For more information, see "tog" on page 59.

Corresponds to: **Debug → Toggle All Breakpoints**

watchpoint

watchpoint *expr*

watchpoint -delete

Sets a watchpoint on the address indicated by `expr`, causing the process to halt when the address is written to.

This command is implemented in one of two ways:

- On systems that support hardware breakpoints, a hardware breakpoint is set at the given address. See also "hardbrk" on page 50.
- If hardware breakpoints are not available, the watchpoint may be set using an efficient software hook. Only one watchpoint of this type may be set at a time. For information about enabling the software hook, see the documentation about run-time error checks in the *MULTI: Building Applications* book.

  To disable this software watchpoint, enter:

  ```
  watchpoint -delete
  ```

  The `-delete` option only applies to software watchpoints; it does not disable hardware watchpoints.

If neither of these methods is available, the watchpoint is not set.

Corresponds to: **Debug → Set Watchpoint**

Chapter 4

Building Command Reference

Contents

The commands in this chapter allow you to build a program, launch the MULTI Project Manager, or launch the **Utility Program Launcher**. For more information, see the *MULTI: Managing Projects and Configuring the IDE* book.

Building Commands

The following list provides a brief description of each building command. For a command's arguments and for more information, see the page referenced.

- **build** — Attempts to build the specified program (see "build" on page 64).
- **builder** — Opens the MULTI Project Manager (see "builder" on page 64).
- **wgutils** — Opens the **Utility Program Launcher**, which provides a GUI interface to Green Hills utility programs (see "wgutils" on page 65).

build

build [*program_or_project_name*]

GUI only

Attempts to build the given `program_or_project_name`. The build progress and error messages are displayed in a window. If no `program_or_project_name` is specified, the name of the current program is used.

Corresponds to: **Tools → Rebuild**

builder

builder

GUI only

Opens the MULTI Project Manager.

Corresponds to: **Tools → Project Manager**

wgutils

wgutils

GUI only

Opens the **Utility Program Launcher**, which provides a GUI interface to Green Hills utility programs. For more information, see the documentation about utility programs in the *MULTI: Building Applications* book.

Corresponds to: **Tools → Launch Utility Programs**

Chapter 5

Call Stack Command Reference

Contents

The commands in this chapter allow you to view call stacks (also known as *call stack traces* or simply *stack traces*). A call stack lists the stack frames that are currently active in your program. Each stack frame typically represents a function call. Stack frames are shown in order from most to least recently created. For more information about viewing call stacks in the **Call Stack** window, see “Viewing Call Stacks” in Chapter 18, “Using Other View Windows” in the *MULTI: Debugging* book.

Call Stack Commands

The following list provides a brief description of each call stack command. For a command's arguments and for more information, see the page referenced.

- **calls** — Displays the current call stack (see “calls” on page 68).
- **callsview** — Displays the current call stack in the **Call Stack** window (see “callsview” on page 69).
- **cvconfig** — Configures the **Call Stack** window specified (see “cvconfig” on page 70).

calls

calls [*maxdepth*] [par | nopar] [pos | nopos] [local | nolocal] [showallframes | noshowallframes]

Displays the current call stack, where:

- `maxdepth` — Specifies the maximum number of stack frames you want to display. The default value of `maxdepth` is 20 and the maximum value is 32768.
- `par` | `nopar` — Specifies whether or not parameters passed to functions are displayed. If neither argument is specified, the parameters are displayed.
- `pos` | `nopos` — Specifies whether or not source positions of functions are displayed. If neither argument is specified, the source positions are displayed.
- `local` | `nolocal` — Specifies whether or not local variables used in functions are displayed. If neither argument is specified, the local variables are not displayed.

- `showallframes` | `noshowallframes` — Specifies whether or not the Debugger displays stack frames before `main()`. If neither argument is specified, stack frames before `main()` are not displayed.

You can view the call stack in its own window by using the **callsview** command (see “callsview” on page 69).

callsview

callsview [%*name*] [*maxdepth*] [par | nopar] [pos | nopos] [win | nowin] [local | nolocal] [showallframes | noshowallframes]

GUI only

Displays the current call stack in the **Call Stack** window, unless the `nowin` argument is specified (see below).

The optional arguments allow you to specify what information should be displayed, where:

- `%`*`name`* — Specifies a name for the window. *`name`* may be either a C string or an identifier in the style permitted by C (letters, numbers and underscores, beginning with a letter). *`name`* must not be the same as the name of any existing **Call Stack** window.
- *`maxdepth`* — Specifies the maximum number of stack frames you want to display. If this argument is not specified, the previously defined value is used. If no previously defined value exists, the default value is 20. The maximum value is 32768.
- `par` | `nopar` — Specifies whether the parameters passed to functions are displayed.
- `pos` | `nopos` — Specifies whether the source positions of functions are displayed.
- `win` | `nowin` — Specifies where to display the call stack. If `win` is specified (the default), a **Call Stack** window is created. If `nowin` is specified, the call stack is printed to the command pane. `%`*`name`* should not be specified in conjunction with `nowin`.

- `local` | `nolocal` — Specifies whether or not the local variables used in functions are displayed. (This option is only applicable if `nowin` has been specified).
- `showallframes` | `noshowallframes` — Specifies whether or not the Debugger displays stack frames before `main()`.

At the beginning of a debugging session, this command defaults to the following settings: `par pos win noshowallframes`. Subsequent calls to this command default to the previous configuration of the **Call Stack** window, except that `win` is always the default. Thus, if you change a setting other than `nowin` for the **Call Stack** window, it will be remembered the next time you open the **Call Stack** window (see "Viewing Call Stacks" in Chapter 18, "Using Other View Windows" in the *MULTI: Debugging* book).

Corresponds to: 

Corresponds to: **View → Call Stack**

cvconfig

cvconfig [%*name*] *key* [*key*]...

GUI only

Configures the **Call Stack** window identified by *`name`*. If no *`name`* is specified, **cvconfig** configures the last **Call Stack** window that was created or configured. (The name of a **Call Stack** window is the same as the caption that appears in its title bar.)

This command is primarily intended for use in scripts, since the functionality it provides is directly accessible from the GUI of the **Call Stack** window.

The *`key`* argument(s) can be directives with no arguments or parameters with assigned values. Acceptable values for *`key`* and their meanings are listed below:

- `stop` — Freezes the **Call Stack** window.
- `refresh` — Unfreezes the **Call Stack** window.
- `help` — Opens online help for the **Call Stack** window.
- `par` — Shows parameters passed to the functions.

- `nopar` — Hides parameters passed to the functions.
- `pos` — Shows source position of functions.
- `nopos` — Hides source position of functions.
- `showallframes` — Shows stack frames before `main()`.
- `noshowallframes` — Hides stack frames before `main()`.
- `edit` — Opens an Editor on the function currently selected in the window.
- `local` — Reuses an existing Data Explorer (if any) or opens a Data Explorer displaying all of the local variables of the function currently selected in the window.
- `copy` — Copies the contents of the **Call Stack** window to the clipboard.
- `print` — Prints the **Call Stack** window.
- `quit` — Closes the **Call Stack** window.
- `name=`*`newname`* — Renames the **Call Stack** window to *`newname`*.
- `mdepth=`*`depth`* — Sets the maximum depth of the **Call Stack** window to *`depth`*.
- `select=`*`num`* — Selects the stack level *`num`* within the **Call Stack** window.

Keys are handled sequentially in the order they are given. The keys `stop`, `refresh`, `help`, `copy`, and `quit` terminate the command when they are encountered, causing any remaining keys to be ignored. The same is true for any errors encountered during processing of the keys.

Keys and key values are case-insensitive.

For more information, see "Viewing Call Stacks" in Chapter 18, "Using Other View Windows" in the *MULTI: Debugging* book.

Chapter 6

Configuration Command Reference

Contents

The configuration commands are broken up into two sections. The general configuration commands in the first section allow you to configure the Debugger or IDE. The button, menu, and mouse commands in the second section allow you to access or configure menus, toolbar buttons, key bindings, and mouse buttons.

For more information about configuring various aspects of the MULTI IDE, see Chapter 8, “Configuration Options” in the *MULTI: Managing Projects and Configuring the IDE* book.

General Configuration Commands

The following list provides a brief description of each general configuration command. For a command's arguments and for more information, see the page referenced.

- **clearconfig** — Clears your default configuration for MULTI (see “clearconfig” on page 75).
- **configoptions** — Opens the **Options** dialog box (see “configoptions” on page 75).
- **configure** — Changes the value of a MULTI configuration option (see “configure” on page 76).
- **configurefile** — Reads the specified file, which must be a MULTI configuration file, and applies the options it describes to the current session (see “configurefile” on page 76).
- **fileextensions** — Performs operations that affect the file type and extension mappings used by the file choosers throughout MULTI (see “fileextensions” on page 77).
- **fontsize** — Increases or decreases the font size (see “fontsize” on page 77).
- **imagename** — Specifies that an executable will be running from the specified path, rather than from the source directory (see “imagename” on page 78).
- **loadconfigfromfile** — Opens a file chooser that allows you to select a MULTI configuration file to load into MULTI (see “loadconfigfromfile” on page 78).
- **saveconfig** — Saves the current configuration settings to the default configuration file (see “saveconfig” on page 78).

- **saveconfigtofile** — Saves the current configuration settings to a specified file (see “saveconfigtofile” on page 79).
- **setintegritydir** — Opens the **Default INTEGRITY Distribution** dialog box (see “setintegritydir” on page 79).
- **setuvelositydir** — Opens the **Default u-velOSity Distribution** dialog box (see “setuvelositydir” on page 80).
- **source** — Specifies directories for MULTI to search to find source files for the debugged executable (see “source” on page 80).
- **sourceroot** — Clears, lists, creates, or replaces the source root, which is the path MULTI prepends to each file's relative path (see “sourceroot” on page 81).
- **syncolor** — Sets syntax coloring options (see “syncolor” on page 82).

clearconfig

clearconfig

Clears your default configuration for MULTI. Note that this command affects the entire development environment.

Corresponds to: **Config → Clear User Default Configuration**

configoptions

configoptions

GUI only

Opens the **Options** dialog box.

Corresponds to: **Config → Options**

configure

configure *config_option* [= | :] *value*

configure *config_option*

configure ?

Changes the value of a MULTI configuration option. The `configure ?` command displays a list of configurable options. You can separate *`config_option`* from *`value`* with an equal sign (=), a colon (**:**), or a whitespace character ( ). If *`value`* is a Boolean, you can omit it and MULTI will toggle the option's setting.

An example use of this command, which changes MULTI's tab size to 9, follows:

```
> configure tabsize=9
```

Note

Do not use this command while the **Options** window is open.

For more information, see “Using the configure Command” in Chapter 7, “Configuring and Customizing MULTI” in the *MULTI: Managing Projects and Configuring the IDE* book.

configurefile

configurefile *file*

Reads *`file`*, which must be a MULTI configuration file, and applies the options it describes to the current session. MULTI configuration files can be created with the **saveconfigtofile** command (see “saveconfigtofile” on page 79).

For more information about configuration files, see “Creating and Editing Configuration Files” in Chapter 7, “Configuring and Customizing MULTI” in the *MULTI: Managing Projects and Configuring the IDE* book.

fileextensions

fileextensions *option filename*

GUI only

Performs operations that affect the file type and extension mappings used by the file choosers throughout MULTI. Each operation is performed on a file specified by `filename`. The behavior of this command depends on the value of `option`, which must be one of the following:

- `-load` — Loads in extension mappings from the file named `filename`. The extension mappings from that file replace all of the extension mappings throughout MULTI.
- `-save` — Creates a file named `filename` that can be loaded to reconstruct the extension mappings currently in use.
- `-append` — Inserts the extension mappings from the file named `filename` into the existing mappings. Existing extensions that are not modified by `filename` are preserved.

For more information, see "Configuring File Extensions" in Chapter 7, "Configuring and Customizing MULTI" in the *MULTI: Managing Projects and Configuring the IDE* book.

fontsize

fontsize -inc | -dec

Changes the size of the source code font, where `-inc` increments the size and `-dec` decrements the size. For more information about configuring fonts, see **Source Code Font** and **GUI Font** in "General Configuration Options" in Chapter 8, "Configuration Options" in the *MULTI: Managing Projects and Configuring the IDE* book.

imagename

imagename [*path_to_executable*]

Specifies that an executable will be running from `path_to_executable`, rather than from the source directory.

By default, MULTI assumes that the final executable resides in the source directory where it gets built. If the executable will not be located in the source directory and/or the executable name will change, you must use this command to let MULTI know where the final executable will be running from. For example, some development tools automatically move the final executable out of the source directory and into another directory (sometimes renaming the executable in the process). The executable image in the alternative directory must be identical to the executable that is built in the source directory.

This command is only applicable if you are debugging an operating system such as Linux, Solaris, or Windows and the debug information for your program resides in a different location than that of the executable file.

loadconfigfromfile

loadconfigfromfile

GUI only

Opens a file chooser that allows you to select a MULTI configuration file to load into MULTI.

Corresponds to: **Config → Load Configuration**

saveconfig

saveconfig

Saves the current configuration settings to the default configuration file. MULTI reads this file upon startup to restore your configuration settings. See also "saveconfigtofile" on page 79.

For more information about configuration files, see “Creating and Editing Configuration Files” in Chapter 7, “Configuring and Customizing MULTI” in the *MULTI: Managing Projects and Configuring the IDE* book.

Corresponds to: **Config → Save Configuration as User Default**

saveconfigtofile

saveconfigtofile

GUI only

Saves the current configuration settings to a specified file.

This command is similar to the **saveconfig** command (see “saveconfig” on page 78), except that it opens a file chooser dialog box that allows you to choose a file in which to save the configuration. This can be useful when used with the command **configurefile** (see “configurefile” on page 76).

For more information about configuration files, see “Creating and Editing Configuration Files” in Chapter 7, “Configuring and Customizing MULTI” in the *MULTI: Managing Projects and Configuring the IDE* book.

Corresponds to: **Config → Save Configuration As**

setintegritydir

setintegritydir

GUI only

Opens the **Default INTEGRITY Distribution** dialog box in which you can provide MULTI with the location of the installed INTEGRITY distribution. This information is used to add INTEGRITY documentation to MULTI's **Help** menu and to determine the default INTEGRITY distribution (used by the **Project Wizard**). For more information, see “Configuring MULTI for Use with INTEGRITY or u-velOSity” in Chapter 2, “MULTI Tutorial” in the *MULTI: Getting Started* book.

Corresponds to: **Config → Set INTEGRITY Distribution**

setuvelositydir

setuvelositydir

GUI only

Opens the **Default u-velOSity Distribution** dialog box in which you can provide MULTI with the location of the installed u-velOSity distribution. This information is used to add u-velOSity documentation to MULTI's **Help** menu and to determine the default u-velOSity distribution (used by the **Project Wizard**). For more information, see “Configuring MULTI for Use with INTEGRITY or u-velOSity” in Chapter 2, “MULTI Tutorial” in the *MULTI: Getting Started* book.

Corresponds to: **Config → Set u-velOSity Distribution**

source

source [*num*] [*dir*]...

source - [*dir*]...

Specifies directories for MULTI to search to find source files for the debugged executable.

If, in the first format of the **source** command, `num` is specified, the directory numbered `num` in the current source path is replaced by the new one given by `dir`. If `num` is specified without a replacement directory, the specified entry is deleted from the list. The directory list is zero-based. If `num` is not specified, the specified directories are added to the list. If no arguments are specified, this command lists the directories that will be searched.

The second format of the **source** command discards any previously specified directories, replacing them with `dir` (if provided).

In either command format, you can specify multiple directories by separating them with spaces. On Linux/Solaris, directory names may include a tilde (~) as an abbreviation for the home directory.

Note

If MULTI cannot find the debugging information files associated with an executable, you must use the **loadsym** command (see “loadsym” on page 21) to specify the location of the files.

Corresponds to: **View → Source Path**

sourceroot

sourceroot [clear | list | *new_root* | remap *old_dir1* [,*old_dir2*]... *new_dir1* [,*new_dir2*]...]

Clears, lists, creates, or replaces the source root, which is the path MULTI prepends to each file's relative path, where:

- `clear` — Clears the current source root.
- `list` — Lists the current source root.
- *`new_root`* — Creates a new root that is prepended to the relative paths of files.
- `remap` *`old_dir1`*`[,`*`old_dir2`*`]...` *`new_dir1`*`[,`*`new_dir2`*`]...` — Replaces the *`old_dir`* portion of the source root(s) with the corresponding *`new_dir`*. Both *`old_dir`* and *`new_dir`* are case-sensitive.

Defining a new source root allows you to build an executable with source files from one location and debug that same executable with those source files accessible in a different location. For example, if you build a project using source files from **C:\checkout\src**, MULTI locates the executable and its supporting files relative to this location. Now suppose you want to debug on a computer where the source files are accessible in **X:\src**. You can change the source root by specifying:

```
> sourceroot remap C:\checkout\src X:\src
```

You can specify multiple source locations. For example, if you build a project using source files from **/usr/local/proj1/src** and **/usr/local/shared/src**, and you want to debug on a computer where the source files are accessible in **/machine2/src1** and **/machine2/srcshared**, you can change both source roots with one command by specifying:

```
> sourceroot remap /usr/local/proj1/src,/usr/local/shared/src \
    /machine2/src1,/machine2/srcshared
```

For more information, see the documentation about building and debugging on different hosts in the *MULTI: Building Applications* book.

syncolor

syncolor [0 | 1] [a] [C] [k] [d] [n] [s] [c]

GUI only

Sets syntax coloring options.

- `0` (zero) — Turns off syntax coloring for all categories.
- `1` (one) — Turns on syntax coloring for all categories.
- `a` — Toggles syntax coloring for all categories.
- `c` (lowercase) — Toggles syntax coloring for character constants.
- `C` (uppercase) — Toggles syntax coloring for comments.
- `d` — Toggles syntax coloring for dead code.
- `k` — Toggles syntax coloring for language keywords.
- `n` — Toggles syntax coloring for numbers.
- `s` — Toggles syntax coloring for string constants.

For example, the command `syncolor 0Ck` turns off syntax coloring for all categories, then toggles it on for comments and language keywords, while `syncolor 1d` turns on syntax coloring for all categories, then toggles it off for dead code. Without any arguments, **syncolor** prints the present state of all the categories.

Button, Menu, and Mouse Commands

The following list provides a brief description of each button, menu, and mouse command. For a command's arguments and for more information, see the page referenced.

- **->** — Opens the specified menu (see "->" on page 83).
- **customizemenus** — Opens the **Customize Menus** window, which allows you to create new menus or edit existing menus for a number of MULTI tools (see "customizemenus" on page 83).

- **customizetoolbar** — Opens the **Customize Toolbar** window, which allows you to rearrange the order of buttons on the Debugger toolbar, add pre-defined and custom buttons, and delete buttons (see “customizetoolbar” on page 84).
- **debugbutton**, **editbutton** — Adds, deletes, or configures a button on the Debugger's or Editor's toolbar (see “debugbutton, editbutton” on page 84).
- **inspect** — Opens a shortcut menu on the specified string (see “inspect” on page 86).
- **keybind** — Binds a key to a command (see “keybind” on page 87).
- **menu** — Defines a menu item to attach to a menu bar, MULTI button, mouse button, or keyboard key (see “menu” on page 87).
- **mouse** — Defines the function of the mouse buttons (see “mouse” on page 87).

->

-> *menu_name*

GUI only

Opens the menu `menu_name`. For example:

```
>-> FileMenu
```

opens the **File** menu.

This command can also be used to create submenus. For more information, see “Configuring and Customizing Menus” in Chapter 7, “Configuring and Customizing MULTI” in the *MULTI: Managing Projects and Configuring the IDE* book.

customizemenus

customizemenus

GUI only

Opens the **Customize Menus** window, which allows you to create new menus or edit existing menus for a number of MULTI tools. For more information, see “Configuring and Customizing Menus” in Chapter 7, “Configuring and Customizing MULTI” in the *MULTI: Managing Projects and Configuring the IDE* book.

Corresponds to: **Config → Customize Menus**

customizetoolbar

customizetoolbar

GUI only

Opens the **Customize Toolbar** window, which allows you to rearrange the order of buttons on the Debugger toolbar, add pre-defined and custom buttons, and delete buttons. For more information, see "Adding, Removing, and Rearranging Toolbar Buttons" in Appendix A, "Debugger GUI Reference" in the *MULTI: Debugging* book.

Corresponds to: **Config → Customize Toolbar**

debugbutton, editbutton

debugbutton [*num*] [*name*] [c=*command*] [i=*iconname*] [h=*helpstring*] [t=*tooltip*]

editbutton [*num* | *name*] [c=*command*] [i=*iconname*] [h=*helpstring*] [t=*tooltip*]

GUI only

Adds, deletes, or configures a button on the Debugger's (**debugbutton**) or Editor's (**editbutton**) toolbar, where:

- *`num`* is the number that MULTI assigns to the button.
- *`name`* is the name of the button.
- *`command`* is the command executed when the button is pressed. You may use semicolons to execute multiple commands. For example:

  ```
  > debugbutton printxy c="print x;print y"
  ```

  This command creates a button named **printxy** that, when clicked, prints out the values of the variables `x` and `y` in the current context.

- `iconname` is the name of the button's icon, which may be:
  - A built-in icon. To obtain the names of built-in icons and to see what the icons look like, select **Config → Options**+**Editor**+**Configure Editor Buttons** or, from the Debugger, select **Config → Customize Toolbar**+**Add Custom Button** ().
  - The filename of an icon you have created yourself. If only a partial path is given, it is assumed to be relative to the MULTI IDE installation directory. For information about creating icons, see “Creating and Working with Icons” in Chapter 7, “Configuring and Customizing MULTI” in the *MULTI: Managing Projects and Configuring the IDE* book.
- `helpstring` is the text that appears in the status bar when the cursor moves over the button.
- `tooltip` is the text that appears when the cursor hovers over the button. If you do not specify a tooltip, the name of the button is used.

The arguments `name`, `command`, `iconname`, `helpstring`, and `tooltip` must be entered as either single words or quoted strings of the form:

```
"This is a quoted string."
"These are quotes \" \" within a quoted string."
```

These commands have the following several special forms:

- **debugbutton** or **editbutton**— Lists defined Debugger or Editor buttons. The **debugbutton** command does not list the **Close Debugger** button or the separator before it; these cannot be modified or deleted.
- **debugbutton** 0 or **editbutton** 0 — Deletes all Debugger or Editor buttons, with the exception that the **debugbutton** 0 command does not delete the **Close Debugger** button or the separator before it.
- **debugbutton *num*** or **editbutton *num*** — Deletes the Debugger or Editor button numbered `num`. You can view button numbers by entering **debugbutton** or **editbutton** in the command pane.
- **debugbutton *name* [...]** — If no optional arguments are specified, deletes the button named `name`. If optional arguments are specified and if a button named `name` exists, the button is replaced. Otherwise a new button named `name` is added to the end of the Debugger toolbar. You can view button names by entering **debugbutton** in the command pane.

- **debugbutton *num name* [...]** — Replaces the button numbered `num` with a new button named `name`. You can view button numbers by entering **debugbutton** in the command pane.

You cannot save **debugbutton** changes across MULTI sessions. As a result, this command is generally only useful for the creation or modification of buttons executed by scripts. For information about how to change the Debugger toolbar permanently, see “Adding, Removing, and Rearranging Toolbar Buttons” in Appendix A, “Debugger GUI Reference” in the *MULTI: Debugging* book.

To save **editbutton** changes across MULTI sessions, select **Config → Save Configuration as User Default**.

Note

The **debugbutton** command does not affect customizations you make through the **Customize Toolbar** window. For information about this window, see “Adding, Removing, and Rearranging Toolbar Buttons” in Appendix A, “Debugger GUI Reference” in the *MULTI: Debugging* book.

inspect

inspect [*string*]

GUI only

Opens a shortcut menu on `string`, equivalent to the default behavior when you right-click `string`.

This command is generally bound to a mouse click using the **mouse** command (see “Customizing Mouse Behavior with the mouse Command” in Chapter 7, “Configuring and Customizing MULTI” in the *MULTI: Managing Projects and Configuring the IDE* book).

See also “browseref, xref” on page 269.

keybind

keybind [*location*]

keybind *key* [|*modifiers*] [@*location*] [=*command*]

GUI only

Binds a key to a command. For a complete description of this command, see "Customizing Keys with the keybind Command" in Chapter 7, "Configuring and Customizing MULTI" in the *MULTI: Managing Projects and Configuring the IDE* book.

menu

menu [*name*] [{ { *label* ['*label*'] *cmd* } }]

GUI only

Defines a menu item to attach to a menu bar, MULTI button, mouse button, or keyboard key. For a complete description of this command, see "Configuring and Customizing Menus" in Chapter 7, "Configuring and Customizing MULTI" in the *MULTI: Managing Projects and Configuring the IDE* book.

The **l M** (lowercase `L`, uppercase `M`) command lists the menus defined with this command (see "l" on page 102).

mouse

mouse [*location*]

mouse *button_num* *Click*click_num* [(AtOnce)] [|*modifiers*] @*location* =*command*

GUI only

Defines the function of the mouse buttons. For a complete description of this command, see the "Customizing Mouse Behavior with the mouse Command" in Chapter 7, "Configuring and Customizing MULTI" in the *MULTI: Managing Projects and Configuring the IDE* book.

Note

The command arguments should not be separated by spaces.

Chapter 7

Debugger Note Command Reference

Contents

The commands in this chapter allow you to create, access, and delete Debugger Notes. Debugger Notes allow you to associate notes with any line of source or assembly code. For more information about Debugger Notes, see Chapter 10, “Using Debugger Notes” in the *MULTI: Debugging* book.

Debugger Note Commands

The following list provides a brief description of each Debugger Note command. For a command's arguments and for more information, see the page referenced.

- **notedel** — Deletes one or more Debugger Notes (see “notedel” on page 90).
- **noteedit** — Creates a new Debugger Note with the properties specified, or modifies an existing Note (see “noteedit” on page 91).
- **notelist** — Lists all Debugger Notes that exist for the current executable (see “notelist” on page 91).
- **notestate** — Loads Debugger Notes from the specified file, or saves the current executable's list of Debugger Notes to the specified file (see “notestate” on page 92).
- **noteview** — Navigates to the location of the specified Debugger Note or opens a Note Browser displaying all Debugger Notes for the program being debugged (see “noteview” on page 92).

notedel

notedel [*@num* | *address_expression* | -all]

Deletes a Debugger Note with the number specified by `@num` or at the location specified by `address_expression`. (For information about using an `address_expression` to specify a location, see “Using Address Expressions in Debugger Commands” on page 5.) If `-all` is specified, this command deletes all Debugger Notes. If no argument is specified, the Note at the current position is deleted. If the last Note in a group is deleted, that group is also deleted.

noteedit

noteedit [@*num*] [*address_expression*] [-name *name*] [-group *group_name*] [-text *text* | -prepend *text* | -append *text*] [-noedit]

Creates a new Debugger Note with the properties specified, or modifies an existing Note.

- `@num` — Specifies the number of the Debugger Note that will be modified.
- `address_expression` — Specifies the location of the Debugger Note that will be modified. See “Using Address Expressions in Debugger Commands” on page 5.
- `-name name` — Specifies the name of the Debugger Note.
- `-group group_name` — Specifies the group to which to the Debugger Note belongs.
- `-text text` — Specifies the text contained in the Debugger Note.
- `-prepend text` — Prepends `text` to an existing Debugger Note.
- `-append text` — Appends `text` to an existing Debugger Note.
- `-noedit` — Suppresses the **Edit Note** dialog box.

If `@num` is specified, or `@num` is not specified and the location specified already contains a Note, that Note will be edited. If `name`, `group`, or `text` is specified, it will be changed in the Note.

notelist

notelist [-menu]

Lists all Debugger Notes that exist for the current executable. If no argument is specified, the Notes are listed in the command pane.

If `-menu` is specified, a shortcut menu displays the names of the Notes, which you can use to navigate to one of the Notes. The Notes are divided by group with the group name dimmed at the beginning of each group. In addition, the four most recently used Notes are displayed at the top of the menu.

notestate

notestate [-load *filename* | -save *filename*]

Loads Debugger Notes from the specified file, or saves the current executable's list of Debugger Notes to the specified file.

If you load Notes from a file, they are merged into the executable's existing list of Notes (if any). Notes that already exist at a specific location are not replaced by Notes loaded from the file.

noteview

noteview [@num | -prev | -next | -error]

Navigates to the location of the specified Debugger Note or opens a Note Browser displaying all Debugger Notes for the program being debugged, where the arguments have the following effects:

- `@`*`num`* — Goes to the specified Note.
- `-prev` — Goes to the previous Note.
- `-next` — Goes to the next Note.
- `-error` — Displays the error string from the last time a Debugger Note state was loaded.

If no argument is specified, the **Note Browser** window opens.

Corresponds to: **View → Debugger Notes**

Chapter 8

Display and Print Command Reference

Contents

The commands in this chapter allow you to print information to the command pane and control certain aspects of the MULTI Debugger's display. For information about the main Debugger window's display, see Chapter 2, “The Main Debugger Window” in the *MULTI: Debugging* book.

Display and Print Commands

The following list provides a brief description of each display and print command. For a command's arguments and for more information, see the page referenced.

- **assem** — Controls the display mode of the Debugger window's source pane (see “assem” on page 96).
- **cat** — Prints the contents of the specified files to the command pane (see “cat” on page 96).
- **clear** — Clears the command pane, target pane, I/O pane, serial terminal pane, Python pane, or traffic pane of the Debugger (see “clear” on page 96).
- **comeback** — Restores the Debugger and debug-related windows after the **goaway** command has hidden them (see “comeback” on page 97).
- **components** — Lists components and their aliases (see “components” on page 97).
- **dbprint** — Prints the source currently being viewed in the Debugger (see “dbprint” on page 98).
- **debugpane** — Changes the Debugger command pane to the specified pane (see “debugpane” on page 98).
- **dumpfile** — Writes the contents of the Debugger's source pane or the file on display in the Debugger to a text file (see “dumpfile” on page 99).
- **E** — Displays the source code corresponding to the stack frame you specify (see “E” on page 99).
- **echo** — Prints the given text to the command pane, removing quotation marks if there are any (see “echo” on page 100).
- **eval** — Evaluates the given expression (see “eval” on page 100).
- **examine** — Examines the given object (see “examine” on page 101).
- **goaway** — Hides the Debugger and debug-related windows (see “goaway” on page 101).

