To our customers,

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April 1st, 2010
Renesas Electronics Corporation

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User's Manual

SH-2A, SH-2 E200F Emulator

User's Manual

SH-2A, SH-2 E200F
R0E0200F1EMU00E
Renesas Microcomputer
Development Environment
System

Renesas Electronics
www.renesas.com

Rev.10.00 2009.10

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IMPORTANT INFORMATION

READ FIRST

• READ this user's manual before using this emulator product.

• KEEP the user's manual handy for future reference.

Do not attempt to use the emulator product until you fully understand its mechanism.

Emulator Product:

Throughout this document, the term "emulator product" shall be defined as the following products produced only by Renesas Technology Corp. and Renesas Solutions Corp. excluding all subsidiary products.

- E200F main unit
- External bus trace unit
- EV-chip unit
- Expansion profiling unit
- Emulation memory unit
- User system interface board
- Trace cable

The user system or a host machine is not included in this definition.

Purpose of the Emulator Product:

This emulator product is a software and hardware development tool for systems employing the Renesas microcomputer SH-2A, SH-2 series (hereinafter referred to as SH-2A, SH-2). This emulator product must only be used for the above purpose.

Limited Applications:

This emulator product is not authorized for use in transportation, vehicular, medical (where human life is potentially at stake), aerospace, nuclear, or undersea repeater applications. Buyers of this emulator product must notify Renesas Technology Corporation, Renesas Solutions Corporation or an authorized Renesas Technology product distributor before planning to use the product in such applications.

Improvement Policy:

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Target User of the Emulator Product:

This emulator product should only be used by those who have carefully read and thoroughly understood the information and restrictions contained in the user's manual. Do not attempt to use the emulator product until you fully understand its mechanism.

It is highly recommended that first-time users be instructed by users that are well versed in the operation of the emulator product.

Users are required to be familiar with the basic knowledge for the electric circuits, logic circuits, and microcomputers.

Precautions to be Taken when Using This Product:

1. This emulator is a development supporting unit for use in your program development and evaluation stages. In mass-producing your program you have finished developing, be sure to make a judgment on your own risk that it can be put to practical use by performing integration test, evaluation, or some experiment else.

2. In no event shall Renesas Solutions Corporation be liable for any consequence arising from the use of this emulator.

3. Renesas Solutions Corporation strives to renovate or provide a workaround for product malfunction at some charge or without charge. However, this does not necessarily mean that Renesas Solutions Corporation guarantees the renovation or the provision under any circumstances.

4. This emulator has been developed by assuming its use for program development and evaluation in laboratories. Therefore, it does not fall under the application of Electrical Appliance and Material Safety Law and protection against electromagnetic interference when used in Japan.

5. This emulator does not conform to safety standards such as UL or IEC. Be careful when you take this emulator overseas.

6. Renesas cannot anticipate every possible circumstance that might involve a potential hazard. The warnings in this user's manual and on the emulator product are therefore not all inclusive. Therefore, you must use the emulator product safely at your own risk.

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Figures:

Some figures in this user's manual may show items different from your actual system.

SAFETY PAGE

READ FIRST

• READ this user's manual before using this emulator product.

• KEEP the user's manual handy for future reference.

Do not attempt to use the emulator product until you fully understand its mechanism.

DEFINITION OF SIGNAL WORDS

Either in the user's manual or on the product, several icons are used to insure proper handling of this product and also to prevent injuries to you or other persons, or damage to your properties. Their graphic images and meanings are given in this safety page. Be sure to read this chapter before using the product.

This is the safety alert symbol. It is used to alert you to potential personal injury hazards. Obey all safety messages that follow this symbol to avoid possible injury or death.

⚠ DANGER **DANGER** indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury.

⚠ WARNING **WARNING** indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.

⚠ CAUTION **CAUTION** indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury.

CAUTION **CAUTION** used without the safety alert symbol indicates a potentially hazardous situation which, if not avoided, may result in property damage.

NOTE emphasizes essential information.

In addition to the four above, the following are also used as appropriate.

 means WARNING or CAUTION.

Example:  CAUTION AGAINST AN ELECTRIC SHOCK

 means PROHIBITION.

Example:  DISASSEMBLY PROHIBITED

 means A FORCIBLE ACTION.

Example:  UNPLUG THE POWER CABLE FROM THE RECEPTACLE.

⚠ WARNING

Warnings for AC Power Supply:

• If the attached AC power cable does not fit the receptacle, do not alter the AC power cable and do not plug it forcibly. Failure to comply may cause electric shock and/or fire.

• Use an AC power cable which complies with the safety standard of the country.

• Do not touch the plug of the AC power cable when your hands are wet. This may cause electric shock.

• This product is connected signal ground with frame ground. If your developing product is transformless (not having isolation transformer of AC power), this may cause electric shock. Also, this may give an unrepairable damage to this product and your developing one.

While developing, connect AC power of the product to commercial power through isolation transformer in order to avoid these dangers.

• If other equipment is connected to the same branch circuit care should be taken not to overload the circuit. Refer to nameplate for electrical ratings.

• When installing this equipment, insure that a reliable ground connection is maintained.

⚠ WARNING

• If you smell a strange odor, hear an unusual sound, or see smoke coming from this product, then disconnect power immediately by unplugging the AC power cable from the outlet.

Do not use this as it is because of the danger of electric shock and/or fire. In this case, contact your local distributor.

• When installing or connecting this product with other equipment, shut down AC power or disconnect the AC power cord from the equipment to prevent personal injury or damage to the equipment.

Warnings to Be Taken for This Product:

• Do not disassemble or modify this product. Personal injury due to electric shock may occur if this product is disassembled and modified.

• Make sure nothing falls into the cooling fan on the top panel, especially liquids, metal objects, or anything combustible.

Warning for Installation:

• Do not set this product in water or areas of high humidity. Make sure that the product does not get wet. Spilling water or some other liquid into the product may cause unrepairable damage.

Warning for Use Environment:

• This equipment is to be used in an environment with a maximum ambient temperature of 35°C. Care should be taken that this temperature is not exceeded.

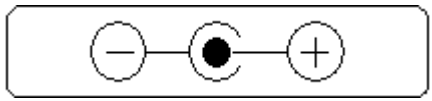
⚠ CAUTION

Cautions for AC Adapter:

• Use only the AC adapter included in this product package.

• The included AC adapter is for this emulator. Do not use it for other product.

• The DC plug on the included AC adapter has the below polarity.



• The included AC adapter has no power supply switch. The power is always applied to the AC adapter while connecting the AC power cable.

Cautions to Be Taken for This Product:

• Use caution when handling this product. Be careful not to apply a mechanical shock.

• Do not pull the main unit by the probe of the emulation probe or the flexible cable which are connected to this product. Excessive flexing or force of the flexible cable for connecting this product to the emulation probe may break connector.

Caution for Installation:

• When in use do not place the emulator on its side.

Introduction

The High-performance Embedded Workshop is a powerful development environment for embedded applications targeted at Renesas microcontrollers. The main features are:

- A configurable build engine that allows you to set-up compiler, assembler and linker options via an easy to use interface.
- An integrated text editor with user customizable syntax coloring to improve code readability.
- A configurable environment to run your own tools.
- An integrated debugger which allows you to build and debug in the same application.
- Version control support.

The High-performance Embedded Workshop has been designed with two key aims; firstly to provide you, the user, with a set of powerful development tools and, secondly, to unify and present them in a way that is easy to use.

About This Manual

This manual describes preparation before using the emulator, emulator functions, debugging functions specific to the emulator, tutorial, and emulator's hardware and software specifications.

Refer to the High-performance Embedded Workshop User's Manual for details on the information on the basic usage of the High-performance Embedded Workshop, customization of the environment, build functions, and debugging functions common to each High-performance Embedded Workshop product.

