Suite56™ Application Development System (ADS)

Debugger User Manual, Release 6.3

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Chapter 1
Introduction

Motorola’s Suite56 DSP Application Development System (ADS) is a development tool used to design real-time signal processing systems. The ADS consolidates complex hardware and software development tools within a low-cost workstation environment and runs on most of the well-supported operating systems, such as Windows, HP-UX, Sun and Solaris. By providing a solid foundation for application development and test, the ADS significantly reduces development costs and time-to-market. The versatile ADS not only allows rapid initial development, but also supports comprehensive testing of prototype designs.

The four ADS components are the following:

- Host-Bus Interface Board—There are two types of boards available: 16-bit ISA bus (for PC-compatibles and HP7xx workstations) and SBus (for Sun and SPARC workstations).
- Command Converter (CC)— The command converter takes care of communication between your host computer and the target system. Motorola’s ADS offers several different command converters, based on your development needs. For details of each command converter, see the user manual for the particular command converter that you are using.
- Control, Development, and Debugging Software—This software is available for the following operating systems: Windows® 95, Windows NT® 4.0, HP-UX 9.x, Sun OS 4.x, and Solaris 5.x.
- Application Development Module (ADM)—This module supports development and testing with a specific device (a DSP chip).

Motorola DSPs have a common OnCE™ (on-chip emulation) module that allows the development tools to have identical features. Using the concept of a common serial debug port, Motorola has developed one set of tools which allows you to communicate with any Motorola DSP architecture through a command converter. In some Motorola DSPs, this module uses a dedicated OnCE serial port to access the internal module. In other Motorola DSPs, the internal OnCE module is addressed by using the IEEE Joint Test Action Group

(JTAG) 4-wire Test Access Port (TAP) Boundary Scan Architecture protocol. Motorola's DSP software tools can use either the direct OnCE serial port or the JTAG serial port.

The ADS provides a tool for designing, debugging, and evaluating DSP-based systems. It consists of three hardware circuit boards, and two software programs. The hardware circuit boards are the host-bus interface, command converter, and the ADM. The two software programs are the ADS user interface program which is executed on the host computer and the Command Converter monitor program.

The ADM card has a 14-pin connector which provides an access point for the command converter's JTAG/OnCE interface. You can use the ADS as an emulator to debug the hardware or software for a defined target system; to do so, you must provide an access point on the target hardware for a 14-pin JTAG/OnCE interface cable, which may be as simple as a 2 row x 7 set of test points.

The software program provides the routines necessary for the user to communicate with the target DSP on the ADM or the target application. The software program's powerful commands enable you to perform a variety of tasks. You can make operating system command calls from within the program, or you can make temporary exits to the operating system without disturbing current setups to the target DSP.

Note that the individual ADM user's manuals specify which version of the software to load (e.g., DSP56301ADM uses the ADS56300 or GDS56300 software). The macro command filename (default .cmd extension) is an optional parameter. The macro command file should contain a sequence of commands to execute upon ADS start-up and prior to command entry from the keyboard. You can "nest" macro commands to any level (a macro command file may call another macro command file). You generate the macro commands from within the ADS program using the **log** command. Refer to Section 13.30, "LOG - Log Commands or Session Output," on page 13-37 for further details. If you are working on a host computer which invokes the ADS using a mouse, it may not be easy to invoke the user interface program with a macro command file. To solve this problem the ADS searches for a specific file named startup.cmd in the same directory from which the ADS is invoked. If the ADS finds startup.cmd, it is opened as a macro command file and the commands are executed prior to checking for the optional macro command file argument.

The host-bus to ADM interface board provides a physical link between the host computer and the ADM via a parallel data path and a control-bus cable. The parallel data path enables high-speed data transfers. The control bus signals enable the host computer to reset, interrupt, and send commands to ADMs simultaneously or sequentially.

The ADM is the basic platform for evaluating the DSP. It contains a DSP chip with a JTAG/OnCE interface connector to configure it as a slave to the host computer or as a stand-alone unit. In the slave configuration, the user controls the DSP processor and is able to interrogate its status. This enables the user to debug hardware and software easily. In the stand-alone configuration, a user program resident in ROM controls the ADM and may be used as a prototype system for an end product.

For more information see section 1.1, “Features of the Debugger,” section 1.2, “Configuring the Operating Environment,” section 1.3, “Entering Commands,” and See “Getting Started” on page 1..

1.1 Features of the Debugger

Features of the Motorola DSP Debugger include the following:

- Single/multiple stepping through DSP programs
- Source-level symbolic debug of assembly and C source programs
- Conditional or unconditional software and hardware breakpoints
- Program patching using a single-line assembler
- Session and/or command logging for later reference
- Loading and saving of files to/from ADM memory
- Macro command definition and execution
- Display registers and memory
- Debug commands supporting multiple DSP development
- Hexadecimal/decimal/binary/fractional/floating-point calculator
- Multiple input/output file access from DSP object programs
- On-line help screens for each command and DSP register
- Compatibility with Motorola’s Suite56 DSP Assembler & Simulator
- Single command converter supporting OnCE and JTAG protocols

1.2 Configuring the Operating Environment

The ADS hardware and software is supported on the following platforms:

- PC-compatibles
- Hewlett Packard HP-UX 9.x operating system
- Sun 4.x operating system
- Solaris 5.x operating system

1.2.1 PC-Compatible Requirements

A PC-compatible computer should meet the following minimum requirements:

- Processor: 486, 100 MHZ or faster
- Memory: 32 Mbytes of RAM
- Operating system: Windows 95 or Windows NT 4.0
- Storage: 8 Mbytes of free space on hard drive
- Peripherals: mouse, keyboard, CD-ROM drive
- Ports: One 16-bit I/O ISA expansion slot
- Addresses: free I/O addresses 100-102 hex, or 200-202 hex, or 300-302 hex

1.2.2 Hewlett Packard Requirements

An HP workstation should meet the following minimum requirements:

- HP workstation running HP-UX Version 9.x (10.x is not supported)
- Hard drive with 12 Mbytes of free space
- Mouse and keyboard
- One EISA expansion slot

1.2.3 Sun Workstation Requirements

A Sun workstations should meet the following minimum requirements:

- SUN Operating System Release 4.1.1 or later or SOLARIS Release 5.1 or later
- Hard drive with 12 Mbytes of free space
- Mouse and keyboard
- One Sbus expansion slot

1.3 Specifying a Command Converter

Depending on the ADS that you using, you may have several options for the type of command converter that you use. The type of command converter that you are using must be indicated when you launch the ADS Debugger software. You indicate the type of command converter by including certain switches with the command that starts the ADS Debugger software. If you do not properly specify the type of command converter, the ADS Debugger software will not be able to communicate with the target board (ADM).

Table 1-1. ADS Command Converter Switches

Type of Command Converter (CC)	Operating System	Command Switch to use when starting the ADS Debugger	Comments
UCC	Win 95/98	`-d <port>`	where `port` can equal 100, 200, or 300
UCC	Win NT	`-d UCC`	UCC indicates that a Universal Command Converter (UCC) is connected.
UCC	SunOS4, Solaris, HP-UX 9, and HP-UX 10.2	`-d <driver_name>`	The default `<driver_name>` is `/dev/mdsp0` The driver name will vary if installed to a directory other than `/dev`
Parallel Port	Win 95/98/NT	`-d parallel:#`	# can be 1, 2, or 3 denoting LPT1 LPT2 LPT3
Ethernet	all operating systems	`-d ethernet:<IP/hostname>`	<IP /hostname> denotes IP address or hostname of the command converter
PCI	Win 95/98/NT	`-d pci`	

The following table contains examples of switches used to launch the ADS Debugger for various command converters.

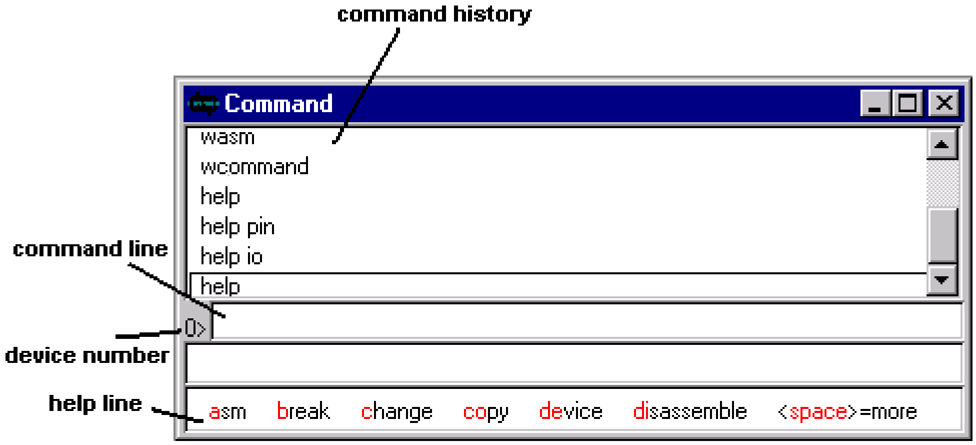
Example 1-1. ADS Switches for Command Converters

Command Example	Explanation
`ads56300 -d 300`	Launches the text version of the ADS Debugger for the DSP56300. Assuming that the Debugger is running on Win95 or Win98, the switch indicates that the command converter being used is a Universal Command Converter (UCC) addressed on port 300.
`ads56300 -d UCC`	Launches the text version of the ADS Debugger for the DSP56300. Assuming that the Debugger is running on a Win NT operating system, the switch indicates that the command converter being used is a Universal Command Converter (UCC).
`ads56300 -d /dev/mdsp0`	Launches the text version of the ADS Debugger for the DSP56300. Assuming that the Debugger is running on a UNIX operating system, the switch indicates that the command converter being used is a Universal Command Converter (UCC).
`gds56300 -d parallel:3`	Launches the GUI version of the ADS Debugger for the DSP56300. The switch indicates that the command converter being used is a parallel port command converter located on the LPT3 port.
`gds56800 -d pci`	Launches the GUI version of the ADS Debugger for the DSP56800. The switch indicates that the command converter being used is a PCI command converter.
`gds56600 -d ethernet:123.123.123.123`	Launches the GUI version of the ADS Debugger for the DSP56600. The switch indicates that the command converter being used is an ethernet command converter installed on the server with IP address 123.123.123.123.

1.4 Entering Commands

You can perform most of the work with the debugger by using the menu bar and the toolbar. However, you might sometimes find it useful to perform some commands from a command line. Motorola's DSP Debugger provides you the option of entering commands at a command line.

The command line is a part of the Command window, see Figure 1-1.



```
wasm
wcommand
help
help pin
help io
help
```

```
asm   break   change   copy   device   disassemble   <space>=more
```

Figure 1-1. DSP Debugger Command Window

In the Command window, notice that several common commands are displayed on the help line. The remaining commands can be displayed by pressing the SPACE bar when the cursor is at the beginning of the command line.

It is not necessary to type the complete command. You only need to type the first one to three characters of the command for the debugger to recognize the command. The minimum number of required characters for each command is highlighted in red on the help line.

You can display the complete syntax for a particular command by typing the command (or the required characters) on the command line and then pressing the SPACE bar. The complete syntax of the command that you began typing is displayed on the help line.

Any text that follows a semicolon on the command line is considered a user comment. You might use comments if you were logging output from the Session window or creating and running a command macro.

The command that you have typed in on the command line is executed when you press the ENTER key or the CARRIAGE RETURN key. If the command is not a valid debugger command, the debugger interprets the command as the name of a command macro and executes the macro, if it exists.

For more information see Chapter 13, "Debugger Command Reference," specifically section 13.2, "Command Syntax," on page 13-5.

Chapter 2
Getting Started

The Motorola Suite56 DSP Debugger is designed to give you flexibility in how you debug your object code. There are many approaches that you can take. There is no one way in which to go about debugging your code. However, there are some fairly common windows and commands with which you will want to become familiar. The following steps describes how to begin a typical session with the DSP debugger.

Typically, you will want to:

1. Reset the device
2. Set the path of the working directory
3. Load an object file
4. Set up the display environment by opening windows to view the source code, assembly code, register values, and memory values
5. Use a watch list
6. Set and modify breakpoints
7. Go or step through instructions

Once you are familiar with the debugger, you won’t need to perform each of the steps described above. Instead you will probably already have your windows positioned as you like them by making sure that the windows settings are saved in Window Preferences. You will probably also have command macros that set the path, load the program, and set up watch expressions.

Once you are comfortable with these basics, you can then become familiar with more complex debugging by using simulated device input and output (I/O). If you are using C code as your source code, you will also want to learn about specific commands useful in debugging C source code.

For more information see Chapter 6, “Input and Output Files,” Chapter 7, “Debugger and Device Configurations,” Chapter 8, “Debugging C Source Code,” Chapter 10, “Expressions,” Chapter 13, “Debugger Command Reference,” Chapter 11, “Debugger Toolbar,”

2.1 Resetting the System

The Debugger can reset the entire system at once, including the command converter. This is useful when you want to reinitialize all registers, and peripherals, and also want to reset the command converter to recognize that the target device is in Debug mode.

To reset the system:

- From the execute menu, choose **Reset**, hen select **System**.

  The command converter and the target device are both reset. The target device is reset to the debug mode.

For more information see, section 13.22, “FORCE - Assert RESET or BREAK on Target,” on page 13-28 ,section 13.8, “CFORCE - Assert Reset or Break on Command Converter,” on page 13-16.

2.2 Setting and Clearing the Path

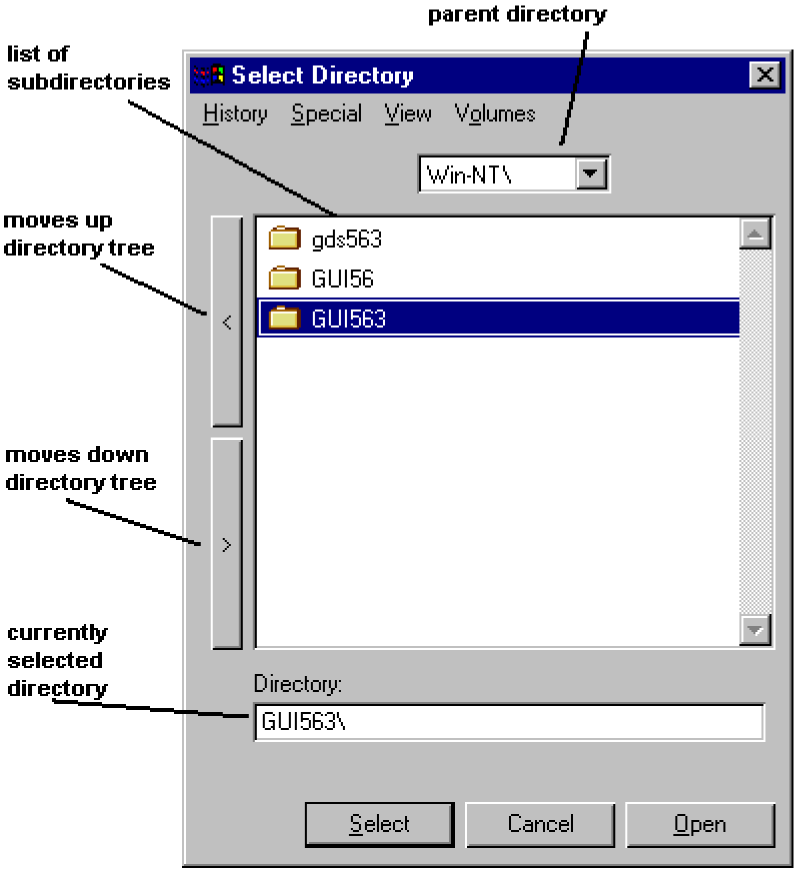
The Suite56 DSP Debugger makes use of two types of paths for saving and accessing files:

- the working directory path
- alternate directory paths

The working directory is the primary path. It is the default directory used when searching for an input file (assuming no path is explicitly specified with the input filename). If an input file is not found in the working directory, alternate paths are automatically searched. The advantage to you is that object files, source files, and command macros can each be kept in separate directories, but still accessed without having to constantly redefine the path.

To set the path of the working directory:

1. From the **File** menu choose **Path** then select **Set**. A dialog box similar to Figure 2-1 appears.



Directory: GUI563\

Figure 2-1. Setting the Working Directory Path

2. If appropriate, select another drive from the **Volumes** menu.
3. Move up or down the directory tree until the directory you want is in the list of subdirectories. There are a number of ways to do this. You can:

   — move up and down the directory tree with the left arrow and right arrow buttons;

   — move down the tree by double clicking in the list of subdirectories;

   — move up the tree by selecting a directory from the drop down box where the parent directory is displayed;

   — select a directory from the **History** menu, which shows recently selected directories.

4. Click once on the desired directory from the list of subdirectories so that it is highlighted. Notice that the highlighted directory appears in the area labeled **Directory**
5. Click **Select**.
   The selected directory is now the working directory. Display the current path to see the absolute path of the working directory

To set an alternate path:

1. From the **File** menu choose **Path**, then select **Add**.
2. If appropriate, select another drive from the **Volumes** menu.
3. Move up or down the directory tree until the directory you want is in the list of subdirectories.
4. Highlight the desired directory by single clicking it in the list of subdirectories.
5. Click **Select**.

The selected directory is now added to the end of the list of alternate paths. Display the current path to see the list of alternate paths.

To clear the alternate paths:

1. From the **File** menu, choose **Path**, then select **Clear Alternate Path List**.

The list of alternate paths is cleared for all devices. The path of the working directory is not cleared.

Keep in mind that a separate working directory is maintained for each device. However, all devices share the same alternate directory paths. To be safe, always check the path of the working directory after adding a device or setting the default device.

Remember that in order to change the path of a device that is not currently the default device, you must first change the default device.

For information see section 2.3, “Loading Object Files,” section 7.2, “Setting the Default Device,” on page 7-4, section 13.34, “PATH - Define File Directory Path,” on page 13-42.

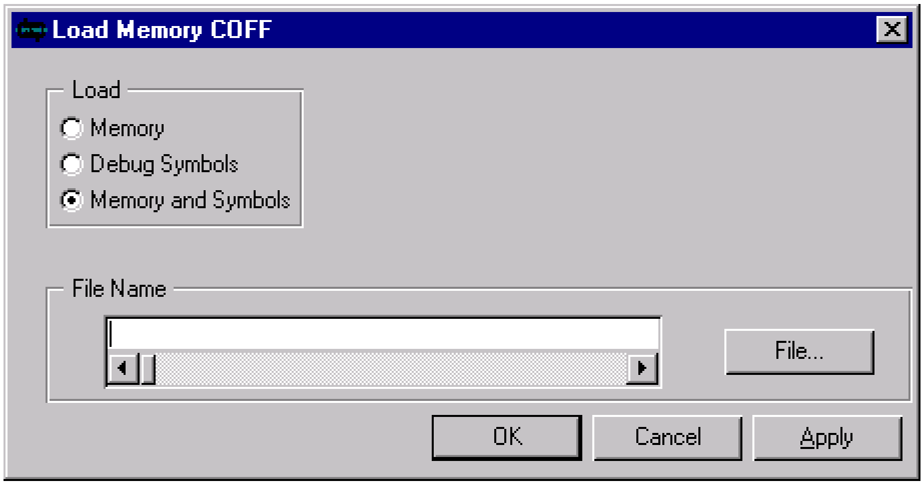
2.3 Loading Object Files

You can load DSP Object Module Format (OMF) files or Common Object File Format (COFF) files directly into the Debugger memory. OMF files are identified by the .lod extension. COFF files are identified by the .cld extension. Motorola’s Suite56 DSP Assembler generates both file formats.

You can also generate both of the file formats with the DSP Debugger when saving object files.

To load a COFF (.cld) file:

1. From the **File** menu, choose **Load**. then select **Memory COFF**. The dialog box in Figure 2-2 appears:



Load Memory COFF

Load
○ Memory
○ Debug Symbols
● Memory and Symbols

File Name

Figure 2-2. Loading a COFF (.cld) File

2. Under **Load**, select **Memory**, **Debug Symbols**, or both.
   The Debugger will process the symbol and line number information contained in a COFF format object file (.cld file) only if the file was compiled or assembled with debugging enabled. (In the Motorola DSP Assembler this is represented by the –g option.)
   If symbol information has been loaded, the evaluator will accept symbol names or source file line numbers and translate them into an associated memory address.
3. Under **Filename** specify the filename of the object file to load or click on the **File** button to browse for the file.
4. Click **OK**.
   If the .cld file is not found in the selected directory, the Debugger will try to load the file from the working directory. If the file does not exist in the working directory, the Debugger will try to load the file from the alternate directories. An error message is displayed if the file is not found in any of these directories.

To load an OMF (.lod) file:

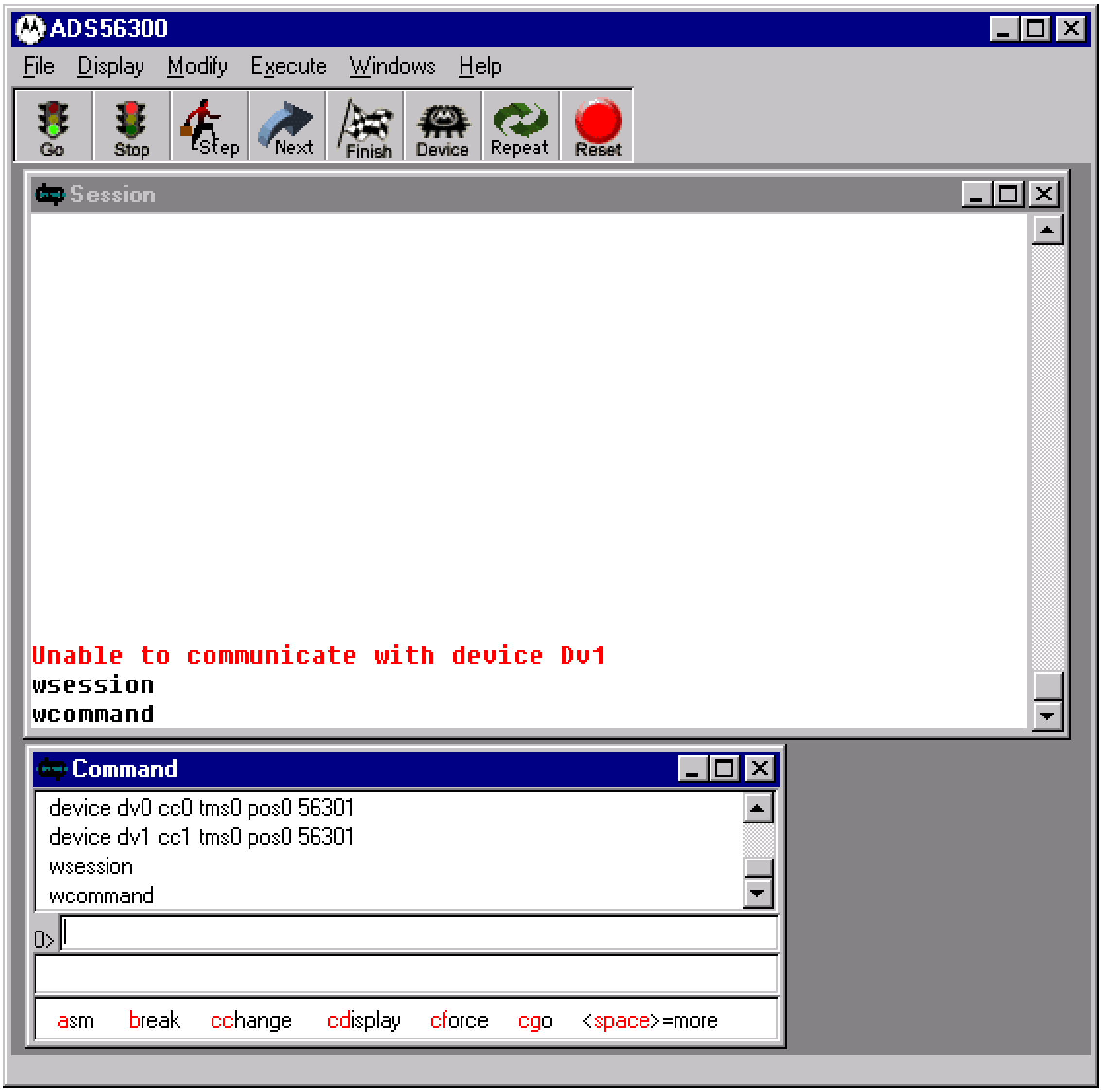
1. From the **File** menu, choose **Load**. then select **Memory OMF**.
2. Specify the filename in the dialog box.
   It is not necessary to type the extension with the filename. The Debugger assumes the .lod extension.
3. Click **Open**.

Keep in mind that the object file is loaded into the memory of the current device. If you want to load the file into another device, you must first select that device as the default device.

For more information see section 2.2, “Setting and Clearing the Path,”, section 4.4, “Saving Object Files,” on page 4-5, section 7.2, “Setting the Default Device,” on page 7-4, section 7.4, “Loading Debugger State Files,” on page 7-7, and section 13.29, “LOAD - Load DSP Files,” on page 13-36.

2.4 Setting Up the Display Environment

Two windows are displayed when the Debugger first starts: the Session window and the Command window. You might need to scroll around to get both windows into view at the same time, but the screen should look something like Figure 2-3.


ADS56300
File Display Modify Execute Windows Help
Go
Stop
Step
Next
Finish
Device
Repeat
Reset
Session
Command
0>
asm break cchange cdisplay cforce cgo <space>=more

```
Unable to communicate with device Dv1
wsession
wcommand
```

```
device dv0 cc0 tms0 pos0 56301
device dv1 cc1 tms0 pos0 56301
wsession
wcommand
```

Figure 2-3. Setting Up the Display Environment

The display environment refers to the way the windows of the Debugger are arranged on your monitor. There is no right or wrong way to set up the display environment. However, there are some windows that you will commonly want to have opened besides the Session and Command windows. These include:

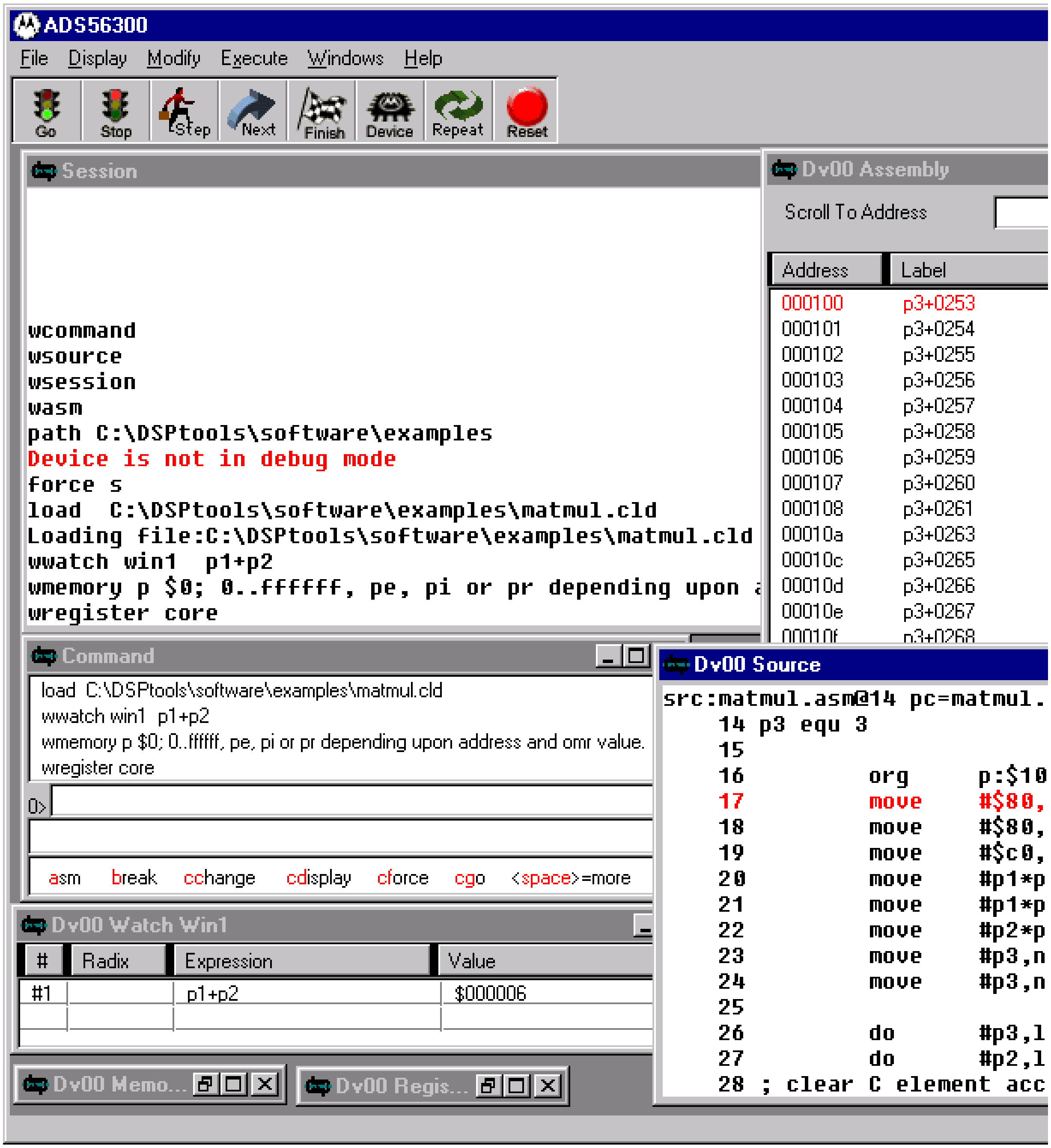
- the Assembly window
- the Source window (if a COFF file with debugging information is loaded)

You will also want to have windows for:

- displaying register values,
- displaying memory values , and perhaps
- a watch list

If you are debugging a program written in C, you will also want to have the Stack window open so that you can see the call stack.

Depending on the size and resolution of your monitor, having all of these windows open at once means that there will be some overlapping. Your own experience with the Debugger will lead you to the best configuration of these windows. However, in a typical session the Debugger might look like Figure 2-4.



```
wcommand
wsource
wsession
wasm
path C:\DSPtools\software\examples
Device is not in debug mode
force s
load  C:\DSPtools\software\examples\matmul.cld
Loading file:C:\DSPtools\software\examples\matmul.cld
wwatch win1  p1+p2
wmemory p $0; 0..ffffff, pe, pi or pr depending upon a
wregister core
```

Address	Label
000100	p3+0253
000101	p3+0254
000102	p3+0255
000103	p3+0256
000104	p3+0257
000105	p3+0258
000106	p3+0259
000107	p3+0260
000108	p3+0261
00010a	p3+0263
00010c	p3+0265
00010d	p3+0266
00010e	p3+0267
00010f	p3+0268

```
load  C:\DSPtools\software\examples\matmul.cld
wwatch win1  p1+p2
wmemory p $0; 0..ffffff, pe, pi or pr depending upon address and omr value.
wregister core
0>
```

```
src:matmul.asm@14 pc=matmul.
    14 p3 equ 3
    15
    16          org     p:$10
    17          move    #$80,
    18          move    #$80,
    19          move    #$c0,
    20          move    #p1*p
    21          move    #p1*p
    22          move    #p2*p
    23          move    #p3,n
    24          move    #p3,n
    25
    26          do      #p3,l
    27          do      #p2,l
    28 ; clear C element acc
```

#	Radix	Expression	Value
#1		p1+p2	$000006

Figure 2-4. A Typical Session Window Using the Suite56 Debugger

For more information about customizing your work environment, see section 7.5, “Changing and Saving Window Preferences,” on page 7-8, and section 11, “Debugger Toolbar,” on page 11-1.

2.5 Using a Watch List

You can watch the contents of a specific memory location, register, or expression by setting up a watch list. The watch list is updated every time program execution is stopped.

The expression that you watch can be valid even if it is not calculated during program execution. C expressions can be used, but must be enclosed in curly brackets: {c_expression}. Symbolic references may be used if symbols have been loaded from the object module.

To add an item to a watch list:

1. From the **Windows** menu choose **Watch**. The dialog box in Figure 2-5 appears.

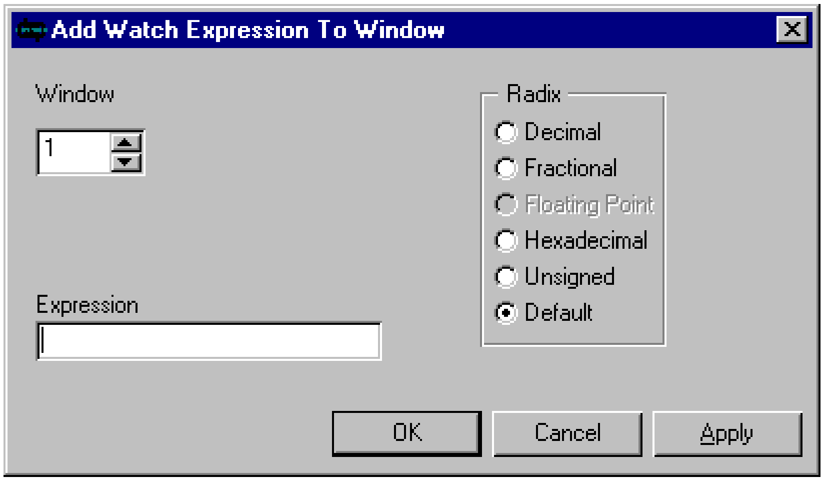


Figure 2-5. Add Item to a Watch List

2. Under **Window** select the window number that you want to assign to the Watch window. This is useful when you have more than one Watch window open.
3. Under **Expression**, type the expression that you want to appear in the Watch window.
4. If the expression is a C expression, enclose it in curly brackets: {c_expression}.
5. Under **Radix**, select the radix format in which you want the variables displayed.
6. Click **OK**.
   The expression that you specified now appears in the Watch window; if the expression you type is not valid, you will get an error message explaining why the expression is not valid.

Keep in mind that a C expression that refers to C variables can only be evaluated in the context in which the watch is established. That is, the variables in the expression are only valid while they are in scope. If one of the variables in an expression goes out of scope (either because a function call or return from a function), the value is replaced with the message **Expression out of scope**. When all elements of the expression are back in scope, the value is again displayed.

An expression that has gone out of scope because of a function call can be evaluated and displayed by selecting the stack frame for the evaluation context. The stack frame assignment remains in effect only until the next instruction is executed. An expression that is out of scope because of a function exit cannot be evaluated until the function is again invoked since the expression's variables no longer exist.

For more information about watch lists, see section 8.1, "Moving Up and Down the Call Stack,"section 10.7, "Setting Up and Modifying a Watch list," on page 10-10, section 12.1, "Displaying the Radix," on page 12-1, and section 13.49, "WATCH - Set, Modify, View, or Clear Watch Item," on page 13-52.

2.6 Setting and Clearing Software Breakpoints

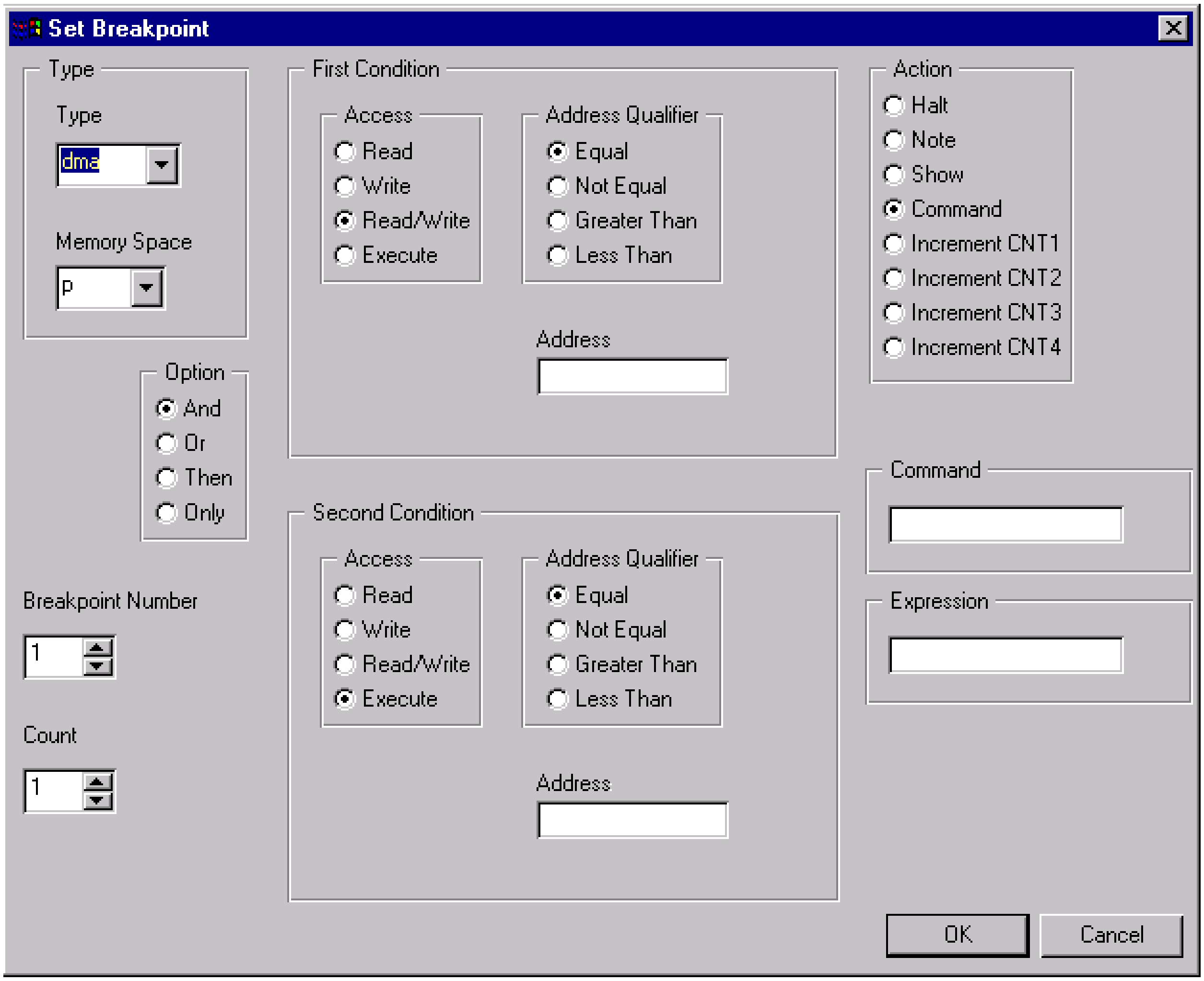
Software breakpoints are used to specify that a particular action be taken whenever a certain condition is met. In this way, software breakpoints are very similar to hardware breakpoints. However, software breakpoints are more limited than hardware breakpoints in that:

- software breakpoints can only be set on the first word of an instruction (they cannot be set to detect the access of registers or data memory)
- software breakpoints must be set in RAM (they cannot be set in ROM)

Despite the above limitations, it is recommended that you use software breakpoints instead of hardware breakpoints whenever possible. Why? Because, effectively only one hardware breakpoint can be set at a time whereas a virtually unlimited number of software breakpoints can be set.

2.6.1 To Set a Software Breakpoint

1. From the **Execute** menu, choose **Breakpoints**, then select **Set Software**. The **Set Breakpoints** dialog box shown in Figure 2-6 appears.



Set Breakpoint

Type

Type: dma

Memory Space: p

Option: ● And ○ Or ○ Then ○ Only

Breakpoint Number: 1

Count: 1

First Condition

Access: ○ Read ○ Write ● Read/Write ○ Execute

Address Qualifier: ● Equal ○ Not Equal ○ Greater Than ○ Less Than

Address:

Second Condition

Access: ○ Read ○ Write ○ Read/Write ● Execute

Address Qualifier: ● Equal ○ Not Equal ○ Greater Than ○ Less Than

Address:

Action: ○ Halt ○ Note ○ Show ● Command ○ Increment CNT1 ○ Increment CNT2 ○ Increment CNT3 ○ Increment CNT4

Command:

Expression:

Figure 2-6. Setting a Software Breakpoint

2. Under **Breakpoint Number** select the number you want to assign to this breakpoint. The default number that is shown is the next available number. Breakpoint numbers do not have to be consecutive, they can be assigned arbitrarily. For example, it may be convenient to allocate breakpoints so that one function is assigned breakpoints 1 to 10, another 11 to 20, and so on.
3. Under **Count** specify how many times the Debugger should encounter the breakpoint before performing the action. For example, if you set the count to 3, the breakpoint will be triggered the third time that the breakpoint is encountered. Real time execution will be affected if you set the count to more than one.

4. If you have assigned an input file, you can mark EOF. The breakpoint will be acted upon when the input file reaches an end-of-file. If you have marked EOF, under **Input File Number** select the number of the input file. The input file number is the number that you designated when you assigned the input file.
5. Under **Type** select the type of software breakpoint to set. If you select **al**, the breakpoint will always be acted upon. Breakpoint types other than **al** are conditional and device specific. See Table 3-2, "Software Breakpoints (DEBUGcc) Available on the DSP56000, DSP56100, DSP56300, and DSP56600," on page 3-13 and Table 3-3, "Software Breakpoints (FDEBUGcc) Available on the DSP96002," on page 3-15 for a list of software breakpoints.
6. Under **Address**, type the address where you want the breakpoint to be set. For example, to set a breakpoint at address $103 in p memory, type: `p:$103`

Note: This address *must* be the first word of an instruction.

Note: If you have set the breakpoint type (in step 5) to a conditional breakpoint (that is, any type other than al), the breakpoint can *only* be set to an address which contains a nop. Setting the breakpoint to an address which contains any other opcode will cause your program to execute incorrectly.

7. Under **Expression** you can type an expression. The expression will be evaluated when the address you specified is reached. If the expression is true, the breakpoint will be triggered. If the expression is false, no action is taken and program execution continues. Be aware that a side effect of evaluating an expression (whether it is true or false) is that the program will not be executed in real time.
8. Under **Action** select what action is taken when the breakpoint is encountered:

Table 2-1. Software Breakpoint Actions

Breakpoint	Resulting Action
Halt	Stops program execution when the breakpoint is encountered.
Note	Displays the breakpoint expression in the Session window each time it is true. Program execution continues. The display in the Session window is not updated until program execution stops.
Show	Displays the enabled register/memory set. Program execution continues.
Command	Executes a Debugger command at the breakpoint. Device execution commands, such as TRACE or GO, will not execute.
Increment[n]	Increments the n counter by one.

9. If the action specified is to execute a command, under **Command** type the Debugger command.
10. Click **OK**.

2.6.2 To Clear a Software Breakpoint

1. From the **Execute** menu, choose **Breakpoints**, then select **Clear**.
   The **Clear Breakpoints** dialog box shown in Figure 2-7 displays a list of all the current breakpoints.

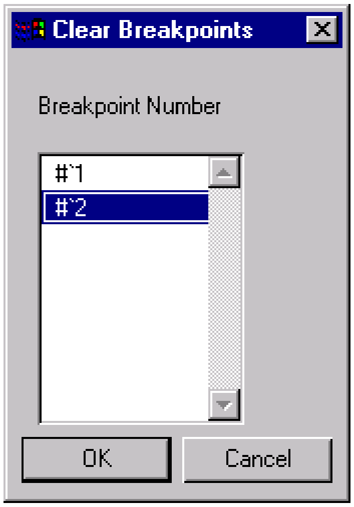


Figure 2-7. Clear Breakpoints Dialog Box

2. Select the breakpoint you want removed so that it is highlighted.
   If you are clearing consecutive breakpoints, you can click and drag to highlight more than one breakpoint. Or hold down the CTRL key while clicking on breakpoints to select more than one.
3. Click **OK**.
   The breakpoints you selected are now deleted.
   Breakpoints will not be renumbered. For example, if you have set breakpoints #1, #2, and #3, and then clear breakpoint #2, the remaining breakpoints will be numbered #1 and #3.

Notice that breakpoints are indicated in the Assembly window and the Source window (if applicable). Enabled breakpoints appear in blue. Disabled breakpoints appear in pink.

For more information see section 2.7, “Setting and Clearing Hardware Breakpoints,” section 3.10, “Enabling and Disabling Breakpoints,” on page 3-22, Chapter 10, “Expressions,” section 12.2, “Display the Current Breakpoint,” on page 12-2, and section 13.5, “BREAK - Set, Modify, or Clear Breakpoints,” on page 13-10 in Chapter 13, “Debugger Command Reference.”

2.7 Setting and Clearing Hardware Breakpoints

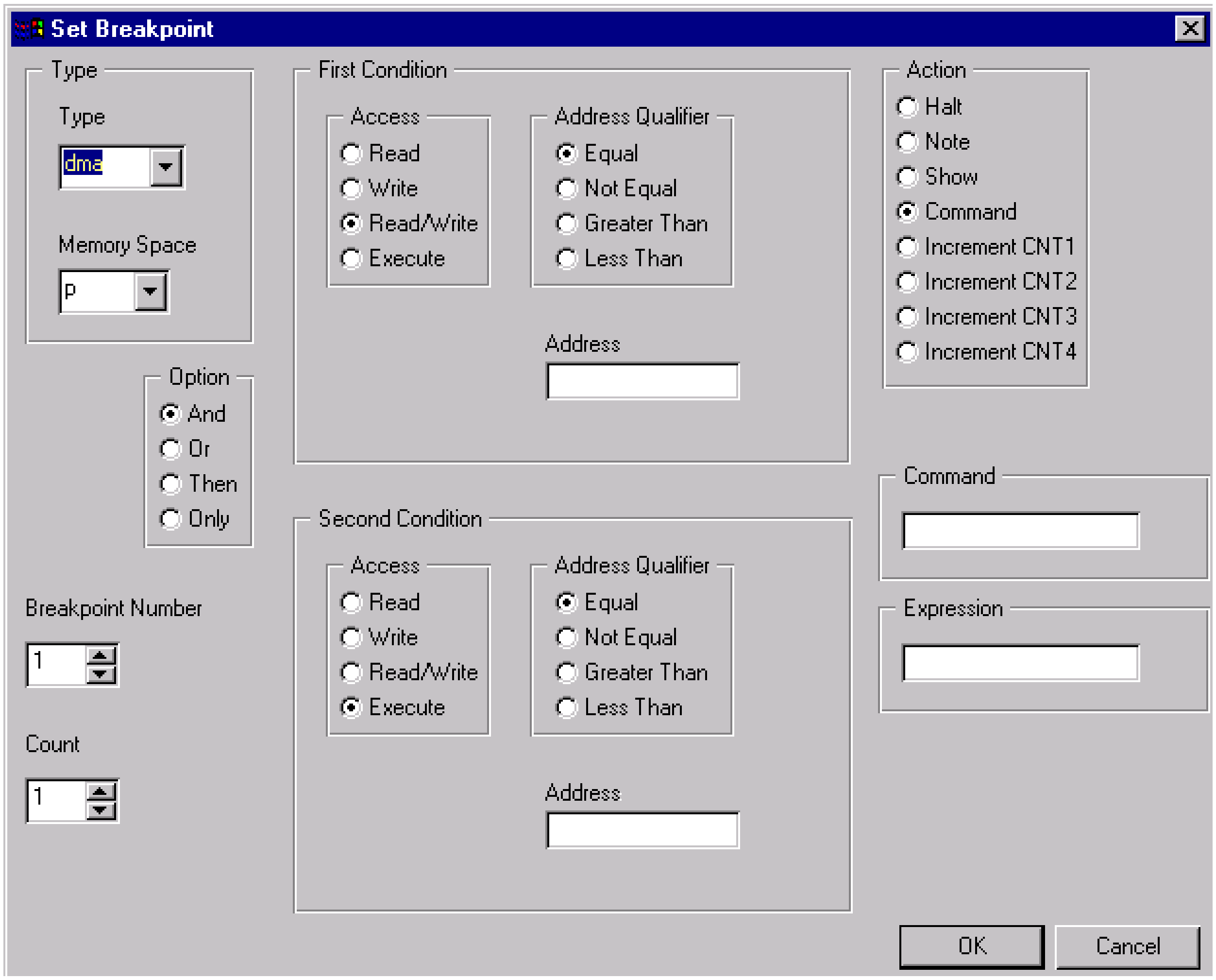
Hardware breakpoints are used to specify that a particular action be taken whenever a certain condition is met. In this way, hardware breakpoints are very similar to software breakpoints. However, there are some differences. Hardware breakpoints:

- use the OnCE circuitry on the device
- can break on the execution of an instruction
- can be set in ROM or RAM
- can be set to detect an access of data memory

Although hardware breakpoints are more flexible than software breakpoints, you will want to use hardware breakpoints judiciously. In effect, only one hardware breakpoint can be enabled at any time.

2.7.1 To Set a Hardware Breakpoint

1. From the **Execute** menu, choose **Breakpoints**, then select **Set Hardware**. The dialog box in Figure 2-8 appears.



Set Breakpoint

Type
Type: dma
Memory Space: p

Option
● And
○ Or
○ Then
○ Only

Breakpoint Number: 1

Count: 1

First Condition
Access: ○ Read ○ Write ● Read/Write ○ Execute
Address Qualifier: ● Equal ○ Not Equal ○ Greater Than ○ Less Than
Address:

Second Condition
Access: ○ Read ○ Write ○ Read/Write ● Execute
Address Qualifier: ● Equal ○ Not Equal ○ Greater Than ○ Less Than
Address:

Action
○ Halt
○ Note
○ Show
● Command
○ Increment CNT1
○ Increment CNT2
○ Increment CNT3
○ Increment CNT4

Command:

Expression:

Figure 2-8. Setting a Hardware Breakpoint

2. Under **Type** select the type of hardware breakpoint to set. Breakpoint types are device specific. See Table 2-2 for an explanation of each type of breakpoint.
3. Under **Memory Space**, select the memory space in which the breakpoint is to be set.
4. Under **First Condition** specify the conditions under which the breakpoint occurs.
   Under **Access** indicate what kind of access should be detected by the breakpoint. For example, if you want the breakpoint to detect when a memory location is read but not written to, select **Read**. If you want either a read or a write to be detected, chose **Read/Write**, etc.
   Under **Address Qualifier** indicate the qualifier for the address location.
   Under **Address** type the address that the breakpoint references.

5. Under **Option**, indicate whether a second condition should be considered. **And** indicates that both conditions must be met to trigger the breakpoint. **Or** indicates that either condition can be met. **Then** indicates that the **First Condition** must be satisfied followed by the **Second Condition**. **Only** indicates that only the first condition must be met to trigger the breakpoint.
6. Under **Second Condition** specify the conditions for the second condition. This will only apply if you have indicated so under **Option** in step 5.
7. Under **Breakpoint Number** select the number you want to assign to this breakpoint. The default number shown is the next available number.
   Breakpoint numbers do not have to be consecutive, they can be assigned arbitrarily. For example, it may be convenient to allocate breakpoints so that one function is assigned breakpoints 1 to 10, another uses 11 to 20, and so on.
8. Under **Count** specify how many times the Debugger should encounter the breakpoint before stopping. For example, if you set the count to 3, the breakpoint will be triggered the third time that the breakpoint is encountered.
   Specifying a count will not affect real time execution.
9. Under **Expression** you can type an expression. The expression will be evaluated when the first (and second) condition you specified is satisfied. If the expression is true, the breakpoint will be triggered. If the expression is false, no action is taken and program execution continues.
10. Under **Action** select what action is taken when the breakpoint is encountered:

Table 2-2. Hardware Breakpoint Actions

Breakpoint	Resulting Action
Halt	Stops program execution when the breakpoint is encountered.
Note	Displays the breakpoint expression in the Session window each time it is true. Program execution continues. The display in the Session window is not updated until program execution stops.
Show	Displays the enabled register/memory set. Program execution continues.
Command	Executes a Debugger command at the breakpoint. Device execution commands, such as TRACE or GO, will not execute.
Increment[n]	Increments the n counter by one.

11. If the action specified is to execute a command, under **Command** type the Debugger command.
12. Click **OK**.

2.7.2 To Clear a Hardware Breakpoint

1. From the **Execute** menu, choose **Breakpoints**, then select **Clear**.
   The **Clear Breakpoints** dialog box, shown in Figure 2-7 on page 2-14, displays a list of all the current breakpoints.
2. Select the breakpoint you want removed so that it is highlighted.
   If you are clearing consecutive breakpoints you can click and drag to highlight more than one breakpoint. Or hold down the CTRL key while clicking on breakpoints to select more than one.
3. Click **OK**.
   The breakpoints you selected are now deleted.
   Breakpoints will not be renumbered. For example, if you have set breakpoints #1, #2, and #3, and then clear breakpoint #2, the remaining breakpoints will be numbered #1 and #3.

Notice that breakpoints are indicated in the Assembly window and the Source window (if applicable). Enabled breakpoints appear in blue. Disabled breakpoints appear in pink.

For more information see section 2.6, “Setting and Clearing Software Breakpoints,” section 3.10, “Enabling and Disabling Breakpoints,” Chapter 10, “Expressions,” and section 12.2, “Display the Current Breakpoint.” The command reference line option for hardware breakpoints is covered in section 13.5, “BREAK - Set, Modify, or Clear Breakpoints,” in Chapter 13, “Debugger Command Reference.”

