To our customers,

Old Company Name in Catalogs and Other Documents

On April 1\textsuperscript{st}, 2010, NEC Electronics Corporation merged with Renesas Technology Corporation, and Renesas Electronics Corporation took over all the business of both companies. Therefore, although the old company name remains in this document, it is a valid Renesas Electronics document. We appreciate your understanding.

Renesas Electronics website: http://www.renesas.com

April 1\textsuperscript{st}, 2010
Renesas Electronics Corporation

Issued by: Renesas Electronics Corporation (http://www.renesas.com)

Send any inquiries to http://www.renesas.com/inquiry.
Notice

1. All information included in this document is current as of the date this document is issued. Such information, however, is subject to change without any prior notice. Before purchasing or using any Renesas Electronics products listed herein, please confirm the latest product information with a Renesas Electronics sales office. Also, please pay regular and careful attention to additional and different information to be disclosed by Renesas Electronics such as that disclosed through our website.

2. Renesas Electronics does not assume any liability for infringement of patents, copyrights, or other intellectual property rights of third parties by or arising from the use of Renesas Electronics products or technical information described in this document. No license, express, implied or otherwise, is granted hereby under any patents, copyrights or other intellectual property rights of Renesas Electronics or others.

3. You should not alter, modify, copy, or otherwise misappropriate any Renesas Electronics product, whether in whole or in part.

4. Descriptions of circuits, software and other related information in this document are provided only to illustrate the operation of semiconductor products and application examples. You are fully responsible for the incorporation of these circuits, software, and information in the design of your equipment. Renesas Electronics assumes no responsibility for any losses incurred by you or third parties arising from the use of these circuits, software, or information.

5. When exporting the products or technology described in this document, you should comply with the applicable export control laws and regulations and follow the procedures required by such laws and regulations. You should not use Renesas Electronics products or the technology described in this document for any purpose relating to military applications or use by the military, including but not limited to the development of weapons of mass destruction. Renesas Electronics products and technology may not be used for or incorporated into any products or systems whose manufacture, use, or sale is prohibited under any applicable domestic or foreign laws or regulations.

6. Renesas Electronics has used reasonable care in preparing the information included in this document, but Renesas Electronics does not warrant that such information is error free. Renesas Electronics assumes no liability whatsoever for any damages incurred by you resulting from errors in or omissions from the information included herein.

7. Renesas Electronics products are classified according to the following three quality grades: “Standard”, “High Quality”, and “Specific”. The recommended applications for each Renesas Electronics product depends on the product’s quality grade, as indicated below. You must check the quality grade of each Renesas Electronics product before using it in a particular application. You may not use any Renesas Electronics product for any application categorized as “Specific” without the prior written consent of Renesas Electronics. Further, you may not use any Renesas Electronics product for any application for which it is not intended without the prior written consent of Renesas Electronics. Renesas Electronics shall not be in any way liable for any damages or losses incurred by you or third parties arising from the use of any Renesas Electronics product for an application categorized as “Specific” or for which the product is not intended where you have failed to obtain the prior written consent of Renesas Electronics. The quality grade of each Renesas Electronics product is “Standard” unless otherwise expressly specified in a Renesas Electronics data sheets or data books, etc.

   “Standard”: Computers; office equipment; communications equipment; test and measurement equipment; audio and visual equipment; home electronic appliances; machine tools; personal electronic equipment; and industrial robots.

   “High Quality”: Transportation equipment (automobiles, trains, ships, etc.); traffic control systems; anti-disaster systems; anti-crime systems; safety equipment; and medical equipment not specifically designed for life support.

   “Specific”: Aircraft; aerospace equipment; submersible repeaters; nuclear reactor control systems; medical equipment or systems for life support (e.g., artificial life support devices or systems), surgical implantations, or healthcare intervention (e.g. excision, etc.), and any other applications or purposes that pose a direct threat to human life.

8. You should use the Renesas Electronics products described in this document within the range specified by Renesas Electronics, especially with respect to the maximum rating, operating supply voltage range, movement power voltage range, heat radiation characteristics, installation and other product characteristics. Renesas Electronics shall have no liability for malfunctions or damages arising out of the use of Renesas Electronics products beyond such specified ranges.

9. Although Renesas Electronics endeavors to improve the quality and reliability of its products, semiconductor products have specific characteristics such as the occurrence of failure at a certain rate and malfunctions under certain use conditions. Further, Renesas Electronics products are not subject to radiation resistance design. Please be sure to implement safety measures to guard them against the possibility of physical injury, and injury or damage caused by fire in the event of the failure of a Renesas Electronics product, such as safety design for hardware and software including but not limited to redundancy, fire control and malfunction prevention, appropriate treatment for aging degradation or any other appropriate measures. Because the evaluation of microcomputer software alone is very difficult, please evaluate the safety of the final products or system manufactured by you.

10. Please contact a Renesas Electronics sales office for details as to environmental matters such as the environmental compatibility of each Renesas Electronics product. Please use Renesas Electronics products in compliance with all applicable laws and regulations that regulate the inclusion or use of controlled substances, including without limitation, the EU RoHS Directive. Renesas Electronics assumes no liability for damages or losses occurring as a result of your noncompliance with applicable laws and regulations.

11. This document may not be reproduced or duplicated, in any form, in whole or in part, without prior written consent of Renesas Electronics.

12. Please contact a Renesas Electronics sales office if you have any questions regarding the information contained in this document or Renesas Electronics products, or if you have any other inquiries.

(Note 1) “Renesas Electronics” as used in this document means Renesas Electronics Corporation and also includes its majority-owned subsidiaries.

(Note 2) “Renesas Electronics product(s)” means any product developed or manufactured by or for Renesas Electronics.
<table>
<thead>
<tr>
<th>Notes regarding these materials</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. This document is provided for reference purposes only so that Renesas customers may select the appropriate Renesas products for their use. Renesas neither makes warranties or representations with respect to the accuracy or completeness of the information contained in this document nor grants any license to any intellectual property rights or any other rights of Renesas or any third party with respect to the information in this document.</td>
</tr>
<tr>
<td>2. Renesas shall have no liability for damages or infringement of any intellectual property or other rights arising out of the use of any information in this document, including, but not limited to, product data, diagrams, charts, programs, algorithms, and application circuit examples.</td>
</tr>
<tr>
<td>3. You should not use the products or the technology described in this document for the purpose of military applications such as the development of weapons of mass destruction or for the purpose of any other military use. When using the products or technology described herein, you should follow the applicable export control laws and regulations, and procedures required by such laws and regulations.</td>
</tr>
<tr>
<td>4. All information included in this document such as product data, diagrams, charts, programs, algorithms, and application circuit examples, is current as of the date this document is issued. Such information, however, is subject to change without any prior notice. Before purchasing or using any Renesas products listed in this document, please confirm the latest product information with a Renesas sales office. Also, please pay regular and careful attention to additional and different information to be disclosed by Renesas such as that disclosed through our website. (<a href="http://www.renesas.com">http://www.renesas.com</a>)</td>
</tr>
<tr>
<td>5. Renesas has used reasonable care in compiling the information included in this document, but Renesas assumes no liability whatsoever for any damages incurred as a result of errors or omissions in the information included in this document.</td>
</tr>
<tr>
<td>6. When using or otherwise relying on the information in this document, you should evaluate the information in light of the total system before deciding about the applicability of such information to the intended application. Renesas makes no representations, warranties or guarantees regarding the suitability of its products for any particular application and specifically disclaims any liability arising out of the application and use of the information in this document or Renesas products.</td>
</tr>
<tr>
<td>7. With the exception of products specified by Renesas as suitable for automobile applications, Renesas products are not designed, manufactured or tested for applications or otherwise in systems the failure or malfunction of which may cause a direct threat to human life or create a risk of human injury or which require especially high quality and reliability such as safety systems, or equipment or systems for transportation and traffic, healthcare, combustion control, aerospace and aeronautics, nuclear power, or underwater communication transmission. If you are considering the use of our products for such purposes, please contact a Renesas sales office beforehand. Renesas shall have no liability for damages arising out of the uses set forth above.</td>
</tr>
<tr>
<td>8. Notwithstanding the preceding paragraph, you should not use Renesas products for the purposes listed below:</td>
</tr>
<tr>
<td>(1) artificial life support devices or systems</td>
</tr>
<tr>
<td>(2) surgical implantations</td>
</tr>
<tr>
<td>(3) healthcare intervention (e.g., excision, administration of medication, etc.)</td>
</tr>
<tr>
<td>(4) any other purposes that pose a direct threat to human life</td>
</tr>
<tr>
<td>Renesas shall have no liability for damages arising out of the uses set forth in the above and purchasers who elect to use Renesas products in any of the foregoing applications shall indemnify and hold harmless Renesas Technology Corp., its affiliated companies and their officers, directors, and employees against any and all damages arising out of such applications.</td>
</tr>
<tr>
<td>9. You should use the products described herein within the range specified by Renesas, especially with respect to the maximum rating, operating supply voltage range, movement power voltage range, heat radiation characteristics, installation and other product characteristics. Renesas shall have no liability for malfunctions or damages arising out of the use of Renesas products beyond such specified ranges.</td>
</tr>
<tr>
<td>10. Although Renesas endeavors to improve the quality and reliability of its products, IC products have specific characteristics such as the occurrence of failure at a certain rate and malfunctions under certain use conditions. Please be sure to implement safety measures to guard against the possibility of physical injury, and injury or damage caused by fire in the event of the failure of a Renesas product, such as safety design for hardware and software including but not limited to redundancy, fire control and malfunction prevention, appropriate treatment for aging degradation or any other applicable measures. Among others, since the evaluation of microcomputer software alone is very difficult, please evaluate the safety of the final products or system manufactured by you.</td>
</tr>
<tr>
<td>11. In case Renesas products listed in this document are detached from the products to which the Renesas products are attached or affixed, the risk of accident such as swallowing by infants and small children is very high. You should implement safety measures so that Renesas products may not be easily detached from your products. Renesas shall have no liability for damages arising out of such detachment.</td>
</tr>
<tr>
<td>12. This document may not be reproduced or duplicated, in any form, in whole or in part, without prior written approval from Renesas.</td>
</tr>
<tr>
<td>13. Please contact a Renesas sales office if you have any questions regarding the information contained in this document, Renesas semiconductor products, or if you have any other inquiries.</td>
</tr>
</tbody>
</table>
About This Manual

This manual describes the HEW system. This manual is composed of two parts. HEW part describes information on the basic “look and feel” of the HEW and customizing the HEW environment and detail the build. Figure in the HEW part are those of the SH series. Simulator/Debugger part describes Debugger functions of the High-performance Embedded Workshop.

This manual does not intend to explain how to write C/C++ or assembly language programs, how to use any particular operating system or how best to tailor code for the individual devices. These issues are left to the respective manuals.

Document Conventions

This manual uses the following typographic conventions:

Table 1 Typographic Conventions

<table>
<thead>
<tr>
<th>Convention</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>[Menu-&gt;Menu Option]</td>
<td>Bold text with ‘-&gt;’ is used to indicate menu options</td>
</tr>
<tr>
<td>FILENAME.C</td>
<td>Uppercase names are used to indicate filenames.</td>
</tr>
<tr>
<td>“enter this string”</td>
<td>Used to indicate text that must be entered (excluding the “&quot; quotes).</td>
</tr>
<tr>
<td>Key + Key</td>
<td>Used to indicate required key presses. For example, CTRL+N means press the CTRL key and then, whilst holding the CTRL key down, press the N key.</td>
</tr>
<tr>
<td>(The “how to” symbol)</td>
<td>When this symbol is used, it is always located in the left hand margin. It indicates that the text to its immediate right is describing “how to” do something.</td>
</tr>
</tbody>
</table>
Contents

Section 1  Overview .......................................................................................................................... 1

Section 2  Simulator/Debugger Functions .......................................................................................... 3
2.1 Features ...................................................................................................................................... 3
2.2 Target User Program .................................................................................................................. 3
2.3 Range of Simulation ................................................................................................................... 4
2.4 Functions Supported by SH-4 Series .......................................................................................... 7
  2.4.1 Bus State Controller (BSC) ................................................................................................. 7
  2.4.2 Direct Memory Access Controller (DMAC) ....................................................................... 8
2.5 External/Internal Clock Ratio ..................................................................................................... 9
2.6 Endian .......................................................................................................................................... 9
2.7 Memory Management Unit (MMU) ............................................................................................ 10
2.8 Cache ......................................................................................................................................... 12
  2.8.1 Displaying Cache Contents ................................................................................................. 12
  2.8.2 Cache Hit Rate ................................................................................................................... 18
2.9 Timer ......................................................................................................................................... 19
  2.9.1 Supported Range ................................................................................................................ 19
  2.9.2 Control Registers .............................................................................................................. 19
  2.9.3 Clocks .................................................................................................................................. 21
  2.9.4 Using a Timer .................................................................................................................... 21
  2.9.5 Notes on Using a Timer .................................................................................................... 22
2.10 Control Registers ...................................................................................................................... 23
2.11 Pipeline Reset Processing ......................................................................................................... 25
2.12 Exception Processing ................................................................................................................. 26
2.13 Memory Management ............................................................................................................... 28
2.14 Trace ......................................................................................................................................... 29
2.15 Standard I/O and File I/O Processing ....................................................................................... 30
2.16 Break Conditions ..................................................................................................................... 31
2.17 Floating-Point Data .................................................................................................................. 35
2.18 Display of Function Call History ............................................................................................ 36
2.19 Performance Measurement ....................................................................................................... 37
  2.19.1 Profiler ............................................................................................................................ 37
  2.19.2 Performance Analysis ....................................................................................................... 37
2.20 Pseudo-Interrupts .................................................................................................................. 38
2.21 Coverage ................................................................................................................................. 39
Section 3 Debugging .................................................................41
3.1 Creating the Workspace for Simulator/Debugger ...............................42
  3.1.1 Selecting a Debugging Platform ............................................42
  3.1.2 Setting up a Workspace for the Simulator/Debugger .........44
3.2 Modifying the Simulator/Debugger Settings ........................................46
  3.2.1 Modifying the Simulator System ............................................46
  3.2.2 Modifying the Memory Map and Memory Resource Settings ...49
  3.2.3 Set Memory Map Dialog Box .................................................53
  3.2.4 Set State Dialog Box .............................................................55
  3.2.5 Set Memory Resource Dialog Box .........................................58
3.3 Simulating Peripheral Functions .......................................................59
  3.3.1 Registering Peripheral Function Simulation Modules .................59
  3.3.2 Changing the Addresses of Peripheral Functions ....................61
  3.3.3 Changing the Interrupt Source Information of Peripheral Functions 63
  3.3.4 Changing the Address of the Bank Control Register (SH2A-FPU Only).....65
  3.3.5 Allocating Memory Resources to the Interrupt Priority Register ...65
  3.3.6 Viewing the Names of Connected Peripheral Functions ..........65
3.4 Using the Simulator/Debugger Breakpoints .........................................66
  3.4.1 Listing the Breakpoints .........................................................66
  3.4.2 Setting a Breakpoint ...............................................................68
  3.4.3 Modifying Breakpoints ...........................................................79
  3.4.4 Enabling a Breakpoint ............................................................79
  3.4.5 Disabling a Breakpoint ...........................................................79
  3.4.6 Deleting a Breakpoint .............................................................79
  3.4.7 Deleting All Breakpoints .........................................................79
  3.4.8 Viewing the Source Line for a Breakpoint .................................80
  3.4.9 Closing Input or Output File ...................................................80
  3.4.10 Closing All Input and Output Files .........................................80
3.5 Viewing Trace Information.............................................................81
  3.5.1 Opening the Trace Window .....................................................81
  3.5.2 Specifying Trace Acquisition Conditions .................................81
  3.5.3 Acquiring Trace Information ..................................................83
  3.5.4 Searching for a Trace Record ..................................................91
  3.5.5 Clearing the Trace Information ...............................................92
  3.5.6 Saving the Trace Information in a File ....................................92
  3.5.7 Viewing the Source File ..........................................................92
  3.5.8 Trimming the Source ..............................................................92
  3.5.9 Analyzing Statistical Information .........................................93
3.6 Viewing the Profile Information .......................................................94
  3.6.1 Stack Information Files .........................................................94
3.6.2 Profile Information Files ............................................................................................................. 96
3.6.3 Loading Stack Information Files ........................................................................................................ 98
3.6.4 Enabling the Profile ......................................................................................................................... 100
3.6.5 Specifying Measurement Mode ....................................................................................................... 100
3.6.6 Executing the Program and Checking the Results ............................................................................ 100
3.6.7 List Sheet ........................................................................................................................................ 101
3.6.8 Tree Sheet ....................................................................................................................................... 102
3.6.9 Profile-Chart Window ..................................................................................................................... 105
3.6.10 Types and Purposes of Displayed Data ........................................................................................... 106
3.6.11 Creating Profile Information Files ................................................................................................. 108
3.6.12 Notes ............................................................................................................................................. 109

3.7 Analyzing Performance .......................................................................................................................... 110
3.7.1 Opening the Performance Analysis Window ...................................................................................... 110
3.7.2 Specifying a Target Function .......................................................................................................... 111
3.7.3 Starting Performance Data Acquisition ............................................................................................ 111
3.7.4 Resetting Data .................................................................................................................................. 111
3.7.5 Deleting a Target Function .............................................................................................................. 111
3.7.6 Deleting All Target Functions ......................................................................................................... 112
3.7.7 Saving the Currently Displayed Contents .......................................................................................... 112

3.8 Acquiring Code Coverage ...................................................................................................................... 112
3.8.1 Opening the Coverage Window ....................................................................................................... 112
3.8.2 Acquiring All Coverage Information ................................................................................................. 116
3.8.3 Clearing All Coverage Information ................................................................................................. 116
3.8.4 Viewing the Source Window ............................................................................................................ 116
3.8.5 Specifying the New Coverage Range ................................................................................................. 116
3.8.6 Changing the Coverage Range ......................................................................................................... 116
3.8.7 Deleting the Selected Coverage Range .............................................................................................. 117
3.8.8 Acquiring Coverage Information ..................................................................................................... 118
3.8.9 Clearing Coverage Information ........................................................................................................ 118
3.8.10 Saving Coverage Information in a File .............................................................................................. 118
3.8.11 Loading Coverage Information from a File ...................................................................................... 119
3.8.12 Updating the Information ................................................................................................................. 119
3.8.13 Confirmation Request Dialog Box .................................................................................................. 120
3.8.14 Save Coverage Data Dialog Box .................................................................................................... 121
3.8.15 Displaying the Coverage Information in the [Editor] Window .......................................................... 122
3.8.16 Displaying the Coverage Information in the [Disassembly] Window ............................................ 123

3.9 Generating a Pseudo-Interrupt Manually .............................................................................................. 124
3.9.1 [Trigger] Window .......................................................................................................................... 124
3.9.2 [GUI I/O] Window .......................................................................................................................... 127

3.10 Standard I/O and File I/O Processing .................................................................................................. 131
3.10.1 Opening the Simulated I/O Window ................................................................. 131
3.10.2 I/O Functions ................................................................................................. 132
3.11 Viewing the TLB Contents .................................................................................. 135
  3.11.1 Opening a TLB Window ................................................................................. 135
  3.11.2 Modifying the TLB Contents ................................................................. 141
  3.11.3 Flushing the TLB Contents ................................................................. 141
  3.11.4 Searching the TLB Items ........................................................................... 142
  3.11.5 Continuing the TLB Search ................................................................. 142
  3.11.6 Saving the Currently Displayed Contents .............................................. 143
3.12 Viewing the Cache Contents ............................................................................. 143
  3.12.1 Opening a Cache Window ........................................................................... 143
  3.12.2 Modifying the Cache Contents ................................................................. 151
  3.12.3 Flushing the Cache Contents ...................................................................... 151
  3.12.4 Searching the Cache Items ......................................................................... 152
  3.12.5 Continuing the Cache Search ..................................................................... 152
  3.12.6 Modifying the Cache Capacity ................................................................. 153
  3.12.7 Saving the Currently Displayed Contents .............................................. 158
3.13 Viewing the Contents of Register Banks ........................................................... 159
  3.13.1 Opening the [Register Bank] Window ....................................................... 159
  3.13.2 Modifying the Contents of Register Banks .............................................. 160
  3.13.3 Changing the Radix .................................................................................... 160
3.14 Creating a Virtual I/O Panel ............................................................................ 161
  3.14.1 Opening the [GUI I/O] Window ................................................................. 162
  3.14.2 Creating a Button ......................................................................................... 163
  3.14.3 Creating a Label .......................................................................................... 165
  3.14.4 Creating an LED ......................................................................................... 168
  3.14.5 Creating Fixed Text .................................................................................... 171
  3.14.6 Changing the Size and Position of an Item .............................................. 173
  3.14.7 Copying an Item ......................................................................................... 173
  3.14.8 Deleting an Item ......................................................................................... 174
  3.14.9 Showing the Grid ....................................................................................... 174
  3.14.10 Saving I/O Panel Information ............................................................... 174
  3.14.11 Loading I/O Panel Information ............................................................... 174

Section 4  Windows .................................................................................................. 175

Section 5  Command Lines ..................................................................................... 177
  5.1 Commands (Functional Order) ......................................................................... 177
    5.1.1 Execution ................................................................................................. 177
    5.1.2 Download ............................................................................................... 178

RenCes
5.1.3 Register ................................................................................................................ 178
5.1.4 Register Bank (SH2A-FPU Only)........................................................................ 179
5.1.5 Memory................................................................................................................ 179
5.1.6 Assemble/Disassemble .................................................................................. 179
5.1.7 Break.................................................................................................................... 180
5.1.8 Trace .................................................................................................................... 180
5.1.9 Coverage........................................................................................................... 181
5.1.10 Performance....................................................................................................... 181
5.1.11 Watch................................................................................................................ 181
5.1.12 Script/Logging ..................................................................................................... 182
5.1.13 Memory Resource............................................................................................ 182
5.1.14 Simulator/Debugger Settings .......................................................................... 182
5.1.15 Standard I/O and File I/O................................................................................ 183
5.1.16 Utility.................................................................................................................. 183
5.1.17 Project/Workspace ....................................................................................... 184
5.1.18 Test Tool Facility............................................................................................. 184
5.1.19 Commands (Alphabetical Order) ...................................................................... 185

Section 6 Messages ............................................................................................191
6.1 Information Messages ........................................................................................... 191
6.2 Error Messages ..................................................................................................... 192

Section 7 Tutorial ...............................................................................................197
7.1 Preparation ............................................................................................................ 197
7.1.1 Sample Program ............................................................................................. 197
7.1.2 Creating the Sample Program ...................................................................... 197
7.2 Settings for Debugging ....................................................................................... 198
7.2.1 Allocating the Memory Resource .................................................................. 198
7.2.2 Downloading the Sample Program ............................................................... 199
7.2.3 Displaying the Source Program .................................................................... 200
7.2.4 Setting a PC Breakpoint .............................................................................. 201
7.2.5 Setting the Profiler ...................................................................................... 202
7.2.6 Setting the Simulated I/O ............................................................................ 203
7.2.7 Setting the Trace Information Acquisition Conditions ................................ 205
7.2.8 Setting the Stack Pointer and Program Counter ....................................... 206
7.3 Start Debugging .................................................................................................. 206
7.3.1 Executing a Program .................................................................................... 206
7.3.2 Using the Trace Buffer ................................................................................. 210
7.3.3 Performing Trace Search ............................................................................. 211
7.3.4 Checking Simulated I/O .............................................................................. 212
7.3.5 Checking the Breakpoints
7.3.6 Watching Variables
7.3.7 Executing the Program in Single Steps
7.3.8 Checking Profile Information
Section 1  Overview

The simulator/debugger is a powerful development environment tool for embedded applications running on Renesas Technology microcomputers.

The simulator/debugger is used with the High-performance Embedded Workshop (HEW). The HEW provides a graphical user interface that eases the development and debugging of applications written in the C/C++ programming languages or assembly language for Renesas Technology microcomputers. Its aim is to provide a powerful yet intuitive way of accessing, observing and modifying the debugging platform on which the application is running.

READ the simulator/debugger and HEW help information before using the simulator/debugger.
SuperH™ RISC engine Simulator/Debugger User’s Manual

Section 2   Simulator/Debugger Functions

This section describes the functions of the SuperH™ RISC engine simulator/debugger.

2.1   Features

• Since the simulator/debugger runs on a host computer, software debugging can start without using an actual user system, thus reducing overall system development time.
• The simulator/debugger provides pseudo-interrupt and I/O-simulation functions for simple system-level simulation.
• The simulator/debugger offers the following functions that enable efficient program testing and debugging.
  — The ability to handle all of the SuperH™ RISC engine series CPUs
  — Functions to stop or continue execution when an error occurs during user program execution
  — Profile data acquisition and function-unit performance measurement
  — A comprehensive set of break functions
  — Functions to set or edit memory maps
  — Functions to display function call history
  — Coverage information is displayed in the C/C++ or assembly-source level
  — Visual debugging functions provided through the display of memory contents as images or waveforms
• The breakpoints, memory map, performance, and trace can be set through the dialog boxes under Windows®. Environments corresponding to each memory map of the SuperH™ RISC engine microcomputers can be set through the dialog box.
  — Intuitive user interface
  — Online help
  — Common display and operability

2.2   Target User Program

Load modules in the Elf/Dwarf2 format can be symbolically debugged with the simulator/debugger. Load modules in other formats can be downloaded, and their instructions can be executed; however, they cannot be symbolically debugged. For details, refer to section 17.18.2, Elf/Dwarf2 Support in the High-performance Embedded Workshop V.4.03 User’s Manual.
2.3 Range of Simulation


(2) The SH2-DSP series consists of the SH2-DSP (Core), the SH2-DSP (SH7410), and the SH2-DSP (SH7065) which do not have cache, and the SH2-DSP (SH7612) which has on-chip cache. In this manual, the SH2-DSP series refers to the SH2-DSP (Core), the SH2-DSP (SH7410), the SH2-DSP (SH7065), and the SH2-DSP (SH7612).

(3) The SH3-DSP series consists of the SH3-DSP (Core) and the SH3-DSP; these two types have different DSP functions. In this manual, the SH3-DSP series refers to the SH3-DSP (Core) and the SH3-DSP.

(4) The SH-4 series consists of two types of microcomputers, SH-4 and SH-4 (SH7750R), which have different cache specifications. In addition, the SH-4 has two different versions of microcomputers; one improves the simulation speed by limiting part of the simulation functions (called SH-4 in this manual) and the other provides high-level functions (called SH-4BSC in this manual). Note that in this manual, the SH-4 series refers to the SH-4, the SH-4BSC, and the SH-4 (SH7750R).

(5) The SH-4A series consists of the SH4AL-DSP that incorporates the DSP, and the SH-4A that incorporates the FPU. The extended version is not supported. In this manual, the SH-4A series refers to the SH4AL-DSP and the SH-4A.

(6) Pipeline simulation is supported for the SH-1, SH-2, SH-2E, SH-3, SH-3E, SH2-DSP, SH3-DSP, and SH-4 series microcomputers. As well as pipeline simulation, a further type of debugging target platform is available for the SH3-DSP and SH-4 microcomputers: a functional simulator that supports instruction-unit simulation. Inclusion of “Functional Simulator” in the name of the debugging target indicates this kind of target. In a functional simulator, the number of executed instruction cycles is calculated on the assumption that each instruction is executed in one cycle.
(7) The SH-4A series and SH2A-FPU microcomputers have two types of debugger target. Inclusion of “Cycle Base Simulator” in the debugger target name indicates support for pipeline simulation while the inclusion of “Functional Simulator” indicates support for instruction-unit simulation. In a functional simulator, the number of executed instruction cycles is calculated on the assumption that each instruction is executed in one cycle. In a cycle-based simulator, the number of executed instruction cycles is calculated according to the contents of a table that defines the internal operation of instructions and the state of usage of resources such as registers as a result of instruction-set level simulation. The number of cycles, however, still might not match the result on the actual device. To figure out the exact number of execution cycles (execution time), we recommend that you use the actual device on the emulator or evaluation board.

(8) The simulator/debugger supports the following SuperH™ RISC engine series microcomputer functions:
- All CPU instructions
- Exception processing
- Registers
- All address space
- Peripheral functions shown in table 2.1
### Table 2.1 Simulator/Debugger Functions and Corresponding CPUs

<table>
<thead>
<tr>
<th>Names of Debugging Platforms</th>
<th>Endian</th>
<th>MMU</th>
<th>Cache</th>
<th>Register</th>
<th>BSC</th>
<th>DMAC</th>
<th>Timer</th>
</tr>
</thead>
<tbody>
<tr>
<td>SH-1</td>
<td>⎯</td>
<td>⎯</td>
<td>⎯</td>
<td>⎯</td>
<td>⎯</td>
<td>⎯</td>
<td>⎯</td>
</tr>
<tr>
<td>SH-2</td>
<td>○</td>
<td>⎯</td>
<td>⎯</td>
<td>⎯</td>
<td>⎯</td>
<td>⎯</td>
<td>Δ</td>
</tr>
<tr>
<td>SH-2E</td>
<td>⎯</td>
<td>⎯</td>
<td>⎯</td>
<td>⎯</td>
<td>⎯</td>
<td>⎯</td>
<td>Δ</td>
</tr>
<tr>
<td>SH-3</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>⎯</td>
<td>⎯</td>
<td>⎯</td>
<td>Δ</td>
</tr>
<tr>
<td>SH-3E</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>⎯</td>
<td>⎯</td>
<td>⎯</td>
<td>⎯</td>
</tr>
<tr>
<td>SH3-DSP</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>⎯</td>
<td>⎯</td>
<td>⎯</td>
<td>Δ</td>
</tr>
<tr>
<td>SH3-DSP Functional Simulator</td>
<td>○</td>
<td>⎯</td>
<td>○</td>
<td>⎯</td>
<td>⎯</td>
<td>⎯</td>
<td>Δ</td>
</tr>
<tr>
<td>SH3-DSP (Core)</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>⎯</td>
<td>⎯</td>
<td>⎯</td>
<td>Δ</td>
</tr>
<tr>
<td>SH-4</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>Δ</td>
<td>⎯</td>
<td>⎯</td>
<td>Δ</td>
</tr>
<tr>
<td>SH-4 Functional Simulator</td>
<td>○</td>
<td>⎯</td>
<td>○</td>
<td>⎯</td>
<td>⎯</td>
<td>⎯</td>
<td>Δ</td>
</tr>
<tr>
<td>SH-4BSC</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>⎯</td>
<td>○</td>
<td>Δ</td>
<td></td>
</tr>
<tr>
<td>SH-4 (SH7750R)</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>Δ</td>
<td>⎯</td>
<td>Δ</td>
<td></td>
</tr>
<tr>
<td>SH2-DSP (SH7410)</td>
<td>⎯</td>
<td>⎯</td>
<td>⎯</td>
<td>⎯</td>
<td>⎯</td>
<td>⎯</td>
<td>Δ</td>
</tr>
<tr>
<td>SH2-DSP (Core)</td>
<td>⎯</td>
<td>⎯</td>
<td>⎯</td>
<td>⎯</td>
<td>⎯</td>
<td>⎯</td>
<td>Δ</td>
</tr>
<tr>
<td>SH2-DSP (SH7065)</td>
<td>○</td>
<td>⎯</td>
<td>⎯</td>
<td>⎯</td>
<td>⎯</td>
<td>⎯</td>
<td>Δ</td>
</tr>
<tr>
<td>SH2-DSP (SH7612)</td>
<td>○</td>
<td>⎯</td>
<td>○</td>
<td>⎯</td>
<td>⎯</td>
<td>⎯</td>
<td>Δ</td>
</tr>
<tr>
<td>SH-2A-FPU</td>
<td>⎯</td>
<td>⎯</td>
<td>○</td>
<td>⎯</td>
<td>⎯</td>
<td>Δ</td>
<td></td>
</tr>
<tr>
<td>SH-4A</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>⎯</td>
<td>⎯</td>
<td>Δ</td>
<td></td>
</tr>
<tr>
<td>SH-4AL-DSP</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>⎯</td>
<td>⎯</td>
<td>Δ</td>
<td></td>
</tr>
</tbody>
</table>

Note: ○: Supported
      ⎯: Not supported
      Δ: Partly supported
(9) The simulator/debugger does not support the following SuperH™ RISC engine series MCU functions. Programs that use these functions must be debugged with the SuperH™ RISC engine series emulator.