- **l** — Lists various Debugger objects (see “l” on page 102).
- **map** — Lists the section address map for the current program, including section starts, ends, and sizes (see “map” on page 103).
- **mprintf** — Prints to the command pane (see “mprintf” on page 103).
- **mrulist** — Allows you to display and modify the contents of the most recently used lists (see “mrulist” on page 104).
- **mute** — Controls how much output from Debugger commands is displayed (see “mute” on page 105).
- **p**, **print** — Displays the value of the given expression using the specified format (see “p, print” on page 105).
- **printline** — Prints the specified number of source lines, starting at the specified line number (see “printline” on page 106).
- **printphys** — Takes in a numerical address or an address expression and prints the physical address mapped to that virtual address (see “printphys” on page 106).
- **printwindow** — Prints a specified section of source code (see “printwindow” on page 106).
- **pwd** — Prints MULTI's current working directory (see “pwd” on page 107).
- **Q** — Sets or toggles the Debugger's quiet mode (see “Q” on page 107).
- **savedebugpane** — Saves the contents of the specified Debugger pane to the specified file (see “savedebugpane” on page 107).
- **windowcopy** — Copies the specified window's current selection to the clipboard (see “windowcopy” on page 108).
- **windowpaste**, **windowspaste** — Pastes the current selection into the input buffer of the specified window (see “windowpaste, windowspaste” on page 108).

assem

assem [on | off | tog | nosource]

GUI only

Controls the display mode of the Debugger window's source pane, where:

- `on` — Interlaces the appropriate disassembled instructions between lines of source code. This option corresponds to **View → Display Mode → Interlaced Assembly** and the button when selected.
- `off` — Shows source code only. This option corresponds to **View → Display Mode → Source Only** and the button when not selected.
- `tog` — Toggles the display between source code only and interlaced source code with disassembly. This is the default.
- `nosource` — Shows disassembly only. This option corresponds to **View → Display Mode → Assembly Only**.

  If this option is used and the current file contains no program code (such as a header file), the source file is displayed, but if you navigate to another file that contains program code, the Debugger displays disassembly only.

cat

cat *filename* [*filename*]...

Prints the contents of the specified files to the command pane. Multiple files will be printed in the order specified, one after the other. If you specify a filename containing a space, you must enclose *`filename`* in double quotation marks.

clear

clear [cmd | target | io | serial | python | traffic]

GUI only

Clears the command pane, target pane, I/O pane, serial terminal pane, Python pane, or traffic pane of the Debugger. With no arguments, this command clears the pane that is currently visible in the Debugger. With `cmd`, `target`, `io`, `serial`, `python`, or `traffic` specified, this command clears the specified pane.

comeback

comeback

GUI only

Restores the Debugger and debug-related windows after the **goaway** command has hidden them (see “goaway” on page 101).

The **goaway** and **comeback** commands are only useful when MULTI is being externally controlled via a command script because there is no way to interactively issue **comeback** after **goaway** has hidden the Debugger.

components

components [*component_name*]

Lists components and their aliases. When run without the *`component_name`* argument, **components** lists the unique name of all components in the system along with a short list of aliases (if any) for each component. When a specific component name is specified, **components** lists that component's unique name along with all of its aliases.

Unique names are of the form:

`component.`*`number`*

where *`number`* is unique for each component, and increases from `1`. The unique names of components may change between releases as new types of components are added.

To create a new alias for a new component, use the **new** command (see “new” on page 24).

To route commands to components, use the **route** command (see “route” on page 181).

dbprint

dbprint [w | f]

GUI only

Prints the source currently being viewed in the Debugger. If `f` is specified, the entire source file will be printed. If `w` is specified, only the source lines that are currently visible in the Debugger window will be printed. If you run this command without arguments, it has the same effect as `dbprint w`.

The **dbprint** `w` command corresponds to **File → Print Window**.

The **dbprint** `f` command corresponds to **File → Print**.

debugpane

debugpane [cmd | target | io | serial | python | traffic | next | prev]

GUI only

Changes the Debugger command pane to the specified pane. There are six possible panes: the command pane, the target pane, the I/O pane, the serial terminal pane, the Python pane, and the traffic pane.

Specifying `cmd`, `target`, `io`, `serial`, `python`, or `traffic` will switch to that pane. Specifying `next` or `prev` will switch to the next or previous pane (in the order: command pane, target pane, I/O pane, serial terminal pane, Python pane, traffic pane). With no arguments, `debugpane` will switch to the next pane. See also “savedebugpane” on page 107.

In addition to this command, the Debugger also includes six tabs that allow you to switch panes. See “The Cmd, Trg, I/O, Srl, Py, and Tfc Panes” in Chapter 2, “The Main Debugger Window” in the *MULTI: Debugging* book.

dumpfile

dumpfile [*filename*]

GUI only

Writes the contents of the Debugger's source pane to a text file, or, if debug information is available, writes the entire file. You can use this command to capture your program's disassembly, as well as source interlaced with your program's disassembly. The output is written to the specified file, creating the file if necessary. If no file is specified, you are prompted to name one.

E

E [*stack* | +[*num*] | -[*num*]]

Displays the source code corresponding to the stack frame you specify. If there is no source for the instructions near the program counter, the Debugger will display the disassembly of your program at that location.

The **E** command can be used in the following forms:

- **E** — Displays the procedure at the top of the stack. This option corresponds to **e 0_** (see “e” on page 133), , and **View → Navigation → Current PC**.
- **E *stack*** — Displays the procedure at call stack frame number `stack`. Equivalent to the **e *num*_** command (see “e” on page 133).
- **E +[*num*]** — Displays the procedure `num` procedures above the currently visible procedure on your process's call stack, where `num` defaults to `1` if not specified. For example, **E +1** displays one procedure above the current one on the stack. This is different from **E 1**, which displays the procedure at stack frame number one.

  This option corresponds to and **View → Navigation → UpStack**.
- **E -[*num*]** — Displays the procedure `num` procedures below the currently visible procedure on your process's call stack, where `num` defaults to `1` if not specified. For example, **E -1** displays one procedure below the current one on the stack. This is different from **E 1**, which displays the procedure at stack frame number one.

This option corresponds to  and **View → Navigation → DownStack**.

echo

echo *text*

Prints the given `text` to the command pane, removing quotation marks if there are any. For example, both of the following give the same result:

```
> echo foo bar
foo bar
> echo "foo bar"
foo bar
```

This command differs from the **print** command, in that the Debugger does not attempt to evaluate the given text as a programmatic expression (see “p, print” on page 105).

eval

eval *expr*

Evaluates `expr`, which is an expression in the current source language. Note that this command may read from and write to target memory. This command is similar to the **print** command (see “p, print” on page 105), except that it does not echo the results. This command should be used instead of the **print** command when performing I/O accesses, since printing the result of `expr` may cause an extra read of the I/O address.

For example:

```
> eval *(int *)0xffffa0c0 = 0x123
```

will write `0x123` to the address `0xffffa0c0`. For information about accessing I/O memory, see also the system variable `_CACHE` in “System Variables” in Chapter 14, “Using Expressions, Variables, and Procedure Calls” in the *MULTI: Debugging* book.

examine

examine [/*format*] *expr*

examine *address_expression*

examine *number*b

Examines the given object, possibly with the given formatting options. This command has three forms:

- When the given argument is `[/format] expr`, **examine** is equivalent to **print /*format expr***, which evaluates the expression and prints the result with the given formatting options (see “p, print” on page 105).
- When the given argument is `address_expression`, **examine** is equivalent to **e *address_expression***; **p *address_expression***, which displays the given location in the source pane and then prints the address in the command pane. See “e” on page 133 and “p, print” on page 105.
- When the given argument is `numberb`, **examine** causes MULTI to display the location where the breakpoint with the ID `number` is set in the Debugger source pane.

goaway

goaway

GUI only

Hides the Debugger and debug-related windows such as the Data Explorer, the **Register View** window, and the **Memory View** window. MULTI Editor windows that were opened from the Debugger are also hidden. Use the **comeback** command to restore these windows (see “comeback” on page 97).

The **goaway** and **comeback** commands are only useful when MULTI is being externally controlled via a command script because there is no way to interactively issue **comeback** after **goaway** has hidden the Debugger.

l

l [*object*] [*string*]

(This command is a lowercase `L`.)

Lists various Debugger objects. An optional *`string`* argument may be specified for some types of objects, which restricts file lists to objects whose names contain *`string`* and other lists to objects whose names start with *`string`*. Permitted values for *`object`* are as follows:

- `[no parameter]` — Lists local variables and parameters of the current procedure.
- `@` — Lists the addresses of local variables. For this type of object, if *`string`* is specified, it is interpreted as a procedure name, and variables local to that procedure are listed. The procedure must be on the stack.
- `b` — Lists breakpoints. Identical to the **B** command (see “B” on page 40).
- `d` — Lists directories that will be searched for source files. Identical to the **source** command (see “source” on page 80).
- `D` — Lists all dialog boxes.
- `f` — Lists source files (optional *`string`* parameter permitted).
- `g` — Lists global variables (optional *`string`* parameter permitted).
- `i` — Lists source files included by the currently displayed file.
- `m` — Lists procedures with their mangled names. Like `l p`, except that the mangled names of C++ procedures are also listed.
- `M` — Lists menus defined with the **menu** command (see “Configuring and Customizing Menus” in Chapter 7, “Configuring and Customizing MULTI” in the *MULTI: Managing Projects and Configuring the IDE* book).
- `p` — Lists procedures and their addresses. If the optional *`string`* parameter is given, only procedures in file *`string`* are displayed. An asterisk (*) indicates that the procedure has no debugging information. This command takes wildcards.
- `P` — Lists processes.
- `r` — Lists registers (optional *`string`* parameter permitted). See also “The View Menu” in Appendix A, “Debugger GUI Reference” in the *MULTI: Debugging* book and “regview” on page 174.

- `R` — Lists register synonyms.
- `s` — Lists system variables (optional *`string`* parameter permitted). System variables that begin with an underscore (_) represent the internal state of the Debugger and are excluded by default, but you can list them with `l s _`.
- `S` — Lists static variables. The optional *`string`* parameter may specify a prefix to the variable name or a filename.
- `t` — Lists type definitions (optional *`string`* parameter permitted).
- `T` — Lists tasks.
- `z` — Lists signals.
- *`proc`* — Lists all locals and parameters of the procedure *`proc`* (which must be on the stack). If *`proc`* is a C++ instance method, this argument lists the `this` pointer as well. If *`proc`* starts with an `@`, the addresses of all locals, parameters, and `this` are printed.

Corresponds to: **View → List →** ***Object***

map

map [*filename* | -modules | -find *address*]

Lists the section address map for the current program, including section starts, ends, and sizes.

- *`filename`* — Lists the section address map for the specified module only.
- `-modules` — Lists the names and locations of the currently loaded modules.
- `-find` *`address`* — Lists the module and section that contains the specified memory address.

mprintf

mprintf (*format_string, ...*)

Prints to the command pane. This command takes the same syntax as the C library `printf()` function, except that the `%n` conversion specifier is not supported.

For example, given the following target code:

```
char * my_str = "hello world";
int my_int = 10;
```

And with the following command:

```
> mprintf("my_str=\"%s\" and (2*my_int+1)=%d", my_str, \
continued> 2*my_int+1);
```

The Debugger will display:

```
my_str="hello world" and (2*my_int+1)=21
```

mrulist

mrulist *subcommand* [*args*]

GUI only

Allows you to display and modify the contents of the most recently used (MRU) lists. Two examples of MRU lists are the recent files list and the recent projects list.

The argument *`subcommand`* is required and must be one of the following:

- `listall` — Lists the name of each existing MRU list.
- `print` *`listname`* — Lists the contents of the specified MRU list.
- `insert` *`listname slot entry`* — Inserts an entry into the specified MRU list at the specified slot number. The entry will be placed in the specified slot, and all previous entries at or below the slot will be shifted down by one. If the slot number is greater than the number of entries, the entry will be added to the end of the list. The slot numbers are zero based, and the maximum number of entries is nine; therefore the useful range of slot numbers is 0 to 8.
- `delete` *`listname`* `[`*`slot`*`]` — Deletes an entry or all entries from the specified MRU list. If a slot is specified, the entry at the slot is deleted. If no slot is specified, all entries are deleted.
- `change` *`listname slot entry`* — Changes the entry in the specified MRU list at the specified slot.

- `update` *`listname entry`* — Moves the specified entry to the first slot of the MRU list if the entry already exists in the list, or inserts the entry at the top of the list if the entry does not already exist in the list.

mute

mute *state*

Controls how much output from Debugger commands is displayed. The argument *`state`* is required and must be one of the following:

- `off` — All output from Debugger commands is displayed. This is the default setting.
- `some` — Only serious error messages are displayed. All other output is suppressed.
- `on` — All output from Debugger commands is suppressed, including all error messages.

p, print

p [/*format*] *expr*

print [/*format*] *expr*

Displays the value of the expression *`expr`*, using the format *`format`*, by evaluating the expression exactly as the current language does. The expression *`expr`* can be any expression in the current language. For a list of available formats, see “Expression Formats” in Chapter 14, “Using Expressions, Variables, and Procedure Calls” in the *MULTI: Debugging* book.

See also “echo” on page 100, “eval” on page 100, and “examine” on page 101.

Corresponds to: **View → Print Expression**

printline

printline [*count* [*line*]]

Prints `count` source lines, starting at the file-relative line number `line`. If `count` is not specified, one line is printed. If `line` is not specified, the current line is the starting point. The current line is updated to the last line printed after this command is executed, which will change the source display in GUI mode.

In non-GUI mode, entering a line number prints out that line.

printphys

printphys [*address* | *expression*]

Takes in a numerical address or an address expression and prints the physical address mapped to that virtual address. The following example output is from a Power Architecture INTEGRITY target being debugged in freeze mode:

```
> printphys $pc
Virtual:    0x00010318 (main)
Physical:   0x00345318
```

Note

This command is not supported in run mode or if a TimeMachine-enabled task is selected in the target list and the target processor does not support data trace.

printwindow

printwindow [*line* [*num*]]

Prints a section of source code, `num` lines long, centered around the file-relative line `line`. The default value for `num` is specified by the system variable `_LINES`, which defaults to 22. The default for `line` is the current line. See “System Variables” in Chapter 14, “Using Expressions, Variables, and Procedure Calls” in the *MULTI: Debugging* book. The current line is indicated by a greater-than sign (>) between the line numbers and the source code. The current viewing position is not affected by this command. See also “printline” on page 106.

This command is typically used in non-GUI mode.

pwd

pwd

Prints MULTI's current working directory.

Q

Q [0 | 1 | b]

Sets or toggles the Debugger's quiet mode. The command `Q 0` turns off quiet mode (the default for quiet mode is off), the command `Q 1` turns on quiet mode, and the command `Q` alone toggles quiet mode. When the Debugger is in quiet mode, many commands are less verbose. For example, when a breakpoint is being set or toggled in quiet mode, the breakpoint will not be echoed to the command pane.

The command `Q b` is valid only in a breakpoint's command list. When the process stops at a breakpoint that contains `Q b` in its command list, the Debugger will not print a message about the breakpoint being hit (`Stopped by breakpoint`).

savedebugpane

savedebugpane [[cmd]|[target]|[io]|[serial]|[python]|[traffic]] ["*filename*"]

GUI only

Saves the contents of the specified Debugger pane to the file *`filename`*. If you do not specify *`filename`*, a **Save As** dialog box prompting you to choose a file appears. There are six possible panes: the command pane, the target pane, the I/O pane, the serial terminal pane, the Python pane, and the traffic pane. If you do not specify a pane, the contents of the currently visible pane are saved. See also “debugpane” on page 98.

windowcopy

windowcopy wid=*num*

GUI only

Copies the current selection in the window specified by the window identification number, `num`, to the clipboard. For more information about window identification numbers, see “Customizing Keys and Mouse Behavior” in Chapter 7, “Configuring and Customizing MULTI” in the *MULTI: Managing Projects and Configuring the IDE* book.

windowpaste, windowspaste

windowpaste wid=*num*

windowspaste wid=*num*

GUI only

Pastes the current selection into the input buffer of the window whose identification number is `num`. This command is typically used as part of a **mouse** or **keybind** command. For more information about the **mouse** and **keybind** commands and window identification numbers, see “Customizing Keys and Mouse Behavior” in Chapter 7, “Configuring and Customizing MULTI” in the *MULTI: Managing Projects and Configuring the IDE* book.

The **windowspaste** command uses the selection, whereas the **windowpaste** command uses the clipboard.

Chapter 9

Help and Information Command Reference

Contents

The commands in this chapter allow you to access help information or information about your MULTI installation.

Help and Information Commands

The following list provides a brief description of each help and information command. For a command's arguments and for more information, see the page referenced.

- **about** — Displays information about MULTI (see “about” on page 110).
- **aboutlic** — Displays information about the licenses in use by MULTI (see “aboutlic” on page 111).
- **bugreport** — Launches the **gbugrpt** utility, which allows you to append displayed information to a bug report form that you can fill out and email to Green Hills Software's Technical Support (see “bugreport” on page 111).
- **help** — Displays or searches for documentation in the Help Viewer (see “help” on page 111).
- **info** — Prints information about the state of MULTI (see “info” on page 111).
- **usage** — Prints the syntax for the specified Debugger command (see “usage” on page 112).

about

about

Displays information about MULTI.

In GUI mode, this command opens a dialog box that contains information about the current version of MULTI. In non-GUI mode, this command prints this information to standard output.

Corresponds to: **Help → About MULTI**

aboutlic

aboutlic

GUI only

Displays information about the licenses in use by MULTI.

Corresponds to: **Help → License Info**

bugreport

bugreport

GUI only

Launches the **gbugrpt** utility, which displays information about your MULTI installation and allows you to append it to a bug report form that you can fill out and email to Green Hills Software's Technical Support.

help

help [*keyword* | *command_name* | *configuration_option*]

Opens the Help Viewer on documentation for `command_name` or `configuration_option` or, if a keyword is specified, searches all manuals for `keyword`. If no argument is specified, the *MULTI: Debugging* book opens in the Help Viewer.

info

info

Prints the following information about the state of MULTI:

- Debugging status
- Current target connection
- On Linux/Solaris, core file status

- Child program status
- Output recording status
- Command recording status
- Case sensitivity status

usage

usage *command*

Prints the syntax for the specified MULTI Debugger command.

The conventions for displaying the command syntax in the command pane are similar to those used in this book (see “Conventions Used in the MULTI Document Set” on page xviii), with the following exception: In the syntax returned by the **usage *command*** command, words that appear in all capital letters are placeholders and should be replaced in your actual command line with a value appropriate for your context. (These placeholders appear in italics, rather than capital letters, in the print and online documentation.) For example, `FILENAME` indicates that you should substitute the name of the file to be used for the operation performed by the command.

Chapter 10

Memory Command Reference

Contents

The commands in this chapter allow you to perform memory-related operations such as filling, copying, or writing to a specified block of memory and performing memory reads and tests. See also “Cache View Commands” on page 279.

General Memory Commands

The following list provides a brief description of each general memory command. For a command's arguments and for more information, see the page referenced. (Note that complete descriptions for some of these commands are located in other chapters.)

- **compare**, **compareb** — Compares two blocks of memory (see “compare, compareb” on page 115).
- **copy**, **copyb** — Copies one region of memory to another (see “copy, copyb” on page 116).
- **disassemble** — Disassembles a specified region of memory (see “disassemble” on page 117).
- **fill**, **fillb** — Fills a specified block of target memory (see “fill, fillb” on page 118).
- **find**, **findb** — Searches for a block of memory (see “find, findb” on page 119).
- **flash** — Writes a file to flash memory on the target (see “flash” on page 120).
- **memdump** — Copies a section of memory on the target to a specified file on the host (see “memdump” on page 122).
- **memload** — Loads the contents of a file on the host machine into a portion of target memory (see “memload” on page 123).
- **memread** — Performs a sized memory read from the target and prints the result (see “memread” on page 124).
- **memtest** — Configures and launches memory tests (see “memtest” on page 125).
- **memview** — Opens a **Memory View** window for displaying and modifying memory contents (see “memview” on page 273 in Chapter 21, “View Command Reference” on page 265).
- **memwrite** — Performs a sized memory write to the target (see “memwrite” on page 128).

- **verify** — Verifies that the contents of memory match the contents of the executable program file (see “verify” on page 129).

compare, compareb

compare -gui

compareb -gui

compare [*operation*] *src1 src2 length* [*size*]

compareb [*operation*] *src1 src2 bytes* [*size*]

The `-gui` argument to the **compare** or **compareb** command opens a window where you can enter the parameters for comparing two blocks of memory.

The **compare** `-gui` command corresponds to **Target** → **Memory Manipulation** → **Compare** and to the **Memory View** menu selection **Memory** → **Compare**.

The second format of the **compare** and **compareb** commands compares the elements of two regions of memory beginning at the addresses *`src1`* and *`src2`*. The size of the block of memory that is compared is determined by *`length`* for the **compare** command and *`bytes`* for the **compareb** command.

Corresponding elements from the two locations are each compared in turn, using the given *`operation`*, where each element is *`size`* bytes long. For the **compare** operation, the total size in bytes of the blocks compared is (*`length`* `x` *`size`*), and for the **compareb** operation it is *`bytes`*. The argument *`size`* may be either 1, 2, 4, or 8 bytes. If *`size`* is not specified, the default is the size of an integer on the target system.

The argument *`operation`* may be any of the following values:

- `<=` — The element in *`src1`* is less than or equal to the element in *`src2`*.
- `<` — The element in *`src1`* is less than the element in *`src2`*.
- `>=` — The element in *`src1`* is greater than or equal to the element in *`src2`*.
- `>` — The element in *`src1`* is greater than the element in *`src2`*.
- `==` — The element in *`src1`* is equal to the element in *`src2`*.
- `!=`— The element in *`src1`* is not equal to the element in *`src2`*.

If *operation* is not specified, equality (==) is used.

The **compare** and **compareb** commands will print each pair of corresponding elements that have the relationship described by *operation*.

The following example compares two overlapping arrays of six 4-byte integers. The first array starts at `0x10000`, and the second at `0x10008`. The **compare** command displays only the pairs that satisfy *operation*.

```
> compare >= 0x10000  0x10008 6 4
0x10000,  0x10008 : 2091264888, 2086935416
0x10004,  0x1000c : 2089100152, 945815572
0x10008,  0x10010 : 2086935416, 1279398274
0x10014,  0x1001c : 1207968893, 1099038740
```

These commands require that MULTI be connected to a target and that the target be in a state such that MULTI can access memory.

To interrupt these commands, press **Esc**.

copy, copyb

copy -gui

copyb -gui

copy *src dest length* [*size*] [*direction*]

copyb *src dest bytes* [*size*]

The `-gui` argument to the **copy** or **copyb** command opens a window where you can enter the parameters for copying one region of memory to another.

The **copy** `-gui` command corresponds to **Target → Memory Manipulation → Copy** and to the **Memory View** menu selection **Memory → Copy**.

The second format of the **copy** and **copyb** commands copies a block of memory with elements of size *size* from *src* to *dest*. For the **copy** command, the block consists of *length* elements of size *size*. Thus, the total size of memory copied in bytes is (*length* x *size*). For the **copyb** command, the total size of the block is *bytes*. The argument *size* may be either 1, 2, 4, or 8 bytes. If *size* is not specified, it defaults to the size of an integer on the target system. For the **copy** command, the direction of the copy may be specified by `direction`, and may be either `forw` for forward copying [default], or `backw` for reverse copying.

Reverse copying is the same as forward copying, except that the elements at the end of the block are written first, before the elements at the beginning of the block. Reverse copying will have the same effect as forward copying, unless the `src` and `dest` regions overlap.

These commands require that MULTI be connected to a target and that the target be in a state such that MULTI can access memory.

To interrupt these commands, press **Esc**.

disassemble

disassemble [-quiet] *addr_expr* [*size*]

disassemble [-quiet] -section *section*

disassemble [-quiet] -recheck

Disassembles a specified region of memory and adds it to MULTI's cache. By default, the disassembled instructions are displayed in the command pane. Available options are:

- `-quiet` — Specifies that disassembled instructions should not be displayed in the command pane.
- `addr_expr [size]` — Specifies the region of memory to disassemble, beginning at `addr_expr` and ending `size` bytes later. However, if the last instruction of the region continues past `size` bytes, the full instruction is disassembled. `addr_expr` may be any expression that represents a memory address. If `size` is not specified, MULTI disassembles the region of memory starting at `addr_expr` and ending at the end of the containing function.
- `-section section` — Specifies the section of memory to disassemble.
- `-recheck` — Performs the last disassembly again.

fill, fillb

fill -gui

fillb -gui

fill *dest length* [*value* [*size*]]

fillb *dest bytes* [*value* [*size*]]

The `-gui` argument to the **fill** or **fillb** command opens a window where you can enter the parameters for filling a specified block of memory.

The **fill** `-gui` command corresponds to **Target → Memory Manipulation → Fill** and to the **Memory View** menu selection **Memory → Fill**.

The second format of the **fill** and **fillb** commands fills the target's memory with the given value. For the **fill** command, the block starts at *`dest`* and extends for *`length`* elements of *`size`* bytes. Thus, the total size of the block in bytes is (*`length`* `x` *`size`*). For the **fillb** command, the block has a length in bytes of *`bytes`*. The block will be filled with *`value`*, or zero if *`value`* is not specified. The argument *`size`* is the number of bytes to place *`value`* in and may be either 1, 2, 4, or 8. If *`size`* is not specified, the default is the size of an integer on the target system. If *`value`* is too large to fit in the elements of the size given, the most significant bits of *`value`* are truncated.

These commands require that MULTI be connected to a target and that the target be in a state such that MULTI can access memory.

To interrupt these commands, press **Esc**.

find, findb

find -gui

findb -gui

find *src length value* [*size* [*mask*]]

findb *src bytes value* [*size* [*mask*]]

The `-gui` argument to the **find** or **findb** command opens a window where you can enter the parameters for searching for a value in memory.

The **find** `-gui` command corresponds to **Target → Memory Manipulation → Find**.

The **findb** `-gui` command corresponds to the **Memory View** menu selection **Memory → Find**.

The second format of the **find** and **findb** commands searches memory starting at *`src`* for an element that is *`size`* bytes long and has the given *`value`*. The argument *`size`* may be 1, 2, 4, or 8 bytes and, if not specified, is the size of an integer on the target system. For the **find** command, the search stops when *`length`* elements have been checked. For the **findb** command, the search stops when *`bytes`* bytes have been checked. If *`mask`* is specified, it is logically `AND`ed with each memory location value before being compared with *`value`*. Every match found is listed on a separate line with the address of the match.

These commands require that MULTI be connected to a target and that the target be in a state such that MULTI can access memory.

To interrupt these commands, press **Esc**.

flash

flash gui [*program_name*]

flash burn [-baseaddress=*address*] [-type= elf | raw | srec] [-offset=*offset*] [-executable=*filename*] [-endian= big | little | auto] [-rambase=*address*] [-script=*filename*] [-eraseonly= yes | no] [-unlock= yes | no] [-verify= yes | no] [-memrequire=*kilobytes*]

The `gui` argument to the **flash** command opens a window where you can enter the parameters for writing a file to flash memory on the target. The available option is:

- *`program_name`* — Opens this window on the program specified. If you do not specify a *`program_name`*, this window opens on the program you are debugging.

The **flash** `gui` command corresponds to **Target → Flash**.

See also "prepare_target" on page 228.

The `burn` argument to the **flash** command causes the **MULTI Fast Flash Programmer** to write a file to flash memory on the target, where:

- `-baseaddress=`*`address`* — Specifies the base address of the flash memory in the target memory map. *`address`* can be in decimal or hex format. This defaults to the last value you specified for this executable. If no previous value is available, `0` is used.
- `-type=elf|raw|srec` — Identifies the file format of the file to be written to flash memory (that is, the file specified via the `-executable` argument). Use `elf` if the file format is ELF. Use `raw` if the file is an unformatted memory image. Use `srec` if the file is a collection of S-Records. This defaults to `elf`.
- `-offset=`*`offset`* — Specifies an offset for the write. If the file is a memory image, the offset is the location relative to the base address where it will be written. If the file is an ELF or S-Record format program, the offset is added to the addresses of each section. This defaults to `0`.
- `-executable=`*`filename`* — Specifies the path on the host of the file to be written to flash memory. This defaults to the program you are currently debugging.

- `-endian=big|little|auto` — Specifies the endianness of the target CPU. This defaults to `auto`, which causes the **MULTI Fast Flash Programmer** to read the setting from the debug adapter.
- `-rambase=`*`address`* — Sets the location in target RAM where the **MULTI Fast Flash Programmer** will temporarily store agents and other data. This defaults to the RAM base address defined in the executable's linker directives file. If the RAM base address cannot be determined, the last value you specified for this executable is used; otherwise, `0` is used.
- `-script=`*`filename`* — Specifies the path to a setup script that will be run before the flash programming session. This defaults to the setup script path (if any) provided in the target's connection settings.
- `-eraseonly=yes|no` — This disables the programming function of the **MULTI Fast Flash Programmer**, which causes the sectors covered by the input file to be left in the erased state. This defaults to `no`.
- `-unlock=yes|no` — Specifies whether locked sectors should be unlocked before programming. This defaults to `no`. Reprogramming locked sectors may change the boot sequence of the target board.
- `-verify=yes|no` — Enables or disables the verification stage of flash programming. This defaults to `yes`.
- `-memrequire=`*`kilobytes`* — Specifies, in kilobytes, the amount of target RAM to be used for target agents and other data. Generally, increasing this value results in faster flash programming. This defaults to all available RAM (up to 2 MB) as defined in the executable's linker directives file. If the amount of available RAM cannot be determined, 128 KB is used.