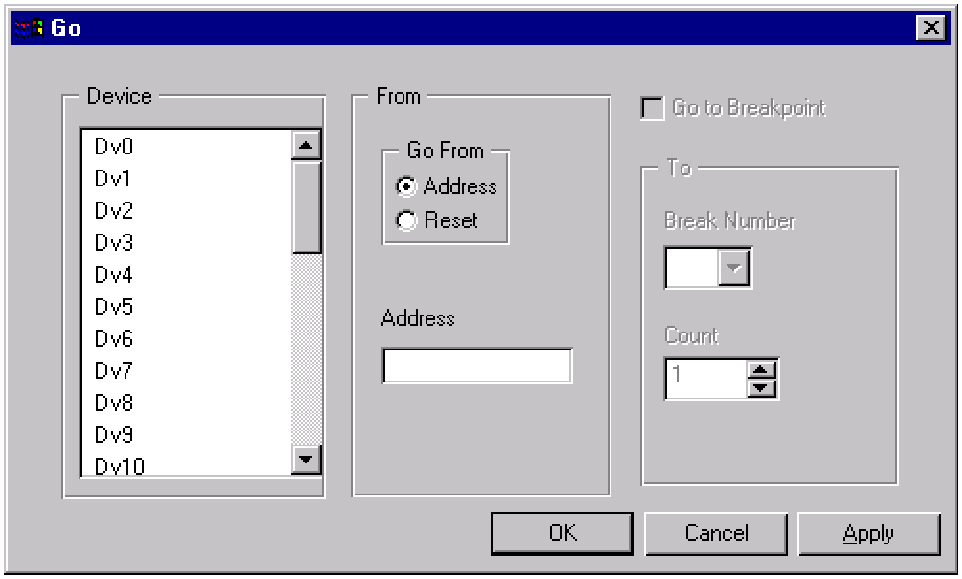
2.8 Starting Execution with Go

The most common way to initiate the execution of your program is with go. When you indicate go to the Debugger, it fetches, decodes, and executes instructions in the exact manner as a device would if you were debugging an actual device. The go command executes the program until one of the following occurs:

- a breakpoint is reached,
- you indicate stop,
- or a debug instruction is encountered.

2.8.1 To Start Executing Instructions with Go

1. From the **Execute** menu choose **Go**. You will see the dialog box in Figure 2-9



Go From
● Address
○ Reset

□ Go to Breakpoint

Count
1

Figure 2-9. Executing Instructions with Go

2. Under **Go From**, choose whether to **Go from an address** or to **Reset**.
   If you choose **Reset**, the Debugger simulates the reset sequence in the processor. The instruction pipeline, instruction counter, and cycle counter will be cleared before program simulation begins. The device registers are reset and execution begins at the reset exception address.
3. If you chose to go from an address, under **Address**, type in the address from which you want to begin executing instructions. If you leave the address blank, execution will begin from the current program counter value. If you specify an address, the instruction pipeline, instruction counter, and cycle counter will be cleared before program simulation. Execution will begin from the address you specify.
4. Select the **Go to Breakpoints** checkbox if you want to stop execution at a particular breakpoint. If selected, all other stop breakpoints will be ignored.
5. Under **Break Number** select the breakpoint where you want to stop execution. To see where you have breakpoints set **Display the Current Breakpoints** in the breakpoint window.
6. Under **Count** specify how many times the Debugger should encounter the breakpoint before stopping. For example, if you set the count to 3, the program execution will be stopped on the third time that the breakpoint is encountered. The last instruction executed will be the breakpoint.
7. When all conditions are set, click **OK**. Execution will begin.

Notice that during execution, the status bar in the lower left corner of the Debugger window shows the number of the device where execution is taking place, the PC (program counter), and the cycle count (updated every 1,000 cycles).

As an alternative, you can start program execution using the **GO** button located on the toolbar.

For more information see section 5.1, “Resetting the Device Registers.” Also see section 13.24, “GO - Execute DSP Program,” in Chapter 13, “Debugger Command Reference.”

Chapter 3
Controlling Execution

This chapter includes a description of various functions necessary to control the execution of a program that you are debugging. The following functions can be used in the execution of the program: go, step, trace, next, until, break, wait, finish, stop.

3.1 Starting Execution with Go

The most common way to initiate the execution of your program is with go. When you indicate go to the Debugger, it fetches, decodes, and executes instructions in the exact manner as a device would if you were debugging an actual device. The go command executes the program until one of the following occurs:

- a breakpoint is reached,
- you indicate stop,
- or a debug instruction is encountered.

3.1.1 To Start Executing Instructions with Go

1. From the **Execute** menu choose **GO**.. The Go dialog box in Figure 3-1 appears.

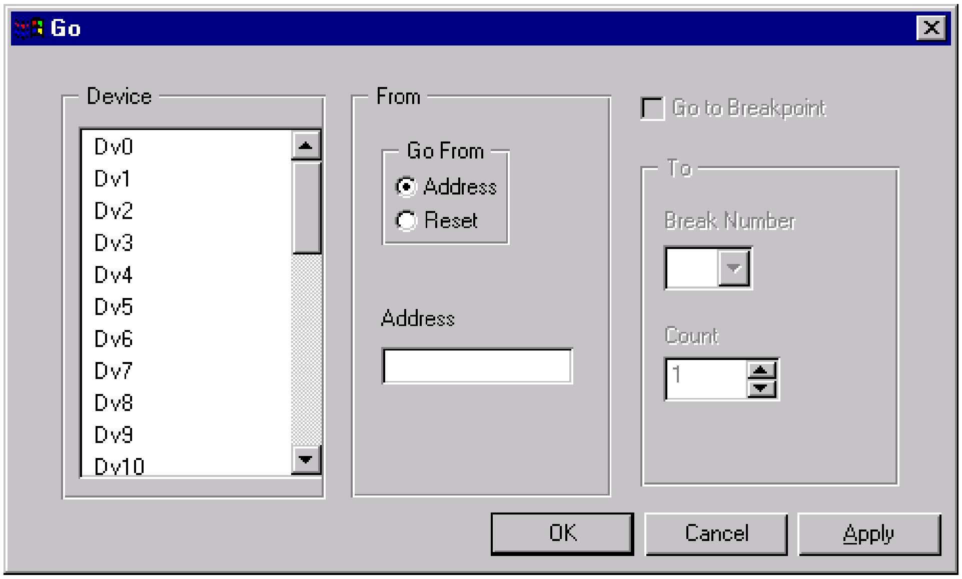


Figure 3-1. Executing Instructions with Go

2. Under **Go From**, choose **Address** or **Reset**.
   If you choose **Reset**, the Debugger simulates the reset sequence in the processor. The instruction pipeline, instruction counter, and cycle counter will be cleared before program simulation begins. The device registers are reset and execution begins at the reset exception address.
3. If you chose to go from an address, under **Address**, type in the address from which you want to begin executing instructions. If you leave the address blank, execution will begin from the current program counter value. If you specify an address, the instruction pipeline, instruction counter, and cycle counter will be cleared before program simulation. Execution will begin from the address you specify.
4. Select the **Go to Breakpoint** checkbox if you want to stop execution at a particular breakpoint. If selected, all other stop breakpoints will be ignored.
5. Under **Break Number** select the breakpoint where you want to stop execution. To see where you have breakpoints set **Display the Current Breakpoints** in the breakpoint window.
6. Under **Count** specify how many times the Debugger should encounter the breakpoint before stopping. For example, if you set the count to 3, the program execution will be stopped on the third time that the breakpoint is encountered. The last instruction executed will be the breakpoint.
7. When all conditions are set, click **OK**. Execution will begin.

Notice that during execution, the status bar in the lower left corner of the Debugger window shows the number of the device where execution is taking place, the PC (program counter), and the cycle count (updated every 1,000 cycles).

As an alternative, you can start program execution using the **GO** button located on the toolbar.

For more information see section 5.1, “Resetting the Device Registers.” Also see section 13.24, “GO - Execute DSP Program,” in Chapter 13, “Debugger Command Reference.”

3.2 Step Through Instructions

You can specify the number of instructions or lines that you would like the Debugger to execute before stopping.

Performing a step through instructions is similar to performing a trace except that the display of the registers and memory blocks occurs only after the specified number of lines or instructions have been executed.

Executing instructions with **step** is also similar to executing the **next** instruction. The important difference between using **step** as opposed to **next** is the way subroutines and macros are handled. (Remember that for the Debugger to recognize macros, the symbolic debug information for the source code must have been included when it was compiled.)

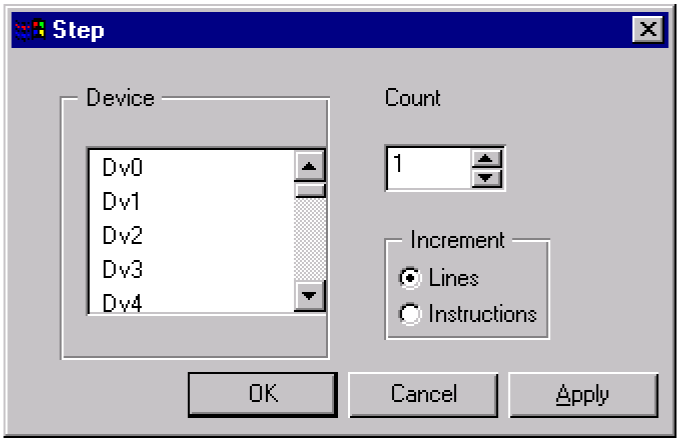
If one of the instructions being stepped through calls a subroutine or begins execution of a macro, the instructions of the subroutine or macro are counted towards the number of instructions that have been stepped. (Some developers refer to this as stepping through the subroutine.) For example, let’s suppose that you indicate to the Debugger to execute the next five instructions. Let’s further suppose that the third instruction is a JSR (a jump to a subroutine) and that the subroutine contains fourteen instructions. Execution will occur in the following manner:

- the first two instructions are executed
- the third instruction (a JSR) calls a subroutine
- the next two instructions of the subroutine are executed (the rest of the subroutine will not be executed because a total of five instructions have now been stepped through)

If by stepping through a subroutine, as in the above example, the end of the subroutine is not reached you can indicate to the Debugger that it should allow the current function to finish.

3.2.1 To Step Through Program Instructions

1. From the **Execute** menu choose **Step**. The dialog box in Figure 3-2 appears.



Step

Device

Dv0
Dv1
Dv2
Dv3
Dv4

Count

1

Increment

● Lines

○ Instructions

Figure 3-2. Step Through Program Instructions

2. Under **Device**, select the device on which you are debugging.
3. Under **Increment**, select whether to step by lines or instructions.
(You can only specify lines if the object code includes debugging information.)
4. Under **Count**, specify the number of lines or instructions to step.
5. Click **OK**.

Notice that the values in the register window, the memory window, and all other Debugger windows are updated after the last line or instruction is executed.

As an alternative, you can use the **STEP** Button on the toolbar to step one instruction or line at a time.

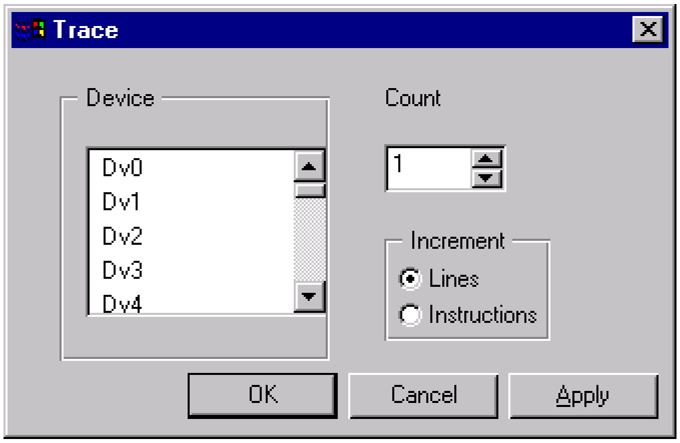
Using the step command from the command line is covered in section 13.39, “STEP - Step Through DSP Program,” on page 13-46 of Chapter 13, “Debugger Command Reference.”

3.3 Trace the Execution of Instructions

You can look at a snap shot of the enabled registers and memory after each instruction or line is executed by tracing program execution.

3.3.1 To Trace Program Execution

1. From the **Execute** menu choose **Trace**. The dialog box in Figure 3-3 appears.



Count: 1

Increment: ● Lines ○ Instructions

Figure 3-3. Trace Program Execution

2. Under **Device**, select the device on which you are debugging.
3. Under **Increment** select whether to trace each line or instruction.
   (You can only specify lines if the object code includes debugging information.)
4. Under **Count** specify the total number of lines or instructions to trace Execution will stop after this number of lines/instructions.
5. Click **OK**.

Notice that the values in the Register window, the Memory window, and other Debugger windows are updated after each line or instruction is executed. Because these values are updated at the speed of execution, they will pass by very quickly. In order to review the values, scroll back through the Session window once execution has stopped. It is often useful to log output from the Session window log.

Using trace from the command line is covered in section 13.42, “TRACE - Trace Through DSP Program,” on page 13-48 of Chapter 13, “Debugger Command Reference.”

3.4 Executing the Next Instruction

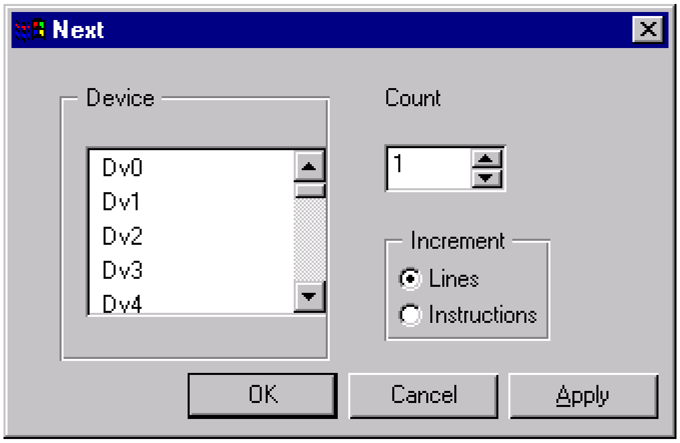
You can specify the number of instructions or lines that you would like the Debugger to execute before stopping. Executing the next specific number of instructions is a quick way to control execution without having to set a breakpoint.

Executing instructions with **next** is similar to performing a step through instructions except that you can only specify the number of lines or instructions, and not cycles. Like stepping through instructions, the display of the registers and memory blocks occurs only after the specified number of lines or instructions have been executed.

The important difference between using **next** as opposed to **step** is the way subroutines are handled. If the next instruction to be executed calls a subroutine or begins execution of a macro, all the instructions of the subroutine or macro are executed before execution is stopped. The enabled registers, memory, and other updated values are then displayed. (In order to recognize macros, the symbolic debug information for the program code must be loaded. The debug information is included in the COFF format .cld files generated using the Motorola Suite56 Assembler's `-g` option.)

3.4.1 To Execute the Next Program Instruction

1. From the **Execute** menu choose **Next**. The dialog box in Figure 3-4 appears.



Count: 1

Increment: ● Lines ○ Instructions

Figure 3-4. Executing the Next Program Instruction

2. Under **Increment**, select whether to execute by lines or instructions.
3. Under **Count**, specify the number of lines or instructions to execute
4. Select the checkbox labeled **Halt at Breakpoints** if you want breakpoints to be observed. If the checkbox is not selected, breakpoints will be ignored and will not halt program execution.
5. Click **OK**.

Notice that the values in the register window, the memory window, and all other Debugger windows are updated after the last line or instruction is executed.

As an alternative, you can use the **Next** button on the toolbar to execute the next instruction or line.

Using next from the toolbar is covered in section 11.4, “Next Button,” on page 11-4. Using next from the command reference line is coverd in section 13.32, “NEXT - Step Through Subroutine Calls or Macros,” on page 13-39.

3.5 Providing an Until Condition

You can provide an **until** condition which will cause the Debugger to execute the currently loaded program until a specified location is encountered. The location may be specified as a program line number, an address, or a label.

3.5.1 To Provide an Until Condition

1. From the **Execute** menu, choose **Until**. The dialog box in Figure 3-5 appears.

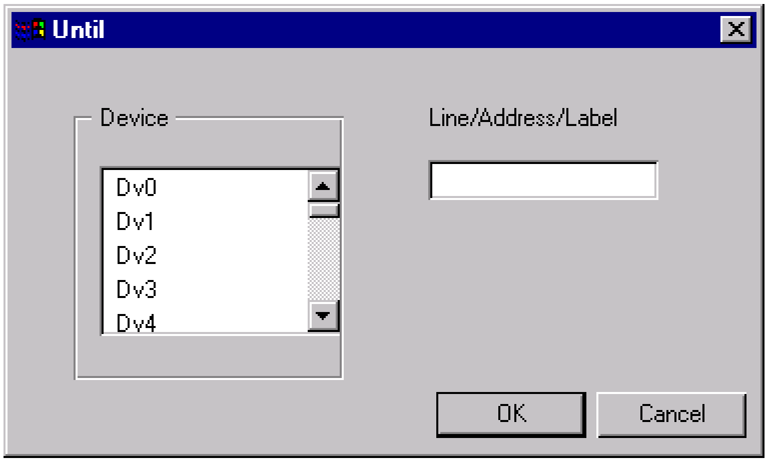


Figure 3-5. Providing an Until Condition

2. Under **Device**, select the device on which you are debugging.

   Type the line, address or label at which to stop execution. (Line numbers and labels can only be used if the object code includes debugging information.)
   To specify an address, include the memory space followed by a colon, followed by the address. For example, to execute instructions until address $00c103 is reached, type:

   ```
   p:$00c103
   ```

   To specify a line number in the currently loaded source file, just type in the line number. Or to specify a line number of a particular source file, include the filename. For example, to execute until line number 20 of a source file named clrmem.cld located in the working directory, type:

   ```
   clrmem@20
   ```

3. Click **OK**.

Using **until** from the command line is covered in section 13.45, “UNTIL - Step Until Address,” on page 13-50 .

3.6 Software Breakpoints

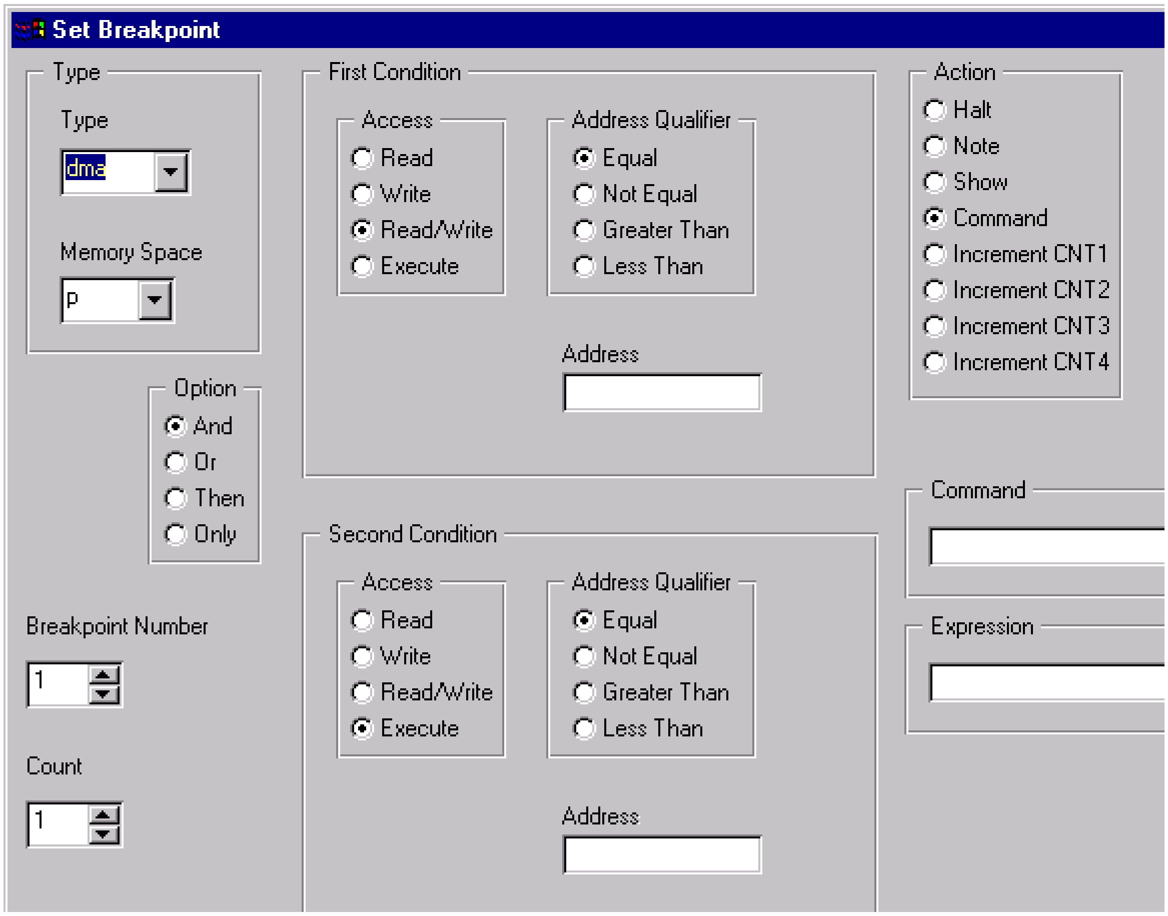
Software breakpoints are used to specify that a particular action be taken whenever a certain condition is met. In this way, software breakpoints are very similar to hardware breakpoints. However, software breakpoints are more limited than hardware breakpoints in that:

- software breakpoints can only be set on the first word of an instruction (they cannot be set to detect the access of registers or data memory)
- software breakpoints must be set in RAM (they cannot be set in ROM)

Despite the above limitations, it is recommended that you use software breakpoints instead of hardware breakpoints whenever possible. Why? Because, effectively only one hardware breakpoint can be set at a time whereas a virtual unlimited number of software breakpoints can be set.

3.6.1 To Set a Software Breakpoint

1. From the **Execute** menu, choose **Breakpoints**, then select **Set Software**. The **Set Breakpoint** dialog box shown in Figure 3-6 appears.



Set Breakpoint

Type
Type: dma
Memory Space: P

Option
● And
○ Or
○ Then
○ Only

Breakpoint Number: 1

Count: 1

First Condition
Access: ○ Read ○ Write ● Read/Write ○ Execute
Address Qualifier: ● Equal ○ Not Equal ○ Greater Than ○ Less Than
Address:

Second Condition
Access: ○ Read ○ Write ○ Read/Write ● Execute
Address Qualifier: ● Equal ○ Not Equal ○ Greater Than ○ Less Than
Address:

Action
○ Halt
○ Note
○ Show
● Command
○ Increment CNT1
○ Increment CNT2
○ Increment CNT3
○ Increment CNT4

Command:

Expression:

Figure 3-6. Setting a Software Breakpoint

2. Under **Breakpoint Number** select the number you want to assign to this breakpoint. The default number that is shown is the next available number. Breakpoint numbers do not have to be consecutive, they can be assigned arbitrarily. For example, it may be convenient to allocate breakpoints so that one function is assigned breakpoints 1 to 10, another 11 to 20, and so on.

3. Under **Count** specify how many times the Debugger should encounter the breakpoint before performing the action. For example, if you set the count to 3, the breakpoint will be triggered the third time that the breakpoint is encountered. Real time execution will be affected if you set the count to more than one.

4. If you have assigned an input file, you can mark EOF. The breakpoint will be acted upon when the input file reaches an end-of-file. If you have marked EOF, under **Input File Number** select the number of the input file. The input file number is the number that you designated when you assigned the input file.

5. Under **Type** select the type of software breakpoint to set. If you select **al**, the breakpoint will always be acted upon. Breakpoint types other than **al** are conditional and device specific. See Table 3-1 for a list of software breakpoints.
6. Under **Address**, type the address where you want the breakpoint to be set. For example, to set a breakpoint at address $103 in p memory, type: `p:$103`

Note: This address *must* be the first word of an instruction.

Note: If you have set the breakpoint type (in step 5) to a conditional breakpoint (that is, any type other than al), the breakpoint can *only* be set to an address which contains a nop. Setting the breakpoint to an address which contains any other opcode will cause your program to execute incorrectly.

7. Under **Expression** you can type an expression. The expression will be evaluated when the address you specified is reached. If the expression is true, the breakpoint will be triggered. If the expression is false, no action is taken and program execution continues. Be aware that a side effect of evaluating an expression (whether it is true or false) is that the program will not be executed in real time.
8. Under **Action** select what action is taken when the breakpoint is encountered:

Table 3-1. Software Breakpoint Actions

Breakpoint	Resulting Action
Halt	Stops program execution when the breakpoint is encountered.
Note	Displays the breakpoint expression in the Session window each time it is true. Program execution continues. The display in the Session window is not updated until program execution stops.
Show	Displays the enabled register/memory set. Program execution continues.
Command	Executes a Debugger command at the breakpoint. Device execution commands, such as TRACE or GO, will not execute.
Increment[n]	Increments the n counter by one.

9. If the action specified is to execute a command, under **Command** type the Debugger command.
10. Click **OK**.

3.6.2 To Clear a Software Breakpoint

1. From the **Execute** menu, choose **Breakpoints**, then select **Clear**.
   The **Clear Breakpoints** dialog box (shown in Figure 2-7 on page 2-14) displays a list of all the current breakpoints.
2. Select the breakpoint you want removed so that it is highlighted.
   If you are clearing consecutive breakpoints, you can click and drag to highlight more than one breakpoint. Or hold down the CTRL key while clicking on breakpoints to select more than one.
3. Click **OK**.
   The breakpoints you selected are now deleted.
   Breakpoints will not be renumbered. For example, if you have set breakpoints #1, #2, and #3, and then clear breakpoint #2, the remaining breakpoints will be numbered #1 and #3.

Notice that breakpoints are indicated in the Assembly window and the Source window (if applicable). Enabled breakpoints appear in blue. Disabled breakpoints appear in pink.

For more information see section 2.7, “Setting and Clearing Hardware Breakpoints,” section 3.10, “Enabling and Disabling Breakpoints,” on page 3-22, Chapter 10, “Expressions,” section 12.2, “Display the Current Breakpoint,” on page 12-2, and section 13.5, “BREAK - Set, Modify, or Clear Breakpoints,” on page 13-10 in Chapter 13, “Debugger Command Reference.”

3.7 Types of Software Breakpoints

There are several types of software breakpoints that you can set with the Debugger. The types that are available to you depend on the device on which you are debugging. Look below for the device that matches your device to see the software breakpoints that are available to you.

3.7.1 DSP56000, DSP56100, DSP56300, and DSP56600 Families

The DSP56000, DSP56300, and 56600 device families recognize the **DEBUGcc** opcode, where cc represents a conditional code. The **DEBUGcc** opcode is used to indicate that the device should enter into the debug mode if the specified conditional code (**cc**) is true. See Motorola DSP family manual specific to the device you are debugging for more information on the **DEBUGcc** and **cc** opcodes.

Table 3-2. Software Breakpoints (DEBUGcc) Available on the DSP56000, DSP56100, DSP56300, and DSP56600

Breakpoint Type (cc)	Meaning	Condition Code Bit(s) *
`cc or hs`	carry clear	`C = 0`
`cs or lo`	carry set	`C = 1`
`ec`	extension clear	`E = 0`
`eq`	equal	`Z = 1`
`es`	extension set	`E = 1`
`ge`	greater or equal	`N (xor) V = 0`
`gt`	greater than	`Z or (N (xor) V) = 0`
`lc`	limit clear	`L = 0`
`le`	less or equal	`Z or (N (xor) V) = 1`
`ls`	limit set	`L = 1`
`lt`	less than	`N (xor) V = 1`
`mi`	minus	`N = 1`
`ne`	not equal	`Z = 0`
`nr`	normalized	`Z or (Not U (and) Not E) = 1`
`pl`	plus	`N = 0`
`nn`	not normalized	`Z or (Not U (and) Not E) = 0`
`al`	always	`N.A. (not conditional)`

* **(and)** denotes the logical AND operator
(xor) denotes the logical Exclusive OR operator
or denotes the logical OR operator

3.7.2 DSP96002 Device Family

The DSP96002 recognizes the **FDEBUGcc** and the **DEBUGcc** opcode, where **cc** represents a conditional code. The FDEBUGcc opcode is used to indicate that the device should enter into the debug mode if the specified floating-point conditional code (**cc**) is true. See the DSP96002 User’s Manual for more information on the **FDEBUGcc** opcode and the **DEBUGcc** opcode.

Table 3-3. Software Breakpoints (FDEBUGcc) Available on the DSP96002

Breakpoint Type	Meaning	Condition Code Bit(s)
`eq`	equal	`Z = 1`
`err`	error	`UNCC or SNAN or OPERR or OVF or UNF or DZ = 1`
`ge`	greater or equal	`NAN or (N and ~Z)= 0`
`gl`	greater or less than	`NAN or Z = 0`
`gle`	greater, less or equal	`NAN = 0`
`gt`	greater than	`NAN or Z or N = 0`
`inf`	infinity	`I = 1`
`le`	less or equal	`NAN or ~(N or Z) = 0`
`lt`	less than	`NAN or Z or ~N = 0`
`mi`	minus	`N = 1`
`ne`	not equal	`Z = 0`
`nge`	not (greater or equal)	`NAN or (N and ~Z) = 1`
`ngl`	not (greater or less)	`NAN or Z = 1`
`ngle`	not (greater, less or equal)	`NAN = 1`
`ngt`	not greater than	`NAN or Z or N = 1`
`ninf`	not infinity	`I = 0`
`nle`	not (less than or equal)	`NAN or ~(N or Z) = 1`
`nlt`	not less than	`NAN or Z or ~N = 1`
`or`	ordered	`NAN = 0`
`pl`	plus	`N = 0`
`un`	unordered	`NAN = 1`

For more information see section 3.6, “Software Breakpoints,” and section 3.9, “Types of Hardware Breakpoints.”

3.8 Hardware Breakpoints

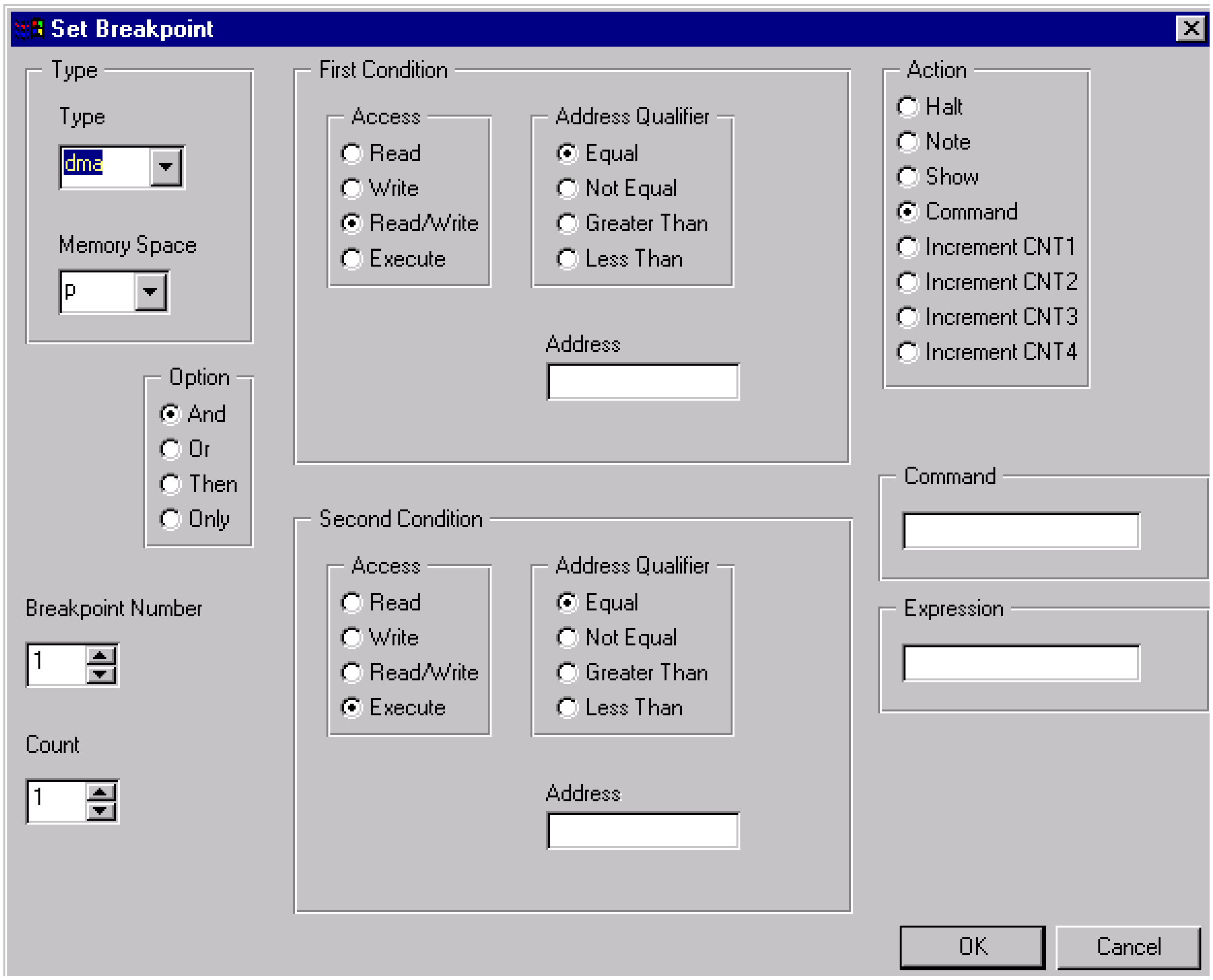
Hardware breakpoints are used to specify that a particular action be taken whenever a certain condition is met. In this way, hardware breakpoints are very similar to software breakpoints. However, there are some differences. Hardware breakpoints:

- use the OnCE circuitry on the device
- can break on the execution of an instruction
- can be set in ROM or RAM
- can be set to detect an access of data memory

Although hardware breakpoints are more flexible than software breakpoints, you will want to use hardware breakpoints judiciously. In effect, only one hardware breakpoint can be enabled at any time.

3.8.1 To Set a Hardware Breakpoint:

1. From the **Execute** menu, choose **Breakpoints**, then select **Set Hardware**. The dialog box in Figure 3-7 appears.



Set Breakpoint

Type
Type: dma
Memory Space: p

Option
● And
○ Or
○ Then
○ Only

Breakpoint Number: 1

Count: 1

First Condition
Access: ○ Read ○ Write ● Read/Write ○ Execute
Address Qualifier: ● Equal ○ Not Equal ○ Greater Than ○ Less Than
Address:

Second Condition
Access: ○ Read ○ Write ○ Read/Write ● Execute
Address Qualifier: ● Equal ○ Not Equal ○ Greater Than ○ Less Than
Address:

Action
○ Halt
○ Note
○ Show
● Command
○ Increment CNT1
○ Increment CNT2
○ Increment CNT3
○ Increment CNT4

Command:

Expression:

Figure 3-7. Setting a Hardware Breakpoint

2. Under **Type** select the type of hardware breakpoint to set. Breakpoint types are device specific. See Table 3-4 for an explanation of each type of breakpoint.
3. Under **Memory Space**, select the memory space in which the breakpoint is to be set.
4. Under **First Condition** specify the conditions under which the breakpoint occurs. Under **Access** indicate what kind of access should be detected by the breakpoint. For example, if you want the breakpoint to detect when a memory location is read but not written to, select **Read**. If you want either a read or a write to be detected, chose **Read/Write**, etc.
   Under **Address Qualifier** indicate the qualifier for the address location.
   Under **Address** type the address that the breakpoint references.
5. Under **Option**, indicate whether a second condition should be considered. **And** indicates that both conditions must be met to trigger the breakpoint. **Or** indicates that either condition can be met. **Then** indicates that the **First Condition** must be

satisfied followed by the **Second Condition**. **Only** indicates that only the first condition must be met to trigger the breakpoint.

6. Under **Second Condition** specify the conditions for the second condition. This will only apply if you have indicated so under **Option** in step 5.
7. Under **Breakpoint Number** select the number you want to assign to this breakpoint. The default number shown is the next available number.
   Breakpoint numbers do not have to be consecutive, they can be assigned arbitrarily. For example, it may be convenient to allocate breakpoints so that one function is assigned breakpoints 1 to 10, another uses 11 to 20, and so on.
8. Under **Count** specify how many times the Debugger should encounter the breakpoint before stopping. For example, if you set the count to 3, the breakpoint will be triggered the third time that the breakpoint is encountered.
   Specifying a count will not affect real time execution.
9. Under **Expression** you can type an expression. The expression will be evaluated when the first (and second) condition you specified is satisfied. If the expression is true, the breakpoint will be triggered. If the expression is false, no action is taken and program execution continues.
10. Under **Action** select what action is taken when the breakpoint is encountered. Table 3-4 lists the possible choices.

Table 3-4. Hardware Breakpoint Actions

Breakpoint	Resulting Action
Halt	Stops program execution when the breakpoint is encountered.
Note	Displays the breakpoint expression in the Session window each time it is true. Program execution continues. The display in the Session window is not updated until program execution stops.
Show	Displays the enabled register/memory set. Program execution continues.
Command	Executes a Debugger command at the breakpoint. Device execution commands, such as TRACE or GO, will not execute.
Increment[n]	Increments the n counter by one.

11. If the action specified is to execute a command, under **Command** type the Debugger command.
12. Click **OK**.

3.8.2 To Clear a Hardware Breakpoint

1. From the **Execute** menu, choose **Breakpoints**, then select **Clear**.
   The **Clear Breakpoints** dialog box (shown in Figure 2-7 on page 2-14) displays a list of all the current breakpoints.
2. Select the breakpoint you want removed so that it is highlighted.
   If you are clearing consecutive breakpoints you can click and drag to highlight more than one breakpoint. Or hold down the CTRL key while clicking on breakpoints to select more than one.
3. Click **OK**.
   The breakpoints you selected are now deleted.
   Breakpoints will not be renumbered. For example, if you have set breakpoints #1, #2, and #3, and then clear breakpoint #2, the remaining breakpoints will be numbered #1 and #3.

Notice that breakpoints are indicated in the Assembly window and the Source window (if applicable). Enabled breakpoints appear in blue. Disabled breakpoints appear in pink.

For more information see section 2.6, “Setting and Clearing Software Breakpoints,” section 3.10, “Enabling and Disabling Breakpoints,” Chapter 10, “Expressions,” and section 12.2, “Display the Current Breakpoint.” The command reference line option for hardware breakpoints is covered in section 13.5, “BREAK - Set, Modify, or Clear Breakpoints,” in Chapter 13, “Debugger Command Reference.”

3.9 Types of Hardware Breakpoints

There are several types of hardware breakpoints that you can set. The types that are available to you depend on the device on which you are debugging. Table 3-5 through Table 3-10 provide detailed breakpoint information for each Suite56 device family supported the by the Suite56 debugger.

Table 3-5. DSP56000 Device Family Hardware Breakpoint Types

Breakpoint Type	Meaning
`pcf`	break on any Program core fetch (read only)
`pcm`	break on Program read (fetch or move – read only)
`pcfm`	break on Program access (fetch or P move – r/w)
`pce`	break on executed fetch only (read only)
`pa`	break on Program access (r/w)
`xa`	break on X data memory access (r/w)
`ya`	break on Y data memory access (r/w)

Table 3-6. DSP56100 Device Family Hardware Breakpoint Types

Breakpoint Type	Meaning
`pcf`	break on any Program core fetch (read only)
`pcm`	break on Program read (fetch or move – read only)
`xab1`	break on X address bus 1 access
`xab2`	break on X address bus 2 access

Table 3-7. DSP56300 Device Family Hardware Breakpoint Types

Breakpoint Type	Meaning
`dma`	break on DMA access (r, w, or r/w)
`pa`	break on Program access (r, w, or r/w)
`xa`	break on X data memory access (r, w, or r/w)
`ya`	break on Y data memory access (r, w, or r/w)

Table 3-8. DSP56600 Family Hardware Breakpoint Types

Breakpoint Type	Meaning
`pa`	break on Program access (r, w, or r/w)
`xa`	break on X data memory access (r, w, or r/w)
`ya`	break on Y data memory access (r, w, or r/w)

Table 3-9. DSP56800 Family Hardware Breakpoint Types

Breakpoint Type	Meaning
`pcf`	break on any Program core fetch (read only)
`pcm`	break on Program read (fetch or move – read only)
`xab1`	break on X address bus 1 access

Table 3-10. DSP96000 Family Hardware Breakpoint Types

Breakpoint Type	Meaning
`pcf`	break on any Program core fetch (read only)
`pcm`	break on Program read (fetch or move – read only)
`pcfm`	break on Program access (fetch or P move – r/w)
`pdma`	break on Program memory DMA access
`xa`	break on X data memory access (r/w)
`ya`	break on Y data memory access (r/w)
`xdma`	break on X memory DMA access
`ydma`	break on Y memory DMA access

For more information see section 3.7, “Types of Software Breakpoints,”and section 3.8, “Hardware Breakpoints.”

3.10 Enabling and Disabling Breakpoints

Breakpoints can be enabled and disabled. While disabled, breakpoints have no effect on DSP program execution, and do not cause any of the actions associated with the breakpoint.

1. From the Execute menu, choose Breakpoints, then select **Enable** or **Disable**. A dialog box similar to the one in Figure 3-8 appears.

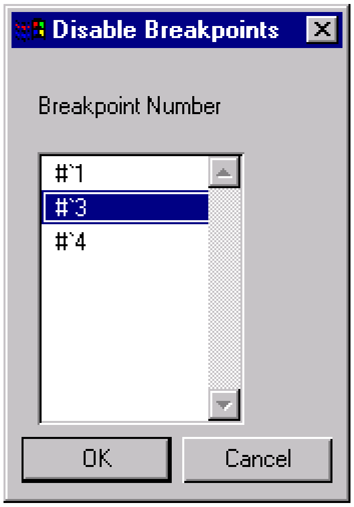


Figure 3-8. Disable Breakpoints Dialog Box

2. Highlight the breakpoint that you want enabled or disabled.
3. Click **OK**.
   You can see a list of all breakpoints by displaying the current breakpoint. .

The Debugger also indicates breakpoints in the Assembly window and Source window. In the Assembly window and Source window, enabled breakpoints appear in blue. Disabled breakpoints appear in pink.

For information about setting breakpoints from the command line, see section 13.5, “BREAK - Set, Modify, or Clear Breakpoints,” on page 13-10.

See section 3.6, “Software Breakpoints,”and section 3.8, “Hardware Breakpoints,” for more information about the uses of breaktpoints in debugging with the Suite56 Debugger.

3.11 Using Expressions in Breakpoints

It is possible to use expressions in conjunction with both software breakpoints and hardware breakpoints. When a breakpoint is reached the expression is evaluated. If the expression is true, the action indicated by the breakpoint is taken. If the expression is false, no action is taken and program execution continues

A valid expression can consist of a combination of symbols, constants, operators, and parentheses. Expressions follow the conventional rules of algebra and Boolean arithmetic and might contain any combination of integers, floating point numbers, memory space symbols or register symbols. Table 3-11 lists the operators that can be used in the breakpoint expression.

Table 3-11. List of Operators

Syntax	Description
<	less than
&&	logical "and"
<=	less than or equal to
||	logical "or"
==	equal to
!	logical "negate"
>=	greater than or equal to
&	bitwise "and"
>	greater than
|	bitwise "or"
!=	not equal to
~	bitwise one’s complement
+	addition
^	bitwise "exclusive or"
-	subtraction
<<	shift left
/	division
>>	shift right

Register names can also be used in the expression. A breakpoint expression usually involves comparison of register or memory values.

C expressions can also be used. Remember to enclose C expressions in curly bracket: {c_expression}.

You can find more information about expressions in Chapter 10, “Expressions.” You can find more information about setting breakpoints in section 3.6, “Software Breakpoints,” on page 3-9 and section 3.8, “Hardware Breakpoints,” on page 3-16.

3.12 Pausing Execution with Wait

You can pause program execution by specifying the number of seconds you want the Debugger to wait. Execution resumes after the pause.

This is particularly useful when writing a command macro. That is, if you cause the Debugger to **wait** while logging commands, you can then save the log file. A command macro results. The pause that was recorded while logging commands will be replayed when the macro is executed. This provides a useful way to pause execution so that you can examine certain values or windows.

3.12.1 To Pause Execution

1. From the **Execute** menu, choose **Wait**.
2. Select the number of seconds to pause or click on the checkbox marked **Forever** to pause indefinitely.
3. Click **OK**.
4. An information box appears to let you know that the Debugger is paused. If you don’t want to wait for the pause to end automatically, you can resume program execution by clicking on **Cancel**.
   Keep in mind that if you click cancel while recording a command macro that the cancellation of the pause is not recorded. So, for example, if you specify a **wait** of ten seconds and then cancel after three, when the command macro executes, it will pause for the full ten seconds.

See section 9.1, “Creating and Running a Command Macro,” on page 9-1 for more information about using macros with the Debugger. To use **wait** from the command line, see section 13.48, “WAIT - Wait Specified Time,” on page 13-51.

3.13 Allowing the Current Function to Finish

Sometimes you will find that program execution has stopped while in the middle of executing a subroutine or function. This might occur for several reasons. It might occur because you specified that a certain number of steps be executed which happened to end in the middle of the subroutine. Or an **until** condition or breakpoint might be reached while in the middle of a subroutine.

In any instance where the Debugger has stopped execution in the middle of a subroutine or function, the subroutine or function can be made to finish execution.

3.13.1 To Finish Execution of the Current Function or Subroutine

1. From the **Execute** menu, choose **Finish**
   The Debugger continues until encountering an RTS instruction.
   Execution continues only to the end of the current function. If another function is encountered during a **finish** operation, the execution of the function that was encountered is not completed.

As an alternative, you can also use the **Finish** button on the toolbar.

To use the **finish** command from the command line, see section 13.21, “FINISH - Step Until End of Current Subroutine,” on page 13-28.

More information about the **finish** command is available in section 3.2, “Step Through Instructions,” and section 3.4, “Executing the Next Instruction,”

3.14 Stopping Program Execution

You can stop program execution or the execution of a command macro at any time.

3.14.1 To Stop Program or Command Macro Execution

1. From the **Execute** menu, choose **Stop**.
   Notice that this is the only menu item you can choose while program or command macro execution is in progress.
   Keep in mind that if you began the execution by providing an **until** condition then this temporary breakpoint will be cleared.
   In the Assembly window (and the Source window if applicable) the next instruction to be executed is highlighted in red.

When program execution is stopped the Session window will display **Simulation aborted**. Notice that the values in the Session window, the Register window, the Memory window, and all other Debugger windows are updated to reflect the last instruction or line that was executed.

As an alternative, you can also use the **Stop** button on the toolbar to stop program execution.

For more information related to using **stop** see section 3.5, “Providing an Until Condition,” and section 5.1, “Resetting the Device Registers,” on page 5-1. To use stop from the command line, see section 3.14, “Stopping Program Execution.”

Chapter 4
Object Files and Data Files

This chapter describes how to set and change the path of the working directory and how to load and save object files.

4.1 Displaying the Current Path

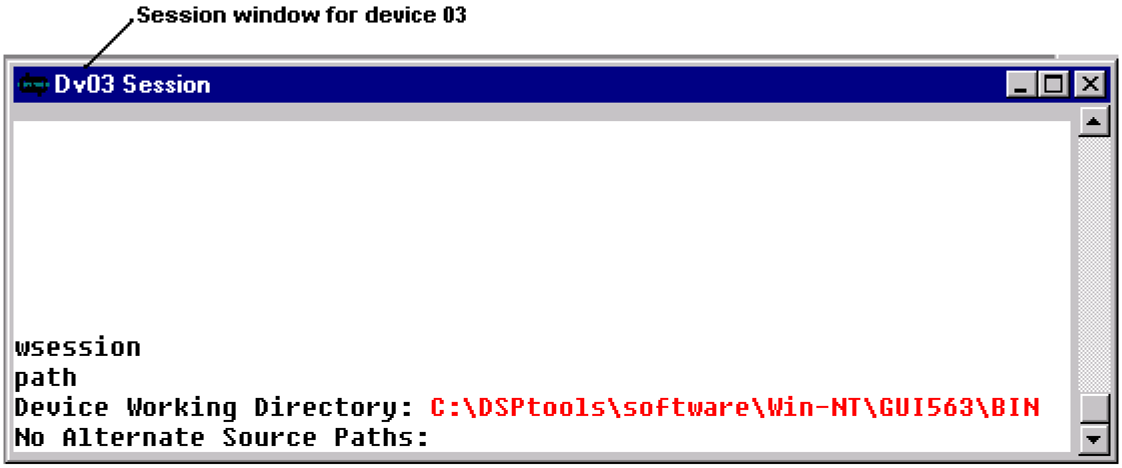
The Suite56 DSP Debugger makes use of two types of paths for saving and accessing files:

- the working directory
- alternate directories

The working directory is the default directory the Debugger uses when searching for an input file or object file (assuming no path is explicitly specified with the filename). Alternate directories are also searched, in turn, if an input file or object file are not found in the working directory.

4.1.1 To Display the Current Paths

1. From the **Display** menu, choose **Path**.
2. Open the Session window if not already open. The window in Figure 4-1 appears. You will see the current working directory and the alternate source paths displayed.



```
wsession
path
Device Working Directory: C:\DSPtools\software\Win-NT\GUI563\BIN
No Alternate Source Paths:
```

Figure 4-1. Displaying Current Paths

Keep in mind that a separate directory path is maintained for each device. This means that as you switch from one device to another, the working directory also changes according to the current device. The device number of the current device is indicated in the top left corner of the Session window.

For more information see section 2.2, “Setting and Clearing the Path,” on page 2-2, and section 7.1, “Setting the Default Device,” on page 7-3. To set or clear the path from the command line see section 13.34, “PATH - Define File Directory Path,” on page 13-42.

4.2 To Set the Working Directory Path

1. From the **File** menu choose **Path,** then select **Set**. A dialog box similar to the one in Figure 4-1 appears.

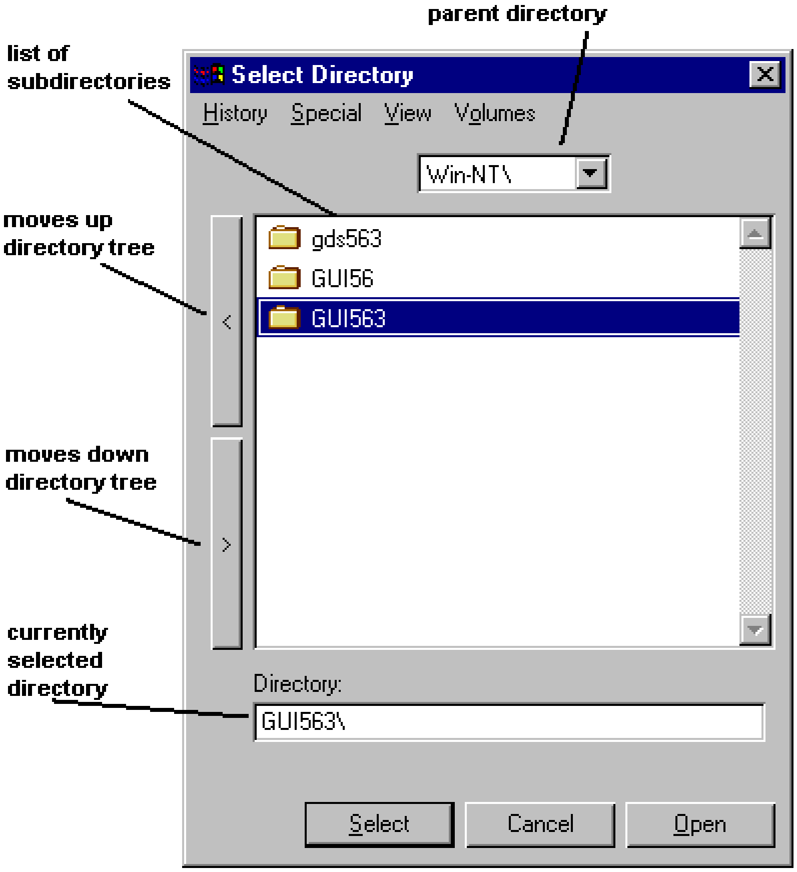


Figure 4-2. Setting the Working Directory Path

2. If appropriate, select another drive from the **Volumes** menu.

3. Move up or down the directory tree until the directory you want is in the list of subdirectories. There are a number of ways to do this. You can:
   — move up and down the directory tree with the left arrow and right arrow buttons;

   — move down the tree by double clicking in the list of subdirectories;

   — move up the tree by selecting a directory from the drop down box where the parent directory is displayed;

   — select a directory from the **History** menu, which shows recently selected directories.
4. Single click on the desired directory from the list of subdirectories so that it is highlighted.
   Notice that the highlighted directory appears in the area labeled **Directory**
5. Click on **Select**.
   The selected directory is now the working directory.

Note: From the **Display** menu, select **Path** to see the absolute path of the working directory

4.2.1 To Set an Alternate Path

1. From the **File** menu choose **Path**, then select **Add**.
2. If appropriate, select another drive from the **Volumes** menu.
3. Move up or down the directory tree until the directory you want is in the list of subdirectories.
4. Highlight the desired directory by single clicking on it in the list of subdirectories.
5. Click on **Select**.
   The selected directory is now added to the end of the list of alternate paths.