- Serial communication interface (SCI)
- I/O ports

(10) The SH2A-FPU supports register banks that allow fast save/restore operations in interrupt processing. Up to 15 register banks (banks 0 to 14) are supported.

2.4 Functions Supported by SH-4 Series

2.4.1 Bus State Controller (BSC)

For the SH-4BSC, the simulator/debugger has the functions for specifying and modifying the memory map in accordance with the BSC setting so that a user program using the BSC can be debugged.

For the SH-4 and SH-4 (SH7750R), the simulator/debugger does not support the bus control function in the BSC, only SRAM, bus width, and the number of states can be specified.

Table 2.2 is a list of memory types that can be specified for the SH-4BSC, SH-4, and SH-4 (SH7750R).
Table 2.2 Memory Types for SH-4BSC, SH-4, and SH-4 (SH7750R) Simulator/Debugger

<table>
<thead>
<tr>
<th>Address</th>
<th>Specifiable Memory Types</th>
</tr>
</thead>
<tbody>
<tr>
<td>H’00000000 to H’03FFFFFF (area 0)</td>
<td>Normal memory, burst ROM, and MPX</td>
</tr>
<tr>
<td>H’04000000 to H’07FFFFFF (area 1)</td>
<td>Normal memory, byte control SRAM, and MPX</td>
</tr>
<tr>
<td>H’08000000 to H’0BFFFFFF (area 2)</td>
<td>Normal memory, DRAM, SDRAM, and MPX</td>
</tr>
<tr>
<td>H’0C000000 to H’0FFFFFFF (area 3)</td>
<td>Normal memory, DRAM, SDRAM, and MPX</td>
</tr>
<tr>
<td>H’10000000 to H’13FFFFFF (area 4)</td>
<td>Normal memory, byte control SRAM, and MPX</td>
</tr>
<tr>
<td>H’14000000 to H’17FFFFFF (area 5)</td>
<td>Normal memory, burst ROM, and MPX</td>
</tr>
<tr>
<td>H’18000000 to H’1BFFFFFF (area 6)</td>
<td>Normal memory, burst ROM, and MPX</td>
</tr>
<tr>
<td>H’1C000000 to H’1FFFFFFF (area 7)</td>
<td>Cannot be specified</td>
</tr>
<tr>
<td>H’7C000000 to H’7C001FFF</td>
<td>Internal RAM (cannot be changed)</td>
</tr>
<tr>
<td>H’E0000000 to H’FFFFFFFF</td>
<td>I/O (cannot be changed)</td>
</tr>
</tbody>
</table>

The high-order three bits of the addresses for areas 0 to 7 in table 2.2 must be ignored; H’00000000 and H’20000000 are both in area 0.

The simulator/debugger does not support the PCMCIA interface.

For details on settings of memory mapping, refer to section 3.2.2, Modifying the Memory Map and Memory Resource Settings.

2.4.2 Direct Memory Access Controller (DMAC)

For the SH-4BSC, the simulator/debugger simulates the 4-channel DMAC operations; the user program using the DMAC can be debugged.

For the SH-4 and SH-4 (SH7750R), the DMA function cannot be used.
2.5 External/Internal Clock Ratio

The external/internal clock ratio is 1:1. This can be modified by the CLOCK_RATE command only for the SH-4 series. For details on the CLOCK_RATE command, refer to the help information of the simulator/debugger.

2.6 Endian

In the SH-2 series, SH-3, SH-3E, SH3-DSP series, SH-4 series, SH-4A series, SH2-DSP (SH7065), and SH2-DSP (SH7612), the byte order according to little endian as well as big endian can be specified as the data allocation format in the memory. This enables a user program created in the little endian format to be simulated and debugged.

Specify the endian when selecting the debugging platform. When “(Little endian)” is added to the platform name, it indicates little endian (otherwise big endian).

The specified endian is valid for all accesses to external memory. It is also valid for accesses to the X or Y memory with the SH3-DSP series, the L memory with the SH-4A series, and the X, Y, or U memory with the SH4AL-DSP series. Word or longword data is written to or read from the memory in the specified byte order.

Note: The specified endian is applied to all accesses to external memory in common. The SH2-DSP (SH7612) and SH2-DSP (SH7065) have the function to specify endian in memory area units, but the simulator/debugger does not support this function.
2.7 Memory Management Unit (MMU)

For the SH-3, SH-3E, SH3-DSP series, SH-4 series, and SH-4A series, the simulator/debugger simulates MMU operations such as TLB operations, address translation, or MMU-related exceptions (TLB miss exception, TLB protection exception, TLB invalid exception, and initial page write exception). The user program using address translation by the MMU can thus be simulated and debugged. In addition, the MMU-related exception handler routines can be simulated and debugged. The MMU functions differ depending on the CPU.

**SH-3, SH-3E, and SH3-DSP Series:**

The following window and dialog boxes are provided to manipulate the 32-entry 4-way TLB contents.

- **TLB window:** Displays and flushes the TLB contents
- **TLB item modify dialog boxes:** Modifies the TLB items
- **TLB item find dialog boxes:** Searches for the TLB items

For details, refer to section 3.11, Viewing the TLB Contents.

The TLB is mapped in the range of addresses H'F2000000 to H'F3FFFFFF (all entries of the TLB are allocated within this range).

**Note:** The SH3-DSP functional simulator and SH3 functional simulator do not simulate MMU operations.
SH-4 Series and SH-4A Series:

The following windows and dialog boxes are provided to manipulate the 4-entry instruction TLB and 64-entry unified TLB contents:

- Instruction TLB window: Displays and flushes the instruction TLB contents
- Unified TLB window: Displays and flushes the unified TLB contents
- TLB item modify dialog boxes: Modifies the TLB items
- TLB item find dialog boxes: Searches for the TLB items

In the SH-4A, the following window is also provided to manipulate the 16-entry instruction PMB contents:

- PMB window: Displays and flushes the PMB contents

For details, refer to section 3.11, Viewing the TLB Contents.

The simulator/debugger does not support data array 2 for both the instruction TLB and unified TLB.

As well as during simulation, the MMU translates virtual addresses into physical addresses during address display or input in the dialog boxes or windows. Therefore, in the dialog boxes and windows, memory can be accessed with the virtual addresses used in the user program. Note, however, that physical addresses must be used in [Memory map] and [System memory resource].

Notes:
1. If an associative write to a TLB entry is performed using the [Memory] window, the entry may not be modified correctly. In this case, use the [Edit] dialog box in the longword format. To open the [Edit] dialog box in the longword format, open the [Memory] window in the longword format and double-click the data to be modified.
2. Some devices do not incorporate the PMB.
3. The SH-4 functional simulator does not simulate MMU operations.
2.8 Cache

For the SH-3, SH-3E, SH3-DSP series, SH-4 series, SH2A-FPU series, SH-4A series, and SH2-DSP (SH7612), the simulator/debugger simulates cache operations and displays the cache contents and cache hit rate. This allows cache operations to be monitored during user program execution. The cache contents differ depending on the CPU.

2.8.1 Displaying Cache Contents

SH-3, SH-3E, SH3-DSP Series, and SH2-DSP (SH7612):

The following window and dialog boxes are provided to manipulate the cache contents:

- Cache window: Displays and flushes the cache contents
- Cache item modify dialog boxes: Modifies the cache items
- Cache item find dialog boxes: Searches for the cache items

For the SH-3 and SH-3E series, the [Cache Capacity] dialog box enables the cache capacity to be specified. This function is unique to this simulator/debugger. Half of the cache can be specified as the internal RAM. Table 2.3 shows the cache capacity and the ways to be used.

Table 2.3 Specifiable Cache Capacity for SH-3 and SH-3E Series Simulator/Debugger

<table>
<thead>
<tr>
<th>Cache Capacity</th>
<th>Ways to Be Used</th>
<th>Internal RAM Specification (Ways that Can Be Used as Internal RAM)</th>
</tr>
</thead>
<tbody>
<tr>
<td>8 Kbytes</td>
<td>Ways 0 to 3</td>
<td>Ways 2 and 3 can be used as internal RAM</td>
</tr>
<tr>
<td>4 Kbytes</td>
<td>Ways 0 and 1</td>
<td>Way 1 can be used as internal RAM</td>
</tr>
<tr>
<td>2 Kbytes</td>
<td>Way 0</td>
<td>No way can be used as internal RAM (internal RAM specification is ignored)</td>
</tr>
</tbody>
</table>

For details, refer to section 3.12, Viewing the Cache Contents.

The cache is mapped in the range of addresses H'F0000000 to H'F1FFFFFF in the SH-3, SH-3E, and SH3-DSP series. In the SH2-DSP (SH7612), the address array is mapped in the range of addresses H'60000000 to H'7FFFFFFF, and the data array is mapped in the range of addresses H'C0000000 to H'C0000FFF.
SH-4 and SH-4BSC:

The simulator/debugger simulates operations of the 8-kbyte instruction cache, the 16-kbyte operand cache, and two 32-byte store queues (SQ). The following windows and dialog boxes are provided to manipulate the cache contents:

- Instruction cache window: Displays and flushes the instruction cache contents
- Operand cache window: Displays and flushes the operand cache contents
- Cache item modify dialog boxes: Modifies the cache items
- Cache item find dialog boxes: Searches for the cache items

For details, refer to section 3.12, Viewing the Cache Contents.

The instruction cache is mapped in the range of addresses H'F0000000 to H'F1FFFFFF, the operand cache is mapped in the range of addresses H'F4000000 to H'F5FFFFFF, and the SQ is mapped in the range of addresses H'E0000000 to H'E3FFFFFF.

Note: If an associative write to a cache entry or modification of a cache address array is performed by using the [Memory] window, the entry or array may not be modified correctly. In this case, use the [Edit] dialog box in the longword format. To open the [Edit] dialog box in the longword format, open the [Memory] window in the longword format and double-click the data to be modified.

The simulator/debugger does not change the high-order three bits of the address tag stored in a cache address array to zeros.

When loading a program to the area where the cache is mapped by using the [Load Object File] dialog box or by copying memory data to this area via the [Copy Memory] dialog box, clear the AT bit of the MMUCR to zero to disable the MMU.
SH-4 (SH7750R):

The simulator/debugger simulates operations of the 16-kbyte instruction cache, the 32-kbyte operand cache, and two 32-byte store queues (SQ). The following windows and dialog boxes are provided to manipulate the cache contents:

- Instruction cache window: Displays and flushes the instruction cache contents
- Operand cache window: Displays and flushes the operand cache contents
- Cache item modify dialog boxes: Modifies the cache items
- Cache item find dialog boxes: Searches for the cache items

For details, refer to section 3.12, Viewing the Cache Contents.

The instruction cache is mapped in the range of addresses H'F0000000 to H'F1FFFFFF, the operand cache is mapped in the range of addresses H'F4000000 to H'F5FFFFFF, and the SQ is mapped in the range of addresses H'E0000000 to H'E3FFFFFF.

Note: If an associative write to a cache entry or modification of a cache address array is performed by using the [Memory] window, the entry or array may not be modified correctly. In this case, use the [Edit] dialog box in the longword format. To open the [Edit] dialog box in the longword format, open the [Memory] window in the longword format and double-click the data to be modified.

The simulator/debugger does not change the high-order three bits of the address tag stored in a cache address array to zeros.

When loading a program to the area where the cache is mapped by using the [Load Object File] dialog box or by copying memory data to this area via the [Copy Memory] dialog box, clear the AT bit of the MMUCR to zero to disable the MMU.
SH2A-FPU Series:

The simulator/debugger for the SH2A-FPU simulates the operation of the instruction cache, operand cache, and ROM cache. The following windows and dialog boxes are provided for the manipulation of cache contents:

- **Instruction cache window**: Displays and flushes the contents of the instruction cache.
- **Operand cache window**: Displays and flushes the contents of the operand cache.
- **ROM prefetch cache window**: Displays and flushes the contents of the ROM prefetch cache.
- **ROM prefetch miss cache window**: Displays and flushes the contents of the ROM prefetch miss cache.
- **ROM operand cache window**: Displays and flushes the contents of the ROM operand cache.
- **Modify cache dialog box**: Modifies cache entries.
- **Find cache dialog box**: Searches for cache entries.

The [Cache Capacity] dialog box enables specification of the cache capacity. Table 2.4 shows the cache type and the cache capacity.
Table 2.4 Specifiable Cache Capacity for SH2A-FPU Simulator/Debugger

<table>
<thead>
<tr>
<th>Cache Type</th>
<th>Cache Capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Instruction cache</td>
<td>8 Kbytes</td>
</tr>
<tr>
<td></td>
<td>16 Kbytes</td>
</tr>
<tr>
<td></td>
<td>32 Kbytes</td>
</tr>
<tr>
<td></td>
<td>64 Kbytes</td>
</tr>
<tr>
<td></td>
<td>128 Kbytes</td>
</tr>
<tr>
<td></td>
<td>256 Kbytes</td>
</tr>
<tr>
<td></td>
<td>512 Kbytes</td>
</tr>
<tr>
<td></td>
<td>1 Mbyte</td>
</tr>
<tr>
<td>Operand cache</td>
<td>8 Kbytes</td>
</tr>
<tr>
<td></td>
<td>16 Kbytes</td>
</tr>
<tr>
<td></td>
<td>32 Kbytes</td>
</tr>
<tr>
<td></td>
<td>64 Kbytes</td>
</tr>
<tr>
<td></td>
<td>128 Kbytes</td>
</tr>
<tr>
<td></td>
<td>256 Kbytes</td>
</tr>
<tr>
<td></td>
<td>512 Kbytes</td>
</tr>
<tr>
<td></td>
<td>1 Mbyte</td>
</tr>
</tbody>
</table>

For details, refer to section 3.12, Viewing the Cache Contents.

The address array and data array of the instruction cache are mapped to the ranges of addresses H'F0000000 to H'F07FFFFF and H'F1000000 to H'F17FFFFF, respectively. The address array and data array of the operand cache are mapped to the ranges of addresses H'F0800000 to H'F0FFFFFF and H'F1800000 to H'F1FFFFFF, respectively.

Notes:
1. If an associative write to a cache entry or modification of a cache address array is performed by using the [Memory] window, the entry or array may not be modified correctly. In this case, use the [Edit] dialog box in the longword format. To open the [Edit] dialog box in the longword format, open the [Memory] window in the longword format and double-click the data to be modified.
2. If you attempt to change instruction-cache enabled data via the [Disassembly] or [Memory] window, only the external memory content is updated; the actual instruction-cache data are not affected. To change instruction-cache enabled data, disable the instruction cache beforehand.
SH-4A Series:

The simulator/debugger simulates operations of the instruction cache and the operand cache. With the SH-4A, level-2 cache and two 32-byte store queues (SQ) are simulated. The following windows and dialog boxes are provided to manipulate the cache contents:

- Instruction cache window: Displays and flushes the instruction cache contents
- Operand cache window: Displays and flushes the operand cache contents
- Level-2 cache window (SH-4A only): Displays and flushes the level-2 cache contents
- Cache item modify dialog boxes: Modifies the cache items
- Cache item find dialog boxes: Searches for the cache items

The [Cache Capacity] dialog box enables the cache capacity to be specified. This function is unique to this simulator. Table 2.5 shows the cache type and the cache capacity.

Table 2.5 Specifiable Cache Capacity for SH-4A and SH4AL-DSP Simulator/Debugger

<table>
<thead>
<tr>
<th>Cache Type</th>
<th>Cache Capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Instruction cache</td>
<td>8 Kbytes</td>
</tr>
<tr>
<td></td>
<td>16 Kbytes</td>
</tr>
<tr>
<td></td>
<td>32 Kbytes</td>
</tr>
<tr>
<td></td>
<td>64 Kbytes</td>
</tr>
<tr>
<td></td>
<td>128 Kbytes</td>
</tr>
<tr>
<td>Operand cache</td>
<td>8 Kbytes</td>
</tr>
<tr>
<td></td>
<td>16 Kbytes</td>
</tr>
<tr>
<td></td>
<td>32 Kbytes</td>
</tr>
<tr>
<td></td>
<td>64 Kbytes</td>
</tr>
<tr>
<td></td>
<td>128 Kbytes</td>
</tr>
<tr>
<td>Level-2 cache (SH-4A only)</td>
<td>128 Kbytes</td>
</tr>
<tr>
<td></td>
<td>256 Kbytes</td>
</tr>
<tr>
<td></td>
<td>512 Kbytes</td>
</tr>
<tr>
<td></td>
<td>1 Mbyte</td>
</tr>
</tbody>
</table>

For details, refer to section 3.12, Viewing the Cache Contents.
The instruction cache is mapped in the range of addresses H'F0000000 to H'F1FFFFFF and the operand cache is mapped in the range of addresses H'F4000000 to H'F5FFFFFF. For the SH-4A, the level-2 cache is mapped in the range of addresses H'F8000000 to H'F9FFFFFF and the SQ is mapped in the range of addresses H'E0000000 to H'E3FFFFFF.

Notes: 1. If an associative write to a cache entry or modification of a cache address array is performed by using the [Memory] window, the entry or array may not be modified correctly. In this case, use the [Edit] dialog box in the longword format. To open the [Edit] dialog box in the longword format, open the [Memory] window in the longword format and double-click the data to be modified.

2. Some devices do not incorporate the level-2 cache.

When loading a program to the area where the cache is mapped by using the [Load Object File] dialog box or by copying memory data to this area via the [Copy Memory] dialog box, clear the AT bit of the MMUCR to zero to disable the MMU.

2.8.2 Cache Hit Rate

Checking and Displaying the Cache Hit Rate: The simulator/debugger acquires the rate of the number of cache hits count to the cache access count as the cache hit rate. The cache hit rate is displayed in percentage in the [Platform] sheet in the [Status] window. The cache hit rate is obtained by dividing the cache hit count by the cache access count (the sum of the cache hit count and cache miss count).

The cache hit count and cache miss count are also displayed.

Initializing the Cache Hit Rate: The displayed cache hit rate is initialized when the simulator/debugger is initiated, the pipeline is reset, or the CCR control register value is modified. In the SH3-DSP series, the cache hit rate is initialized also when the CCR2 control register value is modified.
2.9 Timer

2.9.1 Supported Range

The simulator/debugger only supports channel 0 of each timer.

In addition, the simulator/debugger also supports interrupts by an overflow, underflow, or compare match, but does not support functions with the input and output of the pin such as the input capture.

2.9.2 Control Registers

This simulator/debugger supports timer control registers. Table 2.6 shows the control registers supported by the simulator/debugger.

The addresses of the timer control registers, interrupt vector numbers, and positions of the interrupt priority registers can be changed in the [Peripheral Module Configuration] dialog box. For details on the [Peripheral Module Configuration] dialog box, refer to section 3.3, Simulating Peripheral Functions.
## Table 2.6  Timer Control Registers Supported by the Simulator/Debugger

<table>
<thead>
<tr>
<th>Names of Debugging Platforms</th>
<th>Timer</th>
<th>Supported Control Register</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>SH-1 ITU0</td>
<td></td>
<td>TSTR</td>
<td>△</td>
</tr>
<tr>
<td></td>
<td></td>
<td>TCR</td>
<td>△</td>
</tr>
<tr>
<td></td>
<td></td>
<td>TIER</td>
<td>○</td>
</tr>
<tr>
<td></td>
<td></td>
<td>TSR</td>
<td>○</td>
</tr>
<tr>
<td></td>
<td></td>
<td>TCNT</td>
<td>○</td>
</tr>
<tr>
<td></td>
<td></td>
<td>GRA</td>
<td>○</td>
</tr>
<tr>
<td></td>
<td></td>
<td>GRB</td>
<td>○</td>
</tr>
<tr>
<td>SH-2/SH-2E/SH2-DSP (SH7065)/SH2A-FPU CMT0</td>
<td>CMSTR</td>
<td>○</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>CMCSR</td>
<td>○</td>
</tr>
<tr>
<td></td>
<td></td>
<td>CMCNT</td>
<td>△</td>
</tr>
<tr>
<td>SH-3/SH3-DSP/SH3-DSP (Core)/SH-4/SH-4BSC/SH-4 (SH7750R)/SH4AL-DSP TMU0</td>
<td>TCR</td>
<td>○</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>TCNT</td>
<td>○</td>
</tr>
<tr>
<td></td>
<td></td>
<td>TSTR</td>
<td>○</td>
</tr>
<tr>
<td>SH-4A TMU0</td>
<td></td>
<td>TSTR0</td>
<td>○</td>
</tr>
<tr>
<td></td>
<td></td>
<td>TCR0</td>
<td>△</td>
</tr>
<tr>
<td></td>
<td></td>
<td>TCNT0</td>
<td>○</td>
</tr>
<tr>
<td></td>
<td></td>
<td>TCR1</td>
<td>○</td>
</tr>
<tr>
<td></td>
<td></td>
<td>TCR3</td>
<td>○</td>
</tr>
<tr>
<td></td>
<td></td>
<td>TCR3</td>
<td>△</td>
</tr>
</tbody>
</table>
Table 2.6 Timer Control Registers Supported by the Simulator/Debugger (cont)

<table>
<thead>
<tr>
<th>Names of Debugging Platforms</th>
<th>Timer</th>
<th>Supported Control Register</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>SH2-DSP (Core)</td>
<td>FRT0</td>
<td>TIER</td>
<td>Δ</td>
</tr>
<tr>
<td></td>
<td></td>
<td>FTCSR</td>
<td>Δ</td>
</tr>
<tr>
<td></td>
<td></td>
<td>FRC</td>
<td>o</td>
</tr>
<tr>
<td></td>
<td></td>
<td>OCRA</td>
<td>o</td>
</tr>
<tr>
<td></td>
<td></td>
<td>OCRB</td>
<td>o</td>
</tr>
<tr>
<td></td>
<td></td>
<td>TCR</td>
<td>Δ</td>
</tr>
<tr>
<td></td>
<td></td>
<td>TOCR</td>
<td>Δ</td>
</tr>
</tbody>
</table>

Note: o: Supported
Δ: Partly supported (bits for the function described in section 2.9.1, Supported Range)

2.9.3 Clocks

The simulator/debugger supports an internal clock that provides timing in access to memory, a peripheral function clock, and clocks for operating the timers.

The numbers of cycles of the internal clock required for access to memory correspond to the specifications for the memory map. Set the frequency ratio of the internal clock to the peripheral function clock in the [Set Peripheral Function Simulation] dialog box.

Use the timer control register to specify the division ratio to create the clock for operating the timers.

2.9.4 Using a Timer

To use a timer, the timer module must be registered in the [Set Peripheral Function Simulation] dialog box, which is opened at initiation of the simulator/debugger.

For details on the timer module registration, refer to section 3.3, Simulating Peripheral Functions.
2.9.5 Notes on Using a Timer

1. Even if the actual CPU can only clear a bit to 0, the simulator can write 1 to this bit.
2. During simulation, the SH-2DSP (core) accesses the 16-bit registers via a temporary register. However, during command access, the SH-2DSP (core) directly accesses those registers without using the temporary register.
3. The user can select whether or not to cause a break when a timer interrupt occurs. This can be set in the [Simulator System] dialog box or by the EXEC_STOP_SET command.
2.10 Control Registers

For the SH-3, SH-3E, SH3-DSP series, SH-4 series, and SH-4A series, the simulator/debugger supports the memory-mapped control registers that are used for exception processing, MMU control, and cache control. In addition, for the SH-4 series, the simulator/debugger also supports the control registers that are used for BSC and DMAC control. For the SH2A-FPU, the simulator/debugger supports the memory-mapped control registers that are used for cache control and register bank control. For the SH2-DSP (SH7612), the simulator/debugger only supports the CCR register that is used for cache control. Therefore, a user program using exception processing, MMU control, cache control, BSC control, and DMAC control can be simulated and debugged. For control registers related to timers, refer to section 2.9.2, Control Registers.

The control registers supported by the simulator/debugger are listed below.

**MMU**
- **PTEH**: Page table entry high register
- **PTEL**: Page table entry low register
- **TTB**: Translation table base register
- **TEA**: TLB exception address register
- **MMUCR**: MMU control register
- **PASCR**: Physical address space control register

**Exception processing**
- **TRA**: TRAPA exception register
- **EXPEVT**: Exception event register
- **INTEVT**: Interrupt event register

**INTC**
- **IBCR**: Bank control register
- **IBNR**: Bank number register
- **USERIMASK**: User interrupt mask level setting register

**INTC2**
- **INT2PRI0**: Interrupt priority setting register 0
- **INT2PRI1**: Interrupt priority setting register 1
- **INT2A0**: Interrupt source register (mask state not affected)
- **INT2A1**: Interrupt source register (mask state affected)
- **INT2MSKR**: Interrupt mask register
- **INT2MSKCR**: Interrupt mask clear register
- **INT2B0**: Individual module interrupt source register

**Cache**
- **CCR**: Cache control register
- **CCR1**: Cache control register 1
- **CCR2**: Cache control register 2
- **QACR0 and QACR1**: Queue address control registers 0 and 1
- **RCCR**: ROM cache control register
- **RCCR2**: ROM cache control register 2
RCCR4*: ROM cache control register 4

BSC
BCR1 and BCR2*: Bus control registers 1 and 2
WCR1 and WCR2*: Wait state control registers 1 and 2
WCR3*: Wait state control register 3
MCR*: Individual memory control register
RTCSR*: Refresh timer control/status register
RTCNT*: Refresh timer/counter
RTCOR*: Refresh time constant register
RFCR*: Refresh count register

DMAC
SAR0 to SAR3*: DMA source address registers 0 to 3
DAR0 to DAR3*: DMA destination address registers 0 to 3
DMATCR0 to DMATCR3*: DMA transfer count registers 0 to 3
CHCR0 to CHCR3*: DMA channel control registers 0 to 3
DMAOR*: DMA operation register

X/Y memory
XSA*: X memory transfer source address register
YSA*: Y memory transfer source address register
XDA*: X memory destination address register
YDA*: Y memory destination address register
XPR*: X bus protection control register
YPR*: Y bus protection control register
XER*: X bus exception control register
YER*: Y bus exception control register

RAM
RAMACYC*: RAM access cycle setting register

L memory
LSA0 and LSA1*: L memory transfer source control register 0 and 1
LDA0 and LDA1*: L memory transfer destination control register 0 and 1

Notes:
1. Only supported by the SH3-DSP series.
2. Only supported by SH-4 series.
3. Only supported by the SH-4A series.
4. Only supported by the SH4AL-DSP series.
5. Only supported by the SH2A-FPU series.
6. Only supported by the SH-4BSC series.
7. Only the CCR register is supported by the SH2-DSP (SH7612).

The simulator/debugger does not support the PCMCIA interface or the synchronous DRAM mode register.
To modify or display a control register value, use the [IO] window. For details, refer to section 17.6, Looking at I/O Memory, in the High-performance Embedded Workshop V.4.03 User’s Manual.

In the SH-4/SH-4 (SH7750R), the simulator supports only a part of bits of the following registers.

<table>
<thead>
<tr>
<th>Register Name</th>
<th>Bit Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>BCR1</td>
<td>ENDIAN</td>
</tr>
<tr>
<td>BCR2</td>
<td>A6SZ-A0SZ</td>
</tr>
<tr>
<td>WCR1</td>
<td>A6IW-A0IW</td>
</tr>
<tr>
<td>WCR2</td>
<td>A6W-A0W</td>
</tr>
</tbody>
</table>

Note: Values of the registers that are not supported can be modified or referenced via the [IO] window, etc., but the simulator/debugger execution will not be affected.

2.11 Pipeline Reset Processing

The simulator/debugger that simulates the pipeline execution, resets the pipeline when:

- The program counter (PC) is modified after the instruction simulation stops and before it restarts.
- The Run command to which the execution start address has been specified is executed.
- Initialization is performed or the program is loaded.

When the pipeline is reset, data already fetched and decoded is discarded, and new data is fetched and decoded from the current PC. In addition, the number of executed instructions and the number of instruction execution cycles are zero-cleared.
2.12 Exception Processing

The simulator/debugger detects the generation of exceptions corresponding to TRAPA instructions, general illegal instructions, slot illegal instructions, and address errors. In addition, for the SH-3, SH-3E, SH3-DSP series, SH-4 series, and SH-4A series, the simulator/debugger simulates MMU-related exception processing (TLB miss, TLB protection exception, TLB invalid exception, and initial page write). For the SH-2E, SH-3E, SH-4 series, and SH-4 series, the simulator/debugger also simulates FPU exception processing. Accordingly, simulation can be performed even when an exception occurs.

The simulator/debugger simulates exception processing with the following procedures, depending on the [Execution Mode] setting in the [Simulator System] dialog box.

**SH-1, SH-2, SH-2E, SH2A-FPU, and SH2-DSP Series:**

- When [Continue] is selected (continuation mode):
  1. Detects an exception during instruction execution.
  2. Saves the PC and SR in the stack area.
  3. Reads the start address from the vector address corresponding to the vector number.
  4. Starts instruction execution from the start address. If the start address is 0, the simulator/debugger stops exception processing, shows that an exception processing error has occurred, and enters the command input wait state.

- When [Stop] is selected (stop mode):
  Executes steps 1 to 3 above, then stops.

**SH-3, SH-3E, SH3-DSP Series and SH4AL-DSP:**

- When [Continue] is selected (continuation mode):
  1. Detects an exception during instruction execution.
  2. Saves the PC and SR to the SPC and SSR, respectively.
  3. Sets the BL bit, RB bit, and MD bit in the SR to 1.
  4. Sets an exception code in control register EXPEVT. If necessary, appropriate values are set in other control registers.
  5. Sets the PC to the vector address corresponding to the exception source. (If an exception is detected when the BL bit in the SR is 1, reset vector address H'FA000000 is set in the PC regardless of the exception source.)
  6. Starts instruction execution from the address set in the PC.
• When [Stop] is selected (stop mode):
  Executes steps 1 to 5 above, then stops.

**SH-4 Series and SH-4A:**

• When [Continue] is selected (continuation mode):
  1. Detects an exception during instruction execution.
  2. Saves the PC and SR to the SPC and SSR, respectively.
  3. Sets the BL bit, RB bit, and MD bit in the SR to 1.
  4. Sets the FD (FPU disable) bit in the SR to 0 at reset.
  5. Sets an exception code in control register EXPEVT. If necessary, appropriate values are set in other control registers.
  6. Sets the PC to the vector address corresponding to the exception source. (If an exception is detected when the BL bit in the SR is 1, reset vector address H'00000000 is set in the PC regardless of the exception source.)
  7. Starts instruction execution from the address set in the PC.
• When [Stop] is selected (stop mode):
  Executes steps 1 to 6 above, then stops.
2.13 Memory Management

Memory Map Specification: A memory map is used to calculate the number of memory access cycles during simulation. The following items can be specified:

- Memory type
- Start and end addresses of the memory area
- Number of memory access cycles
- Memory data bus width

The memory types that can be specified differ depending on the CPU. For details, refer to section 3.2, Modifying the Simulator/Debugger Settings. The user program can be executed in all areas except for the internal I/O area.

Memory Resource Specification: A memory resource must be specified to load and execute a user program. The following items can be specified:

- Start address
- End address
- Access type

The access type can be readable/writable, read-only, or write-only.

Since an error occurs if the user program attempts an illegal access (for example, trying to write to read-only memory), such an illegal access in the user program can be easily detected.

For details on memory resource setting, refer to section 3.2.2, Modifying the Memory Map and Memory Resource Settings.
2.14 Trace

The simulator/debugger writes the execution results of each instruction into the trace buffer. The conditions for trace information acquisition can be specified in the [Trace Acquisition] dialog box. Right-clicking on the [Trace] window displays the pop-up menu. Choose [Acquisition...] from the pop-up menu to display the [Trace Acquisition] dialog box. The acquired trace information is displayed in the [Trace] window. The trace information displayed in the [Trace] window differs according to the CPU.