This command requires that MULTI be connected to a target and that the target be in a state such that MULTI can access memory.

For more information, see Chapter 22, “Programming Flash Memory” in the *MULTI: Debugging* book.

memdump

memdump -gui

memdump [-append] [srec | raw] *filename start length*

memdump [-append] [srec | raw] *filename section*

The `-gui` argument to the **memdump** command opens a window where you can enter the parameters for copying a block of memory on the target to a file on the host.

The **memdump** `-gui` command corresponds to **Target** → **Memory Manipulation** → **Memory Dump** and to the **Memory View** menu selection **Memory** → **Dump**.

The second and third formats of the **memdump** command copy a section of memory on the target to a file on the host, where:

- `-append` — Adds data to the end of the file rather than overwriting existing data in the file.
- `srec` — Specifies Motorola S-Record format.
- `raw` — Specifies raw binary data.
- *`filename`* — Specifies the file that memory is copied to.
- *`start`* — Specifies the starting address in memory to dump.
- *`length`* — Specifies how many bytes of data to dump to the file, beginning at *`start`*.
- *`section`* — Specifies the name of a section in memory to dump.

Both the **memload** and **memdump** commands support three file formats: S-Record, raw, and default. If you do not specify `srec` or `raw`, the default format is used. For a detailed description of these formats, see “memload” on page 123.

This command requires that MULTI be connected to a target and that the target be in a state such that MULTI can access memory.

To interrupt this command, press **Esc**.

memload

memload -gui

memload [srec | raw | legacy] [-w *size*] *filename* [*start* [*length*]]

The `-gui` argument to the **memload** command opens a window where you can enter the parameters for loading the contents of a file on the host machine into a portion of memory on the target.

The **memload** `-gui` command corresponds to **Target** → **Memory Manipulation** → **Memory Load** and to the **Memory View** menu selection **Memory** → **Load**.

The second format of the **memload** command loads the contents of a file on the host machine into a portion of target memory, where:

- `srec` — Specifies Motorola S-Record format.
- `raw` — Specifies raw binary data.
- `legacy` — Specifies that MULTI should use the default format written by MULTI 4 and earlier. This option is only available from the command line.
- *`filename`* — Specifies the file to load into memory.
- *`start`* — Specifies the starting address in memory to load.
- *`length`* — Specifies how many bytes of data to load into memory, beginning at *`start`*. The *`length`* argument must be a multiple of *`size`*.
- *`size`* — Specifies the size (in bytes) of the individual memory writes. The value must be 1, 2, or 4. The default, which depends on your target hardware and debug server, is selected to optimize loading performance.

Both the **memload** and **memdump** (see "memdump" on page 122) commands support three file formats: S-Record, raw, and default.

To use the S-Record format, specify the `srec` option. If the arguments *`start`*, *`length`*, or `size` are specified, they are ignored. The file is read as a Motorola S-Records file.

To use the raw format, specify the `raw` option. In this format, the file contains only the binary data, with no formatting or header information. This format is appropriate for transferring data to external tools that deal with binary data. The starting address *`start`* must be specified. This command loads the specified file, starting at the first byte of the file, and continuing for `length` bytes. If `length` is not specified, this command will load the entire content of the file.

To use the default format, do not specify the `srec` or `raw` option. This file format is proprietary and non-portable. The address and size of the memory region is stored at the beginning of the file in host byte order, using the host integer size. The actual content of the memory region follows the address and size, and is handled as a series of bytes. If `start` and `length` are omitted, the values specified when the file was created are used.

If MULTI is always run on a single host, the default format is the easiest to use when dumping memory to be read back into MULTI. Because the **memdump** command records the address and size in the file (see “memdump” on page 122), it is not necessary to specify either when using the **memload** command to load a file into memory that was created with **memdump**.

To load default format files that were created by MULTI 4 or earlier, specify the `legacy` option.

This command requires that MULTI be connected to a target and that the target be in a state such that MULTI can access memory.

To interrupt this command, press **Esc**.

memread

memread *size address*

Performs a sized memory read from the target and prints the result. This command is intended to be used to perform low-level reads from regions of memory or memory-mapped I/O registers. This command does not make use of MULTI's memory cache, and the read is performed immediately. See also the system variable `_CACHE` in “System Variables” in Chapter 14, “Using Expressions, Variables, and Procedure Calls” in the *MULTI: Debugging* book.

`size` may be 1, 2, or 4. Some targets, such as the Green Hills Probe and INTEGRITY 10 or later, also support 8. The units are bytes. `address` must be aligned correctly to the nearest `size` bytes.

memtest

memtest *start_addr end_addr* -size=*size* -test=*test_choice* [-pattern=*value*] [-complement | -rotate | -random | -complement -rotate] [-maxtransitions] [-resetpattern] [-repeat=*number_of_tests* | -continuous] [-maxerr=*number_of_errors* | -writeonly] [-tgtagent] [-tgtagentstart | -tgtagentend | -tgtagentloc=*expr*]

Configures and launches memory tests, where:

- `start_addr` — Defines the lowest address to test. `start_addr` must be an expression that evaluates to a 32-bit address.
- `end_addr` — Defines the highest address to test. `end_addr` must be an expression that evaluates to a 32-bit address.
- `size` — Indicates the access size (in bytes) to use when performing the test. Valid sizes are 1, 2, and 4.
- `-test=test_choice` — Defines the type of test to run. Acceptable values for `test_choice` are:
    - `a1` — Address walking one test (destructive)
    - `a0` — Address walking zero test (destructive)
    - `d1` — Data walking one test (destructive)
    - `d0` — Data walking zero test (destructive)
    - `p` — Data pattern test (destructive)
    - `r` — Memory read test (nondestructive)
    - `cr` — CRC computation (nondestructive)
    - `cc` — CRC compare test (nondestructive)
    - `fr` — Find start/end ranges test (nondestructive)

  More than one of the destructive memory test options (`a1`, `a0`, `d1`, `d0`, and `p`) can be specified by using multiple `-test=test_choice` arguments. The nondestructive tests (`r`, `cr`, `cc`, and `fr`) must be performed individually. For descriptions of these tests, see "Types of Memory Tests" in Chapter 21, "Testing Target Memory" in the *MULTI: Debugging* book.
- `-pattern=value` — Specifies the data value to use for address bus walking and/or data pattern tests.

- `-complement` — Causes the data pattern value for pattern tests to be complemented between memory writes. (This option can be passed with the `-rotate` option. If both `-complement` and `-rotate` are specified, the pattern will be rotated every other write and complemented every write, resulting in a write sequence similar to `0x01`, `0xfe`, `0x02`, `0xfd`, `...`)
- `-rotate` — Causes the data pattern for pattern tests to be rotated between writes. (This option can be passed with the `-complement` option as well, causing the pattern value to be both complemented and rotated between iterations. See the description for `-complement` above.)
- `-random` — Causes a pseudorandom sequence of values to be used for the pattern test. (This option cannot be used with either the `-complement` or the `-rotate` options.)
- `-maxtransitions` — Causes MULTI to use a sequence of addresses in the data pattern or memory read tests that maximizes the address line transitions between accesses. (The default behavior is to access memory sequentially from low addresses to high addresses.)
- `-resetpattern` — Causes MULTI to use the same starting pattern value for each test iteration rather than using a complemented, rotated, or subsequent pseudorandom value.
- `-repeat=`*`number_of_tests`* — Specifies the number of times to repeat a test or tests. (This option cannot be passed with the `-continuous` option, and does not apply to the CRC compute or find start/end ranges tests.)

  If a `-repeat` value is specified with multiple memory tests, all selected tests are run during each iteration. For example, the options `-test=a0 -test=p -repeat=2` would set the test sequence as:

  ```
  Address walking zero
  Pattern
  Address walking zero
  Pattern
  ```

- `-continuous` — Specifies that the test(s) will run continuously. (This option cannot be passed with the `-repeat=`*`number_of_tests`* option, and does not apply to the CRC compute or find start/end ranges tests.)
- `-maxerr=`*`number_of_errors`* — Causes MULTI to abort the test(s) after detecting the specified number of errors. This option cannot be used with the `-writeonly` option.

- `-writeonly` — Causes MULTI to skip the reading phase of the address bus walking, data bus walking, and data pattern tests. This option cannot be used with the `-maxerr=`*`number_of_errors`* option.
- `-tgtagent` — Causes MULTI to download and use a target-resident agent to perform the memory tests (rather than using the Debugger).
- `-tgtagentstart` — Specifies that the target agent be placed at the start of the memory range to be tested. This option is only valid when used with the `-tgtagent` option.
- `-tgtagentend` — Specifies that the target agent be placed at the end of the memory range to be tested. This option is only valid when used with the `-tgtagent` option.
- `-tgtagentloc=`*`expr`* — Specifies that the target agent be placed at the location specified by the expression *`expr`*. This memory location should not overlap the test range, and must be valid for the test to be performed successfully.

For further details about test types and options, see “Advanced Memory Testing: Using the Perform Memory Test Window” in Chapter 21, “Testing Target Memory” in the *MULTI: Debugging* book and “Types of Memory Tests” in Chapter 21, “Testing Target Memory” in the *MULTI: Debugging* book.

Note

The **memtest** command syntax can be complex, because of the variety of test types and options available. For this reason, we recommend that you use the **Memory Test Wizard** or the **Perform Memory Test** window to configure and run memory tests. Even if you want to write scripts that contain memory testing commands, you can still use the interactive interfaces to determine the exact command syntax for the specific testing options you want to use. To do this, use one of these GUIs to configure the test you want to run, and then run the test. When the test completes, the **Memory Test Results** window will display the exact command syntax that corresponds to the testing options you specified. You can use the command syntax given there from the Debugger command pane or in scripts you write. For more information, see “Advanced Memory Testing: Using the Perform Memory Test Window” in Chapter 21, “Testing Target Memory” in the *MULTI: Debugging* book and “Viewing Memory Test Results” in Chapter 21, “Testing Target Memory” in the *MULTI: Debugging* book.

memwrite

memwrite *size address value*

memwrite -str *address* "*string*"

Performs a sized memory write to the target. This command is intended to be used to perform low-level writes to regions of memory or memory-mapped I/O registers. This command does not make use of MULTI's memory cache, and the write is performed immediately. This command has two possible formats.

In the first format, without `-str` specified, **memwrite** performs a sized memory write, where:

- *`size`* — Specifies the access size in bytes and may be 1, 2, or 4. Some targets, such as the Green Hills Probe and INTEGRITY 10 or later, also support 8.
- *`address`* — Specifies the memory address at which to begin writing. *`address`* must be aligned correctly to the nearest *`size`* bytes.
- *`value`* — Specifies the value to be written. If *`value`* is too large to fit in *`size`* bytes, it is truncated to fit.

In the second format, with `-str` specified, **memwrite** writes the specified string to the target, including the terminating null character, where:

- *`address`* — Specifies the memory address at which to begin writing.
- *`“string”`* — Specifies a string constant to be written to the target. The quotation marks are part of the syntax and must appear around *`string`*.

See also the system variable `_CACHE` in “System Variables” in Chapter 14, “Using Expressions, Variables, and Procedure Calls” in the *MULTI: Debugging* book.

verify

verify [-quiet] [-sparse] -all | -recheck | -section *section_name* | *address_expression* [*num_addresses*]

Verifies that the contents of memory match the contents of the executable program file. If there are any coherency errors (that is, discrepancies), the associated lines are highlighted in the source pane, and a list of differing addresses are printed to the command pane (both the in-memory and the executable program file values are shown). A progress bar displays the work done; **Esc** aborts processing.

Available options are:

- `-quiet` — Highlights lines associated with coherency errors but does not print output to the command pane. Highlighting is done in the source pane.
- `-sparse` — Verifies only a few bytes at the beginning, middle, and end of the indicated range. This allows you to run a quick coherency scan rather than a complete test. This option has no meaning and is ignored if specified in conjunction with `-recheck`.
- `-all` — Verifies all downloaded non-data sections that cannot be written to. The `.text` section is an example of one such section. This may take a long time.

  Because certain sections of memory, such as `.bss`, `.data`, and `.heap`, may be written to during program execution, you can expect them to differ from the executable program file. When you specify this option, the **verify** command does not check these sections. However, you can verify them manually by specifying `verify -section` *`section_name`*.
- `-recheck` — Re-examines any addresses that were previously found to contain coherency errors.
- `-section` *`section_name`* — Verifies the section *`section_name`*.
- *`address_expression`* `[`*`num_addresses`*`]` — Verifies the block of memory starting at the address expression *`address_expression`* and continuing for *`num_addresses`*, where *`num_addresses`* is the number of addresses to verify. If you omit *`num_addresses`*, this command verifies until the end of the function that encloses *`address_expression`*.

You can verify sections from any module loaded into target memory (including shared objects such as `libc.so`). However, if multiple identically named sections exist, `verify -section` *`section_name`* verifies only the first *`section_name`* it finds. For example, if `.text` appears first in a shared object and then in an executable program file, `verify -section .text` finds `.text` only in the shared object. To more accurately specify sections, use the **map** command to determine the starting address and size of the section you want to verify (see "map" on page 103).

For more information about coherency errors, see "Detecting Coherency Errors" in Chapter 21, "Testing Target Memory" in the *MULTI: Debugging* book.

See also "prepare_target" on page 228.

Chapter 11

Navigation Command Reference

Contents

The commands in this chapter allow you to navigate the code displayed in the Debugger source pane. See also Chapter 16, “Search Command Reference” on page 211.

Navigation Commands

The following list provides a brief description of each navigation command. For a command's arguments and for more information, see the page referenced.

- **+** — Moves your current viewing position in the source pane the specified number of lines toward the end of the file (see “+” on page 132).
- **-** — Moves your current viewing position in the source pane the specified number of lines toward the beginning of the file (see “-” on page 133).
- **e** — Navigates around your program in the Debugger's source pane (see “e” on page 133).
- **indexnext** — Changes the current viewing location to the next item in Debugger's history list (see “indexnext” on page 134).
- **indexprev** — Changes the current viewing location to the previous item in the Debugger's history list (see “indexprev” on page 135).
- ***number*** — Moves your current viewing position in the source pane to the file-relative line number specified (see “*number*” on page 135).
- **scrollcommand** — Scrolls the given window by the specified amount and in the specified direction (see “scrollcommand” on page 135).
- **switch** — Changes the selection in the target list (see “switch” on page 137).
- **uptosource** — Displays the first procedure on the stack that contains source code (see “uptosource” on page 137).

+

+ [*num*]

GUI only

Moves your current viewing position in the source pane `num` lines toward the end of the file. The default value for `num` is 1 line.

-

- [*num*]

GUI only

Moves your current viewing position in the source pane `num` lines toward the beginning of the file. The default value for `num` is 1 line.

e

e [*address_expression*]

Navigates around your program in the Debugger's source pane. You can also use this command to open a Browse window. This is one of the most powerful and commonly used navigation features of the MULTI Debugger.

If `address_expression` is specified, the **e** command changes your current viewing location in the code to that address expression. See “Using Address Expressions in Debugger Commands” on page 5. With no arguments, this command prints your viewing location in the code. There are several forms of the **e** command.

- **e** — Shows current file, procedure, line number, and address. For example: `test.c:PrintLine#28: 0x411c`
- **e** ***proc*** — Displays procedure `proc`. If a wildcard pattern such as `My*Functions` is given, a **Browse** window opens to display all of the procedures that match that pattern. If only one procedure matches the specified pattern, that procedure will be displayed without a **Browse** window opening.
- **e "*file*"#*proc*** — Displays procedure `proc` in file `file`. If the procedure element consists of a wildcard pattern (for example, `"test.c"#My*Functions`), a **Browse** window opens to display all of the procedures that match that pattern within the file `file`. If only one procedure matches the specified pattern, that procedure will be displayed without a **Browse** window opening.
- **e** ***file*** — Displays the file `file`. If a wildcard pattern such as **`my*file.c`** is given, a **Browse** window opens to display all of the files in the program that match that pattern. If there is only one such match, that file will be displayed without a **Browse** window opening.

- **e *variable*** — Displays the source location where the variable `variable` is defined. This is only valid for variables with unique names that have absolute locations (i.e., global and file static variables).
- **e *num*_** — Displays the procedure at call stack frame number `num`. The call stack frame number must be followed by an underscore (_). Use the **calls** command to view the entire call stack (see "calls" on page 68).
- **e *address_expression*** — Displays the procedure at the given address. See "Using Address Expressions in Debugger Commands" on page 5.
- **e +*offset*** — Displays the source associated with the instructions that are `offset` source lines after the currently viewed location.
- **e -*offset*** — Displays the source associated with the instructions that are `offset` source lines before the currently viewed location.
- **e *num*b** — Displays the procedure containing breakpoint number `num`. For example, `e 1b` displays the procedure containing breakpoint number one. You can use the **B** command to view breakpoint numbers (see "B" on page 40).

Corresponds to: **View → Navigation → Goto Location**

indexnext

indexnext

GUI only

Changes the current viewing location to the next item in Debugger's history list. See also "Using Navigation History Buttons" in Chapter 9, "Navigating Windows and Viewing Information" in the *MULTI: Debugging* book.

Corresponds to: 

indexprev

indexprev

GUI only

Changes the current viewing location to the previous item in the Debugger's history list. See also “Using Navigation History Buttons” in Chapter 9, “Navigating Windows and Viewing Information” in the *MULTI: Debugging* book.

Corresponds to: 

number

number

GUI only

Moves your current viewing position in the source pane to the file-relative line number *`number`*. This command ignores the option **Use procedure relative line numbers (vs. file relative)** (**procRelativeLines**).

scrollcommand

scrollcommand [+ | -] max[l | c] [wid=*num*]

scrollcommand [+ | -] page[l | c] [wid=*num*]

scrollcommand [+ | -] *count* [l | c] [wid=*num*]

GUI only

Scrolls the window indicated by the identification number *`num`* by the specified amount and in the specified direction.

With Format 1, the window is scrolled completely to the beginning (`-max`) or the end of its view (`+max` or `max`).

With Format 2, the window is scrolled to the previous page (`-page`) or the next page (`+page` or `page`).

With Format 3, the window is scrolled by the *count* number of lines or characters, where *count* may be positive or negative.

If *count*, max, or page is followed by the letter c, the scroll is horizontal and *count* corresponds to the number of characters.

If *count*, max, or page is followed by the letter l (lowercase L), the scroll is vertical and *count* corresponds to the number of lines. Vertical scrolling is the default, if neither c nor l is specified.

The window identification number *num* is obtained by using the special sequence %w with either the **mouse** command or the **keybind** command (see the **keybind** and **mouse** commands in "Customizing Keys and Mouse Behavior" in Chapter 7, "Configuring and Customizing MULTI" in the *MULTI: Managing Projects and Configuring the IDE* book). If no window identification number is specified, the source window is used.

For example, the following command scrolls the source pane one line towards the end of the file:

```
> scrollcommand 1
```

The following scrolls the pane that is currently visible in the Debugger (for example, the command pane) backwards by two lines:

```
> scrollcommand -2 wid=-2
```

The following scrolls the source pane three characters to the right:

```
> scrollcommand 3c
```

Both of the following commands scroll the source pane to the beginning of the code:

```
> scrollcommand -max
> scrollcommand -maxl wid=-1
```

switch

switch -direction up | -direction down | -direction up+ | -direction down+ | -selectall | -component *component_name* | -item *item_prefix*

Changes the selection in the target list. The arguments for this command are:

- `-direction up|down` — Moves the selection up or down one entry.
- `-direction up+|down+` — Extends the selection up or down one entry.
- `-selectall` — Selects all entries in the target list.
- `-component` *`component_name`* — Selects the entry in the target list that matches the specified component, if possible. Some components may not be supported. For information about listing components, see "components" on page 97.
- `-item` *`item_prefix`* — Selects the first entry that matches the given prefix string. Note that prefixes with spaces must be quoted.

uptosource

uptosource

Displays the first procedure on the stack that contains source code. This command does not change the program counter or execute any program instructions on the target.

Corresponds to: **View → Navigation → UpStack To Source**

Chapter 12

Profiling Command Reference

Contents

The commands in this chapter allow you to control MULTI's profiling capabilities, enable the collection of profiling data, open the **Profile** window, and access profiling information.

The button and menu choices listed alongside the following commands are displayed in the **Profile** window.

For more information about profiling, see Chapter 17, “Collecting and Viewing Profiling Data” in the *MULTI: Debugging* book.

For information about the **protrans** shell command, which is used to invoke the **protrans** utility, see the documentation about the protrans utility in the *MULTI: Building Applications* book.

Profiling Commands

The following list provides a brief description of each profiling command. For a command's arguments and for more information, see the page referenced.

- **profdump** — Retrieves profiling data from the target (see “profdump” on page 140).
- **profile** — Enables collection of profiling data and opens the **Profile** window (see “profile” on page 141).
- **profilemode** — Controls MULTI's profiling capabilities (see “profilemode” on page 141).
- **profilereport** — Displays, saves, or prints **Profile** window reports (see “profilereport” on page 144).

profdump

profdump

Retrieves profiling data from the target. You can use this command in conjunction with the **profilemode clear** command (see “profilemode” on page 141) to examine profiling data gathered between two points of execution.

The **profdump** command is not supported in all contexts. For more information about using this command, see “Manually Dumping Profiling Data” in Chapter 17, “Collecting and Viewing Profiling Data” in the *MULTI: Debugging* book.

Corresponds to:  **Profile** window button

profile

profile

GUI only

Enables the collection of profiling data and opens the **Profile** window. For information about the **Profile** window, see “The Profile Window” in Chapter 17, “Collecting and Viewing Profiling Data” in the *MULTI: Debugging* book.

This command is not supported if you are profiling a trace-enabled target. See “tracepro” on page 253 instead.

Corresponds to: **View → Profile**

profilemode

profilemode add | automatic | clear | close | count | coverage | import | long | manual | percent | process | range *start_addr end_addr* | replace | short | start | stop | time *time_unit*

Controls MULTI's profiling capabilities. Available arguments (along with corresponding **Profile** window buttons and/or menu selections) follow. Note that many of the arguments are context-sensitive. For information about the contexts in which an argument is supported, see the referenced section.

- `add` (**Config → New Data → Added to Old**) — Adds new profiling data to existing profiling data. For more information, see “Adding to or Overwriting Existing Profiling Data” in Chapter 17, “Collecting and Viewing Profiling Data” in the *MULTI: Debugging* book. See also the `replace` argument.
- `automatic` (**Config → Data Processing → Automatic**) — Processes profiling data automatically when it is dumped. This is the default behavior unless you are using INTEGRITY. See also the `manual` and `process` arguments.

- `clear` () — Deletes existing profiling data. You may be able to use the **profilemode clear** command in conjunction with the **profdump** command (see “profdump” on page 140) to examine profiling data gathered between two points of execution.
- `close` (and **File → Close**) — Closes the **Profile** window, which halts the collection of profiling data and clears existing profiling data.
- `count` ( ) — Displays, to the left of each line in the Debugger, the total number of times each line (or instruction) was executed, or displays the total number of times each function was called. For more information, see “Viewing Profiling Information in the Debugger” in Chapter 17, “Collecting and Viewing Profiling Data” in the *MULTI: Debugging* book. See also the `coverage` and `percent` arguments.
- `coverage` ( ) — Highlights, in the Debugger, lines of dead code (lines that were never executed). For more information, see “Viewing Profiling Information in the Debugger” in Chapter 17, “Collecting and Viewing Profiling Data” in the *MULTI: Debugging* book. See also the `count` and `percent` arguments.
- `import` — Loads a **.pro** file output by **protrans**. For more information, see “Manually Processing Profiling Data” in Chapter 17, “Collecting and Viewing Profiling Data” in the *MULTI: Debugging* book.
- `long` (**Config → Function Names → Long**) — Displays fully qualified function names in **Profile** window reports. Fully qualified function names include all C++ qualifiers, such as namespace and class names, function arguments, and template information. This argument has no effect on the display of C functions. See also the `short` argument.
- `manual` (**Config → Data Processing → Manual**) — Prevents profiling data from being processed automatically when it is dumped. For more information, see “Manually Processing Profiling Data” in Chapter 17, “Collecting and Viewing Profiling Data” in the *MULTI: Debugging* book. See also the `automatic` and `process` arguments.
- `percent` () — Displays, to the left of each line in the Debugger, the percentage of time spent in each source line. If you are in assembly display mode, the percentage represents the time spent on each instruction. For more information, see “Viewing Profiling Information in the Debugger” in Chapter 17, “Collecting and Viewing Profiling Data” in the *MULTI: Debugging* book. See also the `count` and `coverage` arguments.

- `process` () — Processes profiling data. For more information, see "Manually Processing Profiling Data" in Chapter 17, "Collecting and Viewing Profiling Data" in the *MULTI: Debugging* book. See also the `automatic` and `manual` arguments.
- `range` *`start_addr end_addr`* — Performs a range analysis on the range beginning with *`start_addr`* and ending with *`end_addr`* and displays the results in the command pane. For more information, see "Performing Range Analyses" in Chapter 17, "Collecting and Viewing Profiling Data" in the *MULTI: Debugging* book.
- `replace` (**Config → New Data → Replaces Old**) — Overwrites existing profiling data with new profiling data. For more information, see "Adding to or Overwriting Existing Profiling Data" in Chapter 17, "Collecting and Viewing Profiling Data" in the *MULTI: Debugging* book. See also the `add` argument.
- `short` (**Config → Function Names → Short**) — Omits C++ qualifiers from the function names displayed in **Profile** window reports. This is the default behavior. This argument has no effect on the display of C functions. See also the `long` argument.
- `start` () — Enables the collection of PC samples. This argument is only supported if you are profiling a run-mode task or AddressSpace on an INTEGRITY target or if you are profiling a stand-alone program. See also the `stop` argument.
- `stop` () — Disables the collection of PC samples. This argument is only supported if you are profiling a run-mode task or AddressSpace on an INTEGRITY target or if you are profiling a stand-alone program. See also the `start` argument.
- `time` *`time_unit`* (**Config → Time Units → *time_unit***)— Displays all times in the **Profile** window in the specified *`time_unit`*, where *`time_unit`* may be `seconds`, `milliseconds`, `instructions`, or `cycles`. Not all units are available with all targets.

For more information, see Chapter 17, "Collecting and Viewing Profiling Data" in the *MULTI: Debugging* book.

profilereport

profilereport append [*filename*] | calls | coveragedetailed | coveragesummary | graph | print | save [*filename*] | sourcelines | status

GUI only

Allows you to display, save or print **Profile** window reports. This command is only supported if the **Profile** window is open. Available arguments are:

- `append [`*`filename`*`]` — Appends the text of the report currently displayed in the **Profile** window to an existing on-disk report. If *`filename`* is specified, the report is appended to that file.
- `calls` — Displays the standard calls report if available.
- `coveragedetailed` — Displays the block detailed report if available.
- `coveragesummary` — Displays the coverage report if available.
- `graph` — Displays the call graph report if available.
- `print` — Prints the text of the report currently displayed in the **Profile** window.
- `save [`*`filename`*`]` — Saves the text of the report currently displayed in the **Profile** window. If *`filename`* is specified, the report is saved to that file. The default file extension given to the saved text file is **.rep**.
- `sourcelines` — Displays the source report if available.
- `status` — Displays the status report.

For more information, see "Profiling Reports" in Chapter 17, "Collecting and Viewing Profiling Data" in the *MULTI: Debugging* book.

Chapter 13

Program Execution Command Reference

Contents

The commands in this chapter allow you to control the execution of programs in the Debugger.

General Program Execution Commands

The following list provides a brief description of each general program execution command. For a command's arguments and for more information, see the page referenced.

- **g** — Changes the program counter so that the specified address expression becomes the next instruction to be executed (see “g” on page 146).
- **getargs** — Shows the current arguments that will be passed to your program the next time it is run (see “getargs” on page 146).
- **setargs** — Sets program arguments for the next time the stand-alone application is started from MULTI (see “setargs” on page 147).

g

g *address_expression*

Changes the program counter so that `address_expression` becomes the next instruction to be executed. You cannot set the next execution point to an address that is outside the current procedure.

getargs

getargs

Shows the current arguments that will be passed to your program the next time it is run. Both **getargs** and **setargs** are only applicable to the debugging of programs that take arguments in the traditional `main(argc,argv)` sense. The following example shows the use of **setargs**, **getargs**, and **r**. (See also “setargs” on page 147 and “r” on page 154.)

```
> setargs abc def ghi
> getargs
abc def ghi
> r
running "a.out abc def ghi"
```

setargs

setargs [*program_arguments*]

Sets program arguments for the next time the stand-alone application is started from MULTI. If no arguments are specified, no arguments will be passed to the program.

Arguments must be in a space-separated list and may contain <, >, or >> to redirect standard input (`stdin`) and standard output (`stdout`). Text between quotation marks, either single (`' '`) or double (`" "`), is treated as a single argument. The quotation marks are removed and are not sent to the program. Arguments containing the MULTI command syntax comment delimiter (`//`) must be enclosed in quotation marks (for example, `setargs -perform_url_operation "http://www.example.com"`).

On Linux/Solaris, a tilde (~) expands the same way as the shell if you are running `csh`. However, other shell processing, such as wildcard expansion and pipes, is not performed.

This command is only applicable to the debugging of programs that take arguments in the traditional `main(argc,argv)` sense.

See also “getargs” on page 146 and “r” on page 154.

Corresponds to: **Debug → Set Program Arguments**

Continue Commands

The commands in this section allow you to continue a stopped process.

Some of the continue commands use the `@continue_count` argument to specify how many breakpoints the Debugger will pass before stopping. For example, if `continue_count` is 4, the Debugger will skip over the next three breakpoints and stop the process at the fourth breakpoint, unless stopped earlier by the optional address expression described below.