Note: From the **Display** menu, select **Path** to see the absolute path of the working directory

4.2.2 To Clear the Alternate Paths

1. From the **File** menu, choose **Path**, then select **Clear Alternate Path List**.
   The list of alternate paths is cleared for all devices. The path of the working directory is not cleared.
   Keep in mind that a separate working directory is maintained for each device. However, all devices share the same alternate directory paths. To be safe, always check the path of the working directory after adding a device or setting the default device.

Remember that in order to change the path of a device that is not currently the default device, you must first change the default device; see Section 7.2, “Setting the Default Device,” on page 7-4. To set the path from the command line, see Section 13.34, “PATH - Define File Directory Path,” on page 13-42.

4.3 Loading Object Files

You can load DSP Object Module Format (OMF) files or Common Object File Format (COFF) files directly into the Debugger memory. OMF files are identified by the .lod extension. COFF files are identified by the .cld extension. The Motorola Suite56 DSP Assembler generates both file formats.

You can also generate both of the file formats with the DSP Debugger when saving object files .

4.3.1 To Load a COFF (.cld) File

1. From the **File** menu, choose **Load,** then select **Memory COFF**.
2. Under **Load** select memory, debug symbols or both.
   The Debugger will process the symbol and line number information contained in a COFF format object file (.cld file) only if the file was compiled or assembled with debugging enabled. (In the Motorola DSP Assembler this is represented by the `–g` option.)
   If symbol information has been loaded, the evaluator will accept symbol names or source file line numbers and translate them into an associated memory address.
3. Under **Filename** specify the filename of the object file to load or click on the **File** button to browse for the file.
4. Click **OK**.
   If the .cld file is not found in the selected directory, the Debugger will try to load the file from the working directory. If the file does not exist in the working directory, the Debugger will try to load the file from the alternate directories. An error message is displayed if the file is not found in any of these directories.

4.3.2 To Load an OMF (.lod) File

1. From the **File** menu, choose **Load**, then select **Memory OMF**.
2. Specify the filename in the dialog box.
   It is not necessary to type the extension with the filename. The Debugger assumes the .lod extension.
3. Click **Open**.

Keep in mind that the object file is loaded into the memory of the current device. If you want to load the file into another device, you must first select that device as the default device.

For more information abut setting the default device see Section 7.2, “Setting the Default Device,” on page 7-4 and Section 7.4, “Loading Debugger State Files,” on page 7-7. To load an OMF file from the command line, see Section 13.29, “LOAD - Load DSP Files,” on page 13-36.

4.4 Saving Object Files

You can save memory blocks in DSP COFF or ASCII OMF object files. The object files can be reloaded with the Debugger or used in any other environment where such files are recognized.

4.4.1 To Save a COFF (.cld) File

1. From the **File** menu choose **Save**, then select **Memory COFF**. The dialog box in Figure 4-3 appears.

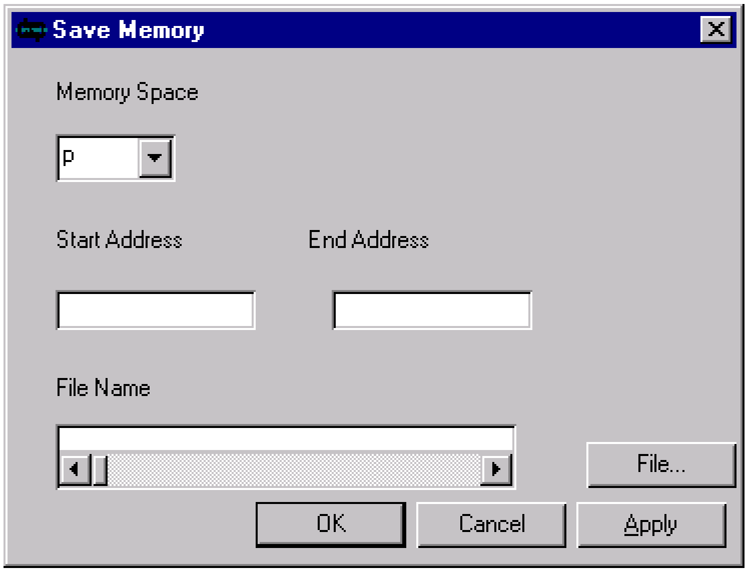


Figure 4-3. Saving a COFF (.cld) File

2. Under **Memory Space**, select the memory to save.
3. Under **Start Address**, type the beginning address of the memory block.
4. Under **End Address**, type the last address of the memory block.
5. Under **File Name**, type in the filename of the file to save or click on **File** to browse for the file.
6. The extension default is .cld.
7. Click **OK**.
   If no directory path is specified, the file will be saved in the working directory. If the file already exists, you will be prompted to decide whether to overwrite the file or to append it.
   The Debugger does not store symbolic debug information.

4.4.2 To Save an OMF (.lod) File

1. From the **File** menu, choose **Save**, then select **Memory OMF**.
2. Under **Memory Space**, select the memory to save.
3. Under **Start Address**, type the beginning address of the memory block.
4. Under **End Address**, type the last address of the memory block.
5. Under **File Name**, type in the filename of the file to save or click on **File** to browse the directories.
   The extension default is .lod.
6. Click **OK**.
   If no directory path is specified, the file will be saved in the working directory. If the file already exists, you will be prompted to decide whether to overwrite the file or to append it.

For more information about object files, see Section 2.3, “Loading Object Files,” on page 2-5. To save an OMF file from the command line, see Section 13.38, “SAVE - Save Memory To File,” on page 13-45.

4.5 Object Module Format

The DSP Object Module Format (OMF) is an ASCII file that can be produced by the Debugger, Motorola’s Suite56 DSP Simulator and also by versions of the Suite56 DSP Assembler prior to release 4.0. An OMF filename uses the .lod extension.

An OMF file consists of variable-length text records. Records can be defined with a fixed number of fields or can contain repeating instances of a given field (such as instructions or data).

4.6 Common Object File Format

The Motorola Suite56 DSP assembler and linker produce a binary object file in a modified form of the AT&T Common Object File Format (COFF). The DSP common object file format can also be produced by the Debugger when saving object files . A COFF filename uses the .cld extension.

COFF is a formal definition for the structure of machine code files. It originated with Unix System V but has sufficient flexibility and generality to be useful in non-hosted environments. In particular, COFF supports user-defined sections and contains extensive information for symbolic software testing and debugging.

The DSP COFF format has been altered to support multiple memory spaces and normalized to promote transportability of object files among host processors. For more information about Motorola's implementation of COFF, please refer to the *Motorola Suite56 DSP Assembler Reference Manual*.

For a more general discussion of COFF see Gintaras R. Gircys' book*, Understanding and Using COFF, O'Reilly & Associates, 1988 (ISBN 0-937175-31-5)*

Chapter 5
Managing Memory and Registers

This chapter discusses changing and displaying both memory and register values. You will also find information concerning dissasembling code stored in memory and the use of a watch list.

5.1 Resetting the Device Registers

You can reset the device registers or the entire system at any time.

To reset the device registers:

1. From the **Execute** menu choose **Reset**, then select **Device**.
   The device registers and peripherals are now reset to the initialized state of the device.

To reset the system:

1. From the **Execute** menu choose **Reset**, then select **System**.
   This resets the command converter and then resets the target devices, putting the target system into Debug mode.

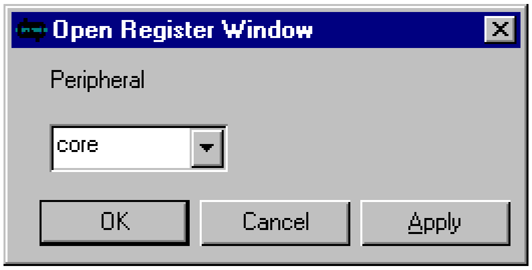
To reset the registers from the command line, see see,Section 13.22, “FORCE - Assert RESET or BREAK on Target,” on page 13-28.

5.2 Displaying Register Values

You can display the device registers and memory any time instruction execution is halted.

5.2.1 To Display the Value in a Register

1. From the **Windows** menu choose **Register**. The dialog box in Figure 5-1 appears.

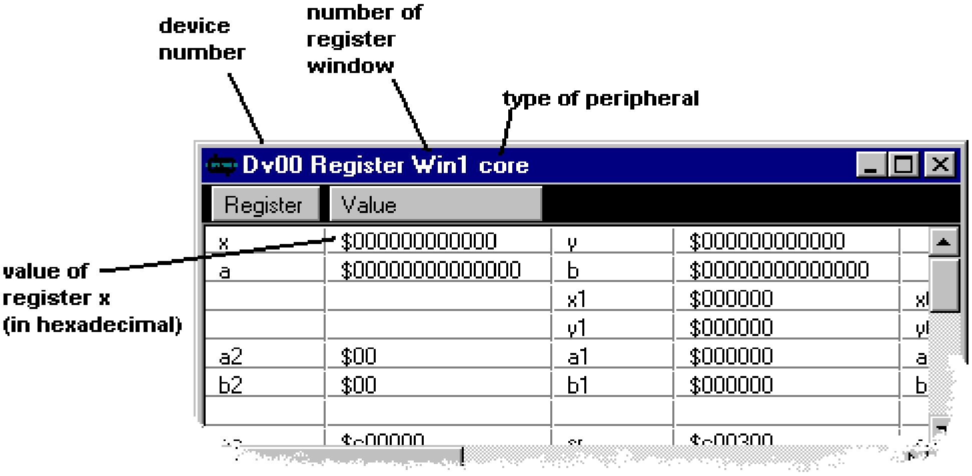


Peripheral: core

Figure 5-1. Open Register Window Dialog Box

2. Select the peripheral that you want to view.
3. Click **OK**.

The register values for the peripheral that you chose appear in a register window. For example, if you had chosen to display the register values for the core, you would see a window similar to the one in Figure 5-2.


device number
number of register window
type of peripheral
value of register x (in hexadecimal)
Dv00 Register Win1 core

Register	Value			
x	$000000000000	y	$000000000000	
a	$00000000000000	b	$00000000000000	
		x1	$000000	xl
		y1	$000000	yl
a2	$00	a1	$000000	a
b2	$00	b1	$000000	b
[illegible]	$c00000	sr	$c00300	

Figure 5-2. Displaying the Register Values

Notice that the title bar of the register window indicates:

- The device number where the peripheral resides,
- the number of the register window. This number is shown because you can display other register windows for other peripherals.
- the type of peripheral. The peripheral type is shown for easy identification. Several register windows can be open – each corresponding to a different peripheral.

5.3 Changing Register Values

You can change the value of the device registers when instruction execution is halted.

5.3.1 To Change the Value of a Specific Register

1. From the **Modify** menu choose **Change Register**. The dialog box in Figure 5-3 appears.

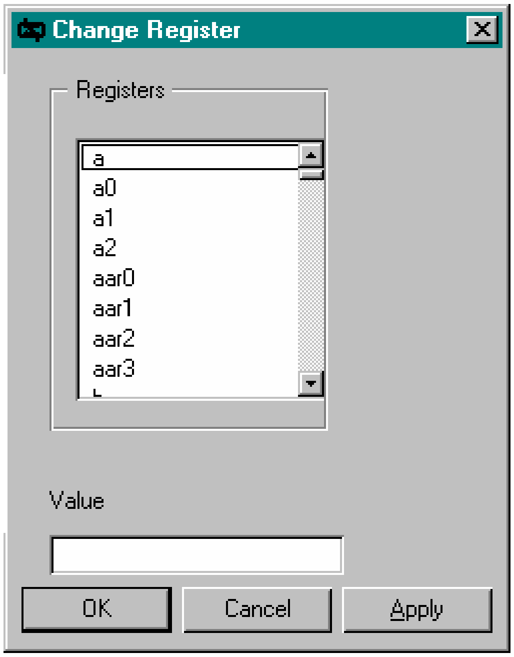


Figure 5-3. Changing the Value of Register

2. Select the register whose value you want to change.
3. Under **Value**, type in the value to which you want the register to be set.
4. Click **OK**.

More information about using registers is available in Section 10.3, “Using Register Name Symbols,” on page 10-3.

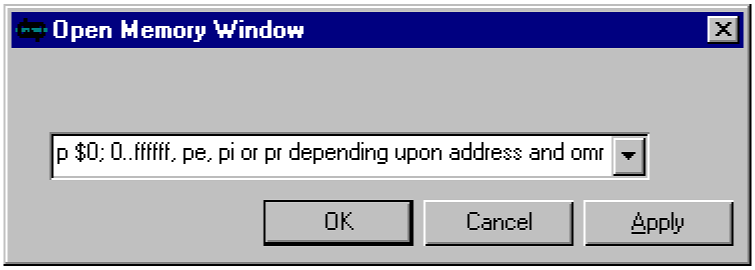
To work with registers from the command line, see Section 13.14, “CHANGE - Change Register or Memory Value,” on page 13-20 ,section 5.2, “Displaying Register Values.”

5.4 Displaying Memory Values

You can display the values in memory whenever instruction execution is halted.

5.4.1 To Display Memory Values

1. From the **Windows** menu choose **Memory** The dialog box in Figure 5-4 appears.



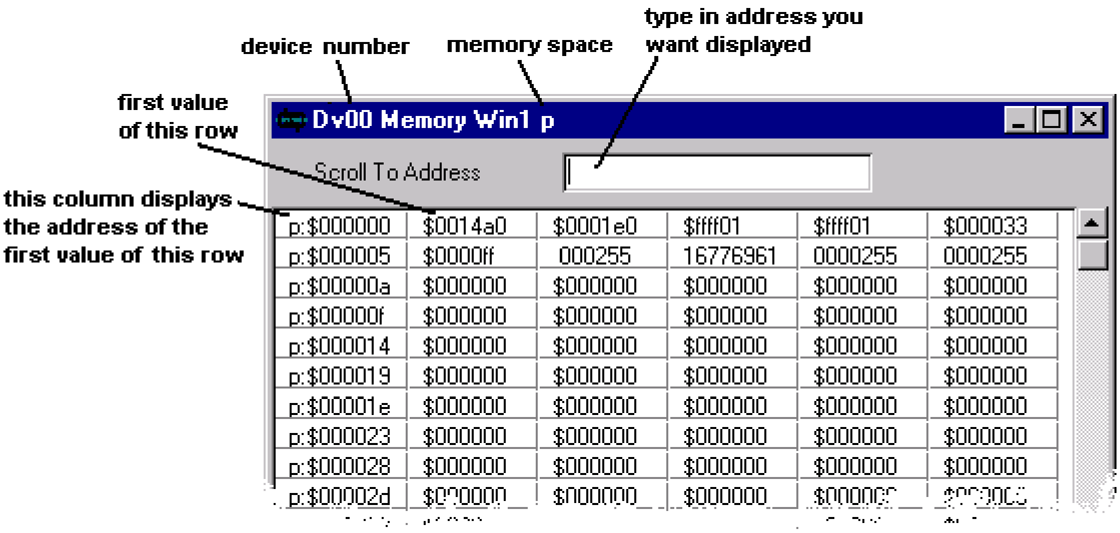
Open Memory Window

p $0; 0..ffffff, pe, pi or pr depending upon address and omr

Figure 5-4. Open Memory Window Dialog Box

2. From the drop-down list, select the memory space for which you want values displayed.
3. Click **OK**.

The memory values for the memory space that you chose appear in a memory window: For example, if you had chosen to display values in the p memory space, you would see a window similar to the one in Figure 5-5.



device number

memory space

type in address you want displayed

first value of this row

this column displays the address of the first value of this row

Dv00 Memory Win1 p

Scroll To Address

p:$000000	$0014a0	$0001e0	$ffff01	$ffff01	$000033
p:$000005	$0000ff	000255	16776961	0000255	0000255
p:$00000a	$000000	$000000	$000000	$000000	$000000
p:$00000f	$000000	$000000	$000000	$000000	$000000
p:$000014	$000000	$000000	$000000	$000000	$000000
p:$000019	$000000	$000000	$000000	$000000	$000000
p:$00001e	$000000	$000000	$000000	$000000	$000000
p:$000023	$000000	$000000	$000000	$000000	$000000
p:$000028	$000000	$000000	$000000	$000000	$000000
p:$00002d	$000000	$000000	$000000	$000000	$000000

Figure 5-5. Displaying Memory Values

Notice that the title bar of the memory window indicates:

- the device number that you are viewing,
- the number of the memory window. This is shown because you can display other memory windows simultaneously.
- the type of memory space. Again, you could have several memory windows open – each corresponding to a different memory space.

The addresses of the memory locations are indicated by the left-most column of numbers. An address in that column is the address of the value immediately to the right (the second column). In the above example, the first address shown is p:$000000, which contains the value $0014a0. The first several addresses above are as shown in Table 5-1.

Table 5-1. Sample P Memory Address Locations

Address	Content
p:$000000	$0014a0
p:$000001	$0001e0
p:$000002	$ffff01
p:$000003	$ffff01
p:$000004	$000033
p:$000005	$0000ff
p:$000006	000255
p:$000007	16776961
p:$000008	000255
p:$000009	000255
p:$00000a	$000000
p:$00000b	$000000
p:$00000c	$000000

Notice that the contents of memory are not necessarily displayed as hexadecimal. You can specify that an address be displayed in another radix by changing the radix. In the above example, the radix of addresses p:$000006 through p:$000009 is decimal. See section 7.3, “Changing the Radix,” for more information. To change the radix from the command line, see section 13.36, “RADIX - Change Input or Display Radix.”

5.5 Changing Memory Values

You can change the values in memory whenever instruction execution is halted.

5.5.1 To Change the Value in Memory

1. From the **Modify** menu choose **Change Memory** The dialog box in Figure 5-6 appears.

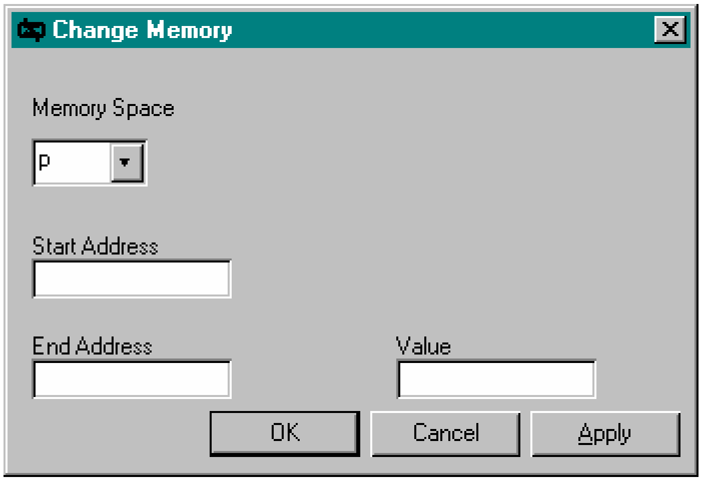


Figure 5-6. Changing the Value in Memory

2. From the drop-down list, select the **Memory Space** that you want to change.
3. Under **Start Address**, type the value of the beginning address that you want to change.
4. Under **End Address**, type the value of the ending address that you want to change.
5. Under **Value**, type the value to which the specified addresses should be changed. Keep in mind that all values, including the starting and ending values will be changed to the value that you specify.
   The format of this value (HEX, decimal, etc.) will automatically be the same as the current default radix. If you want the format of the value to differ from the default, you must use the appropriate radix specifier before the number:

   $ denotes value as hexadecimal
   ‘ denotes value as decimal
   % denotes value as binary
6. Click **OK**.

See Section 5.4, “Displaying Memory Values,” on page 5-4 and section 7.3, “Changing the Radix.” To change the radix from the command line, see Section 13.14, “CHANGE - Change Register or Memory Value,” on page 13-20.

5.6 Copying Memory

You can copy memory from one location to another, either one address at a time or in blocks. The source and destination memory maps may be different. This allows you to move data or program code from one memory map to another or to a different address within the same memory map.

5.6.1 To Copy Memory from One Block to Another

1. From the **Modify** menu choose **Copy Memory**. The dialog box in Figure 5-7 appears.

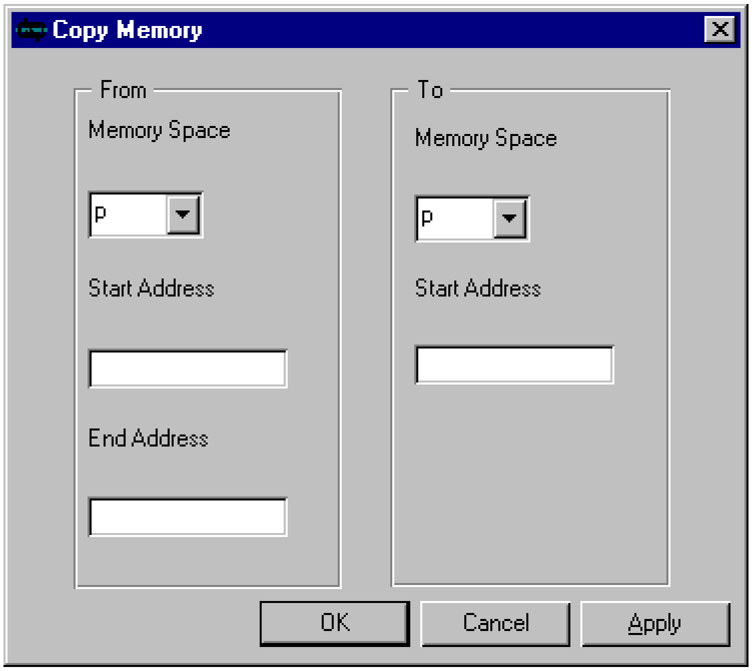


Figure 5-7. Copy Memory Dialog Box

2. In the section labeled **From Memory Space**, select the memory space to copy from. Then type the in the starting address and the ending address of the block that you want copied.
3. In the section labeled **To Memory Space**, select the memory space to copy to. Then type in the starting address to begin copying values.
4. Click **OK**.

Device and debugger configurations is also discussed in Section 7.3, “Changing the Radix,” on page 7-5. To copy memory from the command line, see Section 13.15, “COPY - Copy a Memory Block,” on page 13-21.

5.7 Disassembling Code Stored in Memory

You can disassemble instructions that have been stored in memory. This allows you to review DSP object code in its assembly language mnemonic format. Invalid opcodes are disassembled to a define constant (DC) mnemonic.

5.7.1 To Disassemble Code Stored in Memory

1. From the **Display** menu choose **Disassemble**, then select **Memory Block**. The dialog box in Figure 5-8 appears.

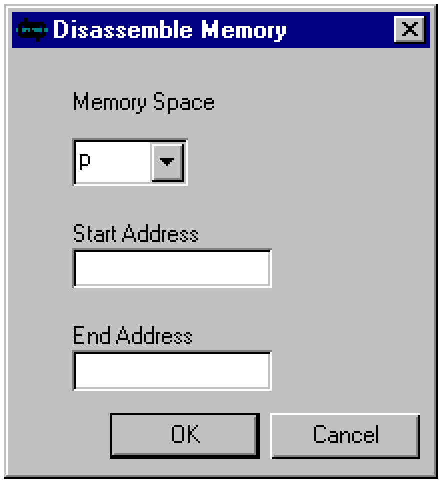


Figure 5-8. Disassemble Memory Dialog Box

2. In the drop-down list, select the **Memory Space** that you want to disassemble.
3. Under **Start Address**, type the address where you want to begin to disassemble..
4. Under **End Address**, type in the address where you want to stop disassembling.
5. Click **OK**.
6. View the Session window. You will see the mnemonics of the memory block that you specified.

More information about disassembly, see Section 7.3, “Changing the Radix,” on page 7-5 and Section 9.2, “Logging Output from the Session Window,” on page 9-2.To disassemble from the command line, see Section 13.17, “DISASSEMBLE - Single Line Disassembler,” on page 13-24.

5.8 Using a Watch List

You can watch the contents of a specific memory location, register, or expression by setting up a **watch** list. The watch list is updated every time program execution is stopped.

The expression that you watch can be valid even if it is not calculated during program execution. C expressions can be used, but must be enclosed in curly brackets: {c_expression}. Symbolic references may be used if symbols have been loaded from the object module.

5.8.1 To Add an Item to a Watch List

1. From the **Windows** menu choose **Watch**. The dialog box in Figure 5-9 appears.

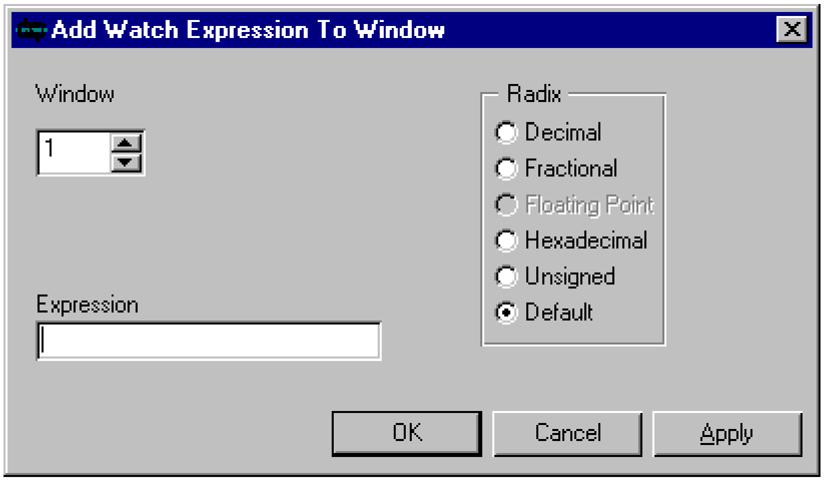


Figure 5-9. Add Watch Expression to Window Dialog Box

2. Under **Window** select the window number that you want to assign to the Watch window. This is useful when you have more than one Watch window open.
3. Under **Expression**, type the expression that you want to appear in the Watch window.
4. If the expression is a C expression, enclose it in curly brackets: {c_expression}.
5. Under **Radix**, select the radix format in which you want the variables displayed.
6. Click **OK**.
   The expression that you specified now appears in a Watch window. If the expression you type is not valid, you will get an error message explaining why the expression is not valid.

Keep in mind that a C expression that refers to C variables can only be evaluated in the context in which the watch is established. That is, the variables in the expression are only valid while they are in scope. If one of the variables in an expression goes out of scope (either because of a function call or return from a function), the value is replaced with the message **Expression out of scope**. When all elements of the expression are back in scope, the value is again displayed.

An expression that has gone out of scope because of a function call can be evaluated and displayed by selecting the stack frame for the evaluation context. The stack frame assignment remains in effect only until the next instruction is executed. An expression that is out of scope because of a function exit cannot be evaluated until the function is again invoked since the expression's variables no longer exist.

You can find more information about watch lists in Section 8.1, “Moving Up and Down the Call Stack,” on page 8-1, in Chapter 10, “Expressions,” and in Section 12.1, “Displaying the Radix,” on page 12-1. To set up a watch list from the command line, see Section 13.49, “WATCH - Set, Modify, View, or Clear Watch Item,” on page 13-52.

Chapter 6
Input and Output Files

The device on which you are debugging your application is of course already in communication with peripherals, ports, or pins. In addition to these inputs and outputs, you might find it useful to provide data from an input file and capture output to an output file. The Suite56 DSP Debugger provides you with the ability to create input and output files.

The Debugger provides input data and captures output data by using I/O files. These I/O files transfer data to and from the device. You can specify whether the input data is to come from a file or from the keyboard (terminal). You can specify output data to be written to a file or to the Session window.

6.1 How are I/O files formatted?

Input and output is represented in ASCII format, which means that I/O files can be conveniently edited or printed from a text editor. To understand how I/O files format data, you should be familiar with these concepts:

- repeat punctuation
- comments
- memory data

6.1.1 Repeat Punctuation

The Debugger provides a way to specify repeated input or output data values and sequences. A single data value can be repeated by adding the following syntax after a data item:

```
#{count}
```

Enclosing several data items in parentheses indicates that the data items are to be treated as a group. The entire group can then be repeated by placing `#{count}` immediately following the closing parenthesis. The parentheses can be nested. A closing parenthesis without a following repeat count will cause the data sequence within the parentheses to repeat forever.

Example 6-1. Repeating Data Values

```
1FF#20
```

Repeats the data item 1FF twenty times.

```
(CC354 CC333 C7000)
```

Repeats the data sequence CC354 CC333 C7000 forever.

```
(1#5 0#5)
```

Repeats the data sequence 1 1 1 1 1 0 0 0 0 0 forever.

6.1.2 Comments

Any information following a semicolon, up to the end-of-line is considered to be a user comment and is not interpreted as input data or timing.

Example 6-2. User Comment

```
FFC 333 972 ;next three p memory data words
```

The first three data values are applied to the device. The information following the semicolon is a user comment.

6.1.3 Memory Data

When assigned to a memory location, the input file data value supplies the value that is read when the Debugger references that memory location. The least significant memory bit maps to the least significant bit of the data value.

The input data value can be in decimal, binary, hexadecimal, or floating-point form. The Debugger will interpret the data based on the input radix specified in the input command. The default input radix is hexadecimal. If a data value contains a decimal point, the data will be input as a floating point value, overriding the input radix specification. The number base of data values can also be denoted by preceding the data value with a dollar sign ($), an apostrophe (‘), or a percent sign (%).

$	input as hexadecimal
‘	input as decimal
%	input as binary

Untimed memory input data values will be applied each time the device performs a read operation on the memory location. In other words, the input file acts like a stack of input data; each successive data value is retrieved from the “stack” file when a read operation occurs.

If a lower case letter `t` is placed in a data position of the input file, you will be prompted for the next input data value as described in section 6.1.4, “Terminal Input of Data Values.”

Output data value can be in decimal, binary, hexadecimal, floating point or string form. The output radix is specified in the output command. The default output radix is hexadecimal. The string form of output data uses the value written to the memory location as the starting address in the same memory space of a zero terminated ASCII character string. The character string is written to the output file.

Example 6-3. Input Data Values to Memory

```
7FFF 7F3F 5D3C 7FC3
```

The untimed memory input file will cause the data sequence 7FFF 7F3F 5D3C 7FC3 to appear during consecutive reads of the specified memory location.

```
(1FF 0)
```

The untimed memory input file will cause the data sequence 1FF 0 to appear repeatedly during consecutive reads of the specified memory location.

6.1.4 Terminal Input of Data Values

There are two levels of terminal data input provided by the Debugger. If the input command specifies term as the input filename, the Debugger opens an editor, which allows creation of an input data file without leaving the Debugger. The data file is given a temporary name, termxxxx.io or termxxxx.tio (xxxx being a numeral between 0000-9999), and is saved on the disk at the termination of the input command. The entire contents of the input file can be specified in this manner.

A second level of terminal data input allows you to be prompted any time the next input data value is needed. This method is triggered if the lower case letter **`t`** is encountered in the data field of the input file. This is only valid for the data field, not for the time field. Each time a **`t`** is encountered, you will be prompted for a single data value from the terminal. Hexadecimal is the default input radix. If you just type the return key at the prompt, without entering a data value, the previous data value will be repeated. If you type the esc key at the prompt, an end-of-file status will be simulated and the previous data value will repeat forever.

You can find more information about changing the radix in Section 7.3, “Changing the Radix,” on page 7-5.

6.2 Assigning an Input File

You can pass simulated data to the target system by providing an input file. The simulated data is written from an input file that you provide to an address that you specify.

There is some preparation that you must perform outside of the Debugger in order for the data from the input file to be written properly. You will need to place a **`debug`** instruction in your program and you will need to set designators in certain registers. You need to do this so that the Debugger knows when to perform the data transfer, from where to get the data, how much data to get, and where to put the data.

6.2.1 To Prepare for Input Data to be Received

1. Write to the appropriate register a designator that will indicate the input file number and the word count of the data that you want to input. (You will assign the input file number of the input file later, when you open it.) The register to which you write this information depends on the target device.

Table 6-1. Input File Numbers for Specific Suite56 DSP Devices

Device Family	Designate the Input File Number and Word Count in Register:	Designate the Input File Number and Word Count in Register:
DSP56000	X0	File Number in the upper 8 bits; count in the lower 16 bits
DSP56100	X0	File Number in the upper 8 bits; count in the lower 8 bits
DSP56300	X0	File Number in the upper 8 bits; count in the lower 16 bits
DSP56600	X0	File Number in the upper 8 bits; count in the lower 8 bits
DSP56800	X0	File Number in the upper 8 bits; count in the lower 8 bits
DSP96000	R0	File Number in the upper 16 bits; count in the lower 16 bits

2. Write to the appropriate register a designator that indicates the memory space, and to another register the address where you want the data to be written. Designate the memory space as follows: `0=p,  1=x,  2=y,  3=l`.

Table 6-2. Input File Memory Space and Destination Register

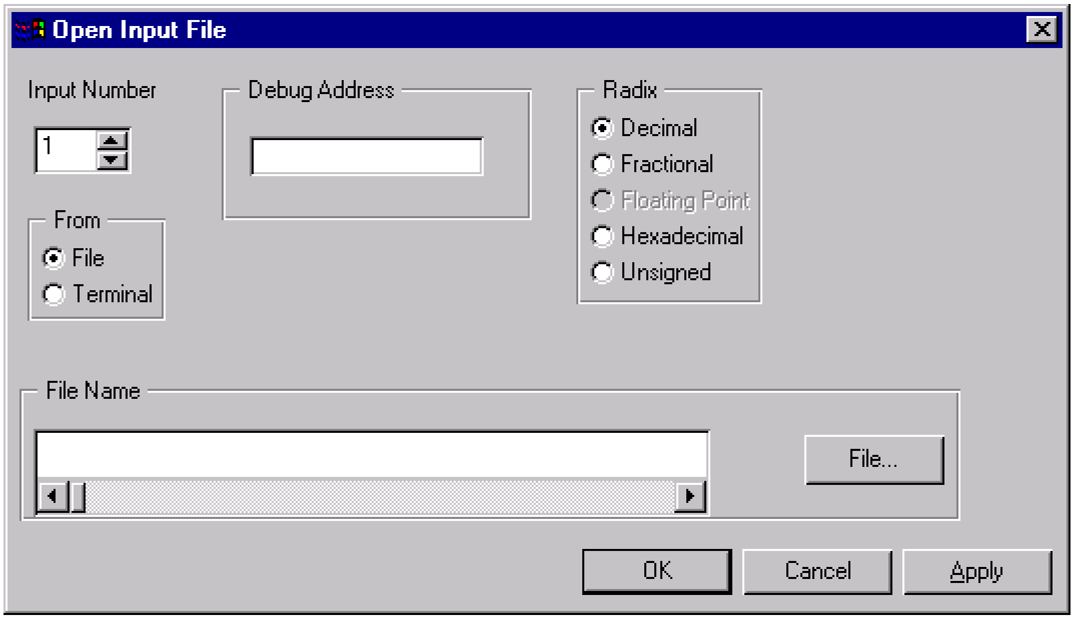
Device Family	Designate the Memory Space in Register:	Put the Address Where the Input Data Will Be Written in Register:
DSP56000	R1	R0
DSP56100	R1	R0
DSP56300	R1	R0
DSP56600	R1	R0
DSP56800	R1	R0
DSP96000	R2	R1

3. Place a **debug** instruction at an appropriate address in your program. This is the point in the program where you want the data transfer to take place.

For more information see section 6.3, “Examples of How to Assign an Input File.” Once the **debug** instruction is written and the registers set, you can assign the input file.

6.2.2 To Assign the Input File

1. From the **File** menu choose **Input,** then select **Open**. The dialog box in Figure 6-1 appears.



Open Input File

Input Number: 1

From: ● File ○ Terminal

Radix: ● Decimal ○ Fractional ○ Floating Point ○ Hexadecimal ○ Unsigned

Figure 6-1. Providing Input Data

2. Under **Input Number** select the number you want to assign to this input file. The default number that is shown is the next available number. Input numbers do not have to be consecutive, they can be assigned arbitrarily, which means that you can assign input numbers in any way that helps you organize the sources of the inputs.
3. Under **From** select the source of the input data. Select **File** if the input data will come from an existing file.
   Select **Terminal** if the input data will be entered directly from the keyboard.
4. Under **Debug Address**, type the address where the **debug** statement of your program resides. When executed, this **debug** statement will indicate to the Debugger that it should transfer the data from the input file.
   The write destination for this data is designated by setting the appropriate registers as described above.
5. Under **Radix** select the number system (hexadecimal, decimal, etc.) that the input data is in.
6. If the input data is coming from a file, under **File Name** type in the name of the input file or click on the **File** button to browse for the file. The default filename extension is .io.

7. Click **OK**.
   If you are entering the data from the terminal (keyboard), the **Interactive Input** dialog box will appear when the **debug** statement is encountered. The **Interactive Input** dialog box will prompt you for the data values. Type in the first data value and click **OK**. After entering a value and clicking **OK**, the **Interactive Input** dialog box appears again, ready for the second data value. Continue to enter values and click **OK** until you have entered all values. When all values have been entered, click on **Cancel** in the **Interactive Input** dialog box.
   A file is created in the working directory that contains the data you entered from the keyboard. The filename will be similar to term0000.io. You can reuse this file as you would any other input file.

To assign an input file from the command line see Section 13.27, “INPUT - Assign Input File,” on page 13-32.

6.3 Examples of How to Assign an Input File

There is some preparation that you must perform outside of the Debugger in order for the data from an input file to be written properly. All of this preparation can be written into your program. Your program will tell the Debugger the destination from which the data should be retrieved, how much data to get, where to put the data, and when to perform the data transfer

These four pieces of information are communicated by including these four elements in your program:

1. a designation of the input file number and data length
2. a designation of the memory space to write to
3. the beginning address to write to, and
4. a **debug** instruction.

The following code snippets demonstrate assembly code that you might use in your program to indicate these four elements.

6.3.1 DSP56000 Family

The input file number and the data length must be indicated in the X0 register (24-bit register). Indicate these by writing the file number in the upper 8 bits and the count in the lower 16 bits. Then indicate the beginning address in register R0. Then indicate the memory space in register R1 (0=P, 1=X, 2=Y, 3=L)

Table 6-3. Input File Assembly Code for DSP56000 Family

Operation	Comment
`MOVE #$03000c, X0`	`;input from file #3 a block of 12 words`
`MOVE #$100,R0`	`;begin writing data at address $100`
`MOVE #1,R1`	`;in X memory space`
`DEBUG`	`;enter Debug mode`

6.3.2 DSP56100 Family

First, the input file number and the data length must be indicated in the X0 register (16-bit register). Indicate these by writing the file number in the upper 8 bits and the count in the lower 8 bits. Then indicate the beginning address in register R0. Then indicate the memory space in register R1 (0=P, 1=X, 2=Y, 3=L).

Table 6-4. Input File Assembly Code for DSP56100 Family

Operation	Comment
`MOVE #$030c, X0`	`;input from file #3 a block of 12 words`
`MOVE #$100,R0`	`;begin writing data at address $100`
`MOVE #1,R1`	`;in X memory space`
`DEBUG`	`;enter Debug mode`

6.3.3 DSP56300 Family

The input file number and the data length must be indicated in the X0 register (24 bit register). Indicate these by writing the File Number in the upper 8 bits and the count in the lower 16 bits. Then indicate the beginning address in register R0. Then indicate the memory space in register R1 (0=P, 1=X, 2=Y, 3=L).

Table 6-5. Input File Assembly Code for DSP56300 Family

Operation	Comment
`MOVE #$03000c, X0`	`;input from file #3 a block of 12 words`
`MOVE #$100,R0`	`;begin writing data at address $100`
`MOVE #1,R1`	`;in X memory space`
`DEBUG`	`;enter Debug mode`

6.3.4 DSP56600 Family

The input file number and the data length must be indicated in the X0 register (16 bit register). Indicate these by writing the File Number in the upper 8 bits and the count in the lower 8 bits. Then indicate the beginning address in register R0. Then indicate the memory space in register R1 (0=P, 1=X, 2=Y, 3=L).

Table 6-6. Input File Assembly Code for DSP56600 Family

Operation	Comment
`MOVE #$030c, X0`	`;input from file #3 a block of 12 words`
`MOVE #$100,R0`	`;begin writing data at address $100`
`MOVE #1,R1`	`;in X memory space`
`DEBUG`	`;enter Debug mode`

6.3.5 DSP56800 Family

The input file number and the data length must be indicated in the X0 register (16 bit register). Indicate these by writing the File Number in the upper 8 bits and the count in the lower 8 bits. Then indicate the beginning address in register R0. Then indicate the memory space in register R1 (0=P, 1=X, 2=Y, 3=L).

Table 6-7. Input File Assembly Code for DSP56800 Family

Operation	Comment
`MOVE #$030c, X0`	`;input from file #3 a block of 12 words`
`MOVE #$100,R0`	`;begin writing data at address $100`
`MOVE #1,R1`	`;in X memory space`
`DEBUG`	`;enter Debug mode`

6.3.6 DSP96000 Family

The input file number and the data length must be indicated in the X0 register (32 bit register). Indicate these by writing the File Number in the upper 16 bits and the count in the lower 16 bits. Then indicate the beginning address in register R0. Then indicate the memory space in register R1 (0=P, 1=X, 2=Y, 3=L).

Table 6-8. Input File Assembly Code for DSP96000 Family

Operation	Comment
`MOVE #$0003000c, X0`	`;input from file #3 a block of 12 words`
`MOVE #$100,R0`	`;begin writing data at address $100`
`MOVE #1,R1`	`;in X memory space`
`DEBUG`	`;enter Debug mode`

For more information see section 6.2, “Assigning an Input File.”

6.4 Assigning an Output File

You can write data from a target device to a file. The output will be written in ASCII format and can be written in the radix that you specify.

Before opening an output file, there is some preparation that you must perform outside of the Debugger in order for the data to be correctly written to the output file. You will need to place a **debug** instruction in your program and you will need to set designators in certain registers. You need to do this so that the Debugger knows when to perform the data transfer, from where to get the data, how much data to get, and where to put the data.

6.4.1 To Prepare Data to be Written to an Output File

1. Write to the appropriate register a designator that will indicate the output file number and the word count (length) of the data that you want to write. (You will assign the output file number later, when you actually open it.) The register to which you write this information depends on the target device.

Table 6-9. Output File Designators for Specific Suite56 DSP Devices

Device Family	Designate the Output File Number and Word Count in Register:	Designate the Output File Number and the Word Count (I.e. Length) of the Data as Follows:
DSP56000	X0	File Number in the upper 8 bits; count in the lower 16 bits
DSP56100	X0	File Number in the upper 8 bits; count in the lower 8 bits
DSP56300	X0	File Number in the upper 8 bits; count in the lower 16 bits
DSP56600	X0	File Number in the upper 8 bits; count in the lower 8 bits
DSP56800	X0	File Number in the upper 8 bits; count in the lower 8 bits
DSP96000	R0	File Number in the upper 16 bits; count in the lower 16 bits

2. Write to the appropriate registers a designator that indicates the memory space and address from where you want the data to be read. Designate the memory space as follows: `0=p, 1=x, 2=y, 3=l.`

Table 6-10. Designations for Memory Space and Address Registers

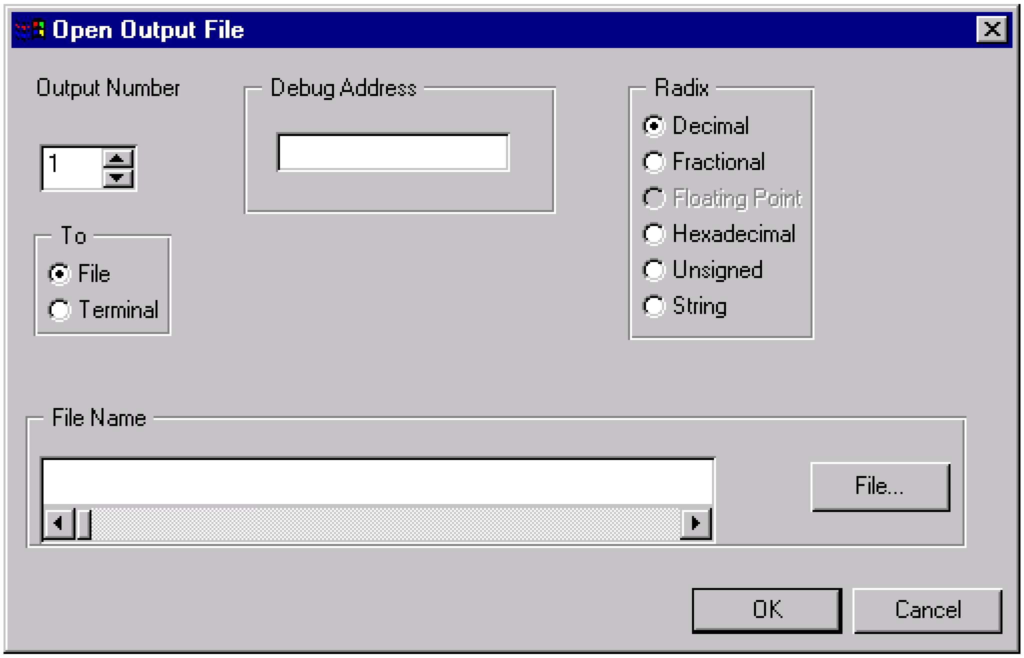
Device Family	Designate the Memory Space in Register:	Put the Address from Where the Data Will Be Read In Register:
DSP56000	R1	R0
DSP56100	R1	R0
DSP56300	R1	R0
DSP56600	R1	R0
DSP56800	R1	R0
DSP96000	R2	R1

3. Place a **debug** instruction at an appropriate address in your program. This is the point in the program where you want the data transfer to take place.

For more information see section 6.5, “Examples of How to Assign an Output File.” Once the registers are set and the **debug** instruction written, you can open the output file.

6.4.2 To Open an Output File

1. From the **File** menu choose **Output**, then select **Open**. The dialog box in Figure 6-2 appears.



Open Output File

Output Number: 1

Debug Address:

To
- ● File
- ○ Terminal

Radix
- ● Decimal
- ○ Fractional
- ○ Floating Point
- ○ Hexadecimal
- ○ Unsigned
- ○ String

File Name:

Figure 6-2. Creating an Output File

2. Under **Output Number** select the number you want to assign to this output. The default number that is shown is the next available number.
   Output numbers do not have to be consecutive, they can be assigned arbitrarily, which means that you can assign output numbers in any way that helps you organize the output files.
3. Under **To** select the destination of the output file.
   Select **File** if the output data is to be written to a file.
   Select **Terminal** if the output data is to be written to the Session window rather than a file.
4. Under **Debug Address** type the address where the Debug instruction that will trigger this data transfer resides.
5. Under **Radix** select the radix (hexadecimal, decimal, etc.) in which the output data should be written.
6. If the output data is being sent to a file, under **File Name** type in the name of the output file or click on the **File** button to browse for the file. The default filename extension is .io. The output file will be in ASCII format.
7. Click **OK**.

For more information see section 6.5, “Examples of How to Assign an Output File.” To assign an output file from the command line, see Section 13.33, “OUTPUT - Assign Output File,” on page 13-40.

6.5 Examples of How to Assign an Output File

There is some preparation that you must perform outside of the Debugger in order for data to be correctly written to an output file. You will need to place a **debug** instruction in your program and you will need to set designators in certain registers. You need to do this so that the Debugger knows when to perform the data transfer, from where to get the data, how much data to get, and where to put the data.

These four pieces of information are communicated by including these four elements in your program:

1. A designation of the output file number and data length,
2. a designation of the memory space to read from,
3. the address to begin reading from, and
4. a **debug** instruction.

The following code snippets demonstrate assembly code that you might use in your program to indicate these four elements.

6.5.1 DSP56000 Family Output

The output file number and the data length must be indicated in the X0 register (24-bit register). Indicate these by writing the file number in the upper 8 bits and the count in the lower 16 bits. Then indicate the beginning address in register R0. Then indicate the memory space in register R1 (0=P, 1=X, 2=Y, 3=L).

Table 6-11. Ouput File Assembly Code for DSP56000 Family

Operation	Comment
`MOVE #$03000c, X0`	`;output to file #3 a block of 12 words`
`MOVE #$100,R0`	`;write data from address $100`
`MOVE #1,R1`	`;in X memory space`
`DEBUG`	`;enter Debug mode`

6.5.2 DSP56100 Family Output

First, the output file number and the data length must be indicated in the X0 register (16 bit register). Indicate these by writing the File Number in the upper 8 bits and the count in the lower 8 bits. Then indicate the beginning address in register R0. Then indicate the memory space in register R1 (0=P, 1=X, 2=Y, 3=L).

Table 6-12. Output File Assembly Code for DSP56100 Family

Operation	Comment
`MOVE #$030c, X0`	`;output to file #3 a block of 12 words`
`MOVE #$100,R0`	`;write data from address $100`
`MOVE #1,R1`	`;in X memory space`
`DEBUG`	`;enter Debug mode`

6.5.3 DSP56300 Family Output

The output file number and the data length must be indicated in the X0 register (24 bit register). Indicate these by writing the File Number in the upper 8 bits and the count in the lower 16 bits. Then indicate the beginning address in register R0. Then indicate the memory space in register R1 (0=P, 1=X, 2=Y, 3=L).

Table 6-13. Output File Assembly Code for DSP56300 Family

Operation	Comment
`MOVE #$03000c, X0`	`;output to file #3 a block of 12 words`
`MOVE #$100,R0`	`;write data from address $100`
`MOVE #1,R1`	`;in X memory space`
`DEBUG`	`;enter Debug mode`

6.5.4 DSP56600 Family Output

The output file number and the data length must be indicated in the X0 register (16-bit register). Indicate these by writing the file number in the upper 8 bits and the count in the lower 8 bits. Then indicate the beginning address in register R0. Then indicate the memory space in register R1 (0=P, 1=X, 2=Y, 3=L).

Table 6-14. Output File Assembly Code for DSP56600 Family

Operation	Comment
`MOVE #$030c, X0`	`;output to file #3 a block of 12 words`
`MOVE #$100,R0`	`;write data from address $100`
`MOVE #1,R1`	`;in X memory space`
`DEBUG`	`;enter Debug mode`

6.5.5 DSP56800 Family Output

The output file number and the data length must be indicated in the X0 register (16-bit register). Indicate these by writing the file number in the upper 8 bits and the count in the lower 8 bits. Then indicate the beginning address in register R0. Then indicate the memory space in register R1 (0=P, 1=X, 2=Y, 3=L).

Table 6-15. Output File Assembly Code for DSP56800 Family

Operation	Comment
`MOVE #$030c, X0`	`;output to file #3 a block of 12 words`
`MOVE #$100,R0`	`;write data from address $100`
`MOVE #1,R1`	`;in X memory space`
`DEBUG`	`;enter Debug mode`

6.5.6 DSP96000 Family Output

The output file number and the data length must be indicated in the X0 register (32-bit register). Indicate these by writing the file number in the upper 16 bits and the count in the lower 16 bits. Then indicate the beginning address in register R0. Then indicate the memory space in register R1 (0=P, 1=X, 2=Y, 3=L).

Table 6-16. Output File Assembly Code for DSP96000 Family

Operation	Comment
`MOVE #$0003000c, X0`	`;output to file #3 a block of 12 words`
`MOVE #$100,R0`	`;write data from address $100`
`MOVE #1,R1`	`;in X memory space`
`DEBUG`	`;enter Debug mode`

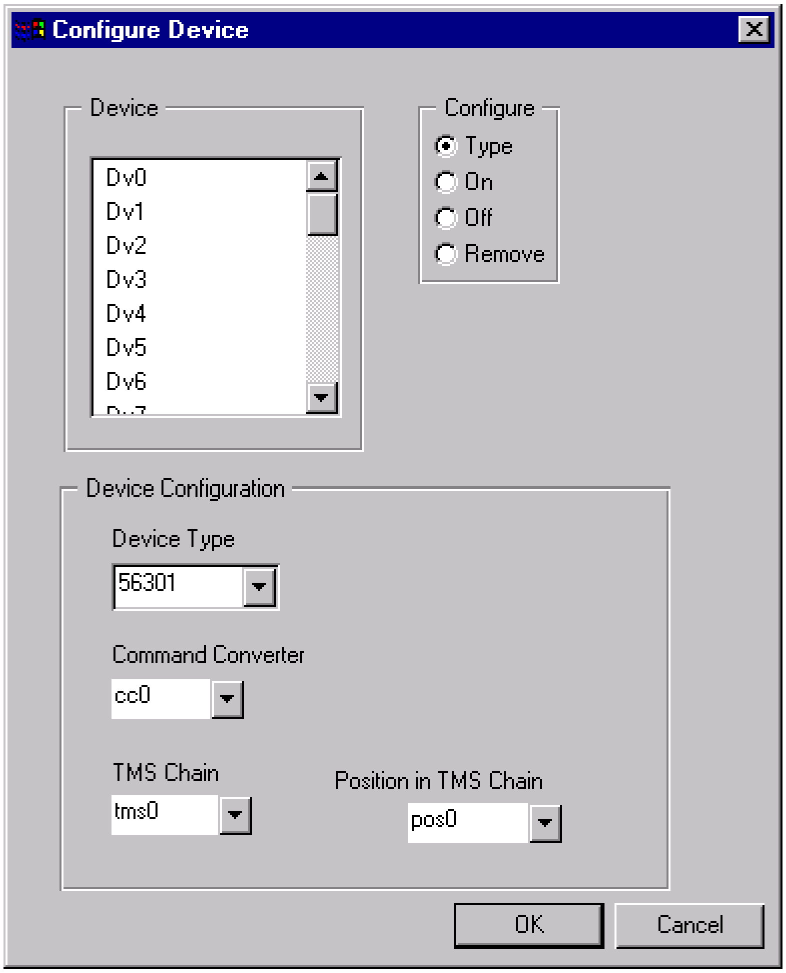
For more information see section 6.4, “Assigning an Output File.”