The trace information can be searched. The search conditions can be specified in the [Trace Search] dialog box. Right-clicking on the [Trace] window displays the pop-up menu. Choose [Find...] from the pop-up menu to display the [Trace Search] dialog box.

For details, refer to section 3.5, Viewing Trace Information.
2.15  Standard I/O and File I/O Processing

The simulator/debugger enables the standard I/O and file I/O processing listed in table 2.8 to be executed by the user program. When the I/O processing is executed, the [Simulated I/O] window must be open. Table 2.8 shows the supported I/O functions.

Table 2.8  I/O Functions

<table>
<thead>
<tr>
<th>No.</th>
<th>Function Code</th>
<th>Function Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>H'21</td>
<td>GETC</td>
<td>Inputs one byte from the standard input</td>
</tr>
<tr>
<td>2</td>
<td>H'22</td>
<td>PUTC</td>
<td>Outputs one byte to the standard output</td>
</tr>
<tr>
<td>3</td>
<td>H'23</td>
<td>GETS</td>
<td>Inputs one line from the standard input</td>
</tr>
<tr>
<td>4</td>
<td>H'24</td>
<td>PUTS</td>
<td>Outputs one line to the standard output</td>
</tr>
<tr>
<td>5</td>
<td>H'25</td>
<td>FOPEN</td>
<td>Opens a file</td>
</tr>
<tr>
<td>6</td>
<td>H'06</td>
<td>FCLOSE</td>
<td>Closes a file</td>
</tr>
<tr>
<td>7</td>
<td>H'27</td>
<td>FGETC</td>
<td>Inputs one byte from a file</td>
</tr>
<tr>
<td>8</td>
<td>H'28</td>
<td>FPUTC</td>
<td>Outputs one byte to a file</td>
</tr>
<tr>
<td>9</td>
<td>H'29</td>
<td>FGETS</td>
<td>Inputs one line from a file</td>
</tr>
<tr>
<td>10</td>
<td>H'2A</td>
<td>FPUTS</td>
<td>Outputs one line to a file</td>
</tr>
<tr>
<td>11</td>
<td>H'0B</td>
<td>FEOF</td>
<td>Checks for end of the file</td>
</tr>
<tr>
<td>12</td>
<td>H'0C</td>
<td>FSEEK</td>
<td>Moves the file pointer</td>
</tr>
<tr>
<td>13</td>
<td>H'0D</td>
<td>FTELL</td>
<td>Returns the current position of the file pointer</td>
</tr>
</tbody>
</table>

For details on I/O functions, refer to section 3.10, Standard I/O and File I/O Processing.
2.16 Break Conditions

The simulator/debugger provides the following conditions for interrupting the simulation of a user program during execution.

- Break due to the satisfaction of a break command condition
- Break due to the detection of an error during execution of the user program
- Break due to a trace buffer overflow
- Break due to execution of the SLEEP instruction
- Break due to the [STOP] button

**Break Due to Satisfaction of a Break Command Condition:** There are six break commands as follows:

- **BREAKPOINT:** Break based on the address of the instruction executed
- **BREAK_ACCESS:** Break based on access to a memory range
- **BREAK_CYCLE:** Break based on the number of execution cycles
- **BREAK_DATA:** Break based on the value of data written to memory
- **BREAK_REGISTER:** Break based on the value of data written to a register
- **BREAK_SEQUENCE:** Break based on a specified execution sequence

If [Stop] is specified as the action for when a break condition is satisfied, user program execution stops when the break condition is satisfied. For details, refer to section 3.4, Using the Simulator/Debugger Breakpoints.

When a break condition is satisfied and user program execution stops, the instruction at the breakpoint may or may not be executed before a break depending on the type of break, as listed in table 2.9.
Table 2.9  Processing When a Break Condition is Satisfied

<table>
<thead>
<tr>
<th>Command</th>
<th>Instruction When a Break Condition is Satisfied</th>
</tr>
</thead>
<tbody>
<tr>
<td>BREAKPOINT</td>
<td>Not executed</td>
</tr>
<tr>
<td>BREAK_ACCESS</td>
<td>Executed</td>
</tr>
<tr>
<td>BREAK_CYCLE</td>
<td>Executed</td>
</tr>
<tr>
<td>BREAK_DATA</td>
<td>Executed</td>
</tr>
<tr>
<td>BREAK_REGISTER</td>
<td>Executed</td>
</tr>
<tr>
<td>BREAK_SEQUENCE</td>
<td>Not executed</td>
</tr>
</tbody>
</table>

For BREAKPOINT and BREAKSEQUENCE, if a breakpoint is specified at an address other than the beginning of an instruction, the break will not be detected.

When a break condition is satisfied during user program execution, a break condition satisfaction message is displayed in the [Output] window and execution stops.
Break Due to Error Detection during User Program Execution: The simulator/debugger detects simulation errors, that is, program errors that cannot be detected by the CPU exception generation functions. The [Simulator System] dialog box specifies whether to stop or continue the simulation when such an error occurs. Table 2.10 lists the error messages, error causes, and the action of the simulator/debugger in the continuation mode.

Table 2.10 Simulation Errors

<table>
<thead>
<tr>
<th>Error Message</th>
<th>Error Cause</th>
<th>Processing in Continuation Mode</th>
</tr>
</thead>
<tbody>
<tr>
<td>Memory Access Error (Address: H'nnnnnnnn)</td>
<td>Access to a memory area that has not been allocated</td>
<td>On memory write, nothing is written; on memory read, all bits are read as 1.</td>
</tr>
<tr>
<td></td>
<td>Write to a memory area having the write-protected attribute</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Read from a memory area having the read disable attribute</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Access to an area where memory data do not exist</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Access to a control register in an invalid size</td>
<td></td>
</tr>
<tr>
<td>Illegal Operation</td>
<td>Zero division executed by the DIV1 instruction</td>
<td>Operates in the same way as the actual device operation.</td>
</tr>
<tr>
<td></td>
<td>Writing zero by the SETRC instruction</td>
<td></td>
</tr>
<tr>
<td>Illegal DSP Operation</td>
<td>Shift of more than 32 bits executed by the PSHA instruction</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Shift of more than 16 bits executed by the PSHL instruction</td>
<td></td>
</tr>
<tr>
<td>Invalid DSP Instruction Code</td>
<td>Invalid DSP instruction code</td>
<td>Always stops.</td>
</tr>
<tr>
<td>TLB Multiple Hit</td>
<td>Hit to multiple TLB entries at MMU address translation (only for the SH-3, SH-3E, and SH3-DSP series)</td>
<td>Undefined.</td>
</tr>
</tbody>
</table>

When a simulation error occurs in the stop mode, the simulator/debugger returns to the command input wait state after stopping instruction execution and displaying the error message. When a memory access error occurs, the address where the error occurred is also displayed. Table 2.11 lists the states of the program counter (PC) at a simulation error stop. The status register (SR) value does not change at a simulation error stop.
Table 2.11  Register States at Simulation Error Stop

<table>
<thead>
<tr>
<th>Error Message</th>
<th>PC Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Memory Access Error</td>
<td>When an instruction is read:</td>
</tr>
<tr>
<td></td>
<td>— SH2-DSP and SH3-DSP series</td>
</tr>
<tr>
<td></td>
<td>The third instruction address before the instruction that caused the error.</td>
</tr>
<tr>
<td></td>
<td>— SH-1, SH-2, SH-2E, SH-3, SH-3E, and SH-4 series</td>
</tr>
<tr>
<td></td>
<td>The instruction address before the instruction that caused the error.</td>
</tr>
<tr>
<td></td>
<td>The slot address if an error occurs when a branch destination is read.</td>
</tr>
<tr>
<td></td>
<td>When an instruction is executed:</td>
</tr>
<tr>
<td></td>
<td>The instruction address following the instruction that caused the error.</td>
</tr>
<tr>
<td>Illegal Operation</td>
<td>The instruction address following the instruction that caused the error.</td>
</tr>
<tr>
<td>Illegal DSP Operation</td>
<td>The second instruction address following the instruction that caused the error.</td>
</tr>
<tr>
<td>Invalid DSP Instruction Code</td>
<td>The second instruction address following the instruction that caused the error.</td>
</tr>
<tr>
<td>TLB Multiple Hit</td>
<td>The address of the instruction that caused the error.</td>
</tr>
</tbody>
</table>

Use the following procedure when debugging programs that include instructions that generate simulation errors.

1. First execute the program in the stop mode and confirm that there are no errors except those in the intended locations.
2. After confirming the above, execute the program in the continuation mode.

Note: If an error occurs in the stop mode and simulation is continued after changing the simulator/debugger mode to the continuation mode, simulation may not be performed correctly. When restarting simulation, always restore the register contents (general, control, and system registers) and the memory contents to the state prior to the occurrence of the error.
Break Due to a Trace Buffer Overflow: After the [Break] mode is specified with [Trace Buffer Full Handling] in the [Trace Acquisition] dialog box, the simulator/debugger stops execution when the trace buffer becomes full. The following message is displayed in the [Output] window when execution is stopped.

Trace Buffer Full

Break Due to Execution of the SLEEP Instruction: When the SLEEP instruction is executed during instruction execution, the simulator/debugger stops execution. The following message is displayed in the [Output] window when execution is stopped.

Sleep

Note: When restarting execution, change the PC value to the instruction address at the restart location.

Break Due to the [STOP] Button: Users can forcibly terminate execution by clicking the [STOP] button during instruction execution. The following message is displayed in the [Output] window when execution is stopped.

Stop

Execution can be resumed with the GO or STEP command.

2.17 Floating-Point Data

Floating-point numbers can be used for the following real-number data, which makes floating-point data processing easier. The following data can be specified for floating-point data:

- Data when the break type is set to [Break Data] or [Break Register] in the [Select Break Type] dialog box
- Data in the [Memory] window
- Data in the [Fill Memory] dialog box
- Data in the [Search Memory] dialog box
- Input data in the [Register] dialog box

The floating-point data format conforms to the ANSI C standard.
In simulator/debugger, the rounding mode depends on the debugging platform as shown below:

<table>
<thead>
<tr>
<th>Debugging Platform</th>
<th>Round Mode</th>
</tr>
</thead>
<tbody>
<tr>
<td>SH-3, SH3-DSP series, SH-4 series, or SH4A-series</td>
<td>Round to Zero (RZ)</td>
</tr>
<tr>
<td>Others</td>
<td>Round to Nearest (RN)</td>
</tr>
</tbody>
</table>

If a denormalized number is specified for binary-to-decimal or decimal-to-binary conversion, it is converted to zero in RZ mode, and left as a denormalized number in RN mode. If an overflow occurs during decimal-to-binary conversion, the maximum floating-point value is returned in RZ mode, and the infinity is returned in RN mode.

### 2.18 Display of Function Call History

The simulator/debugger displays the function call history in the [Stack Trace] window when simulation stops, which enables program execution flow to be checked easily. Selecting a function name in the [Stack Trace] window displays the corresponding source program in the [Editor] window. This allows the function that has called the current function to also be checked.

The displayed function call history is updated in the following cases:

- When simulation stops due to the break conditions described in section 2.16, Break Conditions.
- When register values are modified while simulation stops due to the above break conditions.
- While single-step execution is performed.

For details, refer to section 17.15, Viewing the Function Call History in the High-performance Embedded Workshop V.4.03 User’s Manual.
2.19 Performance Measurement

The simulator/debugger has the profiler function and performance analysis function for performance measurement of the user program.

2.19.1 Profiler

The profiler function displays the memory address and size allocated to functions and global variables, the number of function calls, and the profile data for the entire user program. The profile data to be displayed depends on the CPU.

Profile information is displayed in list, tree, and chart formats.

Profile information is useful in optimizing user programs by reducing the size and putting the most frequently called functions in-line.

When using the profile information saved in a file, it is possible to optimize user programs based on dynamic information using the optimizing linkage editor.

For details, refer to section 3.6, Viewing the Profile Information, and description of PROfile in section 4.2.4, Optimize Option in the Optimizing Linkage Editor User's Manual.

2.19.2 Performance Analysis

The performance analysis function displays the number of execution cycles and function calls for the specified function in the user program. Since performance data for only the specified function is acquired, faster simulation is possible. For details, refer to section 3.7, Analyzing Performance.
2.20 Pseudo-Interrupts

The simulator/debugger can generate pseudo-interrupts during simulation in the following two ways:

1. Pseudo-interrupts generated by satisfaction of break conditions
   A pseudo-interrupt can be generated using a break command to specify [Interrupt] as the action when a break condition is satisfied. For details, refer to section 3.4, Using the Simulator/Debugger Breakpoints.

2. Pseudo-interrupts generated from windows
   A pseudo-interrupt can be generated by clicking a button in the [Trigger] or [GUI I/O] window. For details, refer to section 3.9, Generating a Pseudo-Interrupt Manually.

If another pseudo-interrupt occurs between a pseudo-interrupt occurrence and its acceptance, only the interrupt that has a higher priority can be processed.

3. Break by pseudo-interrupts
   The user can select whether or not to cause a break when a pseudo-interrupt occurs. This can be set in the [Simulator System] dialog box or by the EXEC_STOP_SET command.

Note: Whether an interrupt is accepted is determined by the specifications of the CPU for the selected debugging platform. Note however that when H’11 is specified as the priority level of an interrupt, that interrupt is always accepted. The simulator/debugger does not simulate the operation of the interrupt controller.
2.21 Coverage

The simulator/debugger acquires instruction coverage information during instruction execution within the measurement range specified by the user.

This address range can either be a range entered directly by the user or through a source file, in which it covers several ranges dedicated for the functions.

The state of each instruction execution can be monitored through the instruction coverage information. In addition, this information can be used to determine which part of a program has not been executed.

The [Coverage] window displays the acquired instruction coverage information:

The instruction coverage information can be displayed in the [Editor] window by highlighting the column corresponding to the source line of the executed instruction.

The statistic of the instruction executed within a range, or a function is also displayed, in percentage. This gives the user a clear idea how much the program has been executed.

The instruction coverage information can be saved in or loaded from a file. Only a file in the .COV format can be loaded.

For details, refer to section 3.8, Acquiring Code Coverage.
Section 3  Debugging

This section describes the simulator/debugger operations and their related windows and dialog boxes.

For details on the functions common to the HEW listed below, refer to the HEW help information.

— Preparations for Debugging
— Viewing a Program
— Operating Memory
— Displaying Memory Contents as Waveforms
— Displaying Memory Contents as an Image
— Modifying the Memory Contents
— Viewing the I/O Memory
— Looking at Registers
— Executing Your Program
— Viewing the Current Status
— Synchronizing Multiple Debugging Platforms
— Debugging with the Command Line Interface
— Elf/Dwarf2 Support
— Looking at Labels
3.1 Creating the Workspace for Simulator/Debugger

To use the simulator/debugger, a workspace for the simulator/debugger must be created. This section only describes the procedures specific to the simulator/debugger. For details, refer to the HEW help.

3.1.1 Selecting a Debugging Platform

When you create a new workspace, the dialog box shown below appears. Specify the debugging platform (depending on the CPU type, endian, and simulator type) in step 7.

![Figure 3.1 Debugger Target Setting Display (Step 7)](image-url)
[Targets]  Sets the debugger targets. Select (by checking) the debugger targets. No selection or a selection of more than one target is possible.

[Target type]  Specifies the type of the targets displayed in [Targets].

Note:  The endian type selected in step 2 will be applied to the compiler and assembler settings. This is not dependent on the endian type of the debugger target selected in step 7. In step 1, [SH-2A] not having the FPU or [SH2A-FPU] having the FPU can be selected. Even if you have selected [SH-2A] in step 1, you need to select the SH2A-FPU simulator in step 7 because the simulator(debugger) only supports the SH2A-FPU.
3.1.2 Setting up a Workspace for the Simulator/Debugger

Set up the workspace for the simulator/debugger in step 8.

![Debugger Option Setting Display (Step 8)](image)

**Figure 3.2  Debugger Option Setting Display (Step 8)**

**[Configuration name]** By default, the HEW generates two configurations: [Release] and [Debug]. If a debugger target has been selected, a configuration for the selected target is also generated (an abbreviation including the target name). This configuration name can be changed in **[Configuration name]**.

**[Detail options]** Sets the debugger target options. To modify an option, select [Item] and click [Modify]. If the selected item cannot be modified, [Modify] remains gray even when [Item] is selected.
**[Simulator I/O]**  Simulation for standard I/O or file I/O from the user program is enabled ([Enable]) or disabled ([Disable]).

**[Simulator I/O addr.]**  Address for the above simulated I/O.

**[On-chip ROM mode]**  Internal ROM capacity (SH2A-FPU only).

<table>
<thead>
<tr>
<th>Capacity</th>
<th>Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>Disable</td>
<td>Internal ROM is disabled</td>
</tr>
<tr>
<td>Enable (128K byte)</td>
<td>128 Kbytes</td>
</tr>
<tr>
<td>Enable (256K byte)</td>
<td>256 Kbytes</td>
</tr>
<tr>
<td>Enable (512K byte)</td>
<td>512 Kbytes</td>
</tr>
<tr>
<td>Enable (1M byte)</td>
<td>1 Mbyte</td>
</tr>
<tr>
<td>Enable (2M byte)</td>
<td>2 Mbytes</td>
</tr>
</tbody>
</table>

**[Bus mode]**  Currently cannot be used by the simulator/debugger.
3.2 Modifying the Simulator/Debugger Settings

This section describes how to modify the simulator system, memory map, and memory resource settings after the simulator/debugger is started.

3.2.1 Modifying the Simulator System

The [System] tab in the [Simulator System] dialog box is used to modify the location to start the simulated I/O or execution mode.

Choose [Setup -> Simulator -> System...] or click the [Simulator System] toolbar button to open the [System] tab in this dialog box.

![Simulator System Dialog Box (System Tab)](image)

Figure 3.3 Simulator System Dialog Box (System Tab)
The following items can be specified in this dialog box:

**[CPU]** Current CPU. (The CPU must be specified in the [Debug Settings] dialog box.) For the SH2-DSP (SH7410), select [Internal Mode] or [External Mode].
For SH2-DSP (SH7065), one of the followings can be selected:
- [ROM Disable/Fast Mode] Internal ROM disabled/fast access mode
- [ROM Disable/Slow Mode] Internal ROM disabled/slow access mode
- [ROM Enable/Fast Mode] Internal ROM enabled/fast access mode
- [ROM Enable/Slow Mode] Internal ROM enabled/slow access mode
For SH2-DSP (Core), either of the followings can be selected:
- [ROM Disable] Internal ROM disabled mode
- [ROM Enable] Internal ROM enabled mode

**[Bit size]** Address bus width fixed to 32 bits

**[Endian]** Currently selected endian

**[Clock Rate]** This can be specified only for SH-4 series.
Specify the internal clock ratio when the external clock is assumed 1. (H’1 to H’10)

**[Simulated I/O Address]** Start address of a simulated I/O that performs standard input/output or file input/output processing from the user program.
[Enable] Checking this box enables the simulated I/O.

**[Response]** Window refresh timing; that is, how many instructions should be executed between refresh operations (D’1 to D’2,147,483,647. The default is D’40000).

**[Execution Mode]** Whether the simulator/debugger stops or continues operation when a simulation error occurs. An interrupt is assumed as a simulation error. It is also possible to specify an action to take place when an interrupt occurs by clicking the [Detail...] button.
- [Stop] Stops simulation.
- [Continue] Continues simulation.
[Step Unit] This can be specified only for the SH-3, SH3-DSP series, and SH-4 series. Select the status of the instruction executed when STEP command is executed, and a PC break is satisfied.

[Stage] Stops before instruction is executed.
Pipeline operation is not affected.

[Instruction] Stops after instruction is executed.
Pipeline operation is affected, and as a result, the number of effective cycles becomes incorrect.

Clicking the [OK] or [Apply] button stores the modified settings. Clicking the [Cancel] button closes this dialog box without modifying the settings.
3.2.2 Modifying the Memory Map and Memory Resource Settings

The [Memory] tab in the [Simulator System] dialog box is used to set and modify the memory map and memory resource.

![Simulator System Dialog Box (Memory Tab)](image)

The following items can be specified in this dialog box:

- **[Memory Map]** Displays the memory type, start and end addresses, data bus width, and the number of access cycles.

- **[Memory Resource]** Displays the access type and start and end addresses of the current memory resource.
[Memory Map] can be added, modified, or deleted using the following buttons:

- Adds [Memory Map] items. Clicking this button opens the [Set Memory Map] dialog box (figure 3.5), and memory map items can be added.

- Modifies [Memory Map] items. Select an item to be modified in the list box and click this button. The [Set Memory Map] dialog box (figure 3.5) opens and memory map items can be modified.

- Deletes [Memory Map] items. Select an item to be deleted in the list box and click this button.

[Memory Resource] can be added, modified, or deleted using the following buttons:

- Adds [Memory Resource] items. Clicking this button opens the [Set Memory Resource] dialog box, and memory map items can be specified.

- Modifies [Memory Resource] items. Select an item to be modified in the list box and click this button. The [Set Memory Resource] dialog box opens and memory map items can be modified.

- Deletes [Memory Resource] items. Select an item to be deleted in the list box and click this button.

[Memory Resource] is the same setting information as that of [Memory Resource] of the [Debugger] sheet in the [SuperH RISC engine Standard Toolchain] dialog box. Modifications are reflected on both items.

When there is a linkage list file (.map) output by the optimizing linkage editor, the memory resource can be automatically allocated according to the memory map and linkage map information. For details, refer to section 13.1.9, Automatically Allocating the Memory Resource, in the High-performance Embedded Workshop V.4.03 User’s Manual.
In the [Memory Map], the start address, end address, memory type, data bus width, read cycles, and write cycles are displayed in that order. The memory types are as follows:

- **SH-1, SH-2, SH-2E, SH2A-FPU, SH-3, and SH-3E**
  - ROM (internal ROM), RAM (internal RAM), EXT (external memory), I/O (internal I/O)
- **SH2-DSP (SH7410)/SH3-DSP**
  - XROM (internal XROM), YROM (internal YROM), XRAM (internal XRAM), YRAM (internal YRAM), EXT (external memory), I/O (internal I/O)
- **SH2-DSP (SH7612)**
  - XRAM (internal XRAM), YRAM (internal YRAM), INTRAM (internal RAM), EXT (external memory), I/O (internal I/O)
- **SH2-DSP (SH7065)**
  - XRAM (internal XRAM), YRAM (internal YRAM), INTROM (internal ROM), EXT (external memory), I/O (internal I/O)
- **SH2-DSP (Core)**
  - XRAM (internal XRAM), YRAM (internal YRAM), INTROM (internal ROM), INTRAM (internal RAM), EXT (external memory), I/O (internal I/O)
- **SH3-DSP (Core)**
  - XRAM (internal XRAM), YRAM (internal YRAM), URAM (user RAM), EXT (external memory), I/O (internal I/O)
- **SH-4/SH-4 (SH7750R)**
  - NORMAL (normal memory), INTRAM (internal RAM), I/O (internal I/O)
- **SH-4BSC**
  - NORMAL (normal memory), MPX (Multiplex), BCSRAM (byte-control SRAM), BSTROM (burst ROM and burst count), DRAM (DRAM), SDRAM (synchronous DRAM), INTRAM (internal RAM), I/O (internal I/O)
- **SH-4A**
  - LRAM (internal RAM), URAM (user RAM), EXT (external memory), I/O (internal I/O)
- **SH4AL-DSP**
  - XRAM (internal XRAM), YRAM (internal YRAM), URAM (user RAM), EXT (external memory), I/O (internal I/O)
Note: For the SH-4BSC, the following must be noted:

- The access cycle count is displayed as --.
- Memory map entries cannot be newly created or canceled. Therefore, only the [Modify] button can be used for [Memory Map].
- For the internal RAM and I/O, the memory map entries cannot be modified. To enable or disable the internal RAM, use the ORA bit of the CCR control register.
- The memory map contents depend on the BSC settings in addition to the settings in the [Memory Map Modify] dialog box. If the memory map contents cannot be determined due to BSC incorrect settings, this dialog box shows ?????? for memory types and ?? for the bus width.

[Memory Map] and [Memory Resource] can be reset to the default value by the button. Clicking the [OK] or [Apply] button stores the modified settings. Clicking the [Cancel] button closes this dialog box without modifying the settings.
3.2.3 Set Memory Map Dialog Box

The [Set Memory Map] dialog box specifies the memory map of the target CPU.

The contents displayed in this dialog box depend on the target CPU. The simulator/debugger uses the specified data to calculate the number of cycles for memory accesses.

Figure 3.5 Set Memory Map Dialog Box
The following items are specified:

- **[Memory type]** Memory type
- **[Begin address]** Start address of the memory corresponding to the memory type
- **[End address]** End address of the memory corresponding to the memory type
- **[Data bus size]** Memory data bus width
- **[Read state count]** Number of cycles (“states”) for read access to the specified type of memory
- **[Write state count]** Number of cycles (“states”) for write access to the specified type of memory

For the SH-4 series, [Begin address] and [End address] cannot be modified. Specify [Memory type] and [Data bus size].

In addition, for the SH-4 series, clicking the [Set state...] button opens the [Set State] dialog box (section 3.2.4), and the number of wait-state cycles to be inserted in areas 0 to 7 can be specified. The specified values correspond to the values in the WCR1 and WCR2 control registers.

In terms of the memory resources of the SH-4 series and SH2A-FPU, note the following.

- [Memory type] cannot be modified.
- Unless the selected memory type is EXT, [Begin address] and [End address] are not modifiable.
- For the SH-4A series, [Write state count] is not modifiable, regardless of the selected type of memory.
- When an instruction-unit simulator is in use, settings for numbers of read cycles are invalid because the simulator/debugger handles one instruction per cycle.

Note: The memory map setting for the area allocated to a system memory resource cannot be deleted or modified. First delete the system memory resource allocation on the [Memory] tab of the [Simulator System] dialog box, then delete or modify the memory map setting.

Clicking the [OK] button stores the settings. Clicking the [Cancel] button closes this dialog box without modifying the settings.
3.2.4 Set State Dialog Box

The [Set State] dialog box specifies the wait-state cycles to be inserted in each area. This dialog box is provided only for the SH-4 series.

Note that only the normal memory is supported for the SH-4/SH-4 (SH7750R).

The [Set State] dialog box contents depend on the memory type allocated to the target area. The values set in this dialog box are also set in the WCR1 and WCR2 control registers.

Normal Memory, Burst ROM, and Byte-Control SRAM:

Figure 3.6 Set State Dialog Box (Normal Memory)

[Inserted Idle Cycle] Number of idle cycles to be inserted when the access type changes from read to write, or when the access area changes (corresponds to the AnIW in WCR1)

[Inserted Wait Cycle] Number of wait-state cycles to be inserted in all accesses (corresponds to the AnW in WCR2)
SuperH™ RISC engine Simulator/Debugger User’s Manual

DRAM:

![Set State Dialog Box (DRAM)](image)

**Figure 3.7 Set State Dialog Box (DRAM)**

[Inserted Idle Cycle] Number of idle cycles to be inserted when the access type changes from read to write, or when the access area changes (corresponds to the AnIW in WCR1)

[CAS Assertion Width] CAS assertion width (corresponds to the AnW in WCR2)

SDRAM:

![Set State Dialog Box (SDRAM)](image)

**Figure 3.8 Set State Dialog Box (SDRAM)**

[Inserted Idle Cycle] Number of idle cycles to be inserted when the access type changes from read to write, or when the access area changes (corresponds to the AnIW in WCR1)

[CAS Latency Cycle] Number of CAS latency cycles (corresponds to AnW in WCR2)
MPX:

Figure 3.9 Set State Dialog Box (MPX)

[Inserted Idle Cycle]  Number of idle cycles to be inserted when the access type changes from read to write, or when the access area changes (corresponds to the AnIW in WCR1)

[First Read Cycle]  Number of cycles to be inserted in the first cycle for the read access

[First Write Cycle]  Number of cycles to be inserted in the first cycle for the write access

[Second After Cycle]  Number of cycles to be inserted in the second and the following cycles for the burst transfer

Note: The items marked with * correspond to the AnW in WCR2.
3.2.5 Set Memory Resource Dialog Box

The [Set Memory Resource] dialog box sets and modifies memory resources.

![Set Memory Resource Dialog Box](image)

The following items are specified:

- **[Begin Address]** Start address of the memory area to be allocated
- **[End Address]** End address of the memory area to be allocated
- **[Attribute]** Access type
  - [Read] Read only
  - [Write] Write only
  - [Read/Write] Readable/writable

Click the [OK] button after specifying the [Begin Address], [End Address], and [Attribute]. Clicking the [Cancel] button closes this dialog box without modifying the settings.
Notes: 1. If memory resources are set, memory in the host computer will be used. If the user allocates too much memory resources, operation of the host computer will be extremely slow.

2. There are the following notes on memory resources for the SH2A-FPU and SH-4A series:
   a. Memory resources can only be allocated on 64-kbyte boundaries. If memory resource is allocated across a 64-kbyte boundary, this memory resource will be aligned to 64-kbyte boundaries that include the specified memory range. Similarly, address ranges for attributes are also allocated on 64-kbyte boundaries. XRAM and YRAM are also allocated on 64-kbyte boundaries; thus the amount of memory actually used must be within the range defined in the hardware manual when specifying memory resource less than 64 kbytes.
   b. Do not clear the memory resources allocated as the I/O area at default. Otherwise, the operation of the MMU or cache memory will be incorrect.

3.3 Simulating Peripheral Functions

The simulator/debugger is able to simulate peripheral functions by using DLL modules. This section describes how to register the peripheral function simulation modules to enable the simulation of individual peripheral functions, and how to set their configurations.

3.3.1 Registering Peripheral Function Simulation Modules

Peripheral function simulation modules can be registered in the [Set Peripheral Function Simulation] dialog box, which is opened on initiation of the simulator/debugger.

Once a peripheral function simulation module has been registered in this dialog box, the simulated peripheral function provided by that simulation module becomes available. The registered settings cannot be modified after the simulator/debugger has fully started up. To change the peripheral function simulation modules that are in use, restart the simulator/debugger to bring up this dialog box.
The following items are specified in this dialog box:

- **[Peripheral Functions]** Shows information on the peripheral function simulation modules.
- **[Module Name]** Names of peripheral functions to be simulated
- **[File Name]** Names of files holding peripheral function simulation modules

Check the checkbox under [Module Name] to register the corresponding peripheral function simulation module and make it available.

- **[Enable All]** Enables all peripheral functions.
- **[Disable All]** Disables all peripheral functions.
- **[Detail…]** Opens the [Peripheral Module Configuration] dialog box, allowing you to view information on the corresponding peripheral function, and change the address where it starts and the interrupt-source information.

- **[Peripheral Clock Rate]** The ratio between the peripheral clock and the internal clock (the number of cycles of the internal clock corresponding to one cycle of the peripheral clock) is specified here. The clock rate setting can be selected as 1, 2, 3, 4, 6, 8, 12, 16, 24, or 32.
Clicking the [OK] button makes the settings effective. Clicking the [Cancel] button closes this dialog box without storing the settings.

If you do not wish this dialog box to be opened when the simulator/debugger is subsequently initiated, check [Don’t show this dialog box].

### 3.3.2 Changing the Addresses of Peripheral Functions

The addresses of peripheral functions can be changed in the [Address] tab of the [Peripheral Module Configuration] dialog box. To open this dialog box, select a peripheral function in [Peripheral Functions] of the [Set Peripheral Function Simulation] dialog box and then press the [Detail...] button.

![Peripheral Module Configuration Dialog Box (Address Tab)](image)

Figure 3.12 Peripheral Module Configuration Dialog Box (Address Tab)
The following items can be set or displayed in this dialog box:

[Module]  Name of the peripheral function supported by the selected peripheral function simulation module

[Start Address]  Start address of the peripheral function selected in [Module]

[Register Address]  Names and addresses of registers of the peripheral function selected in [Module]. It is not possible to change the register addresses.