Note

Only breakpoints that stop program execution are counted. A conditional breakpoint whose condition is false or a breakpoint whose commands resume a process are not counted.

You can view the `continue_count` by using the `CONTINUECOUNT` system variable. See “System Variables” in Chapter 14, “Using Expressions, Variables, and Procedure Calls” in the *MULTI: Debugging* book.

Most of the continue commands also accept an optional address expression. If specified, a temporary breakpoint is set at that location. The breakpoint is removed as soon as it is reached and the process is stopped, even if fewer than `continue_count` breakpoints were skipped. For more information about address expressions, see “Using Address Expressions in Debugger Commands” on page 5.

Note

In MULTI 4.x, if you wanted to debug your program from its start address (typically `_start`), you had to set a breakpoint at the start address and continue to it, even after using the **load** command to load your program. In MULTI 5.x and later, you can use **load** or **prepare_target -load** to debug your program from its start address. If you have already executed **load** or **prepare_target -load**, the continue commands will not hit a breakpoint set at the program start address. See “load” on page 227 and “prepare_target” on page 228.

The following list provides a brief description of each continue command. For a command's arguments and for more information, see the page referenced.

- **c** — Continues a stopped process (see “c” on page 149).

- **cb** — Continues a stopped process and does not process any further commands until your process has stopped again (see “cb” on page 150).
- **cf** — Continues a stopped process from the given address expression instead of the current program counter (see “cf” on page 150).
- **cfb** — Continues a stopped process from the given address expression instead of the current program counter, and does not process any further commands until your process has stopped again (see “cfb” on page 151).
- **runtohere** — Runs to the current line or address (see “runtohere” on page 151).

c

c [*@continue_count*] [*expr*]

Continues a stopped process. Available options are:

- `@continue_count` — Specifies the continue count. For more information, see “Debugger Command Conventions” on page 3.
- `expr` — Specifies an address expression where a temporary breakpoint is set. If the temporary breakpoint is hit, the process stops even if fewer than `continue_count` breakpoints were skipped.

On Linux/Solaris, if the process stops because of a signal, the **c** command continues with or without the signal based on the current signal handling specified for that signal by the **zignal** command (see “zignal” on page 166).

To interrupt this command, press **Esc**.

See also “cu, cU” on page 161.

Corresponds to: 

Corresponds to: **Debug → Go on Selected Items**

cb

cb [*@continue_count*] [*expr*]

Continues a stopped process and does not process any further commands until your process has stopped again. Available options are:

- `@continue_count` — Specifies the continue count. For more information, see “Debugger Command Conventions” on page 3.
- `expr` — Specifies an address expression where a temporary breakpoint is set. If the temporary breakpoint is hit, the process stops even if fewer than `continue_count` breakpoints were skipped.

The **cb** command behaves like the **c** command except that further commands are blocked until the process has stopped. Signals for **cb** are handled as they are for **c**. See “c” on page 149.

Some commands, such as data printing and viewing commands, only work correctly when your process is stopped. When these commands appear in a script that controls your process, it is important to ensure that your process has stopped before executing these commands. Using the **cb** command makes sure your process stops running before further script commands are executed. Your process will stop running once it has done one of the following:

- Run to completion.
- Hit a breakpoint.
- Stopped with an exception, signal, segmentation violation, bus error, or similar cause.

To interrupt this command, press **Esc**.

cf

cf *address_expression*

Continues a stopped process from the given `address_expression` instead of the current program counter. This will have the effect of skipping some of your program's code and is equivalent to issuing a **g** command followed by a **c** command (see “g” on page 146 and “c” on page 149). The given `address_expression` must describe a location within the currently executing procedure. See “Using Address Expressions in Debugger Commands” on page 5.

The following example installs a breakpoint on line `12` of procedure `foo`. When the process hits the breakpoint, it will continue from line `14` of procedure `foo`, effectively skipping lines `12` and `13` of procedure `foo`.

```
> b foo#12 { cf foo#14; }
```

The following example installs a breakpoint at label `bar` of procedure `foo`. When the process hits the breakpoint, it will continue from the exit point of the procedure, effectively skipping the rest of the procedure and returning immediately.

```
> b foo##bar { cf ($retadr()) }
```

To interrupt this command, press **Esc**.

cfb

cfb *address_expression*

Continues a stopped process from the given *`address_expression`* instead of the current program counter. This command behaves like the **cf** command, except that no further commands will be processed until your process has stopped again (see “cf” on page 150). For a discussion of command blocking, see “cb” on page 150.

To interrupt this command, press **Esc**.

runtohere

runtohere

Runs to the current line or address.

This command sets a temporary breakpoint on the current line or current address and executes the **c** command (see “c” on page 149). Upon reaching the temporary breakpoint, the process stops and the Debugger automatically clears the breakpoint.

As an alternative to using this command, you can double-middle-click anywhere on a line to make the process run to that line (assuming that you have not configured a double-middle-click to perform a different function).

To interrupt this command, press **Esc**.

Halt Commands

The commands in this section allow you to halt the process being debugged.

The following list provides a brief description of each halt command. For a command's arguments and for more information, see the page referenced.

- **H** — Prints the cause of a halt (see “H” on page 152).
- **halt** — Halts the current process (see “halt” on page 152).
- **k** — Kills the current process (see “k” on page 153).

H

H

Prints the cause of a halt.

halt

halt [{*commands*}]

Halts the current process. The process halts without sending an interrupt, allowing you to cleanly continue the process later.

If Debugger commands are specified in `commands` (see “Using Command Lists in Debugger Commands” on page 12), the specified commands will be executed when the process halts.

Corresponds to: 

Corresponds to: **Debug → Halt on Selected Items**

k

k [force]

Kills the current process. The process must be halted in order to be killed. Specifying `k force` kills the process without asking for verification.

Corresponds to: **Debug → Kill Selected Items**

Run Commands

The commands in this section allow you to run the program being debugged.

The following list provides a brief description of each run command. For a command's arguments and for more information, see the page referenced.

- **bc** — Runs a halted process backward (see “bc” on page 154).
- **r** — Runs a new target program and passes the specified arguments to the program in a space-separated list (see “r” on page 154).
- **R** — Runs a new target process with no arguments (see “R” on page 155).
- **rb**, **Rb** — Runs or restarts the program (see “rb, Rb” on page 155).
- **restart** — Restarts program execution or resets aspects of program and target (see “restart” on page 156).
- **resume** — Resumes program execution at the specified address expression, after all other commands in the breakpoint command list have been issued (see “resume” on page 156).
- **rundir** — Changes the directory or prints the current run directory (see “rundir” on page 157).
- **runtask** — Starts a task running on a VxWorks target (see “runtask” on page 157).

bc

bc

TimeMachine command, GUI only

Runs a halted process backward. The process runs either until a breakpoint is hit or the first traced instruction is reached.

Corresponds to: 

r

r [*arguments*]

Runs a new target program and passes *`arguments`* to the program in a space-separated list. (For example, the command `r fly 3`, runs the program with the two arguments `fly` and `3`.) If a process already exists, the Debugger kills it and then prepares the target using the current prepare target settings (see “prepare_target” on page 228).

Program arguments can only be passed to stand-alone applications that are started from MULTI. If no arguments are specified, the ones from the previous run are used. If no previous run exists, no arguments are used.

Arguments may contain <, >, or >> to redirect standard input (`stdin`) and standard output (`stdout`). Text between quotation marks, either single (`' '`) or double (`" "`), is treated as a single argument. The quotation marks are removed and are not sent to the program. Arguments containing the MULTI command syntax comment delimiter (`//`) must be enclosed in quotation marks (for example, `r -perform_url_operation "http://www.example.com"`).

On Linux/Solaris, a tilde (~) expands the same way as the shell if you are running `csh`. However, other shell processing, such as wildcard expansion and pipes, is not performed.

See also “setargs” on page 147, “restart” on page 156, and “R” on page 155.

R

R

Runs a new target process with no arguments. If the process already exists, it will be killed and restarted.

See also “r” on page 154.

rb, Rb

rb [*arguments*]

Rb

Runs or restarts the program. These commands behave like the **r** and **R** commands except that no further commands will be processed until the process terminates, hits a breakpoint, or stops in any other way (see “r” on page 154 and “R” on page 155). While the command line input is blocked, you can still perform all interactive operations appropriate to a process, such as pressing the **Halt** button.

This command is useful for writing scripts that control execution of a process running on the target, since you often want to perform the next command only after the process stops.

The **Rb** command behaves like **rb**, except that it runs the program without arguments.

To interrupt these commands, press **Esc**.

See also “cb” on page 150, “r” on page 154, and “R” on page 155.

restart

restart

Restarts program execution or resets aspects of program and target, depending on debugging context and specified arguments.

- During native and embedded debugging, this command is identical to the **r** command with no arguments (see "r" on page 154).
- During debugging of Dynamic Download INTEGRITY applications, this command attempts to (re)load the application. This command may not be available for use with relocatable modules.

Corresponds to: 

Corresponds to: **Debug → Restart**

resume

resume [*address_expression*]

(This command is only valid within a breakpoint command list. See "Using Command Lists in Debugger Commands" on page 12.)

Resumes program execution at the specified `address_expression`, after all other commands in the breakpoint command list have been issued. If no `address_expression` is specified, the process will resume from the location of the breakpoint. See "Using Address Expressions in Debugger Commands" on page 5.

For example, to skip over line 5 in your program, you could use the following command, which makes the process stop at line 5 and then resume execution at line 6:

```
> b 5 {resume 6}
```

resume will continue the process in the same manner that the breakpoint was encountered. For example, if the Debugger was performing a **c** (continue) command when the breakpoint was encountered, the **c** command will be resumed. If the

Debugger was performing an **S** (single-step) command and the step completed when the breakpoint was encountered, the process stops.

rundir

rundir [*dir* | -clear]

Changes the directory or prints the current run directory, where:

- `dir` — Changes the directory in which the process runs to `dir`. The run directory setting is saved between sessions.

  For embedded processes that use host I/O, `dir` becomes the directory that MULTI uses to perform host I/O operations. Processes that have already started running when the **rundir** command is issued are not affected by the new host I/O directory setting.

  For information about the GUI equivalent of the **rundir *dir*** command, see the description of the **Start in** field in "The Arguments Dialog Box" in Appendix A, "Debugger GUI Reference" in the *MULTI: Debugging* book.
- `-clear` — Removes any saved run directory setting and changes the run directory back to the default directory. The default directory is the current working directory.

If you do not specify an argument, this command prints the current run directory.

runtask

runtask *proc* [*args*]

Starts a task running on a VxWorks target, where:

- `proc` is the name of any downloaded procedure.
- `args` is a list of space delimited arguments to pass to the procedure. Acceptable values for `args` are:
  - Decimal and hexadecimal numeric constants.
  - Character constants.

- String constants enclosed in double quotation marks (" ").
- Names of global variables (the `&` operand cannot be used here).
- I/O redirection operators < and >.

During C++ debugging, *proc* may be the member function of a global object, specified as *object.function*. If the requested function is ambiguous, MULTI will open a dialog box showing all the options so you can choose the correct one.

Single-Stepping Commands

The commands in this section allow you to single-step through your program. The commands differ in whether they allow you to step into or step over procedure calls and whether they advance by a single machine instruction or a single high-level source line or statement, as shown in the table below.

	Steps into procedure calls	**Steps over procedure calls**
Advances one high-level statement	**sl**	**Sl** **nl**
Advances one machine instruction	**si**	**Si** **ni**
Advances one machine instruction when in either assembly-only mode or interlaced assembly mode. Advances one high-level statement in source-only mode.	**s**	**S** **n**

The single-stepping commands listed in the above table accept the following optional parameters:

- *num* — Specifies how many single-steps to perform. If no *num* is specified, one step is performed. If a breakpoint is encountered before *num* steps have taken place, the remainder of the steps are aborted.
- `n | b` — Specifies whether Debugger commands are blocked during the single-step. If `b` (blocking) is specified, no Debugger commands will be executed until the step finishes. If `n` is specified, subsequent Debugger commands can execute before the step is finished. If neither `n` nor `b` is specified, the step will be blocking or non-blocking according to the `BlockStep`

configuration option, which defaults to non-blocking, but can be changed from the configuration GUI or via the **configure BlockStep** command. For more information about the `BlockStep` configuration option, see "The More Debugger Options Dialog" in Chapter 8, "Configuration Options" in the *MULTI: Managing Projects and Configuring the IDE* book.

Tip

If you inadvertently step into a procedure (with an **s**, **si**, or **sl** command), you can issue the **cU** command (see "cu, cU" on page 161), click the button, or press **F9** to return from the procedure.

The following list provides a brief description of each single-stepping command. For a command's arguments and for more information, see the page referenced.

- **bcU** — Steps backward, up to the caller of the current function (see "bcU" on page 160).
- **bprev** — Steps backward one statement, stepping over procedure calls (see "bprev" on page 160).
- **bs** — Steps backward one statement (see "bs" on page 160).
- **bsi** — Steps backward one machine instruction (see "bsi" on page 161).
- **cu**, **cU** — Steps up to the caller of the current function or to the specified address expression (see "cu, cU" on page 161).
- **s** — Single-steps one statement, stepping into any procedure calls (see "s" on page 161).
- **S**, **n** — Single-steps one statement, stepping over procedure calls instead of into procedures (see "S, n" on page 162).
- **si** — Single-steps one machine instruction, stepping into procedure calls (see "si" on page 163).
- **Si**, **ni** — Single-steps one machine instruction, stepping over procedure calls (see "Si, ni" on page 163).
- **sl** — Single-steps one high-level language statement, stepping into procedure calls (see "sl" on page 163).
- **Sl** — Single-steps one high-level language statement, stepping over procedure calls (see "Sl, nl" on page 164).

- **stepinto** — Sets a temporary breakpoint in the supplied function and steps once (see “stepinto” on page 164).

bcU

bcU

TimeMachine command, GUI only

Steps backward, up to the caller of the current function.

Corresponds to: 

bprev

bprev

TimeMachine command, GUI only

Steps backward one statement, stepping over procedure calls.

Corresponds to: 

bs

bs

TimeMachine command, GUI only

Steps backward one statement. In assembly-only mode or interlaced assembly mode, this command will step one machine instruction instead of one high-level statement. To step backward one machine instruction unconditionally, use the **bsi** command instead (see “bsi” on page 161).

Corresponds to: 

bsi

bsi

TimeMachine command, GUI only

Steps backward one machine instruction. For source-level stepping, use the **bs** command (see “bs” on page 160).

s

s [*num*] [n | b]

Single-steps one statement, stepping into any procedure calls. The options `num`, `n`, and `b` behave as specified in “Single-Stepping Commands” on page 158.

In assembly-only mode or interlaced assembly mode, the **s** command steps one machine instruction instead of one high-level statement. For information about these modes, see “Source Pane Display Modes” in Chapter 2, “The Main Debugger Window” in the *MULTI: Debugging* book.

To interrupt this command, press **Esc**.

Corresponds to: **F11**

Corresponds to: 

Corresponds to: **Debug → Step (into Functions) on Selected Items**

cu, cU

cu [*address_expression*]

cU [*address_expression*]

With no argument, steps up to the caller of the current function. This is useful if you have accidentally single-stepped into a procedure that you meant to step over, or if you want execution to proceed to another place further up the call stack.

If `address_expression` is specified, steps up to the caller of the current function or to the temporary breakpoint set at `address_expression`—whichever is reached first. For more information about address expressions, see “Using Address Expressions in Debugger Commands” on page 5.

The **cu** command sets a permanent breakpoint at the return site of the currently executing procedure. The **cU** command sets a temporary breakpoint at the return site of the currently executing procedure. The **cu** and **cU** commands handle signals like the **c** command. See “c” on page 149.

The **cu** and **cU** commands rely on the Debugger's ability to generate a partial stack trace. They may not work correctly (for example, they may set a breakpoint at the wrong address) if the stack trace obtained by the Debugger is incorrect. For restrictions on tracing the call stack, see “Viewing Call Stacks” in Chapter 18, “Using Other View Windows” in the *MULTI: Debugging* book.

For information about continuing a stopped process from an up-level breakpoint, see “bu, bU” on page 44.

cU corresponds to: 

cU corresponds to: **Debug → Return on Selected Items**

S, n

S [*num*] [n | b]

n [*num*] [n | b]

Single-steps one statement, stepping over procedure calls instead of into procedures. The options `num`, `n`, and `b` behave as specified in “Single-Stepping Commands” on page 158.

To interrupt these commands, press **Esc**.

Corresponds to: **F10**

Corresponds to: 

Corresponds to: **Debug → Next (over Functions) on Selected Items**

si

si [*num*] [n | b]

Single-steps one machine instruction, stepping into procedure calls. The options `num`, `n`, and `b` behave as specified in "Single-Stepping Commands" on page 158.

This command behaves like the **s** command (see "s" on page 161), except that the **si** command causes the process to advance by one machine instruction instead of one high-level source line. Furthermore, the stop position is displayed as a disassembled instruction.

To interrupt this command, press **Esc**.

Si, ni

Si [*num*] [n | b]

ni [*num*] [n | b]

Single-steps one machine instruction, stepping over procedure calls. The options `num`, `n`, and `b` behave as specified in "Single-Stepping Commands" on page 158.

These commands behave like the **S** and **n** commands (see "S, n" on page 162), except that the **Si** and **ni** commands cause the process to advance by one machine instruction instead of one high-level source line, and the stop position is displayed as a disassembled instruction.

To interrupt these commands, press **Esc**.

sl

sl [*num*] [n | b]

(This command is a lowercase `S` and a lowercase `L`.)

Single-steps one high-level language statement (even if you are viewing your code in interlaced assembly mode), stepping into procedure calls. The options `num`, `n`, and `b` behave as specified in "Single-Stepping Commands" on page 158.

To interrupt this command, press **Esc**.

Sl, nl

Sl [*num*] [n | b]

(This command is an uppercase `S` and a lowercase `L`.)

nl [*num*] [n | b]

(This command is a lowercase `N` and a lowercase `L`.)

Single-steps one high-level language statement (even if you are viewing your code in interlaced assembly mode), stepping over procedure calls. The options *`num`*, `n`, and `b` behave as specified in “Single-Stepping Commands” on page 158.

To interrupt these commands, press **Esc**.

stepinto

stepinto *expr*

Sets a temporary breakpoint in the supplied function and steps once. This command is useful in situations where there are a number of functions on a single line but you are interested in stepping into only one of them. The breakpoint used is a special type of breakpoint that will only trigger one stack level below the current stack level. This command performs the same action as the **Step Into This Function** right-click menu option.

Task Execution Commands

The command in the following section allows you to control one or more run-mode tasks.

taskaction

taskaction -r|-h|-s [-addressSpace *address_space_name*] [-taskname] *task_name1* [,*task_name2*]... | [-taskid] *task_id1* [,*task_id2*]...

Performs an operation on the run-mode task(s) specified by task name or task ID. Possible operations are:

- `-r` — Resumes the task(s).
- `-h` — Halts the task(s).
- `-s` — Single-steps the task(s).

If neither `-taskname` nor `-taskid` is specified, MULTI assumes that numeric entries are task IDs and that other entries are task names.

The `-addressSpace` option is used to specify an INTEGRITY AddressSpace in which the specified task or tasks exist. Use this option if you want to refer to a task by name, but more than one AddressSpace contains a task with that name. This option is only meaningful if you are debugging an INTEGRITY process.

Signal Commands

The commands in this section are only applicable to Linux/Solaris targets.

The following list provides a brief description of each signal command. For a command's arguments and for more information, see the page referenced.

- **signal** — Sends the given signal to the specified process or to the current process (see “signal” on page 166).
- **zignal** — Sets up the signal handling table (see “zignal” on page 166).

signal

signal *signal* [pr=*num*]

Linux/Solaris targets only

Sends the signal `signal` to the process specified by slot number `num`, or to the current process if `num` is not specified.

Note

Sending a fatal signal (for example, `SIGKILL`) to a stopped process may have unpredictable results.

zignal

zignal *signal* [s] [i] [r] [b] [C] [Q]

Linux/Solaris targets only

Sets up the signal handling table. To list the current signal settings, use the **l z** command (see “l” on page 102).

The optional flags are described below.

- `s` — Toggles `stop`. If `stop` is on, the process stops when the signal occurs.
- `i` — Toggles `ignore`. If `ignore` is on, the Debugger does not send the signal to the process.

- `r` — Toggles `report`. If `report` is on, a message is displayed every time the signal occurs.
- `b` — Toggles `bell`. If `bell` is on, a beep sounds every time the signal occurs.
- `C` — Clears the signal by setting all four of the above flags to false.
- `Q` — Does not print the new state of the signal.

For example, if the default state is do not stop, do not ignore, do not report, and no bell, the command `zignal 14 sr` sets the alarm clock signal to stop, do not ignore, report, and no bell. Running `zignal 14 sr` again toggles these flags back to the previous state. Running `zignal 14 Csb`, in any signal state, will set the alarm clock signal to stop, do not ignore, beep, and do not report.

Modifying the state of the “breakpoint” signal (usually SIGTRAP) is not supported.

Chapter 14

Register Command Reference

Contents

The commands in this chapter allow you to modify register definitions while debugging a program; open windows for viewing registers; and add, remove, load, and save registers. For more information about working with registers, see Chapter 13, “Using the Register Explorer” in the *MULTI: Debugging* book.

Note

Any modifications to the register descriptions made from the command line are active only until you reload the program or connect to a different target. For persistent modifications, you must use `rc` files or customize the default register description files. See “Customizing Registers in Default .rc Files” in Chapter 13, “Using the Register Explorer” in the *MULTI: Debugging* book.

Register Commands

The following list provides a brief description of each register command. For a command's arguments and for more information, see the page referenced.

- **regadd** — Dynamically adds a memory-mapped register into the Debugger context and opens a **Register Setup** dialog, which allows you to specify other basic information for the register (see “regadd” on page 171).
- **regappend** — Loads the register description file specified by the given file, and applies the modifications to the registers defined in the Debugger (see “regappend” on page 171).
- **regbasefile** — Prints out the full path to the file that is used as the base for the register descriptions of the active Debugger (see “regbasefile” on page 171).
- **regload** — Removes all of the registers that are currently defined in the Debugger and creates a new set of registers from the register definition file specified (see “regload” on page 172).
- **regtab** — Modifies the configuration of the specified tab on all open **Register View** windows (see “regtab” on page 172).
- **regunload** — Removes all of the registers that are defined in the specified file (see “regunload” on page 173).
- **regvalload** — Loads register values from the specified file (see “regvalload” on page 174).
- **regvalsave** — Saves register values (see “regvalsave” on page 174).

- **regview** — Opens a **Register View** window displaying all registers, or opens a **Register Information** window displaying the specified register (see "regview" on page 174).

regadd

regadd *name address* [*size_in_bytes*]

Dynamically adds a memory-mapped register into the Debugger context and opens a **Register Setup** dialog, which allows you to specify other basic information for the register. For more information, see "The Register Setup Dialog" in Chapter 13, "Using the Register Explorer" in the *MULTI: Debugging* book.

regappend

regappend *filename*

Loads the register description file specified by `filename`, and applies the modifications to the registers defined in the Debugger. If you do not provide an absolute path to `filename`, MULTI searches the following directories in the order listed:

1. The current working directory.
2. The **registers** directory located in your personal configuration directory.
3. The **registers** directory located in the site-wide configuration directory.
4. The **registers** directory located in the MULTI **defaults** directory.

By storing frequently used register additions and modifications in a file, you can use **regappend** to quickly insert them into your Debugger.

regbasefile

regbasefile

Prints out the full path to the file that is used as the base for the register descriptions of the active Debugger. This is the full path to the root `GRD` file—the file that was automatically loaded by MULTI or the file from the most recent **regload** command (see “regload” on page 172).

regload

regload [*filename*]

GUI only

Removes all of the registers that are currently defined in the Debugger and creates a new set of registers from the register definition file `filename`. If you do not provide an absolute path to `filename`, MULTI performs an ordered search of the directories listed in “regappend” on page 171. If no filename is specified, the default register definition files are reloaded.

We recommend that you use the **regappend** command (see “regappend” on page 171) unless the file you are loading contains one of the default register description files via a `%include` directive, or describes all of the registers you want to use.

regtab

regtab [-norefresh] *operation tab*

GUI only

Modifies the configuration of the specified tab on all open **Register View** windows, where:

- `-norefresh` — Specifies that open **Register View** windows will not be updated to reflect the changes indicated by the **regtab** command. This option is useful for avoiding screen flicker when issuing multiple consecutive **regtab** commands in scripts or loops on the command line.
- `operation` — Specifies the configuration modification to be performed on the tab specified by `tab`. One of the operations listed below must be specified.
    - `-show group` — Shows the group or register identified by the dot-separated path `group`.
    - `-hide group` — Hides the group or register identified by the dot-separated path `group`.

- `-reroot` *`group`* — Re-roots the tab at the group specified by the dot-separated path *`group`*.
- `-unroot` — Unroots the tab.
- `-insert` — Adds a new tab named *`tab`*.
- `-remove` — Deletes the specified tab.
- `-promote` — Moves the tab one to the left in the tab ordering.
- `-demote` — Moves the tab one to the right in the tab ordering.
- `-activate` — Makes the specified tab the active tab.

The *`group`* argument required by some of the above options indicates the group or register to use in the operation, and is a path that lists the name of the item to be used, preceded by the names of all of its parent groups. For example, to specify a register named `f0` that is contained within a `64-bit` subgroup of the `Floating Point Registers` group, the dot-separated group path would be:

```
Floating Point Registers.64-bit.f0
```

Quotation marks are not required around the group path even if the path contains spaces.

- *`tab`* — Specifies the tab to be modified and must be the last argument for every **regtab** command. The tab name must contain only alphanumeric characters and underscores and does not require quotation marks.

This command only changes the appearance of open **Register View** windows. It has no effect if no **Register View** windows are open in the current Debugger.

regunload

regunload *filename*

Removes all of the registers that are defined in the file *`filename`*, which has been incrementally loaded using the **regappend** command (see “regappend” on page 171) or the **File → Load Register Definitions from File** menu option in the **Register View** window.

regvalload

regvalload [*filename*]

Loads register values from `filename`. If no filename is specified, a file chooser for register value files (**.grv**) is displayed so you can select a file containing register values.

For information about the simple syntax of register value files, examine a saved register file (see "regvalsave" on page 174).

regvalsave

regvalsave [-all|-tab|-selected] [-nomemmapped] [*filename*]

Saves register values, where:

- `-all` — Saves values for all registers in the Debugger. This is the default behavior.
- `-tab` — Saves values for all registers visible in the current tab of the **Register View** window. (See "The Register View Window" in Chapter 13, "Using the Register Explorer" in the *MULTI: Debugging* book.)
- `-selected` — Saves values for all selected registers in the current tab of the **Register View** window.
- `-nomemmapped` — Prevents memory-mapped registers from being saved. This option qualifies the behavior of `-all`, `-tab`, and `-selected`.
- `filename` — Specifies the **.grv** file in which to save the register values. If no filename is specified, a file chooser prompts you to select a **.grv** file.

regview

regview [*register_name*]

GUI only

Opens a **Register View** window displaying all of the registers, or opens a **Register Information** window displaying the specified register. The leading `$` in register name will be omitted. See “The Register View Window” in Chapter 13, “Using the Register Explorer” in the *MULTI: Debugging* book.

Corresponds to: 

Corresponds to: **View → Registers**

Chapter 15

Scripting Command Reference

Contents

The commands in this chapter are particularly useful within scripts. See also Chapter 1, “Using MULTI Scripts” in the *MULTI: Scripting* book.

Command Manipulation and Macro Commands

The commands in this section manipulate other commands or deal with macros.

The following list provides a brief description of each command manipulation and macro command. For a command's arguments and for more information, see the page referenced.

- **alias** — Creates or lists aliases (see “alias” on page 179).
- **cedit** — Prints the output of the specified command to an Editor window (see “cedit” on page 179).
- **define** — Creates a macro for later use in the Debugger (see “define” on page 179).
- **macrotrace** — Prints the stack of all presently executing macro commands (see “macrotrace” on page 181).
- **return** — Returns from the currently executing macro, evaluating the specified expression and returning it as the macro value (see “return” on page 181).
- **route** — Routes the specified command to the specified component (see “route” on page 181).
- **sc** — Performs syntax checking on either a single command or an entire script file and all nested script files (see “sc” on page 182).
- **shell** — Invokes a shell to run the specified shell commands (see “shell” on page 182).
- **substitute** — Executes the output of the specified command string as a Debugger command (see “substitute” on page 183).
- **unalias** — Reverses a previous **alias** command (see “unalias” on page 184).

alias

alias [*string1* [*string2*]]

Creates or lists aliases.

- If no strings are specified as arguments, the **alias** command lists all aliases.
- If only one `string` argument is specified, the **alias** command lists the alias (that is, the value that is substituted for the `string` by the alias), if any exists.
- If two strings are specified, the **alias** command translates `string1`, when encountered as the first word in a command, into `string2`. Substitution is only performed once, so references to other aliases are ignored. For example, if you enter:

  ```
  > alias sh showdef
  ```

  you will be able to type `sh` instead of `showdef` to use the **showdef** command.

`string1` must follow the rules of C/C++ identifiers. It may not be quoted, may not contain spaces, and must begin with a letter or underscore.

See also “unalias” on page 184.

cedit

cedit *command*

GUI only

Executes the `command` specified as its argument and places the command output in an Editor window. This is useful for examining the output of commands that print large amounts of information.

define

define *name*([*arguments*]) { *body* }

Creates a macro for later use in the Debugger.

`name` is the name of the macro followed by a set of arguments to pass to the macro.

The *body* of the macro is a command list that can contain **if** statements and loops (see “if” on page 187, “do” on page 186, “for” on page 187, and “while” on page 188). Macros can also return a value by using the **return** command in the *body* (see “return” on page 181). See also “Using Command Lists in Debugger Commands” on page 12.