Chapter 7
Debugger and Device Configurations

You will want to make sure that you have specified a specific DSP configuration for each device. The internal memory attributes are determined by the selected device configuration. External memory access is also determined by the device configuration. However, the effects of writing external RAM, ROM or peripherals can be totally controlled by you.

7.1 To Set the Configuration of a Device

1. From the **Modify** menu select **Device**. Then choose configure. The dialog box in Figure 7-1appears.



● Type
○ On
○ Off
○ Remove

Device Type: 56301

Command Converter: cc0

TMS Chain: tms0

Position in TMS Chain: pos0

Figure 7-1. Setting the Configuration of a Device

2. Under **Device** select the number of the device that you want to configure
3. Under **Configure** select whether you are designating the **Type** of the device, whether it is to be enabled or disabled by indicating **On** or **Off**, or indicate that you want to **Remove** the device from being part of your target system.
   At least one device must be activated at all times; the last device cannot be removed.
4. Under **Device Type** select the appropriate device type.

5. Under **Command Converter** select the command converter to which the device is connected. The ADS supports up to eight command converters on a single development host. Each command converter supports one JTAG chain which can serve up to twenty-four devices.
6. Under **TMS Chain** select the TMS (Test Module Select) line that controls this device
7. Under **Position in TMS Chain** select the position that the device occupies in the JTAG chain The device connected directly to TDO from the command converter is pos0.
8. Click **OK**.

The Debugger provides the flexibility for you to define external memory responses by supplying the C language source code for the external memory functions. The source code used as a default is contained in the file simvmem.c.

By changing memory values you can change the on-chip bootstrap and data ROM areas. The bootstrap ROM is specified by using PR: as the memory space designator. The data ROMs can be specified by XR: or YR:. Loading an assembler output file can also modify the bootstrap ROM or data ROM areas. The ROM areas can be reinitialized by selecting Reset from the Execute menu, then selecting State.

For more information see Section 5, “Managing Memory and Registers,” on page 5-1.

7.2 Setting the Default Device

You can specify any device to be the default device. This, of course, is necessary when you are debugging a system that contains more than one device.

7.2.1 To Set the Default Device

1. From the **Modify** menu choose **Device** then select **Set Default**. The dialog box in Figure 7-2 appears.

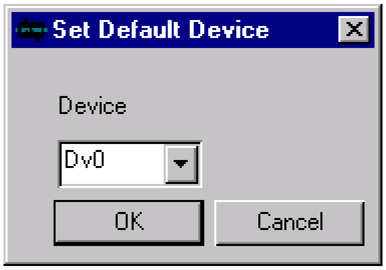


Figure 7-2. Setting the Default Device

2. Under **Device** select the number of the device that you want to be the default device (also referred to as the current device).
3. Click **OK**.

The default device is the device to which commands are applied. When you change the default device, the Session window and the Command window will automatically change to reflect the information for the new device. However, other windows such as the Assembly window, Source window, etc. will not automatically update themselves to reflect the new device. This allows you to display the information for separate devices in separate windows at the same. To see the information for the new default device, open another Assembly window, Source window, etc.

To specify the default device from the command line, see Section 13.16, “DEVICE - Select Default Device,” on page 13-22.

7.3 Changing the Radix

You can change the default radix (number base) that the Debugger uses for command parameters and other values that you input. You can also change the radix used to display specific registers and memory locations.

As an alternative to changing the default radix, you can also denote the number base of a value by preceding it with a dollar sign ($), an apostrophe (‘), or a percent sign (%).

$	value is hexadecimal
‘	value is decimal
%	value is binary

The Debugger begins with the default radix set to decimal for input and hexadecimal for most output. Changing the default input radix is useful because it allows you to enter values without having to type the radix specifiers before each value.

7.3.1 To Change the Radix of Input

1. From the **Modify** menu choose **Radix** then select **Set default**. The dialog box in Figure 7-3 appears.

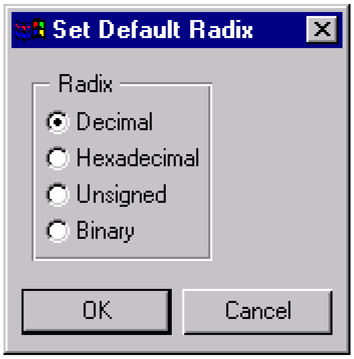
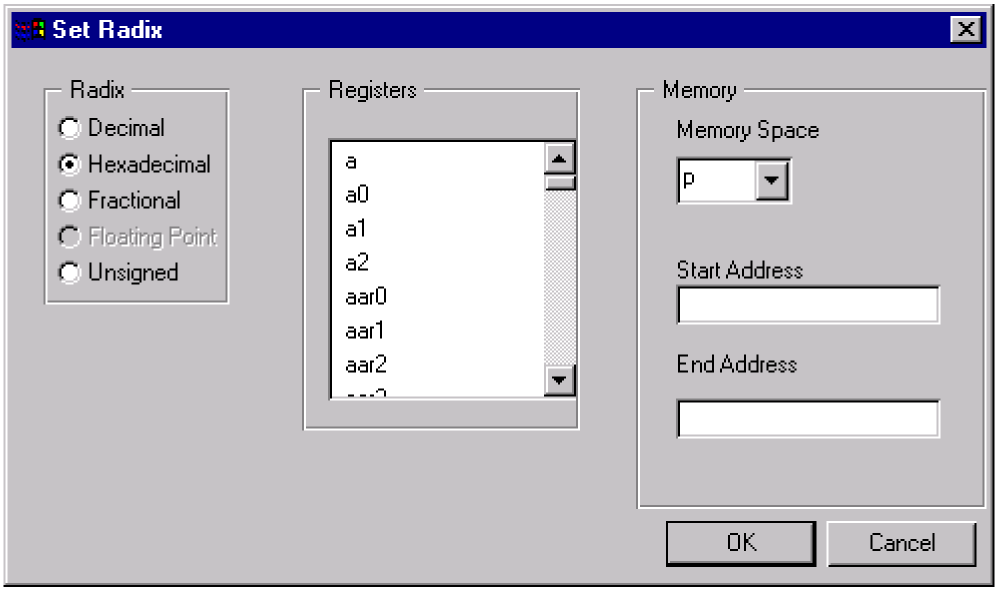


Figure 7-3. Changing the Radix of Input

2. Note that the current default radix is automatically selected.
3. Under **Radix** select the number system to use. This system will be the default for values that you provide when performing commands.
4. Click **OK**.
   This change to the input radix does not affect the display radix of registers or memory.

7.3.2 To Change the Radix in which to Display a Register or Memory Location

1. From the **Modify** menu choose **Radix**, then select **Set Display**. The dialog box in Figure 7-4 appears.



Radix
○ Decimal
● Hexadecimal
○ Fractional
○ Floating Point
○ Unsigned

Memory Space: P

Figure 7-4. Displaying a Register or Memory Locations

2. Under **Radix** select the number system to use.
3. Under **Registers** select the register that will be displayed with the new radix To select more than one register, hold down the CTRL key while single clicking on the register names.
4. Under **Memory** select the memory space and addresses that will be displayed with the new radix.
5. Click **OK**.
   You have now changed the radix in which the selected registers and memory will be displayed. This change to the display radix does not, however, affect the input radix.

To set the input or display radix from the command line, see Section 13.36, “RADIX - Change Input or Display Radix,” on page 13-44. You can also find more infomration in Section 12.1, “Displaying the Radix,” on page 12-1.

7.4 Loading Debugger State Files

You can reset the condition of the Debugger to a previous state. This is done with a Debugger state file (.adm). The state file acts like an initialization file which includes information about:

- the state of all DSP devices in the system, and their device type
- enabled registers, counters, status registers, peripheral registers, etc.
- the entire contents of memory,
- the windows settings, and
- the Session window output buffer for each device

Essentially, a state file contains all the information needed to exactly duplicate the condition of the Debugger as it existed when the state file was saved.

This may be used in several ways. For example, if you are in a long development session and want to take a break, save the Debugger state to a state file so as not to lose your place. Or if a particular part of a program is proving troublesome, the state may be saved just before the problem area, simplifying the setup for repeated attempts to isolate the problem. There are, of course, many reasons for saving the state of the Debugger.

7.4.1 To Load a Debugger State File

1. From the **File** menu, choose **Load**, then select **State**.
2. Specify the name of the state file in the dialog box.
3. Click on **Open**.
   The current state of the Debugger is replaced by the state information in the .adm file.

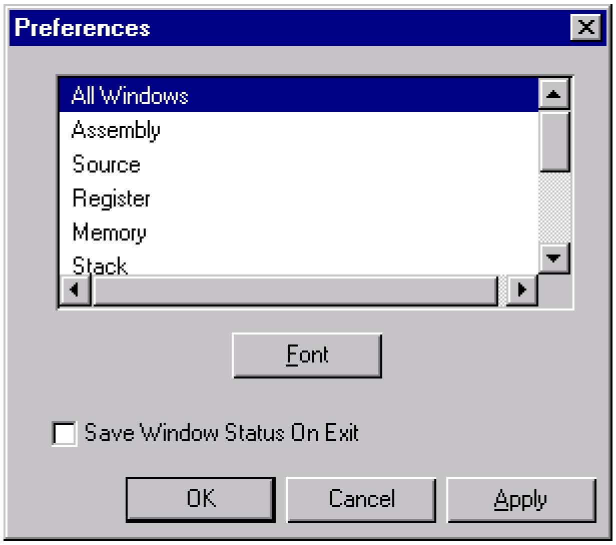
For more information see Section 2.3, “Loading Object Files,” on page 2-5.

7.5 Changing and Saving Window Preferences

You can save the positions and settings of windows that you have open in the Debugger. When you restart the Debugger, all window positions and settings will be restored.

7.5.1 To Save Window Settings

1. From the **File** menu choose **Preferences**. The dialog box in Figure 7-5 appears.



□ Save Window Status On Exit

Figure 7-5. Saving Window Status on Exit

2. Mark the checkbox labeled **Save Window Status On Exit**.
3. Click **OK**.

The position and font of each window that is open will be retained after you have exited the Debugger.

Chapter 8
Debugging C Source Code

The Debugger provides several features that are specifically used in debugging C source code. The following topics will help you understand how to best use the Debugger for debugging C source code. (Remember when you compile your source code to include debug information.)

- Moving up and down the Call Stack
- Displaying the Call Stack
- Monitoring C Function Calls
- Enabling/Disabling IO Streams
- Redirecting an IO Stream
- Display the TYPE of a C variable or expression

8.1 Moving Up and Down the Call Stack

8.1.1 To Move Up the Call Stack

You can move the current frame up and down the call stack.

1. From the **Modify** menu choose **Up** The dialog box in Figure 8-1 appears.

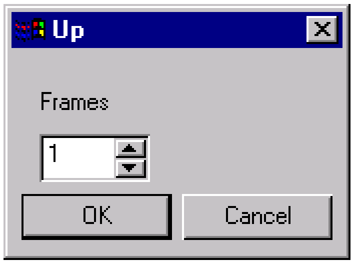


Figure 8-1. Moving Up the Call Stack

2. Under **Frames** select the number of frames to move up in the stack
3. Click **OK**.
   The frame to which you moved is now the current starting point for evaluations.

8.1.2 To Move Down The Call Stack

1. From the **Modify** menu choose **Down** The dialog box in Figure 8-2 appears.

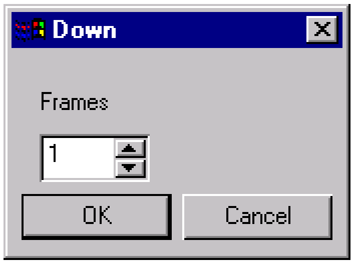


Figure 8-2. Moving Down the Call Stack

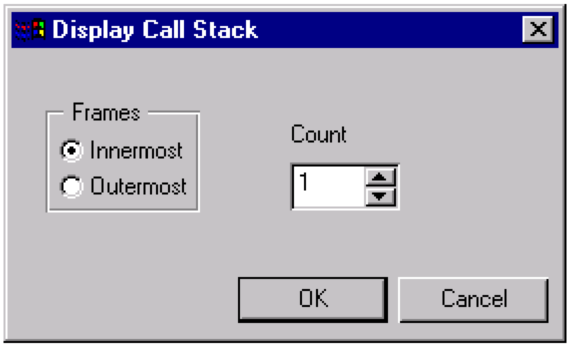
2. Under **Frames** select the number of frames to move down the stack
3. Click **OK**.
   The frame to which you moved is now the current starting point for evaluations.

To move up and down the call stack from the command line, see Section 13.46, “UP - Move Up the C Function Call Stack,” on page 13-51 and Section 13.19, “DOWN - Move Down the C Function Call Stack,” on page 13-26.

8.2 Displaying the Call Stack

You can display the C function call stack beginning with the frame you specify.

1. From the **Display** menu choose **Call Stack**. The dialog box in Figure 8-3 appears



Display Call Stack

Frames

● Innermost

○ Outermost

Count: 1

Figure 8-3. Displaying the Call Stack

2. Under **Frames**, select whether you want to display the innermost or outermost frames.
3. Under **Count**, specify the number of frames you want to display.
4. Click **OK**.

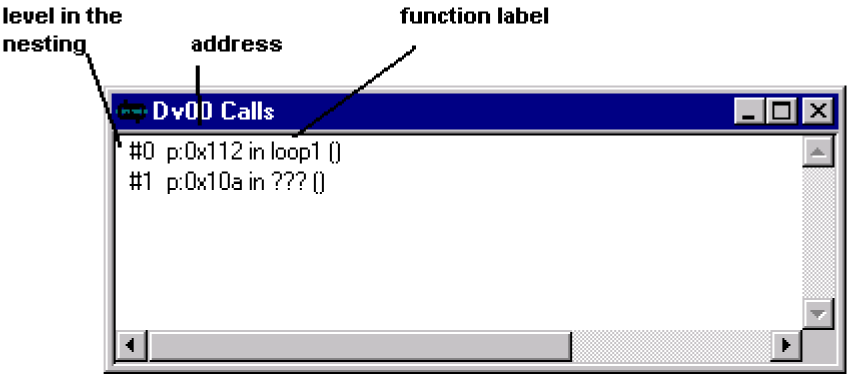
If you are writing a script, it can be useful to use the **where** command to display the C function call stack.

To use **where** from the command line, see Section 13.54, “WHERE - GUI C Call Stack Window,” on page 13-54.

8.3 Monitoring C Function Calls

You can monitor the calls that are made by C functions by displaying the Calls window. The Calls window is updated as each instruction is executed. If the instruction contains no function call, three question marks are shown ??? to indicate that no function is recognized.

1. From the **Windows** menu choose **Calls**. The dialog box in Figure 8-4 appears.



```
#0  p:0x112 in loop1 ()
#1  p:0x10a in ??? ()
```

Figure 8-4. Monitoring C Function Calls

2. Double-click a stack level to select it as the expression context to evaluate expressions.

Each function call adds another stack frame, each return removes one. Entry #0 is the most nested function, that is the top entry on the stack, The highest number is the main() function. Each line of the Calls window shows:

- a number to indicate the level to which the call is nested,
- the PC return address (i.e. the address after the function call), and
- the name of the function.

The top level represents the call that first entered the debug monitor, and so indicates the next instruction to be executed.

The call stack also indicates the context to use for evaluating C expressions. As each function may have its own copy of a named variable, it may be necessary to indicate which instance is required.

To use monitor C function calls from the command line, see Section 13.23, “FRAME - Select C Function Call Stack Frame,” on page 13-29 and Section 13.52, “WCALLS - GUI C Calls Stack Window,” on page 13-54.

8.4 Enabling/Disabling IO Streams

You can enable or disable stream I/O for C programs that are running on the current device. The standard stream files are supported: STDIN, STDOUT, and STDERR. Any references by C programs to these files may be redirected to files on the host.

Stream file handling may be configured independently for each device. Streams handling is enabled by default. If a C program attempts to access a stream file while it is not enabled and redirected, the access is ignored. Output is discarded, and a standard value is supplied as input. To enable or disable the I/O stream:

1. From the **File** menu choose **IO Streams**.
2. Select **Enable** or **Disable**.

To enable or disable the I/O stream from the command line, see Section 13.40, “STREAMS - Enable/Disable Handling of I/O for C Programs,” on page 13-47.

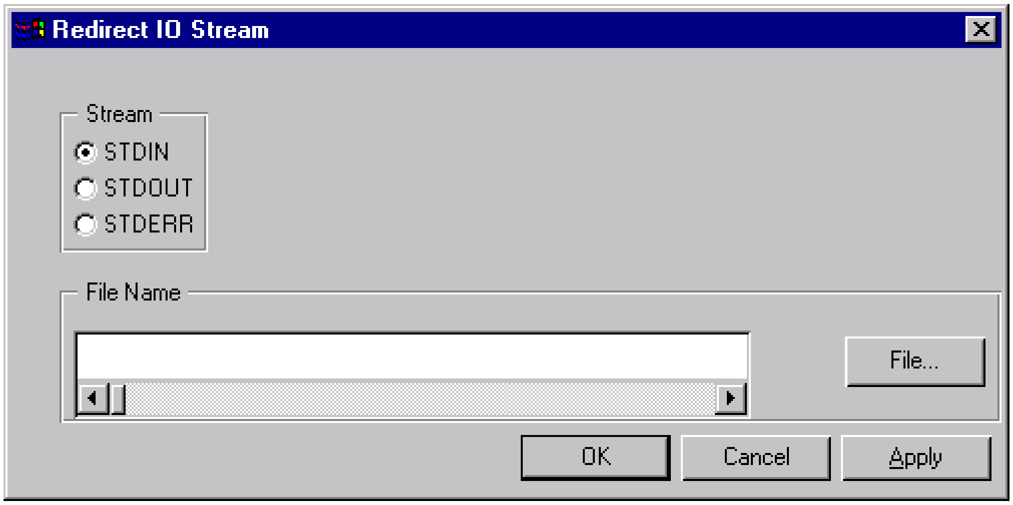
8.5 Redirecting an I/O Stream

You can redirect an I/O stream from the current device to a file on the host. Each stream file can be assigned individually; unwanted streams do not have to be redirected.

Streams can be redirected whether stream support is enabled or disabled; however, for the redirection to be effective, stream operations must be enabled. Disabling stream support while a stream is redirected does not terminate the redirection. It merely makes it ineffective until streams are enabled.

8.5.1 To Redirect the I/O Stream

1. From the **File** menu choose **IO Redirect**, then select **Streams**. The dialog box in Figure 8-5 appears.



Redirect IO Stream

Stream

● STDIN
○ STDOUT
○ STDERR

File Name

Figure 8-5. Redirecting the I/O Stream

2. Under **Stream** select the type of stream that you want redirected: **STDIN**, **STDOUT**, or **STDERR**.
3. Under **File Name** specify the filename to redirect the stream or click on the **File** button to browse for the file.
4. Click **OK**.

8.5.2 To Stop Redirecting the Stream I/O

1. From the **File** menu choose **IO Streams**, then select **Off**.
2. Select the type of stream to stop redirecting.
3. Click **OK**.

8.5.3 To Display Redirected Stream I/O

1. From the **Display** menu choose **Redirected IO Streams**
2. View the Session window. The redirected stream will be listed with the filename to which the stream are being directed.

To redirect the stream I/O from the command line, see Section 13.37, “REDIRECT - Redirect stdin/stdout/stderr for C Programs,” on page 13-44.

8.6 Displaying the Type of a C Expression

You can display a C variable or expression’s type. Keep in mind that you might need to move up or down the call stack to select the desired expression context. You can also change the current context when monitoring c function calls.

8.6.1 To Display The Type of a C Variable or Expression

1. From the **Display** menu choose **Type**. The dialog box in Figure 8-6. appears

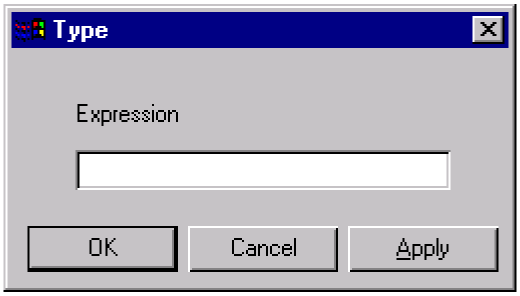


Figure 8-6. Displaying the Type of a C Variable or Expression

2. Type in the expression. Remember to enclose C expressions in curly brackets. For example:

```
{gi * i}
```

3. Click **OK**.
4. The data type is displayed in the Session window . If the result of the expression is a storage location (for example, a variable name or an element of an array), the address of the storage location will be displayed in addition to its data type

To display the type of a C variable from the command line, see Section 13.43, “TYPE - Display the Result Type of a C Expression,” on page 13-49.

Chapter 9
Macros, Scripts, and Log Files

The command macro is a useful tool for performing multiple Debugger commands. The command macro is useful for performing commonly repeated tasks such as setting the path, loading source programs, and setting up watch windows. However, a macro can consist of almost any Debugger commands.

9.1 Creating and Running a Command Macro

The command macro is a standard ASCII text file, and can be created or edited with any text editor. The macro can also be created by recording commands to a log file.

9.1.1 To Record a Command Macro

1. From the **File** menu, choose **Log**, then select **Commands.**
2. Specify the filename and save.
   The default filename extension is .cmd. A different extension can be used, but is not recommended for the sake of consistency.
   If you specify a filename that already exists, you can choose to overwrite the file or append the new commands to the end of the existing file.
3. The log file is now recording all Debugger commands, whether issued from the menu bar or from the command line in the Command window. Use the Debugger commands just as you would during normal program execution.
   Note that there is an exception. If you **stop** program execution while recording commands, the **stop** is not recorded. The only way to pause execution from within a macro is to use **step**, **next**, **trace**, **until**, **wait** or a **breakpoint**.
   If you have any question about whether a command can be recorded, think of it this way: if it appears in the command window, it is recorded.
4. To stop recording, from the **File** menu choose **Log**, then select **Close**.
5. From the dialog box select **Commands**.
6. Click **OK**
   The command macro is now saved and can be replayed or edited.

9.1.2 To Run a Command Macro

1. From the **File** menu, choose **Macro**.
2. Specify the file to run and click **Open**.
   The command macro begins. The commands are displayed in the Command window as they are executed. The commands are also echoed in the Session window, along with any output that is generated.

You can stop the execution of the command macro by choosing **Stop** from the **Execute** menu or by clicking on the **Stop** button on the tool bar.

You can find more information about program exection in Section 3.12, “Pausing Execution with Wait,” on page 3-24 and in Section 3.14, “Stopping Program Execution,” on page 3-26 To use command macros from the command line, see Section 13.30, “LOG - Log Commands or Session Output,” on page 13-37.

9.2 Logging Output from the Session Window

You can log all output that is displayed in the Session window. This is especially useful if you are trying to capture information that might span several screens.

9.2.1 To Log Output Displayed in the Session Window

1. From the **File** menu choose **Log**, then select **Session**
2. Specify the filename that you want to give the log file and click **OK**.
   All output that is echoed in the Session window will now also be written to the log file you specified.

9.2.2 To Stop Logging from the Session Window

1. From the **File** menu choose **Log**, then select **Close**. A dialog box appears.
2. Mark the **Session** checkbox.
3. Click **OK**.

Chapter 10
Expressions

An expression consists of a combination of symbols, constants, operators, and parentheses. Expressions follow the conventional rules of algebra and Boolean arithmetic. Expressions might contain any combination of integers, floating-point numbers, memory space symbols and register symbols.

The Debugger allows the use of expressions for various purposes. Expressions can be used in most places where a constant is valid. For example, an expression can take the place of the start and stop location in the specification of an address range. Or, an expression might be used to indicate the location of a breakpoint. Expressions can also be used in a watch list. You will find that there are various uses for expressions.

10.1 Evaluate Expressions

You can evaluate DSP assembler expressions and C expressions and write the result to the Session Window.

1. From the **Display** menu choose **Evaluate**. The dialog box in Figure 10-1 appears.

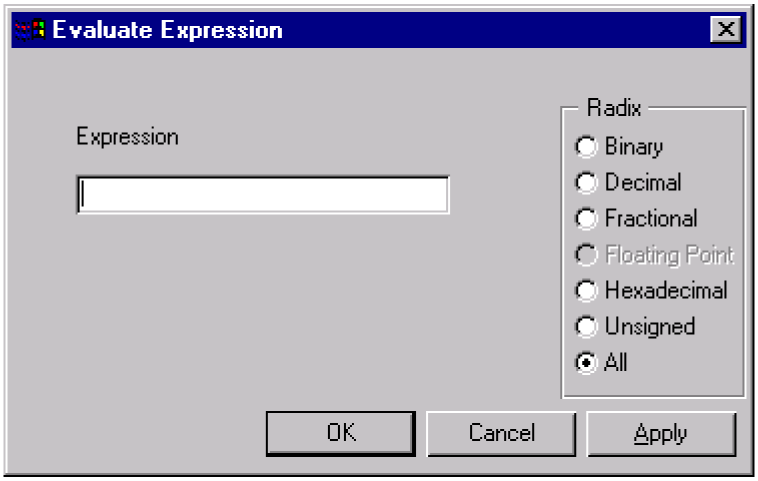


Figure 10-1. Evaluating an Expression

2. Under **Expression** type the expression that you want to evaluate; if the expression is a C expression, enclose it in curly braces: `{c_expression}`
   Note that some hexadecimal constants, such as a0 or d1, may also be valid register names for the target device. It is usually best to precede hexadecimal constants with a dollar sign ($) to distinguish them from registers that might have the same name. If there is no dollar sign ($) preceding an hexadecimal number and it is in fact also the name of a register, the Debugger assumes that you are referring to the register.
3. Under **Radix** select the radix in which to display the result of the expression.
   If **All** is selected, a C expression will display the type of the expression and the value in the format that is normal for the expression type.
   Selecting **All** when evaluating a DSP assembler expression will display select radices depending on the expression itself.
4. Click **OK**.
   The Session window displays the result of your evaluation.

C expressions are evaluated in the context of the current stack frame by default - that is, the value displayed is that which would have been returned if the expression had been included in the program at the current execution point. C expressions can be evaluated in the context of any of the functions on the call path to the current function.

To evaluate expressions from the command line, see Section 13.20, “EVALUATE - Evaluate an Expression,” on page 13-27.

10.2 Using Memory Space Symbols

The Debugger interprets a memory space symbol followed by an expression as the contents of a memory location. The expression following a memory space symbol is converted to an integer constant in the address range of the DSP.

To see a list of valid memory space prefixes and their corresponding address ranges, from the command line of the Command window type help mem.

Some memory space symbols, such as p: or x:, require the Debugger to first read the device Operating Mode Register (OMR). Others, such as xi: or pr:, refer to an exact memory location regardless of the chip operating mode.

For more information see Section 5, “Managing Memory and Registers,” on page 5-1 and Section 5.5, “Changing Memory Values,” on page 5-6.

10.3 Using Register Name Symbols

The Debugger interprets a register symbol in an expression as the contents of that register.

To see a list of valid register names for the device that you are targeting, from the command line of the Command window type `help reg.`

Note that some hexadecimal constants, such as a0 or d1, may also be valid register names for the target device. It is usually best to precede hexadecimal constants with a dollar sign ($) to distinguish them from registers that might have the same name.

For more information see Section 5.2, “Displaying Register Values,” on page 5-2 and Section 7.3, “Changing the Radix,” on page 7-5.

10.4 Using Assembler Debug Symbols

When loading object files with the Debugger, the symbol and line number information present in a COFF (.cld) object file are also be loaded. (This requires the object file to have been assembled with debugging information.) The Debugger will accept symbol names or source file line numbers and translate them into an associated memory address.

In general a symbol name may be referenced in the Debugger just as it was defined in the original source file, except for symbol names that conflict with a device’s register name. In that case the symbol name must be preceded by the `@` character.

A symbol name can be further delimited by specifying a containing section name in the form `section_name@symbol_name`, with the `@` character being used as the separator. The section name global may be used for the global section. If a symbol is specified without a preceding section name, the Debugger assumes the section containing the current pc.

Line numbers can be expressed simply as a decimal integer preceded by the `@` character when referring to a line in the current source file. If an address field is being specified in a command, the `@` character can be omitted. A line number in a particular source file should be expressed in the form `source_filename@line_number`.

Table 10-1 provides valid forms of symbol names and line numbers.

Table 10-1. Symbol Names and Line Numbers

Syntax	Description
`symbol_name`	Translates to the address associated with symbol_name. Example: `change pc lab_d`
`@symbol_name`	Translates to the address associated with symbol_name. Example: `disassemble @start_1`
`section_name@symbol_name`	Translates to the address associated with symbol_name in section section_name Example: `display sec3@xdata`
`@section_name@symbol_name`	Translates to the address associated with symbol_name in section section_name Example: `display @sec3@xdata`
`line_number`	Translates to the address associated with line_number in the current source file. Example: `break 30`
`@line_number`	Translates to the address associated with line_number in the current source file. Example: `change pc @30`
`source_filename@line_number`	Translates to the address associated with line_number in the named source file. Example: `change pc test.asm@30`
`@source_filename@line_number`	Translates to the address associated with line_number in the named source file. Example: `change pc @test.asm@30`
`source_filename`	Translates to the address associated with the first line in the named source file. Example: `list test.asm`
`@source_filename`	Translates to the address associated with the first line in the named source file. Example: `list @test.asm`

For more information see Section 2.3, “Loading Object Files,” on page 2-5.

10.5 Using Constants

Constants represent quantities of data that do not vary in value during the execution of a program.

10.5.1 Numeric Constants

Numeric constants can be in one of three bases:

- Binary constants consist of a percent sign (%) followed by a string of binary digits (0,1). For example:

  ```
  %11010
  %1001100
  ```

- Hexadecimal constants consist of a dollar sign ($) followed by a string of hexadecimal digits (0-9, A-F or a-f). For example:

  ```
  $FF
  $12FF
  $12ff
  ```

- Decimal constants can be either floating point or integer. Integer decimal constants consist of a string of decimal (0-9) digits. Floating point constants are indicated either by a preceding, following, or included decimal point or by the presence of an upper or lower case ’E’ followed by the exponent. The special constants `inf` and `nan` can be used in floating point expressions to represent the IEEE floating point values of infinity and not-a-number for DSP devices which operate with IEEE floating point values. For example:

  12345(integer)

  6E10(floating point)

  .6(floating point)

  2.7e2(floating point)

A constant can be written without a leading radix indicator by changing the radix. For example, a hexadecimal constant can be written without the leading dollar sign ($) if the input radix is set to hex. The default for the input radix is decimal.

For more information see Section 7.3, “Changing the Radix,” on page 7-5.

10.6 Operators in Expressions

Some operators can be used with both floating-point and integer values. If one of the operands of the operator has a floating point value and the other has an integer value, the integer will be converted to a floating point value before the operator is applied and the result will be floating point. If both operands of the operator are integers, the result will be an integer value. Similarly, if both the operands are floating point, the result will be a floating point value.

Operators recognized by the Debugger include the following.

10.6.1 Unary Operators

minus (-)

negate (~) - Integer only

logical negate (!) - Integer only

The unary negate operator will return the one’s complement of the following operand. The unary logical negation operator will return an integer 1 if the operand following it is 0 and will return a 0 otherwise. The operand must have an integer value.

10.6.2 Arithmetic Operators

addition (+)

subtraction (-)

multiplication (*)

division (/)

mod (%)

The divide operator applied to integer numbers produces a truncated integer result. The mod operator applied to integers will yield the remainder from the division of the first expression by the second. If the mod operator is used with floating point operands, the mod operator will apply the following rules:

```
Y % Z = Y if Z = 0
= X if Z <> 0
```

where X has the same sign as Y, is less than Z, and satisfies the relationship:

```
Y = i * Z + X
```

where i is an integer.

10.6.3 Bitwise Operators (Binary)

AND (&) - Integer only

inclusive OR (|) - Integer only

exclusive OR (^) - Integer only

Bitwise operators cannot be applied to floating point operands.

10.6.4 Shift Operators (Binary)

shift right (>>) - Integer only

shift left (<<) - Integer only

The shift right operator causes the left operand to be shifted to the right (and zero-filled) by the number of bits specified by the right operand. The shift left operator causes the left operand to be shifted to the left by the number of bits specified by the right operand. The sign bit will be replicated. Shift operators cannot be applied to floating point operands.

10.6.5 Relational Operators

less than (<)

greater than (>)

equal (==) or (=)

less than or equal (<=)

greater than or equal (>=)

not equal (!=)

Relational operators all work the same way. If the indicated condition is true, the result of the expression is an integer 1. If it is false, the result of the expression is an integer 0. For example, if D has a value of 3 and E has a value of 5, then the result of the expression D<E is 1, and the result of the expression D>E is 0. Each operand of the conditional operators can be either floating point or integer. Test for equality involving floating point values should be used with caution, since rounding error could cause unexpected results.

10.6.6 Logical Operators

Logical AND (&&)

Logical OR (||)

The logical AND operator returns an integer 1 if both of its operands are non-zero; otherwise, it returns an integer 0.
The logical OR operator returns an integer 1 if either of its operands is non-zero; otherwise it returns an integer 0. The types of the operands may be either integer or floating point. Logical operators are primarily intended for use with the Debugger BREAK command.

10.6.7 Operator Precedence

Expressions are evaluated with the following operator precedence:

1. parenthetical expression (innermost first)
2. unary minus, unary negate, unary logical negation
3. multiplication, division, mod
4. addition, subtraction
5. shift
6. less than, greater than, less or equal, greater or equal
7. equal, not equal
8. bitwise AND
9. bitwise EOR
10. .bitwise OR
11. logical AND
12. logical OR

Operators of the same precedence are evaluated left to right. All integer results (including intermediate) of expression evaluation are 32-bit, truncated integers. Valid operands include numeric constants, memory addresses, or register symbols. The logical, bitwise, unary negate unary logical negation and shift operators cannot be applied to floating point operands. That is, if the evaluation of an expression (after operator precedence has been applied) results in a floating point number on either side of any of these operators, an error will be generated.

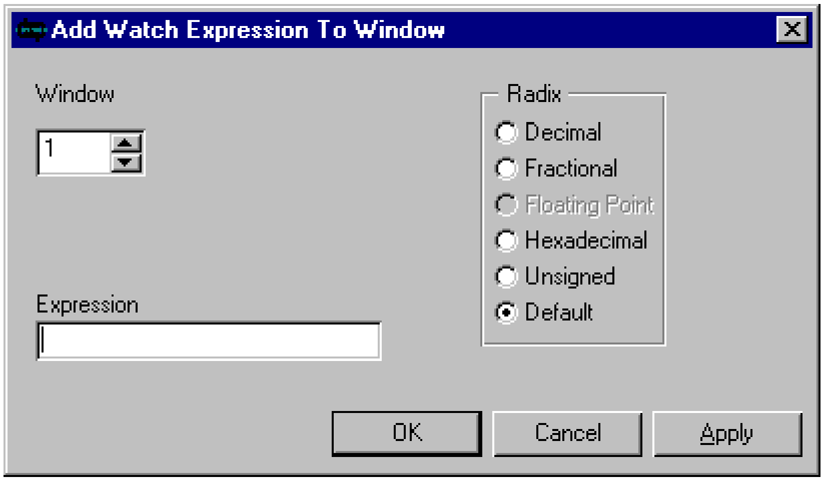
10.7 Setting Up and Modifying a Watch list

You can watch the contents of a specific memory location, register, or any arbitrary value or expression by setting up a Watch window. The Watch window displays a list of the watch items that you have specified. The watch list gets updated every time program execution is halted (including breakpoints).

The value or expression that you watch can be valid even if it is not calculated during program execution. C expressions can be used, enclosed in braces: {c_expression}. Symbolic references can be used if symbols have been loaded from the object module. The values are re-calculated at each break in execution.

To display a value in a **watch** list:

1. From the **Windows** menu choose **Watch**. The dialog box in Figure 10-2 appears.



Add Watch Expression To Window

Window: 1

Expression:

Radix
○ Decimal
○ Fractional
○ Floating Point
○ Hexadecimal
○ Unsigned
● Default

Figure 10-2. Displaying a Value in a Watch List

2. Select the window number where you want the expression to appear. You will want to do this when you have more than one Watch window open.
3. Under **Expression**, type in the expression that you want to add to the Watch window.
4. Under **Radix**, select the radix format in which you want the variables displayed.
5. Click **OK**.
   The expression that you specified now appears in a Watch window: If the expression you type is not valid, you will get an error message explaining why the expression is not valid.

A C expression which refers to C variables can only be evaluated in the context in which the watch is established. That is, the expression is only valid when all the variables used in the expression are in scope. So if one (or more) of the variables in an expression goes out of scope (either because a function call or return from a function), the value is replaced with the message Expression out of scope. When all elements of the expression are back in scope, the value is again displayed.

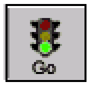
An expression that has gone out of scope because of a function call can be evaluated and displayed by selecting the stack frame for the evaluation context. The stack frame assignment remains in effect only until the next instruction is executed. An expression that is out of scope because of an exit from a function cannot be evaluated until the function is called again as its variables no longer exists.

To set a watch list from the command line, see Section 13.49, “WATCH - Set, Modify, View, or Clear Watch Item,” on page 13-52.

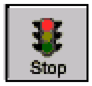
Chapter 11
Debugger Toolbar

You can use the toolbar to control some program execution. The icons located on the toolbar duplicate the same kind of controls found under the **Execute** menu. Using the toolbar provides a quicker way to do some of these things than using the Execute menu.

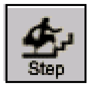
The icons on the toolbar are as follows:



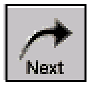
Go Button
Starts program execution from the next address. All breakpoints are observed



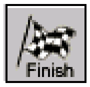
Stop Button
Stops program execution or a command macro, if running.



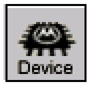
Step Button
Executes next instruction or line.



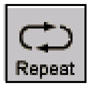
Next Button
Executes next instruction or line.



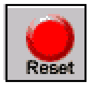
Finish Button
Allows the current function to execute to completion.



Device Button
Allows setting of the default device to which all commands will be directed.



Repeat Button
Repeats the last command in the history buffer.

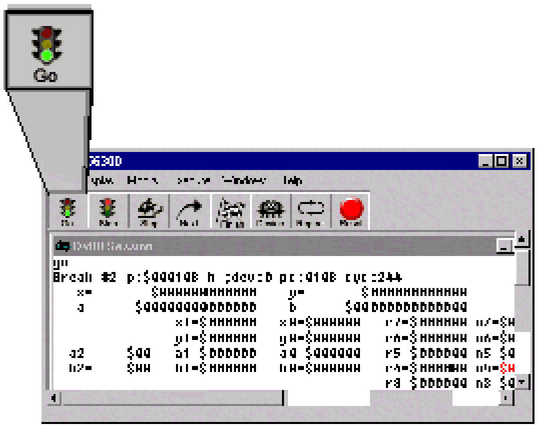


Reset Button
Resets the current device.

All of these commands are also available from the command line, described in Chapter 13, “Debugger Command Reference.”

11.1 Go Button

The **Go** button starts program execution beginning with the next address, Figure 11-1.



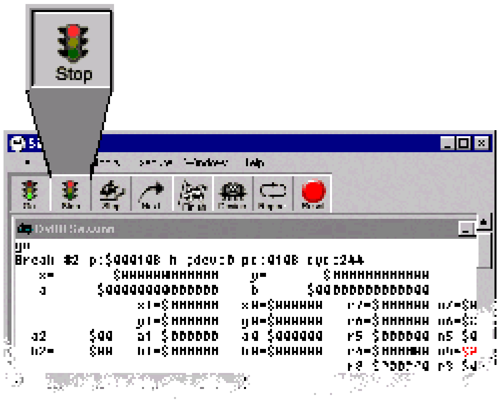
```
go
Break #2 p:$000108 h ;dev:0 pc:0108 cyc:244
   x=        $HHHHHHHHHHHH     y=       $HHHHHHHHHHHH
   a       $000000000000000    b      $0000000000000000
              x1=$HHHHHH   x0=$HHHHHH   r7=$HHHHHH n7=$H
              y1=$HHHHHH   y0=$HHHHHH   r6=$HHHHHH n6=$H
  a2     $00   a1 $000000   a0 $000000   r5 $000000 n5 $0
  b2=    $HH   b1=$HHHHHH   b0=$HHHHHH   r4=$HHHHHH n4=$H
                                         r3 $000000 n3 $0
```

Figure 11-1. Go Button

Go is also discussed in Section 3.1, “Starting Execution with Go,” on page 3-1, and in Section 13.24, “GO - Execute DSP Program,” on page 13-29.

11.2 Stop Button

The **Stop** button stops program execution or if a command macro is running, stops the macro. See Figure 11-2.



```
go
Break #2 p:$000108 h ;dev:0 pc:0108 cyc:244
   x=        $HHHHHHHHHHHH     y=       $HHHHHHHHHHHH
   a       $000000000000000    b      $0000000000000000
              x1=$HHHHHH   x0=$HHHHHH   r7=$HHHHHH n7=$H
              y1=$HHHHHH   y0=$HHHHHH   r6=$HHHHHH n6=$H
  a2     $00   a1 $000000   a0 $000000   r5 $000000 n5 $0
  b2=    $HH   b1=$HHHHHH   b0=$HHHHHH   r4=$HHHHHH n4=$H
                                         r3 $000000 n3 $0
```

Figure 11-2. Stop Button

Stop is also dicussed in Section 3.14, “Stopping Program Execution,” on page 3-26.

11.3 Step Button

The **Step** button executes the next instruction or line. See Figure 11-3.

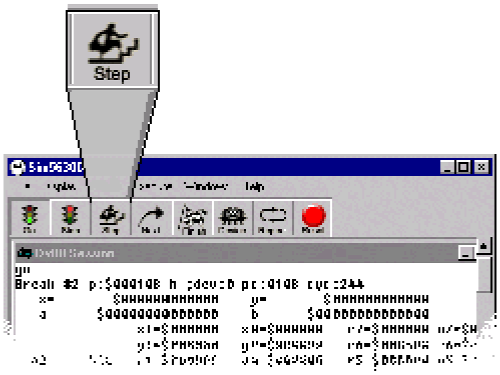


Figure 11-3. Step Button

If the Source window is open, displaying the program source, the **Step** button executes one line of code. Otherwise, the **Step** button executes one instruction. On encountering a JSR instruction (a jump to a subroutine), the Debugger begins with the first instruction of the subroutine, and steps through it one instruction at a time.

To step one instruction at a time from the toolbar:

1. Make sure that program execution is halted and that the Source window is not open.
2. Click the **Step** button on the toolbar. The Debugger will execute the next assembly instruction.

To step one line at a time from the toolbar:

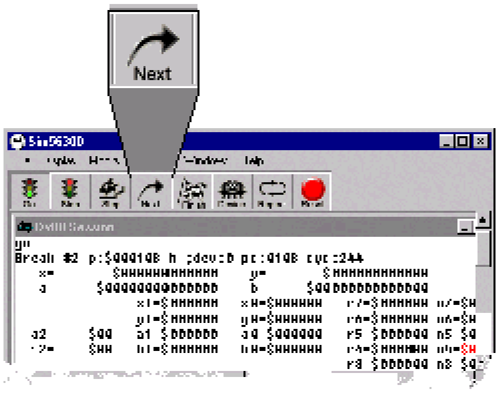
1. Make sure that program execution is halted and that the Source window is open. If the Source window is not open, the Debugger will automatically execute the next instruction in the Assembly window rather than then next line in the Source window.
2. Click the **Step** button on the toolbar. The Debugger will execute the next executable line of code in the Source window. (Comments lines in the source code are ignored.)

Notice that the values in the Register window, the Memory window, and all other Debugger windows are updated each time you click **step**.

You can find more information about about the **step** command in Section 3.2, “Step Through Instructions,” on page 3-3, and in Section 3.4, “Executing the Next Instruction,” on page 3-6 . To use step from the command line, see Section 13.39, “STEP - Step Through DSP Program,” on page 13-46.

11.4 Next Button

The **Next** button executes the next instruction or line. See Figure 11-4.



```
y"
Break #2 p:$000108 h ;dev:0 pc:0108 cyc:244
   x=        $HHHHHHHHHHHH     y=        $HHHHHHHHHHHH
   a       $00000000000000     b       $00000000000000
              x1=$HHHHHH   x0=$HHHHHH   r7=$HHHHHH  n7=$H
              y1=$HHHHHH   y0=$HHHHHH   r6=$HHHHHH  n6=$H
  a2    $00   a1 $000000   a0 $000000   r5 $000000  n5 $0
  b2=   $HH   b1=$HHHHHH   b0=$HHHHHH   r4=$HHHHHH  n4=$H
                                        r3 $000000  n3 $0
```

Figure 11-4. Next Button

If the next instruction to be executed calls a subroutine or begins execution of a function, all the instructions of the subroutine or function are executed before stopping. The enabled registers, memory, and other updated values are then displayed. In order to recognize functions, the symbolic debug information for the program code must be loaded.

To execute the next instruction from the toolbar:

1. Make sure that program execution is halted and that the Source window is not open.
2. Click on the **Next** button on the toolbar
   The Debugger will execute the next assembly instruction.

To execute the next line from the toolbar:

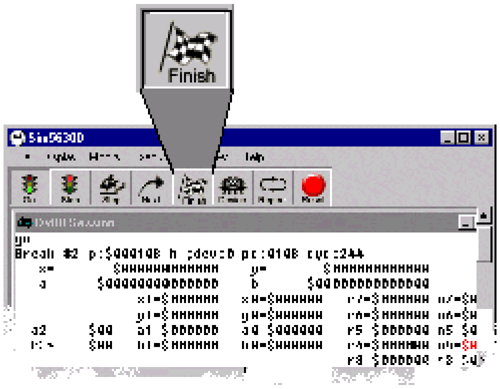
1. Make sure that program execution is halted and that the Source window is open. If the Source window is not open, the Debugger will automatically execute the next instruction in the Assembly window rather than then next line in the Source window.
2. Click on the **Next** button on the toolbar.
   The Debugger will execute the next executable line of code in the Source window. (Comments lines in the source code are ignored.)

Notice that the values in the register window, the memory window, and all other Debugger windows are updated each time you click on Next.

You can find more information about the **next** command in Section 3.4, “Executing the Next Instruction,” on page 3-6. To use **next** from the command line, see Section 13.32, “NEXT - Step Through Subroutine Calls or Macros,” on page 13-39.

11.5 Finish Button

The **Finish** button allows the current function to execute to completion. See Figure 11-5.



```
go
Break #2 p:$00010B h ;dev:0 pc:010B cyc:244
   x=          $HHHHHHHHHHHH     y=          $HHHHHHHHHHHH
   a         $00000000000000     b       $00000000000000
                  x1=$HHHHHH   x0=$HHHHHH   r7=$HHHHHH  n7=$H
                  y1=$HHHHHH   y0=$HHHHHH   r6=$HHHHHH  n6=$H
  a2      $00     a1 $000000   a0 $000000   r5 $000000  n5 $0
  [illegible]     $HH     b1=$HHHHHH   b0=$HHHHHH   r4=$HHHHHH  n4=$H
                                            r3 $000000  n3 $0
```

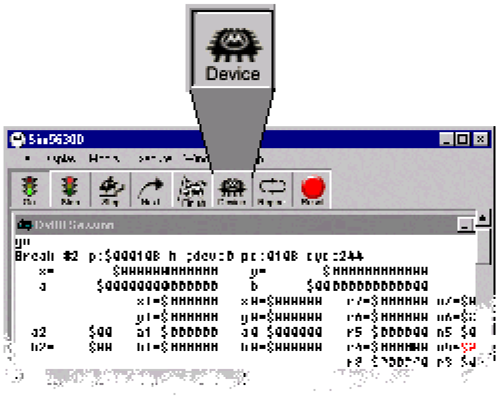
Figure 11-5. Finish Button

When stepping through a program, it is possible that execution will stop in the middle of a function or subroutine. Clicking on the **Finish** button completes the execution of the function or subroutine. The Debugger continues until encountering an RTS instruction. If another function is encountered during a **finish** operation, execution continues to the end of the current function.

You can find more information about the **finish** command in Section 3.13, “Allowing the Current Function to Finish,” on page 3-25. To use **finish** from the command line, see Section 13.21, “FINISH - Step Until End of Current Subroutine,” on page 13-28.

11.6 Device Button

The **Device** button allows you to set the default device to which all commands will be directed. See Figure 11-6.



```
go
Break #2 p:$000108 h ;dev:0 pc:0108 cyc:244
```

Figure 11-6. Device Button

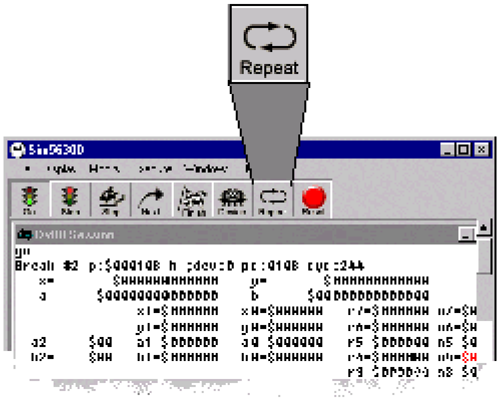
The **Device** button opens a dialog box that allows you to set the default device. This designates the device to which all commands will be directed.

Notice that when you designate another device as the default device that the Session window and Command window automatically reflect information for the new device. However, other windows such as the Assembly window, Source window, Stack window, etc. must be specifically opened to reflect the information for the new default device.

You can find more information about the **device** command in Section 7.2, “Setting the Default Device,” on page 7-4. To use device from the command line, see Section 13.16, “DEVICE - Select Default Device,” on page 13-22.

11.7 Repeat Button

The **Repeat** button repeats the last command in the history buffer. See Figure 11-7.



```
g
Break #2 p:$000108 h ;dev:0 pc:0108 cyc:244
   x=        $HHHHHHHHHHHH    y=       $HHHHHHHHHHHH
   a       $00000000000000    b      $000000000000000
                  x1=$HHHHHH  x0=$HHHHHH   r7=$HHHHHH  n7=$H
                  y1=$HHHHHH  y0=$HHHHHH   r6=$HHHHHH  n6=$H
  a2     $00    a1 $000000  a0 $000000   r5 $000000  n5 $0
  b2=    $HH    b1=$HHHHHH  b0=$HHHHHH   r4=$HHHHHH  n4=$H
                                          r3 [illegible]  n3 $0
```

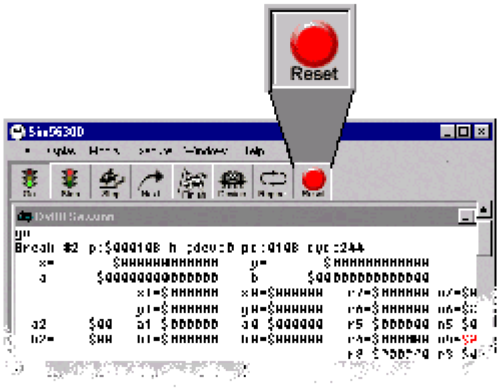
Figure 11-7. Repeat Button

The **Repeat** button repeats the last command in the history buffer - that is, the last command listed in the Command window. Pressing this button is the same as clicking on the last command in the Command window and pressing ENTER.

You can find more information about the **repeat** command in Section 12.3, “Command Window,” on page 12-3.

11.8 Reset Button

The **Reset** button resets the current device. See Figure 11-8.



```
go
Break #2 p:$000108 h ;dev:0 pc:0108 cyc:244
   x=        $HHHHHHHHHHHH     y=        $HHHHHHHHHHHH
   a       $00000000000000     b       $00000000000000
                 x1=$HHHHHH   x0=$HHHHHH   r7=$HHHHHH n7=$H
                 y1=$HHHHHH   y0=$HHHHHH   r6=$HHHHHH n6=$
  a2     $00   a1 $000000   a0 $000000   r5 $000000 n5 $0
  b2=    $HH   b1=$HHHHHH   b0=$HHHHHH   r4=$HHHHHH n4=
```

Figure 11-8. Reset Button

The **Reset** button resets the current device the same as if you had chosen **Reset System** from the **Execute** menu.

You can find more information about the **reset** command in Chapter 5, “Managing Memory and Registers.” To use **reset** from the command line, see Section 13.22, “FORCE - Assert RESET or BREAK on Target,” on page 13-28.

Chapter 12
Displayed Information

This chapter shows you how to display the following information in the Debugger:

- Radix
- Current breakpoint
- Command window
- Session window
- Assembly window
- Source window
- Stack window

12.1 Displaying the Radix

You can display the default radix (number base) that is currently used for command parameters and other values that you input. That is, the radix that is used when you type a value into a dialog box or at the command line.

To display the current default radix:

1. From the **Display** menu, choose **Radix**.
2. The default radix is displayed in the Session window.

If the default radix for the Debugger is set to decimal, this means that values you enter are presumed to be decimal, and you don't need to type a preceding apostrophe ('). If the default radix for the Debugger is set to hexadecimal, this means that values can be entered in hexadecimal without typing a preceding dollar ($). Similarly, if the default radix is unsigned or binary, their respective specifiers do not need to be typed before the value.

Be careful to distinguish the input radix from the output radix. The default radix refers to the input radix.

