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 depend 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.
E6000 Emulators for the H8S Family
How to Use the Conditional Trace Function

Overview

This document describes how to use the conditional trace function of the E6000 full-specification emulator for the H8S/2215.

While the operations described in this document can be performed independently on this H8S/2214 E6000 emulator. These functions are also available through all E6000 emulators for the H8S family.

Contents

1. Specifications................................................................. 2
2. Functional Descriptions.................................................. 2
3. Software Preparation..................................................... 2
    3.1 Introduction.......................................................... 2
    3.2 Installing the E8 Emulator Software.......................... 2
    3.3 Installing Other Necessary Software.......................... 2
4. Operations................................................................. 3
    4.1 Activating the High-performance Embedded Workshop...... 3
    4.2 Opening a Workspace................................................ 4
    4.3 Downloading a Program........................................... 8
    4.4 Point-to-Point Trace Condition.................................. 9
    4.5 Range Trace Condition............................................ 15
    4.6 Event Trace Condition............................................. 21
5. Related Documents...................................................... 26
1. Specifications

The E6000 emulator has an event detection system; this is available for the accurate description of conditions of interest that define events, which are specified combinations of MCU signals.

Applying the event detection system to the trace acquisition function can make the debugging of user systems very efficient.

Note: The data acquisition, condition checking, and actions (such as stopping the user program) specified for event points are processed by the E6000 hardware, and thus the actions are delayed by several cycles from satisfaction of the condition.

2. Functional Descriptions

This document describes how to use the conditional trace function in the H8S/2214 E6000 emulator.

It guides you through the procedures for setting event points in the sample program provided on the CD-ROM for the H8S/2214 E6000 emulator and making conditional trace settings for the event points, and describes the acquisition of trace information on a program in execution.

Product version: E6000 Emulator Software V.6.01 Release 00

3. Software Preparation

3.1 Introduction

Expand the sample program (tutorial workspace) to be used with this document onto your personal computer by installing the software provided on the CD-ROM for the H8S/2214 E6000 emulator.

If the High-performance Embedded Workshop has already been installed on the personal computer where you are installing the software, some dialog boxes in the installation process may be skipped.

3.2 Installing the E8 Emulator Software

Execute setup.exe from the CD-ROM for the H8S/2214 E6000 emulator.

For details on installation, refer to the Setup Guide for the E6000 Emulator and follow the instructions displayed on the screen. The procedure is not described in this document.

3.3 Installing Other Necessary Software

(1) Install the software that corresponds to the type of connection (PCI card, PC card, LAN, or USB adaptor) supported by the host interface board that has been selected for the H8S/2214 E6000 emulator. The installation procedure is described in the manual supplied with the host interface board and is not covered in this document.

(2) The procedures in this document include the modification of part of the sample program before checking program operation. For this purpose, the H8S, H8/300 series C/C++ compiler package is necessary. If you already have the product version of the compiler package, install it.

(3) If you do not have the product version of the compiler package, an evaluation version is available free of charge from the Renesas website. From the top page of the Renesas site, go to [Support] -> [Software Download for Tools], select [Evaluation Software] from [Category:], and search for the H8S, H8/300 series C/C++ compiler package. For the address of the Renesas website, refer to section 5, Related Documents. For restrictions on usage and the procedure for installing the evaluation version of the compiler package, refer to the download page.
4. Operations

This section describes how to activate the High-performance Embedded Workshop (HEW) and how to use the conditional trace function in the following steps.

Start of operations

Activating the High-performance Embedded Workshop

Opening a workspace

Downloading a program

Point-to-point trace condition

Range trace condition

Event trace condition

End of operations

Figure 4.1 Procedure for Sample Program Execution

4.1 Activating the High-performance Embedded Workshop

Activate the High-performance Embedded Workshop by opening the [Start] menu and selecting [All Programs], [Renesas], [High-performance Embedded Workshop], and [High-performance Embedded Workshop] in that order.
4.2 Opening a Workspace

(1) The [Welcome!] dialog box will appear above the High-performance Embedded Workshop window.

Check that power to the H8S/2214 E6000 emulator is turned on.

Select the [Browse to another project workspace] radio button in the [Welcome!] dialog box and click on the [OK] button.
(2) The [Open Workspace] dialog box will appear.

If the software from the CD-ROM for the emulator has been installed, the workspace "Tutorial.hws" will be in the folder shown below (standard location). Specify the correct location by opening the folders in order. Select the workspace "Tutorial.hws" and click on the [Select] button.

```
C:\WorkSpace\Tutorial\E6000\2214\Tutorial.hws
```

Note: The above directory will not be specifiable for some earlier versions of the High-performance Embedded Workshop. In this case, select the directory indicated below.

```
<High-performance Embedded Workshop installation directory>
\Tools\Renesas\DebugComp\Platform\E6000\2214\Tutorial
```

Examples:

```
C:\hew3\Tools\Renesas\DebugComp\Platform\E6000\2214\Tutorial
C:\hew2\Tools\Renesas\DebugComp\Platform\E6000\2214\Tutorial
```

(3) If the workspace was made with an old version of the High-performance Embedded Workshop, the following dialog box will appear.