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

Convention	Meaning
[Menu->Menu Option]	Bold text with '->' is used to indicate menu options (for example, **[File->Save As...]**).
FILENAME.C	Uppercase names are used to indicate filenames.
"enter this string"	Used to indicate text that must be entered (excluding the "" quotes).
Key + Key	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.
➲ (The "how to" symbol)	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.

Contents

Section 1 Product Overview

The High-performance Embedded Workshop is a graphical user interface intended to ease the development and debugging of applications written in C/C++ programming language and assembly language for Renesas microcomputers. Its aim is to provide a powerful yet intuitive way of accessing, measuring, and modifying the debugging platform in which the application is running.

The E200F emulator (hereafter referred to as the emulator) is a software and hardware development support tool for application systems using the Renesas original microcomputer.

The emulator main unit case is connected, through the dedicated debugging interface, to the user system. The user system can be debugged under the conditions similar to the actual application conditions. The emulator enables debugging; the host machine for controlling the emulator must be an IBM PC compatible machine with USB 1.1/2.0.

Figure 1.1 shows the system configuration using the emulator.

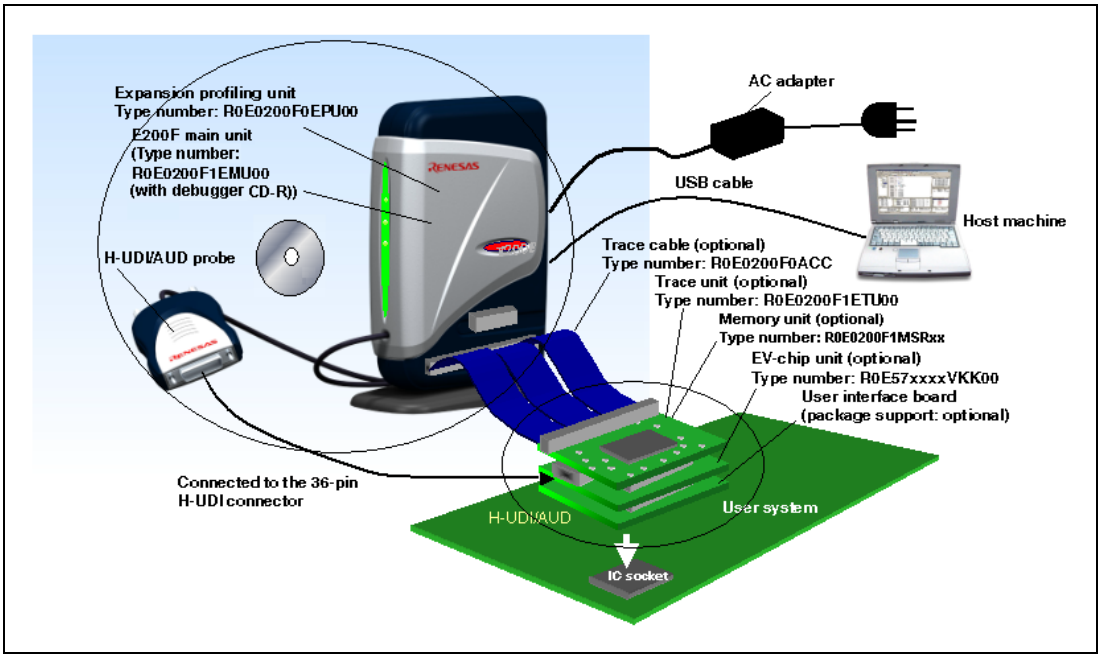


Figure 1.1 System Configuration with the Emulator

Note: The H-UDI is an interface compatible with the Joint Test Action Group (JTAG) specifications.

The emulator provides the following features:

- Various debugging functions
  - Various break and trace functions enable efficient debugging. Breakpoints and break conditions can be set by the specific window, and trace information can be displayed on a window. In addition, various emulation functions, such as performance and profiling functions, are provided.
  - High-speed downloading is implemented by supporting USB 2.0.
  - Emulator functions can be changed by each debugging phase.
  - Various command-line functions can be used.
- Realtime emulation

  Realtime emulation of the user system is enabled at the maximum operating frequency of the CPU.
- Excellent operability

  Using the High-performance Embedded Workshop on the Microsoft® Windows® 2000, Microsoft® Windows® XP, or Windows Vista® operating system enables user program debugging using a pointing device such as a mouse. The High-performance Embedded Workshop enables high-speed downloading of load module files.
- Debugging of the user system in the final development stage

  The user system can be debugged under conditions similar to the actual application conditions.
- Compact debugging environment

  When the emulator is used, a laptop computer can be used as a host machine, creating a debugging environment in any place.

⚠ CAUTION

READ the following warnings before using the emulator product. Incorrect operation will damage the user system and the emulator product. The USER PROGRAM will be LOST.

1. Check all components against the component list after unpacking the emulator.
2. Never place heavy objects on the casing.
3. Protect the emulator from excessive impacts and stresses. For details, refer to section 1.4, Environmental Conditions.
4. When moving the host machine or user system, take care not to vibrate or damage it.
5. After connecting the cable, check that it is connected correctly. For details, refer to section 2, Setting Up the Emulator.
6. Supply power to the connected equipment after connecting all cables. Cables must not be connected or removed while the power is on.

1.1 Components

Check all the components after you have unpacked the box. For details on the emulator components, refer to section 1.1 in the additional document, Supplementary Information on Using the SHxxxx. If the components are not complete, contact Renesas sales office.

1.2 Emulator Hardware Configuration

As shown in figure 1.2, the emulator consists of a main unit case, an external bus trace unit (optional), an emulation memory unit (optional), an EV-chip unit (optional), an expansion profiling unit (optional), a USB cable, an AC adapter, and an external probe. The emulator is connected to the host machine via USB 2.0.

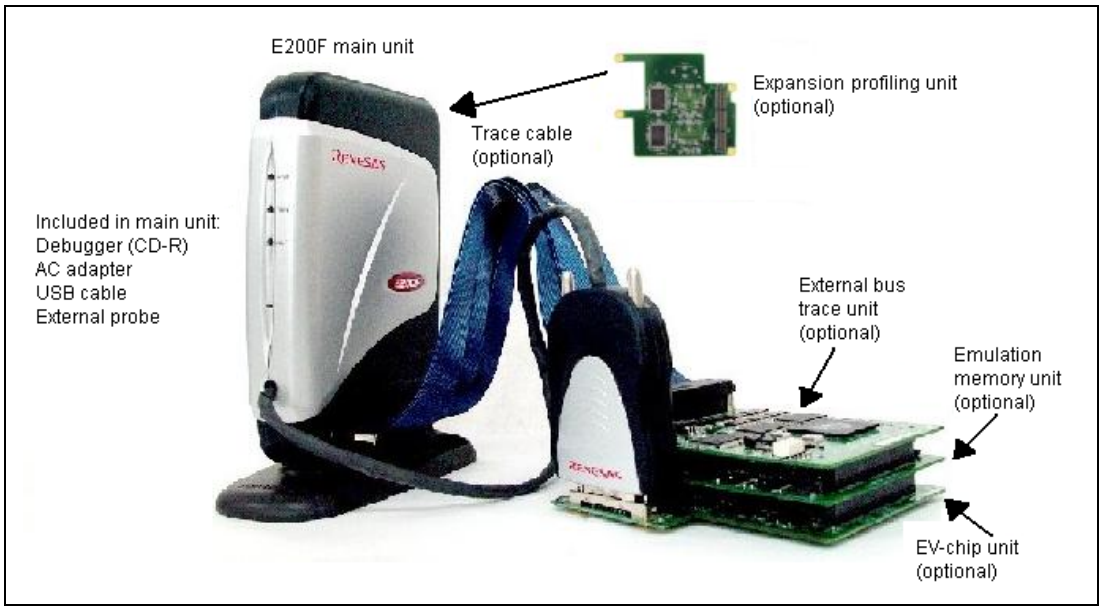


Figure 1.2 Emulator Hardware Configuration

The names of sections of the emulator are explained below.