The output radix refers to the display radix and can be different from the input radix. The output radix is the radix that describes the way values are displayed in the Memory window, Register window, Watch window, etc. You can change the radix for a particular register or for a particular memory location by changing the radix.

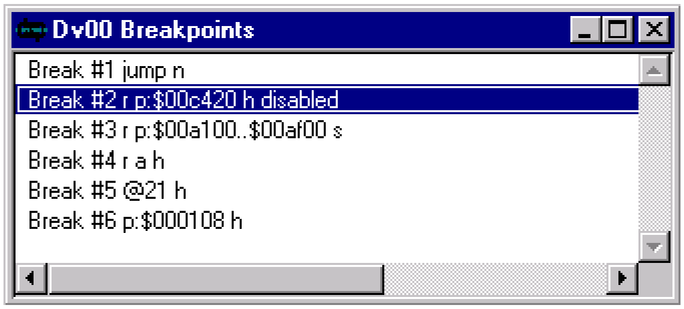
For more information see Section 7.3, "Changing the Radix," on page 7-5.

12.2 Display the Current Breakpoint

It is often useful to display the enabled and disabled breakpoints for the current device by opening the Breakpoints window.

To display the current breakpoints

1. From the **Windows** menu, choose **Breakpoints**. A dialog box shows a list of the breakpoints set for the current device.
   The dialog box in Figure 12-1 shows an example of a list of six breakpoints. Disabled breakpoints, such as the breakpoint #2, are indicated with the word **disabled**.



Break #1 jump n
Break #2 r p:$00c420 h disabled
Break #3 r p:$00a100..$00af00 s
Break #4 r a h
Break #5 @21 h
Break #6 p:$000108 h

Figure 12-1. Breakpoints

2. Double click on a breakpoint from the list to toggle it from disabled to enabled, or from enabled to disabled.

Breakpoints that were set by double clicking on a line in the Source window, such as breakpoint #5 above, are identified by the line number.

Breakpoints that were set by double clicking on a line in the Assembly window, such as breakpoint #6 above, are identified by the address.

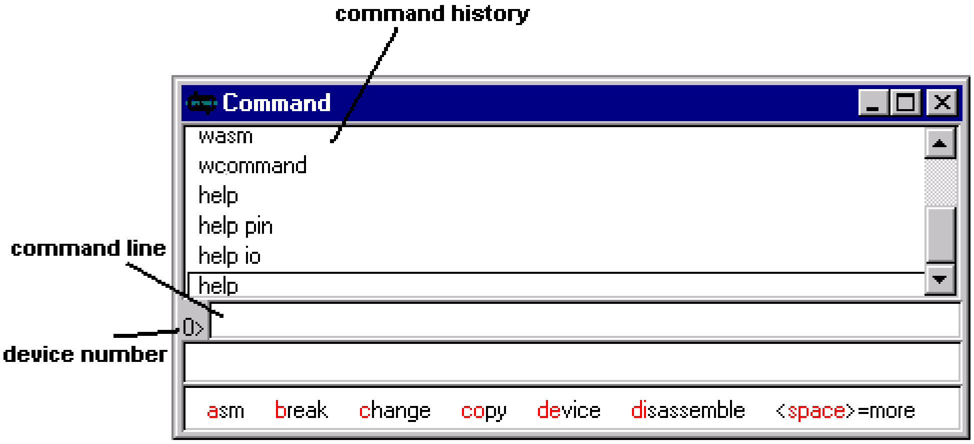
Breakpoints and their usage are also discussed in Section 2.6, “Setting and Clearing Software Breakpoints,” on page 2-11, Section 2.7, “Setting and Clearing Hardware Breakpoints,” on page 2-15, Section 3.10, “Enabling and Disabling Breakpoints,” on page 3-22, Section 12.6, “Source Window,” on page 12-8 , Section 12.5, “Assembly Window,” on page 12-7

12.3 Command Window

The Command window permits you to enter Debugger commands on a command line. In this way, the Command window provides an alternative to using the menu bar or the toolbar. The Command window is also a useful source of information in that it echoes the commands from the menu bar and from the toolbar. It also provides a source of history. The command history buffer holds the ten most recent commands. If the last command is repeated exactly, the duplicate is not stored.

To display the Command window:

1. From the **Windows** menu, choose Command. See the Command window in Figure 12-2.



```
wasm
wcommand
help
help pin
help io
help
```

Figure 12-2. Command Window

2. Notice that the device number is indicated. This is the device to which the commands are applied. In order to affect another device, the default device must be changed.

The command window also provides access to device specific information such as pin and port information.

To display device specific information

1. From the command line of the Command window, type:

   ```
   help
   ```

2. A list of help topics is displayed in the Session Window. Check the list for the device specific information that you are wanting. You might have to scroll back up the Session window to see the whole list.
3. From the command line of the Command window, type help followed by the name of the help topic. For example, to list the on-chip io registers and their addresses, on the command line type:

   ```
   help io
   ```

   The help information is displayed in the Session window. Some of this information can be lengthy, so it might be useful to log the Session window output.

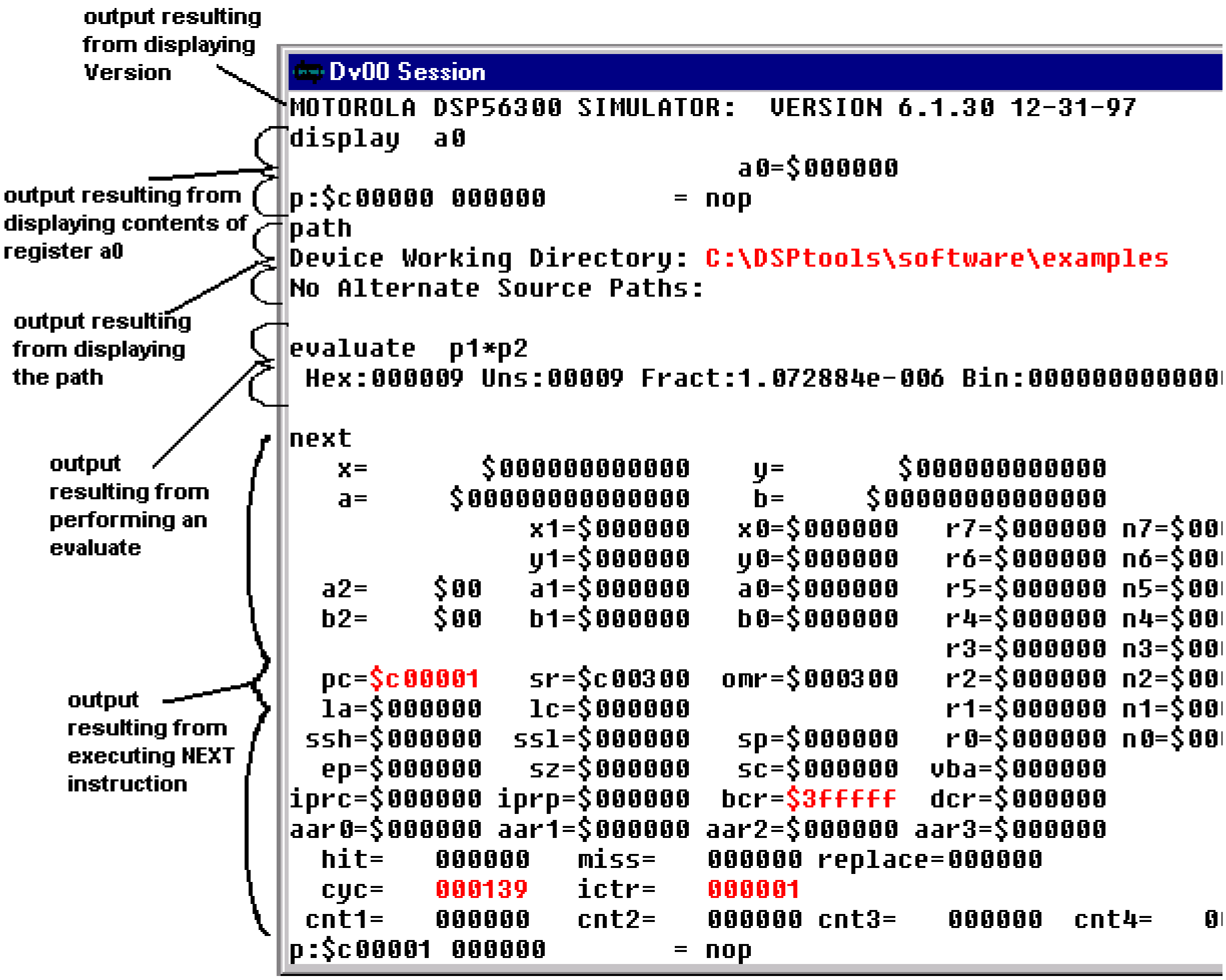
For more information about the command window and its usage, see Section 1.4, “Entering Commands,” on page 1-7, Section 2.4, “Setting Up the Display Environment,” on page 2-7, Section 7.2, “Setting the Default Device,” on page 7-4, and Section 9.2, “Logging Output from the Session Window,” on page 9-2.

12.4 Session Window

The Session window is the main output for the Debugger. The Session window displays:

- an echo of all commands input at the command line (from the Command Window),
- output from commands,
- information from the Display menu,
- views of source code and assembly code,
- values in registers and memory locations at breakpoints,
- values in registers and memory locations after execution is halted, and
- error messages.

During a typical session, the window might look like the one in Figure 12-3.


Dv00 Session
output resulting from displaying Version
output resulting from displaying contents of register a0
output resulting from displaying the path
output resulting from performing an evaluate
output resulting from executing NEXT instruction

```
MOTOROLA DSP56300 SIMULATOR:  VERSION 6.1.30 12-31-97
display  a0
                            a0=$000000
p:$c00000 000000        = nop
path
Device Working Directory: C:\DSPtools\software\examples
No Alternate Source Paths:

evaluate  p1*p2
 Hex:000009 Uns:00009 Fract:1.072884e-006 Bin:0000000000000

next
   x=       $000000000000    y=       $000000000000
   a=     $00000000000000    b=     $00000000000000
               x1=$000000   x0=$000000   r7=$000000 n7=$00
               y1=$000000   y0=$000000   r6=$000000 n6=$00
  a2=    $00   a1=$000000   a0=$000000   r5=$000000 n5=$00
  b2=    $00   b1=$000000   b0=$000000   r4=$000000 n4=$00
                                         r3=$000000 n3=$00
  pc=$c00001   sr=$c00300  omr=$000300   r2=$000000 n2=$00
  la=$000000   lc=$000000                r1=$000000 n1=$00
 ssh=$000000  ssl=$000000   sp=$000000   r0=$000000 n0=$00
  ep=$000000   sz=$000000   sc=$000000  vba=$000000
iprc=$000000 iprp=$000000  bcr=$3fffff  dcr=$000000
aar0=$000000 aar1=$000000 aar2=$000000 aar3=$000000
  hit=   000000   miss=   000000 replace=000000
  cyc=   000139   ictr=   000001
 cnt1=   000000   cnt2=   000000 cnt3=   000000  cnt4=   0
p:$c00001 000000        = nop
```

Figure 12-3. Session Window

To display the Session window

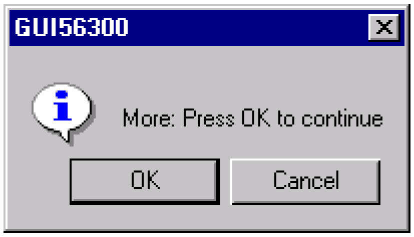
1. From the **Window** menu, choose **Session**.
2. The Session window opens. You will probably have to scroll and resize the window to be suitably visible.
   Note that it is not possible to have more than one Session window open at a time.

The Session window only displays output for the current device. However, each device writes output to its own buffer. That is, a device retains the contents of the Session window even when you have named another device as the default device. In order to see the Session window for a specific device, you must specify that specific device as the current device.

The Session window buffers the last 100 lines of output. It might be necessary to scroll through the Session window to see previous output. At times, you might perform a command that displays more than 100 lines of output to the Session window. In this case you will want to pause the output to the Session window.

To pause output to the Session window:

1. From the **Display** menu, choose **More**. Then select **On**.
2. The Session window will now pause if more than 100 lines of information are displayed at once.
   For example, if you perform a command such as typing `help io` from the command line, it is likely that the resulting output to the Session window will be greater than 100 lines. The dialog box in Figure 12-4 appears.



More: Press OK to continue

Figure 12-4. Pausing Output to the Session Window

3. Click **OK** to display the next 100 lines in the Session window.

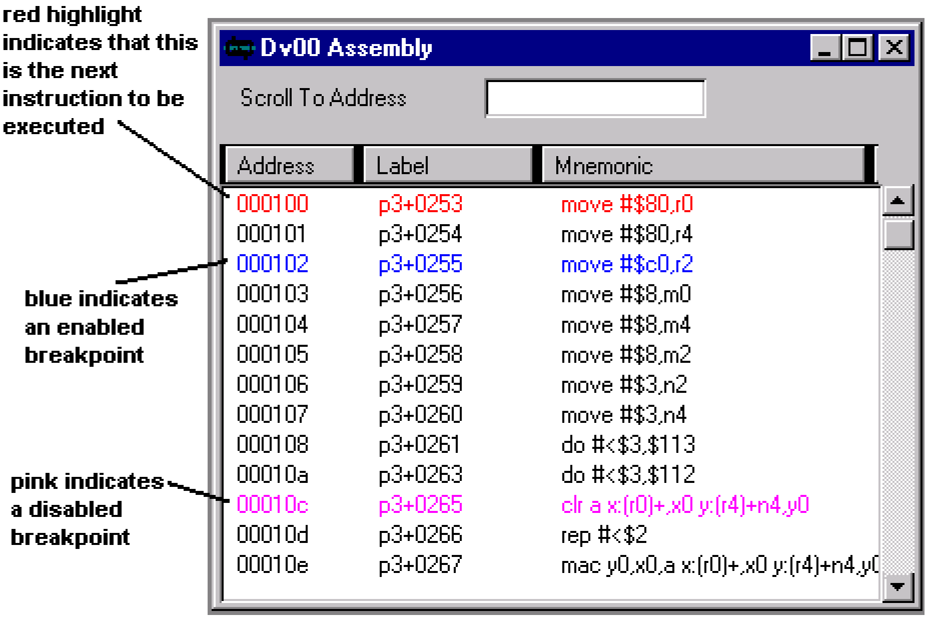
For more information see Section 2.4, “Setting Up the Display Environment,” on page 2-7 and Section 7.2, “Setting the Default Device,” on page 7-4.

12.5 Assembly Window

The Assembly window allows you to display and edit the contents of memory, set and clear breakpoints, and follow program execution. As the program executes, the display is updated at each break in execution. The next instruction to be executed is always displayed, highlighted in red.

To use the Assembly window:

1. From the **Windows** menu, choose **Assembly**. The Assembly window appears as in Figure 12-5.



red highlight indicates that this is the next instruction to be executed

blue indicates an enabled breakpoint

pink indicates a disabled breakpoint

Address	Label	Mnemonic
000100	p3+0253	move #$80,r0
000101	p3+0254	move #$80,r4
000102	p3+0255	move #$c0,r2
000103	p3+0256	move #$8,m0
000104	p3+0257	move #$8,m4
000105	p3+0258	move #$8,m2
000106	p3+0259	move #$3,n2
000107	p3+0260	move #$3,n4
000108	p3+0261	do #<$3,$113
00010a	p3+0263	do #<$3,$112
00010c	p3+0265	clr a x:(r0)+,x0 y:(r4)+n4,y0
00010d	p3+0266	rep #<$2
00010e	p3+0267	mac y0,x0,a x:(r0)+,x0 y:(r4)+n4,y0

Figure 12-5. Assembly Window

2. To scroll to a specific address, type the address in the box labeled `Scroll To Address` and press ENTER.
3. To edit an instruction, single click the mnemonic. Notice that the mnemonic text is now highlighted. Type the new assembly instruction and press ENTER.
   Notice that the next instruction is highlighted. In order to avoid accidentally typing over that instruction, click on an area outside of the mnemonic.
4. Breakpoints can be set, disabled, or cleared by double clicking an address or label field.
   Double click the address or label to set the breakpoint. Double click again on the address or label to disable the breakpoint. Double click again on the address or label to remove the breakpoint.
   Enabled breakpoints appear in blue. Disabled breakpoints appear in pink.

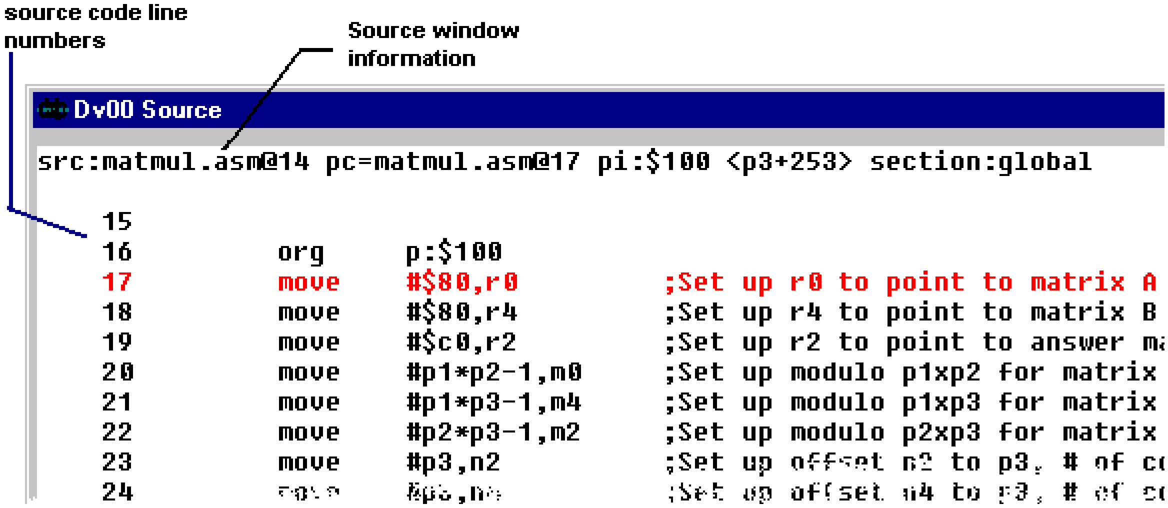
The assembly window and its usage are discussed in Section 2.4, “Setting Up the Display Environment,” on page 2-7, Section 7.2, “Setting the Default Device,” on page 7-4, and in Section 12.2, “Display the Current Breakpoint,” on page 12-2. To use the assembly window from the command line, see Section 13.4, “ASM - Single Line Interactive Assembler,” on page 13-8.

12.6 Source Window

The Source window displays the source code that has been loaded in memory. The source code may reside in the directory containing the object module or in any of the directories specified in the path.

To display the Source window:

1. From the **Windows** menu, choose **Source**. The Source window indicates the current program counter (PC) and highlights the corresponding source line in red. See Figure 12-6.



```
src:matmul.asm@14 pc=matmul.asm@17 pi:$100 <p3+253> section:global

 15
 16         org     p:$100
 17         move    #$80,r0         ;Set up r0 to point to matrix A
 18         move    #$80,r4         ;Set up r4 to point to matrix B
 19         move    #$c0,r2         ;Set up r2 to point to answer ma
 20         move    #p1*p2-1,m0     ;Set up modulo p1xp2 for matrix
 21         move    #p1*p3-1,m4     ;Set up modulo p1xp3 for matrix
 22         move    #p2*p3-1,m2     ;Set up modulo p2xp3 for matrix
 23         move    #p3,n2          ;Set up offset n2 to p3, # of co
 24         move    #p3,n4          ;Set up offset n4 to p3, # of co
```

Figure 12-6. Source Window

2. You can use the Source window to set halt breakpoints. To set or clear a breakpoint double-click on any line in the Source window.
   The breakpoint is added to the breakpoint list, displayed in the breakpoint window and highlighted blue in the Assembly window.

The Source window and its usage are also discussed in Section 2.2, “Setting and Clearing the Path,” on page 2-2 and Section 2.4, “Setting Up the Display Environment,” on page 2-7.

12.7 Stack Window

You can watch the call stack by opening the Stack window.

To display the call stack

1. From the **Windows** menu, choose **Stack**.
   The call stack will be displayed.

You can find more information about the stack in Chapter 8, “Debugging C Source Code,” specifically, Section 8.1, “Moving Up and Down the Call Stack,” on page 8-1.

Chapter 13
Debugger Command Reference

The following chapter lists and describes the Debugger commands. There are a total of sixty Debugger commands that can be performed from the command line. (The command line is a part of the Command Window. These commands, and their syntax, are useful to know if you are using the command line or if you are writing a command macro.

The Debugger commands can be grouped into six categories:

- memory/register modification,
- file I/O,
- execution control,
- C Source Code Debug Commands,
- miscellaneous tasks, and
- windows controls (used especially in writing command macros)

Memory/Register Modification

The following commands relate to modifying memory and registers. These allow you to:

- ASSEMBLE (ASM) DSP instructions,
- CHANGE register or memory locations,
- COPY a block of memory to a new location,
- DISASSEMBLE code stored in the device memory,
- DISPLAY registers and memory values,
- DISPLAY the Debugger revision number or memory configuration,
- FORCE the reset of the device,
- WATCH certain variables and expressions.

File I/O

The following commands relate to file Input and Output. These allow you to:

- INPUT which allow you to INPUT peripheral or memory location values from a file,
- OUTPUT peripheral or memory location values to a file,
- LOAD DSP Assembler object module files or Debugger state files,
- LOG Debugger commands, session display output or DSP program execution profile, and
- SAVE Debugger memory to an object module file or the Debugger state to a state file.

Execution Control

The following commands relate to control of program execution. These allow you to:

- specify BREAK conditions,
- GO until a break condition is met,
- STEP a specified number of instructions or cycles before displaying register and memory changes,
- TRACE a specified number of instructions or cycles displaying register and memory changes at each step,
- The NEXT instruction operates essentially the same as the STEP instruction, except that if the instruction being executed calls a subroutine or function, execution continues until return from the subroutine or function.
- The UNTIL instruction has the effect of setting a temporary breakpoint at a specified address, executing until a breakpoint is en-countered, then clearing the temporary breakpoint.
- The FINISH instruction proceeds until an RTS instruction is encountered for the current subroutine.

C Source Code Debug Commands

The following commands relate to debugging C source code. These include:

- WHERE to display the C function call stack,
- UP, DOWN and FRAME are used to traverse the call stack,
- REDIRECT is used to redirect data from stdin/stdout/stderr to files,
- STREAMS enable the io streams, and
- TYPE displays the data type of a variable, function or C expression.

Miscellaneous Tasks

The following commands include miscellaneous tasks:

- DEVICE specifies a new device and its device type,
- EVALUATE evaluates expressions in five different radices,
- HELP displays device specific information in the Session window,
- PATH defines the working directory and alternate directories,
- QUIT ends a debugging session,
- HOST changes the attributes of the Host Interface Card
- RADIX specifies the default number base (hex, decimal, etc.) used during expression evaluation and data entry or data display,
- SYSTEM executes an operating system command in two modes,
- WAIT specifies a number of seconds to pause execution before proceeding to the next instruction.
- LIST displays a specified source file when symbolic debug is in effect,
- VIEW allows selection of the Debugger display mode - Source, Assembly or Register.
- UNLOCK provides password enabling of unannounced device types.

Windows Controls

The following commands control the display of windows and are particularly useful in writing command macros:

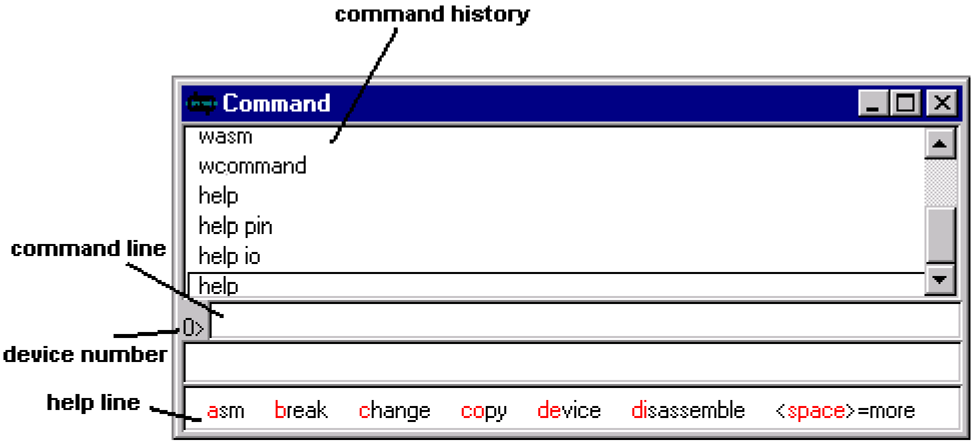
- WASM opens an assembly window displaying addresses, labels, and mnemonics
- WBREAKPOINT opens a breakpoint window displaying current breakpoints
- WCALLS opens a C call stack window
- WCOMMAND opens a command window
- WINPUT opens an input window
- WLIST opens a list window displaying contents of a specified file
- WMEMORY opens a memory window
- WOUTPUT opens an output window
- WREGISTER opens a register window
- WSESSION opens the Session window
- WSOURCE opens a Source window
- WSTACK opens a stack window
- WWATCH opens a watch window displaying expressions that have been specified for the watch list

For more information see, Section 9.1, “Creating and Running a Command Macro,” on page 9-1, Section 13.2, "Command Syntax." , Section 13.3, "Command Parameters: List of Abbreviations."

13.1 Entering Commands

Most of your work with the Debugger will be performed by using the menu bar and the toolbar. However, you might sometimes find it useful to perform some commands from a command line. Motorola’s DSP Debugger provides you the option of entering commands at a command line.

The command line is a part of the Command Window. See Figure 13-1.



```
wasm
wcommand
help
help pin
help io
help
```

asm break change copy device disassemble <space>=more

Figure 13-1. ADS Debugger Command Window

In the Command window, you will notice that several common commands are displayed on the help line. The remaining commands can be displayed by pressing the SPACE bar when the cursor is at the beginning of the command line.

It is not necessary to type the complete command. You only need to type the first one to three characters of the command for the Debugger to recognize the command. The minimum number of required characters for each command is highlighted in red on the help line.

What is the complete syntax for a command? You can display the complete syntax for a particular command by typing the command (or the required characters) on the command line and then pressing the SPACE bar. The complete syntax of the command that you began typing is displayed on the help line.

Any text that follows a semicolon on the command line is considered a user comment. You might use comments if you were logging output from the Session window or creating and running a Command Macro

The command that you have typed in on the command line is executed when you press the ENTER key or the CARRIAGE RETURN key. If the command is not a valid Debugger command, the Debugger interprets the command as the name of a command macro and executes the macro, if it exists.

For more information see, Section 13, “Debugger Command Reference,” on page 13-1, Section 13.2, "Command Syntax."

13.2 Command Syntax

The syntax of a Debugger command is written with special punctuation to indicate command keywords, required or optional fields, repeated fields, and implied actions. For example, the syntax of the CHANGE, DISPLAY, and WAIT commands look like this:

D`ISPLAY [`**ON/OFF/R/W/RW**`] [reg[_block/_group]/addr[_block]]...`

E`VALUATE [`**B**`(binary)/ `**D**`(dec)/ `**F**`(float)/ `**H**`(hex)/ `**U**`(unsigned)] expression/{c_expression}`

W`AIT [count(seconds)]`

The punctuation of the syntax line includes:

Table 13-1. Command Syntax

Syntax	Description
`[ ]`	Square brackets enclose command parameters that are optional. The brackets themselves are not entered as a part of the command. For example, in the WAIT command the count parameter is optional.
`/`	The slash is used to separate alternative command parameters. You can only enter one of the parameters in the list. The slash is not entered as a part of the command. For example, in the EVALUATE command, the optional first parameter can be one of the following: B, D, F, H, or U.
`()`	Parentheses surround a description of an implied action. This is included to help clarify some of the abbreviations of the command. Neither the parentheses nor the description inside the parentheses are entered as part of the command. For example, when entering the EVALUATE command, the optional first parameter consists of one letter. The words binary, dec, float, etc. are only in the command syntax line for clarification.
`...`	An ellipse (three consecutive periods) indicates that the preceding field may optionally be repeated. For example, the DISPLAY command can specify multiple registers.

Table 13-1. Command Syntax

Syntax	Description
CAPS	Capitalized words indicate command keywords. Command keywords must be entered exactly as shown. The portion of the command keyword shown in BOLDFACE represents the minimum portion of the keyword that you must type. The portion of the keyword that is not in boldface may be typed if desired, but is not required. The Debugger will automatically type the remainder of a keyword if you type the boldface characters and then press the SPACE key.

Many of the command parameters, such as addr and reg, are abbreviations. See the Command Parameters: List of Abbreviations for a list of parameter abbreviations.

For more information see, Section 1.4, “Entering Commands,” on page 1-7 , Section 13.3, "Command Parameters: List of Abbreviations."

13.3 Command Parameters: List of Abbreviations

The following is a list of abbreviations used for parameters on the command syntax line:

Table 13-2. List of Abbreviations

Abbreviation	Description
address	An address may be specified as a source file line number or as a symbol name if a previously loaded COFF object file contains symbolic debug information. Otherwise, a memory space designator must be used. To see a list of the valid memory space prefixes, from the command line of the Command window type help mem
address_block	addressÖlocation/address#count
bn	Break number. A decimal integer constant in the range 1 to 99.
break_action	H(halt)/In(increment CNTn)/N(note)/S(show)/X [command]
count	Positive integer expression in range 1 to $7fffffff.
dev_list	Device list in the form dvx, dv0..x, dvx,y,z, where x represents a device number. One or more targets can be addressed this way. For example, device group 0 through 4 is expressed dv0..4. And the device set of 1,3, and 5 is expressed as dv1,3,5.
dev_num	Device number. Range is dv0 to dv31.

Table 13-2. List of Abbreviations (Continued)

Abbreviation	Description
dev_type	Device type.
expression	Any arithmetic expression valid for the DSP Assembler. Register names can also be used in the expression.
c_expression	Any expression valid in the current C program. A c_expression must be enclosed in curly braces: { }
file	Any valid filename, including relative and absolute paths..
ioradix	-RD(decimal)/-RF(float or fractional)/-RH(hexadecimal)/-RU(unsigned)
location	Integer expression. It will be mapped into the device address range. For ex-ample, -1 translates to the maximum address.
mode	Device operating mode in the form Mn.
pathname	Any valid pathname.
periph	Valid peripheral names are displayed by the Debugger help periph command.
pin	Valid pin names are displayed by the Debugger help pin command. A pin name may optionally be preceded by pin: in order to resolve conflicts that may exist between pin and register names or constants.
pin_block	pin..pin
port	Valid port names are displayed by the Debuggerr help port command
reg	Valid register names are displayed by the Debugger display all command. A register name may optionally be preceded by reg: in order to resolve con-flicts that may exist between register and pin names or constants.
reg_block	reg**..**reg
reg_group	periph/**all**
topic	Help topic keywords used with the HELP command.

For more information see, Section 1.4, “Entering Commands,” on page 1-7 , Section 13.2, "Command Syntax."

13.4 ASM - Single Line Interactive Assembler

```
ASM [dev_num] [B(byte wide)] [(beginning at) address]
assembler_mnemonic
```

The ASM command allows you to create or edit DSP object code programs in memory using assembly language mnemonics. Each line of source code is immediately converted into machine language code and stored in the Application Development Module (ADM) or target system memory. The line of assembly source code is not saved.

The address parameter is optional. The beginning address may be in any of the three (p, x, or y) memory maps of the DSP.

Note: The Y memory is only valid for DSP56000 and DSP96002 family members. If no address is specified, assembly begins in the p (program) memory space using the current program counter value as the beginning address.

Invoking this command causes existing object code at the beginning address to be disassembled and displayed on the screen. The user may optionally enter a new Assembler mnemonic on the command line or edit the existing object code. The Assembler is called when the carriage return key is entered. If the new instruction cannot be assembled correctly an error message is displayed on the error line and the cursor is placed at the point of error.

The B (byte-wide) parameter takes one byte from each memory word starting at the specified address to build up the instruction word to be displayed. Similarly the assembled mnemonic instruction is divided into bytes and stored in successive words.

If the interactive Assembler is invoked with the GUI version of the ADS, a dialog box displays the original instruction at the specified location. To change the instruction and display the next, type the new instruction and click [OK]. To exit the interactive Assembler, click [CANCEL]. Any new instruction which has been typed before clicking [CANCEL] will not be written to the current location.

The Session and Command windows will be written to during interactive Assembler operations. Both windows display the original ASM command, the Session window displays each change as it is applied.

Example 13-1. ASM Commands

Command	Explanation
`asm p:$50`	Start interactive Assembler at program memory address 50 hex of the current default device.
`asm`	Start interactive Assembler at current program counter value of the current default device.
`asm myfile.asm@7`	Start interactive Assembler at the address corresponding to myfile.asm line 7.
`asm dv3 p:10`	Start interactive Assembler at target address #3 program memory address 10.
`asm nop`	Overwrite the instruction at the current pc with the specified instruction.
`asm x:0 add #<2,a`	Store assembled instruction in specified data memory location. This feature may be useful for patching overlaid programs where overlays are copied from data to program memory before execution.

`asm dv3 b`
`y:$040100`
	Perform byte-wide assembly from address $40100 in y memory. Each byte of the instruction is stored in successive locations, so two or three locations are required to store each 16- or 24-bit instruction. Even if assembled into program memory, this code cannot be executed directly; it is intended for use with code similar to the byte-wide loader in the ROM bootstrap code. Byte-wide assembly may be used interactively (as in this example) or to assemble a single instruction.

For more information see, Section 13.5, "BREAK - Set, Modify, or Clear Breakpoints." , Section , "CCHANGE - Change Command Converter Memory."

13.5 BREAK - Set, Modify, or Clear Breakpoints

Syntax to clear, enable, or disable breakpoints

```
BREAK [dev_list] [#bn[,bn,Ö] [OFF/E(enable)/D(disable)]
```

Syntax for Software Breakpoints

```
BREAK [dev_list] [#bn] swbp_type address [t(expression)] [count]
[action]
```

Syntax for Hardware Breakpoints on the DSP56300 and DSP56600 Device Families

```
BREAK [dev_list] [#bn] [access] [hwbp_type] [addr_qual]
addr[_block]
   [break_qual [addr_qual] address] [t(expression) [count]
[action]
```

Syntax for Hardware Breakpoints on the DSP56000, DSP56100, DSP56800, and DSP9600 Families

```
BREAK [dev_list] [#bn] access] [hwbp_type] [addr[_block]] [count]
[action]
```

The BREAK command can be used to set, clear, enable, and or disable breakpoints. Breakpoints, when triggered, can cause program execution to halt and the device to enter the Debug mode of operation. There are two types of breakpoints: hardware breakpoints and software breakpoints.

Software breakpoints are very similar to hardware breakpoints. However, software breakpoints are more limited than hardware breakpoints in that:

- software breakpoints can only be set on the first word of an instruction (they cannot be set to detect the access of registers or data memory)
- software breakpoints must be set in RAM (they cannot be set in ROM)

Despite the above limitations, it is recommended that you use software breakpoints instead of hardware breakpoints whenever possible. This is recommended because, in effect only one hardware breakpoint can be set at a time whereas a virtual unlimited number of software breakpoints can be set.

Software Breakpoints

The optional parameter `dev_list` represents the device or list of devices on which the breakpoints will be set.

The optional parameter `#bn` represents a breakpoint number. Breakpoint numbers do not have to be consecutive, they can be assigned arbitrarily. For example, it may be convenient to allocate breakpoints so that one function is assigned breakpoints 1 to 10, another uses 11 to 20, and so on. If no breakpoint number is assigned, the default will be the next available consecutive number.

The parameter `swbp_type` represents the software breakpoint type and is required. If you type al, the breakpoint will always be acted upon. Breakpoint types other than al are conditional and device specific. See the list of Types of Software Breakpoints for an explanation of each type of breakpoint.

The parameter address represents the address where the software breakpoint is set. This parameter is required. For example, to set a breakpoint at address `$103` in p memory, type:

```
p:$103
```

IMPORTANT: This address MUST be the first word of an instruction.

Note: ALSO: If you have provided a swbp_type (breakpoint type), the breakpoint can ONLY be set to an address which contains a nop. Setting the breakpoint to an address which contains any other opcode will cause your program to execute incorrectly.

The optional parameter `t(expression)` represents a test of the expression within the parentheses. If the expression is true the breakpoint will cause the action to be performed. If the expression is false, program execution continues. Be aware that a side effect of evaluating an expression (whether it is true or false) is that the program will not be executed in real time. See Using Expressions in Breakpoints for more information.

The optional parameter `count` represents the number of times the Debugger should encounter the breakpoint before performing the action. For example, if you set the count to 3, the breakpoint will be triggered the third time that the breakpoint is encountered. Keep in mind that real time execution will be affected if you set the Count to more than one.

The optional parameter `action` indicates the action to be taken when the breakpoint is triggered. If no action is provided, Halt will be assumed as the default. Possible actions are:

H Halt. Stops program execution when the breakpoint is encountered.

N Note. Displays the breakpoint expression in the Session window each time it is true. Program execution continues. The display in the Session window is not updated until program execution stops.

S Show. Displays the enabled register/memory set. Program execution continues.

In Increment. Increments the CNTn counter by one, where n equals 1,2, or 3.

Hardware Breakpoints

The optional parameter dev_list represents the device or list of devices on which the breakpoints will be set.

The optional parameter #bn represents a breakpoint number. Breakpoint numbers do not have to be consecutive, they can be assigned arbitrarily. For example, it may be convenient to allocate breakpoints so that one function is assigned breakpoints 1 to 10, another uses 11 to 20, and so on. If no breakpoint number is assigned, the default will be the next available consecutive number.

The optional parameter access represents the kind of access that the breakpoint should detect: r=read, w=write, rw=read or write at the address that you will specify.

The optional parameter hwbp_type refer to the hardware breakpoint type. Breakpoint types are device specific. See the list of Types of Hardware Breakpoints for an explanation of each type of breakpoint.

The parameter addr[_block] represents the address where the software breakpoint is set. An address block can also be provided, in which case an access of any address in the range of addresses will be detected by the breakpoint. For example, to set a breakpoint that covers address $103 to $110 in p memory, type:

```
p:$103..$110
```

The optional parameter t(expression) represents a test of the expression within the parentheses. If the expression is true the breakpoint will cause the action to be performed.

If the expression is false, program execution continues. Real time execution of is not affected. See Using Expressions in Breakpoints for more information.

The optional parameter `count` represents the number of times the Debugger should encounter the breakpoint before performing the action. For example, if you set the count to 3, the breakpoint will be triggered the third time that the breakpoint is encountered. Real time execution will not be affected if you indicate a Count.

The optional parameter `action` indicates the action to be taken when the breakpoint is triggered. If no action is provided, Halt will be assumed as the default. Possible actions are:

`H` Halt. Stops program execution when the breakpoint is encountered.

`N` Note. Displays the breakpoint expression in the Session window each time it is true. Program execution continues. The display in the Session window is not updated until program execution stops.

`S` Show. Displays the enabled register/memory set. Program execution continues.

`In` Increment. Increments the CNTn counter by one, where n equals 1,2, or 3.

Table 13-3. Examples of BREAK on DSP devices with OnCE or JTAG/OnCE Ports

Command	Explanation
`break`	Display all currently enabled breakpoints for all target DSPs.
`break dv2`	Display currently enabled breakpoints for target DSP address #2.
`break off`	Disable all currently enabled breakpoints for the default target DSP address.
`break dv2 off`	Disable currently enabled breakpoints for target DSP address 2.
`break off 2`	Disable breakpoint number 2 of the current default target address.

Table 13-3. Examples of BREAK on DSP devices with OnCE or JTAG/OnCE Ports

Command	Explanation
`break dv2 p:$100`	Halt DSP program execution of target DSP address 2 and display enabled registers and memory when the DSP instruction at program address 100 hex is reached. This is a hardware breakpoint which will work with OnCE and JTAG/OnCE based DSPs.
`break p:$30 s`	Display enabled registers and memory of the current default target DSP address and continue program execution when the DSP instruction at program address 30 hex is reached. This is a hardware breakpoint which will work with OnCE and JTAG/OnCE based DSPs.
`break dv3 p:$200 t(r0>r1) h`	If the value of R0 is greater than R1 in target DSP address 3 when its DSP instruction at its program counter 200 hex is reached, halt target DSP address 3. To evaluate whether R0 is greater than R1, the host computer will set a hardware breakpoint at address 200 and will interrogate the target DSP every time a breakpoint occurs at that address. This is a hardware breakpoint which will work with OnCE and JTAG/OnCE based DSPs.
`break al @32 t({i>10}) h`	Break if the program reaches line 32 and the C variable i is greater than 10.
`break le p:$320 h`	Halt DSP program execution of default target DSP address and enter Debug mode when the Z or (N and V) bits of the CCR are equal to 1 at the address $320 of program memory. This is a software breakpoint, and testing of the Condition Code Register is done real-time.
`break al p:$320`	Halt DSP program execution of default target DSP address and enter Debug mode unconditionally at the address $320 of program memory. This is a software breakpoint and must be placed in SRAM.
`break r xa x:300`	Halt DSP program execution of the default target DSP address and enter Debug mode when a read access of X data memory address 300 occurs. This is a hardware breakpoint which will work with OnCE and JTAG/OnCE based DSPs.

Examples of BREAK on DSP devices with OnCE Ports

```
break rw pcfm p:$100 $20
```

Halt DSP program execution of the default target DSP address and enter the Debug mode when the 32nd occurrence of a read or write access of a program core fetch or move occurs at address `$100`.

```
break rw pce p:$250
```

Halt DSP program execution of default target DSP address and enter Debug mode when a read or write access of program memory address 250 hex occurs.

Examples of BREAK on DSP devices with JTAG/OnCE Ports

```
break r xa > x:104 and < x:110
```

Halt DSP program execution on default target DSP when a read access of X memory address range 105 to 109 occurs 1 time.

```
break rw pa == p:104 or == p:110
```

Halt DSP program execution on default target DSP when a read or write access of program memory address 104 or 110 occurs one time.

13.6 CCHANGE - Change Command Converter Memory

CCHANGE [**dev_list**] [**FLAG**/**XPTR**/**YPTR**/address[_block]] [expression]

The CCHANGE command allows you to examine or modify the memory of the OnCE Command Converter P, X or Y data memory spaces of the DSP56002. This command is useful if you wish to design and debug OnCE command sequences.

The XPTR is Command Converter x memory location 4 and is used to point to the x memory area where values read from the target OnCE are to be stored. The YPTR is Command Converter x memory location 2 and is used to point to the y memory area where sequences are to start from when issuing a CGO command.

Note that the Command Converter X memory addresses $0 to $7F (hex) are reserved for use by the Command Converter monitor. These locations should not be changed. For more details on the usage of these locations refer to the monitor program source listing. P memory locations $0 to $1B0 (hex) are reserved for the monitor which is boot loaded from the Command Converter EPROM.

Example 13-2. Examples of the CChange Command

```
cchange dv2 x:0
```

Display the current value of X:0 of Command Converter #2 memory and prompt the user for a new value. Subsequent values may be displayed or changed by entering a carriage return. To exit this interactive mode, use the escape key.

```
cchange y:0..$10 $0
```

Change the y:0 through y:$10 of the default Command Converter to a value of 0.

13.7 CDISPLAY - Display Command Converter Flags and Memory

```
CDISPLAY [dev_list] FLAG/XPTR/YPTR/address[_block]...
```

The CDISPLAY command allows you to examine the Command Converter flag register, Y memory pointer, or the P, X or Y memory values used to transfer OnCE serial command sequences to the target DSP. These values are displayed in hexadecimal in the Session window.

Command converter X memory locations 0 to 10 hex are used for temporary storage of flags and constants.

Example 13-3. CDISPLAY Commands

```
cdisplay flag
```

Display the Command Converter flag register. The flag register is used to store status bits of whether the target DSP is in the Debug mode or User mode, as well as other Command Converter monitor flags.

```
cdisplay y:0..$10
```

Display the Command Converter Y memory space which is used for the OnCE command sequence transfers to the target DSP.

```
cdisplay xptr
```

Display the X memory pointer, which is used to save values read from the OnCE port when executing OnCE serial sequences.

13.8 CFORCE - Assert Reset or Break on Command Converter

```
CFORCE [dev_list] R(reset)/B(break)/D(Debug mode)/U(User mode)
```

The CFORCE command is used for forcing a hardware reset or hardware interrupt on a Command Converter. The D option can be used to force the Command Converter into the Debug mode in the event that the target has entered the Debug mode by some means other than through the ADS program (such as a DEBUG instruction in the user code).

The U option can be used to force the Command Converter into the User mode in the event that the target has entered the User mode by some means other than through the ADS program (such as a push button reset or power-on reset). When using the U or D arguments, internal flags of the user interface program are also set or cleared.

Caution: Placing the Command Converter in Debug mode when the target is NOT in Debug mode can cause unexpected results in the ADS.

Example 13-4. CFORCE Command

Command	Explanation
`cforce dv1 r`	Force a hardware reset on Command Converter #1.
`cforce b`	Force an interrupt (break) on the default Command Converter.
`cforce d`	Force the default Command Converter into the Debug mode.
`cforce u`	Force the default Command Converter into the User mode.

13.9 CGO - Execute OnCE Sequence

CGO [**dev_list**] [(from) address]

The CGO command allows the user to execute OnCE command sequences in the DSP56002 controller's Y memory. This command is useful for debugging user defined OnCE serial command sequences which will be used in a target system. A sequence memory pointer resides in the DSP56002 controller's internal X memory at address 2. This pointer is used as the start location and may be changed using the CCHANGE command.

Example 13-5. CGO Command

```
cgo
```

Execute the OnCE sequence of the default Command Converter starting at the current address in the Command Converter PTR.

```
cgo $10
```

Change the Command Converter PTR to hex 10 and execute the OnCE sequence of the default Command Converter starting at that address.

13.10 CLOAD - Load OnCE Command Sequence

CLOAD [**dev_list**] **filename**

The CLOAD command is used for loading a user defined OnCE serial command sequence into the Command Converter internal Y memory. The file must be in DSP object module format (OMF) and have a .lod suffix name. The CLOAD command allows you to write a OnCE command sequence using the Command Converter monitor program OnCE sequence format.

Example 13-6. CLOAD Command

```
cload onceseq.lod
```

Load the file "onceseq.lod" into the Y memory of the default Command Converter.

13.11 CSAVE - Save Command Converter Memory to a File

CSAVE [**dev_num**] address_block filename [**-o**/**-a**/**-c**]

The CSAVE command allows you to save the Command Converter X or Y data memory to a disk file. This is useful when debugging user defined OnCE command sequences using the Command Converter monitor program sequence format.

If a file currently exists with the filename specified your will be prompted for an action of either appending the data to the file, overwriting the file, or aborting the command. You can include the file action in the command line using the -o (overwrite), -a (append), or the -c (cancel) argument. These flags are especially useful when using macro command files.

Example 13-7. CSAVE Command

```
csave dv0..3 y:0..$20 onceseq.lod
```

Saves the contents of Command Converters 0, 1, 2, and 3 Y memory addresses 0 to hex 20 to a file named "onceseq.lod".

```
csave x:$10#10 newdata.lod
```

Saves the contents of the default Command Converter’s X memory addresses hex 10 through hex 1A to a file named “newdata.lod”.

13.12 CSTEP - Step Through OnCE Sequence

CSTEP [**dev_list**] [count]

The CSTEP command allows you to execute a group of OnCE serial sequences before displaying the OnCE register contents. This gives you the opportunity to write and debug a OnCE command sequence using the Command Converter monitor program sequence format.

Note that the OPDBR and OPILR registers always display the last values stored after executing a GO, STEP or TRACE command or after servicing a breakpoint. The values of these registers will not reflect the changes made to them when executing the CGO, CSTEP, or CTRACE when doing a display of the OnCE registers.

Also, it is important to remember that writing to the OPDBR register is in effect manipulating the DSP program controller. Whenever 2-word opcodes are being written to the OPDBR, it is best to CTRACE or CSTEP 2 before displaying registers.

Example 13-8. CSTEP Command

```
cstep
```

Executes one OnCE serial command of the default Command Converter's Y memory pointed at by its YPTR. The OnCE registers will be displayed after the command is executed.

```
cstep $10
```

Executes 10 (hex) OnCE serial commands of the default Command Converter's Y memory pointed at by its YPTR. The OnCE registers will be displayed after the 10 (hex) commands have all been executed.

A macro command file can help in single stepping through user defined OnCE sequences and displaying results. The display of registers after a CSTEP or CTRACE were not implemented because of the nature of having to access the OPDBR register to retrieve the register values. An example of a macro file would be the following:

Example 13-9. CSTEP Command in a Macro

```
cstep 2
```

;execute 2 OnCE commands then show XPTR and YPTR

```
cdisplay x:80..90 y:80..9f
```

;display the Command Converter x and y memory

```
display
```

;display the target registers

13.13 CTRACE - Trace Through OnCE Sequence

CTRACE [**dev_list**] [count]

The CTRACE command allows the user to single step through a OnCE command sequence in the Command Converter Y memory pointed at by the Command Converter YPTR. This enables the user to write and debug OnCE command sequences using the Command Converter monitor program sequence format.

Note that the OPDBR and OPILR registers always display the last values stored after executing a GO, STEP or TRACE command or after servicing a breakpoint. The values of these registers will not reflect the changes made to them when executing the CGO, CSTEP, or CTRACE when doing a display of the OnCE registers.

Also, it is important to remember that writing to the OPDBR register is in effect manipulating the DSP program controller. Whenever 2-word opcodes are being written to the OPDBR, it is best to CTRACE or CSTEP 2 before displaying registers.

Example 13-10. CTRACE Command

```
ctrace 10
```

Executes 10 OnCE serial commands of the default Command Converter and displays the OnCE register contents after each command is executed. The serial commands reside in the Command Converter Y memory and are pointed to by the Command Converter YPTR register.

A macro command file can help in single stepping through user defined OnCE sequences and displaying results. The display of registers after a CSTEP or CTRACE were not implemented because of the nature of having to access the OPDBR register to retrieve the register values. An example of a macro file would be the following:

Example 13-11. CTRACE Command in a Macro

```
    ctrace 2                              ; single step 2 OnCE commands and
                                                  show XPTR and ;YPTR
                                                  after each trace.
    cdisplay x:80..90 y:80..9f            ;display the Command Converter x
                                                  and y memory
    display                               ;display the target registers
```

13.14 CHANGE - Change Register or Memory Value

CHANGE [**dev_list**] [reg[_block]/address[_block] [expression]]...

The CHANGE command allows you to examine or modify values contained in registers or memory. Memory blocks can be initialized to a particular value by including an end address. If the command is entered without a value, the register or memory location of the current default target DSP address will be displayed with its current value on the command line. You will then be prompted for a new value.

Multiple changes can be specified in a single command line. Each specified destination (block) must be followed by the value of the expression to be assigned to it.

An interactive mode of register or memory display and change can be started by specifying a single register or memory location without an associated expression. In this mode each register or memory location can be examined and optionally modified. To change the register or memory location contents and display the next register or location, type the new value followed by carriage return. Subsequent or previous memory locations or register names can be examined and changed if required by typing, respectively, Up-Arrow (Ctrl-U) or Down-Arrow (Ctrl-N). Typing a new value followed by Up- or Down-arrow does not change the open location. Pressing the Esc key causes the interactive CHANGE command to terminate.

CAUTION Be aware that some peripheral registers contain handshake bits that change state when they are read. Reading these registers can interfere with the proper operation of the peripheral when returning to the user's program.

The Session and Command windows are written during interactive change operations. Both windows display the original CHANGE command, the Session window displays each change as it is made.

Example 13-12. CHANGE Command

Command	Explanation
`change`	Displays the current default target DSP address's register values individually starting with register a. You will be prompted to enter new values.
`change x:$55`	Displays x memory location hexadecimal 55 of the current default target DSP address and prompt the user for a new value. Subsequent or previous memory locations may be examined and changed using the up arrow key for the previous address and down arrow for the next address.
`change dv3 pc`	Display the current value of the program counter on target DSP address 3 and prompt the user for a new value. Subsequent or previous register values may be examined and changed using the up arrow key for the previous address and down arrow for the next address.
`change p:$20 $123456`	Change the current default target DSP address's p memory address hexadecimal 20 to hexadecimal 123456.
`change r0..r7 0 p:$30..$300 0 x:$fffe $55 pc ‘100`	Change the current default target DSP address's registers r0 to r7 to 0, p memory addresses 30 hex to 300 hex to 0, x memory address fffe hex to 55 hex and the program counter to 100 decimal.
`change dv1,3,5 r0..r7 0 p:$1000..$2000 0`	Change target DSP addresses 1,3 and 5 registers r0 to r7 to 0 and their program memory addresses 1000 hex to 2000 hex to a value of 0.
`change xdat..xdat+5 35`	Change memory block beginning at the address corresponding to symbolic label xdat and ending at xdat + 5 to decimal value 35.

13.15 COPY - Copy a Memory Block

COPY (from)[**dev_num**] address[_block] (to) address

The COPY command allows you to copy memory blocks from one location to another. The source and destination memory maps can be different. This allows you to move data or program code from one memory map to another or to a different address within the same memory map. The COPY command allows the copying of program or data blocks within a single target DSP device. To transfer information from one target device to another, use the SAVE command to create an object file, which may then be loaded into the destination device.