The macro's arguments can be accessed as local variables in the macro body. You may also refer to your program's variables, or to special Debugger variables. See “MULTI Special Variables and Operators” in Chapter 14, “Using Expressions, Variables, and Procedure Calls” in the *MULTI: Debugging* book. When resolving the value of a variable within the body of the macro, the Debugger searches the list of macro arguments before searching any registers, special variables, or program variables. As a result, if an argument in a macro has the same name as a register, you cannot reference that register from within the macro.

Macro arguments may not be accessible inside the body of some commands, but will instead be used literally. One method of avoiding this problem is to use the **substitute** command (see “substitute” on page 183). For example:

```
> define fails(bar) { b bar }
> fails(main)
No match to bar*
> define works(bar) {substitute %EVAL{mprintf("b %s",bar)}}
> works("main")
    main#1: 0xlocation count: 1
```

You can invoke a macro by issuing the command `name([argument_values])`. The statements in the body of the macro will then be executed as described above.

For example, you can define a macro that returns the sum of its arguments like this:

```
> define sum(x, y) {return(x + y)}
> sum(3,6)
9
```

A trace of the macro call stack can be produced with the **macrotrace** command (see “macrotrace” on page 181). If an error occurs inside of a macro, a trace of the macro's invocation stack is printed and all pending macro executions are aborted.

For information about more extensive scripting functionality in MULTI, see Chapter 2, “Introduction to the MULTI-Python Integration” in the *MULTI: Scripting* book.

macrotrace

macrotrace

Prints the stack of all presently executing macro commands. For example, with the following macros:

```
> define mac1() {return mac2();}
> define mac2() {return mac3();}
> define mac3() {macrotrace; return 42;}
```

the following would be displayed if you enter `mac1()`:

```
> mac1()
 0 mac3()
 1 mac2()
 2 mac1()
42
```

See also “define” on page 179.

return

return [*expr*]

Returns from the currently executing macro, evaluating *`expr`*, if specified, and returning it as the macro value.

This command is only valid in Debugger macros (see “define” on page 179). When a macro is running and the **return** command is issued, the macro stops and exits. If an expression *`expr`* is specified, it is evaluated and returned as the macro's value.

route

route *destination_component command*

Routes the specified command to the specified destination component. Note that *`destination_component`* overrides the selection in the target list, causing *`command`* to always execute on *`destination_component`* and never on the currently selected target list entry.

The component may be fully specified, or just the unique portion of the component name may be used. For example, `debugger.pid.543` and `pid.543` are equivalent as long as the latter is unique. If a match is not unique, a list of matching components is printed out.

To list components and their aliases, use the **components** command (see "components" on page 97).

To create a new alias for a new component, use the **new** command (see "new" on page 24).

sc

sc ["*command*" | <*filename*]

Performs syntax checking on either a single command or an entire script file and all nested script files. See "Syntax Checking" in Chapter 14, "Using Expressions, Variables, and Procedure Calls" in the *MULTI: Debugging* book.

The filename will be searched for using the default search path. See "Default Search Path for Files Specified in Commands" on page 14.

shell

shell [-wait | -w] [-noconsole] *commands*

Invokes a shell to run the specified shell *`commands`*, where:

- `-wait|-w` — Causes MULTI to wait for shell commands to finish before continuing. This option is only applicable in GUI mode. In non-GUI mode, MULTI always waits for shell commands to finish. You can abort the waiting process by pressing **Esc**.
- `-noconsole` — Prevents MULTI from creating a new console window in which to run the shell commands (but does not prevent commands from opening their own GUIs, etc.). If you do not specify this option, you can see shell command output and/or type input to the commands from the console window. This option is only applicable on Windows.

Before being passed to the shell, the command string following `shell` is processed and all instances of the escape sequence `%EVAL{`*`multi_commands`*`}` are replaced by the result of evaluating *`multi_commands`*. This is useful for constructing dynamic arguments (that is, arguments that vary depending on your current debugging context) to shell tools. For example, to run a tool on the current file, construct a command of the form:

```
> shell toolname constant_args %EVAL{$_FILE}
```

Use the **shellConfirm** configuration option to govern behavior of the shell or command window used by *`commands`* (see “Other Debugger Configuration Options” in Chapter 8, “Configuration Options” in the *MULTI: Managing Projects and Configuring the IDE* book).

substitute

substitute *cmd_string*

Executes the output of *`cmd_string`* as a Debugger command.

The *`cmd_string`* argument contains the template of the command to be executed. Within *`cmd_string`*, you may use the escape sequence `%EVAL{`*`commands`*`}` to evaluate expressions or Debugger commands within the command list *`commands`* and to perform substitutions in *`cmd_string`*. The output that the Debugger would print if *`commands`* were executed directly is instead captured and inserted as plain text into *`cmd_string`* in place of the `%EVAL` sequence. The output of a `%EVAL` sequence is substituted directly, and includes any newline characters or other output formatting provided by the Debugger, except that if the output returned by `%EVAL` for the evaluated expression or Debugger commands begins and ends with double quotation marks (`"`), these quotation marks will be removed. You may need to use the **mprintf** command to properly format complicated output (see “mprintf” on page 103).

You can use more than one `%EVAL` sequence. After all sequences have been replaced with the output of the respective expressions or commands, the Debugger executes the resulting *`cmd_string`*.

As an example use of this command, suppose you want to use a graphical file chooser to specify the path to a file you are going to edit. You could enter:

```
> substitute edit "%EVAL{filedialog}"
```

In the above example, the Debugger command **filedialog** returns a chosen file path, but it will not be quoted. In order to handle the case where the chosen file path contains spaces, a pair of quotation marks is placed around the `%EVAL` sequence in the example.

Note

The **implicitEvalEcho** configuration option may have an effect on the expected output of this command. If this option is set to `off`, the values of expressions are not echoed, preventing expressions contained in *`commands`* from being evaluated or subsequently substituted in *`cmd_string`*. In this case, be sure to use the **mprintf** command to force the values of expressions specified in *`commands`* to echo. For example, rather than using a command like the following:

```
> substitute memread 4 %EVAL{$addr}
```

you should use this command:

```
> substitute memread 4 %EVAL{mprintf("0x%x", $addr)}
```

For more information, see “mprintf” on page 103 and the **implicitEvalEcho** option in “Other Debugger Configuration Options” in Chapter 8, “Configuration Options” in the *MULTI: Managing Projects and Configuring the IDE* book.

unalias

unalias *string*

Reverses a previous **alias** command (disassociates *`string`* from its substitution). For example, if **sh** is aliased to **showdef**, the command:

```
> unalias sh
```

disassociates **sh** from the **showdef** command.

See also “alias” on page 179.

Conditional Program Execution Commands

The commands in this section allow you to set conditions that must be met before commands are executed.

Composite commands for conditional program execution follow the same syntax rules as all MULTI Debugger commands. For information that may be helpful when entering conditional program execution commands, see “Using Command Lists in Debugger Commands” on page 12, “Continuing Commands onto Subsequent Lines” on page 13, and “Terminating Commands” on page 14.

The following list provides a brief description of each conditional program execution command. For a command's arguments and for more information, see the page referenced.

- **break** — Breaks out of a loop created with the Debugger **do**, **for**, or **while** command (see “break” on page 186).
- **continue** — Causes the current iteration of a loop created with the Debugger **do**, **for**, or **while** command to terminate and the next iteration to begin (see “continue” on page 186).
- **do** — Executes the specified command list at least once, and then for as long as the specified expression evaluates to a non-zero value (see “do” on page 186).
- **for** — Executes `init-expr` once, then executes the specified command list and the increment `inc-expr` for as long as the specified expression evaluates to a non-zero value (see “for” on page 187).
- **if** — Specifies conditional command execution (see “if” on page 187).
- **while** — Executes the specified command list for as long as the specified expression evaluates to a non-zero value (see “while” on page 188).

break

break [-fail | -succeed]

Breaks out of a loop created with the Debugger **do**, **for**, or **while** command, where:

- `-fail` — Causes **break** to be treated as a failure. This can be used to abort downloading to a target from a setup script if the script detects a failure condition.
- `-succeed` — [default] Causes **break** to be treated as a successful action.

This is similar to the **break** command in C.

See also “do” on page 186, “for” on page 187, and “while” on page 188.

continue

continue

Causes the current iteration of a loop created with the Debugger **do**, **for**, or **while** command to terminate and the next iteration to begin. For the **do** and **while** commands, this means the condition is tested; for the **for** command, the increment is executed. This is similar to the **continue** command in C. See “do” on page 186, “for” on page 187, and “while” on page 188.

do

do {*commands*} while (*expr*)

Executes the command list `commands` at least once, and then as long as `expr` (an expression in the current language) evaluates to a non-zero value. For example:

```
> do {
continued>   mprintf("%d\n", $i);
continued>   $i++;
continued> } while ($i<20)
```

In this case, the value of `($i)` will always be printed at least once, regardless of its initial value. This is similar to the **do** command in C. See “Using Command Lists in Debugger Commands” on page 12.

To interrupt this command, press **Esc**.

for

for ([*init-expr*] ; [*cond*] ; [*inc-expr*]) {*commands*}

Executes `init-expr` once, then executes the command list `commands` and the increment `inc-expr` as long as `cond` (an expression in the current language) evaluates to a non-zero value.

For example:

```
> for ($i=0; $i<20; ++$i) {
continued>   if($i%2==0) {
continued>     print "even";
continued>   } else {
continued>     print "odd";
continued>   }
continued> }
```

In this case, the variable `($i)` is initialized to `0`, and the body of the loop is then executed twenty times. See “Using Command Lists in Debugger Commands” on page 12.

Any of `init-expr`, `cond`, or `inc-expr` may be empty. If `init-expr` or `inc-expr` is empty, there will be, respectively, no initialization or increment executed. If `cond` is empty, it is taken to be the value `1` and the loop will continue to execute until halted. This is similar to the **for** command in C.

To interrupt this command, press **Esc**.

if

if (*expr*) {*commands*} [else if (*expr*) {*commands*}]... [else {*commands*}]

Specifies conditional command execution. If the first expression `expr` evaluates to a non-zero value, the first group of specified commands (see “Using Command Lists in Debugger Commands” on page 12) is executed. However, if the first expression evaluates to zero and there are subsequent `else if` clauses, the commands in the first `else if` clause with a non-zero expression are executed. If there is an `else` clause, and the `if` clause and any `else if` clauses resolve to zero, the commands in the `else` clause are executed. This is similar to the **if** command in C.

This command can be nested.

The following example sets a breakpoint that conditionally prints information:

```
> b main {
continued>   if(argc==1) {
continued>     print "one";
continued>   } else if (argc==2) {
continued>     print "two";
continued>   } else {
continued>     print "many";
continued>   }
continued> }
```

while

while (*expr*) {*commands*}

Executes the command list *`commands`* as long as *`expr`* (an expression in the current language) evaluates to a non-zero value. For example:

```
> while ($i<20) {
continued>   $j+=$i;
continued>   if ($j>50) {
continued>     $j=50;
continued>     break;
continued>   };
continued>   $i++;
continued> }
```

In this case, if `($j>50)` is true, the loop will terminate regardless of the value of `($i)`. This is similar to the **while** command in C. See "Using Command Lists in Debugger Commands" on page 12.

To interrupt this command, press **Esc**.

Dialog Commands

The commands in this section allow you to open dialog boxes.

The following list provides a brief description of each dialog command. For a command's arguments and for more information, see the page referenced.

- **alertdialog** — Displays a dialog box containing the specified string (see “alertdialog” on page 189).
- **dialog** — Opens the predefined dialog box specified (see “dialog” on page 189).
- **directorydialog** — Opens a directory chooser and returns the name of the directory that is selected from the chooser (see “directorydialog” on page 190).
- **filedialog** — Opens a file chooser and returns the name of the file that is selected from the chooser (see “filedialog” on page 190).

alertdialog

alertdialog *string*

GUI only

Displays a dialog box containing `string`. The Debugger blocks further input until you dismiss this dialog box. This command is useful inside a **.rc** script for displaying a message. For information about displaying other dialog boxes, see “dialog” on page 189.

dialog

dialog *name* [*arguments*]

GUI only

Opens the predefined dialog box named `name` and takes arguments `arguments` if the dialog box permits them. To display a list of the currently defined dialog boxes, use the **l D** (lowercase `L`, uppercase `D`) command (see “l” on page 102).

At present, the only supported dialog box is named `textinput`. The `textinput` dialog box displays a prompt and a text field for the user to enter a string. Invoking this dialog box requires two arguments: the first is used as the prompt in the dialog box and the second specifies the MULTI command that is run on the string entered by the user.

The `textinput` dialog box is useful if you would like a custom menu item to run a MULTI command that takes a user-specified argument. For example, suppose that when a custom menu item is selected, you would like a dialog box to prompt the user for the name of a procedure. Suppose further that the **e** command should be run on the procedure, displaying the location in source where the procedure is defined (see "e" on page 133). You might specify that the following command is executed when the menu item is selected:

```
> dialog textinput "Go to the definition of procedure:" e
```

directorydialog

directorydialog [*window_title*]

GUI only

Opens a directory chooser and returns the name of the directory that is selected from the chooser. By default, the title of the window is **Choose Directory**, but you may change it with the *`window_title`* parameter. This command is useful for interacting with a user while you are running scripts or evaluating macros. See also "filedialog" on page 190.

filedialog

filedialog [*button_label window_title* [-defaultdir *dir_name*] [-preset *preset_name*] [-filetypes *file_type* [*file_type*]...]]

GUI only

Opens a file chooser and returns the name of the file that is selected from the chooser. This command is useful for interacting with a user while you are running scripts or evaluating macros. See also "directorydialog" on page 190.

By default, the dialog box's button is labeled **Select** and the title of the window is **Choose File**. You may change these with the *`button_label`* and *`window_title`* parameters.

The `-defaultdir` option specifies that the file chooser displays the *`dir_name`* directory, where *`dir_name`* is the directory you specify. If you do not specify the `-defaultdir` option, the file chooser displays the directory of the last file selected from a Debugger file chooser.

The `-preset` option specifies that the file chooser displays all the file types associated with *`preset_name`* in its file type drop-down list. Some common *`preset_names`* and their corresponding file types are:

- `Debugger` — Lists **All Files**, **Executable**, and **Shared Libraries** in the file type drop-down list.
- `Editable` — Lists **C Source**, **C++ Source**, **Assembly Source**, **Link Map**, **Green Hills Script**, **Configuration File**, **Java Source**, and **Text Files** in the file type drop-down list.
- `Editor` — Lists **All Files** and all file types listed for `Editable` in the file type drop-down list.
- `Object` — Lists **All Files**, **Object Files**, **Shared Libraries**, and **Libraries** in the file type drop-down list.

The `-filetypes` option adds individual file types to the preset. If *`file_type`* contains a space, enclose it in quotation marks. If you specify more than one *`file_type`*, separate each with a space. Some common *`file_types`* and their corresponding file types are:

- `All Files` — Lists **All Files (*)** in the file type drop-down list.
- `Assembly Source` — Lists **Assembly Source (*.s, *.asm, *.si, *.86, *.arm, *.thm, *.68, *.cf, *.mip, *.ppc, *.sh, *.800, *.850, *.830, *.810, *.bf)** in the file type drop-down list.
- `C Source` — Lists **C Source (*.c, *.h)** in the file type drop-down list.
- `C++ Source` — Lists **C++ Source (*.cc, *.cxx, *.cpp, *.cp, *.c++, *.C, *.h, *.hh, *.H, *.h++, *.hxx, *.hpp)** in the file type drop-down list.
- `Libraries` — Lists **Archive (*.a, *.lib, *.olb, *.a88)** in the file type drop-down list.

For more information about preset options and file types, refer to Part II, “Configuring the MULTI IDE” in the *MULTI: Managing Projects and Configuring the IDE* book.

External Tool Commands

The commands in this section deal with external components and sockets.

The following list provides a brief description of each external tool command. For a command's arguments and for more information, see the page referenced.

- **evaltosocket** — Sends the output of the specified command(s) to any socket connected to MULTI via the **socket** command (see “evaltosocket” on page 192).
- **make** — Executes the system command **make** to build a target (see “make” on page 192).
- **socket** — Opens a socket connection using the specified port number (see “socket” on page 192).

evaltosocket

evaltosocket *commands*

Sends the output of `commands`, which may consist of one or more commands, to any socket connected to MULTI via the **socket** command (see “socket” on page 192). The output is not sent to the command pane.

make

make [*make_target*]

Executes the system command **make** to build the target `make_target`. If you do not specify a target, the name of the executable you are debugging is used. The output of **make** appears in an Editor window.

socket

socket [-global] *port_number*

Opens a socket connection using the specified port number. The socket connection allows an external process to send commands to the Debugger and receive output from the Debugger. For example, if you started MULTI on a machine named `myhost` and used the command `socket 40000`, you could run the command `telnet` `myhost 40000` to connect a telnet window to the Debugger. From the telnet window, you could enter commands that would be executed in the Debugger and receive output from the Debugger. Instead of using telnet, you can run any program that connects to `myhost` on port `40000` and interacts with the Debugger.

Normally, the socket connection will be associated only with the Debugger component that created it. If you specify the `-global` option, output from all Debugger components will be sent to the socket. By default, input from the socket will be sent to the first Debugger component. To send commands to a different Debugger component, see “route” on page 181 and “components” on page 97.

The command line option `-socket` creates a global socket when the Debugger opens. For more information about this option, see Appendix C, “Command Line Reference” in the *MULTI: Debugging* book.

History Commands

The commands in this section deal with commands kept in the Debugger history.

The Debugger maintains a history of the most recent commands entered in the command pane. The number of commands remembered defaults to 256, but can be set with the **history** configuration option (for more information, see “Other Debugger Configuration Options” in Chapter 8, “Configuration Options” in the *MULTI: Managing Projects and Configuring the IDE* book).

If you open multiple Debugger windows in a single Debugger session, each Debugger window has its own command history, but when you close the Debugger windows, MULTI saves only the history of the last window. When you launch the Debugger, the history list from the previous session is loaded upon startup (i.e., your command history is maintained across debugging sessions). This behavior can be turned off with the **saveCommandHistory** configuration option (for more information, see “Session Configuration Options” in Chapter 8, “Configuration Options” in the *MULTI: Managing Projects and Configuring the IDE* book).

Tip

For a description of keyboard shortcuts that allow you to auto-complete commands based on your command history, display the last command in your command history, etc., see also “Command Pane Shortcuts” in

Appendix B, “Keyboard Shortcut Reference” in the *MULTI: Debugging* book.

The following list provides a brief description of each history command. For a command's arguments and for more information, see the page referenced.

- **!** — Re-executes a command (see “!” on page 194).
- **!!** — Re-executes the last command (see “!!” on page 195).
- **backhistory** — Gives the previous command in the command pane history list (see “backhistory” on page 195).
- **forwardhistory** — Gives the next command in the command pane history list (see “forwardhistory” on page 196).
- **h** — Lists or clears the command history (see “h” on page 196).

!

! [*string*] [*args*]

! [*num*] [*args*]

Re-executes the most recent command beginning with `string`, or re-executes the command numbered `num`. Do not put a space between `!` and `string` or between `!` and `num`. If you include a space, the entire string after `!` is treated as `args`. If specified, `args` are appended as arguments to the command.

If neither a string nor a command number is specified, `!` matches the previous command. In any case, MULTI prints out what was substituted. For example:

```
> echo hello
hello
> !echo hello
"!echo" = "echo hello"
hello hello
> ! echo hello
"!" = "echo hello hello"
hello hello echo hello
> foo
Unknown name "foo" in expression.
> ! echo hello
```

```
"!" = "foo"
Unknown name "foo" in expression.
```

!!

!! [*args*]

Re-executes the last command.

You can add additional arguments (`args`) to the end of the command. For example, if the most recent command was

```
echo hi
```

and you type

```
> !! bye
```

then the command

```
echo hi bye
```

will be executed.

The space between `!!` and `args` is required. If you do not include a space, `args` are ignored.

backhistory

backhistory

GUI only

Gives the previous command in the command pane history list. This command is intended to be bound to a key (see “Customizing Keys with the keybind Command” in Chapter 7, “Configuring and Customizing MULTI” in the *MULTI: Managing Projects and Configuring the IDE* book). By default, the Debugger binds the **UpArrow** key to this command.

forwardhistory

forwardhistory

GUI only

Gives the next command in the command pane history list. This command is intended to be bound to a key (see “Customizing Keys with the keybind Command” in Chapter 7, “Configuring and Customizing MULTI” in the *MULTI: Managing Projects and Configuring the IDE* book). By default, the Debugger binds the **DownArrow** key to this command.

h

h [clear | *num*]

This command has three forms:

- **h** — Lists the existing command history. This option corresponds to **Config → State → Show Command History**.
- **h clear** — Clears the command history.
- **h *num*** — Lists the most recent `num` entries in the command history.

Hook Commands

The commands in this section allow you to add hooks to Debugger actions, remove hooks, and list hooks.

The following list provides a brief description of each hook command. For a command's arguments and for more information, see the page referenced.

- **addhook** — Adds a hook to a Debugger action (see “addhook” on page 197).
- **clearhooks** — Removes hooks (see “clearhooks” on page 198).
- **listhooks** — Prints a list of current hooks to the Debugger's **Cmd** pane (see “listhooks” on page 199).

addhook

addhook [-order *number*] [-board | -core *number*] -before *action* {*commands*} | -after *action* {*commands*}

Adds a hook to a Debugger action. You must be connected to a target before using this command.

Available arguments are:

- `-order number` — Specifies the new hook's order in the sequence of hooks that run for `action`. (When `action` occurs, the hooks for `action` run in order from the hook with the smallest order number to the hook with the largest order number.) The hook's order is indicated by `number`, which must be a positive integer. You may use the same order numbers for different actions.

  If you do not specify `-order number`, an order number is automatically generated for the new hook. The automatically generated order number is larger than the order number of any existing hook for the given action, allowing you to add hooks without assigning order numbers. Hooks added in this fashion are run in the order that you added them.
- `-board` — [default] Does not associate your new hook with a particular CPU. For example, when you download a program to your target, `-board` hooks for downloading run regardless of the CPU you download to.
- `-core number` — Associates your new hook with a particular CPU. The CPU is indicated by `number`, which must be a non-negative integer. The number you specify should be the same as the number your target connection uses to identify the CPU. For example, if you are using the Green Hills Probe, you should use the core ID number printed out by the **tl** command.

  This option is useful for initializing registers in multi-core systems. When you download a program to your target, hooks for cores other than the one to which you are downloading are not run, but `-board` hooks are run.

  If you do not specify `-board` or `-core number`, `-board` is passed by default.
- `-before action {commands}` — Runs the command list `commands` before `action` happens to your target. Available `actions` are: `reset` and `download`. If your target has an ordinary, non-“early” MULTI board setup script or a legacy debug server setup script, `-before download` hooks run before the

setup script. For information about early MULTI board setup scripts, see "Early MULTI Board Setup Scripts with Debugger Hooks" in Chapter 6, "Configuring Your Target Hardware" in the *MULTI: Debugging* book.

- `-after` *`action`* `{`*`commands`*`}` — Runs the command list *`commands`* after *`action`* happens to your target. Available *`actions`* are: `connect`, `download`, `reset`, and `rominit`.

  Hooks specified with `-after connect` are only meaningful if you add them from an early MULTI board setup script. For information about early MULTI board setup scripts, see "Early MULTI Board Setup Scripts with Debugger Hooks" in Chapter 6, "Configuring Your Target Hardware" in the *MULTI: Debugging* book.

  Hooks specified with `-after download` should leave the target in a halted state rather than a running state. If you want to run the downloaded program immediately after downloading it, use the **r** command (see "r" on page 154).

  Hooks specified with `-after rominit` are only valid for programs that are run out of ROM or copied from ROM to RAM. When running from ROM, the `rominit` command is executed after the ROM is initialized, just before the first user instruction of `main()`. When copying from ROM to RAM, the `rominit` command is executed just before the first instruction after the ROM-to-RAM copy.

clearhooks

clearhooks [-order *number*] [-board | -core *number*] [-before *action* | -after *action*]

Removes hooks. If no arguments are specified, this command removes all Debugger hooks from your target. You must be connected to a target before using this command.

Available arguments are:

- `-order` *`number`* — Removes the hook with the order number specified.
- `-board` — Removes `-board` hooks.
- `-core` *`number`* — Removes hooks for the CPU indicated by *`number`*.

- `-before` *`action`* — Removes hooks that run before *`action`*. Available *`actions`* are: `reset` and `download`.
- `-after` *`action`* — Removes hooks that run after *`action`*. Available *`actions`* are: `connect`, `download`, `reset`, and `rominit`.

For example, to remove all hooks that run after reset, you can issue the following command:

```
> clearhooks -after reset
```

To remove only those hooks that are explicitly bound to run on core 2 after download, you can enter the following command:

```
> clearhooks -core 2 -after download
```

If you are not sure what hooks have already been added, it is a good idea to run the **clearhooks** or **listhooks** command before adding a new set of hooks. See “listhooks” on page 199.

listhooks

listhooks [-order *number*] [-board | -core *number*] [-before *action* | -after *action*]

Prints a list of current hooks to the Debugger's **Cmd** pane. The hooks are printed in a manner suitable for passing them as arguments to the **addhook** command (see “addhook” on page 197).

If no arguments are specified, this command prints all Debugger hooks on your target. You must be connected to a target before using this command.

Available arguments are:

- `-order` *`number`* — Prints the hook with the order number specified.
- `-board` — Prints `-board` hooks.
- `-core` *`number`* — Prints hooks for the CPU indicated by *`number`*.
- `-before` *`action`* — Prints hooks that run before *`action`*. Available *`actions`* are: `reset` and `download`.

- `-after` *`action`* — Prints hooks that run after *`action`*. Available *`actions`* are: `connect`, `download`, `reset`, and `rominit`.

The following example uses the **listhooks** command for a Power Architecture target:

```
> clearhooks
> addhook -core 4 -after reset { target rw cpsr 0xd3 }
> addhook -core 4 -after reset { target rw control 0x1 }
> listhooks -after reset
-order 10   -after reset  -core 4  { target rw cpsr 0xd3 }
-order 20   -after reset  -core 4  { target rw control 0x1 }
```

If you are not sure what hooks have already been added, it is a good idea to run the **listhooks** or **clearhooks** command before adding a new set of hooks. See “clearhooks” on page 198.

MULTI-Python Script Commands

The commands in the following section are related to MULTI-Python scripting. See also the *MULTI: Scripting* book.

The following list provides a brief description of each MULTI-Python script command. For a command's arguments and for more information, see the page referenced.

- **python**, **py**— Executes a Python statement or script (see “python, py” on page 201).
- **pywin** — Opens or closes the **Py Window** (see “pywin” on page 202).

python, py

python [-b | -nb] -s "*Python_statements*" | -f *Python_script_name* [*args*]

py [-b | -nb] -s "*Python_statements*" | -f *Python_script_name* [*args*]

GUI only

Executes a Python statement or script, where:

- `-b` — Indicates that the Python statement or script executes in blocking mode. In this mode, no Debugger commands are executed until the statement or script has completed.
- `-nb` — [default] Indicates that the Python statement or script executes in non-blocking mode. In this mode, subsequent Debugger commands can execute before the statement or script completes.
- `-s "`*`Python_statements`*`"` — Specifies one or more Python statements for execution. Python statements must be enclosed in quotation marks.
- `-f` *`Python_script_name`* `[`*`args`*`]` — Specifies the Python script for execution. If *`Python_script_name`* contains spaces, enclose it in quotation marks. The *`args`* option specifies arguments to the Python script.

  The `-f` *`Python_script_name`* argument does not require you to enter the full Python script path. If you do not enter the full path, the filename is searched for using the default search path (see "Default Search Path for Files Specified in Commands" on page 14). The first command line argument, `sys.argv[0]`, in the executed Python script is the full path to the Python script file. Other arguments (if any) are those you specified with *`args`*.

Note

The **python** and **py** commands function identically.

For information about using Python scripts to run MULTI, see Chapter 2, "Introduction to the MULTI-Python Integration" in the *MULTI: Scripting* book.

pywin

pywin [-close]

GUI only

Opens or closes the **Py Window**. For information about the **Py Window**, see "MULTI-Python Interfaces" in Chapter 2, "Introduction to the MULTI-Python Integration" in the *MULTI: Scripting* book.

If no option is specified, the **Py Window** appears. If `-close` is specified, the **Py Window** closes.

Object Structure Awareness (OSA) Commands

The commands in this section are intended to be used with Object Structure Awareness packages. For more information, see Chapter 26, "Freeze-Mode Debugging and OS-Awareness" in the *MULTI: Debugging* book.

The following list provides a brief description of each OSA command. For a command's arguments and for more information, see the page referenced.

- **osacmd** — Sends a quoted list of commands to the corresponding OSA package (see "osacmd" on page 203).
- **osaexplorer** — Opens an **OSA Explorer** on the current process in a freeze-mode debugging environment or on the current debug server in a run-mode debugging environment (see "osaexplorer" on page 203).
- **_osaFillGuiWithObj** — Fills in a widget with OSA object attribute values (see "_osaFillGuiWithObj" on page 205).
- **osainject** — Injects the specified message to the specified object (see "osainject" on page 205).
- **osasetup** — Tells MULTI where to find a customized OSA package (see "osasetup" on page 205).
- **osatask** — Opens the Debugger on the task specified (see "osatask" on page 206).
- **osaview** — Opens the OSA Object Viewer (see "osaview" on page 207).