Emulator Front View:

Figure 1.3 Emulator Front View

(a) POWER LED:	Marked ‘PWR’. When this LED is lit, the emulator is supplied with power.
(b) RUN LED:	Marked ‘RUN’. When this LED is lit, the user program is in operation.
(c) ACTION LED:	Marked ‘ACT’. When this LED is lit, the emulator is in operation.

Emulator Rear-side View:

Figure 1.4 Emulator Rear-side View

(a) Power switch:	Marked ‘POWER’. Turning this switch to I (input) turns the emulator on and O (output) turns the emulator off.
(b) DC plug:	Marked ‘DC IN’. This is a connector to input DC (+12 V) of the AC adapter. Be sure to connect this plug to the provided AC adapter.
(c) External probe connector:	Marked ‘EXT’. This is a connector for the external probe. Be sure to connect this connector to the provided external probe.
(d) Host-side connector (USB connector):	Marked ‘ ’. A connector (USB connector) for the host machine is provided at the side of this mark. Be sure to connect this connector to the provided USB cable.

Emulator Right-side View:

Figure 1.5 Emulator Right-side View

(a) E200F logo plate:	A wine-red plate (R0E0200F1EMU00) dedicated for the emulator is provided to be easily distinguished from other E200F main unit case.
(b) Analyzer unit connector:	Marked ‘ANALYZER I/F’. This is a connector for the analyzer unit. Be sure to connect this connector to the dedicated analyzer cable provided for the optional analyzer unit.
(c) External bus trace unit connector:	Marked ‘TRACE I/F’. This is a connector for the external bus trace unit. Be sure to connect this connector to the dedicated trace cable provided for the optional external bus trace unit.

Emulator Left-side View:

Figure 1.6 Emulator Left-side View

(a) Label for product management: The serial number, revision, and safety standard, etc. of the emulator are written to. The contents differ depending on the time when you purchased the product.

Probe H-UDI/AUD Upper View:

Figure 1.7 Probe H-UDI/AUD Upper View

(a) Screws for fastening the probe H-UDI/AUD: These screws fasten the user system and the probe H-UDI/AUD.

Probe H-UDI/AUD Front View:

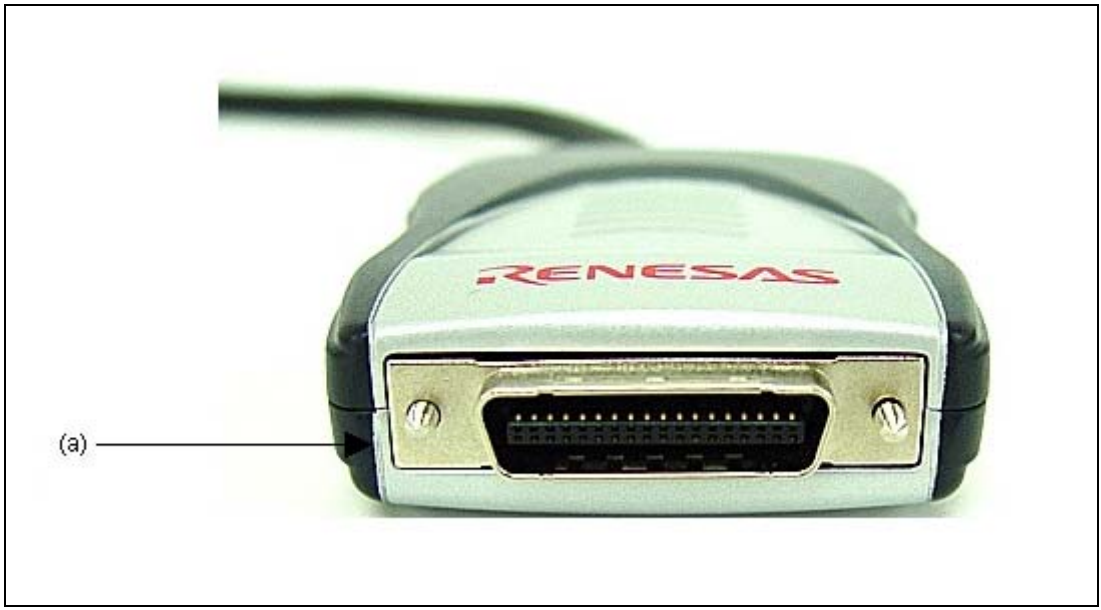


Figure 1.8 Probe H-UDI/AUD Front View

(a) H-UDI port connector for user system:	This connector is used when the emulator is used as the on-chip debugger (the same as that of the 36-pin E10A-USB).

Storing the Probe H-UDI/AUD:

Figure 1.9 Storing the Probe H-UDI/AUD

(a) Base unit for placing the emulator vertically:	A base unit when the emulator is placed vertically. The probe H-UDI/AUD can be stored when the emulator is not in use.

EV-chip Unit (Optional) Upper View:

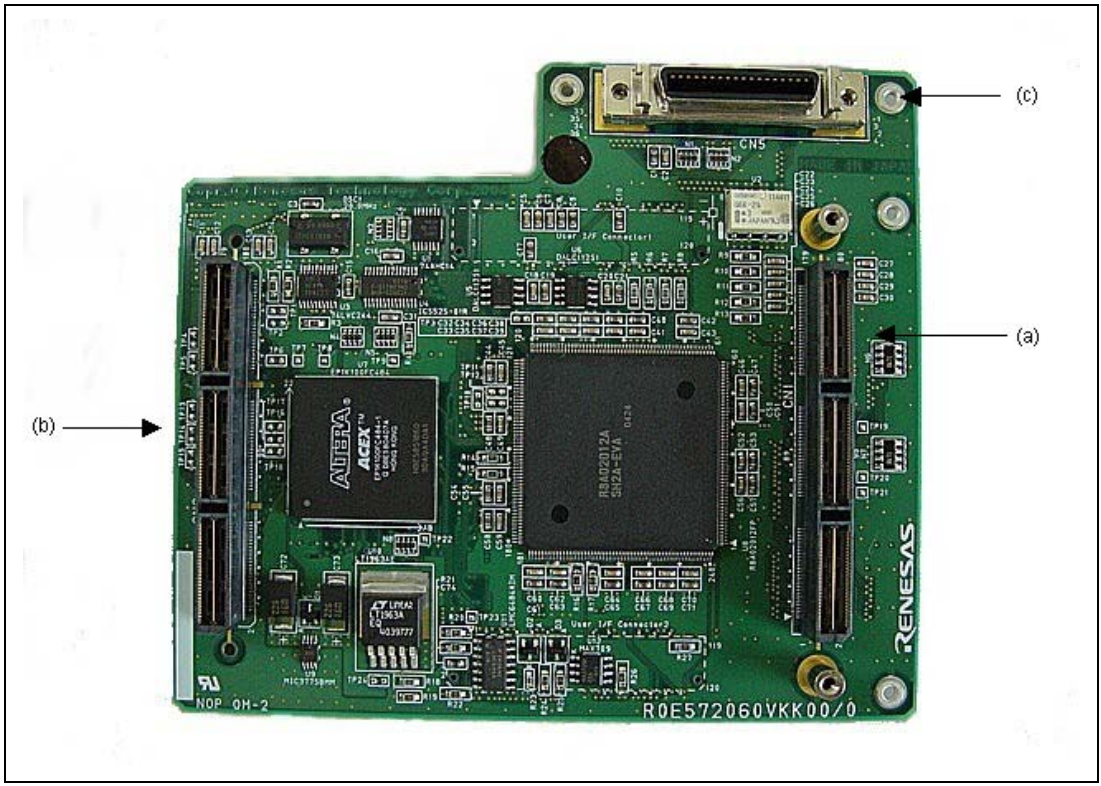


Figure 1.10 EV-chip Unit (Optional) Upper View

(a) External bus trace unit connector 1:	Connectors for connecting the external bus trace unit. When only the EV-chip is used, connect the optional trace cable.
(b) External bus trace unit connector 2:	Connectors for connecting the external bus trace unit. When only the EV-chip is used, these connectors are not used.
(c) Probe H-UDI/AUD connector:	Connector for connecting the probe H-UDI/AUD.