Example 13-13. COPY Command

Command	Explanation
`copy p:0..30 p:100`	Copy the data in current default target DSP address program memory starting at 0 and ending at 30 to program memory starting at 100.
`copy dv3 p:0..30 dv2 p:100`	Copy the data in target DSP address number 3 program memory starting at 0 and ending at 30 to target DSP address number 2 program memory starting at 100.
`copy x:0#100 p:0`	Copy one hundred memory locations beginning at x memory location 0 to p memory beginning at location 0.
`copy x:$100..$200 x:$150`	Copy the data in the current default target DSP address X memory starting from hex $200 down to hex $100 and put the data in the current default target DSP address X memory starting at hex $250 down to hex $150. Whenever the addresses of the source and destination overlap, the source end address will be used and the addresses will be decremented rather than incremented.
`copy xdat..xdat+40 ydat`	Copy 40 memory locations beginning at the address corresponding to symbolic label xdat to the block beginning at address corresponding to symbolic label ydat.

13.16 DEVICE - Select Default Device

DEVICE [**dev_list** [**device_type**/**ON**/**OFF**/**X**]]
DEVICE [**dev_num**] [**chain_num**] [**tms_num**] [**chain_pos**] [**device_type**]
DEVICE **cc_num tms_num chain_pos IR count**

The DEVICE command allows you to:

- Select the current device for command input and session output
- Activate one or more of the target devices controlled by the ADS.
- Specify the device type of each target device
- List the type and status of each device
- Specify the position of devices in a JTAG chain
- Specify non-Motorola devices in a JTAG chain
- Enable and disable each device

- Deactivate a device and deallocate all associated structures

The command line prompt displays the number of the currently selected device. At start-up, device DV0 is activated and selected as the current device.

- device_type specifies which type of DSP is being emulated. If omitted, a default value will be selected, depending on the device family in use. Use DEVICE command for a list of supported device types.
- ON makes the specified device(s) active for program execution
- OFF suspends program execution for the specified device. The state of the device is not otherwise changed.
- X deactivates the device and discards all associated structures. If the X parameter is used for the current device, another device will become the current device. At least one device must be activated at all times; the last device may not be deactivated.
- JTAG parameters—The ADS supports up to eight command converters on a single development host. Each Command Converter supports one JTAG chain that can service up to twenty-four devices. The DEVICE command associates each device in any position in the JTAG chain with an ADS device number (dvn). The ADS only performs debugging operations on Motorola DSP devices. However, to support target systems incorporating other devices, the DEVICE command also permits the specification of the JTAG instruction register length so such devices may be handled correctly.

  – DVn—Specifies the device number to be used to access the device described by the remainder of the parameters. (0..31)

  – CCn—Specifies the Command Converter to which the device is connected (0..7)

  – TMSn—Specifies which TMS (Test Mode Select) line controls this device (0..1); Command Converter revision 6 only supports TMS0.

  – POSn—Specifies which position the device occupies in the JTAG chain. The device connected directly to TDO from the Command Converter is position 0. (0 £ n)

  – IR n—Specifies the length of the instruction register for unsupported devices. (2 £ n)

  The defaults for the above parameters are as follows: CCn defaults to the device number DVn and all other parameters default to zero.

Example 13-14. DEVICE Command

Command	Explanation
`device`	Display all activated target DSP addresses and device types, and lists all supported family members.
`device dv0..2 on`	Activate target DSP address 0, target DSP address 1, and target DSP address 2.
`device dv0,3 off`	Deactivate target DSP address 0 and target DSP address 3.
`device dv2`	Select target DSP address 2 as the default target DSP for command entry.
`device dv1 x`	Deactivate target DSP address 1 and discard all associated data structures. If this was the selected device, select another.
`device dv12 cc3 pos2 56301`	Specifies that device DV12 refers to a DSP56301, which is controlled by Command Converter #3, occupying the third (0,1,2...) position in the chain. TMS0 is used by default.
`device cc3 tms0 pos1 ir 3`	The device on Command Converter 3, TMS chain 0, position 1 is not to be used in this development session. It has an instruction register 3 bits wide. Note that no device number may be specified, and that all fields are required.

Note: The instruction register length must not be specified for a device which has been allocated an ADS device number.

13.17 DISASSEMBLE - Single Line Disassembler

DISASSEMBLE [**dev_list**] [**B**(byte wide)][address[_block]]

The DISASSEMBLE command allows the user to review DSP object code in its assembly language mnemonic format. All invalid opcodes will display "DC" for define constant. The b (byte-wide) parameter constructs the instruction words by taking one byte from each word of memory, starting from the specified address.

Example 13-15. DISASSEMBLE Command

Command	Explanation
`disassemble`	Disassemble a page of instructions pointed at by the user interface program disassembler counter of the current default target DSP address. A counter maintains the last instruction disassembled so subsequent instructions may be disassembled by merely entering a carriage return to execute the same instruction again.

Example 13-15. DISASSEMBLE Command

Command	Explanation
`disassemble p:0..20`	Disassemble program memory address block 0 to 20 of the current default target DSP address.
`disassemble dv2 x:$50#10`	Disassemble ten instructions of the target DSP address 2 starting at x memory map 50 hex.
`disassemble lab_1..lab_2`	Disassemble memory address block beginning at the address corresponding to symbolic label lab_1 and ending at lab_2.
`disassemble b y:$1000#$40`	Disassemble forty instructions starting at address y:$1000. The instruction words are constructed by taking one byte from each location; thus depending on the target processor, two or three locations are required to hold each instruction word.

13.18 DISPLAY - Display Register or Memory

```
DISPLAY [W(executing targets)/[dev_list] V(ADS user interface program
version)]
DISPLAY [dev_list] [ON/OFF] [reg[_block/_group]/address[-_block]]...
```

The DISPLAY command allows the user to examine the contents of a register group and/or memory block in the radix specified by the RADIX command. The default display radix is hexadecimal. It may also be used to enable or disable particular registers or memory locations for automatic display when executing debug commands.

Entering the command with no parameters will cause the display of all enabled registers and memory blocks. Registers and memory blocks may be enabled or disabled by entering the command with one of the "enable" keywords (i.e., ON or OFF) prior to the register and/or memory list. The keywords have the following meaning:

- **ON** = Enable display of the following registers and memory locations.
- **OFF** = Disable display of the following registers and memory locations.

Entering the DISPLAY command with only a register or memory list causes immediate display of the listed registers and memory locations without affecting their "enable" status. Several register group names have been predefined and may be used in the display list to enable, disable or display all of the registers in the group. The list of group names available depends on the target device. For a list of the peripheral names available with a particular ADS system, use the command HELP periph.

CAUTION Some peripheral registers contain handshake bits that change state when they are read. Reading these registers can interfere with the proper operation of the peripheral within the user program.

Example 13-16. DISPLAY Command

Command	Explanation
`display`	Display all currently enabled registers and memory of the current default target DSP address.
`display on`	Enable all programming model registers for display on the current default target DSP address.
`display p:0..300`	Display p memory addresses 0 through 300 of the current default target DSP address.
`display on p:0..20 x:30..40 x:$100`	Display enable p memory address block 0 to 20, x memory address block 30 to 40 and X memory address hexadecimal 100 of the current default target DSP address.
`display dv2 p:30..50`	Display p memory address block 30 to 50 of target DSP address 2.
`display w`	Display all target DSP addresses that are currently executing user programs.
`display v`	Display the user interface program and Command Converter monitor program revision numbers.
`display on host`	Display enable the host peripheral registers.
`display on all`	Display enable all programming model and peripheral registers.
`display X:0..$100`	Display the values of x memory locations 0 to 100 hex.

13.19 DOWN - Move Down the C Function Call Stack

DO`WN [`**dev_list**`] [n]`

The DOWN command is used to move down the call stack. It can be used in conjunction with the WHERE, FRAME, and UP commands to display and traverse the C function call stack. After entering a new call stack frame using DOWN, that call stack frame becomes the current scope for evaluation. In other words, for C expressions, the EVALUATE command acts as though this new frame is the proper place to start looking for variables.

Example 13-17. DOWN Command

```
down
```

Move down the call stack by one stack frame.

```
down 2
```

Move down the call stack by two stack frames.

13.20 EVALUATE - Evaluate an Expression

EVALUATE [dev_list]
B(binary)/**D**(decimal)/**F**(float/fract.)/**H**(hex)/**U**(unsigned)]
expression/{c_expression}

The EVALUATE command is used as a calculator for evaluating arithmetic expressions or for converting values from one radix to another. The result of the expression evaluation is displayed in the specified radix. If a radix is not specified in the EVALUATE command line, the current default radix (specified by the RADIX command) will be used. An expression consists of an arithmetic combination of operators and operands. An operand may be a register name, a memory location, or a constant value. For example, A2 evaluates to the contents of register A2. To evaluate A2 as hexadecimal, a dollar sign must precede the value. The same holds for the values A0, A1, A2, B0, B1, and B2.

The order of evaluation of an expression's operators will be associated from left to right. Parenthesis may be used to force the order of evaluation of the expression. A more extensive discussion of the expressions which are valid for the EVALUATE command is in the DSP Assembler Reference Manual (Section 3). The valid symbols for an expression are listed in the description of the BREAK command.

Example 13-18. EVALUATE Command

Command	Explanation
`evaluate ro+p:$50`	Add the value in r0 register to the value in program memory address hexadecimal 50 of the current default target DSP address and display the result using the default radix.
`evaluate dv4 r0+p:$1000`	Add the value in r0 register of target DSP address 4 to the value in its program memory address hexadecimal 1000 and display the result using the default radix.
`evaluate b $345`	Convert hexadecimal 345 to binary and display the result.
`evaluate h %10101010&p:r0`	Calculate the bitwise AND of program memory address specified by the value in r0 register and the binary value 10101010 and display the result in hexadecimal.
`evaluate $a0+$b0`	Calculate the sum of hexadecimal a0 plus hexadecimal b0.
`evaluate {count}`	Display the value of the C variable count.
`evaluate {count+max}`	Evaluate the sum of the C variables count and max, and display the result.

Example 13-18. EVALUATE Command

Command	Explanation
`evaluate {lookup(i)}`	Call the C function lookup from the command line, with the argument i. Display the result of calling the function.

13.21 FINISH - Step Until End of Current Subroutine

```
FINISH [dev_list]
```

The FINISH command executes instructions until a Return-To-System (RTS) instruction is executed within the current subroutine. The ADS interface program simply steps, checking if any instruction is an RTS. If so, that RTS is executed, and instruction execution halts immediately afterward. While stepping, if a branch to subroutine or jump to subroutine instruction is encountered, tests for the RTS instruction are suspended until execution resumes at the address following the subroutine call.

Example 13-19. FINISH Command

```
finish
```

Finish the current subroutine continuing from the current address until an RTS is executed.

13.22 FORCE - Assert RESET or BREAK on Target

```
FORCE[dev_list] R(reset to Debug mode)/B(break)/RU(reset to User
mode)/S(System)
```

The FORCE command asserts a hardware reset or asserts a debug request on one or more target systems. This command is useful for reinitializing all registers, as well as peripherals to their Reset state or when the user wishes to halt real-time executing of the target DSP to interrogate its registers and/or memory. All communication with the target DSP program model must be done while the target DSP is in the Debug mode of operation. Asserting a debug request is only required once to enter the Debug mode. Exiting the Debug mode is accomplished via a GO, TRACE, or STEP command, or a FORCE RU.

The B(break) argument asserts a debug request on the DSP and the register values will not be altered. Program execution can be resumed after a break by using a GO command. The R(reset to Debug mode) argument asserts the debug request on the DSP after the RESET pin is asserted and continues asserting the debug request until after the RESET pin is de-asserted, thus bringing the DSP into the Debug mode of operation at reset.

The RU (reset to User mode) argument asserts the RESET on the DSP pin only and does not assert a debug request, thus bringing the DSP out of reset into the mode specified by the external mode pins (which can be set by the user). The S (System) argument causes a CFORCE R followed by a FORCE R of the devices specified in the command. This command basically resets the Command Converter and then the target putting it into the Debug mode of operation.

Example 13-20. FORCE Command

Command	Explanation
`force r`	Force a reset on the current default target DSP address. This command will destroy the contents of some registers since a hardware reset initializes them automatically.
`force b`	Force the current default target DSP address into the Debug mode of operation. Program execution will halt and the DSP will enter the Debug mode waiting for command entry from the Host computer via the OnCE debug port.
`force dv1,4,5 b`	Force target DSPs 1, 4, and 5 to halt DSP program execution and enter the Debug mode of operation for user commands.
`force ru`	Reset the default target DSP into the User mode specified by its mode pins.

13.23 FRAME - Select C Function Call Stack Frame

FRAME [dev_list] [#fn]

The FRAME command is used to select the current call stack frame. It can be used in conjunction with the WHERE, DOWN, and UP commands to display and traverse the C function call stack. After entering a new call stack frame using FRAME, that call stack frame becomes the current scope for evaluation. In other words, for C expressions, the EVALUATE command acts as though this new frame is the proper place to start looking for variables.

Example 13-21. FRAME Command

```
frame #2
```

Select call stack frame number two.

```
frame #0
```

Select call stack frame number zero (innermost frame).

13.24 GO - Execute DSP Program

GO [dev_list] [(from)location/**R**(reset)] [[#break_number] [:(occurrence)count]]

The GO command initiates program execution of DSP code. It can be used to start multiple ADMs or target systems simultaneously. The Command Converter monitor passes control to the user program on the ADM or target system until a breakpoint is reached or a break is asserted with the FORCE command. The GO command can be used to resume execution after a force break.

Invoking the command with no argument will start execution at the current program counter value. Enabled break-points are examined at the end of every instruction cycle. If an address argument is included, program execution begins at the address specified. The R(reset) parameter will cause program execution to start from the user defined reset exception.

The optional #break_number parameter may be used to cause the code execution to halt only if that particular breakpoint condition occurs. All other breakpoint conditions are ignored. The optional :count parameter may be used to cause the code execution to halt only if the breakpoint has occurred a specified number of times. The occurrence count may only be used with the break_number parameter.

Example 13-22. GO Command

```
go dv0,1
```

Start DSP program execution from the current address specified by the program counter of target DSP addresses 0 and 1. The target DSP addresses will stop at the first occurrence of any breakpoint set and report to the user the register results.

```
go $100
```

Start DSP program execution at program memory address hex.100 of the current default target DSP address.

```
go 100 #5 :3
```

Start DSP program execution at location 100 (default radix) of the current default target DSP address and halt on the third occurrence of breakpoint number 5.

13.25 HELP - ADS Debugger Help

`HELP [dev_num] [command/reg] [command] ?`

The HELP command allows the user to review the Application Development System command set or a particular command’s description. The HELP line for command entry is designed so that a minimum amount of documentation is required to use the ADS interface program.

Invoking the command with a command name causes a summary of that command’s parameters with a brief description and example to be displayed on the screen. If no command name parameter is included, the entire command set is displayed.

The HELP command may also be used to review the register names and bit descriptions of peripheral control registers. Invoking the command with a register name causes the register contents of the default or selected target DSP address to be displayed on the screen.

Help for a particular command can also be obtained by entering the command and a question mark "?".

Example 13-23. HELP Command

Command	Explanation
`help`	Display a summary of the available commands with their arguments.
`help a`	Display a summary of the ASM command, its arguments, and some examples.
`help dv1 omr`	Display a description of the OMR bits of target DSP address #1.
`help oscr`	Display a description of the OSCR bits of the default target DSP address.
`break ?`	Display a summary of the BREAK command, its arguments, and some examples.

13.26 HOST - Change HOST Interface Address

HOST [**IO PC IO** addr] [TIMEOUT value]

The HOST command allows the user to reconfigure the Host Interface card I/O address or set the time-out count for interaction with ADMs or target systems. The I/O address may be started at $100, $200, or $300 only on the IBM-PC interface.

The TIMEOUT argument is used to change the host timeout value. In order for the user interface to avoid becoming hung up, it limits the time it will wait for the Command Converter to respond. If the Command Converter does not respond within this limit, an error message will be displayed. The default value of the timeout is 1 second.

Example 13-24. HOST Command

```
host
```

Display the current Host Interface Card address and timeout count being used.

```
host timeout 3
```

Change the host timeout to 3 seconds.

```
host io $200
```

Change the PC Host Interface address to $200.

Note: Changing the Host Interface address should be done only after changing JG1 of the IBM-PC Interface Card, otherwise the target DSP address will not respond to the user interface commands.

13.27 INPUT - Assign Input File

```
INPUT [dev_list] [#(file number)] [OFF/[address TERM/filename
[-rd/-rf/-rh/-ru]]]
```

The INPUT command opens an input file which will pass data to a target device. The Debugger begins the transfer of data when the program in the device memory executes a DEBUG instruction residing at a specific address. There is no limit on the number of input files that can be open.

The optional parameter dev_list represents the device or list of devices on which the command will be performed.

The optional parameter #(file number) represents the number to assign or that has been assigned to an input file.

The optional parameter OFF closes the input file designated by #(file number). If no file number is indicated, all open input files are closed.

The address parameter is required when opening an input file. This address represents the address where the DEBUG instruction resides.

The TERM parameter is required to create an input file; the contents of which are typed in at the keyboard. The input data is in ASCII. Alternatively, an existing input file can be opened by providing a filename. The input, whether from the keyboard or from a file, can be expressed in hexadecimal (-rh), decimal (-rd), unsigned (-ru), or floating point (-rf). If no radix is specified, hexadecimal is assumed as the default.

There is some preparation that you must perform outside of the Debugger in order for the data from the input file to be written properly. You will need to place a DEBUG instruction in your program and you will need to set designators in certain registers. You need to do this so that the Debugger knows when to perform the data transfer, from where to get the data, how much data to get, and where to put the data.

1. Write to the appropriate register a designator that will indicate the Input File Number and the word count of the data that you want to input. (You will assign the Input File Number to the input file later, when you open it.) The register to which you write this information depends on the target device.

Device Family	Designate the Input File Number and word count in register:	Designate the Input File Number and the word count (i.e. length) of the data as follows:
DSP56000	X0	File Number in the upper 8 bits; count in the lower 16 bits
DSP56100	X0	File Number in the upper 8 bits; count in the lower 8 bits
DSP56300	X0	File Number in the upper 8 bits; count in the lower 16 bits
DSP56600	X0	File Number in the upper 8 bits; count in the lower 8 bits
DSP56800	X0	File Number in the upper 8 bits; count in the lower 8 bits
DSP96000	R0	File Number in the upper 16 bits; count in the lower 16 bits

2. Write to the appropriate register a designator that indicates the memory space, and to another register the address where you want the data to be written. Designate the memory space as follows: `0=p, 1=x, 2=y, 3=l.`

Device Family	Designate the memory space in register:	Put the address where the input data will be written in register:
DSP56000	R1	R0
DSP56100	R1	R0
DSP56300	R1	R0

DSP56600	R1	R0
DSP56800	R1	R0
DSP96000	R2	R1

3. Place a DEBUG instruction at an appropriate address in your program. This is the point in the program where you want the data transfer to take place.

Once the registers are set and the DEBUG instruction written, you can assign the input file with the INPUT command.

Command Examples

Example 13-25. INPUT Command

Command	Explanation
input	Displays the currently open input files for the current device.
input dv2 p:200 data.io	Opens "data.io" file for input to device #2. Note: p:200 is the address where the DEBUG instruction resides.
input dv2 off	Closes all current input data files assigned to device #2.
input dv1 #3	Displays the filename of Input File Number 3 for Device #1.
input p:400 data.io -rf	Opens the file "data.io" for input to the default device; in fractional radix. Note: p:400 is the address where the DEBUG instruction resides.
input p:600 term	Creates a input file called "term". The file number defaults to the next available consecutive number. Note: p:600 is the address where the DEBUG instruction resides.

The Debugger provides a way to specify repeated input values and sequences very similar to the DSP Simulator. A single data value may be repeated by specifying #count following the data item. A group of data items may be indicated by enclosing the group in parentheses. The entire group may then be repeated by placing #count immediately following the closing parenthesis. The parentheses may be nested. A closing parenthesis without a following repeat count will cause the data sequence within the parentheses to repeat forever.

Example 13-26. Examples of Input File Data

```
$ABCF
```

A single data item $ABDF

```
1FF#20
```

Repeat the data item 1FF twenty times.

```
(CC 50)#5
```

Repeat the sequence of data pairs CC 50 five times.

There are two levels of terminal data input capability provided by the ADS Debugger. If the INPUT command specifies term as the input filename, the ADS program enters a resident editor which allows creation of an input data file. The data file is given a temporary name, termxxxx.io (xxxx=0000-9999), and is saved on the disk at the termination of the INPUT command. The entire contents of the input file may be specified in this manner, including any of the valid fields specified above.

A second level of terminal data input allows the user to be prompted any time the next input data value is needed. This method is triggered if the lower case letter t is encountered in the data field of the input file. Each time a t is encountered, the user will be prompted for a single data value from the terminal. The ADS Debugger will read the input data using the radix option specified in the INPUT command. Hexadecimal is the default input radix.

Example 13-27. Examples of Terminal Input Within an Input File

```
t#30
```

Request the next thirty input values from the user interactively or until an ESCAPE character is entered.

```
(t)
```

All input values are to come from the user interactively until ESC is pressed.

For more information see, Section 6.3, “Examples of How to Assign an Input File,” on page 6-7

13.28 LIST - List Source File Lines

LIST [+/-/./addr]

The LIST command displays source lines or disassembled instructions from the specified source file, or beginning at the specified address. The current display mode determines whether a source file or assembly mnemonics will be displayed. If the Debugger is in the Register display mode, this command will switch it to the Source display mode and display the source file lines associated with the specified address or line number. If the display mode is already source or assembly, the display mode is not altered. The Assembly display mode displays disassembled instructions corresponding to the specified address or line number.

The next or previous pages of the currently displayed source file may be selected by specifying + or –, rather than a specific address or line number. In addition, the source or assembly associated with the current execution address may be selected by specifying. (period) or by using the LIST command without a parameter.

Example 13-28. LIST Command

Command	Explanation
`list 20`	List source or assembly corresponding to line 20 of the current source file.
`list test.asm@20`	List source or assembly corresponding to line 20 of the source file test.asm.
`list test.asm`	List source or assembly corresponding to line 1 of the source file test.asm.
`list +`	Display the next page of the current source file or assembly.
`list`	Display source or assembly corresponding to the current execution address.
`list–`	Display the previous page of the current source file or assembly.
`list lab_1`	List source or assembly corresponding to symbolic address lab_1.

13.29 LOAD - Load DSP Files

```
LOAD [dev_list] [B(byte wide) address_offset] (from) file
LOAD [dev_list] [S(state)/M(memory-only)/D(debug symbols-only)] (from)
file
```

The LOAD command transfers DSP Macro-Assembler object files to the target DSP memory. The object module format (OMF) is defined in Appendix A, the Common Object File Format (COFF) is defined in Appendix B. Programs are loaded into the memory map and address specified by each data record. A directory path may be specified with the filename.

If only the file parameter is specified, then the user interface program assumes that the file is an OMF file. The object file may be in either the special ASCII OMF format, or in the DSP COFF format generated by the DSP Macro-Assembler. An OMF file may be created by using the DSP Macro-Assembler, or by using the SAVE command, or by some user generated method. If no filename suffix is specified, a OMF format .lod file is searched first and if not found, then a COFF format .cld file is searched. Loading a COFF format file replaces the target DSP symbolic debug information unless the M option is specified.

Programs are loaded into the memory map and address specified by each data record. A directory path may be specified with the filename. The default path for each target DSP address can be changed with the PATH command.

If S is specified as the second of three parameters, the ADS interface program will load filename as an ADS state file. The ADS state file may be created using the SAVE s command. Loading the ADS state changes all ADS setups as well as registers and memory, to the previous definition saved in the state filename. If no filename suffix is specified, .adm is assumed.

If M is specified as the second parameter, the ADS interface program will load object file filename, .cld or .lod, without modifying the target DSP symbolic debug information.

If D is specified as the second parameter, the ADS will load only the symbolic debug information from the object file filename. The device memory contents are not altered. Only the COFF format files (.cld suffix) are supported by this option.

If B is specified as the second parameter, the third parameter must be an address offset which is added to the OMF data record start address where data is to be loaded. The file must be in OMF and will be loaded byte wide sequentially incrementing the address counter on each byte load. The low order byte will be loaded first and the high order byte will be loaded last in each word. This is similar to the byte wide loading format of the bootstrap loader program on the DSP. This feature allows users to download programs into RAM and debug bootloader or overlay programs.

Example 13-29. LOAD Command

Command	Explanation
`load source\testloop.lod`	Load "testloop.lod" file from directory "source".
`load lasttest`	Load "lasttest.lod" file from current directory. If not found look for lastltest.cld and load
`load s lunchbrk`	Load "lunchbrk.adm", ADS state.
`load m test.cld`	Load the COFF format test.cld file, ignoring any symbolic debug information in it.
`load d test.cld`	Load the symbolic debug information from the COFF format test.cld file, ignoring the memory contents of the file.
`load b 300 bootprog.lod`	Load the bootprog.lod file writing the least significant byte first and most significant byte last into each consecutive memory location of the target. The 300 argument is an address offset to be added to the starting location of memory specified in the data record.

13.30 LOG - Log Commands or Session Output

```
LOG [dev_list] [OFF] [C(commands)/S(session)] [filename] [-o/-a/-c]
LOG [dev_list] [OFF] V(source display status line)
```

The LOG command allows the user to record command entries only, or record all session display output to a file. Recording of commands only is useful as a method of generating macro command files. Recording all session display output provides a convenient way for the user to review the results of an extended sequence of commands. The user would otherwise only have access to the last 100 lines of output on the terminal. Since the output log files are in ASCII format, they may easily be printed or reviewed using an editor program.

Entering the LOG command with no parameters will cause a display of the currently opened log filenames. The keyword OFF is used to terminate logging. The C and S key characters are used to specify whether the logfile will contain only commands (C), or all session output (S).

The suffixes .cmd and .log are added, respectively, to the commands-only or session filename if no other suffix is specified. The default file path for each target DSP can be changed with the PATH command. If a file currently exists with the filename specified the user will be prompted for an action of either appending the data to the file, overwriting the file, or aborting the command. The selection of the file action may be included in the command line using the -o (overwrite), -a (append), or the -c (cancel) argument.

Example 13-30. LOG Command

Command	Explanation
`log`	Display currently opened log files.
`log s \debugger\session1`	Log all display entries to filename "session1.log" in directory "debugger"
`log c macro1`	Log all commands to filename "macro1.cmd".
`log off c`	Terminate command logging.
`log off`	Terminate all logging.
`log c macro1 -a`	Log all commands to filename macro1.cmd. If a file with that name currently exists cancel the execution of the command.

13.31 MORE - Enable/Disable Session Paging

```
MORE [OFF]
```

The MORE command allows the user to enable or disable the paging of data on the session window. This is particularly useful when displaying large amounts of data and you wish to examine the data page by page.

The paging feature is turned off by default and data will scroll vertically across the screen when it is larger than the size of the screen.

Example 13-31. MORE Command

```
more
```

Turn on session display paging control.

```
more off
```

Disable Session display paging control (reset or default state).

13.32 NEXT - Step Through Subroutine Calls or Macros

```
NEXT [dev_list] [count] [LI(lines)/IN(inst)]
```

The NEXT command functions the same as the STEP command, except that if the next instruction to be executed calls a subroutine or begins execution of a macro, all the instructions of the subroutine or macro are executed before stopping to display the enabled registers. In order to recognize macros, the symbolic debug information for the program code must be loaded. The debug information is included in the COFF format .cld files generated using the Assembler's –g option.

The optional count value enables repeating of the NEXT command the specified number of times before execution terminates. All breakpoints are ignored while the NEXT command is executing.

Example 13-32. NEXT Command

```
next
```

Step over subroutine calls or macros or otherwise just advance one instruction and display the enabled registers and memory blocks.

```
next 10
```

Execute the equivalent of 10 NEXT instructions, halting to display the enabled registers and memory blocks only after the tenth invocation.

```
next 10 li
```

Step over the 10 next source lines (if there is a source file associated with the current program counter).

13.33 OUTPUT - Assign Output File

OUTPUT [dev_list] [#(file number)... OFF]

OUTPUT [dev_list] [#(file number)] address filename/TERM [-rd/-rf/-rh/-ru] [-o/-a/-c]

The OUTPUT command opens disk files that will accept data from the target DSP.

The optional parameter dev_list represents the device or list of devices on which the command will be performed.

The optional parameter #(file number) represents the number to assign to an output file; or, if referencing an existing file, the number that has been assigned to an output file.

The optional parameter OFF closes the output file designated by #(file number). If no file number is indicated, all open output files are closed.

The `address` parameter is required when opening an output file. This address represents the address where the DEBUG instruction which will trigger the data transfer resides.

To open an output file you must use the OUTPUT command with either the filename parameter or the TERM parameter. If a file currently exists with the filename specified with the filename parameter, you will be prompted for an action of either appending the data to the file, overwriting the file, or aborting the command. The selection of the file action may be included in the command line using the –o (overwrite), -a (append), or the -c (cancel) flag. This is useful when executing macro command files.

The TERM parameter assigns the output to the display terminal rather than a file. The input data is in ASCII. The input, whether from the keyboard or from a file, can be expressed in decimal (-rd), floating point (-rf), hexadecimal (-rh), or unsigned (-ru). If no radix is specified, hexadecimal is assumed as the default.

Before opening an output file, there is some preparation that you must perform outside of the Debugger in order for the data to be correctly written to the output file. You will need to place a DEBUG instruction in your program and you will need to set designators in certain registers. You need to do this so that the Debugger knows when to perform the data transfer, from where to get the data, how much data to get, and where to put the data. To prepare data to be written to an output file:

1. Write to the appropriate register a designator that will indicate the Output File Number and the word count (length) of the data that you want to write. (You will

assign the Output File Number later, when you actually open it.) The register to which you write this information depends on the target device.

Device Family	Designate the Output File Number and word count in register:	Designate the Output File Number and the word count (i.e. length) of the data as follows:
DSP56000	X0	File Number in the upper 8 bits; count in the lower 16 bits
DSP56100	X0	File Number in the upper 8 bits; count in the lower 8 bits
DSP56300	X0	File Number in the upper 8 bits; count in the lower 16 bits
DSP56600	X0	File Number in the upper 8 bits; count in the lower 8 bits
DSP56800	X0	File Number in the upper 8 bits; count in the lower 8 bits
DSP96000	R0	File Number in the upper 16 bits; count in the lower 16 bits

2. Write to the appropriate registers a designator that indicates the memory space and address from where you want the data to be read. Designate the memory space as follows: 0=p, 1=x, 2=y, 3=l.

Device Family	Designate the memory space in register:	Put the address from where the data will be read in register:
DSP56000	R1	R0
DSP56100	R1	R0
DSP56300	R1	R0

DSP56600	R1	R0
DSP56800	R1	R0
DSP96000	R2	R1

3. Place a DEBUG instruction at an appropriate address in your program. This is the point in the program where you want the data transfer to take place.

For more information see the Examples of How to Assign an Output File. Once the registers are set and the DEBUG instruction written, you can open the output file.

OUTPUT Command Examples

Table 13-4. OUTPUT Command

Command	Explanation
`output`	Display all output files currently open for all target devices.
`output dv2 p:300 admout`	Open file "admout.io" for logging of device #2 outputs. Note: p:300 is the address where the DEBUG opcode is to reside.
`output dv2 off`	Close file currently open for device #2 outputs.
`output p:500 outfile.io -rd`	Open file "outfile.io" for logging of default device outputs in decimal radix. Note: p:500 is the address where the DEBUG opcode is to reside.
`output #2 p:700 term`	Open file number 2 for the current device as the terminal. Note: p:700 is the address where the DEBUG opcode will reside.

13.34 PATH - Define File Directory Path

```
PATH [dev_list] [pathname]
PATH + pathname[,pathname,...]
PATH –
```

The PATH command allows the user to pre-define a directory path for file I/O for each target DSP address. This enables the user to effectively partition data files for each target DSP address in their appropriate subdirectory. Once a file is opened for INPUT, OUTPUT, SAVE, or LOGging, subsequent changes to the path will not affect the opened file. To change the path, the file must be closed and reopened with the new path name. The user may still override the default path by explicitly specifying a pathname as a prefix to the filename in any of the commands which reference a file.

Alternate source pathnames may be specified using the PATH + form of the command. Each time the command is issued, the specified pathname, or comma-separated list of pathnames, is added to the current list. When searching for files, the ADS user interface program will search first using the default pathname specified for the current device, then in each of the alternate source pathnames, in the order that they were specified.

Example 13-33. PATH Command

Command	Explanation
`path`	Display the path for the current default target DSP address.
`path dv1..4 \;`	Define a path to the root directory for target DSP addresses 1, 2, 3, and 4. All subsequent commands with filename arguments will have this path string preceded to the filename when making an operating system call.
`path + ..\test`	Add pathname ..\test to the list of alternate source pathnames.
`path + ..\test,..\help`	Add pathnames ..\test+ and +..\help to the list of alternate source pathnames.
`path –`	Clear the list of alternate source pathnames.

13.35 QUIT - Quit Debugger Session

QUIT [E(enable)/D(disable)]

The QUIT command passes control back to the operating system and closes all logging files, assignment files, and macro files currently open. Use the SYSTEM command to exit the ADS program temporarily.

QUIT enable and QUIT disable control the action taken by the ADS if an error occurs during the execution of a macro command. QUIT enable specifies that the macro command is aborted and the ADS quits immediately with a non-zero exit status. QUIT disable specifies that the ADS does not exit.

Example 13-34. QUIT Command

```
quit
```

Close all currently open files and return to the Operating System. Target DSP may be left running until the program is re-entered.

```
quit e
```

Specify that errors in a macro command will cause the ADS to exit with a non-zero status. The ADS does ont exit when this commend is performed.

13.36 RADIX - Change Input or Display Radix

```
RADIX [dev_list][B(bin)/D(dec)/F(flt)/H(hex)/U(uns)]
[reg[_block]/address[_block]]
```

The RADIX command allows the user to change the default number base for command entry. Hexadecimal constants may always be specified by preceding the constant by a dollar sign ($). Likewise, a decimal value may be specified by preceding the constant with a grave accent (‘). Note: The default radix is hexadecimal when the user interface program is initially invoked.

This means that hexadecimal constants must be entered with a preceding dollar sign. Changing the default radix allows the user to enter constants in the chosen radix without typing the radix specifiers before each constant.

The RADIX command also allows the user to select the display radix of registers and/or memory. The default display radix for registers and memory is hexadecimal. The use of the values of hex A or B require the $ preceding the value, otherwise the values will be evaluated as the contents of the registers A or B, respectively.

Example 13-35. RADIX Command

Command	Explanation
`radix`	Display the default radix currently enabled.
`radix h`	Change default radix entry to hexadecimal Hexadecimal constant entries no longer require a preceding dollar sign, but any decimal constants will require a preceding grave accent (‘).
`radix f a`	Change the default display radix for the long register a to display a fractional value whenever the a register is displayed.
`radix u x:100..200`	Enable the display radix for X data memory block 100 to 200 to be unsigned when displayed on the screen.

13.37 REDIRECT - Redirect stdin/stdout/stderr for C Programs

```
REDIRECT [dev_list] STDIN OFF/file
REDIRECT [dev_list] STDOUT/STDERR OFF/file [-A/-O/-C]
REDIRECT [dev_list] [OFF]
```

The REDIRECT command is used to redirect the stdin/stdout/stderr for C programs. It allows the user to redirect stdin from a file, and redirect stdout/stderr to files. No stream file redirection occurs while stream option is disabled.

Note: No I/O processing or handling of redirection occurs if the streams option has been disabled. See STREAMS for more information.

Example 13-36. REDIRECT Command

Command	Explanation
`redirect`	Display the redirect list, which shows each of the three streams that can be redirected, along with to where they are being redirected.
`redirect DV0,3,4,5 off`	Cancel all stream redirection for specified target devices.
`redirect stdin input`	Redirect the C stdin (standard input) stream from the file input.cio (.cio is the default extension).
`redirect stdout output txt`	Redirect the C stdout (standard output) stream to the file output.txt.
`redirect stderr errors`	Redirect the C stderr (standard error) stream to the file errors.cio.
`redirect stdout output -o`	Redirect the C stdout stream to the file output cio, overwriting the file if it already exists.
`redirect stdout output -a`	Redirect the C stdout stream to the file output cio, appending to the end of the file if it already exists.
`redirect stdout output -c`	Redirect the C stdout stream to the file output.cio, but don't redirect if the file already exists.

13.38 SAVE - Save Memory To File

```
SAVE [dev_num] S(state)/address_block... filename [-o/-a/-c]
```

The SAVE command allows creation of an ADS state file from the current ADS state, or creation of an OMF file from specified memory blocks. If S is specified as the second parameter, an ADS state file is created. It contains the entire ADS state, including memory contents, breakpoint settings and the current pointer position of any open files. This file is in an internal format that is efficient for the ADS Interface program to store and load (see the LOAD s command description). The default suffix for an ADS state filename is .adm.

If memory blocks are specified (instead of S) the specified memory areas are stored in Macro_Assembler object module format so the file may be reloaded with the LOAD command. The default suffix for an OMF file is .lod. If a filename suffix of ..cld is explicitly specified, a COFF file will be created.

If a file currently exists with the filename specified the user will be prompted for an action of either appending the data to the file, overwriting the file, or aborting the command.

The selection of the file action may be included in the command line using the –o (overwrite), -a (append), or the -c (cancel) argument. This is useful when executing macro command files.

Example 13-37. SAVE Command

```
save p:0..$ff x:0..$20 session1
```

Save all three memory maps to OMF file "session1.lod" of the current default target DSP address. Prompt for required action if file already exists.

```
save s lunchbrk
```

Save the default ADS state to filename "lunchbrk.adm". Prompt for required action if file already exists.

```
save dv1 s lunchbrk.e1 -o
```

Save the target DSP address 1 state to filename "lunchbrk.e1". Overwrite the current file lunchbrk.e1 if it exists.

13.39 STEP - Step Through DSP Program

STEP [dev_list] [count] [LI(source lines)/IN(instructions)]

The STEP command allows the user to execute count instructions or C source lines before displaying the enabled registers and memory blocks. This command gives the user a quick way to specify execution of a number of instructions without having to set a breakpoint. It is similar to the TRACE command except that display occurs only after the count number of cycles or instructions have occurred.

Note that the address of the first instruction that is to be executed is in the OnCE Program Address Bus Decode Register (OPABD). If the Program Counter is changed before a TRACE or STEP command is issued, the address of the Program Counter Register points to the instruction to be executed.

CAUTION	DSP5616x: When single stepping through a BRKcc instruction and the condition is true, the instruction immediately following the BRKcc instruction will be displayed by the ADS but will not be executed. Instead, the DSP will correctly execute the instruction at LA + 1. Single-stepping Tcc, REPcc or REP instructions with initial loop counter equal to zero may cause incorrect DSP operation.

The main difference between the TRACE and STEP commands is the OnCE port trace counter is armed to trace one instruction in the Trace mode. The STEP command arms the trace counter with the count instructions to be executed in real time before re-entering the Debug mode of operation and displaying the enabled registers and memory.

Example 13-38. STEP Command

Command	Explanation
`step`	Step one instruction at the current target DSP address and display enabled registers and memory blocks.
`step $50`	Execute hex $50 instructions and then display the enabled registers and memory blocks.
`step 3 li`	Step over the next 3 source lines (for a source file associated with the current program counter).
`step dv2,5 5`	Execute 5 instructions on target DSP addresses 2 and 5 simultaneously and display the enabled registers and memory blocks of each when they have each completed their 5 instructions.

13.40 STREAMS - Enable/Disable Handling of I/O for C Programs

STREAMS [dev_num] [ENABLE/DISABLE]

The STREAMS command is used to enable and disable the handling of input and output on the host side for C programs. By default, it is enabled. When enabled all input and output that is done in the C program running on the DSP is handled on the host side. So for example, when an fopen() call is made in the C program running on the DSP call, the host software intercepts the call and does the fopen() on the host side.

Example 13-39. STREAMS Command

```
streams e
```

Enable handling of C input/output. All input/output calls done in a C program running on the DSP will be handled by the host software (e.g. fopen(), fwrite(), printf(), etc.).

```
streams d
```

Disable handling of C input/output.

13.41 SYSTEM - Execute Operating System Commands

SYSTEM [-C(continue immediately)] [system_command [argument_list]]

The SYSTEM command allows operating system commands to be executed. The operating system commands may be executed as subprocesses of the ADS interface program or may be executed independently by temporarily exiting the ADS interface program. Invoking this command with no arguments will cause the ADS Interface Program to pass control to the Operating system but stay resident. To re-enter the ADS

Interface Program the EXIT command must be invoked from the operating system command line.

Operating System commands invoked from within the ADS Interface program will not be logged to the screen buffer for review. When a SYSTEM command is specified on the system command line, the user is prompted to Hit return to continue... before control returns to the ADS. This allows the user to inspect the command output before it is destroyed. The command argument –C (continue immediately) causes control to return to the ADS without prompting the user. This may be useful in macro commands, allowing system commands to be used without requiring operator intervention.

Example 13-40. SYSTEM Command

```
system
```

Temporarily exit the ADS interface program and go to the Operating System To re-enter the ADS interface program invoke the EXIT command. All previous setups will not be altered.

```
system dir
```

Invoke the directory Operating System command from within the ADS Interface program:

```
system
dir *.io
del he.io
exit
```

Create a MS-DOS shell and temporarily exit the ADS user interface program. Execute two MS-DOS commands and re-enter the ADS user interface program using the EXIT command. The current state as well as opened files of all target DSP addresses will remain the same.

```
system -c del e:\temp\*.lod
```

Delete the specified temporary files and continue without issuing the continuation prompt.

13.42 TRACE - Trace Through DSP Program

```
TRACE [dev_list] [count]/[LI(source lines)/IN(instructions)]
```

The TRACE command gives a snap shot of each instruction during program execution. This single stepping capability displays the enabled registers and memory blocks after each instruction until count instruction or C source lines are decremented to zero. To execute an instruction requires exiting the Debug mode of operation and entering the User mode of operation so that the instruction pipeline may be restored and any result of the traced instruction and subsequent instructions update the pipeline and machine state.

Note: The address of the instruction that is to be traced is in the OnCE Program Address Bus Decode Register (OPABD). If the program counter is changed before a TRACE or STEP command is issued, the address of the program counter register will point to the instruction to be traced.

When single stepping through the BRKcc instruction and the condition is true, the instruction immediately following the BRKcc instruction is displayed by the ADS but is be executed. Instead, the DSP correctly executes the instruction at LA + 1. Single-stepping a Tcc, REPcc, or REP instruction with initial loop counter equal to zero may cause incorrect DSP operation.

The main difference between the TRACE and STEP commands is the OnCE port trace counter is armed to trace one instruction in the Trace mode. The STEP command arms the trace counter with the count instructions to be executed in real time before re-entering the Debug mode of operation and displaying enabled registers and memory.

Example 13-41. TRACE Command

Command	Explanation
`trace`	Execute one instruction and display the enabled registers and memory blocks.
`trace 20`	Execute 20 instructions and display the enabled registers and memory blocks after each instruction.
`trace 5 li`	Execute the next 5 lines of source, and display enabled registers and memory blocks after each line.
`trace dv2,4 5`	Execute 5 instructions on target DSP address 2 and target DSP address 4 from their current program counter and display their enabled registers and memory blocks after each instruction.

13.43 TYPE - Display the Result Type of a C Expression

TYPE [dev_list] {c_expression}

The TYPE command is used to display the result type of a C expression. If result of the expression is a storage location (e.g., just a variable name, or an element of an array), it will display the address of the storage location, in addition to its data type.

Example 13-42. TYPE Command

```
type {count}
```

Display the type and location of the variable count.

```
type {0.5+i}
```

Display the type of the given expression.

13.44 UNLOCK - Unlock Password Protected Device Type

UNLOCK dev_type password

The UNLOCK command provides password enabling for emulation of unannounced device types. Once unlocked, the device type may be selected with the DEVICE command.

Example 13-43. UNLOCK Command

```
unlock 56002 x51-234
```

Enable device type 56002 for simulation using the password x51-234.

13.45 UNTIL - Step Until Address

UNTIL [dev_list] addr/line_number/address_label

The UNTIL command sets a temporary breakpoint at the specified line or address, then steps until that breakpoint. It then clears the temporary breakpoint and displays the enabled registers and memory blocks in the same manner as the STEP command.

The addr parameter may be expressed as a line number in the program source file. Specification of a line number is valid only if the symbolic debug information has been loaded from a COFF format .cld file. The debug information is generated using the Assembler’s –g option. Line numbers may be specified as filename@line_number for a line number in a particular file or simply by line_number for line numbers in the currently displayed file.

All other breakpoints are ignored while the UNTIL command is executing.

Example 13-44. UNTIL Command

```
until 20
```

Go until the instruction associated with line 20 in the current file is reached.

```
until p:$50
```

Go until the instruction at hexadecimal address p:50 is reached.

```
until lab_2
```

Go until the instruction at label lab_2 is reached.

13.46 UP - Move Up the C Function Call Stack

UP [dev_list] [n]

The UP command is used to move up the call stack. It can be used in conjunction with the WHERE, FRAME, and DOWN commands to display and traverse the C function call stack.

After entering a new call stack frame using UP, that call stack frame becomes the current scope for evaluation. In other words, for C expressions, the EVALUATE command acts as though this new frame is the proper place to start looking for variables.

Example 13-45. UP Command

```
up
```

Move up the call stack by one stack frame

```
up 3
```

Move up the call stack by three stack frames.

13.47 VIEW - Select Display Mode

VIEW [A(assembly)/S(source)/R(register)]

The VIEW command changes the ADS display mode. There are three display modes: Assembly, Source, and Register. If the VIEW command is entered with a parameter, the specified display mode is selected. When no parameter is entered, the display mode cycles to the next display mode in the following order: Source—Assembly—Register. The same results can be obtained by typing Ctrl-w.

Example 13-46. VIEW Command

Command	Explanation
`view`	Cycle to the next display mode among Source Assembly and Register modes.
`view s`	Select Source display mode.
`view a`	Select Assembly display mode.
`view r`	Select Register display mode.

13.48 WAIT - Wait Specified Time

WAIT [[dev_list] B(break)]/count(seconds)]

The WAIT command pauses for count seconds or until the user types any key before continuing to the next command. If the WAIT command is entered without a count parameter, the command will terminate only if the user types a key. This instruction is useful when executing a macro file and the current display on the screen needs to be examined before executing further instructions from the macro file. The B option causes a pause until all of the specified devices have entered the Debug mode. This option is useful when executing a macro file where the devices must hit breakpoints or complete steps or traces before the next command is accepted.

Example 13-47. WAIT Command

```
wait
```

Wait for a key stroke from the keyboard before executing any further instructions.

```
wait 10
```

Wait ten seconds before executing another command from the keyboard.

```
wait dv0..3 b
```

Wait until devices 0,1,2 and 3 have all entered the debug mode.

13.49 WATCH - Set, Modify, View, or Clear Watch Item

WATCH [dev_list] [#wn] [radix] reg/addr/expression/{c_expression}
WATCH [dev_list] [#wn] OFF

The WATCH command is used to add, modify, view, and clear watch items. Watch items are on a watch list that gets displayed every time the user does a trace, or a breakpoint is hit. Additionally, any time a user types WATCH without any parameters, the watch list is displayed.

Example 13-48. WATCH Command

Command	Explanation
`watch r0`	Add register r0 to the watch list
`watch x:0`	Add x:0 to the watch list
`watch {(count+1)%total}`	Add the given C expression to the watch list
`watch h {count/2}`	Add the given C expression to the watch list with display radix hex.
`watch b {flag}`	Add the given C variable to the watch list with display radix binary.
`watch r0+x:0`	Add the expression r0+x:0 to the watch list

Example 13-48. WATCH Command

Command	Explanation
`watch`	Display the watch list
`watch #3 off`	Remove item number three from the watch list
`watch off`	Remove all items from the watch list

13.50 WASM - GUI Assembly Window

WASM [dev_list] [OFF]

WASM is a GUI command that opens an assembly window. Multiple device windows may be opened for debugging target systems with multiple DSPs.

Example 13-49. WASM Command

```
wasm
```

Open an assembly window for the current device.

```
wasm dv0..1
```

Open an assembly window for devices dv0 and dv1.

```
wasm off
```

Close the assembly window or the current device.

13.51 WBREAKPOINT - GUI Breakpoint Window

WBREAKPOINT [dev_list] [OFF]

WBREAKPOINT is a GUI command that opens a breakpoint window. Multiple device windows may be opened for debugging target systems with multiple DSPs.

Example 13-50. WBREAKPOINT Command

```
wbreakpoint
```

Open a breakpoint window for the current device.

```
wbreakpoint dv0,3,4
```

Open a breakpoint window for the listed devices.

```
wbreakpoint off
```

Close the breakpoint window for the current device.

13.52 WCALLS - GUI C Calls Stack Window

```
WCALLS [dev_list] [OFF]
```

WCALLS is a GUI command that opens a C call stack window. Multiple device windows may be opened for debugging target systems with multiple DSPs.

Example 13-51. WCALLS Command

```
wcalls
```

Open a C call stack window for the current device.

```
wcalls off
```

Close the C call stack window for the current device.

13.53 WCOMMAND - GUI Command Window

```
WCOMMAND [OFF]
```

WCOMMAND is a GUI command that opens the Command window. Only one Command window may be opened even for debugging target systems with multiple DSPs. The Command window is shared between all target DSP devices. All commands affect the current default device unless specifically addressed to other device(s). The prompt on the command entry line indicates the current default device.

Example 13-52. WCOMMAND Command

```
wcommand
```

Open a Command window

```
wcommand off
```

Close the Command window

13.54 WHERE - GUI C Call Stack Window

```
WHERE [dev_list] [[+/-]n]
```

WHERE is a GUI command that displays the C function call stack. Multiple device windows may be opened for debugging target systems with multiple DSPs.

Example 13-53. WHERE Command

```
where
```

Display the call stack

```
where3
```

Display the three innermost frames in the call stack

```
where-5
```

Display the five outermost frames in the call stack

13.55 WINPUT - GUI File Input Window

`WI``NPUT [dev_list] [OFF]`

WINPUT is a GUI command that opens an input window. The input window lists all simulated input assignments for the specified device. Multiple device windows may be opened for debugging target systems with multiple DSPs.

Example 13-54. WINPUT Command

```
winput
```

Open an input window for the current device.

```
winput off
```

Close the input window for the current device.

13.56 WLIST - GUI List Window

`WL``IST [win_num] [OFF]`

WLIST is a GUI command that opens a list window. A list window is used to view a test file within the ADS environment. Multiple list windows may be opened for viewing multiple text files.

Example 13-55. WLIST Command

Command	Explanation
`wlist lfile.1st`	Open a list window with the text file lfile.1st displayed.
`wlist win2 lfile.1st`	Open a list window with a window number of 2 with text lfile.txt displayed. If list window 2 already exists, replace the contents with lfile.1st.
`wlist win2 off`	Close list window number 2.
`wlistoff`	Close all open list windows.
`wlist win3`	Open a list window with a window number of 3 with no text file displayed.

13.57 WMEMORY - GUI Memory Window

```
WMEMORY [dev_list] [win_num] [space [addr]/[OFF]]
```

WMEMORY is a GUI command that opens a memory window. Multiple device windows may be opened for viewing and changing separate memory areas and spaces at the same time, and for debugging target systems with multiple DSPs. The memory window is positioned initially to view the address specified by the addr field. The addr field may also be used in conjunction with the space field to select the exact memory space required.

Example 13-56. WMEMORY Command

Command	Explanation
`wmemory pi`	Open a memory window for the internal program (pi) memory space for the current device.
`wmemory xi 0`	Open a memory window for the xi memory space containing address 0 for the current device.
`wmemory dv2 win3 x $4100`	Open a memory window for memory space x with a window number of 3 for the current device. Scroll window to display address $4100.
`wmemory off`	Close all memory windows for the current device.
`wmemory win3 off`	Close memory window 3 for the current device.

13.58 WOUTPUT - GUI File Output Window

```
WOUTPUT [dev_list] [OFF]
```

WOUTPUT is a GUI command that opens a file output window. The output window displays the simulated output assignments for the specified device. Multiple output windows may be opened for debugging target systems with multiple DSPs.

Example 13-57. WOUTPUT Command

```
woutput
```

Open an output window for the current device.

```
woutput dv1 off
```

Close the output window for the device dv1.

13.59 WREGISTER - GUI Register Window

```
WREGISTER [dev_list] [win_num] [OFF]
```

WREGISTER is a GUI command that opens a register window. Multiple register windows may be opened to display and change separate blocks of registers at the same time. Multiple device windows may be opened for debugging target systems with multiple DSPs.

Example 13-58. WREGISTER Command

```
wregister
```

Open a register window for the current device.

```
wregister win3
```

Open a register window with a window number of 3 for the current device.

```
wregister dv1 off
```

Close all register windows for the device dv1.