Clicking the [OK] or [Set] button makes the settings effective. Clicking the [Cancel] button closes this dialog box without storing the settings.
3.3.3 Changing the Interrupt Source Information of Peripheral Functions

The interrupt source information of peripheral functions can be changed in the [Interrupt] tab of the [Peripheral Module Configuration] dialog box. To open this dialog box, select a peripheral function in [Peripheral Functions] of the [Set Peripheral Function Simulation] dialog box and then press the [Detail...] button.

![Peripheral Module Configuration Dialog Box (Interrupt Tab)](image)

The following items can be displayed in this dialog box:

- **Interrupt Source:** Name of the interrupt source (or sources) supported by the peripheral function
- **INTEVT:** INTEVT value for SH-3, SH-4, and SH-4A series CPUs
- **INTEVT/INTEVT2:** INTEVT value and INTEVT2 value for SH3-DSP series CPUs
- **Vector Number:** Interrupt vector number for other CPUs
- **Priority Register Address/Bit Field Position:** Address of the interrupt priority register and positions of bits in the register
To change the interrupt-source information, open the [Set Interrupt Source Information] dialog box by double-clicking on the line for the interrupt source to be changed.

![Figure 3.14 Set Interrupt Source Information Dialog Box]

The following items can be set or displayed in this dialog box:

- **Interrupt Source**: Interrupt source name
- **INTEVT**: INTEVT value for SH-3, SH-4, SH-4A, and SH3-DSP series CPUs (when the prefix is omitted, values input are taken as hexadecimal, and the display is in hexadecimal notation)
- **INTEVT2**: INTEVT2 value for SH3-DSP series CPUs only (when the prefix is omitted, values input are taken as hexadecimal, and the display is in hexadecimal notation)
- **Interrupt Vector Number**: Interrupt vector number for other CPUs (when the prefix is omitted, values input are taken as decimal, and the display is in decimal notation)
- **Priority Register Address**: Address of the interrupt priority register
- **Priority Register Size**: Size of the interrupt priority register
- **Priority Register Bit Position**: Positions of bits in the interrupt priority register

Clicking the [OK] button makes the settings effective. Clicking the [Cancel] button closes this dialog box without storing the settings.
3.3.4 Changing the Address of the Bank Control Register (SH2A-FPU Only)

The following commands are used to display and change the addresses of the bank control register (IBC) and the bank number register (IBNR) for products of the SH2A-FPU series.

REGISTER_ADDRESS_GET command: Displays the address of the bank control register

REGISTER_ADDRESS_SET command: Sets the address of the bank control register

For details on the commands, refer to the simulator help.

3.3.5 Allocating Memory Resources to the Interrupt Priority Register

The peripheral function simulation module does not allocate the interrupt priority register (IPR) to a location in memory. Allocate the memory resource for the interrupt priority register (IPR) through user operation. For details on the setting of memory resources, refer to section 3.2.2, Modifying the Memory Map and Memory Resource Settings.

3.3.6 Viewing the Names of Connected Peripheral Functions

After the simulator/debugger has been initiated, [Peripheral Modules] on the [Platform] sheet of the [Status] window shows the names of the peripheral functions that are connected.
3.4 Using the Simulator/Debugger Breakpoints

Sophisticated breakpoint functions are available in the simulator/debugger in addition to the HEW standard PC breakpoints. The user can specify break conditions and actions after a break condition is satisfied, and can display the breakpoints set.

3.4.1 Listing the Breakpoints

Choose [View -> Code -> Eventpoints] or click the [Eventpoints] toolbar button to open the [Event] window, which lists the breakpoints set.

![Event Window](image)

**Figure 3.15 Event Window**
The following items are displayed:

[Type] Break types
  [BP]: PC break
  [BA]: Access break
  [BD]: Data break
  [BR]: Register break (register name)
  [BS]: Sequential break
  [BCY]: Number-of-cycles break

[State] Whether the breakpoint is enabled or disabled.
  [Enable]: Valid
  [Disable]: Invalid

[Condition] Condition that causes a break. The contents to be displayed depend on the type of the break. When the type of the break is BR, the register name is displayed, and when the type of the break is BCY, the number of cycles is displayed.
  BP: PC = Program counter (Corresponding file name, line, and symbol name)
  BA: Address = Address (Symbol name)
  BD: Address = Address (Symbol name)
  BR: Register = Register name
  BS: PC = Program counter (Corresponding file name, line, and symbol name)
  BCY: Cycle = Number of cycles (displayed in hexadecimal)

[Action] Operation of the simulator-debugger when a break condition is satisfied.
  [Stop]: Execution halts
  [File Input] (file name) [File state]: Memory data is read from file
  [File Output] (file name) [File state]: Memory data is written to file
  [Interrupt] (Interrupt type/priority): Interrupt processing.
    Only for the SH3-DSP, (Interrupt type 1, interrupt type 2/priority) is displayed.

Conditions specifying [Stop] for [Action] is displayed on the [Software Break] tab and the conditions specifying another action type is on the [Software Event] tab.
3.4.2 Setting a Breakpoint

Selecting [Add...] from the pop-up menu in the [Event] window opens the [Select Break Type] dialog box, which allows the user to set a breakpoint.

Two further dialog boxes can be opened from the [Select Break Type] dialog box: [Set xx Condition] for specifying a break condition and [Set xx Action] for specifying an action to take when the break condition is satisfied. To open the [Select Break Type] dialog box from the [Event] window when you wish to select [Stop] as [Action type] in the [Select Break Type] dialog box, select [Add...] from the pop-up menu on the [Software Break] tab; if you wish to select another action type, select [Add...] from the pop-up menu on the [Software Event] tab.
Selecting a Break Type:

Selecting [Add...] from the popup menu on the [Event] window opens the [Select Break Type] dialog box. Select a break type in the [Break type] combo box of this dialog box.

![Select Break Type Dialog Box](image)

The following options are available:

- **[Break type]**
  - **[PC Breakpoint]**: Breakpoint set at an instruction
  - **[Break Access]**: Break on access to a memory range
  - **[Break Data]**: Break on detection of a memory value
  - **[Break Register]**: Break on detection of a register value
  - **[Break Sequence]**: Sequential breakpoints
  - **[Break Cycle]**: Break after the specified number of cycles

Setting Break Conditions:

Click on [Detail...] after selecting the break type in the [Select Break Type] dialog box. This opens a dialog box that allows you to set conditions for the selected break type.

- **[PC Breakpoint]**

![Set PC Breakpoint Condition Dialog Box](image)
Up to 1024 PC-breakpoint conditions can be specified.

- **Address**: Address of the instruction where a break will occur
- **Count**: Number of times that the specified instruction is fetched
  (1 to 16,383; the default value is 1; if the prefix is omitted, values input are taken as decimal, and the display is in decimal notation).

- **Break Access**

![Set Break Access Condition Dialog Box](image)

**Figure 3.18 Set Access Break Condition Dialog Box**

Up to 1024 access break conditions can be specified.

- **Begin address**: First address of the range of memory for which access generates a break
- **End address**: Last address of the range of memory for which access generates a break (if no data is input, the range corresponds to the first address alone)
- **Access type**: Read, write, or read/write
• [Break Register]

![Set Break Register Condition Dialog Box](image)

**Figure 3.19  Set Register Break Condition Dialog Box**

Up to 1024 register break conditions can be specified.

- **[Register]**: Register name for which the break condition is specified
- **[Option]**: Match or mismatch with the data
- **[Data]**: Data value used in the break condition (if no data is input here, a break will occur whenever data is written to the register)
- **[Data mask]**: Mask condition (specifying 0 for a bit masks the bit)
- **[Size]**: Data size
[Break Sequence]

Only one sequential break condition can be specified.

[Address1] to [Address8]: Addresses that must be passed as conditions to generate the break (not all of the eight breakpoints have to be set).

Figure 3.20 Set Break Sequence Condition Dialog Box
Up to 1024 number-of-cycles break conditions can be specified.

- **[Cycle]**: Number of cycles required to cause a break (H'1 to H'FFFFFFFF).
  - The condition will be satisfied by execution for the number of cycles in the [Cycle] setting × n.
  - However, the specified number of cycles may differ from the number of cycles on which the condition is satisfied.

- **[Count]**: Number of times the break will occur
  - [ALL]: The break will occur whenever the condition is satisfied.
  - [Times]: The break will only occur up to the number of times specified as [Times] (1 to 65535; if the prefix is omitted, values input are taken as hexadecimal, and the display is in hexadecimal notation).
Data break conditions should be set as follows.

Up to 1024 data break conditions can be specified.

[Address]: Address in memory for which the break condition is specified
[Option]: How the data value is used to form the condition that must be satisfied for break generation
  [Equal]: The value written to memory matches [Data].
  [Not equal]: The value written to memory does not match [Data].
  [Inverse sign]*: The sign of the value written to memory is the inverse of that for the previous value.
  [Difference]*: The difference between the current and previous values written to memory exceeds [Data].

[Data]: Data value used in the break condition
[Data mask]: Mask condition (specifying 0 for a bit masks the bit). This option is only available when [Equal] or [Not equal] has been selected.

[Size]: Data size
[Sign]: Sign of the data. This option is only available when [Difference] has been selected.

Note: Since [Inverse sign] and [Difference] require comparison of the data with the value previously written to memory, the break will never occur on the first test after a reset or break generation when either of these conditions has been selected.
• Point for Caution

For the SH3-DSP series, specify values within the range of addresses H’A5000000 to H’A501FFFF (X and Y memory virtual addresses, corresponding to physical addresses H’05000000 to H’0501FFFF) as [Begin address] and [End address] in [Break Access] and as [Address] in [Break Data] to set up a break condition that corresponds to access to X or Y memory by the MOVX or MOXY instruction.

Selecting an Action in Response to a Break:

If you click on [OK] after setting break conditions in the dialog boxes described on the preceding pages, the [Select Break Type] dialog box is opened again. Select an action type in the [Action type] combo box of this dialog box.

![Select Break Type Dialog Box](image)

The following options are available:

[Stop]: Execution of the user program is stopped when the condition is satisfied.

[File Input]: The contents of a specified file are read out and written to the specified memory when the condition is satisfied.

[File Output]: The contents of the specified memory are read out and written to the specified file when the condition is satisfied.

[Interrupt]: Interrupt processing proceeds when the condition is satisfied.
Setting Details of the Action:

Click on [Detail…] after selecting the action type in the [Select Break Type] dialog box. This opens a dialog box that allows you to set details of the selected action.

- [File Input]

![Set File Input Action Dialog Box](image)

When the condition is satisfied, data are read out from the specified file and written to the specified location in memory.

- [Input file]: File from which data are to be read out. When reading out by the simulator/debugger reaches the end of the file, reading out recommences from the beginning of the same file.
- [Address]: Memory address to which data should be written.
- [Data size]: Size of each data value in bytes (1/2/4/8).
- [Count]: Number of values to be written (H’1 to H’FFFFFFFF; when the prefix is omitted, values input are taken as decimal, and the display is in decimal notation).
**Figure 3.25 Set File Output Action Dialog Box**

When the condition is satisfied, the contents at the specified location in memory are written to the specified file.

- **Output file**: Data file to which data are written.
- **Append**: Selects whether the data should be appended to the file if an existing file is specified as the output file.
- **Address**: Memory address to read data from.
- **Data size**: Size of each data value to be read (1/2/4/8).
- **Count**: Number of values to be read (H’1 to H’FFFFFFFF; when the prefix is omitted, values input are taken as decimal, and the display is in decimal notation).
When the condition is satisfied, interrupt processing proceeds. For details, refer to section 2.20, Pseudo-Interrupts.

[Interrupt type 1]: Sets the following values for each CPU (when the prefix is omitted, values input are taken as hexadecimal, and the display is in hexadecimal notation)

- SH-1, SH-2, and SH2-DSP series
  - Interrupt vector number
- SH2A-FPU
  - Interrupt vector number
- SH-3, SH-4, and SH3-DSP series
  - INTEVT (H’0 to H’FFF)
- SH-4A series
  - INTEVT (H’0 to H’3FFF)

[Interrupt type 2]: Only selectable for the SH3-DSP series (when the prefix is omitted, values input are taken as hexadecimal, and the display is in hexadecimal notation): INTEVT2 (H’0 to H’FFF)

[Priority] Interrupt priority (H’0 to H’11; when the prefix is omitted, values input are taken as hexadecimal, and the display is in hexadecimal notation).

When H’10 is specified, the interrupt is always accepted regardless of the value of the I bit value in SR, but is masked by the BL bit in SR. When H’11 is specified, the interrupt is always accepted regardless of the I and BL bit values in SR.
• Point for Caution

When the same file is specified for multiple [File Input] actions, the simulator/debugger will read data from the file in the order of condition satisfaction. When the same file is specified for multiple [File Output] actions, the simulator/debugger will write data to the file in the order of condition satisfaction. However, when the same file is specified for [File Input] and [File Output], the only valid action is that for the first condition to be satisfied.

3.4.3 Modifying Breakpoints

Select a breakpoint to be modified, and choose [Edit...] from the pop-up menu to open the [Select Break Type] dialog box, which allows the user to modify the break conditions. The [Edit...] menu is only available when one breakpoint is selected.

3.4.4 Enabling a Breakpoint

Select a breakpoint and choose [Enable] from the pop-up menu to enable the selected breakpoint.

3.4.5 Disabling a Breakpoint

Select a breakpoint and choose [Disable] from the pop-up menu to disable the selected breakpoint. When a breakpoint is disabled, the breakpoint will remain in the list, but a break will not occur when the specified conditions have been satisfied.

3.4.6 Deleting a Breakpoint

Select a breakpoint and choose [Delete] from the pop-up menu to remove the selected breakpoint. To retain the breakpoint but not have it cause a break when its conditions are met, use the [Disable] option (see section 3.4.5, Disabling a Breakpoint).

3.4.7 Deleting All Breakpoints

Choose [Delete All] from the pop-up menu to remove all breakpoints.
3.4.8 Viewing the Source Line for a Breakpoint

Select a breakpoint and choose [Go to Source] from the pop-up menu to open the [Source] or [Disassembly] window at the address of the breakpoint. The [Go to Source] menu is only available when one breakpoint is selected.

3.4.9 Closing Input or Output File

Select a breakpoint and choose [Close File] from the pop-up menu to close the selected [File Input] or [File Output] data file and to reset the address to read the file.

3.4.10 Closing All Input and Output Files

Choose [Close All Files] from the pop-up menu to close all [File Input] and [File Output] data files and to reset the address for reading the file.
3.5 Viewing Trace Information

The simulator/debugger acquires the results of each instruction execution as trace information and displays it in the [Trace] window. The conditions for the trace information acquisition can be specified in the [Trace Acquisition] dialog box.

3.5.1 Opening the Trace Window

To open the [Trace] window, choose [View -> Code -> Trace] or click the [Trace] toolbar button.

3.5.2 Specifying Trace Acquisition Conditions

After the [Trace] window opens, specify the trace acquisition conditions in the [Trace Acquisition] dialog box. To open this dialog box, choose [Acquisition...] from the pop-up menu.

![Trace Acquisition Dialog Box](image)

Figure 3.27 Trace Acquisition Dialog Box
This dialog box specifies the conditions for trace information acquisition.

[Trace Start/Stop]
- [Disable] Disables trace information acquisition.
- [Enable] Enables trace information acquisition.

[Instruction Type]
- [Instruction] Acquires trace information for all instructions.
- [Subroutine] Acquires trace information for the subroutine instructions only.

[Trace Buffer Full Handling]
- [Continue] Continues acquiring trace information even if the trace information acquisition buffer becomes full.
- [Break] Stops execution when the trace information acquisition buffer becomes full.

The trace buffer capacity can be selected from 1 Kbyte (1,024 records), 4 Kbytes (4,096 records), 16 Kbytes (16,384 records), 32 Kbytes (32,768 records), 64 Kbytes (65,536 records), 128 Kbytes (131,072 records), or 256 Kbytes (262,144 records) in [Trace Capacity].

Clicking the [OK] button stores the settings. Clicking the [Cancel] button closes this dialog box without modifying the settings.
3.5.3 Acquiring Trace Information

After trace acquisition is enabled, trace information is acquired during instruction execution. The acquired information will be displayed in the [Trace] window. The displayed information items depend on the target CPU as follows:

SH-1, SH-2, SH-2E, and SH2-DSP Series:

<table>
<thead>
<tr>
<th>PTR</th>
<th>Cycle</th>
<th>Address</th>
<th>Pipeline</th>
<th>Instruction</th>
<th>Access_Base</th>
<th>Source</th>
<th>Label</th>
</tr>
</thead>
<tbody>
<tr>
<td>-04251</td>
<td>0000007180</td>
<td>00010000</td>
<td>PPP:XM</td>
<td>MOV</td>
<td>R14, 0...</td>
<td>0000030D</td>
<td>void...</td>
</tr>
<tr>
<td>-04250</td>
<td>0000007190</td>
<td>00010002</td>
<td>PPP:XM</td>
<td>ADD</td>
<td>#03, R15</td>
<td>000100030</td>
<td>R15&lt;00000000</td>
</tr>
<tr>
<td>-04249</td>
<td>0000007190</td>
<td>00010004</td>
<td>PPP:XM</td>
<td>MOV</td>
<td>R14, 0...</td>
<td>0000000E</td>
<td>R14&lt;00000000</td>
</tr>
<tr>
<td>-04248</td>
<td>0000007190</td>
<td>00010006</td>
<td>PPP:XM</td>
<td>MOV</td>
<td>R14, 0...</td>
<td>0000000E</td>
<td>R14&lt;00000000</td>
</tr>
<tr>
<td>-04246</td>
<td>0000007190</td>
<td>00010008</td>
<td>PPP:XM</td>
<td>MOV</td>
<td>R14, 0...</td>
<td>0000000E</td>
<td>R14&lt;00000000</td>
</tr>
<tr>
<td>-04245</td>
<td>0000007190</td>
<td>00010010</td>
<td>PPP:XM</td>
<td>MOV</td>
<td>R14, 0...</td>
<td>0000000E</td>
<td>R14&lt;00000000</td>
</tr>
<tr>
<td>-04244</td>
<td>0000007190</td>
<td>00010012</td>
<td>PPP:XM</td>
<td>MOV</td>
<td>R14, 0...</td>
<td>0000000E</td>
<td>R14&lt;00000000</td>
</tr>
<tr>
<td>-04243</td>
<td>0000007190</td>
<td>00010014</td>
<td>PPP:XM</td>
<td>MOV</td>
<td>R14, 0...</td>
<td>0000000E</td>
<td>R14&lt;00000000</td>
</tr>
<tr>
<td>-04242</td>
<td>0000007190</td>
<td>00010016</td>
<td>PPP:XM</td>
<td>MOV</td>
<td>R14, 0...</td>
<td>0000000E</td>
<td>R14&lt;00000000</td>
</tr>
<tr>
<td>-04241</td>
<td>0000007190</td>
<td>00010018</td>
<td>PPP:XM</td>
<td>MOV</td>
<td>R14, 0...</td>
<td>0000000E</td>
<td>R14&lt;00000000</td>
</tr>
<tr>
<td>-04240</td>
<td>0000007190</td>
<td>00010020</td>
<td>PPP:XM</td>
<td>MOV</td>
<td>R14, 0...</td>
<td>0000000E</td>
<td>R14&lt;00000000</td>
</tr>
<tr>
<td>-04239</td>
<td>0000007190</td>
<td>00010022</td>
<td>PPP:XM</td>
<td>MOV</td>
<td>R14, 0...</td>
<td>0000000E</td>
<td>R14&lt;00000000</td>
</tr>
<tr>
<td>-04238</td>
<td>0000007190</td>
<td>00010024</td>
<td>PPP:XM</td>
<td>MOV</td>
<td>R14, 0...</td>
<td>0000000E</td>
<td>R14&lt;00000000</td>
</tr>
</tbody>
</table>

This window displays the following trace information items:

- **[PTR]** Pointer in the trace buffer (0 for the last executed instruction)
- **[Cycle]** Total number of instruction execution cycles (cleared by pipeline reset)
- **[Address]** Instruction address
- **[Pipeline]** Pipeline execution status
  - Each symbol has the following meaning:
    - F: Instruction fetch (with memory access)
    - f: Instruction fetch (without memory access)
    - D: Instruction decode
    - E: Instruction execution
    - M: Memory access
    - W: Write back
    - P: DSP

Figure 3.28 Trace Window (for SH-1, SH-2, SH-2E, and SH2-DSP Series)
SuperH™ RISC engine Simulator/Debugger User’s Manual

m: Multiplier execution
|--: Stall inherent in the instruction
>: Split
<: Stall due to conflict

Refer to the software manual of each device for more information on pipeline operation.

[Instruction] Instruction mnemonic
[Access Data] Data access information (display format: destination <- accessed data)
[Source] C/C++ or assembly-language source programs
[Label] Labels

SH-3 and SH-3E Series:

Figure 3.29 Trace Window (for SH-3 and SH-3E Series)

This window displays the following trace information items:

- PTR: Pointer in the trace buffer (0 for the last executed instruction)
- Cycle: Total number of instruction execution cycles (cleared by pipeline reset)
- Address Bus: Data on the address bus
- Data Bus: Data on the data bus

84
<table>
<thead>
<tr>
<th>Code</th>
<th>Instruction code</th>
</tr>
</thead>
<tbody>
<tr>
<td>No</td>
<td>Instruction number (corresponds to execution number in each stage)</td>
</tr>
<tr>
<td>Instruction</td>
<td>Instruction mnemonic</td>
</tr>
<tr>
<td>IF</td>
<td>Instruction number that was fetched (enclosed by [ ] when the instruction did not access memory)</td>
</tr>
<tr>
<td>DE</td>
<td>Instruction number that was decoded</td>
</tr>
<tr>
<td>EX</td>
<td>Instruction number that was executed</td>
</tr>
<tr>
<td>MA</td>
<td>Instruction number that accessed memory</td>
</tr>
<tr>
<td>SW</td>
<td>Instruction number that wrote back data</td>
</tr>
<tr>
<td>Access Data</td>
<td>Data access information (display format: destination &lt;- accessed data)</td>
</tr>
<tr>
<td>Source</td>
<td>C/C++ or assembly-language source programs</td>
</tr>
<tr>
<td>Label</td>
<td>Labels</td>
</tr>
</tbody>
</table>
SH3-DSP Series:

Figure 3.30  Trace Window (for SH3-DSP Series)

This window displays the following trace information items:

- **PTR**: Pointer in the trace buffer (0 for the last executed instruction)
- **Cycle**: Total number of instruction execution cycles (cleared by pipeline reset)
- **Address**: Program counter value
- **Code**: Instruction code
- **IF**: Instruction number that was fetched (enclosed by [ ] when the instruction did not access memory)
- **DE**: Instruction number that was decoded
- **EX**: Instruction number that was executed
- **MA**: Instruction number that accessed memory
- **SW**: Instruction number that wrote back data
- **No**: Instruction number (corresponds to execution number in each stage)
- **Instruction**: Instruction mnemonic
[Access Data] Data access information (display format: destination <- accessed data)

[Source] C/C++ or assembly-language source programs

[Label] Labels

SH-4 Series:

Figure 3.31 Trace Window (for SH-4 Series)

This window displays the following trace information items:

[PTR] Pointer in the trace buffer (0 for the last executed instruction)

[Cycle] Total number of instruction execution cycles (cleared by pipeline reset). The CPU internal clock cycles are counted as execution cycles. The rates of the external and internal clocks can be specified using the Clock Rate command.

[Address Bus] Program counter value

[Code1] Fetched code 1

[Code2] Fetched code 2

The code currently decoded is marked with *. If two codes are executed in parallel, the code fetched at the smaller address is marked with *.

[EX-EAS] Instruction number that was executed (in the E stage), accessed memory (in the A stage), or wrote back data (in the S stage) in the EX pipeline
<table>
<thead>
<tr>
<th>Label</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>[LS-EAS]</td>
<td>Instruction number that was executed, accessed memory, or wrote back data in the LS pipeline</td>
</tr>
<tr>
<td>[BR-EAS]</td>
<td>Instruction number that was executed, accessed memory, or wrote back data in the BR pipeline</td>
</tr>
<tr>
<td>[FP-EXASD]</td>
<td>Instruction number that was executed, accessed memory, or wrote back data in the FP pipeline (only for FSCA, FSRRRA, FIPR, and FTRV instructions in the X stage, and for FDIV and FSQRT instructions in the D stage)</td>
</tr>
<tr>
<td>[No]</td>
<td>Instruction number (corresponds to execution number in each stage)</td>
</tr>
<tr>
<td>[Address]</td>
<td>Executed instruction address</td>
</tr>
<tr>
<td>[Code]</td>
<td>Executed instruction code</td>
</tr>
<tr>
<td>[Instruction]</td>
<td>Executed instruction mnemonic</td>
</tr>
<tr>
<td>[Access Data]</td>
<td>Data access information (display format: destination &lt;- accessed data)</td>
</tr>
<tr>
<td>[Source]</td>
<td>C/C++ or assembly-language source programs</td>
</tr>
<tr>
<td>[Label]</td>
<td>Labels</td>
</tr>
</tbody>
</table>
SH2A-FPU and SH-4A Series:

![Figure 3.32 Trace Window (SH-4A Series)](image)

This window displays the following trace information items:

- **[PTR]** Pointer in the trace buffer (0 for the last executed instruction)
- **[Cycle]** Total number of instruction execution cycles (cleared by pipeline reset)
- **[Address]** Program counter value
- **[Code]** Executed instruction code
- **[Pipeline]** Pipeline execution status
  - Each symbol has the following meaning:
    - F: Instruction fetch
    - P: Instruction pre-decode (SH-4A series only)
    - D: Instruction decode
    - E: Instruction execution
    - M: Memory access
    - W: Write back
  - Refer to the software manual of each device for more information on pipeline operation. When a functional simulator is in use, there is no pipeline information. In this case, x will be displayed here. If the pipeline information exceeds the display space (the right edge of the [Pipeline] column), the display continues from the start (the left edge) of the column.
<table>
<thead>
<tr>
<th>Key</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Instruction</td>
<td>Executed instruction mnemonic</td>
</tr>
<tr>
<td>Access Data</td>
<td>Data access information (display format: destination &lt;- accessed data)</td>
</tr>
<tr>
<td>Source</td>
<td>C/C++ or assembly-language source program</td>
</tr>
<tr>
<td>Label</td>
<td>Labels</td>
</tr>
</tbody>
</table>
3.5.4 Searching for a Trace Record

Use the [Trace Search] dialog box to search for a trace record. To open this dialog box, choose [Find...] from the pop-up menu.

![Trace Search Dialog Box](image)

This dialog box specifies the conditions for searching trace information. Specify a search item in [Item] and search for the specified contents in [Value].

- **[PTR]** Pointer in the trace buffer (0 for the last executed instruction, specify in the form of -nnn)
- **[Cycle]** Total number of instruction execution cycles
- **[Address]** Instruction address
- **[Instruction]** Instruction mnemonic

Clicking the [OK] button stores the settings and starts searching. Clicking the [Cancel] button closes this dialog box without searching.

When a trace record that matches the search conditions is found, the line for the trace record will be displayed in blue. When no matching trace record is found, a message dialog box will appear.

If a search operation is successful, choosing [Find Next] from the pop-up menu will move to the next found item.
3.5.5 Clearing the Trace Information

Choose [Clear] form the pop-up menu to empty the trace buffer that stores the trace information. If more than one [Trace] window is open, all [Trace] windows will be cleared as they all access the same buffer.

3.5.6 Saving the Trace Information in a File

Choose [Save...] from the pop-up menu to open the [Save As] dialog box, which allows the user to save the contents of the trace buffer as a text file. A range can be specified based on [PTR]. Note that this file cannot be reloaded into the trace buffer.

3.5.7 Viewing the Source File

The [Editor] window corresponding to the selected trace record can be displayed in the following two ways:

- Select a trace record and choose [View Source] from the pop-up menu.
- Double-click a trace record

The [Editor] or [Disassembly] window opens and the selected line is marked with a cursor.

3.5.8 Trimming the Source

Choose [Trim Source] from he pop-up menu to remove the white space from the left side of the source.

When the white space is removed, a check mark is shown to the left of the [Trim Source] menu. To restore the white space, choose [Trim Source] while the check mark is shown.
3.5.9 Analyzing Statistical Information

Choose [Statistic] from the pop-up menu to open the [Trace Statistic] dialog box and analyze statistical information under the specified conditions.

Choose [Statistic] from the pop-up menu to open the [Trace Statistic] dialog box and analyze statistical information under the specified conditions.

![Trace Statistic Dialog Box](image)

This dialog box allows the user to analyze statistical information concerning the trace information. The target of analysis is specified in [Item] and the input value or character string is specified by [Start] and [End].

When [Default] is selected, the input value or character string cannot be specified as a range. To specify a range, select [Range].
[Set] Adds a new condition to the current one
[New] Creates a new condition
[Result] Obtains the result of statistical information analysis
[Clear] Clears all condition and results of statistical information analysis

Clicking the [Close] button closes this dialog box.

### 3.6 Viewing the Profile Information

The profile function enables function-by-function measurement of the performance of the application program in execution. This makes it possible to identify parts of an application program that degrade its performance and the reasons for such degradation.

The HEW displays the results of measurement in three windows, according to the method and purpose of viewing the profile data.

#### 3.6.1 Stack Information Files

The profile function allows the HEW to read the stack information files (extension: .SNI) which are output by the optimizing linkage editor (ver. 7.0 or later). Each of these files contains information related to the calling of static functions in the corresponding source file. Reading the stack information file makes it possible for the HEW to display information related to the calling of functions without executing the user application (i.e. before measuring the profile data). However, this feature is not available when [Setting->Only Executed Functions] is checked in the pop-up menu of the [Profile] window.

When the HEW does not read any stack information files, only the data on the functions executed during measurement will be displayed by the profile function.

To make the linkage editor create a stack information file, choose [Build -> SuperH RISC engine Standard Toolchain...], and select [Other] from the [Category] list box and check the [Stack information output] box in the [Link/Library] sheet of the [Standard Toolchain] dialog box.
Figure 3.35   Standard Toolchain Dialog Box (1)
3.6.2 Profile Information Files

To create a profile information file, measure a profile data of the application program then choose the [Output Profile Information Files…] menu option from the pop-up menu of the [Profile] window and specify the file name.

This file contains information on the number of times functions are called and global variables are accessed. The optimizing linkage editor (ver. 7.0 or later) is capable of reading the profile information file and optimizing the allocation of functions and variables in correspondence with the state of the actual operation of the program.

To input the profiler information file to the linkage editor, choose [Optimize] from the [Category] list box and check the [Include profile] box in the [Link/Library] sheet of the [Standard Toolchain] dialog box, and specify the name of the profile information file.
To enable the settings in the [Include profile] box, specify the [Optimize] list box as some setting other than [None].
3.6.3 Loading Stack Information Files

You can select whether or not to read the stack information file in a message box for confirmation that is displayed when a load module is loaded. Clicking the [OK] button of the message box loads the stack information file. The message box for confirmation will be displayed when:

- There are stack information files (extension: .SNI).
- The [Load Stack Information Files (SNI files)] check box is checked in the [Confirmation] tab of the [Options] dialog box (figure 3.37) that can be opened by choosing [Setup -> Options...] from the main menu.
Figure 3.37   Options Dialog Box
3.6.4 Enabling the Profile

Choose [View->Performance->Profile] to open the [Profile] window.

Choose [Enable Profiler] from the pop-up menu of the [Profile] window. The item on the menu will be checked.

3.6.5 Specifying Measurement Mode

You can specify whether to trace functions calls while profile data is acquired. When function calls are traced, the relations of function calls during user program execution are displayed as a tree diagram. When not traced, the relations of function calls cannot be displayed, but the time for acquiring profile data can be reduced.