EV-chip Unit (Optional) Rear View:

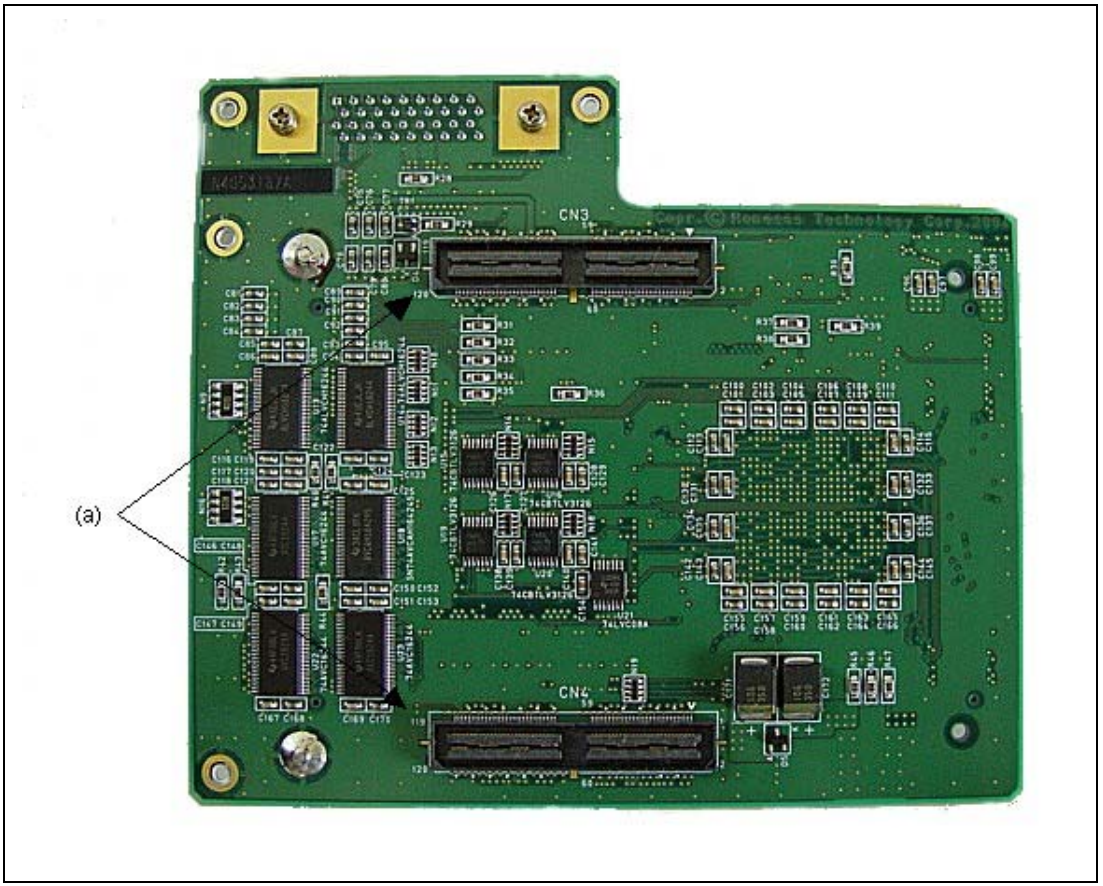


Figure 1.11 EV-chip Unit (Optional) Rear View

(a) User system interface connectors:	Connectors for the user system interface. They are connected to the user system interface board that supports a package or the dedicated connectors on the user system.

External Bus Trace Unit (Optional) Upper View:

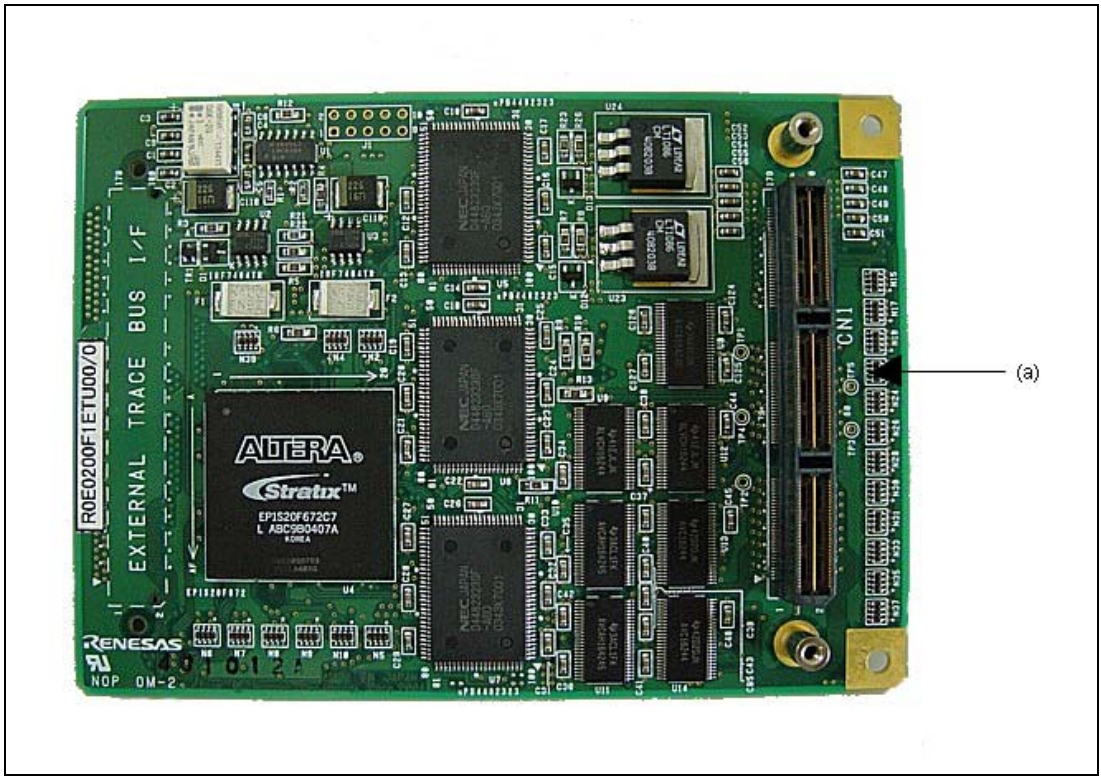


Figure 1.12 External Bus Trace Unit (Optional) Upper View

(a) Trace cable connectors: Connectors for connecting the trace cable in the external bus trace unit. Be sure to use the optional trace cable.