13.60 WSESSION - GUI Session Window

WSESSION [OFF]

The WSESSION command opens a Session window. Only one Session window may be opened even for debugging target systems with multiple DSPs. All session output from all target devices is written to the Session window. A message is output to indicate which target device produced the following output.

Example 13-59. WSESSION Command

```
wsession
```

Open a Session window for the current device.

```
wsession off
```

Close the Session window

13.61 WSOURCE - GUI Source Window

WSOURCE [dev_list] [OFF]

The WSOURCE command opens a Source Code window. Multiple device windows may be opened for debugging target systems with multiple DSPs.

Example 13-60. WSOURCE Command

```
wsource
```

Open a Source window for the current device.

```
wsource off
```

Close the Source windows for the current device.

13.62 WSTACK - GUI Stack Window

```
WSTACK [dev_list] [OFF]
```

The WSTACK command opens a Device Stack window. Multiple device windows may be opened for debugging target systems with multiple DSPs.

Example 13-61. WSTACK Command

```
wstack
```

Open a Stack window for the current device.

```
wstack off
```

Close the Stack window for the current device.

13.63 WWATCH - GUI Watch Window

```
WWATCH [dev_list] [win_num] [#wn] [radix] reg/addr/expression
WWATCH [dev_list] [win_num] [#wn] [OFF]
```

The WWATCH command opens a Watch window Multiple device windows can be opened for debugging target systems with multiple DSPs.

Example 13-62. WWATCH Command

Command	Explanation
`wwatch r0`	Opena Watch window for the current device with the register r0 displayed. If the window already exists, add r0 to the list of watched items.
`wwatch x:$100`	Open a Watch window for the current device with the memory location x:$100 displayed. If the window already exists, add x:$100 to the list of watched items.
`wwatch r2+3`	Open a Watch window for the current device with the expression r2+3 displayed. If the window already exists, add r2+3 to the list of watched items.
`wwatch win2 r0`	Open a Watch window for the current device with a window number of 2 with the register r0 displayed. If the window already exists, add r0 to the list of watched items.
`wwatch off`	Close all Watch windows for the current device.
`wwatch win3 off`	Close Watch window 3 for the current device.
`wwatch #2 off`	Remove watch element #2 from first Watch window’s list of watched elements.

Example 13-62. WWATCH Command

Command	Explanation
`wwatch win4 #2 off`	Remove watch element #2 from Watch window 4’s list of watched elements.

Chapter 14
Library Functions

The ADSDSP emulator package includes several libraries of functions which were used to build the emulator. These libraries allow the user to build his own customized emulator and integrate it with his unique project. The source code for many of the ADSDSP functions is provided, including the code for the main entry point, the code for the terminal I/O functions, and example code for a non-display version of the emulator. The source code can be modified to create an emulator customized for a particular application.

A custom emulator may be built with or without display support. Omitting display support reduces the program size by about half, but sacrifices the screen output facilities used in the ADS; omitting the display also sacrifices the user interface and command parsing and execution routines (which rely on the display routines). A non-display ADS may be used to provide direct program control of the hardware by calling the low-level routines, creating reports and activity logs using standard C functions. Omitting display support does not preclude the use of the standard C input/output functions or the creation of an alternative user interface.

The rest of the chapter covers various aspects of the specification and use of the libraries:

- **Section 14.1, "ADS Object Library Files,"** lists and groups the functions
- **Section 14.2, "Library Function Descriptions,"** defines each function
- **Section 14.3, "Emulator Screen Management Functions,"** defines the display (terminal I/O) functions
- **Section 14.4, "Non-Display Emulator,"** discusses display and non-display support
- **Section 14.5, "Multiple Device Emulation,"** describes the emulation of multiple DSP devices
- **Section 14.6, "Reserved Function Names,"** lists reserved function names
- **Section 14.7, "Emulator Global Variables,"** describes global data used by the emulator
- **Section 14.8, "Modification of Emulator Global Structures,"** covers tailoring items in the global structures

14.1 ADS Object Library Files

The following sections describe the different types of object library files.

14.1.1 Ads Object Library Entrypoints

The library functions are listed below. They are divided into groups by their function name prefix. The prefix indicates to which part of the ADS they belong, and indicates if they are available in the display or non-display versions of the emulator.

- `ads_` ADS-specific routines; both versions
- `dspd_` driver level; not for use by user code; both versions
- `spd_cc_` Command Converter driver level; not for use by user code; both
- `dspt_` DSP device dependent routines; both versions
- `dsp_` both versions
- `dsp_cc_` Command Converter routines; both versions
- `sim_` display only; user interface routines

The driver-level routines (both those referred to above and those documented in the rest of this chapter) are not intended to be called by emulator code. They are designed to be called (directly or indirectly) by the interface routines. They are documented so that the user can rewrite them to drive alternate emulator hardware. Other lower-level functions mentioned in this chapter are not intended to be called by user code; these functions are not documented and are specified by the prefixes `dspl_`, `siml_` and `dsptl_`.

14.1.2 Library Entrypoints Listed By Prefix

The following sections list the different routines.

14.1.2.1 ADS Specific Utility Routines

Table 14-1 lists ADS specific utility routines:

Table 14-1. `ads_`—ADS-Specific Utility Routines

Routine	Description
`ads_cache_registers(devn);`	Read OnCE and core registers from device
`ads_startup(devp, devtype);`	Initialize ADS database and driver

14.1.2.2 Command Converter Driver Level Routines

Table 14-2 lists command converter driver level routines.

Table 14-2. `dspd_cc_`—Command Converter Driver Level Routines

Routine	Description
`dspd_cc_architecture (devn, device_type);`	Initialize Command Converter for DSP family
`dspd_cc_read_flag (devn, flag, value);`	Read Command Converter flag word
`dspd_cc_read_memory(devn, mem, addr, count, value);`	Read from Command Converter memory
`dspd_cc_reset(devn);`	Reset Command Converter
`dspd_cc_revision (devn, revstring);`	Read Command Converter revision number
`dspd_cc_write_flag (devn, flag, value);`	Write Command Converter flag word
`dspd_cc_write_memory(devn, mem, addr, count, value);`	Write to Command Converter memory

14.1.2.3 Driver Level Routines

Table 14-3 lists driver level routines:

Table 14-3. `dspd_`—Driver Level Routines

Routine	Description
`dspd_break(devn, command);`	Force running DSP into debug mode
`dspd_check_service_request (devn);`	See if DSP is requesting service from host
`dspd_fill_memory(devn, mem, addr, count, value);`	Initialize DSP memory buffer to single value
`dspd_go(devn, opcode, operand);`	Begin execution on target DSP device
`dspd_jtag_reset(devn, reset_type);`	Reset JTAG communications
`dspd_read_core_registers (devn, reg_num, count, value);`	Read core registers from DSP device

Table 14-3. dspd_—Driver Level Routines (Continued)

Routine	Description
`dspd_read_memory(devn, mem_space, addr, count, value);`	Read memory block from DSP device
`dspd_read_once_registers (devn, reg_num, count, value);`	Read once registers from DSP device
`dspd_reset(devn, reset_mode);`	Reset specified DSP device
`dspd_status(devn, mode);`	Determine DSP status
`dspd_write_core_registers (devn, reg_num, count, value);`	Write core registers to DSP device
`dspd_write_memory(devn, mem_space, addr, count, value);`	Write to memory in DSP device
`dspd_write_once_registers (devn, reg_num, count, value);`	Write once registers from DSP device

14.1.2.4 DSP Device Specific Routines

Table 14-4 lists DSP device specific routines:

Table 14-4. dspt_—DSP Device Specific Routines

Routine	Description
`dspt_masm_xxxxx (mnemonic, ops, err);`	Assemble mnemonic string to ops
`dspt_unasm_xxxxx (ops, sr, omr, sdbp);`	Disassemble DSP opcodes

14.1.2.5 Command Converter Interface Routines

Table 14-5 lists command converter interface routines:

Table 14-5. dsp_cc_—Command Converter Interface Routines

Routine	Description
`dsp_cc_fmem(device, mtype, addr, count, value);`	Fill Command Converter memory block
`dsp_cc_go(devn);`	Start program on Command Converter
`dsp_cc_ldmem(devn, loadfn);`	Load Command Converter Memory from file

Table 14-5. dsp_cc_—Command Converter Interface Routines (Continued)

Routine	Description
`dsp_cc_reset(device);`	Reset Command Converter
`dsp_cc_revision (devn, revstring);`	Read Command Converter Monitor Revision
`dsp_cc_rmem (device, mtype, addr, value);`	Read Command Converter Memory
`dsp_cc_rmem_blk(device, mtype, addr, count, value);`	Read Command Converter memory block
`dsp_cc_wmem (device, mtype, addr, value);`	Write Command Converter memory
`dsp_cc_wmem_blk(device, mtype, addr, count, value);`	Write Command Converter memory block

14.1.2.6 ADS Interface Routines

Table 14-6 lists ADS interface routines:

Table 14-6. dsp_—ADS Interface Routines

Routine	Description
`dsp_alloc(nbytes,clearmem);`	Allocate Memory
`dsp_check_service_request (devn);`	Determine if device is requesting service
`dsp_findmem(devn,memname,map);`	Get map index for memory prefix
`dsp_findreg (devn,regname,pval,rval);`	Get peripheral and register index
`dsp_fmem (devn,map,addr,blocksz,val);`	Fill memory block with a value
`dsp_free(devn);`	Free memory allocated for a DSP device
`dsp_free_mem(cp);`	Free memory block
`dsp_go(devn);`	Initiate program execution
`dsp_go_address(devn, addr);`	Initiate program execution from addr
`dsp_go_reset(devn);`	Initiate program execution after reset

Table 14-6. dsp_—ADS Interface Routines

Routine	Description
`dsp_init(devn);`	Initialize selected device
`dsp_ldmem(devn,filename);`	Load device memory from filename
`dsp_load(filename);`	Load all device states from filename
`dsp_new(devn,device_type);`	Create new DSP device
`dsp_path (path,base,suffix,new_name);`	Create filename from path, base and suffix
`dsp_realloc(mem_blk, nbytes);`	Reallocate memory block
`dsp_reset(devn);`	Reset specified DSP device
`dsp_rmem (devn,map,addr,mem_val);`	Read DSP memory map addr to mem_val
`dsp_rmem_blk (devn,map,addr,count,value);`	Read Block of DSP Memory Locations
`dsp_rreg (devn,periphn,regn,regval);`	Read DSP peripheral register to regval
`dsp_save(filename);`	Save the state of all devices to filename
`dsp_spath(base, sufx, retn);`	Search path for specified file
`dsp_startup();`	Initialize emulator structures
`dsp_status(devn, mode);`	Determine DSP Device Status
`dsp_step(devn, step);`	Execute counted instructions
`dsp_stop(devn);`	Force DSP device into Debug Mode
`dsp_unlock (device_type,password);`	Unlock password protected device type
`dsp_wmem(devn,map,addr,val);`	Write DSP memory map addr with val
`dsp_wmem_blk (devn,map,addr,count,value;`	Write DSP Memory Block
`dsp_wreg (devn,periphn,regn,regval);`	Write DSP peripheral register with regval

14.1.2.7 User Interface Routines

Table 14-7 lists user interface routines:

Table 14-7. sim_—User Interface Routines

Routine	Description
`sim_docmd(devn,command_string);`	Perform emulator command on DSP device
`sim_gmcmd(devn,command_string);`	Get Command String from Macro File
`sim_gtcmd(devn,command_string);`	Get Command String from Terminal

14.2 Library Function Descriptions

The following sections defines and describes each library function.

14.2.1 ads_cache_registers—Cache OnCE and Core Registers

```
#include "simcom.h"
#include “protocom.h”
int ads_cache_registers(device_index)
int device;/* device affected by command */
```

`ads_cache_registers()` caches all OnCE and core registers on the target device `device_index` to ensure the integrity of values returned by `dsp_rreg().`

This routine must always be called before calling `dsp_rreg()` each time the device returns to debug mode. If it is not called, the values returned by `dsp_rreg()` may be unreliable.

The return value is `TRUE` on successful completion, `FALSE` otherwise. See Example 14-1.

Example 14-1. ads_cache_registers()

```
/* cache registers */
#include “simcom.h”
#include "protocom.h"

int devn = 0;
int periphnum_pc, regnum_pc;
unsigned long pc_value;
int status;

/* Find register reference numbers */
status=dsp_findreg(devn,"pc”,&periphnum_pc,&regnum_pc)
status=dsp_check_service_request(devn)
/* Is device requesting service? */
ckerr(status);
if (status)
/* Yes, so... */
{
status=ads_cache_registers(devn);/* cache the registers */
/* get pc addr for service request */
status=dsp_rreg(devn,periphnum_pc,regnum_pc,&pc_value);
}
```

14.2.2 ads_startup—Initialize ADS Database and Driver

```
#include “simcom.h”
#include “protocom.h”
int ads_startup(devp, devtype)
char *devp;/* device driver name (UNIX) or board address (PC) */
int devtype;/* Device family */
```

ads_startup() initializes the device driver and allocates certain ADS data structures. devp points to a character string containing the name of the device driver on UNIX™ systems, or the board address on PC systems (DOS or WINDOWS). devtype indicates which family of DSP devices is being used.

ads_startup() must be called before calling dsp_startup().

Valid values for devtype are:

- ADSP56000
- ADSP56300
- ADSP96000

The function return value is TRUE on successful completion, FALSE otherwise. See Example 14-2.

Example 14-2. `ads_startup()`

```
/* Initialize ADS software (PC)*/
#include “simcom.h”
#include “protocom.h”

int status;

status=ads_startup(“100”, ADSP56000);

/* Initialize ADS software (UNIX™)*/
#include “simcom.h”
#include “protocom.h”

int status;

status=ads_startup(“/dev/mdsp0”, ADSP56000);
```

14.2.3 `dspd_break`—Force Running DSP into Debug Mode

```
#include “cc.h”
#include “simcom.h”
#include “driver.h”
int dspd_break(device_index, command)
int device_index;/* DSP device to be affected by command */
int command;/* command to be sent to DSP device */
```

`dspd_break()` forces the target device `device_index` into debug mode, using the method specified by the parameter `command`.

Valid values for `command` are:

- `DSP_JTAG_BREAK`—used for devices with JTAG port
- `DSP_ONCE_BREAK`—used for devices with OnCE port

The function returns `DSP_OK` if the operation succeeds, `DSP_ERROR` otherwise. See Example 14-3.

Example 14-3. dspd_break()

```
/* Force DSP into debug mode */
#include "cc.h"
#include "simcom.h"
#include "driver.h"

int devn;
int break_status;

devn=0;
dsp_new(devn,"56002");/* Allocate structure for device 0, a 56002
*/

.....

break_status=dspd_break(devn,DSP_ONCE_BREAK)/* Force device into
DEBUG mode */
```

14.2.4 dspd_cc_architecture—Initialize Command Converter for DSP Family

```
#include "driver.h"
int dspd_cc_architecture(device_index, device_type)
int device_index;/* DSP device affected by command */
int device_type;/* Type of DSP device */
```

This function initializes the Command Converter device_index for the target architecture specified by device_type. The device attached to the Command Converter may be any member of the specified DSP family. See Example 14-4.

Valid values for device_type are:

- DSP_CC_56000
- DSP_CC_56300
- DSP_CC_96000

Example 14-4. dspd_cc_architecture()

```
/* Initialize Command Converter for device 0, a 56002 */

#include "driver.h"

int devn, status;

devn=0;

status=dspd_cc_architecture(devn,DSP_CC_56000);/* setup CC for 56K
family */

dsp_new(devn,"56002");/* Allocate structure for device 0, a 56002 */
```

14.2.5 dspd_cc_read_flag—Read Command Converter Flag Word

```
#include "cc.h"
#include "simcom.h"
#include "driver.h"
int dspd_cc_read_flag(device_index, flag, value)
int device_index;/* Command Converter affected by command */
int flag;/* Specify flag to read */
unsigned long *value;/* Location to receive flag value */
```

`dspd_cc_read_flag()` reads flag word `flag` from Command Converter `device_index`, storing the value obtained in the location pointed to by `value`.

Valid values for `flag` are:

- DSP_CC_FLAGS
- DSP_CC_STATUS
- DSP_CC_XPTR
- DSP_CC_YPTR
- DSP_CC_DEVICE_ADDRESS
- DSP_CC_CLOCK_RATE
- DSP_CC_DEVICE_COUNT
- DSP_CC_DEVICE_ACTIVE

The function returns DSP_OK on success, DSP_ERROR otherwise. See Example 14-5.

Example 14-5. dspd_cc_read_flag()

```
/* Read Command Converter flag word */
#include "cc.h"
#include "simcom.h"
#include "driver.h"

int status, flag_value, devn;

devn=0;

status=dspd_cc_read_flag(devn, DSP_CC_XPTR, &flag_value);
```

14.2.6 dspd_cc_read_memory—Read from Command Converter Memory

```
#include "simcom.h"
#include "driver.h"
#include "cc.h"
int dspd_read_memory(device_index, mem_space, address, count, value)
int device_index;/* Command Converter affected by command */
int mem_space;/* Memory space to read */
unsigned long address;/* Address of first location to read */
unsigned long count;/* Number of locations to read */
unsigned long *value;/* Address of buffer to receive read values */
```

dspd_cc_read_memory() reads a block of memory starting at address address, length count, in memory space mem_space on Command Converter device_index. The values read are stored in the buffer pointed to by value.

Valid values for mem_space are:

- DSP_CC_PMEM
- DSP_CC_XMEM
- DSP_CC_YMEM

The return value is DSP_OK for success, DSP_ERROR if the transaction fails. See Example 14-6.

Example 14-6. dspd_cc_read_memory()

```
/* Read memory block from Command Converter*/
#include "simcom.h"
#include "driver.h"
#include "cc.h"

int devn, status;
unsigned long read_addr, read_len;
unsigned long *read_buf;

devn=0;

read_buf = (unsigned long *)dsp_alloc(100*sizeof(unsigned long));
read_addr=0x0400l;
read_len=100l;

status=dspd_cc_read_memory(devn,DSP_CC_PMEM,read_addr,read_len,read_bu
f);
```

14.2.7 dspd_cc_reset—Reset Command Converter

```
#include "simcom.h"
#include "driver.h"
int dspd_cc_reset(device_index)
int device_index;
```

`dspd_cc_reset()` resets the Command Converter `device_index`.

The return value is `DSP_OK` for success, `DSP_ERROR` if the reset fails. See Example 14-7.

Example 14-7. dspd_cc_reset()

```
/* Reset Command Converter */
#include "simcom.h"
#include "driver.h"

int devn, status;


devn=0;

status=dspd_cc_reset(devn);
```

14.2.8 dspd_cc_revision—Read Command Convertor Revision Number

```
#include "simcom.h"
#include "driver.h"
int dspd_cc_revision(device_index, revstring)
int device_index;/* Command Converter affected by command */
char *revstring;/* pointer to buffer to receive revision number string
*/
```

`dspd_cc_revision()` returns a text string containing the version number of the monitor for Command Converter `device_index` in the buffer pointed to by `revstring`.

The message is created with the format:

```
    "Command Converter monitor revision {%4.2f}"
```

The return value is `DSP_OK` for success, `DSP_ERROR` if the reset fails. See Example 14-8.

Example 14-8. `dspd_cc_revision()`

```
/* Read CC monitor revision number */
#include "simcom.h"
#include "driver.h"

int devn, status;
char *rev_buf;

devn=0;

rev_buf = (unsigned long *)dsp_alloc(100*sizeof(char));

status=dspd_cc_revision(devn,rev_buf);
```

14.2.9 `dspd_cc_write_flag`—Write Command Converter Flag Word

```
#include "cc.h"
#include "simcom.h"
#include "driver.h"
int dspd_cc_write_flag(device_index, flag, value)
int device_index;
int flag;
unsigned long value;
```

`dspd_cc_write_flag()` writes to flag word `flag` on Command Converter `device_index`, fetching the value from the location pointed to by `value`.

Valid values for `flag` are:

- DSP_CC_FLAGS
- DSP_CC_STATUS
- DSP_CC_XPTR
- DSP_CC_YPTR
- DSP_CC_DEVICE_ADDRESS
- DSP_CC_CLOCK_RATE
- DSP_CC_DEVICE_COUNT
- DSP_CC_DEVICE_ACTIVE

The function returns `DSP_OK` on success, `DSP_ERROR` otherwise. See Example 14-9.

Example 14-9. `dspd_cc_write_flag()`

```
/* Write Command Converter flags */
#include "cc.h"
#include "simcom.h"
#include "driver.h"

int devn, status;

devn=0;

status=dspd_cc_write_flags(devn,DSP_CC_YPTR,0x0400l);
```

14.2.10 `dspd_cc_write_memory`—Write to Command Converter Memory

```
#include "simcom.h"
#include "driver.h"
#include "cc.h"
int dspd_write_memory(device_index, mem_space, address, count, value)
int device_index;/* Command Converter affected by command */
int mem_space;/* Memory space to write */
unsigned long address;/* Address of first location to write */
unsigned long count;/* Number of locations to write */
unsigned long *value;/* Address of buffer of values to write */
```

`dspd_cc_write_memory()` writes a block of memory starting at address `address`, length `count`, in memory space `mem_space` on Command Converter `device_index`. The values read are retrieved from the buffer pointed to by `value`.

Valid values for `mem_space` are:

- `DSP_CC_PMEM`—program memory
- `DSP_CC_XMEM`—X data memory
- `DSP_CC_YMEM`—Y data memory

The return value is `DSP_OK` for success, `DSP_ERROR` if the transaction fails. See Example 14-10.

Example 14-10. `dspd_cc_write_memory()`

```
/* Write memory block to Command Converter*/
#include "simcom.h"
#include "driver.h"
#include "cc.h"

int devn, status;
unsigned long write_addr, write_len;
unsigned long *write_buf;

devn=0;

write_buf = (unsigned long *)dsp_alloc(100*sizeof(unsigned long));

get_values_in(write_buf, 100l)/* fetch values to write... */

write_addr=0x0400l;
write_len=100l;

status=dspd_cc_write_memory(devn,DSP_CC_PMEM,write_addr,write_len,writ
e_buf);
```

14.2.11 `dspd_check_service_request`—Check for Service Request

```
#include "simcom.h"
#include "driver.h"
int dspd_check_service_request(device_index)
int device_index;/* DSP index affected by command */
```

`dspd_check_service_request()` checks to see if the target device `device_index` is requesting service from the host computer

The return value is `TRUE` if the device is requesting service, `FALSE` if it is not requesting service, and `DSP_ERROR` if the function cannot complete successfully. See Example 14-11.

Example 14-11. dspd_check_service_request()

```
/* Check to see if a DSP device is requesting service */
#include "simcom.h"
#include "driver.h"

int devn;
int status;

devn=0;
dsp_new(devn,"56002");/* Allocate structure for device 0, a 56002 */

.....
/* wait for device to request service */
while ((status=dspd_check_service_request(devn))==FALSE);

if (status==DSP_ERROR)
   return(DSP_ERROR);

/* device requested service. Now find out why..... */
```

14.2.12 dspd_fill_memory—Initialize DSP Memory Buffer to Single Value

```
#include "simcom.h"
#include "driver.h"
int dsp_fill_memory(device_index,mem_space,address,count,value)
int device_index;/* index of DSP device affected by command */
int mem_space;/* memory space to fill */
unsigned long address;/* address of start of memory block */
unsigned long count;/* length of memory block */
unsigned long value;/* fill value */
```

`dspd_fill_memory()` initializes a block of memory on the specified DSP device `device_index` to the specified value. `count` locations starting at `address` are filled with `value`.

Valid values for `mem_space` are:

- `P_MEM`—program memory
- `X_MEM`—X data memory
- `Y_MEM`—Y data memory

The return value is `DSP_OK` for success, `DSP_ERROR` if the transaction fails. See Example 14-12.

Example 14-12. `dspd_fill_memory()`

```
/* clear P memory on DSP device 1 */
#include "simcom.h"
#include "driver.h"

int devn;
int status;

devn=0;
dsp_new(devn,"56002");/* Allocate structure for device 0, a 56002 */
/* init buffer to ’no value’ */
status=dsp_fill_memory(devn,X_MEM,0x0100l,0x144l,0xffffffl)
```

14.2.13 dspd_go—Begin Execution on Target DSP Device

```
#include "simcom.h"
#include "driver.h"
int dspd_go(device_index, opcode, operand)
int device_index;/* Index of DSP device affected by command */
unsigned long opcode;/* values to load into pipeline */
unsigned long operand;/* before starting program execution */
```

`dspd_go()` is called to start program execution on the target device `device_index`.

The target device’s pipeline is loaded with the parameters `opcode` and `operand`, and the device is forced to start executing.

The values loaded into the pipeline via `opcode` and `operand` should be the values saved from the pipeline when the device entered debug mode; if execution is required to continue from a specific address, the values loaded should form a long jump instruction to the required execution start address:

`opcode`:opcode for long jump to required execution start address.
Symbolic names are defined for JUMP opcodes for the device
families in simcom.h.

`operand`:address of long jump target (execution start address)

The function returns `DSP_OK` on successful completion, `DSP_ERROR` otherwise. See Example 14-13.

Example 14-13. `dspd_go()`

```
/* Start execution from address 0x1000 */
#include "simcom.h"
#include "protocom.h"
#include "driver.h"

int err, status, devn;

devn=0;

err=dsp_load("lunchbrk.adm");/* reload devices and program data */

status=dspd_go(devn, DSP_LONGJUMP_56K, 0x1000l); /* & execute from
0x1000 */
```

14.2.14 `dspd_jtag_reset`—Reset JTAG Communications

```
#include "simcom.h"
#include "driver.h"
int dspd_jtag_reset(device_index, reset_type)
int device_index;/* device affected by command */
int reset_type;/* type of reset to perform */
```

`dspd_jtag_reset()` resets the JTAG TAP controller for the device `device_index`.

`reset_type` may be set to:

- `DSP_JTAG_RESET_HARDWARE`—Force reset by asserting trst pin on JTAG port
- `DSP_JTAG_RESET_SOFTWARE`—Force reset by toggling tms pin on JTAG port until the JTAG TAP controller state machine returns to its reset state.

The function returns `DSP_OK` if the operation succeeds, `DSP_ERROR` otherwise. See Example 14-14.

Example 14-14. `dspd_jtag_reset()`

```
/* reset JTAG communications with */
#include "simcom.h"
#include "driver.h"

int devn;
int status;

devn=0;
dsp_new(devn,"96002");/* Allocate structure for device 0, a 96002 */

status=dspd_jtag_reset(devn, DSP_JTAG_RESET_HARDWARE)
```

14.2.15 dspd_read_core_registers—Read Core Registers from DSP Device

```
#include "adsreg56.h"
#include "simcom.h"
#include "driver.h"
int dspd_read_core_registers(device_index, reg_num, count, value)
int device_index;/* Index of DSP device affected by command */
int reg_num;/* First register to read */
unsigned long count;/* Number of registers to read */
unsigned long *value;/* Pointer to area to receive register values */
```

dspd_read_core_registers() reads count core registers starting at register reg_num for target device device_index, storing the values in the memory pointed to by value.

The order of the registers is specified in the header file adsregXX.h

Note: Calling order is important. dspd_read_once_registers() must be called before calling dspd_read_core_registers(). If the calling order is reversed, the values in the OnCE registers will have been altered.

Some registers, for example the a register, may be too large to be held in a single location. These registers are also defined as a number of smaller registers, a0, a1, and a2. Such registers require an element in the value array for the compound register, and one for each of its component parts. The value returned for the compound register is undefined. Each of the component values is returned, and must be assembled by the calling program if the value of the compound register is required. The return value is DSP_OK if the operation succeeds, DSP_ERROR if it fails. See Example 14-15.

Example 14-15. dspd_read_core_registers()

```
/* Read core registers */
#include "adsreg56.h"
#include "simcom.h"
#include "driver.h"

int devn, status;
unsigned long count_once, buf_once[15], count_core,
buf_core[ADSCOREMAX];
devn=0;
dsp_new(devn,"56002");/* Allocate structure for device 0, a 56002 */
count_once=15;/* all OnCE registers */
count_core = ADSCOREMAX;/* all core registers */
/* get OnCE first, then core */
status=dspd_read_once_registers(devn, OSCR, count_once, buf_once);
status=dspd_read_core_registers(devn, ADS_A, count_core, buf_core);
```

14.2.16 dspd_read_memory—Read Memory Block from DSP Device

```
#include "simcom.h"
#include "driver.h"
int dspd_read_memory(device_index, mem_space, address, count, value)
int device_index;/* Index of DSP device affected by command */
int mem_space;/* Memory space to read */
unsigned long address;/* Address of first location to read */
unsigned long count;/* Number of locations to read */
unsigned long *value;/* Pointer to area to receive memory values */
```

dspd_read_memory() reads count words of memory from the DSP device in memory space mem_space starting at address address, and stores them in the memory pointed to by value.

Valid values for mem_space are:

- P_MEM—program memory
- X_MEM—X data memory
- Y_MEM—Y data memory

The return value is set to DSP_OK if the operation succeeds, DSP_ERROR if it fails. See Example 14-16

Example 14-16. dspd_read_memory()

```
/* Read DSP memory block */
#include "simcom.h"
#include "driver.h"

int devn, status;
unsigned long x_mem_buf[0x100];

devn=0;
dsp_new(devn,"56002");/* Allocate structure for device 0, a 56002 */

.....
/* Read back work buffer */
status = dspd_read_memory(devn, X_MEM, 0x0000l, 0x0100l, x_mem_buf)
```

14.2.17 dspd_read_once_registers—Read OnCE Registers from DSP Device

```
#include "adsreg56.h"
#include "simcom.h"
#include "driver.h"
int dspd_read_once_registers(device_index, reg_num, count, value)
int device_index;/* Index of DSP device affected by command */
int reg_num;/* First once register to read */
unsigned long count;/* Number of registers to read */
unsigned long *value;/* Pointer to area to receive register values */
```

`dspd_read_once_registers()` reads `count` OnCE registers starting from register `reg_num` from target device `device_index` and stores the values in the memory pointed to by `value`.

The order of the registers is specified in the header file adsregXX.h.

Note: Calling order is important. `dspd_read_once_registers` must be called before calling `dspd_read_core_registers`. If the calling order is reversed, the values in the OnCE registers will have been altered.

The function returns `DSP_OK` on success, `DSP_ERROR` otherwise. See Example 14-17.

Example 14-17. dspd_read_once_registers()

```
/* Read once registers */
#include "adsreg56.h"
#include "simcom.h"
#include "driver.h"

int devn, status;
unsigned long count_once, buf_once[15], count_core,
buf_core[ADSCOREMAX];

devn=0;
dsp_new(devn,"56002");/* Allocate structure for device 0, a 56002 */

count_once=15;
count_core = ADSCOREMAX;

status=dspd_read_once_registers(devn, OSCR, count_once, buf_once);
status=dspd_read_core_registers(devn, ADS_A, count_core, buf_core);
```

14.2.18 dspd_reset—Reset DSP Device to Debug or User Mode

```
#include "simcom.h"
#include "driver.h"
int dspd_reset(device_index, reset_mode)
int device_index;/* Index of affected DSP device */
int reset_mode;/* type of reset to perform */
```

`dspd_reset()` resets the target device `device_index`. The device may be reset into debug mode or user mode, based on the value of `reset_mode`.

Valid values for `reset_mode` are:

- `DSP_RESET_DEBUG`—reset device into debug mode
- `DSP_RESET_USER`—reset device into user mode

The function returns `DSP_OK` on success, `DSP_ERROR` otherwise. See Example 14-18.

Example 14-18. `dspd_reset()`

```
/* Place DSP device 3 into debug mode */
#include "simcom.h"
#include "driver.h"

int devn, status;

devn=0;
dsp_new(devn,"56002");/* Allocate structure for device 0, a 56002 */


status = dspd_reset(devn, DSP_RESET_DEBUG);/* Reset device into DEBUG
mode */
```

14.2.19 dspd_status—Determine DSP Status

```
#include "driver.h"
#include "simcom.h"
int dspd_status(device_index, mode)
int device_index;/* DSP device affected by command */
int *mode;/* address of buffer to receive device status */
```

`dspd_status()` places the execution status of the target device device_index in the int pointed to by mode.

Valid values for *mode are:

- `DSP_USER_MODE`—device is executing a user program
- `DSP_DEBUG_MODE`—device is in debug mode

The function returns `TRUE` on success, or `FALSE` otherwise. See Example 14-19.

Example 14-19. `dspd_status()`

```
/* determine status of DSP 0 */
#include "driver.h"
#include "simcom.h"

int devn, status;
int device_mode;

devn=0;
dsp_new(devn,"56002");/* Allocate structure for device 0, a 56002 */


status = dspd_status(devn, &device_mode);/* get device status */
```

14.2.20 `dspd_write_core_registers`—Write Core Registers to DSP Device

```
#include "adsreg56.h"
#include "simcom.h"
#include "driver.h"
int dspd_write_core_registers(device_index, reg_num, count, value)
int device_index;/* Index of DSP device affected by command */
int reg_num;/* First once register to write */
unsigned long count;/* Number of register words to write */
unsigned long *value;/* Pointer to area holding register values */
```

`dspd_write_core_registers()` writes `count` core registers starting at `reg_num` to target device `device_index`. The values written are taken from the memory pointed to by `value`.

The order of the registers is specified in the header file adsregXX.h

Some registers, for example the `a` register, may be considered to be an entity in its own right, or a number of smaller registers, that is `a0`, `a1`,and `a2`. Such registers require an element in the value array for the compound register, and one for each of its component parts. The value for the compound register is ignored. Each of the component values is loaded, thereby changing the value of the compound register.

The function returns `DSP_OK` on success, `DSP_ERROR` otherwise. See Example 14-20.

Example 14-20. `dspd_write_core_registers()`

```
/* Write core registers */
#include "adsreg56.h"
#include "simcom.h"
#include "driver.h"

int devn, status;
unsigned long core_reg_values[15];

devn=0;
dsp_new(devn,"56002");/* Allocate structures for device 0, a 56002 */
.
.
./* write all core registers from buffer */
status=dspd_write_core_registers(devn, ADS_A, 15l, core_reg_values)
```

14.2.21 `dspd_write_memory`—Write to Memory in DSP Device

```
#include "simcom.h"
#include "driver.h"
int dspd_write_memory(device_index, mem_space, address, count, value)
int device_index;/* Index of DSP device affected by command */
int mem_space;/* Memory space to write */
unsigned long address;/* Address of first location to write */
unsigned long count;/* Number of locations to write */
unsigned long *value;/* Pointer to area holding memory values */
```

`dspd_write_memory()` writes `count` words of memory in the DSP device. The values are taken from the buffer pointed to by `value`.

Valid values for `mem_space` are:

- `P_MEM`—program memory
- `X_MEM`—X data memory
- `Y_MEM`—Y data memory

The return value is set to `DSP_OK` if the operation succeeds, `DSP_ERROR` if it fails. See Example 14-21.

Example 14-21. `dspd_write_memory()`

```
/* Write DSP memory block */
#include "simcom.h"
#include "driver.h"

int devn, status;
unsigned long x_mem_buf[0x100];

devn=0;
dsp_new(devn,"56002");/* Allocate structure for device 0, a 56002 */

status = dspd_write_memory(devn, X_MEM, 0x0400l, 0x0100l,
&x_mem_buf[0])
```

14.2.22 `dspd_write_once_registers`—Write OnCE Registers to DSP Device

```
#include "adsreg56.h"
#include "simcom.h"
#include "driver.h"
int dspd_write_once_registers(device_index, reg_num, count, value)
int device_index;/* Index of DSP device affected by command */
int reg_num;/* First once register to write */
unsigned long count;/* Number of registers to write */
unsigned long *value;/* Pointer to area holding register values */
```

`dspd_write_once_registers()` writes `count` OnCE registers starting at register `reg_num` to the target device `device_index`. The values written are taken from the memory pointed to by `value`.

The order of the registers is specified in the header file adsregXX.h.

The function returns `DSP_OK` on success, `DSP_ERROR` otherwise. See Example 14-22.

Example 14-22. `dspd_write_once_registers()`

```
/* Write once registers */
#include "adsreg56.h"
#include "simcom.h"
#include "driver.h"

int devn, status;
unsigned long once_reg_values [15];

devn=0;
dsp_new(devn,"56002");/* Allocate structure for device 0, a 56002 */
.
.
./* write all OnCE registers from buffer */
status=dspd_write_once_registers(devn, OSCR, 15l, once_reg_values)
```

14.2.23 dspt_masm_xxxxx—Assemble DSP Mnemonic

```
#include "proto56n.h"/* n= k,1,3,8 */
#include "proto96k.h"
int dspt_masm_xxxxx(mnemonic,ops,error_ptr)
char *mnemonic;/* Pointer to assembler mnemonic string */
unsigned long *ops;/* Array for words of assembled code */
char **error_ptr;/* Will point to message if an error occurs */
```

`dspt_masm_xxxxx()` invokes the single line assembler to assemble a DSP mnemonic. It returns one of the following integer codes:

- –1 An error occurred. The user supplied error pointer `error_ptr` will point to a message that explains the error.
- 0 The line mnemonic provided was a comment
- 1 The mnemonic assembled correctly and required 1 word of code. The code will be in the `ops[0]` location.
- 2 The mnemonic assembled correctly and required 2 words of code. The first word will be placed in `ops[0]`, the second in `ops[1]`.
- 3 The mnemonic assembled correctly and required 3 words of code. The first word will be placed in `ops[0]`, the second in `ops[1]`, the third in `ops[2]`.

Note: The xxxxx in the function name should be replaced by a device family number. It should be 56k for the 56000 family devices, 56n00 for the 56n00 family devices and 96k for the 96000 family devices. See Example 14-23.

Example 14-23. dspt_masm_xxxxx()

```
/* Assemble the instruction "move r0,r1" */
#include "proto56k.h"

unsigned long opcodes[3];
char *error_ptr;
int retval;

retval=dspt_masm_56k("move r0,r1",&opcodes[0],&error_ptr);
```

14.2.24 dspt_unasm_xxxxx—Disassemble DSP Mnemonics

```
#include "proto56n.h"/* n= k,1,3,8 */
#include "proto96k.h"
int dspt_unasm_xxxxx(ops,return_string,sr,omr,gdbp)
unsigned long *ops;/* Pointer to opcodes to be disassembled */
char *return_string;/* Pointer to return character buffer */
unsigned long sr;/* Value of device status register */
unsigned long omr;/* Value of device operating mode register */
char *gdbp;/* Return value reserved for use by debugger*/
```

dspt_unasm_xxxxx() disassembles ops[0] (and possibly ops[1] and ops[2] if ops [0] requires a second or third word) and places the disassembled mnemonic in the return_string buffer supplied by the user. If correct disassembly requires a device status register and/or operating mode register value, the values should be provided in the sr and omr parameters. The gdbp parameter is a pointer reserved for use by the symbolic debugger; it should be NULL for other applications.

The mnemonic may require as many as 120 characters of return buffer. The function returns the number (1 to 3) of words consumed by the disassembly. It returns 0 for illegal opcodes and a return string containing a DC directive.

Note: The xxxxx in the function name should be replaced by a device family number. It should be 56k for the 56000 family devices, 56n00 for the 56n00 family devices, and 96k for the 96000 family devices. See Example 14-24.

Example 14-24. dspt_unasm_xxxxx()

```
/* Disassembly of the opcode representing NOP */
#include "proto56n.h"

unsigned long ops[3];/*Instruction words to be disassembled.*/
char return_string[120];/*The return mnemonic goes here.*/
int numwords;/*Number of operands used by disassembler.*/
ops[0]=0L;
ops[1]=0L;
ops[2]=0L;
numwords=dspt_unasm_56k(ops,return_string,0L,0L,NULL);
/* Now numwords==1, return_string=="nop" */
```

14.2.25 dsp_alloc—Allocate Memory

The routines dsp_alloc, dsp_free_mem and dsp_realloc are replacements for the standard C functions malloc, free and realloc. They are used in much the same way as the standard functions, for allocating space for structures, buffers, etc. These functions are used in the debugger libraries; they must also be used exclusively in the user debugger code. Any attempt to use the standard routines will have unpredictable results.

```
#include "simcom.h"
#include "protocom.h"
void *dsp_alloc(nbytes,clearmem)
unsigned int nbytes;/* Number of bytes to allocate */
int clearmem;/* Clear allocated memory */
```

`dsp_alloc()` allocates the number of bytes of memory specified in `nbytes`. The memory block allocated is aligned for use as any data type. If `clearmem` is true (nonzero), the allocated memory is cleared to zero.

The address of the allocated buffer is returned as the return value, type `void*`.

If the requested memory cannot be allocated, the error message `"Insufficient memory: dsp_alloc"` is output, and the return value is the `NULL` pointer. See Example 14-25.

Example 14-25. `dsp_alloc()`

```
/* Allocate temporary buffer of 50 int. Buffer is cleared. */
#include "simcom.h"
#include "protocom.h"

int *tbptr

tbptr = (int *) dsp_alloc(50*sizeof(int), 1)
if (tbptr == NULL)
{...handle error...
```

14.2.26 `dsp_cc_fmem`—Fill Command Converter Memory with a Value

```
#include "simcom.h"
#include "protocom.h"
#include "cc.h"
#include "coreaddr.h"
int dsp_cc_fmem(device, mtype, address, count, value)
int device;/* Command Converter affected by command */
enum memory_map mtype;/* Memory space to fill */
unsigned long address;/* Address of start of memory block */
unsigned long count;/* Length of memory block */
unsigned long *value;/* Fill value */
```

`dsp_cc_fmem()` initializes a block of memory in the Command Converter device starting at address `address`, length `count`, in address space `mtype` with the value pointed to by `value`.

Valid values for `mtype` are:

- `DSP_CC_YMEM`
- `DSP_CC_XMEM`
- `DSP_CC_PMEM`

The return value is TRUE for success, FALSE otherwise. If the return value is FALSE, then some but not all of the specified locations may have been changed. See Example 14-26.

Example 14-26. dsp_cc_fmem()

```
/* Initialize CC statistics buffer */
#include "simcom.h"
#include "protocom.h"
#include "cc.h"
#include "coreaddr.h"

int devn, fill_value, status;

devn=0;
dsp_new(devn,"56002");/* Allocate structure for device 0, a 56002 */

fill_value=0;

dsp_cc_fmem(devn, DSP_CC_XMEM, 0xe410l, 0x20l, &fill_value)
```

14.2.27 dsp_cc_go—Start Command Converter Program Execution

```
#include "simcom.h"
#include "protocom.h"
int dspd_cc_go(device_index)
int device_index;
```

dsp_cc_go() starts the Command Converter for the target device device_index executing from the address indicated by the current program counter.

The return value is TRUE for success, FALSE otherwise. See Example 14-27.

Example 14-27. dsp_cc_go()

```
/* Start CC running */
#include "simcom.h"
#include "protocom.h"

int devn, status;

devn=0;
dsp_new(devn,"56002");/* Allocate structure for device 0, a 56002 */

status = dspd_cc_go(devn);/* Start Command Converter monitor */
```

14.2.28 dsp_cc_ldmem—Load Command Converter Memory from File

```
#include "simcom.h"
#include "protocom.h"
int dsp_cc_ldmem(device_index, loadfn)
int device_index;/* Command Converter affected by command */
char *loadfn;/* Name of file to be loaded */
```

`dsp_cc_ldmem()` loads memory in the Command Converter `device_index` from the file `loadfn`. This is a lower-level routine which does not call the user-level filename routines; `loadfn` must contain the fully-specified name of the file to be opened. The file is OMF format; the file extension should be .lod

The return value is `TRUE` on successful completion, `FALSE` otherwise. See Example 14-28.

Example 14-28. `dsp_cc_ldmem()`

```
/* Load Command Converter memory from file */
#include "simcom.h"
#include "protocom.h"

int devn, status;

devn=0;
dsp_new(devn,"56002");/* Allocate structure for device 0, a 56002 */

status = dsp_cc_ldmem(devn,"c:\dspdev\bin\loadfile.lod");
```

14.2.29 dsp_cc_reset—Reset Command Converter

```
#include "simcom.h"
#include "protocom.h"
int dsp_cc_reset(device)
int device;/* CC device affected by command */
```

`dsp_cc_reset()` resets the Command Converter `device`. Function `dspd_cc_architecture()` is called to configure the Command Converter for the type of DSP device attached.

This procedure may be called as part of the initialization procedures to guarantee the Command Converter is in a known state, to recover from a lockup, or at any other time when the Command Converter needs to be restarted.

The return value is `TRUE` if the operation succeeds, `FALSE` otherwise. See Example 14-29.

Example 14-29. dsp_cc_reset()

```
/* reset Command Converter */
#include "simcom.h"
#include "protocom.h"

int devn, status;

devn=0;
dsp_new(devn,"56002");/* Allocate structure for device 0, a 56002 */

status= dsp_cc_reset(devn);/* reset the Command Converter for device 0
*/
```

14.2.30 dsp_cc_revision—Read Command Converter Monitor Revision

```
#include "simcom.h"
#include "protocom.h"
int dspd_cc_revision(device_index, revstring)
int device_index;/* Command Converter affected by command */
char *revstring;/* receives CC monitor revision string */
```

`dsp_cc_revision()` interrogates the Command Converter `device_index` to determine the monitor revision, and returns a formatted string in `revstring` containing the monitor revision.

The format used to create the revstring is:

```
"Command Converter monitor revision {%4.2f}"
```

The return value is `TRUE` on successful completion, `FALSE` otherwise. See Example 14-30.

Example 14-30. dsp_cc_revision()

```
/* obtain Command Converter monitor revision number */
#include "simcom.h"
#include "protocom.h"

int devn, status;
char revision_string[80];

devn=0;
dsp_new(devn,"56002");/* Allocate structure for device 0, a 56002 */

status = dspd_cc_revision(devn, revision_string);
```

14.2.31 dsp_cc_rmem—Read Command Converter Memory

```
#include "simcom.h"
#include "protocom.h"
#include "cc.h"
#include "coreaddr.h"
int dsp_cc_rmem(device, mtype, address, value)
int device;/* Command Converter affected by command */
enum memory_map mtype;/* Memory space to read */
unsigned long address;/* Address of location to read */
unsigned long *value;/* Target location for read value */
```

`dsp_cc_rmem()` reads one location from the Command Converter `device`, memory space `mtype`, address `address`, and stores the value in the location pointed to by `value`.

Valid values for mtype are:

- `DSP_CC_YMEM`
- `DSP_CC_XMEM`
- `DSP_CC_PMEM`

The return value is `TRUE` on successful completion, `FALSE` otherwise. See Example 14-31.

Example 14-31. dsp_cc_rmem()

```
/* Read location from Command Converter memory */
#include "simcom.h"
#include "protocom.h"
#include "cc.h"
#include "coreaddr.h"

int devn, status;
enum memory_map read_memtyp,/* memory space to read */
unsigned long read_address,/* address of location to read */
              read_store;/* location to hold read value */

devn=0;
dsp_new(devn,"56002");/* Allocate structure for device 0, a 56002 */

read_memtyp = DSP_CC_XMEM;/* set memory space for read */
read_address=0x0040l;/* set read address */
/* read required location */
status = dsp_cc_rmem(devn, read_memtyp, read_address, &read_store);
```

14.2.32 dsp_cc_rmem_blk—Read Command Converter Memory Block

```
#include "simcom.h"
#include "protocom.h"
#include "cc.h"
#include "coreaddr.h"
int dsp_cc_rmem_blk(device, mtype, address, count, value)
int device;/* Command Converter affected by command */
enum memory_map mtype;/* Memory space to read */
unsigned long address;/* Address of location to read */
unsigned long count/* number of locations to read */
unsigned long *value;/* Target location for read value */
```

`dsp_cc_rmem_blk()` reads `count` locations from the target Command Converter `device`, memory space `mtype`, address `address`, and stores the values in the buffer pointed to by `value`.

Valid values for mtype are: `DSP_CC_YMEM`, `DSP_CC_XMEM`, and `DSP_CC_PMEM.`

The return value is `TRUE` on successful completion, `FALSE` otherwise. See Example 14-32.

Example 14-32. `dsp_cc_rmem_blk()`

```
/* Read memory block from Command Converter memory */
#include "simcom.h"
#include "protocom.h"
#include "cc.h"
#include "coreaddr.h"

int devn, status;

enum memory_map read_memtyp;/* memory space to read */
unsigned long read_address,/* address of first location to read */
              read_length,/* number of locations to read */
              read_store[1024];/* buffer to hold read values */
devn=0; /* set device number */
dsp_new(devn,"56002");/* Allocate structure for device 0, a 56002 */

read_memtyp = DSP_CC_XMEM;/* set memory space */
read_addr=0x0040l;/* start address */
read_length=55l;/* and block length */
/* now read the memory block into read_store */
status = dsp_cc_rmem_blk(devn, read_memtyp, read_addr, read_length,
read_store);
```

14.2.33 dsp_cc_wmem—Write Command Converter Memory

```
#include "simcom.h"
#include "protocom.h"
#include "cc.h"
#include "coreaddr.h"
int dsp_cc_wmem(device, mtype, address, value)
int device;/* Command Converter affected by command */
enum memory_map mtype;/* Memory space to write */
unsigned long address;/* Address of location to write */
unsigned long *value;/* Source location for value to write */
```

`dsp_cc_wmem()` writes one location in the Command Converter `device`, memory space `mtype`, address `address`, using the value in the location pointed to by `value`.

Valid values for `mtype` are:

- DSP_CC_YMEM
- DSP_CC_XMEM
- DSP_CC_PMEM

The return value is `TRUE` on successful completion, `FALSE` otherwise. See Example 14-33.

Example 14-33. dsp_cc_wmem()

```
/* Write to a location in Command Converter memory */
#include "simcom.h"
#include "protocom.h"
#include "cc.h"
#include "coreaddr.h"

int devn, status;
enum memory_map write_memtyp,/* memory space to write */
unsigned long write_address,/* address of location to write */
              write_store;/* location to hold value to write */

devn=0;
dsp_new(devn,"56002");/* Allocate structure for device 0, a 56002 */

write_memtyp = DSP_CC_XMEM;/* set memory space for write */
write_address=0x0040l;/* set write address */
/* write required location */
status = dsp_cc_wmem(devn, write_memtyp, write_address, &write_store);
```

14.2.34 dsp_cc_wmem_blk—Write Command Converter Memory Block

```
#include "protocom.h"
#include "cc.h"
#include "coreaddr.h"
int dsp_cc_wmem_blk(device, mtype, address, count, value)
int device;/* Command Converter affected by command */
enum memory_map mtype;/* Memory space to write */
unsigned long address;/* Address of location to write */
unsigned long count/* number of locations to write */
unsigned long *value;/* Source buffer for write values */
```

`dsp_cc_wmem_blk()` writes `count` locations in the Command Converter `device`, memory space `mtype`, address `address`, and obtaining the values from the buffer pointed to by `value`.

Valid values for mtype are: `DSP_CC_YMEM`, `DSP_CC_XMEM`, and `DSP_CC_PMEM`.

The return value is `TRUE` on successful completion, `FALSE` otherwise. See Example 14-34.

Example 14-34. `dsp_cc_wmem_blk()`

```
/* Write several locations from Command Converter memory */
#include "simcom.h"
#include "protocom.h"
#include "cc.h"
#include "coreaddr.h"

int devn, status;

enum memory_map write_memtyp;/* memory space to write */
unsigned long write_addr,/* address of first location to write */
              write_length,/* number of locations to write */
              write_store[1024];/* buffer holding values to write*/

devn=0; /* set device number */
dsp_new(devn,"56002");/* Allocate structure for device 0, a 56002 */

write_memtyp = DSP_CC_XMEM;/* set memory space */
write_addr=0x0040l;/* start address */
write_length=55l;/* and block length */
/* now write the memory block to device 0*/
status=dsp_cc_wmem_blk(devn, write_memtyp, write_addr, write_length,
write_store);
```

14.2.35 dsp_check_service_request—Check for Service Request

```
#include "simcom.h"
#include "protocom.h"
int dsp_check_service_request(device_index)
int device_index;/* device affected by operation */
```

`dsp_check_service_request()` checks to see if the target device `device_index` is requesting service from the host computer, that is, checks to see if the target device is in Debug Mode.

The return value is `TRUE` if the device is requesting service, `FALSE` if it is not, and `DSP_ERROR` if the function cannot complete successfully. See Example 14-35.

Example 14-35. dsp_check_service_request()

```
/* Check if device 0 is requesting service */
#include "simcom.h"
#include "protocom.h"

int devn = 0;
int ok;

dsp_new(devn,"56002");/* Allocate structure for device 0, a 56002 */

ok = dsp_cc_reset(devn);/* reset Command Converter */

ok = dsp_reset(devn);/* and device 0 to debug mode*/

ok = dsp_check_service_request(devn)/* Is device ’devn’ requesting
service? */
```

14.2.36 dsp_findmem—Get Map Index for Memory Prefix

```
#include "simcom.h"
#include "protocom.h"
#include "coreaddr.h"
dsp_findmem(device_index,memory_name,memory_map)
int device_index;     /* DSP device to be affected by command */
char *memory_name;/* memory space name */
enum memory_map *memory_map;/* return memory map type */
```

`dsp_findmem()` searches the `dt_var.mem` structure for device `device_index` for a match to the `memory_name` string provided in the function call. If a match is found, `dsp_findmem()`returns the memory map `maintype` structure value through the `memory_map` parameter and `1` as the function return value; otherwise it just returns `0` as the function return value.