To stop tracing function calls, choose [Disable Tree (Not traces function call)] from the pop-up menu in the [Profile] window (a check mark is shown to the left of the menu item).

When acquiring profile data of the program in which functions are called in a special way, such as task switching in the OS, stop tracing function calls.

3.6.6 Executing the Program and Checking the Results

After the user program has been executed and execution has been halted, the results of measurement are displayed in the [Profile] window.

The [Profile] window has two sheets; a [List] sheet and a [Tree] sheet.
3.6.7 List Sheet

This sheet lists functions and global variables and displays the profile data for each function and variable.

![List Sheet](image)

Clicking the column header sorts the items in an alphabetical or ascending/descending order. Clicking the [Function/Variable] or [Address] column displays the source program corresponding to the address in the line.

Right-clicking on the mouse within the window displays a pop-up menu. For details on this pop-up menu, refer to section 3.6.8, Tree Sheet.
3.6.8 Tree Sheet

This sheet displays the relation of function calls along with the profile data that are values when the function is called. This sheet is available when [Disable Tree (Not traces function call)] is not selected from the pop-up menu in the [Profile] window.

Double-clicking a function in the [Function] column expands or reduces the tree structure display. The expansion or reduction is also provided by the “+” or “-” key. Double-clicking the [Address] column displays the source program corresponding to the specific address.

Right-clicking the mouse within the window displays a pop-up menu. Supported menu options are as follows:

- View Source
  Displays the source program or disassembled memory contents for the address in the selected line.
- View Profile-Chart
  Displays the [Profile-Chart] window focused on the function in the specified line.
- Enable Profiler
  Toggles acquisition of profile data. When profile data acquisition is enabled, a check mark is shown to the left of the menu text.
• Not trace the function call
  Stops tracing function calls while profile data is acquired. This menu is used when acquiring
  profile data of the program in which functions are called in a special way, such as task
  switching in the OS.
  To display the relation of function calls in the [Tree] sheet of the [Profile] window, acquire
  profile data without selecting this menu. In addition, do not select this menu when optimizing
  the program by the optimizing linkage editor using the acquired profile information file.
• Find...
  Displays the [Find Text] dialog box to find a character string in the [Function] column. Search
  is started by entering a character string to be found in the edit box and clicking [Find Next] or
  pressing the Enter key.
• Find Data...
  Displays the [Find Data] dialog box.

Figure 3.40  Find Data Dialog Box

By selecting the column to be searched in the [Column] combo box and the search type in the
[Find Data] group then pressing [Find Next] button or Enter key, search is started. If the [Find
Next] button or the Enter key is input repeatedly, the second larger data (the second smaller
data when Minimum is specified) is searched for.

• Clear Data
  Clears the number of times functions are called and the profile data. Data in the [List] sheet of
  the [Profile] window and the data in the [Profile-Chart] window are also cleared.
• Output Profile Information Files...
  Displays the [Save Profile Information Files] dialog box. Profiling results are saved in a profile
  information file (.pro extension). The optimizing linkage editor optimizes user programs
  according to the profile information in this file. For details of the optimization using the profile
  information, refer to the manual of the optimizing linkage editor.

  Note: If profile information has been acquired by choosing the [Not trace the function call] menu,
  the program cannot be optimized by the optimizing linkage editor.

• Output Text File...
  Displays the [Save Text of Profile Data] dialog box. Displayed contents are saved in a text file.

• Setting
  This menu has the following submenus (the menus available only in the [List] sheet are also
  included).
  — Show Functions/Variables
    Displays both functions and global variables in the [Function/Variable] column.
  — Show Functions
    Displays only functions in the [Function/Variable] column.
  — Show Variables
    Displays only global variables in the [Function/Variable] column.
  — Only Executed Functions
    Only displays the executed functions. If a stack information file (.sni extension) output
    from the optimizing linkage editor does not exist in the directory where the load module is
    located, only the executed functions are displayed even if this check box is not checked.
  — Include Data of Child Functions
    Sets whether or not to display information for a child function called in the function as
    profile data.

• Properties...
  This menu cannot be used in this simulator/debugger.
3.6.9 Profile-Chart Window

The [Profile-Chart] window displays the relation of calls for a specific function. This window displays the specified function in the middle, with the callers of the function on the left and the callees of the function on the right. The numbers of times the function calls the functions or is called by the functions are also displayed in this window.

![Profile-Chart Window](image)

**Figure 3.41 Profile-Chart Window**

Right-clicking the mouse within the window displays a pop-up menu. Supported menu options are as follows:

- **View Source**
  Displays the source program or disassembled memory contents for the address of the function on which the cursor is placed when the right-hand mouse button is clicked. If the cursor is not placed on a function when the right-hand mouse button is clicked, this menu option remains gray.

- **View Profile-Chart**
  Displays the [Profile-Chart] window for the specific function on which the cursor is placed when the right-hand mouse button is clicked. If the cursor is not placed on a function when the right-hand mouse button is clicked, this menu option remains gray.

- **Enable Profiler**
  Toggles acquisition of profile data. When profile data acquisition is enabled, a check mark is shown to the left of the menu text.
106

3.6.10 Types and Purposes of Displayed Data

The profile function is able to acquire the following information:

- **Address**
  You can view the locations in memory to which the functions are allocated. Sorting the list of functions and global variables in order of their addresses allows the user to view the way the items are allocated in the memory space.

- **Size**
  Sorting in order of size makes it easy to find small functions that are frequently called. Setting such functions as inline may reduce the overhead of function calls. If you are using a device which incorporates a cache memory, greater amount of cache memory will need to be updated when you execute larger functions. This information allows you to check if those functions that may cause cache misses are frequently called.

- **Stack Size**
  When there is deep nesting of function calls, pursue the route of the function calls and obtain the total stack size for all of the functions on that route to estimate the amount of stack being used.
Sorting by the number of calls or accesses makes it easy to identify the frequently called functions and frequently accessed global variables.

Profile Data Measurement of a variety of CPU-specific data is also available as follows:

- **SH-1/SH-2/SH-2E Series, SH2-DSP (SH7410), SH-2DSP (Core), and SH2-DSP (SH7065):**
  - [Cycle] (the number of execution cycles),
  - [Ext_mem] (the number of external memory accesses),
  - [I/O_area] (the number of internal I/O area accesses),
  - [Int_mem] (the number of internal memory accesses)

- **SH-3/SH-3E/SH3-DSP Series and SH2-DSP (SH7612):**
  - [Cycle] (the number of execution cycles),
  - [Cache miss] (the number of cache misses),
  - [Ext_mem] (the number of external memory accesses),
  - [I/O_area] (the number of internal I/O area accesses),
  - [Int_mem] (the number of internal memory accesses)

- **SH2A-FPU, SH-4 Series and the SH-4A Series:**
  - [Cycle] (the number of execution cycles),
  - [ICache miss] (the number of instruction cache misses),
  - [OCache miss] (the number of operand cache misses),
  - [Ext_mem] (the number of external memory accesses),
  - [I/O_area] (the number of internal I/O area accesses),
  - [Int_mem] (the number of internal memory accesses)

The number of execution cycles and cache misses are calculated by subtracting the total execution cycles or cache misses at a specific function call instruction execution from the total execution cycles or cache misses at a return instruction execution of a specific function.
3.6.11 Creating Profile Information Files

To create a profile information file, choose the [Output Profile Information Files...] menu option from the pop-up menu. The [Save Profile Information Files] dialog box is displayed. Pressing the [Save] button after selecting a file name will write the profile information to the selected file. Pressing the [Save All] button will write the profile information to all of the profile information files.

![Save Profile Information Files Dialog Box](image-url)

Figure 3.42 Save Profile Information Files Dialog Box
3.6.12 Notes

1. The number of executed cycles for an application program as measured by the profile function includes a margin of error. The profile function only allows the measurement of the proportions of execution time that the functions occupy in the overall execution of the application program. Use the Performance Analysis function to precisely measure the numbers of executed cycles.

2. The names of the corresponding functions may not be displayed when the profile information on a load module with no debugging information is measured.

3. The stack information file (extension: .SNI) must be in the same directory as the load module file (extension: .ABS).

4. It is not possible to store the results of measurement.

5. It is not possible to modify the results of measurement.
3.7 Analyzing Performance

Use the [Performance Analysis] window to select a function name and analyze the performance.

3.7.1 Opening the Performance Analysis Window

Choose [View -> Performance -> Performance Analysis] or click the [PA] toolbar button to open the [Performance Analysis] window.

This window displays the number of execution cycles required for each specified function.

The number of execution cycles is calculated as follows:

Execution cycles = total number of execution cycles when execution returns from the function
– total number of execution cycles when the target function is called

The following items are displayed:

[Index] Index number of the set condition
[Function] Name of the function to be measured (or the start address of the function)
[Cycle] Total number of instruction execution cycles
[Count] Total number of calls for the function
[\%] Ratio of execution cycle count required for the function to the execution cycle count required for the whole program

Histogram display of the above ratio

<table>
<thead>
<tr>
<th>Index</th>
<th>Function</th>
<th>Cycle</th>
<th>Count</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>main</td>
<td>1168</td>
<td>1</td>
<td>0%</td>
</tr>
<tr>
<td>1</td>
<td>printf</td>
<td>990</td>
<td>2</td>
<td>0%</td>
</tr>
<tr>
<td>2</td>
<td>rand</td>
<td>330</td>
<td>1</td>
<td>0%</td>
</tr>
</tbody>
</table>

Figure 3.43 Performance Analysis Window
3.7.2 Specifying a Target Function

After the [Performance Analysis] window is open, choose [Add Range...] from the pop-up menu or press the Insert key to open the [Performance Option] dialog box, which allows the user to specify a function to be analyzed.

![Performance Option Dialog Box](image)

This dialog box specifies a function (including a label) to be evaluated. Up to 255 functions can be specified in total.

Clicking the [OK] button stores the setting. Clicking the [Cancel] button closes this dialog box without setting the function to be evaluated.

Select a function that has been set and choose [Edit Range] from the pop-up menu or press the Enter key to open the [Performance Option] dialog box and to change the function to be evaluated.

3.7.3 Starting Performance Data Acquisition

Choose [Enable Analysis] from the pop-up menu to start acquiring performance analysis data.

3.7.4 Resetting Data

Choose [Reset Counts/Times] from the pop-up menu to clear the current performance analysis data.

3.7.5 Deleting a Target Function

Select a function and choose [Delete Range] from the pop-up menu to delete the selected target function and to recalculate the data within other ranges. The selected function can also be deleted by the Delete key.
3.7.6 Deleting All Target Functions

Choose [Delete All Ranges] from the pop-up menu to delete all the current target functions to be evaluated and to clear the performance analysis data.

3.7.7 Saving the Currently Displayed Contents

The contents currently displayed in the window can be saved in a text file. Select [Save to File...] from the pop-up menu.

3.8 Acquiring Code Coverage

The [Coverage] window acquires code coverage information (C0 coverage and C1 coverage) in the range specified by the user, and displays the information.

3.8.1 Opening the Coverage Window

Choose [View -> Code -> Coverage...] or click the [Coverage] toolbar button to open the [Coverage Setting] dialog box.

![Coverage Setting Dialog Box](image)

Figure 3.45 Coverage Setting Dialog Box
This dialog box specifies the coverage acquiring range. To set coverage for a new range, the following two ways are available:

- Specifying the start and end addresses on the new coverage range

  [Start Address]  Start address of coverage information display
  (When a prefix is omitted, values input are taken as hexadecimal.)

  [End Address]  End address of coverage information display
  (When a prefix is omitted, values input are taken as hexadecimal.)

- Specifying the file on the new coverage range

  [File]  Source file whose extension is .C or .CPP in the current project.
  Functions in the specified file can be set as the coverage range.
  If the extension of the file is omitted, .C is complemented.
  The file that has other extensions than .C or .CPP cannot be specified.
  A placeholder or the [Browse...] button is available.
To use the settings saved in a coverage information file, choose the file from [Open a recent coverage file], or open a file open dialog box by [Browse to another coverage file] and select the file. When [Open a recent coverage file] is selected, up to four recent files that have been saved are displayed.

Clicking [OK] opens the [Coverage] window.

When the [Coverage] window has already been displayed for specifying address, settings are added in the window.

- Coverage window (specifying address)

![Coverage Window (Specifying Address)](image)

This window displays the coverage range and statistical information. The following items are displayed:

- **Range**: Address range
- **Statistic**: Percentage of the instruction executed within the function
- **Status**: Enabled or Disable status of the coverage range

When the [Coverage] window is closed, the acquired coverage information and the conditions to acquire information will be cleared.
• Coverage window (specifying source file)

![Coverage Window (Specifying Source File)](image)

This window displays the coverage range and statistical information. The following items are displayed:

- **[Functions]** List of functions
- **[Statistic]** Percentage of the instruction executed within the function
- **[Status]** Enable or Disable status of the respective function

Note: The functions can be sorted by their names or percentage, either in ascending or descending order, by clicking the column tab ([Functions] or [Statistic]).

When the [Coverage] window is closed, the acquired coverage information and the conditions to acquire information will be cleared.
3.8.2 Acquiring All Coverage Information

Choose [Enable All] from the pop-up menu and execute the user program to acquire all coverage information. By default, [Enable All] is selected.

3.8.3 Clearing All Coverage Information

Choosing [Clear All] from the popup menu clears all the coverage information that has been acquired.

3.8.4 Viewing the Source Window

Choose [View Source] from the pop-up menu to open the [Editor] window and to display the [Editor] window corresponding to the cursor location in the [Coverage] window.

3.8.5 Specifying the New Coverage Range

Choose [Add Range...] from the pop-up menu to open the [Coverage Setting] dialog box (figure 3.45). For the [Coverage Setting] dialog box, refer to section 3.8.1, Opening the Coverage Window.

3.8.6 Changing the Coverage Range

- Specifying the coverage range with an address

Choose the coverage range and [Edit Range...] from the pop-up menu to open the [Coverage Range] dialog box.

![Coverage Range Dialog Box (Specifying Address)](image)

Figure 3.48 Coverage Range Dialog Box (Specifying Address)
This dialog box specifies the condition to acquire instruction execution information. The following items can be specified.

[Start address]  Start address (When a prefix is omitted, values input are taken as hexadecimal.)

[End address]  End address (When a prefix is omitted, values input are taken as hexadecimal.)

Clicking [OK] changes the coverage range.

- Specifying the coverage range with a source file

Choose [Edit Range...] from the pop-up menu to open the [Coverage Range] dialog box.

![Coverage Range Dialog Box](image)

Figure 3.49  Coverage Range Dialog Box (Specifying Source File)

This dialog box specifies the condition to acquire instruction execution information. The following items can be specified.

[File]  Source file whose extension is .C or .CPP in the current project. Functions in the specified file can be set as the coverage range. If the extension of the file is omitted, .C is complemented. The file that has other extensions than .C or .CPP cannot be specified. A placeholder or the [Browse...] button is available.

Clicking [OK] changes the coverage range.

### 3.8.7 Deleting the Selected Coverage Range

Select a coverage range and choose [Delete Range] from the pop-up menu to delete the selected coverage range.
3.8.8 Acquiring Coverage Information

Specify a coverage range, choose [Enable Coverage] from the pop-up menu, and execute the user program to acquire coverage information. By default, [Enable Coverage] is selected.

3.8.9 Clearing Coverage Information

Specify a coverage range and choose [Clear Data] from the pop-up menu to clear the acquired coverage information.

3.8.10 Saving Coverage Information in a File

Choose [Save Data...] from the pop-up menu to open the [Save Data] dialog box, which allows the user to save the coverage information in a file.

This dialog box specifies the location and name of a coverage information file to be saved. The placeholder or the [Browse...] button can be used.

If a file name extension is omitted, .COV is automatically added. If a file name extension other than .COV or .TXT is specified, an error message will be displayed.
3.8.11  Loading Coverage Information from a File

Choose [Load Data...] from the pop-up menu to open the [Load Data] dialog box, which allows the user to load the coverage information from a file.

![Figure 3.51  Load Data Dialog Box](image)

This dialog box specifies the location and name of a coverage information file to be loaded. The placeholder or the [Browse...] button can be used.

Only .COV files can be loaded. If a file name extension other than .COV is specified, an error message will be displayed.

3.8.12  Updating the Information

Choose [Refresh] from the pop-up menu to update the [Coverage] window to the latest information.
3.8.13 **Confirmation Request Dialog Box**

A confirmation request dialog box will appear when [Clear All], [Clear Data], [Edit Range...], or [Delete Range] is clicked or an attempt is made to close the [Coverage] window.

![Confirmation Request Dialog Box](image)

**Figure 3.52 Confirmation Request Dialog Box**

Clicking [OK] clears the coverage data. Choosing [Save Coverage data] opens the [Save Data] dialog box (figure 3.50) to save the coverage data in a file before it is cleared.
3.8.14  Save Coverage Data Dialog Box

When [File -> Save Session] menu option is clicked, the [Save Coverage Data] dialog box will appear, which allows the user to save the [Coverage] window data in separate files or a single file.

![Save Coverage Data Dialog Box](image)

**Figure 3.53  Save Coverage Data Dialog Box**

When multiple [Coverage] windows are open, a [Save Coverage Data] dialog box will appear for each open coverage window.

Clicking the [No To All] button closes the dialog box without saving any coverage data.

Clicking the [Yes To All] button saves the data of all [Coverage] windows in a single file.

Note: If a file is specified for the coverage range, not all [Coverage] windows can be saved in a single file.
3.8.15 Displaying the Coverage Information in the [Editor] Window

The coverage information is reflected to the [Editor] window by highlighting the [Coverage] columns corresponding to the source lines of executed instructions. When the coverage settings are modified in the [Coverage] window, the [Coverage] column display will be updated.

![Coverage Column (Source)](image)

Figure 3.54 Coverage Column (Source)
3.8.16 Displaying the Coverage Information in the [Disassembly] Window

The coverage information is reflected to the [Disassembly] window by highlighting the [Coverage – ASM] columns corresponding to the disassembly lines of executed instructions. When the coverage settings are modified in the [Coverage] window, the [Coverage – ASM] column display will be updated.

![Figure 3.55 Coverage Column (Disassembly)]
3.9 Generating a Pseudo-Interrupt Manually

Windows [Trigger] and [GUI I/O] allow the user to generate a pseudo-interrupt manually by pressing a button on the window.

3.9.1 [Trigger] Window

Choose [View -> CPU -> Trigger] or click the [Trigger] toolbar button 🔄 to open the [Trigger] window.

![Figure 3.56 Trigger Window]

This window displays trigger buttons that generate pseudo-interrupts manually. The details of the interrupt to be generated by pressing each trigger button can be specified in the [Trigger Setting] dialog box.

Up to 256 trigger buttons can be used.

For details on the interrupt processing in the simulator/debugger, refer to section 2.20, Pseudo-Interrupts.
• Setting a trigger button

Choose [Setting...] from the pop-up menu to open the [Trigger Setting] dialog box.

![Trigger Setting Dialog Box](image_url)
This dialog box allows the user to specify the details of the pseudo-interrupt to be generated by pressing each trigger button.

[Trigger] Selects the trigger button to be specified in detail

[Name] Specifies a name for the selected trigger button; the name will be displayed in the [Trigger] window

[Enable] Checking this box enables the trigger button.

[Interrupt Type1] Sets the following values for each CPU
- SH-1, SH-2, and SH2-DSP series
  Interrupt vector number
- SH2A-FPU
  Interrupt vector number
- SH-3, SH-4, and SH3-DSP series
  INTEVT (H'0 to H'FFF)
- SH-4A series
  INTEVT (H'0 to H'3FFF)

[Interrupt Type2] Only selectable for the SH3-DSP series: INTEVT2 (H'0 to H'FFF)

[Priority] Interrupt priority (H'0 to H'11; when the prefix is omitted, values input are taken as hexadecimal, and the display is in hexadecimal notation). When H'10 is specified, the interrupt is always accepted regardless of the value of the I bit value in SR, but is masked by the BL bit in SR. When H'11 is specified, the interrupt is always accepted regardless of the I and BL bit values in SR.

Clicking the [OK] button stores the setting. Clicking the [Cancel] button closes this dialog box without setting the details of the interrupt.

Note: If the [Cancel] button is clicked after multiple trigger button settings are modified, the modifications of all those buttons are canceled.
• Changing the number of trigger buttons

Specify the number of trigger buttons displayed in the [Trigger] window in the [Number of Buttons] submenu in the pop-up menu. [4], [16], [64], or [256] can be selected.

• Changing the size of trigger buttons

Specify the size of trigger buttons displayed in the [Trigger] window in the [Size] submenu in the pop-up menu. [Large], [Normal], or [Small] can be selected.

3.9.2 [GUI I/O] Window

Choose [View -> Graphic -> GUI I/O] or click the [GUI I/O] toolbar button to open the [GUI I/O] window.

![GUI I/O Window](image)

**Figure 3.58 GUI I/O Window**

This window displays buttons that generate pseudo-interrupts manually. The details of the interrupt to be generated by pressing each button can be specified in the [Set Button] dialog box.

For details on the interrupt processing in the simulator/debugger, refer to section 2.20, Pseudo-Interrupts.
Setting a button

Choose [Create Button] from the pop-up menu or click the [Create Button] toolbar button ( ). The mouse cursor turns into a “+” symbol. Create the button by dragging the mouse cursor from a higher-left to a lower-right position.

Double-click the created button to open the [Set Button] dialog box.
Figure 3.60  Set Button Dialog Box
This dialog box allows the user to specify the details of the pseudo-interrupt to be generated by pressing each button.

- **Button Name**: Specifies a name for the button; the name will be displayed in the [GUI I/O] window.

- **Select Button Type**: Select [Input] or [Input and Interrupt].

- **Interrupt Type 1**
  - **Interrupt Type1**: Sets the following values for each CPU:
    - SH-1, SH-2, and SH2-DSP series
      - Interrupt vector number
    - SH2A-FPU
      - Interrupt vector number
    - SH-3, SH-4, and SH3-DSP series
      - INTEVT (H’0 to H’FFF)
    - SH-4A series
      - INTEVT (H’0 to H’3FFF)

- **Interrupt Type 2**
  - Only selectable for the SH3-DSP series:
    - INTEVT2 (H’0 to H’FFF)

- **Priority**: Interrupt priority (H’0 to H’11; when the prefix is omitted, values input are taken as hexadecimal, and the display is in hexadecimal notation). When H’10 is specified, the interrupt is always accepted regardless of the value of the I bit value in SR, but is masked by the BL bit in SR. When H’11 is specified, the interrupt is always accepted regardless of the I and BL bit values in SR.
3.10 Standard I/O and File I/O Processing

Use the [Simulated I/O] window to enable the simulation for standard I/O and file I/O from the user program.

3.10.1 Opening the Simulated I/O Window

Choose [View -> CPU -> Simulated I/O] or click the [Simulated I/O] toolbar button to open the [Simulated I/O] window.

![Simulated I/O Window](image)

**Figure 3.61 Simulated I/O Window**

The standard output from the user program is displayed in this window. The key input from this window is handled as the standard input to the user program.
3.10.2 I/O Functions

Table 3.1 lists the supported I/O functions.

### Table 3.1 I/O Functions

<table>
<thead>
<tr>
<th>No.</th>
<th>Function Code</th>
<th>Function Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>H'21</td>
<td>GETC</td>
<td>Inputs one byte from the standard input</td>
</tr>
<tr>
<td>2</td>
<td>H'22</td>
<td>PUTC</td>
<td>Outputs one byte to the standard output</td>
</tr>
<tr>
<td>3</td>
<td>H'23</td>
<td>GETS</td>
<td>Inputs one line from the standard input</td>
</tr>
<tr>
<td>4</td>
<td>H'24</td>
<td>PUTS</td>
<td>Outputs one line to the standard output</td>
</tr>
<tr>
<td>5</td>
<td>H'25</td>
<td>FOPEN</td>
<td>Opens a file</td>
</tr>
<tr>
<td>6</td>
<td>H'06</td>
<td>FCLOSE</td>
<td>Closes a file</td>
</tr>
<tr>
<td>7</td>
<td>H'27</td>
<td>FGETC</td>
<td>Inputs one byte from a file</td>
</tr>
<tr>
<td>8</td>
<td>H'28</td>
<td>FPUTC</td>
<td>Outputs one byte to a file</td>
</tr>
<tr>
<td>9</td>
<td>H'29</td>
<td>FGGETS</td>
<td>Inputs one line from a file</td>
</tr>
<tr>
<td>10</td>
<td>H'2A</td>
<td>FPUTS</td>
<td>Outputs one line to a file</td>
</tr>
<tr>
<td>11</td>
<td>H'0B</td>
<td>FEOF</td>
<td>Checks for end of file</td>
</tr>
<tr>
<td>12</td>
<td>H'0C</td>
<td>FSEEK</td>
<td>Moves the file pointer</td>
</tr>
<tr>
<td>13</td>
<td>H'0D</td>
<td>FTELL</td>
<td>Returns the current position of the file pointer</td>
</tr>
</tbody>
</table>

To perform I/O processing, use the [Simulated I/O Address] in the [Simulator System] dialog box (refer to section 3.2.1, Modifying the Simulator System) in the following procedure.

1. Set the address specialized for I/O processing in the [System Call Address], select [Enable] and execute the program.
2. When detecting a subroutine call instruction (BSR, JSR, or BSRF), that is, a simulated I/O instruction to the specified address during user program execution, the simulator/debugger performs I/O processing by using the R0 and R1 values as the parameters.
Therefore, make the following settings in the user program before issuing a simulated I/O instruction:

- Set the function code (table 3.1) to the R0 register

```
  MSB 1 byte 1 byte LSB
  H'01 Function code ---- ----
```

- Set the parameter block address to the R1 register (for the parameter block, refer to each function description)

```
  MSB LSB
  Parameter block address
```

- Reserve the parameter block and input/output buffer areas

Each parameter of the parameter block must be accessed in the parameter size.

After the I/O processing, the simulator/debugger resumes simulation from the instruction that follows the simulated I/O instruction.

Note: When a JSR, BSR, or BSRF instruction is used as a simulated I/O instruction, the instruction following the JSR, BSR, or BSRF instruction is executed as a normal instruction, not a slot instruction. Therefore, the instruction placed immediately after the simulated I/O instruction (JSR, BSR, or BSRF) must not be one that produces different results depending on whether executed as a normal instruction or as a slot instruction.

Refer to the simulator/debugger help about each I/O function.
The following shows an example for inputting one character as a standard input (from a keyboard).

```
MOV.L PAR_ADR,R1
MOV.L REQ_COD,R0
MOV.L CALL_ADR,R3
JSR @R3
NOP
STOP NOP
SYS_CALL NOP
.ALIGN 4
CALL_ADR .DATA.L SYS_CALL
REQ_COD .DATA.L H'01210000
PAR_ADR .DATA.L PARM
PARM .DATA.L INBUF
INBUF .RES.B 2
.END
```
3.11 Viewing the TLB Contents

The TLB window is used to display the TLB contents in a CPU with the MMU (Memory Management Unit) function. The TLB window differs depending on the CPU. Read the description corresponding to your CPU.

3.11.1 Opening a TLB Window

SH-3, SH-3E, and SH3-DSP Series:

Choose [View -> CPU -> TLB] or click the [TLB] toolbar button to open the [TLB] window.

![Figure 3.62 TLB Window (SH-3/SH-3E/SH3-DSP Series)](image)

This window displays the TLB contents. The selected entry is displayed in green. Since each way has one sheet, clicking the way’s sheet displays the way’s contents. The contents of a currently disabled way are grayed out.
The following items are displayed in the window:

- **[Entry]** Entry number in the TLB (H'00 to H'FF)
- **[VPN]** Virtual page number (longword). Bits 31 to 10 are valid.
- **[PPN]** Physical page number (longword). Bits 31 to 10 are valid.
- **[ASID]** Address space identifier
- **[V]** Validity bit
- **[SZ]** Page-size bit
- **[PR]** Protection key field
- **[C]** Cacheable bit
- **[D]** Dirty bit
- **[SH]** Share status bit
SH-4 Series and SH-4A Series:

The SH-4 series and the SH-4A series have two kinds of TLB windows: instruction TLB window and unified TLB window. The SH-4A series has the PMB window as well as those two windows.

Choose [View -> CPU -> TLB] or click the [TLB] toolbar button [ ] to open the [Select TLB] dialog box (figure 3.63) for selecting the TLB window type to be displayed.

![Select TLB Dialog Box](image)

This dialog box selects the TLB to be displayed. Select one of the following TLB types:

- [Instruction TLB] Opens the instruction TLB window.
- [Unified TLB] Opens the unified TLB window.
- [PMB] Opens the PMB window (the SH-4A series only)

Clicking the [OK] button displays the selected TLB window. Clicking the [Cancel] button closes the dialog box without opening a TLB window.

- Instruction TLB window

![Instruction TLB Window (SH-4 Series)](image)
This window displays the instruction TLB contents. The selected entry is displayed in green.

The following items are displayed in the window:

- **Entry**: Entry number in the instruction TLB (H’0 to H’3)
- **VPN**: Virtual page number (longword). Bits 31 to 10 are valid.
- **PPN**: Physical page number (longword). Bits 31 to 10 are valid.
- **ASID**: Address space identifier
- **V**: Validity bit
- **SZ**: Page-size bit
- **PR**: Protection key field
- **C**: Cacheable bit
- **SH**: Share status bit

- **Unified TLB window**

![Unified TLB Window](image)

Figure 3.65  Unified TLB Window (SH-4 Series)
This window displays the unified TLB contents. The selected entry is displayed in green.

The following items are displayed in the window:

<table>
<thead>
<tr>
<th>[Entry]</th>
<th>Entry number in unified TLB (H’00 to H’3F)</th>
</tr>
</thead>
<tbody>
<tr>
<td>[VPN]</td>
<td>Virtual page number (longword). Bits 31 to 10 are valid.</td>
</tr>
<tr>
<td>[PPN]</td>
<td>Physical page number (longword). Bits 31 to 10 are valid.</td>
</tr>
<tr>
<td>[ASID]</td>
<td>Address space identifier</td>
</tr>
<tr>
<td>[V]</td>
<td>Validity bit</td>
</tr>
<tr>
<td>[SZ]</td>
<td>Page-size bit</td>
</tr>
<tr>
<td>[PR]</td>
<td>Protection key field</td>
</tr>
<tr>
<td>[C]</td>
<td>Cacheable bit</td>
</tr>
<tr>
<td>[D]</td>
<td>Dirty bit</td>
</tr>
<tr>
<td>[SH]</td>
<td>Share status bit</td>
</tr>
<tr>
<td>[WT]</td>
<td>Write-through bit</td>
</tr>
</tbody>
</table>
• PMB window

![PMB Window (SH-4A Series)](image)

This window displays the PMB information and is only supported by the SH-4A series. The selected entry is displayed in green.

The following items are displayed in the window:

- **[Entry]** Entry number in PMB (H'0 to H'F)
- **[VPN]** Virtual page number (longword). Bits 31 to 24 are valid.
- **[PPN]** Physical page number (longword). Bits 31 to 24 are valid.
- **[V]** Validity bit
- **[SZ]** Page-size bit
- **[C]** Cacheable bit
- **[WT]** Write-through bit
- **[UB]** Whether or not to write to the buffer

Note: Some devices do not incorporate the PMB.
3.11.2 Modifying the TLB Contents

Selecting [Modify…] from the pop-up menu with a TLB item selected opens the dialog box to modify the selected TLB item.

![Figure 3.67 Modify TLB Dialog Box (VPN is Selected in SH-3)](image)

This dialog box allows the currently selected TLB item to be modified. The selected TLB item and entry number are displayed in the caption of the dialog box. The way number is also displayed for a TLB with ways. The item name in the dialog box displays the selected TLB item.

Clicking the [OK] button stores the newly entered contents in the TLB. Clicking the [Cancel] button closes the dialog box without storing the newly entered contents in the TLB.

A value can be directly input in the window.