External Bus Trace Unit (Optional) Rear View:

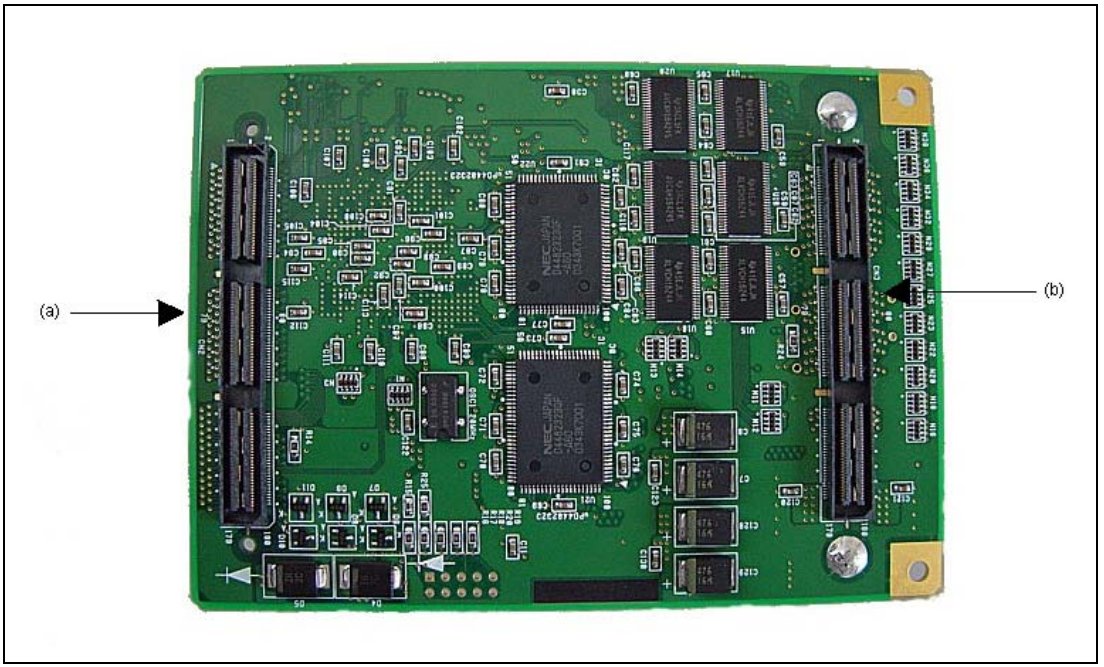


Figure 1.13 External Bus Trace Unit (Optional) Rear View

(a) User system interface connectors for the external bus trace:	Connectors for the user system interface of the external bus trace. They are connected to the EV-chip unit or the dedicated connectors on the user system.
(b) EV-chip unit interface connectors:	Connectors for the EV-chip unit interface. They are connected to the dedicated connectors on the EV-chip unit.

Expansion Profiling Unit (Optional) Rear View:

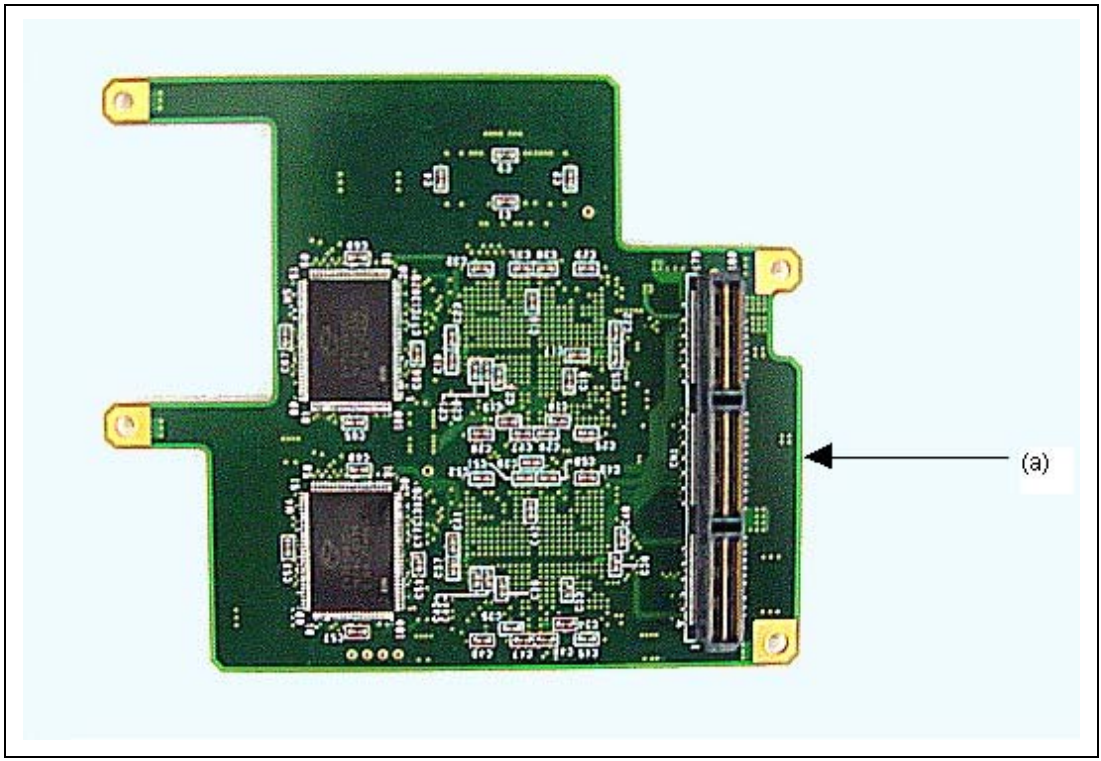


Figure 1.14 Expansion Profiling Unit (Optional) Rear View

(a) Optional connectors in the expansion profiling unit:	Connectors for the interface to connect the expansion profiling unit and the main unit case. They are connected to the optional connector on the main unit case.

Emulation Memory Unit (Optional) Upper View:

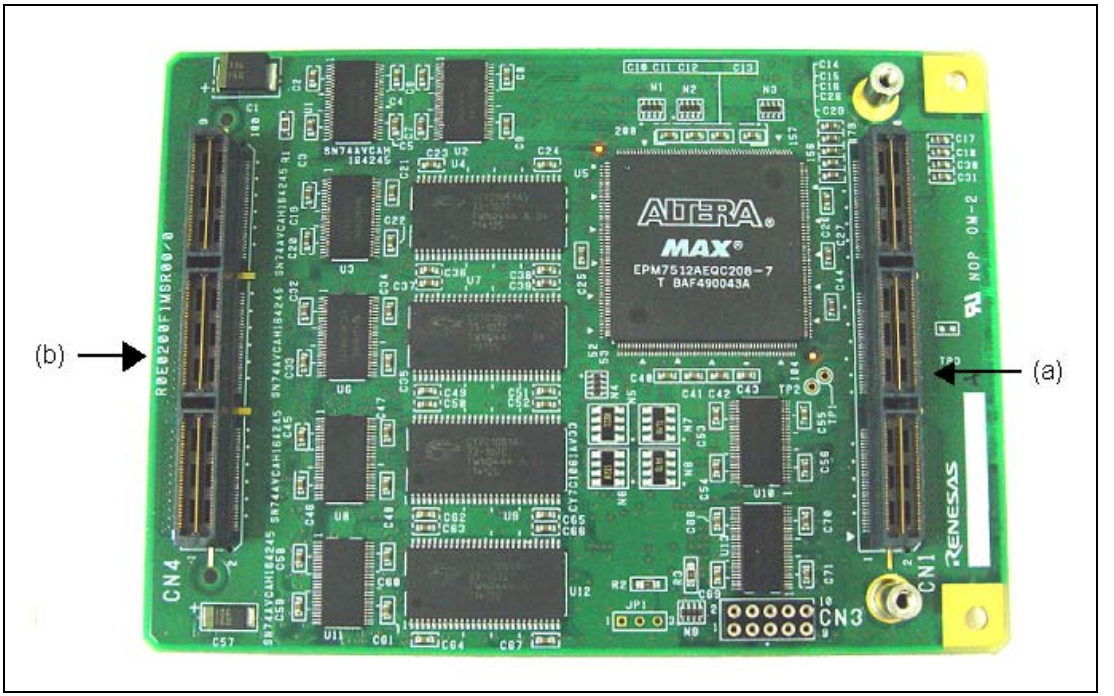


Figure 1.15 Emulation Memory Unit (Optional) Upper View

(a) External bus trace unit connector 1 [CN1]:	Connectors for connecting the external bus trace unit. When the external bus trace unit is not used, connect the optional trace cable.
(b) External bus trace unit connector 2 [CN4]:	Connectors for connecting the external bus trace unit. When the external bus trace unit is not used, these connectors are not used.