To update it to the new version, click on the [OK] button.
(4) If the [Toolchain Version Not Registered in System] dialog box appears, select the name of the target project and click on the [OK] button.

(5) If the [Change Toolchain Version] dialog box appears, select the desired toolchain version and click on the [OK] button.

(6) If the [Change Toolchain Version Summary] dialog box appears, just click on the [OK] button.
(7) The workspace will open and the High-performance Embedded Workshop will be automatically connected to the emulator. The [E6000 Driver Details] dialog box may open when the emulator is connected. In this case, select the driver in use and click on the [Close] button.

(8) After the workspace has been read, operations in the High-performance Embedded Workshop window can proceed.

When the E6000 emulator has been successfully connected, "Connected" is displayed in the [Debug] tabbed page of the Output pane.
4.3 Downloading a Program

(1) Right-click on the download module "Tutorial.abs" in the workspace and select [Download] from the menu.

(2) After downloading of the program has been completed, a downward arrow is added to the icon at left of the file name.
4.4 Point-to-Point Trace Condition

(1) Double-click on the file name "tutorial.cpp" in the workspace so that its contents are displayed in the [Source] pane.

(2) Scroll the [Source] pane down to display the range around line 45. Then, right-click on line 45 in the [Event] column and select [Trace On] from the popup menu.
(3) Right-click on line 47 in the [Event] column and specify [Trace Off].

(4) Select [Code] from the [View] menu and click on [Trace] to open the [Trace] pane.

(6) The [Trace Acquisition] dialog box will appear. Click on tab [1].
(7) Check that [Point to Point] has been selected for [Conditions] and [Start Address] and [Stop Address] have been set, then click on the [OK] button.

(8) Set a software break on line 50.
(9) Select [Reset Go] from the [Debug] menu to execute the program.
(10) The program is executed and execution stops at the software breakpoint on line 50.

Trace information acquired under the point-to-point condition between [Trace On] and [Trace Off] is displayed in the [Trace] pane; i.e., tracing was continuously performed from the call of function "Sample::change()" on line 45 to the return to line 47 of the source file.

In the [Instruction] column at cycle position "-00469" (under [PTR]), we can confirm the presence of a JSR instruction which corresponds to the call of function "Sample::change()". When the contents of the [Trace] pane are scrolled down until the data for the zeroth cycle position are displayed, we find an RTS instruction under [Instruction] where the value under [PTR] is "-00005". This is the return from subroutine for function "Sample::change()".

4.5 Range Trace Condition

(1) The following shows an example of the use of a range trace condition. Select [Symbol]->[Watch] from the [View] menu.

(3) The [Add Watch] dialog box will appear. Enter "a" (symbol name) in the [Variable or expression:] edit box.

(4) Symbol "a" is now registered in the [Watch] pane. Click on [+] to expand the display of "a" and show its contents.

Symbol "a" is an array of ten elements of type long. In this case, the whole array is allocated to the address area from H'FFED70 to H'FFED97.

(5) Click on the [Setup] toolbar button in the [Trace] pane.
(6) The [Trace Acquisition] dialog box will appear. Click on tab [1].

(7) Select the [Range] radio button for [Conditions]. Click on the [Edit] button after selecting the condition of channel 1 for [Range Event].
(8) The [Breakpoint/Event Properties] dialog box will appear. Select the [Range] radio button for the condition of [Address] and specify H'00FFED70 and H'00FFED97 for [Address Lo] and [Address Hi], respectively. This address range is the region to which symbol "a" has been allocated, as described in (4) above. Select the [Write] radio button as the [Direction] condition and click on the [OK] button.

(9) If the condition under [Conditions] has been switched to [Point to Point], specify the condition [Range] again.
(10) Check the condition under [Range Event] for channel 1 and click on the [OK] button.

(11) Pull down the [Debug] menu and click on [Reset Go].
Here, in the same way as in the previous section, execution of the program is stopped at the software breakpoint on line 50.

![Image of memory address and data acquisition](image)

In the trace buffer, data have been acquired on memory-write cycles for the address range specified as the range condition. By checking the [Address] and [Data] columns, we can verify the values that have been written to the memory range we are looking at, and the order in which they were written.