3.11.3 Flushing the TLB Contents

Selecting [Flush] from the pop-up menu flushes the TLB. All valid bits are cleared to 0 and all TLB entries are invalidated.

Note that during execution of an instruction, the [Flush] menu is disabled and the TLB cannot be flushed.
3.11.4 Searching the TLB Items

Selecting [Find…] from the pop-up menu opens the [Find TLB] dialog box in which a TLB item can be searched for in column units.

Note that during execution of an instruction, the [Find…] menu is disabled and the TLB item cannot be searched for.

Figure 3.68 Find TLB Dialog Box

This dialog box searches for a TLB item. The following search conditions can be specified:

[Search column] Item to be searched for

[Search value] Value to be searched for

After setting the search conditions, the search can be started by clicking the [OK] button. As a result, the matching entry is highlighted.

Clicking the [Cancel] button closes the dialog box without searching for a TLB item.

3.11.5 Continuing the TLB Search

The next matching TLB item can be searched for with the search conditions that have previously been set. In the state where a matching TLB item was found in the preceding search, select [Find Next] from the pop-up menu.

Note that during execution of an instruction, the [Find Next] menu is disabled and the next matching TLB item cannot be searched for.
3.11.6 Saving the Currently Displayed Contents

The contents currently displayed in the window can be saved in a text file. Select [Save to File...] from the pop-up menu.

3.12 Viewing the Cache Contents

The cache window is used to display the cache contents in a CPU with cache. The cache window differs depending on the CPU. Read the description corresponding to the CPU.

3.12.1 Opening a Cache Window

SH-3, SH-3E, SH3-DSP, and SH2-DSP (SH7612) Series:

Choose [View -> CPU -> Cache] or click the [Cache] toolbar button [ ] to open the [Cache] window.

This window displays the cache contents. The selected entry is displayed in green. Since each way has one sheet, clicking the way’s sheet displays the way’s contents. The contents of a currently disabled way are grayed out.

Figure 3.69 Cache Window (SH-3/SH-3E/SH3-DSP/SH2-DSP (SH7612) Series)
The following items are displayed in the window:

<table>
<thead>
<tr>
<th>Entry</th>
<th>Entry number in the cache. The specifiable value depends on the CPU.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>• SH-3 and SH-3E series: H'00 to H'7F</td>
</tr>
<tr>
<td></td>
<td>• SH3-DSP series: H'00 to H'FF</td>
</tr>
<tr>
<td></td>
<td>• SH2-DSP (SH7612): H'00 to H'3F</td>
</tr>
</tbody>
</table>

| V     | Validity bit. When this bit is 1, the entry is valid.              |
| U     | Update bit. When this bit is 1, the entry has been written to.    |

| LRU   | Numerical string that determines which way's entry should be replaced when a cache miss occurs. (The same LRU value is assigned to the same entry in all ways.) |

<table>
<thead>
<tr>
<th>Tag Address</th>
<th>Tag address</th>
</tr>
</thead>
<tbody>
<tr>
<td>Longword0</td>
<td>Longword data 0 to 3 set to the cache entry</td>
</tr>
<tr>
<td>Longword3</td>
<td></td>
</tr>
</tbody>
</table>
SH2A-FPU, SH-4 Series, and SH-4A Series:

The SH2A-FPU, SH-4 series, and the SH-4A series have two kinds of cache windows: instruction cache window and operand cache window. In addition, the SH-4A series has the level-2 cache window and the SH2A-FPU has the ROM-cache window.

Choose [View -> CPU -> Cache] or click the [Cache] toolbar button [ ] to open the [Select Cache] dialog box (figure 3.70) for selecting the cache window type to be displayed.

![Select Cache Dialog Box](image)

This dialog box selects the cache to be displayed. Select one of the following cache types:

- **[Instruction Cache]** Opens the instruction cache window.\(^1\)
- **[Operand Cache]** Opens the operand cache window.\(^1\)
- **[Level-2 Cache]** Opens the level-2 cache window (SH-4A only).
- **[ROM Prefetch Cache]** Opens the ROM prefetch cache window (SH2A-FPU only).\(^2\)
- **[ROM Prefetch Miss Cache]** Opens the ROM prefetch miss cache window (SH2A-FPU only).\(^2\)
- **[ROM Operand Cache]** Opens the ROM operand cache window (SH2A-FPU only).\(^2\)

Notes:
1. For the SH2A-FPU series, this type is only displayed when the internal ROM is invalid.
2. This type is only displayed when the internal ROM is valid.
   For specification of the internal ROM of the SH2A-FPU as valid or invalid, refer to section 3.1.2, Setting up a Workspace for the Simulator/Debugger.

Clicking the [OK] button displays the selected cache window. Clicking the [Cancel] button closes the dialog box without opening a cache window.
Instruction cache window

![Instruction Cache Window](image)

This window displays the instruction cache contents. The selected entry is displayed in green. Each way has a sheet, and the contents are displayed when the tab for the sheet to be displayed is clicked. Invalid ways are displayed in gray. (The SH-4 and SH-4BSC have only one way.)
The following items are displayed in the instruction cache window:

- **[Entry]** Entry number in the instruction cache (depends on the cache capacity)
- **[V]** Validity bit. When this bit is 1, the entry is valid.
- **[LRU]** Numerical string that determines which way’s entry should be replaced when a cache miss occurs. (The same LRU value is assigned to the same entry in all ways.)
- **[Tag Address]** Tag address
- **[Longword0]** to **[Longword7]** Longword data 0 to 7 set to the instruction cache entry. In the SH2A-FPU, longword data 0 to 3.

- **Operand cache window**

![Operand Cache Window](Figure 3.72 Opera...nt SH7750R))

This window displays the operand cache contents. The selected entry is displayed in green. Each way has a sheet, and the contents are displayed when the tab for the sheet to be displayed is clicked. Invalid ways are displayed in gray. (The SH-4 and SH-4BSC have only one way.)
The following items are displayed in the operand cache window:

[Entry] Entry number in the operand cache (depends on the cache capacity)

[V] Validity bit. When this bit is 1, the entry is valid.

[U] Update bit. When this bit is 1, the entry has been written to.

[LRU] Numerical string that determines which way's entry should be replaced when a cache miss occurs. (The same LRU value is assigned to the same entry in all ways.)

[Tag Address] Tag address

[Longword0] to Longword data 0 to 7 set to the operand cache entry.

[Longword7] In the SH2A-FPU, longward data 0 to 3.
Level-2 cache window

**Figure 3.73  Level-2 Cache Window (SH-4A)**

This window displays the level-2 cache contents and is only supported by the SH-4A series. The selected entry is displayed in green.

The following items are displayed in the level-2 cache window:

- **[Entry]** Entry number in the level-2 cache (depends on the cache capacity)
- **[V]** Validity bit. When this bit is 1, the entry is valid.
- **[LRU]** Numerical string that determines which way's entry should be replaced when a cache miss occurs. (The same LRU value is assigned to the same entry in all ways.)
- **[Tag Address]** Tag address
- **[Longword0] to [Longword7]** Longword data 0 to 7 set to the operand cache entry

Note: Some devices do not incorporate the level-2 cache.
• ROM cache window

![Figure 3.74 ROM Cache Window (Prefetch Cache)](image)

This window displays the ROM cache contents and is only supported by the SH2A-FPU. There are three types of ROM cache windows; ROM prefetch cache window, ROM prefetch miss cache window, and ROM operand cache window. Items displayed in these three windows are the same. The selected entry is displayed in green.

The following items are displayed in the ROM cache window:

- **[Entry]** Entry number in the ROM cache
- **[V]** Validity bit. When this bit is 1, the entry is valid.
- **[LRU]** Numerical string that determines which way's entry should be replaced when a cache miss occurs. (The same LRU value is assigned to the same entry in all ways.)
- **[Tag Address]** Tag address
- **[Longword0] to [Longword3]** Longword data 0 to 3 set to the operand cache entry
3.12.2 Modifying the Cache Contents

Selecting [Modify…] from the pop-up menu with a cache item selected opens the dialog box to modify the selected cache item.

Note that during execution of an instruction, the [Modify…] menu is disabled and the cache items cannot be modified.

![Figure 3.75 Modify Cache Dialog Box (Tag Address is Selected in SH-3)](image)

This dialog box allows the currently selected cache item to be modified. The selected cache item and entry number are displayed in the caption of the dialog box. The way number is also displayed for a cache with ways. The item name in the dialog box displays the selected cache item.

Clicking the [OK] button stores the newly entered contents in the cache. Clicking the [Cancel] button closes the dialog box without storing the newly entered contents in the cache.

A value can be directly input in the window.

3.12.3 Flushing the Cache Contents

Selecting [Flush] from the pop-up menu flushes cache. All V, U, and LRU bits are cleared to 0 and all cache entries are invalidated.

Note that during execution of an instruction, the [Flush] menu is disabled and cache cannot be flushed.
3.12.4 Searching the Cache Items

Selecting [Find...] from the pop-up menu opens the [Find Cache] dialog box in which a cache item can be searched for in column units.

Note that during execution of an instruction, the [Find...] menu is disabled and the cache item cannot be searched for.

![Find Cache Dialog Box](image)

**Figure 3.76 Find Cache Dialog Box**

This dialog box searches for a cache item. The following search conditions can be specified:

- [Find Column] Item to be searched for
- [Find Value] Value to be searched for

After setting the search conditions, the search can be started by clicking the [OK] button. As a result, the matching entry is highlighted.

Clicking the [Cancel] button closes the dialog box without searching for a cache item.

3.12.5 Continuing the Cache Search

The next matching cache item can be searched for with the search conditions that have previously been set. In the state where a matching cache item was found in the preceding search, select [Find Next] from the pop-up menu.

Note that during execution of an instruction, the [Find Next] menu is disabled and the next matching cache item cannot be searched for.
3.12.6 Modifying the Cache Capacity

This function is only provided for the SH-3, SH-3E series, and SH-4A series. Selecting [Capacity…] from the pop-up menu opens the [Cache Capacity] dialog box in which the cache capacity can be modified.

Note that during execution of an instruction, the [Capacity…] menu is disabled and the cache capacity cannot be modified.

![Cache Capacity Dialog Box](image)

Figure 3.77 Cache Capacity Dialog Box (SH-3/SH-3E Series)

This dialog box allows the cache capacity to be modified.

The following cache capacities can be selected:

- **[8-Kbyte]** 8-Kbyte cache capacity (default)
  
  All four ways, way 0 to way 3 (two ways, way 0 and way 1, when the internal RAM is specified), are valid.

- **[4-Kbyte]** 4-Kbyte cache capacity
  
  Two ways, way 0 and way 1 (one way, way 0, when the internal RAM is specified), are valid.

- **[2-Kbyte]** 2-Kbyte cache capacity
  
  One way, way 0, is valid. The internal RAM specification is ignored.

Clicking the [OK] button modifies the cache capacity. Clicking the [Cancel] button closes the dialog box without modifying the cache capacity.
Figure 3.78  Cache Capacity Dialog Box (SH-4A)

Figure 3.79  Cache Capacity Dialog Box (SH2A-FPU and SH4AL-DSP)

This dialog box allows the cache capacity to be modified.
The following cache capacities can be selected depending on the cache type:

For the SH-4A series:

[Instruction Cache]: Sets the capacity of the instruction cache. Four ways, way 0 to way 3, are all valid, and the number of entry changes. (The number of entries in each way is the same.)

- [8-Kbyte]: 8-Kbyte cache capacity
  (One way: 2 Kbytes, the number of entries: H’000 to H’03F)

- [16-Kbyte]: 16-Kbyte cache capacity
  (One way: 4 Kbytes, the number of entries: H’000 to H’07F)

- [32-Kbyte]: 32-Kbyte cache capacity (default)
  (One way: 8 Kbytes, the number of entries: H’000 to H’0FF)

- [64-Kbyte]: 64-Kbyte cache capacity
  (One way: 16 Kbytes, the number of entries: H’000 to H’1FF)

- [128-Kbyte]: 128-Kbyte cache capacity
  (One way: 32 Kbytes, the number of entries: H’000 to H’3FF)

[Operand Cache]: Sets the capacity of the operand cache. Four ways, way 0 to way 3, are all valid, and the number of entry changes. (The number of entries in each way is the same.)

- [8-Kbyte]: 8-Kbyte cache capacity
  (One way: 2 Kbytes, the number of entries: H’000 to H’03F)

- [16-Kbyte]: 16-Kbyte cache capacity
  (One way: 4 Kbytes, the number of entries: H’000 to H’07F)
[32-Kbyte]: 32-Kbyte cache capacity (default)
            (One way: 8 Kbytes, the number of entries: H’000 to H’0FF)

[64-Kbyte]: 64-Kbyte cache capacity
            (One way: 16 Kbytes, the number of entries: H’000 to H’1FF)

[128-Kbyte]: 128-Kbyte cache capacity
              (One way: 32 Kbytes, the number of entries: H’000 to H’3FF)

[Level-2 Cache]
(SH-4A only):
              Sets the capacity of the level-2 cache. Four ways, way 0 to way 3, are all
              valid, and the number of entry changes. (The number of entries in each
              way is the same.)

[128-Kbyte]: 128-Kbyte cache capacity (default)
              (One way: 32 Kbytes, the number of entries: H’0000 to H’03FF)

[256-Kbyte]: 256-Kbyte cache capacity
              (One way: 64 Kbytes, the number of entries: H’0000 to H’07FF)

[512-Kbyte]: 512-Kbyte cache capacity
              (One way: 128 Kbytes, the number of entries: H’0000 to H’0FFF)

[1-Mbyte]: 1-Mbyte cache capacity
            (One way: 256 Kbytes, the number of entries: H’0000 to H’1FFF)
For the SH2A-FPU series:

**Instruction Cache:**
Sets the capacity of the instruction cache. Four ways, way 0 to way 3, are all valid, and the number of entry changes. (The number of entries in each way is the same.)

- **[8-Kbyte]** 8-Kbyte cache capacity
  (One way: 2 Kbytes, the number of entries: H’007F)
- **[16-Kbyte]** 16-Kbyte cache capacity
  (One way: 4 Kbytes, the number of entries: H’00FF)
- **[32-Kbyte]** 32-Kbyte cache capacity (default)
  (One way: 8 Kbytes, the number of entries: H’01FF)
- **[64-Kbyte]** 64-Kbyte cache capacity
  (One way: 16 Kbytes, the number of entries: H’03FF)
- **[128-Kbyte]** 128-Kbyte cache capacity
  (One way: 32 Kbytes, the number of entries: H’07FF)
- **[256-Kbyte]** 256-Kbyte cache capacity
  (One way: 64 Kbytes, the number of entries: H’0FFF)
- **[512-Kbyte]** 512-Kbyte cache capacity
  (One way: 128 Kbytes, the number of entries: H’1FFF)
- **[1-Mbyte]** 1-Mbyte cache capacity
  (One way: 256 Kbytes, the number of entries: H’3FFF)

**Operand Cache:**
Sets the capacity of the operand cache. Four ways, way 0 to way 3, are all valid, and the number of entry changes. (The number of entries in each way is the same.)

- **[8-Kbyte]** 8-Kbyte cache capacity
  (One way: 2 Kbytes, the number of entries: H’007F)
- **[16-Kbyte]** 16-Kbyte cache capacity
  (One way: 4 Kbytes, the number of entries: H’00FF)
[32-Kbyte] 32-Kbyte cache capacity (default)
(One way: 8 Kbytes, the number of entries: H’01FF)

[64-Kbyte] 64-Kbyte cache capacity
(One way: 16 Kbytes, the number of entries: H’03FF)

[128-Kbyte] 128-Kbyte cache capacity
(One way: 32 Kbytes, the number of entries: H’07FF)

[256-Kbyte] 256-Kbyte cache capacity
(One way: 64 Kbytes, the number of entries: H’0FFF)

[512-Kbyte] 512-Kbyte cache capacity
(One way: 128 Kbytes, the number of entries: H’1FFF)

[1-Mbyte] 1-Mbyte cache capacity
(One way: 256 Kbytes, the number of entries: H’3FFF)

Clicking the [OK] button modifies the cache capacity. Clicking the [Cancel] button closes the
dialog box without modifying the cache capacity.

3.12.7 Saving the Currently Displayed Contents

The contents currently displayed in the window can be saved in a text file. Select [Save to File…]
from the pop-up menu.
3.13 Viewing the Contents of Register Banks

The [Register Bank] window is used to view the contents of the register banks when using the SH2A-FPU simulator/debugger.

3.13.1 Opening the [Register Bank] Window

Choose [View -> CPU -> Register Bank] or click the [Register Bank] toolbar button to open the [Register Bank] window.

<table>
<thead>
<tr>
<th>Name</th>
<th>Value</th>
<th>Radix</th>
</tr>
</thead>
<tbody>
<tr>
<td>R0</td>
<td>00000000</td>
<td>Hex</td>
</tr>
<tr>
<td>R1</td>
<td>00000000</td>
<td>Hex</td>
</tr>
<tr>
<td>R2</td>
<td>00000000</td>
<td>Hex</td>
</tr>
<tr>
<td>R3</td>
<td>00000000</td>
<td>Hex</td>
</tr>
<tr>
<td>R4</td>
<td>00000000</td>
<td>Hex</td>
</tr>
<tr>
<td>R5</td>
<td>00000000</td>
<td>Hex</td>
</tr>
<tr>
<td>R6</td>
<td>00000000</td>
<td>Hex</td>
</tr>
<tr>
<td>R7</td>
<td>00000000</td>
<td>Hex</td>
</tr>
<tr>
<td>R8</td>
<td>00000000</td>
<td>Hex</td>
</tr>
<tr>
<td>R9</td>
<td>00000000</td>
<td>Hex</td>
</tr>
<tr>
<td>R10</td>
<td>00000000</td>
<td>Hex</td>
</tr>
<tr>
<td>R11</td>
<td>00000000</td>
<td>Hex</td>
</tr>
<tr>
<td>R12</td>
<td>00000000</td>
<td>Hex</td>
</tr>
<tr>
<td>R13</td>
<td>00000000</td>
<td>Hex</td>
</tr>
<tr>
<td>R14</td>
<td>00000000</td>
<td>Hex</td>
</tr>
<tr>
<td>MACH</td>
<td>00000000</td>
<td>Hex</td>
</tr>
<tr>
<td>IVO</td>
<td>00000000</td>
<td>Hex</td>
</tr>
<tr>
<td>PR</td>
<td>00000000</td>
<td>Hex</td>
</tr>
<tr>
<td>GBR</td>
<td>00000000</td>
<td>Hex</td>
</tr>
<tr>
<td>MAEL</td>
<td>00000000</td>
<td>Hex</td>
</tr>
</tbody>
</table>

Figure 3.80 [Register Bank] Window
This window displays the register bank information. Since each bank has one sheet, clicking the bank’s sheet displays the its contents. The contents of a currently disabled bank are grayed out.

The following items are displayed in the window:

[Name]  Register name

[Value]  Value

[Radix]  Radix for display

### 3.13.2 Modifying the Contents of Register Banks

Selecting [Modify…] from the pop-up menu with a register bank item selected opens the dialog box to modify the selected register bank item.

![Register Value Setting Dialog Box](image)

**Figure 3.81  Register Value Setting Dialog Box**

This dialog box allows the currently selected register bank item to be modified. The selected register bank item and bank number are displayed in the caption of the dialog box. The item name in the dialog box displays the selected register bank item.

Clicking the [OK] button stores the newly entered contents in the register bank. Clicking the [Cancel] button closes the dialog box without storing the newly entered contents.

A value can be directly input in the window.

### 3.13.3 Changing the Radix

To change the radix for display, select [Radix] from the pop-up menu with a register bank item selected.
3.14 Creating a Virtual I/O Panel

The simulator/debugger has a GUI I/O function for simulating a simple key-input or key-output panel of the user target system in a window. This virtual I/O panel is created in the [GUI I/O] window. That is, virtual buttons and virtual LEDs are arranged in this window to allow the input and output of data.

Figure 3.82 Example of a GUI I/O Window
3.14.1 Opening the [GUI I/O] Window

Choose [View -> Graphic -> GUI I/O] or click the [GUI I/O] toolbar button to open the [GUI I/O] window.

![Figure 3.83 [GUI I/O] Window](image)

This window is used to arrange the following items.

**Button:** Press a button for input of data to a virtual port or generation of a virtual interrupt.

**Label:** A character string which is shown when the value written to a selected address or bit was the specified value and hidden otherwise.

**LED:** A defined region in which a specified color is displayed (representing illumination of a LED) when the value written to a selected address or bit was the specified value.

**Text:** A region for the display of a text string.
3.14.2 Creating a Button

Click on the button of the toolbar or choose [Create Button] from the pop-up menu. The mouse cursor turns into a “+” symbol. Create the button by dragging the mouse cursor from a higher-left to a lower-right position.

Figure 3.84 GUI I/O Window (Create Button)
• Specifying the event generated by clicking the button

Press the button on the toolbar and double-click on the created button to open the [Set Button] dialog box.

![Set Button Dialog Box](image)

**Figure 3.85  Set Button Dialog Box**

Enter the name of the button, input port address, and input data. The button name must not include white space.
3.14.3 Creating a Label

Click on the button of the toolbar or choose [Create Label] from the pop-up menu. The mouse cursor turns into a “+” symbol. Drag the mouse cursor from a higher-left to a lower-right position. This shows the frame for the label.

![GUI I/O Window (Create Label)](image)

Figure 3.86 GUI I/O Window (Create Label)

Press the button on the toolbar or choose [Select Item] from the pop-up menu and double-click on the created label to open the [Set Label] dialog box. Specify the responses to events. The label name must not include white space.
Response to writing of either value to a selected bit

The settings shown below set up display of the character string “Printing in progress” or “Printer ready” when the value of bit 3 at address 0x3E0 is 0 or 1, respectively.

![Set Label Dialog Box (Bit Selection)](image)

Figure 3.87  Set Label Dialog Box (Bit Selection)
Response to writing of specified values to a selected address

The settings shown below set up display of the character string “Printing in progress” or “Printer ready” when the value 0x10 or 0x20, respectively, is written to address 0x3E0.

![Set Label Dialog Box](image)

**Figure 3.88 Set Label Dialog Box (Data Selection)**
3.14.4 Creating an LED

Click on the button on the toolbar or choose [Create LED] from the pop-up menu. The mouse cursor turns into a “+” symbol. Drag the mouse cursor from an upper left to a lower right position. This shows the frame for the LED output.

![GUI I/O Window (Create LED)](image)

Figure 3.89 GUI I/O Window (Create LED)

Press the button on the toolbar or choose [Select Item] from the pop-up menu and double-click on the created LED to open the [Set LED] dialog box. Specify the events and responses.
Response to writing of either value to a selected bit

The settings shown below set up the display of green or red, respectively, in the LED area when the value of bit 2 at address 0x3E0 is 0 or 1.

![Set LED Dialog Box (Bit Selection)](image)

Figure 3.90 Set LED Dialog Box (Bit Selection)
Response to writing of specified values to a selected address

The settings shown below set up the display of green or red, respectively, in the LED area when the value 0x10 or 0x20 is written to address 0x3E0.

![Set LED Dialog Box (Data Selection)](image)

Clicking the [Color 1] or [Color 2] button opens the [Color] dialog box, which allows you to select the color.
3.14.5 Creating Fixed Text

Click the button on the toolbar or choose [Create Text] from the pop-up menu. The mouse cursor turns into a “+” symbol. Create the text box by dragging the mouse cursor from a higher-left to a lower-right position.

Figure 3.92 GUI I/O Window (Create Fixed Text)
Setting the format for the text

Press the button on the toolbar and double-click on the created text to open the [Set Text] dialog box.

![Set Text Dialog Box](image.png)

**Figure 3.93 Set Text Dialog Box**

Click the [Font...] button to select the font and size for the text. Then click the [Text] and [Back] buttons to specify the colors of the text and its background.
3.14.6 Changing the Size and Position of an Item

Press the button on the toolbar and click on the item. The item is selected as shown in the figure below.

![GUI I/O Window (Item Selected)](image)

Drag the item to change its position or the control points to change its size.

3.14.7 Copying an Item

Press the button on the toolbar or choose [Copy] from the pop-up menu. The mouse cursor turns into a “+” symbol. In this state, click on the item you wish to copy. Press the button on the toolbar or choose [Paste] from the pop-up menu to create a new item with the same size and attributes.

3.14.8 Deleting an Item

Press the button on the toolbar or choose [Delete] from the pop-up menu. The mouse cursor turns into a “+” symbol. In this state, click on the item you wish to delete.
3.14.9 Showing the Grid

Press the button on the toolbar or choose [Display Grid] from the pop-up menu. This displays the grid on the background.

![GUI I/O Window (Show Grid)](image)

Figure 3.95 GUI I/O Window (Show Grid)

Clicking the button again hides the grid.

3.14.10 Saving I/O Panel Information

It is possible to reuse created I/O panels by saving the information in files. Press the button on the toolbar or choose [Save] from the pop-up menu to open the [Save GUI I/O Panel File] dialog box. Specify the directory where the file is to be stored and enter the file name.

3.14.11 Loading I/O Panel Information

Press the button on the toolbar or choose [Load] from the pop-up menu to open the [Load GUI I/O Panel File] dialog box. Specify the file you wish to load. Panel information prior to the load will be deleted.
Section 4  Windows

Table 4.1 lists the windows.

Refer to the simulator/debugger help about the toolbar buttons.

<table>
<thead>
<tr>
<th>Window Name</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cache</td>
<td>Viewing the cache contents</td>
</tr>
<tr>
<td>Command Line</td>
<td>Debugging with the Command Line Interface</td>
</tr>
<tr>
<td>Coverage</td>
<td>Acquiring Code Coverage</td>
</tr>
<tr>
<td>Disassembly</td>
<td>Viewing the Assembly-Language Code</td>
</tr>
<tr>
<td>Editor</td>
<td>Viewing a Program</td>
</tr>
<tr>
<td>Event</td>
<td>Using the Simulator/Debugger Breakpoints</td>
</tr>
<tr>
<td>GUI I/O</td>
<td>Creating a Virtual I/O Panel</td>
</tr>
<tr>
<td>Image</td>
<td>Displaying Memory Contents as an Image</td>
</tr>
<tr>
<td>IO</td>
<td>Viewing the I/O Memory</td>
</tr>
<tr>
<td>Label</td>
<td>Looking at Labels</td>
</tr>
<tr>
<td>Local</td>
<td>Looking at Variables (local variables)</td>
</tr>
<tr>
<td>Memory</td>
<td>Viewing a Memory Area</td>
</tr>
<tr>
<td>Profile/Profile-Chart</td>
<td>Viewing the Profile Information</td>
</tr>
<tr>
<td>Performance Analysis</td>
<td>Analyzing Performance</td>
</tr>
<tr>
<td>Register</td>
<td>Looking at Registers</td>
</tr>
<tr>
<td>Register Bank</td>
<td>Viewing the Contents of Register Banks</td>
</tr>
<tr>
<td>Simulated I/O</td>
<td>Standard I/O and File I/O Processing</td>
</tr>
<tr>
<td>Stack Trace</td>
<td>Viewing the Function Call History</td>
</tr>
<tr>
<td>Status</td>
<td>Viewing the Current Status</td>
</tr>
<tr>
<td>TLB</td>
<td>Viewing the TLB contents</td>
</tr>
<tr>
<td>Trace</td>
<td>Viewing the Trace Information</td>
</tr>
<tr>
<td>Trigger</td>
<td>Generating a Pseudo-Interrupt Manually</td>
</tr>
<tr>
<td>Watch</td>
<td>Looking at Variables (any variables)</td>
</tr>
<tr>
<td>Wave</td>
<td>Displaying Memory Contents as Waveforms</td>
</tr>
</tbody>
</table>
Section 5  Command Lines

5.1  Commands (Functional Order)

The following tables show the commands in functional order.

Refer to the help about each command.