- **taskwindow** — Opens the Task Manager in a run-mode debugging environment or displays it in the foreground if it is already open (see "taskwindow" on page 207).

osacmd

osacmd "*OSA_package_commands*"

GUI only

Sends the quoted list of commands to the corresponding OSA package. The Debugger treats the command list as a string; in other words, the command list is not parsed by the Debugger and is sent "as is" to the OSA package.

osaexplorer

osaexplorer [-refresh]

osaexplorer [-tabname *object_name*] [-tabidx *tab_index*] [-refname *reference_name*] [-refidx *reference_index*] [-mslrow *row_index*]

GUI only

Opens an **OSA Explorer** on the current process in a freeze-mode debugging environment or on the current debug server in a run-mode debugging environment. The **OSA Explorer** shows information for objects recognized by the OSA integration module. Each attribute of an object is shown as a column in the **OSA Explorer**. For more information about the **OSA Explorer**, see "The OSA Explorer" in Chapter 26, "Freeze-Mode Debugging and OS-Awareness" in the *MULTI: Debugging* book.

Optional arguments to this command are:

- `-refresh` — Refreshes the object list in the **OSA Explorer**. This option is valid only in a breakpoint's command list in freeze-mode debugging. The `-refresh` option is not valid if specified in conjunction with any other optional argument.
- `-tabname` *`object_name`* — Displays the tab *`object_name`* as the current tab in the **OSA Explorer**. Each tab is named for a particular kind of object. Available **OSA Explorer** tabs appear in the GUI.

- `-tabidx` *`tab_index`* — Displays the tab specified by *`tab_index`* as the current tab. Tab indexing starts from zero (0). The left-most tab in the **OSA Explorer** window has a *`tab_index`* of 0, the next tab a *`tab_index`* of 1, and so on.
- `-refname` *`reference_name`* — Displays the reference list *`reference_name`* for the object selected in the master pane. The reference list is shown in the reference pane. Available references appear in the drop-down list located above the **OSA Explorer** reference pane.
- `-refidx` *`reference_index`* — Displays the reference list specified by *`reference_index`* in the reference pane. Reference indexing starts from zero (0). The first reference object located in the reference pane's drop-down list has a *`reference_index`* of 0, the next reference object a *`reference_index`* of 1, and so on. Any separator present in the drop-down list is included in index numbering.
- `-mslrow` *`row_index`* — Selects the master pane row specified by *`row_index`* and updates the reference pane to show the reference object list for the selected row. Row indexing starts from zero (0). The first row located in the master pane has a *`row_index`* of 0, the next row a *`row_index`* of 1, and so on.

You can specify tab, reference, and row arguments together if they make sense in the corresponding **OSA Explorer**. For example, if you are using an **OSA Explorer** with the INTEGRITY operating system, you can enter:

```
> osaexplorer -tabname Task -mslrow 2 -refname "Other Activities"
```

to open an **OSA Explorer** that displays the **Task** tab, selects the third row in the master pane (indexing starts from 0), and shows the task's **Other Activities** in the reference pane.

See also “taskwindow” on page 207.

Corresponds to: **View → OSA Explorer**

_osaFillGuiWithObj

_osaFillGuiWithObj -Widget *widget_name* -ObjType *object_type_name* -ObjFld *fld1* [*fld2*]...

GUI only

Fills in a widget with OSA object attribute values. The widget must be a `TextField`, `PullDown`, or `MScrollList`.

The command is applicable only in a MULTI dialog script.

osainject

osainject -ObjType *object_type_name* -ObjID *object_id* [*message_string*]

GUI only

Injects the message specified by *`message_string`* to the specified object (with a certain type and ID). MULTI transfers the message injection request to the corresponding OSA module, which then injects the message into the underlying RTOS. The format of *`message_string`* is OSA module-dependent.

osasetup

osasetup *osa_name* [-cfg *config_filename*] [-lib *module_name*] [-log *log_file*]

GUI only

Tells MULTI where to find a customized OSA package, where:

- *`osa_name`* — Specifies the name of the OSA package.
- `-cfg` *`config_filename`* — Specifies the name of the package's configuration file. If no configuration file is specified, MULTI uses ***osa_name*.osa** as the configuration filename.

  You may optionally include the full path to *`config_filename`*. If a full path is not specified, MULTI searches for the configuration file in your personal configuration directory first:

- Windows 7/Vista — ***user_dir*\AppData\Roaming\GHS**
- Windows XP — ***user_dir*\Application Data\GHS**
- Linux/Solaris — ***user_dir*/.ghs**

and then looks for it in the MULTI IDE installation directory. For more information, see "Freeze-Mode and OSA Configuration File" in Chapter 26, "Freeze-Mode Debugging and OS-Awareness" in the *MULTI: Debugging* book.

- `-lib` *`module_name`* — Specifies the package's shared library. If no library is specified, MULTI uses ***osa_name*.dll** (Windows) or ***osa_name*.so** (Linux/Solaris) as the library name.

  You may optionally include the full path to *`module_name`*. If a full path is not specified, MULTI searches for the shared library in the MULTI IDE installation directory first, and if it does not find it, continues to search in a way defined by the host machine.
- `-log` *`log_file`* — Specifies that the communication between MULTI and the OSA package be logged to *`log_file`*.

osatask

osatask [*task_ID*]

GUI only

Opens the Debugger on the task specified by the task identification number *`task_ID`*. When run without the *`task_ID`* argument, **osatask** opens the Debugger on the task that is currently executing.

This command is only applicable when you are debugging an RTOS in freeze mode. (See also Chapter 26, "Freeze-Mode Debugging and OS-Awareness" in the *MULTI: Debugging* book).

osaview

osaview [-context]

GUI only

Opens the OSA Object Viewer. If you specify the `-context` option, the OSA Object Viewer opens on information for the INTEGRITY object (AddressSpace or Task, for example) currently displayed in the Debugger window. If you do not specify an option to this command, it displays information for the entire INTEGRITY target.

Note

This command is only supported if you are debugging a run-mode connection and using INTEGRITY version 10 or later.

For information about the OSA Object Viewer, see “The OSA Object Viewer” in Chapter 25, “Run-Mode Debugging” in the *MULTI: Debugging* book.

taskwindow

taskwindow [-refresh]

GUI only

Opens the Task Manager in a run-mode debugging environment or displays it in the foreground if it is already open. This command works with run-mode debug connections such as those used with INTEGRITY and VxWorks.

The Task Manager displays the tasks that are running on the (embedded, multitasking) target. It contains columns of information about each of the tasks. For more specific information, see “The Task Manager” in Chapter 25, “Run-Mode Debugging” in the *MULTI: Debugging* book.

To automatically attach to and begin a debugging session on a task, double-click the task. This is equivalent to the command **attach** ***process_id*** (see “attach” on page 18). For more information about task management in run-mode, see Chapter 25, “Run-Mode Debugging” in the *MULTI: Debugging* book.

Specify the `-refresh` option to refresh the existing Task Manager window.

This command can be used in freeze mode to launch the **OSA Explorer**, but this usage is deprecated. Instead, use the **osaexplorer** command for that purpose (see "osaexplorer" on page 203). For more information about object-aware and task-aware debugging in freeze mode, see Chapter 26, "Freeze-Mode Debugging and OS-Awareness" in the *MULTI: Debugging* book.

Corresponds to: **View → Task Manager**

Record and Playback Commands

The commands in this section deal with recording and playing back Debugger commands. The Debugger supports the recording and playing back of command sequences to and from files. The files created are ASCII files and can be edited later.

Only Debugger commands can be recorded. If a GUI action executes a Debugger command, that command is recorded. GUI actions include button presses in the Debugger window and mouse clicks in the source pane.

Make sure to follow these guidelines when using record and playback commands and record files:

- If you use the **>** ***file*** or **>>** ***file*** command when a recording file is already set, the old recording file will be closed and all subsequent commands will be recorded to the new `file`. See ">" on page 209 and ">>" on page 210.
- Scripts may include other scripts, to a maximum script depth of 500.
- The playback file should not contain any lines that begin with **>** or **<**. (Add a space at the beginning of a line, if necessary).
- Standard language-style comments are supported in command playback files, as in all Debugger input (see "Including Comments in Debugger Commands" on page 13).
- You cannot play back from a file that is open for recording, or record to a file that you are playing back.
- Some commands can cause errors that may abort playback. You can use the **Continue running script files on error** GUI option (or the **continuePlaybackFileOnError** configuration option) to prevent these commands from stopping a playback. For more information about this option,

see “Debugger Configuration Options” in Chapter 8, “Configuration Options” in the *MULTI: Managing Projects and Configuring the IDE* book.

You can use MULTI's **-p**, **-r**, **-R**, and **-RO** command line options to record commands and/or output or to read from recorded files on startup. For a description of these options, see Appendix C, “Command Line Reference” in the *MULTI: Debugging* book.

The following list provides a brief description of each record and playback command. For a command's arguments and for more information, see the page referenced.

- **>** — Controls or displays the status of command recording (see “>” on page 209).
- **>>** — Controls or displays the state of screen recording (recording commands and their output) (see “>>” on page 210).
- **<** — Starts command playback from the specified file (see “<” on page 210).

>

> [*file* | t | f | c]

(This command is a right angle bracket.)

Controls or displays the status of command recording, where:

- `file` — Sets the command recording file to `file` and turns on command recording. This option corresponds to: **Config → State → Record Commands**.
- `t` — Turns on command recording (to the most recently set command recording file).
- `f` — Turns off command recording (but does not close or reset the command recording file).
- `c` — Turns off command recording and closes the command recording file. (A new recording file will need to be set before recording can be performed again.) This option corresponds to **Config → State → Stop Recording Commands**.

If no argument is specified, the **>** command displays the current command recording status.

>>

\>> [*file* | t | f | c]

(This command is two right angle brackets.)

Controls or displays the state of screen recording (recording commands and their output), where:

- `file` — Sets the screen output recording file to `file` and turns on screen output recording. This option corresponds to **Config → State → Record Commands + Output**.
- `t` — Turns on screen output recording (to the most recently set screen output recording file).
- `f` — Turns off screen output recording (but does not close or reset the screen output recording file).
- `c` — Turns off screen output recording and closes the screen output recording file. (A new recording file will need to be set before recording can be performed again.) This option corresponds to **Config → State → Stop Recording Commands + Output**.

If no argument is specified, the >> command displays the current screen output recording status.

<

< *file*

(This command is a left angle bracket.)

Starts command playback from the specified `file`.

The specified file will be searched for using the default search path unless the full path has been specified (see "Default Search Path for Files Specified in Commands" on page 14).

Corresponds to: **Config → State → Playback Commands**

Chapter 16

Search Command Reference

Contents

The commands in this chapter allow you to search forward and backward in the source pane or in a file, modify a search, or perform an incremental search.

Searches wrap around the beginning and end of files and obey the current case sensitivity setting.

For information about navigating MULTI windows, see Chapter 11, “Navigation Command Reference” on page 131.

Search Commands

The following list provides a brief description of each search command. For a command's arguments and for more information, see the page referenced. (Note that complete descriptions for some of these commands are located in other chapters.)

- **/** — Searches forward through the current file for the specified string (see “/” on page 213).
- **?** — Searches backward for the specified string (see “?” on page 213).
- **bsearch** — Searches backward in the source pane for the previous occurrence of the specified string and highlights it (see “bsearch” on page 214).
- **chgcase** — Sets the case sensitivity of text searches (see “chgcase” on page 214).
- **completeselection** — Selects the smallest complete expression from the text highlighted in the source pane (see “completeselection” on page 215).
- **dialogsearch** — Opens a search dialog box that allows you to search for text or regular expressions in the Debugger's source pane (see “dialogsearch” on page 215).
- **fsearch** — Searches forward in the source pane (after selected text) for the next occurrence of the specified string, and highlights the string (see “fsearch” on page 215).
- **grep** — Searches for the specified text in open files and, if debugging information is available, in all of the files that make up a program (see “grep” on page 216).
- **isearch** — Starts an incremental search in the window specified (see “isearch” on page 217).
- **isearchadd** — Adds the specified text to the search string and continues an incremental search in the specified window (see “isearchadd” on page 218).

- **isearchreturn** — Causes the Debugger to return to the location that was viewed prior to the last **isearch** command (see “isearchreturn” on page 218).
- **printsearch** — Prints the search string or indicates that there is no search string (see “printsearch” on page 219).
- **showdef** — Searches for a C preprocessor definition for each specified name (see “showdef” on page 273 in Chapter 21, “View Command Reference” on page 265).

/

/ [*string*]

In GUI mode, works in the same way as the **fsearch** command (see “fsearch” on page 215).

In non-GUI mode, searches forward through the current file, from the line after the current line, for `string`. Do not put a space between `/` and `string`.

For example, the command

```
/extern
```

causes the cursor to jump forward to the string `extern`. You can then find more occurrences of this word by repeatedly issuing /, and then pressing **Enter**.

?

? [*string*]

In GUI mode, works in the same way as the **bsearch** command (see “bsearch” on page 214).

In non-GUI mode, searches backward, from the line before the current line, for `string`. Do not put a space between `?` and `string`.

For example, the command

```
?extern
```

causes the cursor to jump backward to the string `extern`. You can then find more occurrences of this string by repeatedly issuing **?**, and then pressing **Enter**.

bsearch

bsearch *string*

GUI only

Searches backward in the source pane for the previous occurrence of *`string`* and highlights it. If the search reaches the beginning of the file, MULTI beeps and then resumes searching from the end.

If *`string`* is omitted, the *`string`* argument from the previous **fsearch**, **bsearch**, or incremental search is used. See also “fsearch” on page 215 and “Incremental Searching” in Chapter 9, “Navigating Windows and Viewing Information” in the *MULTI: Debugging* book.

This command is only available in GUI mode. To search backward in non-GUI mode, use the **?** command (see “?” on page 213).

chgcase

chgcase [0 | 1]

Sets the case sensitivity of text searches, where:

- `chgcase 0` makes all future text searches case-sensitive.
- `chgcase 1` makes all future text searches case-insensitive.
- `chgcase` (without an argument) toggles the current case sensitivity setting.

Note

In case-insensitive mode, typing uppercase characters in a search string temporarily changes the search mode to case-sensitive.

completeselection

completeselection

GUI only

Selects the smallest complete expression from the text highlighted in the source pane. If there is no text selected (highlighted) in the source pane, this command does nothing.

If part of a variable name is selected, **completeselection** selects the entire name. It also selects an entire expression in parentheses. For example, if the selection includes an unmatched left parenthesis, the selection will extend to include the matching right parenthesis if it is on the same line as the end of the selection.

dialogsearch

dialogsearch

GUI only

Opens a search dialog box that allows you to search for text or regular expressions in the Debugger's source pane. This dialog contains options for searching forward and backward and for ignoring case.

For more detailed information about the search dialog box, see “The Source Pane Search Dialog Box” in Appendix A, “Debugger GUI Reference” in the *MULTI: Debugging* book.

Corresponds to: **Tools → Search**

fsearch

fsearch *string*

GUI only

Searches forward in the source pane (after selected text) for the next occurrence of `string`, and highlights it. If `string` is not found before the end of the file, the Debugger beeps and then resumes searching from the beginning of the file.

If `string` is omitted, the `string` argument used in the previous **fsearch**, **bsearch**, or incremental search is used. See also “bsearch” on page 214 and “Incremental Searching” in Chapter 9, “Navigating Windows and Viewing Information” in the *MULTI: Debugging* book.

grep

grep [[-i] [-w] [-F | -E] *text*]

GUI only

Searches for `text` in open files and, if debugging information is available, in all of the files that make up a program.

If no options are specified, this command opens the **Search in Files** dialog (see “Viewing Search in Files Results” in Chapter 4, “Editing Files with the MULTI Editor” in the *MULTI: Managing Projects and Configuring the IDE* book). Alternatively, you can specify a `text` argument and search options from the command line to achieve most of the same functionality as the **Search in Files** dialog, where:

- `text` — Specifies the string to search for. `text` is treated as a basic regular expression unless the `-F` or `-E` option is used.
- `-i` — Causes the **grep** command to perform a case-insensitive search. (Without this option, **grep** performs a case-sensitive search.)
- `-w` — Causes the **grep** command to perform a whole word search. This means that the matching string must be preceded by a non-word character and followed by a non-word character, where word characters are letters, digits, and the underscore. For example, if you specify this option, a search for `ice` does not match `slice` or `ice__`, but it does match `ice-9`. (Without this option, **grep** finds any matching text.)
- `-F` — Causes `text` to be treated as a fixed string.
- `-E` — Causes `text` to be treated as an extended regular expression. Extended regular expressions allow you to use the special regular expression syntax characters `|`, `+`, and `?`, which do not normally have any special meaning to the **grep** command.

Some search strings may be difficult to specify on the command line because the Debugger may interpret escaped characters differently than expected (for example, `\"word`, an escaped double quotation mark followed by the string `word`). If you encounter such a problem, use the **Search in Files** dialog to specify your search string and options.

The output from the **grep** command is displayed in the **Search in Files Results** window (see "Viewing Search in Files Results" in Chapter 4, "Editing Files with the MULTI Editor" in the *MULTI: Managing Projects and Configuring the IDE* book).

This command works by running the BSD **grep** utility. A copy of BSD **grep** is installed along with the MULTI IDE. However, BSD **grep** is not part of MULTI and is not distributed under the same license as MULTI. For more information about the license under which BSD **grep** is distributed, refer to the file **bsdgrep.txt**, which is located in the **copyright** subdirectory of the IDE installation directory. For information about the search expression format that BSD **grep** uses, refer to the OpenBSD re_format(7) man page.

Corresponds to: **Tools → Search in Files**

isearch

isearch [+ | -] wid=*num*

GUI only

Starts an incremental search in the window specified by *num*, the window ID number. If an incremental search is already active in that window, the current search string is searched again. A plus sign (+) argument specifies a forward search, and a minus sign (-) causes a backward search. If neither a plus or minus sign are specified, a forward search is performed by default.

This command should not be used from the command window. Instead, use the **keybind** or **mouse** command to bind this command to a key or mouse press. For more information about the **keybind** and **mouse** commands and window ID numbers, see "Customizing Keys and Mouse Behavior" in Chapter 7, "Configuring and Customizing MULTI" in the *MULTI: Managing Projects and Configuring the IDE* book.

isearchadd

isearchadd wid=*num text*

GUI only

Adds `text` (no quotation marks) to the search string and continues an incremental search in the window pointed to by `num`. The window must already be performing an incremental search for this command to work.

This command should not be used from the command window. Instead, use the **keybind** or **mouse** command to bind this command to a key or mouse press. For more information about the **keybind** and **mouse** commands and window ID numbers, see "Customizing Keys and Mouse Behavior" in Chapter 7, "Configuring and Customizing MULTI" in the *MULTI: Managing Projects and Configuring the IDE* book.

isearchreturn

isearchreturn wid=*num*

GUI only

Causes the Debugger to return to the location (in the window specified by the window ID number `num`) that was being viewed prior to the last **isearch** command.

This command is only meaningful after an **isearch** command has been issued (that is, it is only meaningful if the window with the identification number `num` is performing an incremental search).

This command should not be used from the command window. Instead, use the **keybind** or **mouse** command to bind this command to a key or mouse press. For information about the **keybind** and **mouse** commands and window ID numbers, see "Customizing Keys and Mouse Behavior" in Chapter 7, "Configuring and Customizing MULTI" in the *MULTI: Managing Projects and Configuring the IDE* book.

printsearch

printsearch

Prints the search string or indicates that there is no search string.

If a search string exists, it is printed within square brackets, so the beginning and ending whitespace can be seen. For example:

```
> printsearch
```

might print:

```
[ foo  ]
```

meaning that the search string is the word `foo` preceded by one space and followed by two spaces.

Chapter 17

Target Connection Command Reference

Contents

General Target Connection Commands

The commands in this section allow you to connect to and manipulate a debug target platform.

The following list provides a brief description of each general target connection command. For a command's arguments and for more information, see the page referenced.

- **change_binding** — Associates the currently selected executable with a compatible connection, or disassociates the currently selected executable from a connection (see “change_binding” on page 223).
- **connect** — Connects to a target or modifies the logging of transactions between MULTI and the target (see “connect” on page 223).
- **connectionview** — Opens the **Connection Organizer** window, which allows you to create, edit, and manage Connection Methods (see “connectionview” on page 226).
- **disconnect** — Closes an existing connection to a target (see “disconnect” on page 226).
- **iobuffer** — Disables or enables buffering for the current connection's I/O panes (see “iobuffer” on page 227).
- **load** — Downloads the current executable to the target's memory (see “load” on page 227).
- **prepare_target** — Prepares the target or opens the **Prepare Target** dialog box (see “prepare_target” on page 228).
- **reset** — Resets the target (see “reset” on page 230).
- **set_runmode_partner** — Sets or disables a run-mode partner for the current freeze-mode connection or opens the **Set Run-Mode Partner** dialog box (see “set_runmode_partner” on page 230).
- **setup** — Executes a target setup script (see “setup” on page 231).
- **target**, **xmit** — Transmits commands directly to the target debug server, and supplies the debug server with the current task context (see “target, xmit” on page 232).
- **targetinput**, **xmitio** — Feeds a string into target standard input (see “targetinput, xmitio” on page 233).

- **unload** — Unloads programs from the target system's memory (see "unload" on page 233).

change_binding

change_binding bind | unbind

Associates the currently selected executable with a compatible connection, or disassociates the currently selected executable from a connection. If you pass the `bind` option and the executable is only compatible with one connection, it is automatically associated with that connection. If it is compatible with more than one connection, the **Use Which Connection?** dialog box appears. If it is not compatible with any currently available connection, the **Connection Chooser** prompts you to connect to a target.

For more information, see "Associating Your Executable with a Connection" in Chapter 7, "Preparing Your Target" in the *MULTI: Debugging* book.

change_binding `unbind` corresponds to: **Debug → Use Connection → Stop Using Current Connection**

connect

connect *connection_method_name*

connect [setup=*filename* [setupargs=*script_arguments*]] [log[=*filename*]] *debug_server* [*dbserver_arguments*]

connect -restart_runmode

connect log[=*filename*] | nolog

connect

The first three formats of this command connect or reconnect to a target (a simulator, emulator, monitor, or OS, for example). You must connect to a target before you can perform certain MULTI Debugger operations.

The fourth format of the command starts or stops the logging of transactions between MULTI and the debug server.

The fifth format of the command opens the **Connection Chooser**.

The argument for the first format of this command is:

- `connection_method_name` — Specifies the Connection Method that is used to connect to your target. Passing this argument is equivalent to selecting a Connection Method from the **Connection Chooser's** drop-down list.

Arguments for the second format of this command, which is equivalent to creating a Custom Connection Method in the **Connection Chooser**, are:

- `setup=filename` — Specifies the target setup script. The commands in the specified file will be run before downloading is performed. This argument is optional because not all targets require setup scripts.

  The `setup=` option can be used to specify **.mbs**, **.py**, and **.gpy** setup scripts. For more information about setup scripts, see Chapter 6, “Configuring Your Target Hardware” in the *MULTI: Debugging* book.
- `setupargs=script_arguments` — Specifies one or more script arguments to the target setup script `filename` (above). If `script_arguments` contains spaces, enclose the argument string in double quotation marks (`"string with spaces"`).

  At present, only **.py** and **.gpy** Python setup scripts can accept arguments.
- `log[=filename]` — Specifies that transactions between MULTI and the debug server should be logged and sent to standard error or, if specified, to the file `filename`.
- `debug_server` — Specifies the debug server to use to connect to the target. A debug server is a program that controls the target device and must be designed for the hardware debugging interface you are using (if any) and the target CPU for which you are compiling your program.
- `dbserver_arguments` — Specify debug-server-specific options. For supported options for:
  - INTEGRITY run-mode target connections, see Chapter 4, “INDRT2 (rtserv2) Connections” in the *MULTI: Debugging* book or Chapter 5, “INDRT (rtserv) Connections” in the *MULTI: Debugging* book.
  - Green Hills Probe or SuperTrace Probe target connections, see the *Green Hills Debug Probes User's Guide*.

- ◦ Other target connections, see the *MULTI: Configuring Connections* book for your processor family.

If specified, the `setup`, `setupargs`, and `log` options must appear before *`debug_server`*.

Note

If the string of arguments to the **connect** command follows the first or second format of this command, MULTI first attempts to exactly match the string to the name of a Connection Method. If MULTI does not find an exact match, it interprets the string as the name of a target debug server and as setup and debug server options (if specified).

Note

The Debugger ignores the deprecated `mode` argument in connections that specify it. Even for connections that do not explicitly include this argument, the Debugger may print a message stating that the `mode` argument is deprecated. This occurs if the `mode` argument has been associated with a MULTI 4 Connection Method whose name matches the arguments of the **connect** command you entered. To remove the `mode` argument from the Connection Method, edit and save the Connection Method in MULTI 6. For more information, see “Updating MULTI 4 Target Connections” in Chapter 7, “Preparing Your Target” in the *MULTI: Debugging* book.

Arguments for the third and fourth formats of this command are:

- `-restart_runmode` — Attempts to reconnect to your last run-mode partner connection, which can be useful for reestablishing lost run-mode partner connections. This option is only meaningful if you have established a run-mode partner during the current debugging session, and you are eligible to connect to it (that is, you are using a freeze-mode connection, your program is running on the target, and the target supports a run-mode partner). For information about run-mode partners, see “Automatically Establishing Run-Mode Connections” in Chapter 4, “INDRT2 (rtserv2) Connections” in the *MULTI: Debugging* book.

  See also “set_runmode_partner” on page 230.

- `log[=`*`filename`*`]` — Starts transaction logging between MULTI and the debug server, and sends the log to standard error or, if specified, to the file *`filename`*.
- `nolog` — Stops transaction logging and closes the log file. This command is only meaningful if you have previously started transaction logging. See the preceding description of `log=`*`filename`*.

Corresponds to: 

Corresponds to: **Target → Connect**

connectionview

connectionview [*connection_file*]

GUI only

Opens the **Connection Organizer** window, which allows you to create, edit, and manage Connection Methods. If no filename is specified, the window opens with the **[User Methods]** connection file displayed. Otherwise, the window opens with the specified file displayed. If the specified file does not exist, it is created.

For more information about the **Connection Organizer**, see “Using the Connection Organizer” in Chapter 3, “Connecting to Your Target” in the *MULTI: Debugging* book.

Corresponds to: **Target → Show Connection Organizer**

disconnect

disconnect

Closes an existing connection to a target.

Corresponds to: 

Corresponds to: **Target → Disconnect from Target**

iobuffer

iobuffer { on | off }

GUI only

Disables or enables buffering for the current connection's I/O pane. Buffering is enabled by default. If buffering is enabled (on), input to the I/O pane is not sent to the target until a newline character is encountered in the input stream. If buffering is disabled (off), every character is sent to the target as soon as it is typed. Disabling the buffering in MULTI may cause problems on some targets if they expect input to be buffered.

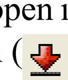
Corresponds to: **Target → IO Buffering**

load

load [-setup | -nosetup] [*filename*]

Downloads the current executable to the target's memory. This may take a long time, depending on the size of the program. After being loaded, the program is not started automatically. Whether the `.bss` section is cleared depends on the debug server.

If `-nosetup` is specified, the Debugger loads the program without running the setup script. The `-setup` option is the default and causes the Debugger to run the setup script specified in the **connect** command before loading the program (see “connect” on page 223). The **setup** command allows you to execute the setup script without loading a program (see “setup” on page 231).

If you specify *`filename`* when connected to a hardware target, the named file will be downloaded to the target's memory without changing the image that is currently open in the Debugger. Use this option with extreme caution. MULTI will assume that the named file contains an adequate subset of the image that is open in the Debugger, and will attempt to execute and debug it as such, without attempting to download the current image as well. Ordinarily, if you want to change which executable you are debugging, you should issue a **debug** command to change the image that is open in the Debugger (see “debug” on page 20), then click the **Prepare Target** button () to download it.

The filename you specify will be searched for using the default search path. See “Default Search Path for Files Specified in Commands” on page 14.

This command behaves specially on a run-mode connection to an INTEGRITY target. You should specify the filename of an INTEGRITY application. The setup script will not be executed, and you should not pass the `-setup` or `-nosetup` options. Loading applications on INTEGRITY is only supported if the target supports and was configured with a dynamic loader (for example, the LoaderTask). Whether the program is started automatically depends on the `StartIt` settings in the Integrate configuration file for the application.

Some targets support interruptible downloads. To interrupt a download in progress, press **Esc**.

See also “prepare_target” on page 228.

prepare_target

prepare_target [-ask | -flash | -load | -verify=sparse | -verify=complete | -verify=none] [-allcores | -onecore] [-save | -nosave]

Prepares the target by downloading, flashing, or verifying one or more executables, or opens the **Prepare Target** dialog box so that you can specify a download, flash, or verify operation. Available options are:

- `-ask` — Opens the **Prepare Target** dialog box.
- `-flash` — Programs the currently selected executable to flash ROM as with the **flash gui** command (see “flash” on page 120).
- `-load` — Downloads the currently selected executable to RAM as with the **load** command (see “load” on page 227).
- `-verify=sparse` — Checks to ensure that the contents of target memory match the file contents of the currently selected executable. As with the **verify -sparse -all** command (see “verify” on page 129), MULTI verifies a few bytes at the beginning, middle, and end of all downloaded non-data sections that cannot be written to.
- `-verify=complete` — Checks to ensure that the contents of target memory match the file contents of the currently selected executable. As with the **verify**

-all command (see “verify” on page 129), MULTI verifies in entirety all downloaded non-data sections that cannot be written to.

- `-verify=none` — Specifies that the currently selected executable is already present in your target's memory and that MULTI should assume, but not verify that the contents of target memory match the contents of the executable program file.
- `-allcores` — Specifies that when you download, flash, or verify the currently selected executable on the core it is associated with, each remaining core of your multi-core target is automatically prepared as if you had run `prepare_target -verify=none` on the executable associated with it. This option has the same effect as setting the **prepareAllCores** configuration option to `on`. See the **prepareAllCores** option in “Other Debugger Configuration Options” in Chapter 8, “Configuration Options” in the *MULTI: Managing Projects and Configuring the IDE* book.
- `-onecore` — Specifies that when you download, flash, or verify the currently selected executable on the core it is associated with, executables associated with the remaining cores of your multi-core target are ignored. This option has the same effect as setting the **prepareAllCores** configuration option to `off`.
- `-save` — Automatically uses these settings the next time you:
  - Pass this command without options or
  - Click the **Prepare Target** button ()

  for the currently selected executable.
- `-nosave` — Does not automatically use these settings (see `-save` above). Instead, MULTI opens the **Prepare Target** dialog box.