Note: There are two types of emulation memory unit: R0E0200F1MSR00 (8 Mbytes) and R0E0200F1MSR01 (16 Mbytes). In this manual, the 16-Mbyte emulation memory unit is used for explanation.

Emulation Memory Unit (Optional) Rear View:

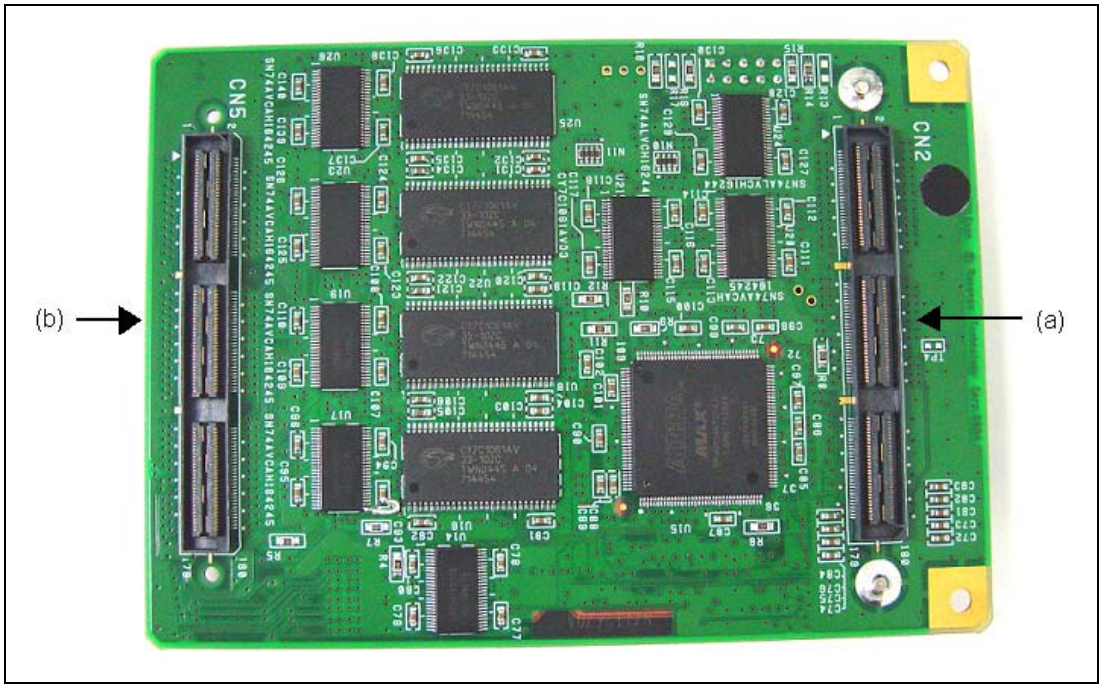


Figure 1.16 Emulation Memory Unit (Optional) Rear View

(a) EV-chip unit interface connector [CN2]:	Connectors for interfacing the EV-chip unit. They are connected to the dedicated connectors on the EV-chip unit.
(b) User system interface connector for the external bus trace [CN5]:	Connectors for interfacing the user system for the external bus trace. They are connected to the dedicated connector installed on the EV-chip unit or the user system.

1.3 Emulator Functions

This section describes the emulator functions. They differ depending on the device supported by the emulator. For the usage of each function, refer to section 5, Debugging, or section 6, Tutorial.

1.3.1 Overview

Table 1.1 gives a functional overview of the emulator.

For details on the functions of each product, refer to the online help.

Table 1.1 Emulator Functions

No.	Item	Function
1	User program execution functions	• Executes a program with the operating frequency within a range guaranteed by devices. • Reset emulation • Step functions: Single step (one step: one instruction) Source-level step (one step: one-line source) Step over (a break will not occur in a subroutine) Step out (when the PC points to a location within a subroutine, execution continues until it returns to the calling function)
2	Reset function	• Issues a power-on reset from the High-performance Embedded Workshop to the device during break.
3	Event detection functions	• On-chip event detection function • AUD event detection function • External-bus event detection function • Other event detection functions Execution time event detection External probe event detection
4	Trace functions	• Internal trace function at on-chip event detection • AUD trace function at AUD event detection • External bus trace function at external bus event detection

Table 1.1 Emulator Functions (cont)

No.	Item	Function
5	Break functions	• Breaks at satisfaction of an S/W breakpoint condition • Breaks at on-chip event detection • Breaks at AUD event detection • Breaks at external-bus event detection • Breaks at other types of event detection • Breaks at overflow of a trace buffer • Forced break function
6	Performance measurement function	• Uses a counter in the device to measure the number of cycles that passes during point-to-point execution. • Uses an AUD event channel to measure the time or counts of point-to-point, point-to-range, or range-to-range execution. • Measures the number of cycles that pass in executing individual functions and lists them at the end of execution from a 'Go' command. • Measures the execution time or execution counts of functions in the address range specified by the user and lists them at the end of execution from a 'Go' command.
7	Memory access functions	• Downloading to RAM • Downloading to flash memory • Single-line assembly • Reverse assembly (disassembly) • Reading of memory • Writing to memory • Automatic updating of a display of selected variables during user program execution • Fill • Search • Move • Copy • Monitor (physical address) • Emulation memory

Table 1.1 Emulator Functions (cont)

No.	Item	Function
8	General/control register access function	Read or write function of the general/control registers
9	Internal I/O register access function	Read or write function of the internal I/O registers
10	Source-level debugging function	Various source-level debugging functions
11	Command line function	Supports command input. Batch processing is enabled when a file is created by arranging commands in input order.
12	Help function	Describes the usage of each function or command syntax input from the command line window.

The specific functions of the emulator are described in the next section.

1.3.2 Event Detection Functions

The emulator has complex event detection functions in addition to the standard S/W breakpoints of the High-performance Embedded Workshop.

(1) Events

In most practical debugging applications, the program or hardware errors that you are trying to debug occur under a certain restricted set of circumstances. For example, a hardware error may only occur after a specific area of memory has been accessed. Tracking down such problems using simple S/W breakpoints can be very time-consuming.

With the emulator, the combination of the specified conditions such as address or data condition can be defined as the eventpoint condition. When an eventpoint condition is satisfied, an event will occur. The event detection function of the emulator can be used to detect a generated event and control the operations of break, trace, and performance measurement start/end.

(2) Types of Events

The emulator has four types of events.

(a) On-chip event function (Onchip Event)

This is a function that uses an on-chip break controller and sets eventpoints according to the information in the MCU. The eventpoints can be defined as a combination of one or more of the following:

- Address condition
- Data condition
- Bus state condition
- Event count condition

For an operation when an event is detected, break, internal trace acquisition/acquisition start/acquisition stop, or internal performance measurement start/end can be specified.

This function can be set in the [Onchip Event] sheet of the [Event] window.

The emulator is used to set event conditions and the software trace in the [Onchip Event] sheet. Table 1.2 lists the conditions of Event Condition.

Table 1.2 Types of Event Condition

Event Condition Type	Description
Address bus condition (Address)	Breaks when the MCU's address bus value or the program counter value matches the specified value
Data bus condition (Data)	Breaks when the MCU's data bus value matches the specified value. Byte, word, or longword can be specified as the access data size.
Bus state condition (Bus State)	There are two bus state condition settings: Bus state condition: Breaks or acquires a trace when the specified bus value is matched. Read/Write condition: Breaks or acquires a trace when the specified read/write condition is matched.
Count	Breaks when the conditions set are satisfied the specified number of times.
Action	Selects the operation when a condition, such as setting a break, trace, or performance start or end, is matched.

Note: The contents that can be set for the on-chip event differ depending on the product. For the specifications of each product, refer to the additional document, Supplementary Information on Using the SHxxxx, or the online help.