5.1.1  Execution

<table>
<thead>
<tr>
<th>Command Name</th>
<th>Abbreviation</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>GO</td>
<td>GO</td>
<td>Executes user program</td>
</tr>
<tr>
<td>GO_RESET</td>
<td>GR</td>
<td>Executes user program from reset vector</td>
</tr>
<tr>
<td>GO_TILL</td>
<td>GT</td>
<td>Executes user program until temporary breakpoint</td>
</tr>
<tr>
<td>HALT</td>
<td>HA</td>
<td>Halts the user program</td>
</tr>
<tr>
<td>RESET</td>
<td>RE</td>
<td>Resets CPU</td>
</tr>
<tr>
<td>STEP</td>
<td>ST</td>
<td>Steps program (by instructions or source lines)</td>
</tr>
<tr>
<td>STEP_MODE</td>
<td>SM</td>
<td>Selects the step mode</td>
</tr>
<tr>
<td>STEP_OUT</td>
<td>SP</td>
<td>Steps out of the current function</td>
</tr>
<tr>
<td>STEP_OVER</td>
<td>SO</td>
<td>Steps program, not stepping into functions</td>
</tr>
<tr>
<td>STEP_RATE</td>
<td>SR</td>
<td>Sets or displays rate of stepping</td>
</tr>
<tr>
<td>STEP_UNIT</td>
<td>SN</td>
<td>Sets the unit of execution</td>
</tr>
</tbody>
</table>
### Download

<table>
<thead>
<tr>
<th>Command Name</th>
<th>Abbreviation</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>BUILD</td>
<td>BU</td>
<td>Performs a build on the current project</td>
</tr>
<tr>
<td>BUILD_ALL</td>
<td>BL</td>
<td>Performs a build all on the current project</td>
</tr>
<tr>
<td>BUILD_FILE</td>
<td>BF</td>
<td>Compiles files</td>
</tr>
<tr>
<td>BUILD_MULTIPLE</td>
<td>BM</td>
<td>Builds multiple projects</td>
</tr>
<tr>
<td>CLEAN</td>
<td>CL</td>
<td>Deletes intermediate and output files produced in building</td>
</tr>
<tr>
<td>DEFAULT_OBJECT_FORMAT</td>
<td>DO</td>
<td>Sets the default object (program) format</td>
</tr>
<tr>
<td>FILE_LOAD</td>
<td>FL</td>
<td>Loads an object (program) file</td>
</tr>
<tr>
<td>FILE_LOAD_ALL</td>
<td>LA</td>
<td>Loads all object (program) files</td>
</tr>
<tr>
<td>FILE_SAVE</td>
<td>FS</td>
<td>Saves memory to a file</td>
</tr>
<tr>
<td>FILE_UNLOAD</td>
<td>FU</td>
<td>Unloads an object (program) file from memory</td>
</tr>
<tr>
<td>FILE_UNLOAD_ALL</td>
<td>UA</td>
<td>Unloads all object (program) files from memory</td>
</tr>
<tr>
<td>GENERATEMAKEFILE</td>
<td>GM</td>
<td>Generates a build makefile for the current workspace</td>
</tr>
</tbody>
</table>

### Register

<table>
<thead>
<tr>
<th>Command Name</th>
<th>Abbreviation</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>REGISTER_ADDRESS_RAGGET</td>
<td>RAG</td>
<td>Displays the address of the bank control register</td>
</tr>
<tr>
<td>REGISTER_ADDRESS_RASSET</td>
<td>RAS</td>
<td>Sets the address of the bank control register</td>
</tr>
<tr>
<td>REGISTER_DISPLAY</td>
<td>RD</td>
<td>Displays CPU register values</td>
</tr>
<tr>
<td>REGISTER_SET</td>
<td>RS</td>
<td>Changes CPU register contents</td>
</tr>
</tbody>
</table>
### 5.1.4 Register Bank (SH2A-FPU Only)

<table>
<thead>
<tr>
<th>Command Name</th>
<th>Abbreviation</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>REGISTER_BANK_DISPLAY</td>
<td>RBD</td>
<td>Displays register bank values</td>
</tr>
<tr>
<td>REGISTER_BANK_SET</td>
<td>RBS</td>
<td>Changes the contents of register banks</td>
</tr>
</tbody>
</table>

### 5.1.5 Memory

<table>
<thead>
<tr>
<th>Command Name</th>
<th>Abbreviation</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>CACHE</td>
<td>-</td>
<td>Sets caching on or off</td>
</tr>
<tr>
<td>MEMORY_COMPARE</td>
<td>MC</td>
<td>Compares memory contents</td>
</tr>
<tr>
<td>MEMORY_DISPLAY</td>
<td>MD</td>
<td>Displays memory contents</td>
</tr>
<tr>
<td>MEMORY_EDIT</td>
<td>ME</td>
<td>Modifies memory contents</td>
</tr>
<tr>
<td>MEMORY_FILL</td>
<td>MF</td>
<td>Modifies the content of a memory area by specifying data</td>
</tr>
<tr>
<td>MEMORY_FIND</td>
<td>MI</td>
<td>Finds a string in an area of memory</td>
</tr>
<tr>
<td>MEMORY_MOVE</td>
<td>MV</td>
<td>Moves a block of memory</td>
</tr>
<tr>
<td>MEMORY_TEST</td>
<td>MT</td>
<td>Tests a block of memory</td>
</tr>
</tbody>
</table>

### 5.1.6 Assemble/Disassemble

<table>
<thead>
<tr>
<th>Command Name</th>
<th>Abbreviation</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASSEMBLE</td>
<td>AS</td>
<td>Assembles instructions into memory</td>
</tr>
<tr>
<td>DISASSEMBLE</td>
<td>DA</td>
<td>Disassembles memory contents</td>
</tr>
<tr>
<td>SYMBOL_ADD</td>
<td>SA</td>
<td>Defines a symbol</td>
</tr>
<tr>
<td>SYMBOL_CLEAR</td>
<td>SC</td>
<td>Deletes a symbol</td>
</tr>
<tr>
<td>SYMBOL_LOAD</td>
<td>SL</td>
<td>Loads a symbol information file</td>
</tr>
<tr>
<td>SYMBOL_SAVE</td>
<td>SS</td>
<td>Saves a symbol information file</td>
</tr>
<tr>
<td>SYMBOL_VIEW</td>
<td>SV</td>
<td>Displays symbols</td>
</tr>
</tbody>
</table>
### 5.1.7 Break

<table>
<thead>
<tr>
<th>Command Name</th>
<th>Abbreviation</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>BREAKPOINT</td>
<td>BP</td>
<td>Sets a breakpoint at an instruction address</td>
</tr>
<tr>
<td>BREAK_ACCESS</td>
<td>BA</td>
<td>Specifies a memory range access as a break condition</td>
</tr>
<tr>
<td>BREAK_CLEAR</td>
<td>BC</td>
<td>Deletes breakpoints</td>
</tr>
<tr>
<td>BREAK_CYCLE</td>
<td>BCY</td>
<td>Specifies a cycle as a break condition</td>
</tr>
<tr>
<td>BREAK_DATA</td>
<td>BD</td>
<td>Specifies a memory data value as a break condition</td>
</tr>
<tr>
<td>BREAK_DATA_DIFFERENCE</td>
<td>BDD</td>
<td>Specifies a difference between two values of data in memory as a break condition</td>
</tr>
<tr>
<td>BREAK_DATA_INVERSE</td>
<td>BDI</td>
<td>Specifies inversion of the sign of a value of data in memory as a break condition</td>
</tr>
<tr>
<td>BREAK_DISPLAY</td>
<td>BI</td>
<td>Displays a list of breakpoints</td>
</tr>
<tr>
<td>BREAK_ENABLE</td>
<td>BE</td>
<td>Enables or disabled breakpoints</td>
</tr>
<tr>
<td>BREAK_REGISTER</td>
<td>BR</td>
<td>Specifies a register data as a break condition</td>
</tr>
<tr>
<td>BREAK_SEQUENCE</td>
<td>BS</td>
<td>Sets sequential breakpoints</td>
</tr>
<tr>
<td>SET_DISASSEMBLY_SOFT_BREAK</td>
<td>SDB</td>
<td>Sets or deletes a software breakpoint at the disassembly level</td>
</tr>
<tr>
<td>SET_SOURCE_SOFT_BREAK</td>
<td>SSB</td>
<td>Sets or deletes a software breakpoint at the source level</td>
</tr>
<tr>
<td>STATE_DISASSEMBLY_SOFT_BREAK</td>
<td>TDB</td>
<td>Enables or disabled a software breakpoint at the disassembly level</td>
</tr>
<tr>
<td>STATE_SOURCE_SOFT_BREAK</td>
<td>TSB</td>
<td>Enables or disabled a software breakpoint at the source level</td>
</tr>
</tbody>
</table>

### 5.1.8 Trace

<table>
<thead>
<tr>
<th>Command Name</th>
<th>Abbreviation</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>TRACE</td>
<td>TR</td>
<td>Displays trace information</td>
</tr>
<tr>
<td>TRACE_ACQUISITION</td>
<td>TA</td>
<td>Enables or disabled trace information acquisition</td>
</tr>
<tr>
<td>TRACE_SAVE</td>
<td>TV</td>
<td>Outputs trace information into a file</td>
</tr>
<tr>
<td>TRACE_STATISTIC</td>
<td>TST</td>
<td>Analyzes statistic information</td>
</tr>
</tbody>
</table>
### 5.1.9 Coverage

<table>
<thead>
<tr>
<th>Command Name</th>
<th>Abbreviation</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>COVERAGE</td>
<td>CV</td>
<td>Enables or disables coverage measurement</td>
</tr>
<tr>
<td>COVERAGE_DISPLAY</td>
<td>CVD</td>
<td>Displays coverage information</td>
</tr>
<tr>
<td>COVERAGE_LOAD</td>
<td>CVL</td>
<td>Loads coverage information</td>
</tr>
<tr>
<td>COVERAGE_RANGE</td>
<td>CVR</td>
<td>Sets a coverage range</td>
</tr>
<tr>
<td>COVERAGE_SAVE</td>
<td>CVS</td>
<td>Saves coverage information</td>
</tr>
</tbody>
</table>

### 5.1.10 Performance

<table>
<thead>
<tr>
<th>Command Name</th>
<th>Abbreviation</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>ANALYSIS</td>
<td>AN</td>
<td>Enables or disables performance analysis</td>
</tr>
<tr>
<td>ANALYSIS_RANGE</td>
<td>AR</td>
<td>Sets or displays performance analysis functions</td>
</tr>
<tr>
<td>ANALYSIS_RANGE_DELETE</td>
<td>AD</td>
<td>Deletes a performance analysis range</td>
</tr>
<tr>
<td>PROFILE</td>
<td>PR</td>
<td>Enables or disables profile</td>
</tr>
<tr>
<td>PROFILE_DISPLAY</td>
<td>PD</td>
<td>Displays profile information</td>
</tr>
<tr>
<td>PROFILE_SAVE</td>
<td>PS</td>
<td>Saves the profile information to file</td>
</tr>
</tbody>
</table>

### 5.1.11 Watch

<table>
<thead>
<tr>
<th>Command Name</th>
<th>Abbreviation</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>WATCH_ADD</td>
<td>WA</td>
<td>Adds an item for watching</td>
</tr>
<tr>
<td>WATCH_AUTO_UPDATE</td>
<td>WU</td>
<td>Selects or cancels automatic updating of watched items</td>
</tr>
<tr>
<td>WATCH_DELETE</td>
<td>WD</td>
<td>Deletes a watched item</td>
</tr>
<tr>
<td>WATCH_DISPLAY</td>
<td>WI</td>
<td>Displays the contents of the Watch window</td>
</tr>
<tr>
<td>WATCH_EDIT</td>
<td>WE</td>
<td>Edits the value of a watched item</td>
</tr>
<tr>
<td>WATCH_EXPAND</td>
<td>WX</td>
<td>Expands or collapses a watched item</td>
</tr>
<tr>
<td>WATCH_RADIX</td>
<td>WR</td>
<td>Changes the radix for display of watched items</td>
</tr>
<tr>
<td>WATCH_RECORD</td>
<td>WO</td>
<td>Outputs the history of updating of the values of a watched item to a file</td>
</tr>
<tr>
<td>WATCH_SAVE</td>
<td>WS</td>
<td>Saves the contents of the Watch window to a file</td>
</tr>
</tbody>
</table>
5.1.12 Script/Logging

<table>
<thead>
<tr>
<th>Command Name</th>
<th>Abbreviation</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>!</td>
<td></td>
<td>Comment</td>
</tr>
<tr>
<td>ASSERT</td>
<td></td>
<td>Checks if an expression is true or false</td>
</tr>
<tr>
<td>AUTO_COMPLETE</td>
<td>AC</td>
<td>Enables or disables the auto-complete function</td>
</tr>
<tr>
<td>ERASE</td>
<td>ER</td>
<td>Clears the [Command Line] window</td>
</tr>
<tr>
<td>EVALUATE</td>
<td>EV</td>
<td>Evaluates an expression</td>
</tr>
<tr>
<td>LOG</td>
<td>LO</td>
<td>Controls command output logging</td>
</tr>
<tr>
<td>SLEEP</td>
<td></td>
<td>Delays command execution</td>
</tr>
<tr>
<td>SUBMIT</td>
<td>SU</td>
<td>Executes a command file</td>
</tr>
<tr>
<td>TCL</td>
<td></td>
<td>Displays TCL information</td>
</tr>
</tbody>
</table>

5.1.13 Memory Resource

<table>
<thead>
<tr>
<th>Command Name</th>
<th>Abbreviation</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>MAP_DISPLAY</td>
<td>MA</td>
<td>Displays memory resource settings</td>
</tr>
<tr>
<td>MAP_SET</td>
<td>MS</td>
<td>Allocates a memory area</td>
</tr>
</tbody>
</table>

5.1.14 Simulator/Debugger Settings

<table>
<thead>
<tr>
<th>Command Name</th>
<th>Abbreviation</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>CLOCK_RATE</td>
<td>CKR</td>
<td>Sets a clock rate</td>
</tr>
<tr>
<td>EXEC_MODE</td>
<td>EM</td>
<td>Sets and displays execution mode</td>
</tr>
<tr>
<td>EXEC_STOP_SET</td>
<td>ESS</td>
<td>Sets or displays the execution mode at the occurrence of an interrupt</td>
</tr>
</tbody>
</table>
### 5.1.15 Standard I/O and File I/O

<table>
<thead>
<tr>
<th>Command Name</th>
<th>Abbreviation</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>SIMULATEDIO_CLEAR</td>
<td>SIOC</td>
<td>Clears the contents of the [Simulated I/O] window</td>
</tr>
<tr>
<td>TRAP_ADDRESS</td>
<td>TP</td>
<td>Sets a simulated I/O address</td>
</tr>
<tr>
<td>TRAP_ADDRESS_DISPLAY</td>
<td>TD</td>
<td>Displays simulated I/O address settings</td>
</tr>
<tr>
<td>TRAP_ADDRESS_ENABLE</td>
<td>TE</td>
<td>Enables or disables the simulated I/O</td>
</tr>
</tbody>
</table>

### 5.1.16 Utility

<table>
<thead>
<tr>
<th>Command Name</th>
<th>Abbreviation</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>HELP</td>
<td>HE</td>
<td>Displays the command line help</td>
</tr>
<tr>
<td>INITIALIZE</td>
<td>IN</td>
<td>Initializes the debugging platform</td>
</tr>
<tr>
<td>QUIT</td>
<td>QU</td>
<td>Exits HEW</td>
</tr>
<tr>
<td>RADIX</td>
<td>RA</td>
<td>Sets default input radix</td>
</tr>
<tr>
<td>RESPONSE</td>
<td>RP</td>
<td>Sets an interval to refresh the window</td>
</tr>
<tr>
<td>STATUS</td>
<td>STA</td>
<td>Displays the debugging platform status</td>
</tr>
<tr>
<td>TOOL_INFORMATION</td>
<td>TO</td>
<td>Outputs information on the currently registered tool to a file</td>
</tr>
</tbody>
</table>
### 5.1.17 Project/Workspace

<table>
<thead>
<tr>
<th>Command Name</th>
<th>Abbreviation</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>ADD_FILE</td>
<td>AF</td>
<td>Adds a file to the current project</td>
</tr>
<tr>
<td>CHANGE_CONFIGURATION</td>
<td>CC</td>
<td>Sets the current configuration</td>
</tr>
<tr>
<td>CHANGE_PROJECT</td>
<td>CP</td>
<td>Sets the current project</td>
</tr>
<tr>
<td>CHANGE_SESSION</td>
<td>CS</td>
<td>Changes the current session</td>
</tr>
<tr>
<td>CHANGE_SUB_SESSION</td>
<td>CB</td>
<td>Changes the currently active session when simultaneous debugging is enabled</td>
</tr>
<tr>
<td>CLEAR_OUTPUT_WINDOW</td>
<td>COW</td>
<td>Clears the contents of the specified tab in the [Output] window</td>
</tr>
<tr>
<td>CLOSE_WORKSPACE</td>
<td>CW</td>
<td>Close the current workspace</td>
</tr>
<tr>
<td>OPEN_WORKSPACE</td>
<td>OW</td>
<td>Opens a workspace</td>
</tr>
<tr>
<td>REFRESH_SESSION</td>
<td>RSE</td>
<td>Updates information on the session</td>
</tr>
<tr>
<td>REMOVE_FILE</td>
<td>REM</td>
<td>Removes a file from the current project</td>
</tr>
<tr>
<td>SAVE_SESSION</td>
<td>SE</td>
<td>Saves the current session</td>
</tr>
<tr>
<td>SAVE_WORKSPACE</td>
<td>SW</td>
<td>Saves the current workspace</td>
</tr>
<tr>
<td>UPDATE_ALL_DEPENDENCIES</td>
<td>UD</td>
<td>Updates all build dependencies of the current project</td>
</tr>
</tbody>
</table>

### 5.1.18 Test Tool Facility

<table>
<thead>
<tr>
<th>Command Name</th>
<th>Abbreviation</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>CLOSE_TEST_SUITE</td>
<td>CTS</td>
<td>Closes a test suite</td>
</tr>
<tr>
<td>COMPARE_TEST_DATA</td>
<td>CTD</td>
<td>Compares test data</td>
</tr>
<tr>
<td>OPEN_TEST_SUITE</td>
<td>OTS</td>
<td>Opens a test suite</td>
</tr>
<tr>
<td>RUN_TEST</td>
<td>RT</td>
<td>Executes a test</td>
</tr>
</tbody>
</table>
5.2 Commands (Alphabetical Order)

Table 5.1 lists the commands in alphabetical order.

Refer to the help about each command.

Table 5.1 Simulator/Debugger Commands

<table>
<thead>
<tr>
<th>No.</th>
<th>Command Name</th>
<th>Abbreviation</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>!</td>
<td></td>
<td>Comment</td>
</tr>
<tr>
<td>2</td>
<td>ADD_FILE</td>
<td>AF</td>
<td>Adds a file to the current project</td>
</tr>
<tr>
<td>3</td>
<td>ANALYSIS</td>
<td>AN</td>
<td>Enables or disables performance analysis</td>
</tr>
<tr>
<td>4</td>
<td>ANALYSIS_RANGE</td>
<td>AR</td>
<td>Sets or displays performance analysis functions</td>
</tr>
<tr>
<td>5</td>
<td>ANALYSIS_RANGE_DELETE</td>
<td>AD</td>
<td>Deletes a performance analysis range</td>
</tr>
<tr>
<td>6</td>
<td>ASSEMBLE</td>
<td>AS</td>
<td>Assembles instructions into memory</td>
</tr>
<tr>
<td>7</td>
<td>ASSERT</td>
<td></td>
<td>Checks if an expression is true or false</td>
</tr>
<tr>
<td>8</td>
<td>AUTO_COMPLETE</td>
<td>AC</td>
<td>Enables or disables the auto-complete function</td>
</tr>
<tr>
<td>9</td>
<td>BREAKPOINT</td>
<td>BP</td>
<td>Sets a breakpoint at an instruction address</td>
</tr>
<tr>
<td>10</td>
<td>BREAK_ACCESS</td>
<td>BA</td>
<td>Specifies a memory range access as a break condition</td>
</tr>
<tr>
<td>11</td>
<td>BREAK_CLEAR</td>
<td>BC</td>
<td>Deletes breakpoints</td>
</tr>
<tr>
<td>12</td>
<td>BREAK_CYCLE</td>
<td>BCY</td>
<td>Specifies a cycle as a break condition</td>
</tr>
<tr>
<td>13</td>
<td>BREAK_DATA</td>
<td>BD</td>
<td>Specifies a memory data value as a break condition</td>
</tr>
<tr>
<td>14</td>
<td>BREAK_DATA_DIFFERENCE</td>
<td>BDD</td>
<td>Specifies a difference between two values of data in memory as a break condition</td>
</tr>
<tr>
<td>15</td>
<td>BREAK_DATA_INVERSE</td>
<td>BDI</td>
<td>Specifies inversion of the sign of a value of data in memory as a break condition</td>
</tr>
<tr>
<td>16</td>
<td>BREAK_DISPLAY</td>
<td>BI</td>
<td>Displays a list of breakpoints</td>
</tr>
<tr>
<td>17</td>
<td>BREAK_ENABLE</td>
<td>BE</td>
<td>Enables or disables a breakpoint</td>
</tr>
<tr>
<td>18</td>
<td>BREAK_REGISTER</td>
<td>BR</td>
<td>Specifies a register data as a break condition</td>
</tr>
<tr>
<td>19</td>
<td>BREAK_SEQUENCE</td>
<td>BS</td>
<td>Sets sequential breakpoints</td>
</tr>
<tr>
<td>20</td>
<td>BUILD</td>
<td>BU</td>
<td>Performs a build on the current project</td>
</tr>
<tr>
<td>21</td>
<td>BUILD_ALL</td>
<td>BL</td>
<td>Performs a build all on the current project</td>
</tr>
<tr>
<td>22</td>
<td>BUILD_FILE</td>
<td>BF</td>
<td>Compiles files</td>
</tr>
<tr>
<td>23</td>
<td>BUILD_MULTIPLE</td>
<td>BM</td>
<td>Builds multiple projects</td>
</tr>
<tr>
<td>No.</td>
<td>Command Name</td>
<td>Abbreviation</td>
<td>Function</td>
</tr>
<tr>
<td>-----</td>
<td>----------------------------</td>
<td>--------------</td>
<td>----------------------------------------------------</td>
</tr>
<tr>
<td>24</td>
<td>CACHE</td>
<td>-</td>
<td>Sets caching on or off</td>
</tr>
<tr>
<td>25</td>
<td>CHANGE_CONFIGURATI</td>
<td>CC</td>
<td>Sets the current configuration</td>
</tr>
<tr>
<td>26</td>
<td>CHANGE_PROJECT</td>
<td>CP</td>
<td>Sets the current project</td>
</tr>
<tr>
<td>27</td>
<td>CHANGE_SESSION</td>
<td>CS</td>
<td>Changes the current session</td>
</tr>
<tr>
<td>28</td>
<td>CHANGE_SUB_SESSION</td>
<td>CB</td>
<td>Changes the currently active session when</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>simultaneous debugging is enabled</td>
</tr>
<tr>
<td>29</td>
<td>CLEAN</td>
<td>CL</td>
<td>Deletes intermediate and output files produced in</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>building</td>
</tr>
<tr>
<td>30</td>
<td>CLEAR_OUTPUT_WINDOW</td>
<td>COW</td>
<td>Clears the contents of the specified tab in the</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>[Output] window</td>
</tr>
<tr>
<td>31</td>
<td>CLOCK_RATE</td>
<td>CR</td>
<td>Sets a clock rate</td>
</tr>
<tr>
<td>32</td>
<td>CLOSE_TEST_SUITE</td>
<td>CTS</td>
<td>Closes a test suite</td>
</tr>
<tr>
<td>33</td>
<td>CLOSE_WORKSPACE</td>
<td>CW</td>
<td>Close the current workspace</td>
</tr>
<tr>
<td>34</td>
<td>COMPARE_TEST_DATA</td>
<td>CTD</td>
<td>Compares test data</td>
</tr>
<tr>
<td>35</td>
<td>COVERAGE</td>
<td>CV</td>
<td>Enables or disables coverage measurement</td>
</tr>
<tr>
<td>36</td>
<td>COVERAGE_DISPLAY</td>
<td>CVD</td>
<td>Displays coverage information</td>
</tr>
<tr>
<td>37</td>
<td>COVERAGE_LOAD</td>
<td>CVL</td>
<td>Loads coverage information</td>
</tr>
<tr>
<td>38</td>
<td>COVERAGE_RANGE</td>
<td>CVR</td>
<td>Sets a coverage range</td>
</tr>
<tr>
<td>39</td>
<td>COVERAGE_SAVE</td>
<td>CVS</td>
<td>Saves coverage information</td>
</tr>
<tr>
<td>40</td>
<td>DEFAULT_OBJECT_FORMAT</td>
<td>DO</td>
<td>Sets the default object (program) format</td>
</tr>
<tr>
<td>41</td>
<td>DISASSEMBLE</td>
<td>DA</td>
<td>Disassembles memory contents</td>
</tr>
<tr>
<td>42</td>
<td>ERASE</td>
<td>ER</td>
<td>Clears the [Command Line] window</td>
</tr>
<tr>
<td>43</td>
<td>EVALUATE</td>
<td>EV</td>
<td>Evaluates an expression</td>
</tr>
<tr>
<td>44</td>
<td>EXEC_MODE</td>
<td>EM</td>
<td>Sets and displays execution mode</td>
</tr>
<tr>
<td>45</td>
<td>EXEC_STOP_SET</td>
<td>ESS</td>
<td>Sets or displays the execution mode at the</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>occurrence of an interrupt</td>
</tr>
<tr>
<td>46</td>
<td>FILE_LOAD</td>
<td>FL</td>
<td>Loads an object (program) file</td>
</tr>
<tr>
<td>47</td>
<td>FILE_LOAD_ALL</td>
<td>LA</td>
<td>Loads all object (program) files</td>
</tr>
<tr>
<td>48</td>
<td>FILE_SAVE</td>
<td>FS</td>
<td>Saves memory to a file</td>
</tr>
<tr>
<td>No.</td>
<td>Command Name</td>
<td>Abbreviation</td>
<td>Function</td>
</tr>
<tr>
<td>-----</td>
<td>----------------------</td>
<td>--------------</td>
<td>---------------------------------------------------------------</td>
</tr>
<tr>
<td>49</td>
<td>FILE_UNLOAD</td>
<td>FU</td>
<td>Unloads an object (program) file from memory</td>
</tr>
<tr>
<td>50</td>
<td>FILE_UNLOAD_ALL</td>
<td>UA</td>
<td>Unloads all object (program) files from memory</td>
</tr>
<tr>
<td>51</td>
<td>FILE_VERIFY</td>
<td>FV</td>
<td>Verifies file contents against memory</td>
</tr>
<tr>
<td>52</td>
<td>GENERATE_MAKE_FILE</td>
<td>GM</td>
<td>Generates a build makefile for the current workspace</td>
</tr>
<tr>
<td>53</td>
<td>GO</td>
<td>GO</td>
<td>Executes user program</td>
</tr>
<tr>
<td>54</td>
<td>GO_RESET</td>
<td>GR</td>
<td>Executes user program from reset vector</td>
</tr>
<tr>
<td>55</td>
<td>GO_TILL</td>
<td>GT</td>
<td>Executes user program until temporary breakpoint</td>
</tr>
<tr>
<td>56</td>
<td>HALT</td>
<td>HA</td>
<td>Halts the user program</td>
</tr>
<tr>
<td>57</td>
<td>HELP</td>
<td>HE</td>
<td>Displays the command line help</td>
</tr>
<tr>
<td>58</td>
<td>INITIALIZE</td>
<td>IN</td>
<td>Initializes the debugging platform</td>
</tr>
<tr>
<td>59</td>
<td>LOG</td>
<td>LO</td>
<td>Controls command output logging</td>
</tr>
<tr>
<td>60</td>
<td>MAP_DISPLAY</td>
<td>MA</td>
<td>Displays memory resource settings</td>
</tr>
<tr>
<td>61</td>
<td>MAP_SET</td>
<td>MS</td>
<td>Allocates a memory area</td>
</tr>
<tr>
<td>62</td>
<td>MEMORYCOMPARE</td>
<td>MC</td>
<td>Compares memory contents</td>
</tr>
<tr>
<td>63</td>
<td>MEMORYDISPLAY</td>
<td>MD</td>
<td>Displays memory contents</td>
</tr>
<tr>
<td>64</td>
<td>MEMORYEDIT</td>
<td>ME</td>
<td>Modifies memory contents</td>
</tr>
<tr>
<td>65</td>
<td>MEMORYFILL</td>
<td>MF</td>
<td>Modifies the content of a memory area by specifying data</td>
</tr>
<tr>
<td>66</td>
<td>MEMORYFIND</td>
<td>MI</td>
<td>Finds a string in an area of memory</td>
</tr>
<tr>
<td>67</td>
<td>MEMORYMOVE</td>
<td>MV</td>
<td>Moves a block of memory</td>
</tr>
<tr>
<td>68</td>
<td>MEMORYTEST</td>
<td>MT</td>
<td>Tests a block of memory</td>
</tr>
<tr>
<td>69</td>
<td>OPENTEST_SUITE</td>
<td>OTS</td>
<td>Opens a test suite</td>
</tr>
<tr>
<td>70</td>
<td>OPENWORKSPACE</td>
<td>OW</td>
<td>Opens a workspace</td>
</tr>
<tr>
<td>71</td>
<td>PROFILE</td>
<td>PR</td>
<td>Enables or disables profile</td>
</tr>
<tr>
<td>72</td>
<td>PROFILEDISPLAY</td>
<td>PD</td>
<td>Displays profile information</td>
</tr>
<tr>
<td>73</td>
<td>PROFILESAVE</td>
<td>PS</td>
<td>Saves the profile information to file</td>
</tr>
<tr>
<td>74</td>
<td>QUIT</td>
<td>QU</td>
<td>Exits HEW</td>
</tr>
<tr>
<td>75</td>
<td>RADIX</td>
<td>RA</td>
<td>Sets default input radix</td>
</tr>
<tr>
<td>76</td>
<td>REFRESH_SESSION</td>
<td>RSE</td>
<td>Updates information on the session</td>
</tr>
</tbody>
</table>
Table 5.1  Simulator/Debugger Commands (cont)

<table>
<thead>
<tr>
<th>No.</th>
<th>Command Name</th>
<th>Abbreviation</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>77</td>
<td>REGISTER_ADDRESS_GET</td>
<td>RAG</td>
<td>Displays the address of bank control registers</td>
</tr>
<tr>
<td>78</td>
<td>REGISTER_ADDRESS_SET</td>
<td>RAS</td>
<td>Sets the address of bank control registers</td>
</tr>
<tr>
<td>79</td>
<td>REGISTER_DISPLAY</td>
<td>RD</td>
<td>Displays CPU register values</td>
</tr>
<tr>
<td>80</td>
<td>REGISTER_SET</td>
<td>RS</td>
<td>Changes CPU register contents</td>
</tr>
<tr>
<td>81</td>
<td>REGISTER_BANK_DISPLAY</td>
<td>RBD</td>
<td>Displays register bank values</td>
</tr>
<tr>
<td>82</td>
<td>REGISTER_BANK_SET</td>
<td>RBS</td>
<td>Changes the contents of register banks</td>
</tr>
<tr>
<td>83</td>
<td>REMOVE_FILE</td>
<td>REM</td>
<td>Removes a file from the current project</td>
</tr>
<tr>
<td>84</td>
<td>RESET</td>
<td>RE</td>
<td>Resets CPU</td>
</tr>
<tr>
<td>85</td>
<td>RESPONSE</td>
<td>RP</td>
<td>Sets an interval to refresh the window</td>
</tr>
<tr>
<td>86</td>
<td>RUN_TEST</td>
<td>RT</td>
<td>Executes a test</td>
</tr>
<tr>
<td>87</td>
<td>SLEEP</td>
<td>-</td>
<td>Delays command execution</td>
</tr>
<tr>
<td>88</td>
<td>SAVE_SESSION</td>
<td>SE</td>
<td>Saves the current session</td>
</tr>
<tr>
<td>89</td>
<td>SAVE_WORKSPACE</td>
<td>SW</td>
<td>Saves the current workspace</td>
</tr>
<tr>
<td>90</td>
<td>SET_DISASSEMBLY_SOFT_BREAK</td>
<td>SDB</td>
<td>Sets or deletes a software breakpoint at the disassembly level</td>
</tr>
<tr>
<td>91</td>
<td>SET_SOURCE_SOFT_BREAK</td>
<td>SSB</td>
<td>Sets or deletes a software breakpoint at the source level</td>
</tr>
<tr>
<td>92</td>
<td>SIMULATEDIO_CLEAR</td>
<td>SIOC</td>
<td>Clears the contents of the [Simulated I/O] window</td>
</tr>
<tr>
<td>93</td>
<td>STATE_DISASSEMBLY_SOFT_BREAK</td>
<td>TDB</td>
<td>Enables or disables a software breakpoint at the disassembly level</td>
</tr>
<tr>
<td>94</td>
<td>STATE_SOURCE_SOFT_BREAK</td>
<td>TSB</td>
<td>Enables or disables a software breakpoint at the source level</td>
</tr>
<tr>
<td>95</td>
<td>STATUS</td>
<td>STA</td>
<td>Displays the debugging platform status</td>
</tr>
<tr>
<td>96</td>
<td>STEP</td>
<td>ST</td>
<td>Steps program (by instructions or source lines)</td>
</tr>
<tr>
<td>97</td>
<td>STEP_MODE</td>
<td>SM</td>
<td>Selects the step mode</td>
</tr>
<tr>
<td>98</td>
<td>STEP_OUT</td>
<td>SP</td>
<td>Steps out of the current function</td>
</tr>
<tr>
<td>99</td>
<td>STEP_OVER</td>
<td>SO</td>
<td>Steps program, not stepping into functions</td>
</tr>
<tr>
<td>100</td>
<td>STEP_RATE</td>
<td>SR</td>
<td>Sets or displays rate of stepping</td>
</tr>
<tr>
<td>101</td>
<td>STEP_UNIT</td>
<td>SN</td>
<td>Sets the unit of execution</td>
</tr>
</tbody>
</table>
## Table 5.1 Simulator/Debugger Commands (cont)

<table>
<thead>
<tr>
<th>No.</th>
<th>Command Name</th>
<th>Abbreviation</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>102</td>
<td>SUBMIT</td>
<td>SU</td>
<td>Executes a command file</td>
</tr>
<tr>
<td>103</td>
<td>SYMBOL_ADD</td>
<td>SA</td>
<td>Defines a symbol</td>
</tr>
<tr>
<td>104</td>
<td>SYMBOL_CLEAR</td>
<td>SC</td>
<td>Deletes a symbol</td>
</tr>
<tr>
<td>105</td>
<td>SYMBOL_LOAD</td>
<td>SL</td>
<td>Loads a symbol information file</td>
</tr>
<tr>
<td>106</td>
<td>SYMBOL_SAVE</td>
<td>SS</td>
<td>Saves a symbol information file</td>
</tr>
<tr>
<td>107</td>
<td>SYMBOL_VIEW</td>
<td>SV</td>
<td>Displays symbols</td>
</tr>
<tr>
<td>108</td>
<td>TCL</td>
<td>-</td>
<td>Enables or disables the TCL</td>
</tr>
<tr>
<td>109</td>
<td>TOOL_INFORMATION</td>
<td>TO</td>
<td>Outputs information on the currently registered tool to a file</td>
</tr>
<tr>
<td>110</td>
<td>TRACE</td>
<td>TR</td>
<td>Displays trace information</td>
</tr>
<tr>
<td>111</td>
<td>TRACE_ACQUISITION</td>
<td>TA</td>
<td>Enables or disables trace information acquisition</td>
</tr>
<tr>
<td>112</td>
<td>TRACE_SAVE</td>
<td>TV</td>
<td>Outputs trace information into a file</td>
</tr>
<tr>
<td>113</td>
<td>TRACE_STATISTIC</td>
<td>TST</td>
<td>Analyzes statistic information</td>
</tr>
<tr>
<td>114</td>
<td>TRAP_ADDRESS</td>
<td>TP</td>
<td>Sets a simulated I/O address</td>
</tr>
<tr>
<td>115</td>
<td>TRAP_ADDRESS_DISPLAY</td>
<td>TD</td>
<td>Displays simulated I/O address settings</td>
</tr>
<tr>
<td>116</td>
<td>TRAP_ADDRESS_ENABLE</td>
<td>TE</td>
<td>Enables or disables the simulated I/O</td>
</tr>
<tr>
<td>117</td>
<td>UPDATE_ALL_DEPENDENCIES</td>
<td>UD</td>
<td>Updates all build dependencies of the current project</td>
</tr>
<tr>
<td>118</td>
<td>WATCH_ADD</td>
<td>WA</td>
<td>Adds an item for watching</td>
</tr>
<tr>
<td>119</td>
<td>WATCH_AUTO_UPDATE</td>
<td>WU</td>
<td>Selects or cancels automatic updating of watched items</td>
</tr>
<tr>
<td>120</td>
<td>WATCH_DELETE</td>
<td>WD</td>
<td>Deletes a watched item</td>
</tr>
<tr>
<td>121</td>
<td>WATCH_DISPLAY</td>
<td>WI</td>
<td>Displays the contents of the Watch window</td>
</tr>
<tr>
<td>122</td>
<td>WATCH_EDIT</td>
<td>WE</td>
<td>Edits the value of a watched item</td>
</tr>
<tr>
<td>123</td>
<td>WATCH_EXPAND</td>
<td>WX</td>
<td>Expands or collapses a watched item</td>
</tr>
<tr>
<td>124</td>
<td>WATCH_RADIX</td>
<td>WR</td>
<td>Changes the radix for display of watched items</td>
</tr>
<tr>
<td>125</td>
<td>WATCH_RECORD</td>
<td>WO</td>
<td>Outputs the history of updating of the values of a watched item to a file</td>
</tr>
<tr>
<td>126</td>
<td>WATCH_SAVE</td>
<td>WS</td>
<td>Saves the contents of the Watch window to a file</td>
</tr>
</tbody>
</table>
Section 6  Messages

6.1  Information Messages

The simulator/debugger outputs information messages as listed in table 6.1 to notify users of execution status.