If you do not specify any options, MULTI either performs the operation(s) last executed when the executable was selected, performs a default operation (based on the type of program you are debugging), or opens the **Prepare Target** dialog box to receive input.

Regardless of the option you specify, MULTI opens the **Prepare Target** dialog box if input is required.

This command may not be available for use with relocatable modules.

For more information, see “Preparing Your Target” in Chapter 7, “Preparing Your Target” in the *MULTI: Debugging* book.

Corresponds to: 

Corresponds to: **Debug → Prepare Target**

reset

reset [halt | run | hold]

Resets the target, where:

- `halt` — Causes the Debugger to wait for the target to halt and leaves the target in the halted state after reset. This is the default behavior if you do not specify any option to the **reset** command. To stop waiting and to abort the command, press **Esc**.
- `run` — Runs the target after performing the reset. This option also disables all hardware breakpoints.
- `hold` — Causes the target to keep asserting the reset signal.

This command is only available for hardware targets, and not every target supports all types of reset. Some targets may need to emulate the **halt** or **run** behaviors (for example, by performing the reset and then performing either the halt or run action immediately thereafter).

Corresponds to: 

set_runmode_partner

set_runmode_partner [-none | -auto | -reset | *Connection_Method_name*]

Sets or disables a run-mode partner for the current freeze-mode connection or opens the **Set Run-Mode Partner** dialog box so you can change the setting via the GUI. For information about run-mode partners, see “Automatically Establishing Run-Mode Connections” in Chapter 4, “INDRT2 (rtserv2) Connections” in the *MULTI: Debugging* book.

Available options are:

- `-none` — Disables the run-mode partner functionality for the current freeze-mode connection.
- `-auto` — Specifies that the operating system should attempt to tell the Debugger what address and method to use to establish a run-mode connection to the target. This option is only supported with certain operating systems (such as INTEGRITY version 10 and later).
- `-reset` — Resets the run-mode partner setting to the default, unset state.
- *`Connection_Method_name`* — Sets *`Connection_Method_name`* as the run-mode partner. If *`Connection_Method_name`* does not exist when the Debugger tries to initialize the run-mode partner, an error is printed.

If you do not specify any options, the **Set Run-Mode Partner** dialog box is displayed. See “The Set Run-Mode Partner Dialog Box” in Chapter 4, “INDRT2 (rtserv2) Connections” in the *MULTI: Debugging* book.

See also the **-restart_runmode** option in “connect” on page 223.

setup

setup [-first] [-args *script_arguments*] [*script_filename*]

Executes a target setup script, where:

- `-first` — Treats the setup script as if it has never been executed on the target. This option clears the `_ALREADY_SETUP_ONCE` system variable. Whether or not this affects the execution of your setup script depends on the setup script itself.
- `-args` *`script_arguments`* — Specifies script arguments to the target setup script. At present, only Python setup scripts can accept arguments.
- *`script_filename`* — Specifies the target setup script to be executed. If you do not specify *`script_filename`*, the target setup script associated with the debug connection is executed.

To interrupt this command, press **Esc**.

Note

The **setup** command is not supported with legacy (**.dbs**) scripts. Use the command **target script *script_filename*** instead (see “target, xmit” on page 232).

See also “connect” on page 223 and “load” on page 227.

target, xmit

target [/NoRmtMsg] *string*

xmit [/NoRmtMsg] *string*

Transmits commands directly to the target debug server, and supplies the debug server with the current task context. You can change the current task context with the **route** command (see “route” on page 181).

Using the **target** or **xmit** command is equivalent to entering *`string`* in the Debugger target pane, where *`string`* is one or more supported debug server commands.

In GUI mode, the first message from the target (while it executes the *`string`* commands) will be printed in the current Debugger window's command pane by default. The `/NoRmtMsg` option directs MULTI to print the message in the target pane instead.

For a list of commands that can be passed to your debug server (if any), see the *MULTI: Configuring Connections* book for your target processor family.

Note

The Debugger cannot predict the effect of a **target** or **xmit** command. If the command changes the state of the target, you may have to take corrective action to cause the new state of the target to be reflected in the Debugger. For example, you may need to issue the **halt** or **update** command after the **target** or **xmit** command completes. See “halt” on page 152 and “update” on page 275.

targetinput, xmitio

targetinput [input_string_to_target]

xmitio [input_string_to_target]

Feeds a string into the target standard input. The input string can be a plain string or be enclosed in double quotation marks. Special characters can be sent in an escape sequence that begins with a backslash (\), as in `C`. For example, a new line can be sent with the sequence: `\n`.

The **targetinput** and **xmitio** commands are subject to the same limitations as the Debugger's **I/O** pane. For more information, see "The I/O Pane" in Chapter 2, "The Main Debugger Window" in the *MULTI: Debugging* book.

unload

unload [-filedialog | *filename*]

Unloads programs from the target system's memory. If *`filename`* is specified (for example, `unload a.out`) and it matches a program on the target, the given file is unloaded. If *`filename`* is not specified, a dialog box appears with a list of programs that can be unloaded from the target.

If `-filedialog` is specified, a file chooser appears. The chosen file is unloaded from the target if it is already loaded.

This command is only supported on INTEGRITY and VxWorks run-mode connections.

Serial Connection Commands

The commands in this section allow you to control MULTI's serial terminal emulator (**MTerminal**). For more information, see Chapter 27, "Establishing Serial Connections" in the *MULTI: Debugging* book.

The following list provides a brief description of each serial connection command. For a command's arguments and for more information, see the page referenced.

- **serialconnect** — Establishes a connection to a serial port (see “serialconnect” on page 234).
- **serialdisconnect** — Terminates a previously established serial connection (see “serialdisconnect” on page 234).

serialconnect

serialconnect *port_name* [-baud *baudrate*] [-databits *DB*] [-parity *P*] [-stopbits *SB*] [-flowcontrol *FC*]

Establishes a connection to a serial port, where:

- `port_name` — Specifies which serial port is being used (for instance, `ttya`, `ttyS0`, or `COM1`).
- `-baud baudrate` — Specifies the baud rate, where `baudrate` can be any one of the following: `50`, `75`, `110`, `134`, `150`, `200`, `300`, `600`, `1200`, `1800`, `2400`, `4800`, `9600`, `19200`, `38400`, `57600`, `115200`, or `230400`. The default is `9600`.
- `-databits DB` — Specifies the data bits, where `DB` can be `5`, `6`, `7`, or `8`. The default is `8`.
- `-parity P` — Specifies parity, where `P` can be `none`, `even`, or `odd`. The default is `none`.
- `-stopbits SB` — Specifies stop bits, where `SB` can be either `1` or `2`. The default is `1`.
- `-flowcontrol FC` — Specifies flow control, where `FC` can be `none` or `xonxoff`. The default is `none`.

Corresponds to: **Tools → Serial Terminal → Make Serial Connection**

serialdisconnect

serialdisconnect

Terminates a previously established serial connection.

Corresponds to: **Tools → Serial Terminal → Disconnect from Serial**

Chapter 18

Task Group Command Reference

Contents

The commands in this chapter allow you to operate on task groups. Task groups allow you to organize tasks, making it easier to work with multiple tasks simultaneously. For information about task groups, see “Working with Task Groups in the Task Manager” in Chapter 25, “Run-Mode Debugging” in the *MULTI: Debugging* book.

Note

For these commands to work properly, the Task Manager must be open. For information about opening the Task Manager, see “The Task Manager” in Chapter 25, “Run-Mode Debugging” in the *MULTI: Debugging* book.

Task Group Commands

The following list provides a brief description of each task group command. For a command's arguments and for more information, see the page referenced.

- **changegroup** — Adds tasks to a task group or removes tasks from a task group (see “changegroup” on page 237).
- **creategroup** — Creates a task group (see “creategroup” on page 238).
- **destroygroup** — Destroys the specified task groups (see “destroygroup” on page 239).
- **groupaction** — Runs, halts, or single-steps all tasks that belong to the specified task groups (see “groupaction” on page 239).
- **listgroup** — Lists task groups (see “listgroup” on page 240).
- **setsync** — Sets task groups to which the same run, halt, or step operation will be synchronously applied when you run, halt, or step the current task (see “setsync” on page 240).
- **showsync** — Shows the task groups for a synchronous operation performed on a task in the current Debugger window, or shows the task group setting for all supported synchronous operations (see “showsync” on page 241).

changegroup

changegroup -add | -del @*task_group* [-addressSpace *AddressSpace_name*] [-taskname] *task_name*[, *task_name*]... | [-taskid] *task_id*[, *task_id*]...

GUI only

Adds tasks to a task group or removes tasks from a task group, where:

- `-add` — Adds the specified tasks into the specified task group.
- `-del` — Deletes the specified tasks from the specified task group.
- `@`*`task_group`* — Specifies the task group that tasks should be added to or deleted from. If *`task_group`* contains spaces, enclose it in quotation marks.
- `-addressSpace` *`AddressSpace_name`* — Specifies the INTEGRITY AddressSpace where the tasks are located. You only need to give the AddressSpace if you specify task names that are not unique. On INTEGRITY, every task ID is unique.
- `[-taskname]` *`task_name`*`[,` *`task_name`*`]...` — Specifies the tasks to operate on by task name.
- `[-taskid]` *`task_id`*`[,` *`task_id`*`]...` — Specifies the tasks to operate on by task ID.

If you do not specify `-taskname` or `-taskid`, MULTI treats numeric values as task IDs and other values as task names.

You can add/delete multiple tasks from the same AddressSpace or add/delete tasks from multiple AddressSpaces. If you want to operate on tasks from multiple AddressSpaces and the tasks share the same name, format the command as shown below:

```
> changegroup -add @"My Group" -addressSpace AddressSpace1 \
Initial -addressSpace AddressSpace2 Initial
```

For information about task groups, see “Working with Task Groups in the Task Manager” in Chapter 25, “Run-Mode Debugging” in the *MULTI: Debugging* book.

Note

The Task Manager must be open when you execute this command.

creategroup

creategroup *@task_group* [-addressSpace *AddressSpace_name*] [-taskname] *task_name*[, *task_name*]... | [-taskid] *task_id*[, *task_id*]...

GUI only

Creates a task group, where:

- `@task_group` — Specifies the task group name. If `task_group` contains spaces, enclose it in quotation marks.
- `-addressSpace AddressSpace_name` — Specifies the INTEGRITY AddressSpace where the tasks are located. You only need to give the AddressSpace if you specify task names that are not unique. On INTEGRITY, every task ID is unique.
- `[-taskname] task_name[, task_name]...` — Specifies the names of tasks you want to add to the task group.
- `[-taskid] task_id[, task_id]...` — Specifies the IDs of tasks you want to add to the task group.

If you do not specify `-taskname` or `-taskid`, MULTI treats numeric values as task IDs and other values as task names.

You can add multiple tasks from the same AddressSpace or add tasks from multiple AddressSpaces. If you want to add tasks from multiple AddressSpaces and the tasks share the same name, format the command as shown below:

```
> creategroup @"My Group" -addressSpace AddressSpace1 Initial \
-addressSpace AddressSpace2 Initial
```

For information about task groups, see “Working with Task Groups in the Task Manager” in Chapter 25, “Run-Mode Debugging” in the *MULTI: Debugging* book.

Note

The Task Manager must be open when you execute this command.

destroygroup

destroygroup *@task_group1* [, *@task_group2*]...

GUI only

Destroys the specified task groups. If there are spaces in a task group name, enclose it in quotation marks.

For information about task groups, see “Working with Task Groups in the Task Manager” in Chapter 25, “Run-Mode Debugging” in the *MULTI: Debugging* book.

Note

The Task Manager must be open when you execute this command.

groupaction

groupaction -r|-h|-s *@task_group* [, *@task_group*]...

GUI only

Runs (`-r`), halts (`-h`), or single-steps (`-s`) all tasks that belong to the specified task groups. If *`task_group`* contains spaces, enclose it in quotation marks.

As long as the target operating system supports task groups, these actions will be performed on the individual tasks synchronously. If an operating system does not support task groups, MULTI will send out separate commands to each task in the task group. In this case, the latency time for the operations on different tasks will be unpredictable, depending on various factors such as network traffic, the RTOS debug agent's status, and the target's speed. For more information, see “Synchronous Operations” in Chapter 25, “Run-Mode Debugging” in the *MULTI: Debugging* book.

For information about task groups, see “Working with Task Groups in the Task Manager” in Chapter 25, “Run-Mode Debugging” in the *MULTI: Debugging* book. For information about using this command in a freeze-mode environment, see “Synchronous Run Control” in Chapter 26, “Freeze-Mode Debugging and OS-Awareness” in the *MULTI: Debugging* book.

Note

The Task Manager must be open when you execute this command.

listgroup

listgroup [-d] [@*task_group1* [, @*task_group2*]...]

GUI only

Lists task groups. If you do not specify any arguments, all existing task groups are listed. If you specify `-d`, MULTI lists detailed information about the task groups. Specify one or more task groups to see information only about those task groups. If there are spaces in a task group name, enclose it in quotation marks.

For information about task groups, see “Working with Task Groups in the Task Manager” in Chapter 25, “Run-Mode Debugging” in the *MULTI: Debugging* book.

Note

The Task Manager must be open when you execute this command.

setsync

setsync -r|-h|-s [@*task_group* [, @*task_group*]...]

GUI only

Sets task groups to which the same run (`-r`), halt (`-h`), or step (`-s`) operation is synchronously applied when you run, halt, or step the current task. If *`task_group`* contains spaces, enclose it in quotation marks. If no task group is specified, MULTI clears the setting for the corresponding operation.

Synchronous execution information is persistent within and across debugging sessions while you are performing run-mode debugging. Whenever you attach to a task, the corresponding setting is automatically restored.

To avoid complexity and prevent recursion, MULTI does not nest synchronous trigger operations. For example, suppose task `T1` and task `T2` are specified to synchronously run task group `G1` and `G2`, respectively. Further suppose that task group `G1` contains task `T2`, and task group `G2` contains task `T1`. If task `T1` is run, MULTI synchronously runs the tasks in task group `G1`, thereby causing task `T2` (which is included in `G1`) to run. When task `T2` is run, however, MULTI does not run (synchronously or otherwise) task group `G2`.

For information about task groups, see “Working with Task Groups in the Task Manager” in Chapter 25, “Run-Mode Debugging” in the *MULTI: Debugging* book.

Note

The Task Manager must be open when you execute this command.

See also “showsync” on page 241.

showsync

showsync [-r|-h|-s]

GUI only

If an operation is specified, the command shows the task groups for the synchronous operation for the task currently selected in the target list. If no argument is specified, it shows the task group settings for all supported synchronous operations.

For information about task groups, see “Working with Task Groups in the Task Manager” in Chapter 25, “Run-Mode Debugging” in the *MULTI: Debugging* book.

Note

The Task Manager must be open when you execute this command.

See also “setsync” on page 240.

Chapter 19

Trace Command Reference

Contents

The commands in this chapter allow you to collect, analyze, and save trace data. For information about trace, see Part IV, "TimeMachine Debugging" in the *MULTI: Debugging* book.

Trace Commands

The following list provides a brief description of each trace command. For a command's arguments and for more information, see the page referenced.

- **timemachine** — Enables or disables TimeMachine, or launches Separate Session TimeMachine (see "timemachine" on page 245).
- **trace** — Starts a new trace session or modifies an existing trace session (see "trace" on page 246).
- **tracebrowse** — Launches a trace browser for the specified address expression (see "tracebrowse" on page 250).
- **tracedata** — Configures trace so that the trace trigger occurs when the specified data address is read from or written to (see "tracedata" on page 250).
- **tracefunction** — Configures trace so that trace data is only collected when the process is executing the specified function (see "tracefunction" on page 251).
- **traceline** — Configures trace so that the trace trigger occurs when the specified address is executed (see "traceline" on page 251).
- **traceload** — Loads the previously saved trace session file you specify (see "traceload" on page 251).
- **tracemevsys** — Generates an EventAnalyzer log from the current trace data and opens the **EventAnalyzer** on the information (see "tracemevsys" on page 252).
- **tracepath** — Generates path analysis information from the current trace data and opens a **PathAnalyzer** window on the information (see "tracepath" on page 252).
- **tracepro** — Generates profiling information from the current trace data and opens a **Profile** window on the information (see "tracepro" on page 253).
- **tracesave** — Saves the trace session to the specified file (see "tracesave" on page 253).

- **tracesavetext** — Saves the currently retrieved trace data to the specified text file (see “tracesavetext” on page 254).
- **tracesubfunction** — Configures trace so that trace data is only collected when the process is executing an address within the specified function or when the process is executing a callee of the specified function (see “tracesubfunction” on page 254).

timemachine

timemachine [-newsession | -ns] [-tid *task_ID* | -as_name *AddressSpace*]

GUI only

Enables or disables TimeMachine for the specified item, or launches Separate Session TimeMachine on the specified item. Available arguments are:

- `-newsession` and `-ns` — Launch Separate Session TimeMachine on the item currently selected in the target list or the item specified by `-tid` or `-as_name`. The `-newsession` and `-ns` options function identically. For information about Separate Session TimeMachine, see “Using Separate Session TimeMachine” in Chapter 19, “Analyzing Trace Data with the TimeMachine Tool Suite” in the *MULTI: Debugging* book.
- `-tid` — Enables/disables TimeMachine for the task with the specified *`task_ID`*.
- `-as_name` — Enables/disables TimeMachine for the specified *`AddressSpace`*.

If no arguments are given, TimeMachine is enabled/disabled for the item currently selected in the target list.

For this command to be valid, you must be connected to a target that supports trace and you must have collected trace data. If trace data has been collected but not retrieved, it is automatically retrieved before TimeMachine is enabled.

For more information about TimeMachine, see “The TimeMachine Debugger” in Chapter 19, “Analyzing Trace Data with the TimeMachine Tool Suite” in the *MULTI: Debugging* book.

Corresponds to: 

Corresponds to: **TimeMachine → TimeMachine Debugger**

trace

trace [abort] [bookmarks] [clear] [close] [config=*filename*] [disable | enable] [history - | history +] [list] [options] [path] [pro | profiler] [reg | register] [retrieve [-all]] [set [*option* [*value*]]] [stats] [sync[on | off]] [toggle] [triggers] [updateosa] [api *application_name* [*application_arguments*...]]

Starts a new trace session or modifies an existing trace session.

The available arguments are:

- `abort` — Aborts the retrieval of trace data. This option corresponds to **TimeMachine → Abort Trace Retrieval**.
- `bookmarks` — Opens the **Trace Bookmarks** window. For more information, see "Bookmarking Trace Data" in Chapter 19, "Analyzing Trace Data with the TimeMachine Tool Suite" in the *MULTI: Debugging* book.
- `clear` — Clears all current trace data on the host, trace probe, and target. This option corresponds to **TimeMachine → Clear Data**.
- `close` — Clears trace data and closes all windows associated with trace. This argument overrides other specified options.
- `config=`*`filename`* — Specifies the name of a saved trace configuration file to load.
- `disable` — Stops trace collection and retrieves trace data. This option corresponds to **TimeMachine → Disable Trace**.
- `enable` — Starts trace collection and clears any previously collected data on the target. Data that has already been retrieved is not cleared, but if trace retrieval is currently in progress, it is aborted. This option corresponds to **TimeMachine → Enable Trace**.
- `history -` — Returns to the previous location in the trace navigation history. This can be useful if you want to undo an action (such as running backwards in the TimeMachine Debugger) that brought you to an unexpected location in your source code.

  The **trace history -** command corresponds to  (see "Pre-Defined Buttons" in Appendix A, "Debugger GUI Reference" in the *MULTI: Debugging* book).

- `history +` — Returns to the next location in the trace navigation history. This option is only meaningful if you have previously issued the **trace history -** command (described above).

  The **trace history +** command corresponds to  (see “Pre-Defined Buttons” in Appendix A, “Debugger GUI Reference” in the *MULTI: Debugging* book).
- `list` — Opens the Trace List. For more information, see “Viewing Trace Data in the Trace List” in Chapter 19, “Analyzing Trace Data with the TimeMachine Tool Suite” in the *MULTI: Debugging* book. This option corresponds to **TimeMachine** → **Trace List**.
- `options` — Opens the **Trace Options** dialog box, which allows you to modify options related to trace data collection and display. For more information, see “The Trace Options Window” in Chapter 20, “Advanced Trace Configuration” in the *MULTI: Debugging* book. This option corresponds to **TimeMachine** → **Trace Options**.
- `path` — Opens the **PathAnalyzer**. For more information, see “The PathAnalyzer” in Chapter 19, “Analyzing Trace Data with the TimeMachine Tool Suite” in the *MULTI: Debugging* book. This option corresponds to **TimeMachine** → **PathAnalyzer**.
- `pro` or `profiler` — Generates profiling data from the current trace data and opens a **Profile** window on the information. The **trace pro[filer]** command functions identically to the **tracepro** command (see “tracepro” on page 253). For more information, see “Using Trace Data to Profile Your Target” in Chapter 19, “Analyzing Trace Data with the TimeMachine Tool Suite” in the *MULTI: Debugging* book. This option corresponds to **TimeMachine** → **Profile**.
- `reg` or `register` — Opens the **Reconstructed Registers** window. The `reg` and `register` options function identically. For more information, see “Viewing Reconstructed Register Values” in Chapter 19, “Analyzing Trace Data with the TimeMachine Tool Suite” in the *MULTI: Debugging* book.
- `retrieve` — Retrieves trace data from the trace probe or target.

  With SuperTrace Probe v3 targets, this either retrieves the amount of data set by the **Target buffer size** option, or it retrieves twice as much data as has already been retrieved. In the latter case, all previously retrieved trace data is cleared from the tools and then retrieved again from the probe. For more information, see “Retrieving Trace Data from a SuperTrace Probe v3” in

Chapter 19, “Analyzing Trace Data with the TimeMachine Tool Suite” in the *MULTI: Debugging* book.

With all other targets, all trace data is always retrieved.

This option corresponds to **TimeMachine → Retrieve Trace**.

- `retrieve -all` — Retrieves all collected data from the SuperTrace Probe v3. Prior to retrieving the data, all trace data in the tools is cleared. For more information, see “Retrieving Trace Data from a SuperTrace Probe v3” in Chapter 19, “Analyzing Trace Data with the TimeMachine Tool Suite” in the *MULTI: Debugging* book.
- `set [`*`option`*`]` — Lists all available target-specific trace options and their current values, or lists only the target-specific option *`option`* and its current value. For information about options, see the documentation about target-specific trace options in the *Green Hills Debug Probes User's Guide* or, if you are using a V850 target, the documentation about V850 trace options in the *MULTI: Configuring Connections* book.
- `set` *`option value`* — Sets the target-specific trace option *option* to *value*. For information about options, see the documentation about target-specific trace options in the *Green Hills Debug Probes User's Guide* or, if you are using a V850 target, the documentation about V850 trace options in the *MULTI: Configuring Connections* book. You can also set target-specific trace options in the **Trace Options** window. For information about this window, see “The Trace Options Window” in Chapter 20, “Advanced Trace Configuration” in the *MULTI: Debugging* book.
- `stats` — Opens the **Trace Statistics** window. For more information, see “Viewing Trace Statistics” in Chapter 19, “Analyzing Trace Data with the TimeMachine Tool Suite” in the *MULTI: Debugging* book. This option corresponds to **TimeMachine → Trace Statistics**.
- `sync` — Prints the status of packet selection synchronization. See the description of `sync on`.
- `sync on` — Enables cross-core synchronization of trace packets based on time. This option is only supported on targets that support multi-core trace. If you attempt to enable trace synchronization on a target that does not support it, the message `Unable to set synchronizer state` is printed. For more information, see “Using Trace Tools on a Multi-Core Target” in Chapter 26,

"Freeze-Mode Debugging and OS-Awareness" in the *MULTI: Debugging* book.

- `sync off` — Disables cross-core synchronization of trace packets. This is the default.
- `toggle` — Toggles collection of trace data. This argument overrides other specified options.
- `triggers` — Opens the **Set Triggers** window, which allows you to specify triggers and other trace events. For more information, see "The Set Triggers Window" in Chapter 20, "Advanced Trace Configuration" in the *MULTI: Debugging* book. This option corresponds to **TimeMachine → Set Triggers**.
- `updateosa` — Refreshes the OSA data used for task-aware trace of an operating system. This argument is intended to be used when the **Assume static OSA** trace option is enabled. It is useful for forcing an update of OSA data when the set of tasks in the system has reached a static state. It can also be useful for refreshing data after the state of the system has been changed, for example, by downloading an application using a run-mode debug server such as **rtserv** or **rtserv2**. For more information, see the **Assume static OSA** option in "The Trace Options Window" in Chapter 20, "Advanced Trace Configuration" in the *MULTI: Debugging* book.
- `api` *`application_name`* `[`*`application_arguments`*`...]` — Launches a C/C++ application or a Python script that uses the live TimeMachine interface. You may optionally supply one or more *`application_arguments`*. All arguments passed after *`application_name`* are treated as application arguments, not as arguments to the **trace** command. For more information, see "The TimeMachine API" in Chapter 19, "Analyzing Trace Data with the TimeMachine Tool Suite" in the *MULTI: Debugging* book.

Note

The `toggle` and `close` arguments override other specified options.

tracebrowse

tracebrowse [-*line*] [*address_expression*]

GUI only

Launches a trace browser for the specified address expression. If the address expression refers to a data address, a **Trace Memory Browser** will be launched to display reads and writes to the address. If the address expression refers to a function, a **Trace Call Browser** will be launched to display the call sites of the function. If `-line` is specified, *`address_expression`* refers to a line number in the current procedure. In this case, a **Trace Instruction Browser** will be launched to display the executions of that particular line. If no address is specified, the current function is displayed in the **Trace Call Browser**.

For more information about the trace browsers, see “Browsing Trace Data” in Chapter 19, “Analyzing Trace Data with the TimeMachine Tool Suite” in the *MULTI: Debugging* book.

Trace data must be collected before this command can be used.

tracedata

tracedata [*address_expression*]

Configures trace so that the trace trigger occurs when the data address specified by *`address_expression`* is read from or written to. Using this command overwrites any triggers or trace events that were previously set.

On INTEGRITY, you can only use this command to set the trigger in the kernel AddressSpace.

For information about triggers, see “Configuring Trace Collection” in Chapter 20, “Advanced Trace Configuration” in the *MULTI: Debugging* book.

tracefunction

tracefunction [*address_expression*]

Configures trace so that trace data is only collected when the process is executing the function specified by `address_expression`. To collect trace data for both the specified function and its callees, use the **tracesubfunction** command (see “tracesubfunction” on page 254).

Using this command overwrites any triggers or trace events that were previously set.

On INTEGRITY, you can only use this command to configure trace collection in the kernel AddressSpace.

For more information, see “Configuring Trace Collection” in Chapter 20, “Advanced Trace Configuration” in the *MULTI: Debugging* book.

traceline

traceline [*address_expression*]

Configures trace so that the trace trigger occurs when the address specified by `address_expression` is executed. If no address is specified, the currently selected line is used. Using this command overwrites any triggers or trace events that were previously set.

On INTEGRITY, you can only use this command to set the trigger in the kernel AddressSpace.

For information about triggers, see “Configuring Trace Collection” in Chapter 20, “Advanced Trace Configuration” in the *MULTI: Debugging* book.

traceload

traceload [*filename*]

Loads the previously saved trace session file `filename`. If you do not specify `filename`, you are prompted to make a selection in the file chooser that appears.

If the file was saved without an ELF file and you are using INTEGRITY, you must load the file from the kernel executable. If the file was saved without an ELF file and you are not using INTEGRITY, you can only load the file while debugging the same program you used to gather the trace data. If you have rebuilt the program since you collected the trace data, loading the saved trace data may produce unexpected behavior. See “Saving and Loading a Trace Session” in Chapter 19, “Analyzing Trace Data with the TimeMachine Tool Suite” in the *MULTI: Debugging* book.

tracemevsys

tracemevsys [-file *description_file*] [-no_task_name]

GUI only

Generates an EventAnalyzer log from the current trace data and opens the **EventAnalyzer** on the information. The `description_file` argument must specify a trace system call description file, which is specific to the operating system for which the EventAnalyzer log is being generated.

If the `-no_task_name` option is specified, task names are not read from the target. By default, reading task names is enabled, which halts the target momentarily if the target is not already halted. If this option is specified, the task ID is used as the task name when the **EventAnalyzer** is displayed.

See “Viewing Trace Events in the EventAnalyzer” in Chapter 19, “Analyzing Trace Data with the TimeMachine Tool Suite” in the *MULTI: Debugging* book.

Corresponds to: **TimeMachine → EventAnalyzer**

tracepath

tracepath

GUI only

Generates path analysis information from the current trace data and opens a **PathAnalyzer** window on the information.

See also “The PathAnalyzer” in Chapter 19, “Analyzing Trace Data with the TimeMachine Tool Suite” in the *MULTI: Debugging* book.

Corresponds to: **TimeMachine → PathAnalyzer**

tracepro

tracepro

GUI only

Generates profiling data from the current trace data and opens a **Profile** window on the information. See “Using Trace Data to Profile Your Target” in Chapter 19, “Analyzing Trace Data with the TimeMachine Tool Suite” in the *MULTI: Debugging* book.

Corresponds to: **TimeMachine → Profile**

tracesave

tracesave [--data | -d | --data_elf | -de | --data_elf_debug | -ded | --win | -w] [--scratch_dir=*path* | -s=*path*] [*filename*]

Saves a trace session, where:

- `--data` | `-d` — Saves trace data only (not the ELF file or debug information).
- `--data_elf` | `-de` — Saves the trace data and ELF file only (not the debug information).
- `--data_elf_debug` | `-ded` — [default] Saves the trace data, ELF file, and debug information.
- `--win` | `-w` — Opens a dialog box allowing you to choose what type of information is saved.
- `--scratch_dir=`*path* | `-s=`*path* — Specifies the path to the directory where temporary files created during the process of saving the trace session are stored. By default, they are stored in the directory where the trace session file is created. If there is not enough space on that file system for both the temporary files and the trace session file, use this option to specify an alternative location for the temporary files.