(b) AUD event function (AUD Event)

This is a function that sets eventpoints according to the information output from the AUD interface. There are eight event detection channels. The eventpoints can be defined as a combination of one or more of the following:

- Branch trace data condition
- Window trace data condition
- Software trace data condition
- Event count condition
- Delay condition after an event has occurred

For an operation when an event is detected, break, AUD trace acquisition/acquisition start/acquisition stop, or AUD performance measurement start/end can be specified.

This function can be set in the [AUD Event] sheet of the [Event] window.

Notes: 1. When a break is generated by detecting the AUD event, there is a delay of several cycles from the time of detection to the break. If the delay from the generation of an event to the break in the user system becomes a problem, use the on-chip event function (Onchip event).
2. When the acquisition mode of the AUD trace is [Realtime trace], data that was not output cannot be compared.
3. When debugging is performed without any connection to the EV-chip unit, a break function cannot be selected in AUD event.
4. The contents that can be set for the AUD event differ depending on the product. For the specifications of each product, refer to the online help.

[Supplementary]: AUD Function

When the AUD trace, AUD event, and AUD performance functions are used, AUD must be enabled according to the following procedures.

- Debugging without any connection to the EV-chip unit

1. Set [AUD pin Select] on the [General] page of the [Configuration] dialog box.
2. Set [AUD clock] on the [General] page of the [Configuration] dialog box.
3. Set the AUD trace information acquisition condition for [Internal/AUD] trace.

- Debugging with a connection to the EV-chip unit

1. Set [AUD clock] on the [General] page of the [Configuration] dialog box.
2. Set the AUD trace information acquisition condition for [Internal/AUD] trace.

For the settings of the [Configuration] dialog box and [Internal/AUD] trace, refer to section 5.1, Setting the Environment for Emulation, and section 6.19, Trace Functions.

(c) External bus event function (BUS Event)

This is a function that sets eventpoints according to the external bus of the MCU or pin information such as an interrupt pin. There are six event detection channels. The eventpoints can be defined as a combination of one or more of the following:

- External address bus condition
- External data bus condition
- Interrupt signal condition
- Event count condition
- Delay condition after an event has occurred

For an operation when an event has been detected, a break or external bus trace acquisition/acquisition start/acquisition stop can be specified.

This function can be set in the [BUS Event] sheet of the [Event] window.

Notes: 1. When a break is generated by detecting the external bus event, there is a delay of several cycles from the time of detection to the break.
2. This function is optional; it is available after an external bus trace unit is purchased.
3. The contents that can be set for the external bus event differ depending on the product. For the specifications of each product, refer to the online help.

(d) Other events (Other Event)

This function can be set in the [Other Event] sheet of the [Event] window.

- Execution time event

  A break occurs after the specified execution time has passed. There is one event detection channel.

- External probe event

  There is one event detection channel. Eventpoints can be defined specifying four external probe signals via the probe cable as the condition.

  For an operation when an event has been detected, a break or AUD trace acquisition/acquisition start/acquisition stop can be specified.

Note: There is a delay of several cycles from the time of detection to the break.

1.3.3 Trace Functions

(1) Trace Functions

The emulator has mainly two trace functions:

- A function that acquires information outside the MCU such as the external bus by a trace

(a) Function to acquire information within the MCU by a trace

The acquired trace information is displayed in the [Internal/AUD] window.

The information to be acquired by a trace is an event that trace acquisition is selected as the action condition in the channel on the [Onchip Event] sheet of the [Event] window. To store such information, there are following three methods:

— Function to store the information in a dedicated trace memory in the MCU

The maximum amount of information acquired by a trace that can be stored is 1024.

This function is enabled when the AUD pin is not connected to the emulator or the memory cannot be used for tracing.

This function is hereafter called as the internal trace function or the Internal trace.

— Function to output the information in realtime from the AUD pins

This is the large-capacity trace function that is useful when the AUD pins are connected to the emulator. The emulator generates a break on the basis of the information output from the AUD pins.

This function is hereafter called as the AUD trace function.

When a set of the branch source and branch destination instructions is one branch, the maximum amount of information acquired by a trace is 262,144.

Note: The contents that can be acquired by a trace differ depending on the product. For details on the specifications of each product, refer to the online help.

— Software trace function

Note: This function can be supported with SHC/C++ compiler (manufactured by Renesas Technology Corp.; including OEM and bundle products) V7.0 or later.

When a specific instruction is executed, the PC value at execution and the contents of one general register are acquired by trace. Describe the Trace(x) function (x is a variable name) to be compiled and linked beforehand. For details, refer to the SuperH™ RISC engine C/C++ Compiler, Assembler, Optimizing Linkage Editor User's Manual.

When the load module is downloaded on the emulator and is executed while a software trace function is valid, the PC value that has executed the Trace(x) function, the general register value for x, and the source lines are displayed.

To activate the software trace function, double-click the event channel on the [AUD Event] sheet of the [Event] window and select the [Software trace data] radio button of the [General] page.

(b) Function to acquire information outside the MCU by a trace

The acquired trace information is displayed in the [BUS trace] window.

External Bus Trace Function (BUS trace):

This is a large-capacity trace function that is useful when the external bus pins of the MCU are connected to the emulator. If an external memory is read from or written to, trace information is output in realtime from the external bus pins.

The external bus trace acquisition, acquisition start, and acquisition end can be controlled depending on the specified external-bus eventpoint condition. For setting eventpoints, refer to section 5.8, Using the Eventpoints.

With this function, information of a maximum of 262,144 cycles can be acquired in each bus cycle.

Notes: 1. This function is optional; it is available after an external bus trace unit is purchased.
2. The contents that can be acquired by a trace differ depending on the product. For details on the specifications of each product, refer to the online help.

(2) Useful functions of the [Trace] window

The [Trace] window provides the following useful functions.

(a) Searches for the specified data.
(b) Extracts the specified data.
(c) Filters and displays again the specified data.
(d) Supplements the information from the branch destination address to the next branch source address.

For the usage of those functions, refer to section 5.9, Viewing the Trace Information.

(e) Changes the trace settings during user program execution.

Trace settings can be changed during user program execution.

1.3.4 Break Function

The emulator has the following seven break functions.

(a) S/W break function (BREAKPOINT)

Breaks the program at the specified address by replacing the dedicated instruction onto the original instruction. This function cannot be set at a place other than RAM since a memory write occurs.

This function can be set in the [Breakpoint] sheet of the [Event] window. It can also be set in the [Editor] or [Disassembly] window by double-clicking on the line to be set in the [Editor] column.

(b) On-chip event break function

Breaks when the specified event has been detected by the on-chip event detection function.

This function is available when the operation after detecting an event is set as 'break' in the [Onchip Event] sheet of the [Event] window.

It can also be set in the [Editor] or [Disassembly] window by double-clicking on the line to be set in the [Onchip event] column.

Note: On-chip event break settings can be changed during user program execution.

(c) AUD event break function

Breaks when the specified event has been detected by the AUD event detection function.

This function is available when the operation after detecting an event is set as 'break' in the [AUD Event] sheet of the [Event] window.

It can also be set in the [Editor] or [Disassembly] window by double-clicking on the line to be set in the [AUD Event] column.

(d) External bus event break function

Breaks when the specified event has been detected by the external bus event detection function.

This function is available when the operation after detecting an event is set as 'break' in the [BUS Event] sheet of the [Event] window.

It can also be set in the [Editor] or [Disassembly] window by double-clicking on the line to be set in the [BUS Event] column.

Notes: 1. When a break is generated by detecting the external bus event, there is a delay of several cycles from the time of detection to the break.
2. This function is optional; it is available after an external bus trace unit is purchased.

3. The contents that can be set for the external bus event differ depending on the product. For the specifications of each product, refer to the online help.