Table 6.1  Information Messages

<table>
<thead>
<tr>
<th>Message</th>
<th>Contents</th>
</tr>
</thead>
<tbody>
<tr>
<td>Break Access (Access Address: H'nnnnnnnnn, Type: xxxx, Access Size: yyyy)</td>
<td>An access break condition was satisfied so execution has stopped. The information in parentheses shows the satisfied access break condition (accessed address, access type, and access unit).</td>
</tr>
<tr>
<td>Break Cycle (Cycle: H'nnnnnnn)</td>
<td>A number-of-cycles condition was satisfied so execution has stopped. The information in parentheses shows the satisfied number-of-cycles condition (number of cycles).</td>
</tr>
<tr>
<td>Break Data (Access Address: H'nnnnnnnnn, Data: H'mmmmmmmmm)</td>
<td>A data break condition ([Equal] or [Not equal]) was satisfied so execution has stopped. The information in parentheses shows the satisfied data break condition (accessed address and value).</td>
</tr>
<tr>
<td>Break Data (Access Address: H'nnnnnnnnn, Previous Data: H'mmmmmmmmm, Current Data: H'mmmmmmmmm)</td>
<td>A data break condition ([Inverse sign] or [Difference]) was satisfied so execution has stopped. The information in parentheses shows the satisfied data break condition (accessed address, and previous and current values).</td>
</tr>
<tr>
<td>Break Register (Register: XX, Value: H'mmmmmmmmm)</td>
<td>A register break condition was satisfied so execution has stopped. The information in parentheses shows the satisfied register break condition (register name and value).</td>
</tr>
<tr>
<td>Break Sequence (PC: H'nnnnnnnnn)</td>
<td>A sequential break condition was satisfied so execution has stopped. The information in parentheses shows the satisfied sequential break condition (address of the last instruction).</td>
</tr>
<tr>
<td>I/O DLL Stop</td>
<td>The peripheral function has stopped.</td>
</tr>
<tr>
<td>PC Breakpoint (PC: H'nnnnnnnnn)</td>
<td>A PC breakpoint condition was satisfied so execution has stopped. The information in parentheses shows the satisfied PC-breakpoint condition (instruction address).</td>
</tr>
<tr>
<td>Sleep</td>
<td>Execution has been stopped by the SLEEP instruction.</td>
</tr>
<tr>
<td>Step Normal End</td>
<td>The step execution succeeded.</td>
</tr>
</tbody>
</table>
Table 6.1  Information Messages (cont)

<table>
<thead>
<tr>
<th>Message</th>
<th>Contents</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stop</td>
<td>Execution has been stopped by the [Stop] button.</td>
</tr>
<tr>
<td>Trace Buffer Full</td>
<td>Since the Break mode was selected by [Trace buffer full handling] in the [Trace Acquisition] dialog box and the trace buffer became full, execution was terminated.</td>
</tr>
</tbody>
</table>

6.2  Error Messages

The simulator/debugger outputs error messages to notify users of the errors of user programs or operation. Table 6.2 lists the error messages.

Table 6.2  Error Messages

<table>
<thead>
<tr>
<th>Message</th>
<th>Contents</th>
</tr>
</thead>
<tbody>
<tr>
<td>Address Error</td>
<td>One of the following states occurred:</td>
</tr>
<tr>
<td></td>
<td>• The PC value was an odd number.</td>
</tr>
<tr>
<td></td>
<td>• An instruction was read from the internal I/O area.</td>
</tr>
<tr>
<td></td>
<td>• Word data was accessed to an address that was not a multiple of 2.</td>
</tr>
<tr>
<td></td>
<td>• Longword data was accessed to an address that was not a multiple of 4.</td>
</tr>
<tr>
<td></td>
<td>• The VBR or SP value was not a multiple of 4.</td>
</tr>
<tr>
<td></td>
<td>• An error occurred in the exception processing of an address error.</td>
</tr>
<tr>
<td></td>
<td>Correct the user program to prevent the error.</td>
</tr>
<tr>
<td>Exception Error</td>
<td>An error occurred during exception processing. Correct the user program to prevent the error.</td>
</tr>
<tr>
<td>File Open Error</td>
<td>An error occurred during opening a file with the file-input/output action of Break. Correct the file setting.</td>
</tr>
<tr>
<td>File Input Error</td>
<td>An error occurred during reading a file with file-input/output action of Break. Correct the file setting.</td>
</tr>
<tr>
<td>File Output Error</td>
<td>An error occurred during writing to a file with file-input/output action of Break. Correct the file setting.</td>
</tr>
<tr>
<td>FPU Disable</td>
<td>An attempt was made to execute an FPU instruction while the FPU is disabled (SR.FD = 1). Correct the user program to prevent the error.</td>
</tr>
<tr>
<td>Message</td>
<td>Contents</td>
</tr>
<tr>
<td>-------------------------</td>
<td>--------------------------------------------------------------------------</td>
</tr>
<tr>
<td>FPU Error</td>
<td>One of the following states occurred during floating-point operation:</td>
</tr>
<tr>
<td></td>
<td>• An FPU error</td>
</tr>
<tr>
<td></td>
<td>• An invalid operation</td>
</tr>
<tr>
<td></td>
<td>• A division by zero</td>
</tr>
<tr>
<td></td>
<td>• An overflow</td>
</tr>
<tr>
<td></td>
<td>• An underflow</td>
</tr>
<tr>
<td></td>
<td>• An inaccurate operation</td>
</tr>
<tr>
<td></td>
<td>Correct the user program to prevent the error.</td>
</tr>
<tr>
<td>General Invalid</td>
<td>Either of the following states occurred:</td>
</tr>
<tr>
<td>Instruction</td>
<td>• A code other than an instruction was executed.</td>
</tr>
<tr>
<td></td>
<td>• An error occurred in the exception processing of a reserved instruction exception.</td>
</tr>
<tr>
<td></td>
<td>Correct the user program to prevent the error.</td>
</tr>
<tr>
<td>Illegal CCR2 Set</td>
<td>The CCR2 value is illegal. Check the setting.</td>
</tr>
<tr>
<td>Illegal Combination</td>
<td>An attempt was made to access the area for which the BSC register setting was invalid. Correct the user program to prevent the error.</td>
</tr>
<tr>
<td>BSC Register</td>
<td></td>
</tr>
<tr>
<td>Illegal DSP Operation</td>
<td>Either of the following states occurred:</td>
</tr>
<tr>
<td></td>
<td>• A shift of more than 32 bits was executed with the PSHA instruction.</td>
</tr>
<tr>
<td></td>
<td>• A shift of more than 16 bits was executed with the PSHL instruction.</td>
</tr>
<tr>
<td></td>
<td>Correct the user program to prevent the error.</td>
</tr>
<tr>
<td>Illegal LRU Set</td>
<td>The LRU value of the cache is invalid. Check the setting.</td>
</tr>
<tr>
<td>Illegal Operation</td>
<td>Either of the following states occurred:</td>
</tr>
<tr>
<td></td>
<td>• A division by zero occurred during DIV1 instruction execution.</td>
</tr>
<tr>
<td></td>
<td>• Zero was written to by the SETRC instruction.</td>
</tr>
<tr>
<td></td>
<td>Correct the user program to prevent the error.</td>
</tr>
<tr>
<td>Illegal PR bit</td>
<td>An attempt was made to execute an FPU instruction while the PR bit value of the FPSCR is illegal. Correct the user program to prevent the error.</td>
</tr>
<tr>
<td>Initial Page Write</td>
<td>An initial page write exception occurred during simulation. Take necessary procedures such as updating the TLB contents.</td>
</tr>
<tr>
<td>Instruction TLB Illegal LRU</td>
<td>The LRU value in the instruction TLB is illegal. Check the setting.</td>
</tr>
</tbody>
</table>
Table 6.2 Error Messages (cont)

<table>
<thead>
<tr>
<th>Message</th>
<th>Contents</th>
</tr>
</thead>
<tbody>
<tr>
<td>Instruction TLB Miss</td>
<td>An instruction TLB miss occurred during memory access. Take necessary procedures such as updating the instruction TLB contents.</td>
</tr>
<tr>
<td>Instruction TLB Multiple Hit</td>
<td>Multiple instruction TLB entries were hit when a virtual address was accessed during simulation or command execution. The instruction TLB is not correctly set. Modify instruction TLB contents and user program (handler routine).</td>
</tr>
<tr>
<td>Instruction TLB Protection Violation</td>
<td>An instruction TLB protection exception occurred during memory access. Take necessary procedures such as updating the instruction TLB contents.</td>
</tr>
<tr>
<td>Interrupt Exception</td>
<td>An interrupt exception occurred, execution halted.</td>
</tr>
<tr>
<td>Invalid DSP Instruction Code</td>
<td>An invalid instruction code was detected in the DSP parallel instruction. Correct the user program to prevent the error.</td>
</tr>
<tr>
<td>Invalid Slot Instruction</td>
<td>Either of the following states occurred:</td>
</tr>
<tr>
<td></td>
<td>• An instruction that changes the PC value (a branch instruction)</td>
</tr>
<tr>
<td></td>
<td>immediately after a delayed branch instruction was executed.</td>
</tr>
<tr>
<td></td>
<td>• An error occurred during the exception processing of an invalid slot instruction.</td>
</tr>
<tr>
<td></td>
<td>Correct the user program to prevent the error.</td>
</tr>
<tr>
<td>Invalid Register Bank Number</td>
<td>A bank or entry that does not exist was specified in a STBANK or LDBANK instruction. Specify a correct bank or entry.</td>
</tr>
<tr>
<td>I/O area not exist</td>
<td>An attempt was made to delete the I/O area. Be sure to set the I/O area.</td>
</tr>
<tr>
<td>I/O DLL Illegal Interrupt Information (errNum=2xx)</td>
<td>Information on interrupts is incorrect. [errNum] shows the details on this error. Correct the information.</td>
</tr>
<tr>
<td></td>
<td>200: The specified vector is outside the supported range.</td>
</tr>
<tr>
<td></td>
<td>201: The specified priority is outside the supported range.</td>
</tr>
<tr>
<td>I/O DLL Memory Access Error (errNum=0xx, Address=0xXXXXXXXX)</td>
<td>An error has occurred during a memory access to the peripheral function. [errNum] shows the details on this error and [Address] shows the address where this error occurred. Correct the user program according to the error information.</td>
</tr>
<tr>
<td></td>
<td>001: The specified address is outside the supported range.</td>
</tr>
<tr>
<td></td>
<td>002: No memory exists in the specified area.</td>
</tr>
<tr>
<td></td>
<td>003: The required memory cannot be allocated.</td>
</tr>
<tr>
<td></td>
<td>004: The specified data size is outside the supported range.</td>
</tr>
<tr>
<td></td>
<td>005: The specified address cannot be accessed.</td>
</tr>
<tr>
<td>Message</td>
<td>Contents</td>
</tr>
<tr>
<td>----------------------------------------------</td>
<td>-----------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>I/O DLL Register Access Error (errNum=1xx,</td>
<td>An error has occurred during a register access to the peripheral function. [errNum] shows the details on this error and [RegisterName] shows the register where this error occurred. Correct the user program according to the error information.</td>
</tr>
<tr>
<td>RegisterName=xxxx)</td>
<td></td>
</tr>
<tr>
<td>100: The register description is incorrect.</td>
<td></td>
</tr>
<tr>
<td>101: The specified data value is incorrect.</td>
<td></td>
</tr>
<tr>
<td>Memory Access Error</td>
<td>One of the following events occurred (the information in parentheses shows the target address for the operation that generated the error):</td>
</tr>
<tr>
<td>(Address: H’nnnnnnnn)</td>
<td>• A memory area that had not been allocated was accessed.</td>
</tr>
<tr>
<td></td>
<td>• Data was written to a memory area having the write-protected attribute.</td>
</tr>
<tr>
<td></td>
<td>• Data was read from a memory area having the read-disabled attribute.</td>
</tr>
<tr>
<td></td>
<td>• A memory area in which memory does not exist was accessed. Allocate memory, change the memory attribute, or correct the user program to prevent the memory from being accessed.</td>
</tr>
<tr>
<td>Multiple Exception</td>
<td>Multiple exceptions occurred. Correct the user program to prevent the error.</td>
</tr>
<tr>
<td>PMB Multiple Hit</td>
<td>Multiple PMB entries were hit when a virtual address was accessed during simulation or command execution. PMB is not correctly set. Modify PMB contents and user program (handler routine).</td>
</tr>
<tr>
<td>PMB Miss</td>
<td>PMB miss occurred during simulation or command execution. Take necessary procedures such as updating the PMB contents.</td>
</tr>
<tr>
<td>Register Bank Overflow</td>
<td>An interrupt that uses register banks was generated after acceptance of register bank overflows had been selected and data had been saved in all register banks.</td>
</tr>
<tr>
<td>Register Bank Underflow</td>
<td>A RESBANK instruction was executed when no data had been saved in the register banks.</td>
</tr>
<tr>
<td>Slot FPU Disable</td>
<td>An attempt was made to execute an FPU instruction in a delay slot while the FPU is disabled (SR.FD = 1). Correct the user program to prevent the error.</td>
</tr>
<tr>
<td>System Call Error</td>
<td>Simulated I/O error occurred. Modify the incorrect contents of registers R0, R1, and parameter block.</td>
</tr>
<tr>
<td>Message</td>
<td>Contents</td>
</tr>
<tr>
<td>-------------------------------</td>
<td>-------------------------------------------------------------------------</td>
</tr>
<tr>
<td>The memory resource has not been set up</td>
<td>The memory resource was set outside the range of memory mapping. Modify the memory resource settings so that no error will occur.</td>
</tr>
<tr>
<td>TLB Invalid</td>
<td>TLB invalid exception occurred during simulation or command execution. Take necessary procedures such as updating the TLB contents.</td>
</tr>
<tr>
<td>TLB Miss</td>
<td>TLB miss occurred during simulation or command execution. Take necessary procedures such as updating the TLB contents.</td>
</tr>
<tr>
<td>TLB Multiple Hit</td>
<td>Multiple TLB entries were hit when a virtual address was accessed during simulation or command execution. TLB is not correctly set. Modify TLB contents and user program (handler routine).</td>
</tr>
<tr>
<td>TLB Protection Violation</td>
<td>Illegal TLB protection exception occurred during simulation. Take necessary procedures such as updating the TLB contents.</td>
</tr>
<tr>
<td>Unified TLB Miss</td>
<td>A unified TLB miss occurred during memory access. Take necessary procedures such as updating the unified TLB contents.</td>
</tr>
<tr>
<td>Unified TLB Multiple Hit</td>
<td>Multiple unified TLB entries were hit when a virtual address was accessed during simulation or command execution. The unified TLB is not correctly set. Modify the unified TLB contents and user program (handler routine).</td>
</tr>
<tr>
<td>Unified TLB Protection Violation</td>
<td>A unified TLB protection exception occurred during memory access. Take necessary procedures such as updating the unified TLB contents.</td>
</tr>
</tbody>
</table>
Section 7  Tutorial

7.1  Preparation

The basic functions of the simulator/debugger will be described in this section using a sample program.

Note: The contents of usage examples (figures) in this section will differ depending on the compiler version.

7.1.1  Sample Program

The HEW demonstration program is used for the sample program and is written in C language. It first sorts ten random data in the ascending order, and then in the descending order. The sample program:

(1) Generates random data for sorting using the main function.
(2) Inputs the array which stores the random data that is generated by the main function, then sorts the data in the ascending order using the sort function.
(3) Inputs the array generated by the sort function, and sorts the data in the descending order using the change function.
(4) Displays the random data and the sorted data using the printf function.

The HEW demonstration program is used as the sample program.

7.1.2  Creating the Sample Program

Note the following when creating the HEW demonstration program:

- Specify [Demonstration] for [Project Type] in [Creating a New Workspace].
- Specify [SH-1] for [CPU Series:].
- Specify [SH-1 Simulator] for [Target:].
- Specify [SimDebug_SH-1] for the configuration on the toolbar before building the project.
- Specify [SimSession_SH-1] for the session on the toolbar.
- This demonstration program uses no peripheral function (timer). In the [Set Peripheral Function Simulation] dialog box that opens when the session is changed, check [Don’t show this dialog box] and then press the [OK] button.
Since this section explains the debugging function, [Demonstration] has not been optimized. Do not change this setting.

7.2 Settings for Debugging

7.2.1 Allocating the Memory Resource

The allocation of the memory resource is necessary to run the application being developed. When using the demonstration project, the memory resource is allocated automatically, so check the setting.

- Select [Simulator->Memory Resource...] from the [Setup] menu, and display the allocation of the current memory resource.

![Simulator System Dialog Box (Memory Page)](image)

Figure 7.1 Simulator System Dialog Box (Memory Page)
The program area is allocated to the range of the addresses H'00000000 to H'00007FFF. The stack area is allocated to the range of the addresses H'0FFFE000 to H'0FFFFFFF, which can be read from or written to.

- Close the dialog box by clicking [OK].

The memory resource can also be referred to or modified by using the [Debugger] page on the [SuperH RISC engine Standard Toolchain] dialog box. Changes made in either of the dialog boxes are reflected.

### 7.2.2 Downloading the Sample Program

When using the demonstration project, the sample program to be downloaded is automatically set, so check the settings.

- Open the [Debug Setting] dialog box by selecting [Debug Settings...] on the [Debug] menu.

![Debug Settings Dialog Box](image)

Figure 7.2 Debug Settings Dialog Box

- Files to be downloaded are listed in [Download Modules].
- Close the [Debug Settings] dialog box by clicking the [OK] button.
• Download the sample program by selecting [Download Modules->All Download Modules] from the [Debug] menu.

### 7.2.3 Displaying the Source Program

The HEW supports source-level debugging. Display the source file ("Tutorial.c") in the [Source] window.

• Open the [Source] window by double-clicking Tutorial.c on the [Workspace] window.

![Source Window (Displaying the Source Program)](Image)
### 7.2.4 Setting a PC Breakpoint

Breakpoints can be set easily via the [Source] window. To set a breakpoint on a line that includes the sort function call:

- Place the cursor in the line that includes the sort function call and click the right mouse button to launch the pop-up menu, and select [Toggle Breakpoint] from the pop-up menu.

```
void main(void)
{
    long a[10], min, max;
    long i;
    int j;

    printf("Data Input \\

    for( i=0; i<10; i++ )
    { j = rand();
    if(j < 0){
    j = -j;
    a[i] = j;
    printf("a[%d]=%ld\n", i, a[i]);
    }
    sort(a);
    printf("Sorting results \\

    for( i=0; i<10; i++ )
    { printf("a[%d]=%ld\n", i, a[i]);
    }
```

![Figure 7.4](image_url)  
**Source Window (Setting the Breakpoint)**

A [•] is displayed at the line that includes the sort function call, indicating that the PC breakpoint is set at the address.
7.2.5 Setting the Profiler

- Open the [Profile] window by selecting [Profile] from the [View->Performance] menu.

![Profile Window](image)

**Figure 7.5 Profile Window**

- Open the pop-up menu by right clicking the mouse on the [Profile] window, and select [Enable Profiler] to enable acquisition of the profile information.
7.2.6 Setting the Simulated I/O

When the demonstration project is used, the simulated I/O is automatically set, so check the setting.

- Open the [Simulator System] dialog box by selecting [Simulator->System] from the [Setup] menu.

![Simulator System Dialog Box (System Page)](image)

- Confirm that [Enable] of [Simulated I/O Address] is checked.
- Click the [OK] button to enable the simulated I/O.
- Select [Simulated I/O] from the [View->CPU] menu and open the [Simulated I/O] window. The simulated I/O will not be enabled if the [Simulated I/O] window is not open.
Figure 7.7  Simulated I/O Window
7.2.7 Setting the Trace Information Acquisition Conditions

- Select [Trace] from the [View->Code] menu to open the [Trace] window. Open the pop-up menu by right clicking the mouse on the [Trace] window, and select [Acquisition...] from the pop-up menu.

The [Trace Acquisition] dialog box below will be displayed.

![Trace Acquisition Dialog Box](image)

- Set [Trace Start/Stop] to [Enable] in the [Trace Acquisition] dialog box, and click the [OK] button to enable the acquisition of the trace information.
7.2.8 Setting the Stack Pointer and Program Counter

To execute the program, the program counter must be set from the location of the reset vector. In the reset vector of the sample program, the PC value H'800 is written, and the SP value H'0FFFFFF0 is written.

- Select [Reset CPU] from the [Debug] menu, or click the [Reset CPU] button on the toolbar.

Set the program counter to H'800, and the stack pointer to H'0FFFFFF0 from the reset vector.

![Figure 7.9 Reset CPU Button]

7.3 Start Debugging

7.3.1 Executing a Program

- Select [Go] from the [Debug] menu, or click the [Go] button on the toolbar.

![Figure 7.10 Go Button]

The program halts where a breakpoint is set. An arrow is displayed in the [Source] window, indicating the location the execution has stopped. As the termination cause, [PC Breakpoint (PC: H'000013F8)] is displayed in the [Output] window.
Figure 7.11  Source Window (Break Status)

```c
void main(void)
{
    long a[10], min, max;
    long i;
    int j;
    printf("### Data Input ###\n");
    printf("a[%d]=%ld###\n", i, a[i]);
}
```

```c
for( i=0; i<10; i++ )
{
    j = rand();
    if(j < 0)
        j = -j;
    a[i] = i;
    printf("a[%d]=%ld###\n", i, a[i]);
}
```

```c
sort(a);
```

```c
printf("### Sorting results ###\n");
for( i=0; i<10; i++ )
{
    printf("a[%d]=%ld###\n", i, a[i]);
}
```

```c
min = a[0];
max = a[9];
```
The termination cause can be displayed in the [Status] window.


![Status Window](image)

**Figure 7.12 Status Window**

The above status window indicates that:

1. The cause of break is a PC breakpoint
2. Execution is performed from the pipeline reset
3. The number of executed instructions by the GO command is 57,801
4. The executed number of cycles from the pipeline reset is 116,463
Register values can be checked in the [Register] window.

- Select [Registers] from the [View->CPU] menu.

![Register Window](image)

**Figure 7.13 Register Window**

Register values when the program is terminated can be checked.
7.3.2 Using the Trace Buffer

The trace buffer can be used to clarify the history of instruction execution.

- Select [Trace] from the [View->Code] menu to open the [Trace] window. Scroll up to the very top of the window.

![Figure 7.14 Trace Window (Trace Information Display)](image-url)
7.3.3 Performing Trace Search

Click the right mouse button on the [Trace] window to launch the pop-up menu, and select [Find...] to open the [Trace Search] dialog box.

Setting the item to be searched to [Item] and the contents to be searched to [Value] and clicking the [OK] button begins the trace search. When the searched item is found, the first line is highlighted. To continue searching the same contents [Value], click the right mouse button in the [Trace] window to display the pop-up menu, and select [Find Next] from the pop-up menu. The next searched line is highlighted.
7.3.4 Checking Simulated I/O

Random data that is displayed by the printf function can be checked in the [Simulated I/O] window.

- Do not close the [Simulated I/O] window.
7.3.5 Checking the Breakpoints

A list of all the breakpoints that are set in the program can be checked in the [Event] window.

- Select [Eventpoints] from the [View -> Code] menu.

![Event Window](image)

**Figure 7.18 Event Window**

A breakpoint can be set, a new breakpoint can be defined, and a breakpoint can be deleted using the [Event] window.

- Close the [Event] window.

7.3.6 Watching Variables

It is possible to watch the values of variables used in your program and to verify that they change in the way that you expected. For example, set a watch on the long-type array “a” declared at the beginning of the program, by using the following procedure:

- Select [Watch] from the [View -> Symbol] menu to open the [Watch] window. And click the right mouse button on the [Watch] window and choose [Add Watch...] from the pop-up menu.

The following dialog box will be displayed.

![Add Watch Dialog Box](image)

**Figure 7.19 Add Watch Dialog Box**
Type array “a” and click the [OK] button.

The [Watch] window will show the long-type array “a”.
You can double-click the + symbol to the left of array “a” in the [Watch] window to expand the variable and show the individual elements in the array.

Close the [Watch] window.
7.3.7 Executing the Program in Single Steps

The simulator/debugger has various stepping menus that are useful in debugging the program.

<table>
<thead>
<tr>
<th>Menu</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Step In</td>
<td>Executes each statement (includes statements within the function)</td>
</tr>
<tr>
<td>Step Over</td>
<td>Executes a function call in a single step</td>
</tr>
<tr>
<td>Step Out</td>
<td>Steps out of a function, and stops at the next statement of the program that called the function</td>
</tr>
<tr>
<td>Step...</td>
<td>Executes the specified number of steps at the specified speed</td>
</tr>
</tbody>
</table>

**[Step In]:** Enters the called function and stops at the statement at the start of the called function.

- To step in the sort function, select [Step In] from the [Debug] menu, or click the [Step In] button on the toolbar.

![Step In Button](image)

Figure 7.21 Step In Button
The PC location display (=>) in the [Source] window moves to the statement at the start of the sort function.
**[Step Out]**: Steps out of the called function and stops at the next statement in the called program.

- Select [Step Out] from the [Debug] menu to exit the sort function, or click the [Step Out] button on the toolbar.

---

Figure 7.23  Step Out Button

![Figure 7.23  Step Out Button](image)

Figure 7.24  Source Window (Step Out)

![Figure 7.24  Source Window (Step Out)](image)
[Step Over]: Executes a function call in a single step, and stops at the next statement in the main program.

Select [Step Over] from the [Debug] menu or click the [Step Over] button on the toolbar to step over the statements in the printf function.

Figure 7.25  Step Over Button

```c
void main(void) {
    long a[10], min, max;
    long j;
    int i;

    printf("### Data Input ###\n");
    for (i=0; i<10; i++){
        j = rand();
        if(j < 0){
            j = -j;
        }
        a[i] = j;
        printf("a[%d]=%ld\n",i,a[i]);
    }
    sort(a);
    printf("### Sorting results ###\n");
    for (i=0; i<10; i++){
        printf("a[%d]=%ld\n",i,a[i]);
        min = a[0];
        max = a[3];
        min = 0;
        max = 0;
        change(a);
        min = a[3];
        max = a[0];
    }
}
```

Figure 7.26  Source Window (Step Over)
When the printf function has been executed, **Sorting results *** will be displayed in the [Simulated I/O] window.

### 7.3.8 Checking Profile Information

The profile information can be checked in the [Profile] window.

- Clicking the [Go] button and continuing execution from the current PC executes the SLEEP instruction and then stops.

**[List] Sheet:** Displays the profile information as a list.

- Open the [Profile] window by selecting [Profile] from the [View->Performance] menu. The [List] sheet will be displayed.

![Profile Window (List Sheet)](image)

In the above figure, it can be found that the __flclose function was called six times, the execution cycle was 447, the external memory was accessed nine times, and the internal memory was accessed 63 times.

It is possible to search for the critical path, such as a function that is called or accesses the memory many times, for the program performance.
**[Tree] Sheet:** Displays the profile information as a tree diagram.

- Select the [Tree] sheet. Double-clicking the function name in the [Profile] window expands or minimizes the tree structure.

![Profile Window (Tree Sheet)](image)

In above figure, it can be found that the `_fclose` function was called three times from the `_fclose` function, the execution cycle was 315, the external memory was accessed three times, and the internal memory was accessed 45 times.
[Profile-Chart] Window: Displays the relation of calls for a specific function.

- Select the __flclose function on the [Profile] window. Open the pop-up menu by right clicking the mouse on the [Profile] window, and select [View Profile-Chart] to display the [Profile-Chart] window.

In the above figure, it can be found that the __flclose function was called three times from the _fclose and _freopen functions, and the _close function was called three times.

This is the end of the tutorial using the simulator/debugger.

Renesas Technology America, Inc.
450 Holger Way, San Jose, CA 95134-1368, U.S.A
Tel: <1> (408) 382-7500, Fax: <1> (408) 382-7501

Renesas Technology Europe Limited
Dukes Meadow, Millboard Road, Bourne End, Buckinghamshire, SL8 5FH, U.K.
Tel: <44> (1628) 585-100, Fax: <44> (1628) 585-900

Renesas Technology (Shanghai) Co., Ltd.
Unit 204, 205, AZIA Center, No.1233 Lujiazui Ring Rd, Pudong District, Shanghai, China 200120
Tel: <86> (21) 5877-1818, Fax: <86> (21) 6887-7898

Renesas Technology Hong Kong Ltd.
7th Floor, North Tower, World Finance Centre, Harbour City, 1 Canton Road, Tsimshatsui, Kowloon, Hong Kong
Tel: <852> 2285-6688, Fax: <852> 2730-6071

Renesas Technology Taiwan Co., Ltd.
10th Floor, No.99, Fushing North Road, Taipei, Taiwan
Tel: <886> (2) 2715-2886, Fax: <886> (2) 2713-2999

Renesas Technology Singapore Pte. Ltd.
1 Harbour Front Avenue, #06-10, Keppel Bay Tower, Singapore 098632
Tel: <65> 6213-0200, Fax: <65> 6278-6001

Renesas Technology Korea Co., Ltd.
Kukje Center Bldg. 18th Fl., 191, 2-ka, Hangang-ro, Yongsan-ku, Seoul 140-702, Korea
Tel: <82> (2) 796-3115, Fax: <82> (2) 796-2145

Renesas Technology Malaysia Sdn. Bhd
Unit 906, Block B, Menara Amcorp, Amcorp Trade Centre, No.18, Jalan Persiaran Barat, 46050 Petaling Jaya, Selangor Darul Ehsan, Malaysia
Tel: <603> 7955-9390, Fax: <603> 7955-9510
SuperH™ RISC engine Simulator/Debugger
User’s Manual