For a list of memory names use the emulator help mem command. See Example 14-36

Example 14-36. dsp_findmem()

```
/* Get map index for memory space "P" */
#include "simcom.h"
#include "protocom.h"
#include "coreaddr.h"

int devn;
enum memory_map map;
int ok;

devn=0;
dsp_new(devn,"56002");/* Allocate structure for device 0, a 56002 */

ok=dsp_findmem(devn,"P",&map)/* Get memory map index for "P" memory */
```

14.2.37 dsp_findreg—Get Peripheral and Register Index

```
#include "simcom.h"
#include "protocom.h"
dsp_findreg(device_index,reg_name,periph_number,reg_number)
int device_index;     /* DSP device index to be affected by command */
char *reg_name;/* register name */
int *periph_number;/* return peripheral index */
int *reg_number;/* return register index */
```

`dsp_findreg()` searches the `dt_var.periph` structures for a match to the `reg_name` string provided in the function call. If a match is found, `dsp_findreg()` returns the peripheral index through `periph_number`, the register number through the `reg_number` parameter, and `1` as the function return value; otherwise it just returns `0` as the function return value.

You may also use the emulator "help reg" command to obtain a list of the valid `periph_num` and `reg_num` values, and `reg_val` size for each register. See Example 14-37.

Example 14-37. dsp_findreg()

```
/* Get peripheral index and register number for register ’n3’ */
#include "simcom.h"
#include "protocom.h"

int devn;
int regnum, pnum;
int ok;

devn=0;
dsp_new(devn,"56002");/* Allocate structure for device 0, a 56002 */

ok=dsp_findreg(devn,"n3",&pnum,&regnum);/* Get index for "n3" register
*/
```

14.2.38 dsp_fmem—Fill Memory Block with a Value

```
#include "simcom.h"
#include "protocom.h"
#include "coreaddr.h"
dsp_fmem(device_index,memory_map,address,block_size,value)
int device_index;/* DSP device to be affected by command */
enum memory_map memory_map;/* memory designator */
unsigned long address;/* DSP memory start address to write */
unsigned long block_size;/* Number of locations to write */
unsigned long *value;/* Pointer to value to write to memory location */
```

dsp_fmem() initializes a block of DSP memory with a single value.

The memory_map parameter is a memory type that selects the appropriate dt_memory structure from dt_var.mem for the selected device device_index. These structures are described in the simdev.h file which is included with the emulator. The memory_map parameter can be obtained with the function dsp_findmem() by using the memory name as a key. Use the emulator help mem command for a list of valid memory names. The memory_map enum is memory_map_ concatenated with a valid memory map name. As an example, memory_map_pa refers to off chip pa memory on the 96002 device.

If the selected memory map requires two word values, the least significant word should be at the value location and the most significant word at the value + 1 location. See Example 14-38.

Example 14-38. dsp_fmem()

```
/* Write 300 locations beginning at P:$200 with the value 4 */
#include "simcom.h"
#include "protocom.h"
#include "coreaddr.h"

int devn;
unsigned long address, memval, blocksize;

address=0x200L;
blocksize=300;
memval=4L;

devn=0;
dsp_new(devn,"56002");/* Allocate structure for device 0, a 56002 */

dsp_fmem(devn,memory_map_p,address,blocksize,&memval);
```

14.2.39 dsp_free—Free a Device Structure

```
#include "simcom.h"
#include "protocom.h"
dsp_free(device_index)
int device_index;     /* DSP device index to be affected by command */
```

dsp_free() frees all allocated memory associated with a device structure for device_index, and closes any open files associated with the device structure. See Example 14-39.

Example 14-39. dsp_free()

```
/* Create three new device structures, then get rid of device 2. */
#include "simcom.h"
#include "protocom.h"

ads_startup("100",ADSP56000);
dsp_startup();

dsp_new(0,"56002");/* Allocate structure for device 0, a 56002 */
dsp_new(1,"56002");/* Allocate structure for device 1, a 56002 */
dsp_new(2,"56002");/* Allocate structure for device 2, a 56002 */

dsp_free(1);/* Free structure for device 1 */
```

14.2.40 dsp_free_mem—Free Memory Block

The routines dsp_alloc, dsp_free_mem and dsp_realloc are replacements for the standard C functions malloc, free, and realloc. They are used in much the same way as the standard functions, for allocating space for structures, buffers, etc. These functions are used in the debugger libraries; they must also be used exclusively in the user debugger code. Any attempt to use the standard routines will have unpredictable results.

```
#include "simcom.h"
#include "protocom.h"
void dsp_free_mem(cp)
char *cp/* pointer to memory block to be freed */
```

dsp_free_mem() releases a memory block previously allocated with dsp_alloc(). Its argument cp is the address of the data block. See Example 14-40.

Example 14-40. `dsp_free_mem()`

```
/* Allocate and release memory block */
#include "simcom.h"
#include "protocom.h"

int *buffer;
int i;
buffer = (int *) dsp_alloc(sizeof(int)*10, 0)

/* Use the buffer */

for (i=0; i<10; i++)
   buffer[i]++;

/* And discard it */
dsp_free_mem((char*)buffer);
```

14.2.41 dsp_go—Initiate DSP Program Execution

```
#include "simcom.h"
#include "protocom.h"
int dsp_go(device_index)
int device_index;/* DSP device to start executing */
```

`dsp_go()` starts the target device `device_index` to begin executing, in real time, from the address specified by the current program counter.

The function returns `TRUE` on successful completion, `FALSE` otherwise. See Example 14-41.

Example 14-41. `dsp_go()`

```
/* start DSP 0 executing */
#include "simcom.h"
#include "protocom.h"

int devn, status;
char *load_fname="filter2.cld";

devn=0;
dsp_new(devn,"56002");/* Allocate structure for device 0, a 56002 */

status = dsp_ldmem(devn,load_fname);/* load program into memory */

status = dsp_go(devn);/* start program execution */
```

14.2.42 dsp_go_address—Initiate Program Execution from Address

```
#include "simcom.h"
#include "protocom.h"
dsp_go_address(device_index, address)
int device_index;/* DSP device affected by command */
unsigned long address;/* address from which to start executing */
```

`dsp_go_address()` causes the target device `device_index` to begin executing, in real time, from the address specified by `address`.

The function returns `TRUE` on success, `FALSE` otherwise. See Example 14-42.

Example 14-42. `dsp_go_address()`

```
/* Start execution from specified address */
#include "simcom.h"
#include "protocom.h"

int devn, status;
char *load_fname="filter2.cld";

devn=0;
dsp_new(devn,"56002");/* Allocate structure for device 0, a 56002 */

status=dsp_ldmem(devn,load_fname);/* load program into memory */

status=dsp_go_address(devn,0x1400l);/* start program execution */
```

14.2.43 dsp_go_reset—Initiate Program Execution after Device Reset

```
#include "simcom.h"
#include "protocom.h"
dsp_go_reset(device_index)
int device_index;/* DSP device affected by command */
```

`dsp_go_reset()` causes the target device specified by `device_index` to be reset into User Mode. Execution starts at the reset value for pc.

To place a device into debug mode, see `dsp_reset()`.

The function returns `TRUE` on success, `FALSE` otherwise. See Example 14-43.

Example 14-43. dsp_go_reset()

```
/* Initiate program execution by reset */
#include "simcom.h"
#include "protocom.h"

int devn, status;
char *load_fname="filter2.cld";

devn=0;
dsp_new(devn,"56002");/* Allocate structure for device 0, a 56002 */

status=dsp_ldmem(devn,load_fname);/* load program into memory */

status=dsp_go_reset(devn);/* start program execution after device reset
*/
```

14.2.44 dsp_init—Initialize a Single DSP Device Structure

```
#include "simcom.h"
#include "protocom.h"
dsp_init(device_index)
int device_index;     /* DSP device index to be affected by command */
```

dsp_init() initializes a device device_index to the same state that existed following the dsp_new() call which created it. It is equivalent to performing the emulator FORCE S command. All memory spaces are cleared, the registers are reset, breakpoints and input/output file assignments are cleared. See Example 14-44.

Example 14-44. dsp_init()

```
/* re-initialize a device */
#include "simcom.h"
#include "protocom.h"

dsp_new(0,"56002");/* Create new DSP structure */
.
.
.
dsp_init(0);/* Re-initialize device 0 */
```

14.2.45 dsp_ldmem—Load DSP Memory from OMF or COFF File

```
#include "simcom.h"
#include "protocom.h"
int dsp_ldmem(device_index,filename)
int device_index;/* DSP device index to be affected by command */
char *filename;/* Full pathname of OMF format file to be loaded */
```

dsp_ldmem() loads the memory space of a specified DSP device device_index from an object file filename. The file may be created as the output from the DSP Macro Assembler, or by using the Emulator save command; it may be either COFF format or

".lod" format. In order to specify a COFF format file, the filename suffix must be ".cld". A filename with any other suffix is assumed to be in ".lod" format.

This is a lower level function that does not invoke the user interface modules for pathname and automatic ".lod" suffix extension. The entire pathname must be specified.

The function returns 1 if the load is successful, 0 if an error occurred loading the file. See Example 14-45.

Example 14-45. dsp_ldmem()

```
/* Create DSP device structures for a three device emulation. */
#include "simcom.h"
#include "protocom.h"

int devn;
int err;

for (devn=0;devn<3;devn++)
  dsp_new(devn,"56002");/* Create new DSP structures */

/* Load device 1 with a program named filter2.lod.*/

err=dsp_ldmem(1,"c:\p42\bin\filter2.lod");
```

14.2.46 dsp_load—Load All DSP Structures from State File

```
#include "simcom.h"
#include "protocom.h"
int dsp_load(filename)
char *filename;/* Full name of State File to be loaded */
```

`dsp_load()` loads the emulator state of all devices from a specified emulator state file `filename`. It is not necessary to allocate the device structures prior to calling dsp_load. This function does not invoke the user interface modules for pathname and automatic ".adm" suffix extension; the entire filename must be specified.

dsp_load returns 1 if the load was successful, 0 if there was an error. See Example 14-46.

Example 14-46. dsp_load()

```
/* Load the emulator state from the file ’lunchbreak.adm’ */
#include "simcom.h"
#include "protocom.h"

int err;
ads_startup("100",ADSP56000);
dsp_startup();

err=dsp_load("lunchbrk.adm");
```

14.2.47 dsp_new—Create New DSP Device Structure

```
#include "simcom.h"
#include "protocom.h"
dsp_new(device_index,device_type)
int device_index;/* DSP device index to be affected by command */
char *device_type;/* Name corresponding to DSP device type */
```

`dsp_new()` creates a new DSP structure that represents a DSP device, `device_index`, and initializes it. It will be necessary to use the `dsp_unlock()` function call prior to `dsp_new()` if the selected `device_type` is password protected. See Example 14-47.

Example 14-47. dsp_new()

```
/* Create DSP device structures for a three device emulation. */
#include "simcom.h"
#include "protocom.h"

int devn;
ads_startup("100",ADSP56000);
dsp_startup();

for (devn=0;devn<3;devn++)
  dsp_new(devn,"56002");/* Create new DSP structures */
```

14.2.48 dsp_path—Construct Filename

```
#include "simcom.h"
#include "protocom.h"
dsp_path(path_name,base_name,suffix,new_name)
char *path_name;/* Directory pathname */
char *base_name;/* Base filename to be appended to path_name */
char *suffix;/* Suffix string to be appended to base_name */
char *new_name;/* Pointer to return buffer for constructed pathname */
```

`dsp_load()` constructs a fully-specified path and filename from the user-provided `path_name`, `base_name`, and `suffix`. The constructed filename is returned in `new_name`.

If `base_name` begins with a pathname separator or with a device designator, `path_name` will not be prefixed to `base_name`. If `base_name` already ends with `"."` and some filename extension, the string in `suffix` will not be appended. See Example 14-48.

Example 14-48. dsp_load()

```
/* Load file filter2.lod from the current working directory for device
0. */
#include "simcom.h"
#include "protocom.h"
#include "simdev.h"

extern struct dev_const dv_const;/* emulator device structures */
char newfn[80];

dsp_new(0,"56002");/* Create new DSP structure */

/* Create file name from: */
/* Path specified in device structure dv_const.sv[0]->pathwork */
/* created by "path..." command */
/* Base file name filter2 */
/* Filename suffix .lod. Note the "." is not explicitly specified.*/

dsp_path(dv_const.sv[0]->pathwork,"filter2","lod",newfn);

dsp_ldmem(0,newfn); /* Load file into DSP device 0 */
```

14.2.49 dsp_realloc—Reallocate Memory Block

The routines dsp_alloc, dsp_free_mem and dsp_realloc are replacements for the standard C functions malloc, free, and realloc. They are used in much the same way as the standard functions, for allocating space for structures, buffers, etc. These functions are used in the debugger libraries, and must also be used exclusively in the user debugger code. Any attempt to use the standard routines will have unpredictable results.

```
#include "simcom.h"
#include "protocom.h"
void *dsp_realloc(mem_blk, nbytes)
char *mem_blk;/* Address of existing allocated block */
unsigned int nbytes;/* Required size of memory block */
```

dsp_realloc() changes the size of a memory block mem_blk previously allocated with dsp_alloc() to the specified size nbytes. The address of the reallocated block may not be the same as the address of the original block. The contents of the original block are preserved— completely if the block size is increased, or appended to the end of the new block if the block size is reduced. If the requested block cannot be allocated, the original block is unchanged. See Example 14-49.

Example 14-49. dsp_realloc()

```
/* increase buffer size */
#include "simcom.h"
#include "protocom.h"

int status;
char *bufptr;

/* Allocate temporary buffer of 50 characters. Buffer is cleared. */

bufptr = (char *) dsp_alloc(50*sizeof(char), 1)
if (bufptr == NULL)
{...handle error...}

.
.
.

/* increase buffer size to 82 characters, preserving contents */

bufptr = (char *) dsp_realloc(bufptr, 82*sizeof(char))
```

14.2.50 dsp_reset—Reset Specified DSP Device

```
#include "simcom.h"
#include "protocom.h"
int dsp_reset(device_index)
int device_index;/* Index of affected DSP device */
```

`dsp_reset()` resets the target device `device_index` into Debug mode. To reset a device into User mode, see `dsp_go_reset()`.

The function returns `TRUE` on success, `FALSE` otherwise. See Example 14-50.

Example 14-50. dsp_reset()

```
/* Place DSP device 3 into debug mode */
#include "simcom.h"
#include "protocom.h"

int devn, status;


devn=3;

dsp_new(devn,"56002");/* Create new DSP structure */

/* ensure device in known state */
status = dsp_reset(devn);/* Reset device into DEBUG mode */
```

14.2.51 dsp_rmem—Read DSP Memory Location

```
#include "simcom.h"
#include "protocom.h"
#include "coreaddr.h"
int dsp_rmem(device_index,memory_map,address,return_value)
int device_index;   /* DSP device to be affected by command */
enum memory_map memory_map;/* memory designator */
unsigned long address;/* DSP memory address to read */
unsigned long *return_value;/* Returned memory value (or values) */
```

`dsp_rmem()` reads the contents of a selected DSP memory location specified by `memory_map` and `address`, and writes it to `return_value`. If the `memory_map` implies a two-word value, the least significant word will be returned to `return_value`, and the most significant word will be returned to the `return_value+1` location. This function also returns a flag that indicates whether or not the memory location exists. It returns `1` if the location exists, `0` otherwise.

The `memory_map` parameter selects the appropriate `dt_memory` structure from `dt_var.mem` for the selected device. These structures are described in the simdev.h file which is included with the emulator. The `memory_map` parameter can be obtained with the function `dsp_findmem()` by using the memory name as a key. Use the emulator help mem command for a list of valid memory names. The `memory_map` enum is `memory_map_` concatenated with a valid memory name. As an example, `memory_map_pa` refers to off chip pa memory on the 96002 device. See Example 14-51.

Example 14-51. dsp_rmem()

```
/* Read X memory location 100 from device 0. */
#include "simcom.h"
#include "protocom.h"
#include "coreaddr.h"

unsigned long address;
unsigned long memval;
int devn;
int ok;

devn=0;
dsp_new(devn,"56002");/* Allocate structure for device 0, a 56002 */
address=100L;

ok=dsp_rmem(devn,memory_map_x,address,&memval);
```

14.2.52 dsp_rmem_blk—Read Block of DSP Memory Locations

```
#include "simcom.h"
#include "protocom.h"
#include "coreaddr.h"
int dsp_rmem_blk(device_index,memory_map,address,count,return_value)
int device_index;   /* DSP device to be affected by command */
enum memory_map memory_map;/* memory designator */
unsigned long address;/* DSP memory address to read */
unsigned long count;/* number of memory locations to read */
unsigned long *return_value;/* Returned memory value(s) */
```

dsp_rmem_blk() reads count locations starting at address from memory memory_map in device device_index and writes it to the memory block pointed to by return_value. If memory_map implies a two word value, the values are returned in order, with the low-order half of the first word followed by the high-order half, then the low-order half of the second word. For word n (counting from 0) in the memory block, the low-order value is stored in return_value[2*n], the high-order value in return_value[2*n+1]. The function return value indicates whether the memory locations exist. It returns 1 if all the locations exist, 0 otherwise. The memory_map parameter selects the appropriate dt_memory structure from dt_var.mem for the selected device. These structures are described in the simdev.h file. The memory_map parameter can be obtained with the function dsp_findmem() by using the memory name as a key. Use the emulator help mem command for a list of valid memory names. The memory_map enum is memory_map_ concatenated with a valid memory name. See Example 14-52.

Example 14-52. dsp_rmem_blk()

```
/* Read 20 X memory locations starting at 100 from device 0. */
#include "simcom.h"
#include "protocom.h"
#include "coreaddr.h"

unsigned long address;
unsigned long count;
unsigned long memval[20];
int devn;
int ok;

devn=0;

dsp_new(devn,"56002");/* Allocate structure for device 0, a 56002 */

address=100L;
count=20L;

ok=dsp_rmem(devn,memory_map_x,address,count,&memval[0]);
```

14.2.53 dsp_rreg—Read a DSP Device Register

```
#include "simcom.h"
#include "protocom.h"
dsp_rreg(device_index,periph_num,reg_num,reg_val)
int device_index;   /* DSP device index to be affected by command */
int periph_num;/* DSP peripheral number */
int reg_num;/* DSP register number */
unsigned long *reg_val;/* Return register value goes here */
```

dsp_rreg() reads a register specified by periph_num and reg_num from device device_index and stores the value in the location pointed to by reg_val. Registers which return more than one word as the register value will return the least significant word in reg_val[0], or the most significant word in reg_val[1].

Use the emulator "help reg" command to obtain a list of the valid periph_num and reg_num values, and reg_val size for each register.   Also, dsp_findreg() can be used to obtain the peripheral and register number by using the register name as a key. See Example 14-53.

Example 14-53. dsp_rreg()

```
/* Read register r3 from device 0, a 56002. Use dsp_findreg to obtain
the */
/* peripheral and register numbers corresponding to the register name
"r3". */
#include "simcom.h"
#include "protocom.h"

int devn;
int periph_num, reg_num;
unsigned long regval;

devn=0;
dsp_new(devn,"56002");/* Allocate structure for device 0, a 56002 */

if (dsp_findreg(devn,"r3",&periph_num,&reg_num))
    dsp_rreg(devn,periph_num,reg_num,&regval);
```

14.2.54 dsp_save—Save All DSP Structures to State File

```
#include "simcom.h"
#include "protocom.h"
int dsp_save(filename)
char *filename;/* Full name of State File to be saved */
```

dsp_save saves all DSP device structures to an emulation state file. This function does not invoke the user interface functions which provide pathname and.adm suffix extension, so the entire filename must be specified. The function returns 1 if the save is successful, 0 if an error occurs when saving the file. This function will call the function dspl_xmsave() as one of the steps of saving the DSP structure. See Example 14-54.

Example 14-54. dsp_save

```
/* Save debugger status in file lunchbreak.adm */
#include "simcom.h"
#include "protocom.h"

int ok;

dsp_new(0,"56002");/* Allocate structure for device 0, a 56002 */
dsp_new(1,"56002");/* Allocate structure for device 1, a 56002 */
/* Save device 0 and 1 to state file lunchbrk.adm. */
ok=dsp_save("lunchbrk.adm");
```

14.2.55 dsp_spath—Search Path for Specified File

```
#include "simcom.h"
#include "protocom.h"
int dsp_spath(base, sufx, retn)
char *base;/* Ptr to base file name */
char *sufx;/* Ptr to file extension */
char *retn;/* Ptr to buffer to receive completed file name */
```

dsp_spath() takes the base filename *base and suffix *sufx supplied as arguments, and searches the working directory and alternate source paths until the required file is found.

The working directory is searched first, then each of the alternate source directories in the order in which the paths were specified. The search terminates immediately if a match is found. If multiple files exist on the search path with the same name, the only way to access files after the first file encountered in the search path is to specify the full path explicitly in the input filename *base.

If a match is found, the filename return buffer *retn contains the fully-specified filename. *retn is used as working storage and will be changed whether or not a match is found.

This function returns TRUE if the file is found, FALSE otherwise. See Example 14-55.

Example 14-55. `dsp_spath()`

```
/* find required file on search path*/
#include "simcom.h"
#include "protocom.h"

int devn, status;
char full_name[80];

devn=0;
dsp_new(devn,"56002");/* Allocate structure for device 0, a 56002 */

sim_docmd(devn, "path c:\work\temp");/* set up working directory */
sim_docmd(device_index, "path + c:\work\bin");/* and alternate source
path */

/* find first occurrence of ’myfile’ on path */
status = dsp_spath("myfile", "lod", full_name);
```

14.2.56 `dsp_startup`—Initialize DSP Structures

```
#include "simcom.h"
#include "protocom.h"
int dsp_startup();
```

`dsp_startup()` initializes general DSP structures which are not device specific. It should be called once (and only once) during program initialization before any calls to `ads_startup()` and `dsp_new()`. See Example 14-56.

Example 14-56. `dsp_startup()`

```
/* startup */
#include "simcom.h"
#include "protocom.h"

ads_startup("100",ADSP56000);
dsp_startup();/* Initialize DSP structures */

dsp_new(0,"56002");/* Allocate structure for device 0, a 56002 */
dsp_new(1,"56002");/* Allocate structure for device 1, a 56002 */
```

14.2.57 dsp_status—Determine DSP Device Status

```
#include "simcom.h"
#include "protocom.h"
int dsp_status(device_index, mode)
int device_index;/* DSP device affected by command */
int *mode;/* address of buffer to receive device status */
```

`dsp_status()` places the execution status of the target device `device_index` in the int pointed to by `*mode`.

Valid values for `*mode` are:

- `DSP_USER_MODE`—device is executing a user program
- `DSP_DEBUG_MODE`—device is in debug mode

The function returns `TRUE` on success, or `FALSE` otherwise. See Example 14-57.

Example 14-57. dsp_status()

```
/* determine status of DSP 0 */
#include "simcom.h"
#include "protocom.h"

int devn, status;
int device_mode;/* receive mode of device 0 */

devn=0;
dsp_new(devn,"56002");/* Allocate structure for device 0, a 56002 */
.
.
.
status = dsp_status(devn, &device_mode); /* get current mode for device
0 */
```

14.2.58 dsp_step—Execute Counted Instructions

```
#include "simcom.h"
#include "protocom.h"
dsp_step(device_index, step)
int device_index;/*
unsigned long step;
```

`dsp_step()` causes the target device specified by `device_index` to execute `step` instructions. The device then returns to Debug mode.

Note: A success return code means the Command Converter has been instructed to make the target device execute the required number of instructions. It is necessary to call `dsp_check_service_request()` to find out when the target device has executed the instruction and returned to Debug mode.

The function returns TRUE on successful completion, FALSE otherwise. See Example 14-58.

Example 14-58. dsp_step()

```
/* Execute 1 DSP instruction on device 0 */
#include "simcom.h"
#include "protocom.h"

int devn, status;
unsigned long step_count;

devn = 0;
dsp_new(devn,"56002");/* Allocate structure for device 0, a 56002 */

step_count = 1l;

status = dsp_step(devn, step_count);
```

14.2.59 dsp_stop—Force DSP Device into Debug Mode

```
#include "simcom.h"
#include "protocom.h"
dsp_stop(device_index)
int device_index;/* DSP device affected by command */
```

dsp_stop() forces the device device_index into Debug mode.

The function returns TRUE on successful completion, FALSE otherwise. See Example 14-59.

Example 14-59. dsp_stop()

```
/* force DSP device to debug mode */
#include "simcom.h"
#include "protocom.h"

int devn, status;

devn = 0;
dsp_new(devn,"56002");/* allocate structure for device 0, a 56002 */
.
.
.
status = dsp_ldmem(devn,"x14.lod");/* load program file */
status = dsp_go(devn);/* start the device running user program */
.
...later...
.
status = dsp_stop(devn);/* stop the device now */
.
.
status = ads_cache_registers(devn); /* cache regs on entry to debug
mode */
```

14.2.60 dsp_unlock—Unlock Password Protected Device Type

```
#include "simcom.h"
#include "protocom.h"
dsp_unlock(device_type, password)
char *password;/* Pointer to string containing password */
char *device_type;/* Name corresponding to DSP device type */
```

`dsp_unlock()` provides the `password` for protected `device_types`. It must be used prior to the `dsp_new()` function call if the `device_type` is password protected. See Example 14-60.

Example 14-60. dsp_unlock()

```
/* Create a device emulation of the password protected 56001 device */
#include "simcom.h"
#include "protocom.h"

int devn;
ads_startup("100",ADSP56000);
dsp_startup();
devn=0;

dsp_unlock("56001","x51-234"); /* provide password for device */

dsp_new(devn,"56001");/* Create structures for protected device type*/
```

14.2.61 dsp_wmem—Write DSP Memory Location

```
#include "simcom.h"
#include "protocom.h"
#include "coreaddr.h"
dsp_wmem(device_index,memory_map,address,value)
int device_index;/* DSP device to be affected by command */
enum memory_map memory_map;/* memory designator */
unsigned long address;/* DSP memory address to write */
unsigned long *value;/* Pointer to value to write to memory location */
```

`dsp_wmem()` writes a selected DSP memory location.

The `memory_map` parameter selects the appropriate `dt_memory` structure from `dt_var.mem` for the selected device. These structures are described in the simdev.h file which is included with the emulator. The `memory_map` parameter can be obtained with the function `dsp_findmem` by using the memory name as a key. Use the emulator help mem command for a list of valid memory names. Valid `memory_map` values are `memory_map_` concatenated with a valid memory name. As an example, `memory_map_pa` refers to off chip pa memory on the 96002 device.

If the selected memory map requires two word values, the least significant word should be at the `value` location and the most significant word at the `value+1` location. See Example 14-61.

Example 14-61. `dsp_wmem()`

```
/* Write a zero value to address P:200 in device 0 */
#include "simcom.h"
#include "protocom.h"
#include "coreaddr.h"

int devn;
unsigned long address, memval;
address=200L;
memval=0L;

devn=0;

dsp_new(devn,"56002");/* Allocate structure for device 0, a 56002 */

dsp_wmem(devn,memory_map_p,address,&memval);
```

14.2.62 dsp_wmem_blk—Write DSP Memory Block

```
#include "simcom.h"
#include "protocom.h"
#include "coreaddr.h"
dsp_wmem_blk(device_index,memory_map,address,count,value)
int device_index;/* DSP device to be affected by command */
enum memory_map memory_map;/* memory designator */
unsigned long address;/* DSP memory address to write */
unsigned long count;/* Number of locations to write */
unsigned long *value;/* Pointer to value to write to memory location */
```

`dsp_wmem_blk()` writes `count` locations starting at `address` in memory space `memory_map` in device `device_index`, with values taken from the memory block pointed to by `value`.

If `memory_map` implies a two-word value, the values will be retrieved from `value` in order, with the low-order half of the first word followed by the high-order half, then the low-order half of the second word, etc. Thus for word n (counting from 0) in the memory block, the low-order value is taken from `value[2*n]`, the high-order value from `value[2*n+1]`.

The `memory_map` parameter selects the appropriate `dt_memory` structure from `dt_var.mem` for the selected device. These structures are described in the simdev.h file which is included with the emulator. The `memory_map` parameter can be obtained with the function `dsp_findmem()` by using the memory name as a key. Use the emulator help mem command for a list of valid memory names. Valid `memory_map` values are `memory_map_` concatenated with a valid memory name. As an example, `memory_map_pa` refers to off-chip pa memory on the 96002 device. See Example 14-62.

Example 14-62. `dsp_wmem_blk()`

```
/* Copy 100 values in X:$c400 to P:$a000 */
#include "simcom.h"
#include "protocom.h"
#include "coreaddr.h"

int devn;
unsigned long address, count, memval[100];

memval=0L;
devn=0;
dsp_new(devn,"56002");/* Allocate structure for device 0, a 56002 */

address=0xc400;
dsp_rmem(devn,memory_map_x,address,100L,&memval[0]); /* fetch 100 
values */
address=0xa000;                                      /* from X:$c400 */
dsp_wmem(devn,memory_map_p,address,100L,&memval[0]); /* and write to 
P:$a000 */
```

14.2.63 dsp_wreg—Write a DSP Device Register

```
#include "simcom.h"
#include "protocom.h"
dsp_wreg(device_index,periph_num,reg_num,reg_val)
int device_index;   /* DSP device index to be affected by command */
int periph_num;/* DSP peripheral number */
int reg_num;/* DSP register number */
unsigned long *reg_val;/* Value to be written to register */
```

`dsp_wreg()` writes a selected register in the a DSP device.

Use the emulator "help reg" command to obtain a list of the valid `periph_num` and `reg_num` values, and `reg_val` size for each register. Also, the function `dsp_findreg()` can be used to obtain the peripheral and register number by using the register name as a key.

If a register requires more than one word to represent the data value the least significant word should be at `[reg_val]`, with more significant words at `[reg_val+1]`, etc. See Example 14-63.

Example 14-63. `dsp_wreg()`

```
/* Write value 100 to pc register in device 0. Use dsp_findreg to
determine
   device and register numbers for pc. */
#include "simcom.h"
#include "protocom.h"

int devn;
int periph_num, reg_num;
unsigned long regval;

devn=0;
dsp_new(devn,"56002");/* Allocate structure for device 0, a 56002 */
regval=100L;

if (dsp_findreg(devn,"pc",&periph_num,&reg_num))
    dsp_wreg(devn,periph_num,reg_num,&regval);
```

14.2.64 `sim_docmd`—Execute Emulator User Interface Command

```
#include "simcom.h"
#include "protocom.h"
sim_docmd(device_index,command_string)
int device_index;/* DSP device index to be affected by command */
char *command_string;/* User interface command to be executed */
```

`sim_docmd()` executes any emulator command that the emulator normally accepts from the terminal. ADSDSP normally calls `sim_gtcmd()` to get a valid command string from the terminal, then calls `sim_docmd()` to execute it. The `device_index` determines which DSP device (in a multiple DSP emulation) is affected by the command execution. The devices are numbered 0,1,2...n-1 in an n-device system, so be very careful, for example, to use 0 for the `device_index` parameter in a single device system.

If the `command_string` begins macro execution, the selected device structure `in_macro` flag will be set by `sim_docmd()`. ADSDSP retrieves valid commands from the macro file by calling `sim_gmcmd()` as long as the `in_macro` flag is set. The commands are still executed by `sim_docmd()`, whether they come from the terminal or a macro file.

Some commands initiate device execution (such as go or trace). The target executes until execution of a breakpoint or the completion of the requested number of instruction steps. See Example 14-64.

Example 14-64. `sim_docmd()`

```
/* Use sim_docmd to execute device 0 from address P:40 to breakpoint at
P:80 */
#include "simcom.h"
#include "protocom.h"

int devn;

devn=0;
dsp_new(devn,"56002");/* Allocate structure for device 0, a 56002 */

sim_docmd(devn,"change pc $40");/* Change device 0 pc register to $40
*/
sim_docmd(devn,"break h P:$80");/* Set a breakpoint for device 0 */
sim_docmd(devn,"go");/* Begin execution of device 0 */
```

14.2.65 sim_gmcmd—Get Command String from Macro File

```
#include "simcom.h"
#include "protocom.h"
sim_gmcmd(device_index,command_string)
int device_index;     /* DSP device index to be affected by command */
char *command_string; /* Pointer to return buffer for command line */
```

`sim_gmcmd()` reads the next emulator command string from a macro file. The `sim_docmd()` function will normally determine that a command is a macro, open the macro file, and set the device structure `sim_const.in_macro` flag. The `sim_gmcmd()` function returns the next line from the open macro file each time it is called. It will clear the `in_macro` flag at the end of macro execution or if an invalid macro command is processed. The `command_string` buffer should be at least 80 characters. See Example 14-65.

Example 14-65. `sim_gmcmd()`

```
/* Execute the macro command file startup.cmd on DSP device structure 0.
*/
#include "simcom.h"
#include "protocom.h"
#include "simusr.h"
extern struct sim_const sv_const;/* Emulator device structures */
char command_string[80];
int devn;

devn=0;
dsp_new(devn,"56002");/* Create new DSP structure */

sim_docmd(devn,"startup");/* Begin the startup macro */
while (sv_const.in_macro){/* Until end of macro file */
   sim_gmcmd(devn,command_string);/*  Get command from macro file */
   sim_docmd(devn,command_string);/*  Execute command string */
   }
```

14.2.66 sim_gtcmd—Get Command String from Terminal

```
#include "simcom.h"
#include "protocom.h"
sim_gtcmd(device_index,command_string)
int device_index;     /* DSP device index to be affected by command */
char *command_string; /* Pointer to return buffer for command line */
```

`sim_gtcmd()` gets the next command string from the terminal in an interactive mode. The command line editing, command expansion, and on-line help functions are invoked by this terminal command input function. The command string is fully checked for errors prior to returning. The `command_string` buffer should be at least 80 characters. See Example 14-66.

Example 14-66. sim_gtcmd()

```
/* Get and execute emulator commands for device until a go type command
is */
/* entered. */
#include "simcom.h"
#include "protocom.h"
#include "simusr.h"

extern struct sim_const sv_const;/* Emulator device structures */
char command_string[80];
int devn;

devn=0;
dsp_new(devn,"56002");/* Create new DSP structure */

while (!sv_const.sv[devn]->stat.executing){/* Check for go. If not, */
   sim_gtcmd(devn,command_string);/*  Get command and */
   sim_docmd(devn,command_string);/*  Execute command */
 }
```

14.3 Emulator Screen Management Functions

The following sections describe functions which are provided in source code form in the emulator package in the file scrmgr.c. These functions define all the operations associated with emulator terminal I/O. The code includes conditionally compiled sections for MSDOS, UNIX, and VMS. The code is provided to allow customizing of the emulator terminal I/O for a particular environment. The user may, for example, wish to redefine the control characters used by the emulator so that they map to some particular terminal.

Table 14-8 is a quick reference list of the emulator screen management functions:

Table 14-8. Emulator Screen Management Functions

Function	Description
`simw_ceol();`	Clear to end of line
`simw_ctrlbr();`	Check for Ctrl-C signal
`simw_cursor(line,column);`	Move cursor to specified line, column
`simw_endwin();`	End the emulator display
`simw_getch();`	Non-translated keyboard input
`simw_gkey();`	Translated keyboard input
`simw_putc(c);`	Output character to terminal
`simw_puts (line,column,text,flag);`	Output string to terminal at line and column
`simw_redo(device);`	Repaint screen with output from device
`simw_redraw(count);`	Redraw screen after scrolling count
`simw_refresh();`	Screen update after buffering output
`simw_scrnest();`	Nest output buffering another level
`simw_unnest();`	Pop output buffering one level
`simw_winit();`	Initialize window parameters
`simw_wscr (string,commandflag);`	Write string and perform logging functions

14.3.1 `simw_ceol`—Clear to End of Line

`simw_ceol()`

This function must clear the display from the current column to the end of line, then return the cursor to the previous position.

14.3.2 `simw_ctrlbr`—Check for CtrL-C Signal

`simw_ctrlbr()`

This function must check for the occurrence of a Ctrl-C signal from the terminal. If the Ctrl-C signal occurs, it sets a flag for the active breakpoint DSP (defined by `sv_const.breakdev`). It returns the `sim_var.stat.CTRLBR` flag for the current device. This allows the program to select the device that will halt in response to the Ctrl-C signal from the keyboard in a multiple device emulation.

14.3.3 simw_cursor—Move Cursor to Specified Line and Column

```
simw_cursor(line,column)
```

This function must move the cursor to the specified `line` and `column` and update the `sim_const.curline` and `sim_const.curclm` variables.

14.3.4 simw_endwin—End Emulator Window

```
simw_endwin()
```

This function is normally called when returning to the operating system level from the emulator. It must terminate any special processing associated with terminal I/O for the emulator and clear the display.

14.3.5 simw_getch—Non-Translated Keyboard Input

```
simw_getch()
```

This function gets a single character in a non-translated mode from the terminal. It is not used much by the emulator—only when returning from the execution of the system command prior to the time when the emulator's special terminal I/O processing is reinitialized.

14.3.6 simw_gkey—Translated Keyboard Input

```
simw_gkey()
```

This function gets a keystroke from the terminal and maps it to one of the accepted internal codes used by the emulator. The internal codes are defined in simusr.h. This function should not output the character to the terminal. This function is a good candidate for modification if you want to change the set of input control characters used by the emulator.

14.3.7 simw_putc—Output Character to Terminal

```
simw_putc(c)
char c;
```

This function outputs the character in the variable `c` at the current cursor and column position. It advances and updates the `sim_const.curclm` variable. This function is not used often by the emulator, and it is not very time critical when it is used, so the emulator implementation is just to call `simw_puts()` after creating a temporary string from the character `c`.

14.3.8 simw_puts—Output String to Terminal

```
simw_puts(line,column,text,flag)
int line;/* Move cursor to this line for output */
int column;/* Move cursor to this column for output */
char *text;/* Text string to be output */
int flag;/* 0=non-bold, 1=bold on/off by {}, 2=all bold */
```

This function outputs the string in `text` to the terminal at the specified `line` and `column`. Highlighting of output can be enabled either by setting the `flag` parameter to `2` or by enclosing text in curly braces and setting the flag parameter to `1`.

14.3.9 simw_redo—Repaint Screen with Output from Device

```
simw_redo(device)
int device;     /* Use screen buffer from this device to repaint screen
*/
```

This function repaints the screen from a `device` screen buffer. It is normally only called when reentering the emulator following a system command, after loading the device state with the load s filename command, or after switching devices in a multiple device emulation with the device command.

14.3.10 simw_redraw—Redraw Screen after Scroll Count

```
simw_redraw(count)
int count;    /* Number of lines to scroll before repainting the screen
*/
```

This function scrolls up or down `count` lines in the display buffer, then redisplays the text in the buffer at that position. This function only displays the text that is in the scrolling portion of the display.

14.3.11 simw_refresh—Screen Update after Buffering Output

```
simw_refresh()
```

The emulator buffers screen output in implementations other than MSDOS in order to decrease the time spent repainting the screen. This provides a fixed display effect for consecutive trace commands. The `simw_refresh()` function will take care of refreshing the screen following buffering of screen output. It also resets the `sim_const.scrnest` variable to `0` to coincide with the non-buffered status of the screen following the refresh.

14.3.12 simw_scrnest—Increase Screen Buffering One Level

```
simw_scrnest()
```

This function increments a counter to signify the screen output buffering level. The companion `simw_unnest()` and `simw_refresh()` functions provide the output buffering operations for the emulator. The `sim_const.scrnest` variable is incremented each time this function is called.

14.3.13 `simw_unnest`—Decrease Screen Buffering One Level

```
simw_unnest()
```

This function decrements the `sim_const.scrnest` variable each time it is called. If the screen buffering level drops below one, `simw_unnest()` will call `simw_refresh()` to update the screen.

14.3.14 `simw_winit`—Initialize Window Parameters

```
simw_winit()
```

This function initializes any screen or keyboard parameters that are required for the emulator terminal I/O environment. It is called whenever the emulator is entered from the operating system level, which includes the initial emulator entry and re-entry following the system command.

14.3.15 `simw_wscr`—Write String and Perform Logging

```
simw_wscr(text,command_flag)
char *text;/* Text string to write to screen */
int command_flag;/* Flag 1=string is a command, 0= not a command */
```

This function outputs the string `text` to the terminal above the command line after scrolling the display up one line. It also takes care of writing the text string to the proper log files specified by the emulator log s or log c commands, depending on `flag`.

14.4 Non-Display Emulator

The emulator package contains object libraries which support both display and non-display versions of the emulator. The library nwads contains functions available to the non-display version of the emulator. The library wwads contains functions that may only be used in a display version of the emulator. For each device type there are also display and non-display device-specific libraries named wwxxxxx and nwxxxxx where the xxxxx is the device number.

The source code contained in anwdsp.c can be linked with the nwxxxxx and nwsim libraries to create a non-display version of the emulator. Elimination of the user interface functions cuts the code size of the emulator almost in half. However, all of the functions listed in **Section 14.3, "Emulator Screen Management Functions,"** and `sim_docmd()`, `sim_gmcmd()` and `sim_gtcmd()` described in Sections **Section 14.2.64, "sim_docmd—Execute Emulator User Interface Command,"** , **Section 14.2.65, "sim_gmcmd—Get Command String from Macro File,"** , **Section 14.2.66,**

"sim_gtcmd—Get Command String from Terminal," , are sacrificed. The remainder of the functions in **Section 14.2** are available in the non-display emulator libraries.

Some major features of the emulator are eliminated by the loss of the `sim_docmd()` function. In particular, there are no low-level entry points provided to set a breakpoint or to assign input or output files to DSP memory. However, the basic functions required to create a device, load a program, execute the code, and test or modify device registers are all still available. The use of these basic functions to support breakpoints is discussed in **Section 14.4.4, "Testing Breakpoint Conditions,"** . In addition, the `dsp_save()` function provides the capability to save the state of the non-display version. The state file can later be reloaded by a display version of the emulator for visual examination of the registers and memory contents.

The following sections cover several topics that concern the non-display version of the emulator. **Section 14.4.1, "Creating a New Device,"** deals with creating a new device. **Section 14.4.2, "Loading Program Code or Device State,"** describes how to load a program or state file. **Section 14.4.3, "Executing Device Instructions,"** describes how to execute device cycles. **Section 14.4.4, "Testing Breakpoint Conditions,"** describes how to test breakpoint conditions.

14.4.1 Creating a New Device

The simcom.h file defines the maximum number of DSP devices in the constant `DSP_MAXDEVICES`. A new device can be created and numbered from 0 to `DSP_MAXDEVICES-1`. The structures are allocated by calls to the `dsp_new()` function described in **Section 14.2.47, "dsp_new—Create New DSP Device Structure,"** .

The following C source code illustrates the steps necessary to create 3 DSP devices. Note that the numbers used for device number (0, 1, 2 below) reflect the device numbers set up on the target hardware, and do not need to be consecutive. See Example 14-67.

Example 14-67. Device Structures Creation

```
ads_startup("100",ADSP56000);
dsp_startup();
dsp_new(0,"56002");/* Allocate structure for device 0, a 56002 */
dsp_new(1,"56002");/* Allocate structure for device 1, a 56002 */
dsp_new(2,"56002");/* Allocate structure for device 2, a 56002 */
```

14.4.2 Loading Program Code or Device State

The display version of the emulator provides the high level `sim_docmd()` function interface. It allows the user to simply execute the high level load or load s emulator commands to load program code or a emulator state file. The non-display version of the emulator makes use of the lower level function calls, `dsp_ldmem()` and `dsp_load()`, to accomplish the same results. They are described in **Section 14.2, "Library Function Descriptions,"** . The major difference from their high-level counterparts is that no filename expansion is provided in the lower level calls. The program code loaded by the `dsp_ldmem()` function may be any COFF format or OMF format file. The OMF format is created as the output of versions of the Macro Assembler prior to release 4.0 and of the Emulator save command. The COFF format files are the output of the Macro Assembler beginning with release 4.0, or those saved by the Emulator save command with the suffix ".cld".The Emulator state loaded by the `dsp_load()` function may have previously been saved by a display or non-display version of the emulator. The formats are the same. The `dsp_save()` function is provided as a low-level entry point that saves the Emulator state for a non-display version of the Emulator. It is the same function that is called during execution of the high level save s command, which is only available in the display version. The only limitation is that the full save filename must be specified. No automatic expansion is done for the working path or filename suffix as in the higher level emulator calls. The `dsp_save()` function is described in **Section 14.2.54, "dsp_save—Save All DSP Structures to State File,"** .

14.4.3 Executing Device Instructions

After creating a new device—as described in **Section 14.4.1, "Creating a New Device,"** —and loading a program or state file—as described in **Section 14.4.2, "Loading Program Code or Device State,"** —the emulator is ready to execute the program code. Execution begins at the start address specified in the load file, or continues from the previous location in an emulator state file. The user’s code may select a new execution address by writing register "pc" using the `dsp_wreg()` function, or with `dsp_go_address()`.

14.4.4 Testing Breakpoint Conditions

The command line interface in the display version of the emulator provides facilities to specify breakpoint conditions. When the breakpoint condition is met during user program execution, the emulator displays the enabled registers (assuming the breakpoint action is halt). The non-display emulator does not provide a way to specify breakpoint conditions. It is up to the user’s code to examine device registers or memory conditions and decide whether or not to continue execution. The device registers and memory can be examined using the `dsp_rreg()` and `dsp_rmem()` functions. The emulator hardware executes independently of the emulator control software. After successfully completing a call to initiate instruction execution (e.g. `dsp_go_address()`, `dsp_go, dsp_step()`), the device executes until a termination condition is encountered.

Termination conditions include:

- Hardware breakpoint condition satisfied
- DEBUG instruction executed
- Specified number of instructions executed in dsp_step
- Call to dsp_reset, etc.

When the device stops executing, the function `dsp_check_service_request()` returns `TRUE`. It is then the responsibility of the user program to determine the reason for the service request. Hardware breakpoints are described in the appropriate hardware documentation and are not covered here.

Software breakpoints are caused by executing conditional or unconditional `DEBUG` instructions. These instructions must be inserted into the user DSP code. This may be achieved in several possible ways (not all of which are suitable for production code):

- Hard-coded `DEBUG` instructions included in the DSP code.
- NOP instructions in code which may be overwritten with DEBUG instructions.
- Save instruction word and overwrite with an unconditional DEBUG instruction. MUST be the first word of multi-word instructions.

It is the responsibility of the user code to retain the addresses of the `DEBUG` instructions and carry out the desired checks and actions when they are encountered.

In the first two possibilities, no special action is needed to continue program execution. A call to `dsp_go()` or `dsp_step()` will resume device execution at the location following the `DEBUG` instruction. Although inappropriate for production code, this approach is simple.

With the third approach, it is necessary to restore the original instruction before continuing, and then reinstate the breakpoint as necessary. The full operation of setting and handling the breakpoint is outlined below:

1. Save contents of breakpoint location(s).
2. Overwrite with `DEBUG` instruction(s).
3. Start execution with call to `dsp_go().`
4. Repeatedly call `dsp_check_service_request()` until return value is `TRUE.`
5. Save registers with `ads_cache_registers().`
6. Read pc address.
7. Check for breakpoint address and carry out required checks and actions.

8. Write the saved instruction word back to memory.
9. Reset the pc register to the breakpoint address.
10. Execute 1 instruction with dsp_step.
11. Repeatedly call `dsp_check_service_request()` until return value is `TRUE.`
12. Continue from (2) above.....

Note: This is only a general outline and may need to be modified for specific circumstances.

Consideration always needs to be given to the case where the first instruction to be executed is itself the target of a breakpoint. In this case, step over that instruction before inserting the `DEBUG` instructions. Adding or deleting of breakpoints needs to be handled. Steps (4) and (11) above do not need to be tight loops. Calls to `dsp_check_service_request()` may be made at convenient points in other processing to determine when the device is ready.

14.5 Multiple Device Emulation

The ADSDSP emulator may be used to emulate a single DSP device or multiple devices. As many devices as are required by the target configuration may be configured using the device command or `dsp_new function()`. The following sections describe some details about the way the emulator handles multiple devices. **Section 14.5.1, "Allocation and Initialization of Multiple Devices,"** describes the required steps to allocate and initialize multiple DSP structures. **Section 14.5.2, "Controlling Multiple DSP Devices,"** describes the method of controlling multiple devices. **Section 14.5.3, "Multiple DSP Emulator Display,"** describes display of device output in the multiple device environment.

14.5.1 Allocation and Initialization of Multiple Devices

Most of the higher level emulator functions require a device index as one of the parameters. The emulator uses the device index to select a previously allocated DSP structure. The DSP structures are allocated dynamically by calling the `dsp_new()` function for each device. The device type is also selected in the `dsp_new()` function call. In the display version of the emulator, the device command handles the details of calling `dsp_new()`. The proper sequence of instructions necessary to allocate three DSP devices is shown below.

```
ads_startup("100",ADSP56000);
dsp_startup();
dsp_new(0,"56002");/* Allocate structure for device 0, a 56002 */
dsp_new(1,"56002");/* Allocate structure for device 1, a 56002 */
dsp_new(2,"56002");/* Allocate structure for device 2, a 56002 */
```

14.5.2 Controlling Multiple DSP Devices

Each target device operates independently under the control of the ADSDSP emulator. The basic execution sequence for a single target device is unchanged:

1. Initialize DSP device.
2. Load memory.
3. initialize breakpoints as desired.
4. initiate execution (`dsp_go()`, `dsp_step()`, etc.).
5. *If desired*, interrupt execution with `dsp_reset()` or `dsp_stop().`
6. call `dsp_check_service_request()` to detect return to Debug Mode.

When controlling multiple devices, all devices require initialization as above. Whenever a device starts executing, as a result of a command like step or a function call like `dsp_go()`, execution starts immediately for the specified device and continues independently of the ADS. Each device must be started by a separate command or function call. Execution continues until an event in the device causes the device to enter Debug Mode, such as reaching a breakpoint or the required number of instructions being executed, or the ADS stops execution for a target, with a force b command or a call to function `dsp_stop()`. All other devices will continue executing while that device is being serviced. The emulator needs to check each device to see if it has entered Debug Mode by calling `dsp_check_service_request()` for each executing device in turn. This may be coded as a tight loop for maximum response, or interleaved with other activity as required.

14.5.3 Multiple DSP Emulator Display

The emulator display functions are contained in the source file scrmgr.c in the emulator package. This code supports the scrolling virtual screen for the ADS. The supplied display code uses a single window. The lines above the command line form a scrolling region in which session output is displayed. The command line, error line, and help line are the three bottom lines of the display. The default size of the scroll buffer holds 100 lines of output. As each device causes output to the screen, a message is output specifying which device caused the output. The device command allows the user to switch the displayed device. When it switches to a new device, it refreshes the entire screen from the device’s display buffer.

14.6 Reserved Function Names

The public function names used in the emulator all begin with the prefixes dsp_, ads_, or sim_. Functions which begin with sim_ are only available when a display version of the emulator is created. Functions which begin with dsp_ and ads_ are available to both display and non display versions. The screen management functions all begin with simw_. In general, functions which begin with dsp_ or sim_ are higher level functions available for direct reference from the user's code; those beginning with dspd_, dspl_ or siml_ are meant only for internal use by the emulator. The higher level functions and the screen management functions are documented in **Section 14.2, "Library Function Descriptions,"** and **Section 14.3, "Emulator Screen Management Functions,"** . The public functions are listed in the file named global.sym which is included with the distribution.

14.7 Emulator Global Variables

In order to reduce conflicts with user variable names, the emulator global variables have been grouped together into several large structures. In general, the structure names beginning with s are used defined in simusr.h and are only used in the display version of the emulator; while those beginning with d are defined in simdev.h and are used by both the display and non-display versions of the emulator. The prefixes st_ and dt_ are used for structure names of device-type structures, that is structures which must be defined for each device type. The prefixes sim_ and dev_ are used for structure names of general device or simulation structures.

Global variable names may have a prefix dx_, dv_, sx_, or sv_. The prefix dx_ is used for variables of dt_ structures. The prefix dv_ is used for variables of dev_ structures. The prefix sx_ is used for variables of st_ structures. The prefix sv_ is used for variables of sev_ structures. A list of emulator global variables is included in the distribution file named global.sym.

14.8 Modification of Emulator Global Structures

The source file simglob.c, which is included in the emulator package, contains the global structures `sv_const` and `dv_const`. There are some useful modifications, described below, that can be made to the constant definitions at the beginning of simglob.c. The simglob.c module must then be recompiled and relinked using the make file provided with the emulator package.

- **`DSP_MAXDEVICES`**—This define constant determines the maximum number of devices that can be allocated using the emulator's device command. As a default it is set to `32`.
- **`DSP_CMDSZ`**—This define constant determines the size of the previous command stack. The emulator commands are stored in the stack and can be reviewed using the Ctrl-f and Ctrl-b key entries. As a default the previous command stack size is set to `10`.
- **`DSP_WINSZ`**—This define constant determines the size of the screen buffer that is maintained and displayed by the scrmgr.c functions. It specifies the number of display lines that will be allocated for each device as they are created with the emulator device command. The user can use the Ctrl-u, Ctrl-t, Ctrl-v, and Ctrl-d key sequences to review display lines that have scrolled off the screen. This constant should not be set to a value smaller than the number of lines in the display window.

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