- `filename` — Specifies the file that the trace session is saved to. If you do not specify `filename`, you are prompted to make a selection in the file chooser that appears.

You can load `filename` with the **traceload** command (see “traceload” on page 251).

For more information, see “Saving and Loading a Trace Session” in Chapter 19, “Analyzing Trace Data with the TimeMachine Tool Suite” in the *MULTI: Debugging* book.

tracesavetext

tracesavetext *filename*

Saves the currently retrieved trace data to the text file `filename`. The data is saved in a Comma Separated Value format suitable for analysis by custom scripts.

Tip

The recommended interface for custom trace analysis scripts is the TimeMachine API. It is much more powerful and flexible and enables higher performance custom analysis.

Corresponds to: **File** → **Export As CSV** in the Trace List

tracesubfunction

tracesubfunction [*address_expression*]

Configures trace so that trace data is only collected when the process is executing an address within the function specified by `address_expression` or when the process is executing a callee of the function. To collect trace data for the specified function but not for callees, use the **tracefunction** command (see “tracefunction” on page 251).

Using this command overwrites any triggers or trace events that were previously set.

On INTEGRITY, you can only use this command to configure trace collection in the kernel AddressSpace.

For more information, see “Configuring Trace Collection” in Chapter 20, “Advanced Trace Configuration” in the *MULTI: Debugging* book.

Chapter 20

Tracepoint Command Reference

Contents

The commands in this chapter allow you to manipulate tracepoints. These commands are only available if tracepoints are supported on the currently connected target. For more information about tracepoints, see Chapter 24, “Non-Intrusive Debugging with Tracepoints” in the *MULTI: Debugging* book.

Tracepoint Commands

The following list provides a brief description of each tracepoint command. For a command's arguments and for more information, see the page referenced.

- **edittp** — Opens the **Tracepoint Editor** dialog box, which allows you to edit the tracepoint at the current source line (see “edittp” on page 258).
- **passive** — Toggles passive mode on or off or changes the passive mode password (see “passive” on page 259).
- **tpdel** — Deletes a tracepoint (see “tpdel” on page 259).
- **tpenable** — Enables or disables a tracepoint (see “tpenable” on page 260).
- **tplist** — Lists the current tracepoints (see “tplist” on page 260).
- **tpprint** — Collects the current data buffer from the target and displays the data in the command pane as ASCII text (see “tpprint” on page 261).
- **tppurge** — Clears the tracepoint buffer on the target (see “tppurge” on page 261).
- **tpreset** — Resets the hit count for a tracepoint (see “tpreset” on page 262).
- **tpset** — Sets a tracepoint (see “tpset” on page 262).

edittp

edittp

GUI only

Opens the **Tracepoint Editor** dialog box, which allows you to edit the tracepoint at the current source line. If no tracepoint is set on the current line (as indicated by the blue context arrow), you can use the this dialog to create a new tracepoint. For more information, see “Tracepoint Editor Dialog” in Chapter 24, “Non-Intrusive Debugging with Tracepoints” in the *MULTI: Debugging* book.

passive

passive [on | off]

passive [on | off] *password*

passive password *old_pw new_pw*

passive toggles passive mode on or off. In passive mode, the Debugger rejects invasive debugging that significantly impacts program functionality. Passive mode is not available with all targets.

- `password` — Enter the passive mode password for operating system integrations that require a password.

passive password changes the passive mode password. This use of the **passive** command only has meaning for operating system integrations that support passive mode passwords. The following must be specified immediately after the **passive password** command.

- `old_pw` — Enter the old passive mode password.
- `new_pw` — Enter the new passive mode password.

For more information about passive mode and the **passive** command, see “Debugging in Passive Mode” in Chapter 24, “Non-Intrusive Debugging with Tracepoints” in the *MULTI: Debugging* book.

tpdel

tpdel [*address_expression* | %*id*]

Deletes the tracepoint at the specified `address_expression` or with the specified tracepoint identification number `id`. If no argument is given, the tracepoint at the current line is removed. See also “Deleting a Tracepoint” in Chapter 24, “Non-Intrusive Debugging with Tracepoints” in the *MULTI: Debugging* book.

tpenable

tpenable { true | false } [*address_expression* | %*id*]

Enables or disables the tracepoint at the specified `address_expression` or with the specified tracepoint identification number `id`.

If `false` is specified, the tracepoint will not collect data until the tracepoint is re-enabled. Depending on the target operating system, each time a tracepoint is encountered, even if it is disabled, there may be a small processing overhead. If `true` is specified, the tracepoint will actively collect data.

See also “Enabling or Disabling a Tracepoint” in Chapter 24, “Non-Intrusive Debugging with Tracepoints” in the *MULTI: Debugging* book.

tplist

tplist [verbose | quiet] [refresh]

Lists the current tracepoints (whether enabled or disabled). The information listed includes the tracepoint identification number, the location and address, the “hit count / timeout” threshold, and if available, the number of times the tracepoint has been reached.

If `quiet` (the default) is specified, this command displays the tracepoints in a one-per-line format. If `verbose` is specified, this command displays the data gathering command in addition to the location and type information.

Normally, this command displays the information as of the last time the Debugger contacted the target; however, if `refresh` is specified, the Debugger will contact the target for current information. Note that refreshing the list requires transmitting information from the target and may impact the target's execution. By default, this command does not perform a `refresh`.

A sample output of the **tplist** command might be:

```
> tplist
   0 main#2:    0x101f4 200/400 (argc,argv)
```

This output indicates that a tracepoint with identification number `0` is set at the address `0x101f4` to collect the values of variables `argc` and `argv`. The tracepoint will be disabled by the target if it is hit more than `200` times per `400` time units.

Using the **verbose** option provides additional information about the exact actions the tracepoint will perform. For example:

```
> tplist verbose
   0 main#2:    0x101f4 200/400
  (argc) :  READ_MEM RELATIVE 0001 0000000c 00 04 00000001
  (argv) :  READ_MEM RELATIVE 0001 00000008 00 04 00000001
```

See also “Listing Tracepoints” in Chapter 24, “Non-Intrusive Debugging with Tracepoints” in the *MULTI: Debugging* book.

tpprint

tpprint [*filename*]

Collects the current data buffer from the target and displays the data in the command pane as ASCII text. If *`filename`* is specified, the data will be written to that file instead of being displayed in the command pane. See also “Viewing the Tracepoint Buffer” in Chapter 24, “Non-Intrusive Debugging with Tracepoints” in the *MULTI: Debugging* book.

tppurge

tppurge [all | *size*]

Clears the tracepoint buffer on the target. Normally, the argument `all` should be specified to clear the entire contents of the buffer. To clear a portion of the buffer, specify a size in bytes.

The argument *`size`* must fall on a boundary between entries in the tracepoint buffer. Only sizes displayed by the **tpprint** command should be used (see “tpprint” on page 261).

See also “Purging the Tracepoint Buffer” in Chapter 24, “Non-Intrusive Debugging with Tracepoints” in the *MULTI: Debugging* book.

tpreset

tpreset [*address_expression* | %*id*]

Resets the hit count for the tracepoint at the specified *address_expression* or with the specified tracepoint identification number *id*. If no argument is given, the tracepoint at the current line is reset. See also "Resetting a Tracepoint" in Chapter 24, "Non-Intrusive Debugging with Tracepoints" in the *MULTI: Debugging* book.

tpset

tpset *count* / *timeout* (*variable_list*) [*address_expression*] [[*condition*]]

Sets a tracepoint, where:

- *count* — Specifies a hit count.
- *timeout* — Specifies the timeout threshold. The units of the *timeout* period are determined by the target's implementation of tracepoints.
- (*variable_list*) — Specifies a comma-separated list of variables whose values are collected by the tracepoint. You must enclose the variable list in parentheses.
- *address_expression* — Specifies the location.
- [*condition*] — Specifies a condition, whose interpretation is based on the target's implementation of tracepoints. You must enclose the condition in square brackets.

To reduce performance impact, the target automatically disables tracepoints that are hit more than *count* times per *timeout* time units. If you do not want tracepoints to be automatically disabled, specify `0` for both *count* and *timeout*.

The following example sets a tracepoint that collects the values of `argc` and `argv` at the second source line of `main()`. If the tracepoint is hit more than 200 times per 400 time units, it will be automatically disabled. (The exact length and definition of the time units used by tracepoints is implementation-specific. For more information, consult the documentation for your operating system integration.)

```
> tpset 200/400 (argc,argv) main#2
   0 main#2:    0x101f4 200/400
```

```
(argc) :  READ_MEM RELATIVE 0001 0000000c 00 04 00000001
(argv) :  READ_MEM RELATIVE 0001 00000008 00 04 00000001
```

The output from the **tpset** command describes the actual operations that take place when the tracepoint is triggered. In the above example, the target will read register `0001` and add an offset of `0000000c` when gathering data for the variable `argc`. The target will then read `00000001` blocks of `04` bytes and store that value into the tracepoint buffer.

See also “Setting a Tracepoint” in Chapter 24, “Non-Intrusive Debugging with Tracepoints” in the *MULTI: Debugging* book.

Chapter 21

View Command Reference

Contents

General View Commands

The following list provides a brief description of each general view command. For a command's arguments and for more information, see the page referenced. (Note that complete descriptions for some of these commands are located in other chapters.)

- **bpview**, **breakpoints** — Opens the **Breakpoints** window (see "bpview, breakpoints" on page 43 in Chapter 3, "Breakpoint Command Reference" on page 35).
- **browse** — Opens a browser for the specified object type (see "browse" on page 267).
- **browseref**, **xref** — Displays the specified object's cross references in a Browse window or MULTI's command pane (see "browseref, xref" on page 269).
- **callsview** — Opens the **Call Stack** window, which lists all functions on the call stack (see "callsview" on page 69 in Chapter 5, "Call Stack Command Reference" on page 67).
- **connectionview** — Opens the **Connection Organizer** window, which allows you to create, edit, and manage Connection Methods (see "connectionview" on page 226 in Chapter 17, "Target Connection Command Reference" on page 221).
- **diff** — Opens the **Diff Viewer** on the file currently displayed in the source pane (see "diff" on page 270).
- **edit** — Opens an Editor on the file and line specified (see "edit" on page 270).
- **editview** — Opens a MULTI Editor for the object specified (see "editview" on page 271).
- **heapview** — Opens the **Memory Allocations** window (see "heapview" on page 271).
- **localsview** — Opens a Data Explorer displaying all local variables for the current procedure (see "localsview" on page 272).
- **memview** — Opens a **Memory View** window for displaying and modifying memory contents (see "memview" on page 273).
- **noteview** — Navigates to the location of the specified Debugger Note or opens a Note Browser displaying all Debugger Notes for the program being debugged (see "noteview" on page 92 in Chapter 7, "Debugger Note Command Reference" on page 89).

- **osaview** — Opens the OSA Object Viewer (see “osaview” on page 207 in Chapter 15, “Scripting Command Reference” on page 177).
- **regview** — Opens a **Register View** window displaying all registers, or opens a **Register Information** window displaying the specified register (see “regview” on page 174 in Chapter 6, “Configuration Command Reference” on page 73).
- **showdef** — Searches for a C preprocessor definition for each specified name (see “showdef” on page 273).
- **showhistory** — Displays the specified source file's revision history in the **History Browser** (see “showhistory” on page 274).
- **taskwindow** — Opens the Task Manager in a run-mode debugging environment or displays it in the foreground if it is already open (see “taskwindow” on page 207 in Chapter 15, “Scripting Command Reference” on page 177).
- **top** — Opens a **Process Viewer** window, which displays a snapshot of the processes on your native target (see “top” on page 274).
- **update** — Re-evaluates all currently open Data Explorer and monitor windows, halting the process if necessary to get the updated information (see “update” on page 275).
- **view** — Opens a Data Explorer, a Browse window, or an OSA Object Viewer displaying the specified items (see “view” on page 275).
- **viewdel** — Closes all Data Explorer, Browse, **Register View**, **Memory View**, **Call Stack**, and **Breakpoints** windows (see “viewdel” on page 277).
- **viewlist** — Displays a list of structures in the Data Explorer (see “viewlist” on page 277).
- **window** — Creates, deletes, lists, or changes the contents of a monitor window (see “window” on page 278).

browse

browse [*object_type*]

GUI only

Opens a browser for `object_type`. The following list describes available `object_types`, of which you may specify only one. If no argument is given, `procs` is assumed. Passing an unknown object causes a Data Explorer to be opened on the object.

- `files|filelist` — Opens a Browse window listing all files in the program. See “Browsing Source Files” in Chapter 12, “Browsing Program Elements” in the *MULTI: Debugging* book.
- `procs|procedures` — Opens a Browse window listing all procedures in the program. See “Browsing Procedures” in Chapter 12, “Browsing Program Elements” in the *MULTI: Debugging* book.
- `global|globals` — Opens a Browse window listing all the global variables in the program. See “Browsing Global Variables” in Chapter 12, “Browsing Program Elements” in the *MULTI: Debugging* book.
- `types` — Opens a Browse window displaying all structs, classes, and unions used in the program. See “Browsing Data Types” in Chapter 12, “Browsing Program Elements” in the *MULTI: Debugging* book.
- *`file`* — Opens a Browse window listing all the procedures in the file *`file`*.
- `includes [`*`file`*` | all]` — Opens a Graph View window that displays an include file dependency graph. If you specify *`file`*, the graph is centered on the given file. If you specify `all`, the entire program's include file dependency graph is shown (note that this may be very large for many programs). If you do not specify either of these options, the graph is centered on the current file being viewed in the source pane. See “Browsing Includes” in Chapter 12, “Browsing Program Elements” in the *MULTI: Debugging* book.
- `classes` — Opens a Tree Browser for classes. See “Browsing Classes” in Chapter 12, “Browsing Program Elements” in the *MULTI: Debugging* book.
- *`class`* — Opens a Data Explorer listing data members and functions of the class *`class`*.
- `caller [`*`procedure`*`]` — Opens a Browse window displaying the callers of the procedure *`procedure`*, if specified. Otherwise, it displays the callers of the current procedure being viewed in the source pane.
- `callee [`*`procedure`*`]` — Opens a Browse window displaying the callees of the procedure *`procedure`*, if specified. Otherwise, it displays the callees of the current procedure being viewed in the source pane.
- `scalls | calls [`*`procedure`*`]` — Opens a Tree Browser for static calls, rooted on the procedure *`procedure`*, if specified. Otherwise it is rooted on the current procedure being viewed in the source pane. See “Browsing Static Calls

By Function” in Chapter 12, “Browsing Program Elements” in the *MULTI: Debugging* book.

- `dcalls [`*`procedure`*`]` — Opens a Tree Browser for dynamic calls, rooted on the procedure *`procedure`*, if specified. Otherwise, it is rooted on the current procedure being viewed in the source pane. For more information, see “Browsing Dynamic Calls by Function” in Chapter 12, “Browsing Program Elements” in the *MULTI: Debugging* book.
- `fcalls [`*`file`*`]` — Opens a Tree Browser for static calls between files, rooted on the file *`file`*, if specified. Otherwise, it is rooted on the current file being viewed in the source pane. See “Browsing Static Calls By File” in Chapter 12, “Browsing Program Elements” in the *MULTI: Debugging* book.

browseref, xref

browseref [-all | -write | -read | -addr | -nowindow] *object_name*

xref [-all | -write | -read | -addr | -nowindow] *object_name*

GUI only

Displays the specified object's cross references in a Browse window or, if `-nowindow` is specified, in MULTI's command pane. `-all`, which is the default setting, displays all cross references; `-write` displays all writes; `-read` displays all reads; and `-addr` displays all address references. See also Chapter 12, “Browsing Program Elements” in the *MULTI: Debugging* book.

The **browseref** and **xref** commands attempt to resolve *`object_name`* to a symbol in your program as if *`object_name`* were used in an expression, searching for it based on the position of the current line pointer and using the scope rules of the language in use. For more information, see “Expression Scope” in Chapter 14, “Using Expressions, Variables, and Procedure Calls” in the *MULTI: Debugging* book.

Note

For performance reasons, these commands only partially implement compatible type checking when searching for references in compile units other than the one where the search started. This means that two very similar structures in two different compile units can be incorrectly matched as identical. In C++, MULTI can match the wrong structure if two similar nested structures exist. Nameless types exacerbate this problem, so ensuring that all types are named reduces the chance that this will happen.

diff

diff

GUI only

Opens the **Diff Viewer** on the file currently displayed in the source pane. This command is equivalent to running the Diff Viewer from the command line with the currently displayed source file as its argument. For arguments to this command, see “Starting the Diff Viewer from the Command Line” in Chapter 6, “Using MULTI's Version Control Tools and Capabilities” in the *MULTI: Managing Projects and Configuring the IDE* book.

edit

edit [*address_expression*]

GUI only

Opens an Editor on the file and line given by `address_expression`. If no `address_expression` is given, this command opens an Editor on the currently displayed location.

For example: `edit bar` opens the Editor on the file containing the function `bar`, with the cursor positioned at the beginning of the function `bar`. See also “Using Address Expressions in Debugger Commands” on page 5.

Corresponds to: 

editview

editview [*expr* | *proc* | *file*]

GUI only

Opens a MULTI Editor for the object specified by `expr`, `proc`, or `file`, where:

- `expr` — Is an expression.
- `proc` — Is a procedure name.
- `file` — Is a filename.

For procedures and files, the **editview** command opens a MULTI Editor window that contains the specified source code. For expressions and variables, this command opens a Data Explorer that contains the given expression. You can then use the Data Explorer to edit it. You can bind this command to a mouse button to create a "smart" mouse click that views or edits anything you click. For more information, see "Customizing Keys and Mouse Behavior" in Chapter 7, "Configuring and Customizing MULTI" in the *MULTI: Managing Projects and Configuring the IDE* book.

heapview

heapview [showleaks [-new] | showallocations [-new] | setmark | showstats | showvisual]

GUI only

Opens the **Memory Allocations** window. This window's operations are only available for processes that are halted and runnable. For more information, see "Using the Memory Allocations Window" in Chapter 16, "Viewing Memory Allocation Information" in the *MULTI: Debugging* book.

The available arguments are:

- `showleaks` — Causes the window to open with the **Leaks** tab displayed. If `-new` is specified with `showleaks`, only leaks created since the last mark command are shown.

- `showallocations` — Causes the window to open with the **Allocations** tab displayed. If `-new` is specified with `showallocations`, only allocations created since the last mark command are shown.
- `setmark` — Marks all objects in the heap.
- `showstats` — Causes the window to open with the **Visualization** tab displayed, and causes the tab to show heap statistics.
- `showvisual` — Causes the window to open with the **Visualization** tab displayed.

If no `show*` option is specified, the window opens with the **Visualization** tab displayed by default.

Corresponds to: **View → Memory Allocations**

localsview

localsview

GUI only

Displays the current procedure's local variables in a Data Explorer. If the current procedure is a C++ instance method, the Data Explorer displays the `this` pointer as well. If the program counter (PC) moves to a new procedure or if you move up or down the call stack (for example, by clicking or or by clicking a procedure in the **Call Stack** window), the content of the Data Explorer is updated to display information for that procedure. This is equivalent to the **view $locals$** command (see “view” on page 275).

Corresponds to:

Corresponds to: **View → Local Variables**

memview

memview [[*@count*] *address_expression*]

GUI only

Opens a **Memory View** window for displaying and modifying memory contents, where:

- `@`*`count`* — Forces the **Memory View** window to display at most *`count`* bytes. The minimum value that can be specified is `4`.

  This argument is useful if you do not want to manually size the window, but you do want to restrict the amount of data displayed to a small, exact number of bytes. It is less useful for showing a large set of data. If you set *`count`* to a higher number of bytes than the **Memory View** window can display, only the number of bytes that fit in the window are shown.
- *`address_expression`* — Specifies that the contents of the **Memory View** window begin with the memory address *`address_expression`*. If no address expression is specified, an empty **Memory View** window opens.

As an example use of this command, suppose you want to open a **Memory View** window sized to show 128 bytes, beginning with the address `argv[0]`. You would enter:

```
> memview @128 argv[0]
```

For more information, see Chapter 15, “Using the Memory View Window” in the *MULTI: Debugging* book.

Corresponds to: 

Corresponds to: **View → Memory**

showdef

showdef [*name*]...

Searches for a C preprocessor definition for each specified name. Each definition found is printed. If no arguments are specified, this command prints all the preprocessor definitions in the current program. In both cases, the local definitions list is searched first, then the global definitions list is searched. Every name that has a C preprocessor definition anywhere in the current program has an entry in the global definitions list. Any name that has more than one C preprocessor definition in the program has an overriding definition in the local definitions list for any files that use the non-global definition. This command is only enabled for programs built with MULTI debugging information.

showhistory

showhistory [*address_expression*]

GUI only

Displays the revision history in the **History Browser** for the source file specified by `address_expression`. If no address expression is specified, this command displays the revision history for the file corresponding to the currently displayed location.

For more information about address expressions, see “Using Address Expressions in Debugger Commands” on page 5.

top

top

GUI only

Opens a **Process Viewer** window, which displays a snapshot of the processes on your native target, much like the Linux/Solaris `top` or `ps` utilities.

See “Viewing Native Processes” in Chapter 18, “Using Other View Windows” in the *MULTI: Debugging* book.

Corresponds to: **View → Task Manager**

update

update [[-m] *interval*]

GUI only

Forces all currently open Data Explorer and monitor windows (including **Register View**, **Memory View**, **Call Stack**, and OSA Object Viewer windows) to be re-evaluated, halting the process if necessary to get the updated information. If this command must perform a halt, the process resumes after the windows are refreshed. This command provides you with a way to update your Data Explorer to the current values without requiring you to manually halt and resume the process.

If you specify an interval, MULTI automatically updates the windows while the process is running. The update occurs approximately every *`interval`* seconds or, if you pass `-m`, approximately every *`interval`* milliseconds. This is a useful way to monitor the value of a variable continuously while the process is running. To deactivate the automatic update, specify `0` for the *`interval`*.

Corresponds to: **View → Refresh Views**

view

view [/n | /m] [/data] *expr* [, *expr*]... | *type* | **address* | *filename* | $locals$ | *number*:$locals$

GUI only

Opens a Data Explorer, a Browse window, or an OSA Object Viewer displaying the given items.

If specified, the following options must appear before any other options on the command line.

- `/n` — Forces the specified items to open in a new Data Explorer.
- `/m` — Forces the specified items to open in the primary Data Explorer.
- `/data` — Forces the specified variable to open in a Data Explorer rather than in an OSA Object Viewer. This is only relevant for INTEGRITY objects.

The `/n` and `/m` options are mutually exclusive. The `/data` option may be specified in conjunction with the `/n` option or the `/m` option.

The remaining options are:

- *`expr`* `[,` *`expr`*`]...` — Displays the specified expression(s) *`expr`* in a Data Explorer. If the expression is for an INTEGRITY object, the expression appears in an OSA Object Viewer instead.
- *`type`* — Displays the type *`type`* in the Data Explorer.
- `*`*`address`* — Displays the contents of the given memory location in the Data Explorer. You must precede the address with an asterisk (*).
- *`filename`* — Displays *`filename`*'s procedures in the Browse window.
- `$locals$` — Displays the current procedure's local variables in the Data Explorer. If the current procedure is a C++ instance method, the `this` pointer is displayed as well. If the program counter (PC) moves to a new procedure or if you move up or down the call stack (for example, by clicking or or by clicking a procedure in the **Call Stack** window), the content of the Data Explorer is updated to display information for the new procedure. This option corresponds to the button, **View → Local Variables**, and the **localsview** command (see “localsview” on page 272).
- *`number`*`:$locals$` — Displays local variables for the procedure located *`number`* levels up the stack. If the procedure is a C++ instance method, the `this` pointer is displayed as well. The information is displayed in the Data Explorer. The stack frame does not change when the program counter (PC) moves to a new procedure. For a fixed view of the current stack frame, enter:

  ```
  > view 0:$locals$
  ```

For more information about the window in which a given item may be displayed, see one of the following:

- “The Data Explorer Window” in Chapter 11, “Viewing and Modifying Variables with the Data Explorer” in the *MULTI: Debugging* book
- “The Browse Window” in Chapter 12, “Browsing Program Elements” in the *MULTI: Debugging* book
- “The OSA Object Viewer” in Chapter 25, “Run-Mode Debugging” in the *MULTI: Debugging* book

Corresponds to: **View → View Expression**

viewdel

viewdel

GUI only

Closes all of the current Data Explorer, Browse, **Register View**, **Memory View**, **Call Stack**, and **Breakpoints** windows.

Corresponds to: **View → Close All Views**

viewlist

viewlist *structptr nextptr* [*links*]

GUI only

Displays a list of structures in the Data Explorer, where *`structptr`* is the pointer to the structure, *`nextptr`* is the name of the pointer to the next element of the structure, and *`links`* is the number of items in the list to be displayed (default value is 25).

For example, given the following C code:

```
struct S {int a; struct S *next; };struct S *ptr;
```

The command `viewlist ptr next 3` would display the first three items in this list. In this case, the **viewlist** command is equivalent to entering:

```
view ptr; view ptr->next; view ptr->next->next;
```

window

window [*num*] [{*commands*}]

GUI only

Creates, deletes, lists, or changes the contents of a monitor window. A monitor window captures the output of a command or command list (see "Using Command Lists in Debugger Commands" on page 12.) Each time the process stops, the commands are executed, and the output of these commands is printed in the monitor window. There is a limit of 100 defined monitor windows per program. The command list may contain multiple commands separated by a semicolon (`;`), and multiple commands must be surrounded by curly braces (for example, `window {calls; B}`).

This command has several forms.

- **window** — Lists all existing monitor windows and their assigned commands.
- **window** *num* — Deletes monitor window number *`num`*. The number is displayed on the monitor window border. For example, entering `window 2` removes the monitor window named `MONITOR 2`.
- **window** {*commands*} — Creates a monitor window displaying the results of the given command list.
- **window** *num* {*commands*} — Replaces the command list for monitor window *`num`* with *`commands`*. To change the command list, left-click the command's name in the upper-left corner of the monitor window.
- **window** 0 — (The number zero.) Deletes all existing monitor windows.

For example, the command `window calls` displays a stack trace in monitor window **MONITOR 1**. To change the window to display the breakpoints, use the command `window 1 B`. See also "monitor" on page 23.

Cache View Commands

The commands in this section allow you to view the contents of the caches on your processor. These commands are only available on some processors. For more information about viewing caches, see “Viewing Caches” in Chapter 18, “Using Other View Windows” in the *MULTI: Debugging* book.

The following list provides a brief description of each cache view command. For a command's arguments and for more information, see the page referenced.

- **cachefind** — Opens the **Cache Find** window (see “cachefind” on page 279).
- **cacheview** — Opens the **Cache View** window (see “cacheview” on page 279).

cachefind

cachefind [address_expression]

GUI only

Opens the **Cache Find** window. If you specify an address expression, the **Cache Find** window displays cache information for the corresponding address. For more information, see “The Cache Find Window” in Chapter 18, “Using Other View Windows” in the *MULTI: Debugging* book.

Corresponds to: **View → Find Address in Cache**

cacheview

cacheview

GUI only

Opens the **Cache View** window. For more information, see “The Cache View Window” in Chapter 18, “Using Other View Windows” in the *MULTI: Debugging* book.

Corresponds to: **View → Caches**

Data Visualization Commands

The commands in this section allow you to control custom data visualizations. For more information, see Appendix E, “Creating Custom Data Visualizations” in the *MULTI: Debugging* book.

The following list provides a brief description of each data visualization command. For a command's arguments and for more information, see the page referenced.

- **dataview** — Opens a **Graph View** window displaying the specified profile or view (see “dataview” on page 280).
- **dvclear** — Clears all loaded data descriptions (see “dvclear” on page 280).
- **dvload** — Loads the specified **.mdv** file, which is a custom data visualization describing the data definitions, profiles, and views to be used for your MULTI session (see “dvload” on page 281).
- **dvprofile** — Makes the specified profile the active profile (see “dvprofile” on page 281).

dataview

dataview [*profname* | *view_name*]

GUI only

Opens a **Graph View** window displaying the specified profile (`profname`) or view (`view_name`). The graph will use the default root (`defroot`) specified in the profile or view definition.

If no argument is specified, all views will be displayed.

dvclear

dvclear

GUI only

Clears all loaded data descriptions.

dvload

dvload *filename*

GUI only

Loads the specified file of data descriptions, where `filename` is the name of a custom data visualization (**.mdv**) describing the data definitions, profiles, and views to be used for your MULTI session.

dvprofile

dvprofile *profname*

GUI only

Makes the profile with the profile name `profname` the active profile. (See "Profile Descriptions" in Appendix E, "Creating Custom Data Visualizations" in the *MULTI: Debugging* book.)

Appendix A

Deprecated Command Reference

Contents

The commands in this appendix have been deprecated in MULTI and will be removed from a future release.

Deprecated Commands

The following list identifies deprecated commands.

- **ba** (See “b” on page 38 instead.)
- **br** (See “b” on page 38 instead.)
- **bR** (See “bA” on page 41 instead.)
- **findleaks** (See “heapview” on page 271 instead.)
- **infiniteview** (See “memview” on page 273 instead.)
- **refresh** (See “load” on page 227 instead.)
- **remote** (See “connect” on page 223 instead.)
- **romverify** (See “verify” on page 129 instead.)
- **tlist** (To open the Task Manager in a run-mode debugging environment, see “taskwindow” on page 207 instead. To open an **OSA Explorer** on the current process in a freeze-mode debugging environment or on the current debug server in a run-mode debugging environment, see “osaexplorer” on page 203.)

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