Here, since data-write cycles have only been selected as the conditions of trace acquisition, the [Instruction] column will be blank. By enabling the condition [Time Stamp] in the [Trace Acquisition] dialog box in step (6) above, we can record information on the timing with which the data were written in the corresponding column.
4.6 Event Trace Condition

(1) The following shows an example of the use of event trace conditions. Click on the [Setup] toolbar button in the [Trace] pane to open the [Trace Acquisition] dialog box. Then, click on tab [1] and select [Event] under [Condition].

(2) Select the conditions of channels 1 and 2 for [Start Event] and [Stop Event], respectively. The current event conditions of channels 1 and 2 are not relevant at this point. Before editing the individual event conditions, click on the [General] tab.
(3) Select tab [1] again and click on the [Edit] button for [Start Event].

(4) The [Breakpoint/Event Properties] dialog box will appear. Select the [Range] radio button for the condition [Address] and specify the first and last addresses of the range to which symbol "a" has been allocated as [Address Lo] and [Address Hi], respectively. Then, enable [Data Compare] and [Use Mask], specify "H'0001" for [Value] and [Mask], and select the [Word] radio button. Finally, select the [Write] radio button for the condition [Direction] and click on the [OK] button.
(5) Click on the [Edit] button for [Stop Event].

(6) Specify [Don't care] for [Address] on the [General] tabbed page, clear the [Compare] button under [Data Compare], set [Direction] to [Either], and then select the [Action] tabbed page.

(7) Specify "D'3" under [Required number of event occurrences], ensure that [Enable Sequencing] is disabled, and then click on the [OK] button.
(8) Select [Event] under [Conditions], check the contents of the [Start Event] and [Stop Event] conditions, set [Cyclic] as enabled, and click on the [OK] button.

(9) Pull down the [Debug] menu and click on [Reset Go].
Here, in the same way as in the previous section, execution of the program is stopped at the software breakpoint on line 50.

The trace buffer contains data gathered by trace acquisition that started when odd-valued data was written to an address in the range specified as a condition for [Start Event], with consecutive cycles recorded until three instances of any kind of memory access (the condition for [Stop Event]). Since [Cyclic] has been enabled, the trace information between the two conditions will be recorded whenever they occur in order during emulation.

Thus, trace information including the operation of the microcomputer can be recorded immediately after an event of interest (i.e., writing to memory) has occurred, and we can identify the positions in programs that correspond to particular events.

If we had set the value against [Value] under [Data Compare] in step (4) to "H'0000", the condition would be writing of even data. Similarly, when [Use Mask] is disabled and a fixed value is specified for [Value], we can identify the line in the program responsible for writing that value.

Specifying a large value under [Required number of event occurrences] on the [Action] tabbed page in step (7) increases the number of cycles on which trace information will be acquired. This can be useful for the detailed analysis of program execution.
5. Related Documents

The H8S/2214 E6000 emulator and High-performance Embedded Workshop provide many other useful functions not mentioned in this document. Please refer to the following related documents for important information such as detailed specifications, technical information, or restrictions.

Documents Related to the H8S/2214 E6000 Emulator:
  Emulator Debugger Part:
  Section 3.2, Complex Event System (CES)
  Section 5.7, Using the Event Points
  Tutorial:
  Section 6.16, Trace Functions
- Precautions on Using the H8S/2214 E6000 Emulator
- Emulator Options 1 (PC I/F-part) documents

Document Related to High-Performance Embedded Workshop

Documents Related to CPU
- H8S/2214 Group Hardware Manual

Documents Related to H8S, H8/300 Series C/C++ Compiler Package
- Notes on Usage of the C/C++ Compiler Package for H8S, H8/300 series

Information on this product is available at the following Renesas websites:
Global site: http://www.renesas.com/e6000
Japanese site: http://japan.renesas.com/e6000
Renesas Website and Customer Support

Renesas Technology Website:
http://www.renesas.com/

Customer Support:
http://www.renesas.com/inquiry
csc@renesas.com

Revision Record

<table>
<thead>
<tr>
<th>Rev.</th>
<th>Date</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.00</td>
<td>Oct.11.07</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td></td>
<td>First edition issued</td>
</tr>
</tbody>
</table>

---
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.

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.

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 exporting the products or technology described herein, you should follow the applicable export control laws and regulations, and procedures required by such laws and regulations.

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 (http://www.renesas.com)

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.

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.

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 undersea 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.

8. Notwithstanding the preceding paragraph, you should not use Renesas products for the purposes listed below:
   1) artificial life support devices or systems
   2) surgical implants
   3) healthcare intervention (e.g., excision, administration of medication, etc.)
   4) any other purposes that pose a direct threat to human life

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.

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.

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.

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.

12. 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 exporting the products or technology described herein, you should follow the applicable export control laws and regulations, and procedures required by such laws and regulations.

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.