(e) Other event break functions

— Execution time event detection function

— External probe event detection function

Breaks when the specified event has been detected by other event detection functions.

This function is available when the operation after detecting an event is set as 'break' in the [Other Event] sheet of the [Event] window.

(f) Trace break function generated by an overflow of the trace buffer

Breaks when the AUD trace buffer and external bus trace buffer in the emulator become full.

This function can be set in the [I-Trace/AUD-Trace acquisition] dialog box and the [BUS acquisition] dialog box.

(g) Forced break function

Forcibly breaks the user program.

1.3.5 Probe Function

Six external probes can be placed on the emulator.

(1) Four input probes

Monitor input signals, break the user program, and start or end AUD tracing by satisfying the specified condition. This can be set on the [Other Event] sheet of the [Event] window.

(2) One event output probe

Outputs the event signal when the event is detected. This can be set on the [Action] page of the dialog box for setting the eventpoint.

Note: The events that can output the event signals differ depending on the product. For the specifications of each product, refer to the online help.

(3) One GND

A probe for connecting the ground.

1.3.6 Performance Measurement Function

The emulator has three types of performance measurement functions.

(1) On-chip Performance Analysis Function (Onchip Performance Analysis)

This function applies a counter in the device to measure the number of cycles from one specified condition being satisfied until a next specified condition is satisfied.

Not only the number of cycles but also various items such as the number of cache misses can be measured according to the supported devices.

Note: Items to be measured will differ depending on the product. For details on the specifications of each product, refer to the additional document, Supplementary Information on Using the SHxxxx, or the online help.

(a) Setting the performance measurement conditions

To set the performance measurement conditions, use the [Performance Analysis] dialog box and the PERFORMANCE_SET command. When a channel line on the [Performance Analysis] window is clicked with the right mouse button, the popup menu is displayed and the [Performance Analysis] dialog box is displayed by selecting [Setting].

Note: For the command line syntax, refer to the online help.

(b) Specifying the measurement start/end conditions

To set the measurement start/end conditions, firstly, select [Ch1 to Ch2 PA] or [Ch2 to Ch1 PA] in the [Ch1, 2, 3] list of the [Combination action] dialog box that is opened by right-clicking [Combination action] on the [Event Condition] sheet of the [Event] window. Then, specify the measurement start/end conditions for Ch1 and Ch2 of Event condition.

Notes: 1. When no measurement start/end conditions are specified, measurement is started by executing a program and ended when a break condition is satisfied.
2. When only the measurement start or end condition is specified, performance cannot be measured. Be sure to specify both of the measurement start and end conditions.
3. When the measurement start/end conditions are specified, step operation cannot be performed.

- Measurement tolerance
  - The measured value includes tolerance.
  - Tolerance will be generated before or after a break.

- Measurement items

  Items are measured in the [Performance Analysis] dialog box for each channel from Ch1 to Ch4. A maximum of four conditions can be specified at the same time.

Note: Items to be measured will differ depending on the product. For details on the specifications of each product, refer to the additional document, Supplementary Information on Using the SHxxxx, or the online help.

Each measurement condition is also counted when conditions in table 1.3 are generated.

Table 1.3 Performance Measurement Conditions to be Counted

Measurement Condition	Notes
Cache-on counting	Accessing the non-cacheable area is counted less than the actual number of cycles and counts. Accessing the cacheable, and U-RAM areas is counted more than the actual number of cycles and counts.
Branch count	The counter value is incremented by 2. This means that two cycles are valid for one branch.

Notes: 1. In the non-realtime trace mode of the AUD trace and memory output trace, normal counting cannot be performed because the generation state of the stall or the execution cycle is changed.

2. Since the clock source of the counter is the CPU clock, counting also stops when the clock halts in the sleep mode.

- Extension setting of the performance-result storing counter

  The 32-bit counter stores the result of performance, and two counters can be used as a 64-bit counter.

  To set a 64-bit counter, check the [Enable] check box in the [Extend counter] group box of the [Performance Analysis] dialog box for Ch1.

(c) Displaying the result of performance

The result of performance is displayed in the [Performance Analysis] window or the PERFORMANCE_ANALYSIS command in hexadecimal (32 bits).

However, when the extension counter is enabled, it is displayed in hexadecimal (64 bits).

Note: If a performance counter overflows as a result of measurement, "********" will be displayed.

(d) Initializing the measured result

To initialize the measured result, select [Initialize] from the popup menu in the [Performance Analysis] window or specify INIT with the PERFORMANCE_ANALYSIS command.

(2) AUD Performance Analysis Function (AUD Performance Analysis)

The emulator allows you to measure the time or count of execution between specified events in the AUD event detection system. It is possible to set the resolution of the timer to any of the following values:

20 ns, 100 ns, 400 ns, or 1.6 µs.

At 20 ns the maximum time that can be measured is about six hours, and at 1.6 µs the maximum time is about 20 days.

(3) Profiling Function (Profile)

The profiling function is used to measure the performance of each function.

A function having low performance can be easily found if the statistics of the time for each function are maintained.

Items that can be measured are the same as those for the on-chip performance measurement function.

Notes: 1. Use of the profiling and on-chip performance analysis functions at the same time is not possible. The [Can not use this function] error message dialog box will be displayed if simultaneous use is attempted.

2. In this function, a break occurs whenever a branch is generated, and information is collected to execute the user program again. Therefore, realtime emulation of the user program will not be performed.

(4) Realtime Profiling Function (Realtime Profile)

The performance of each function can be measured within the specified address range.

A function having low performance can be easily found if the statistics of the time for each function are monitored.

In this function, performance information is collected without break. Therefore, realtime emulation of the user program will be performed.

The specifiable address ranges are as follows:

- When the expansion profiling unit is not connected: 512 kbytes to 4 Mbytes (8 blocks at 512 kbytes)
- When the expansion profiling unit is connected: 512 kbytes to 12 Mbytes (24 blocks at 512 kbytes)

1.3.7 Coverage Function

The emulator displays the information on the executed instructions in the C/C++ and assembly-language levels to measure the C0 coverage.

1.3.8 Memory Access Functions

The emulator has the following memory access functions.

(1) Memory read/write function

[Memory] window: The memory contents are displayed in the window. Only the amount specified when the [Memory] window is opened can be read. Since there is no cache in the emulator, read cycles are always generated. If the memory is written in the [Memory] window, read cycles in the range displayed in the [Memory] window will occur for updating the window. When the [Memory] window is not to be updated, change the setting in [Lock Refresh] from the popup menu.

me command: A command line function that reads or writes the specified amount of memory at the specified address.

(2) User program downloading function

A load module registered in the workspace can be downloaded. Such module can be selected from [Download Module] in the [Debug] menu. Downloading is also possible by a popup menu that is opened by right-clicking on the mouse at the load module in the workspace. The user program is downloaded to the RAM or flash memory.

When downloading to the flash memory, select [Emulator] from the [Options] menu, open the [Configuration] window, and perform required settings on the [Loading flash memory] page.

This function also downloads information required for source-level debugging such as debugging information.

(3) Memory data uploading function

The specified amount of memory from the specified address can be saved in a file.

(4) Memory data downloading function

The memory contents saved in a file can be downloaded. Select [Load] from the popup menu in the [Memory] window.

(5) Displaying the variable contents

The variable contents specified in the user program are displayed.

(6) Monitoring function

The emulator monitors a value in the area that has been accessed without suspending the execution of program and displays it on the window.

(7) Emulation memory function

The emulator allocates the memory for emulation in the CS area.

(8) Other memory operation functions

Other functions are as follows:

- Memory fill
- Memory copy
- Memory save
- Memory verify
- Memory search
- Internal I/O display
- Cache table display and edit (only for devices incorporating caches)
- Displaying label and variable names and their contents

For details, refer to the online help.

Notes: 1. Memory access during user program execution:
When a memory is accessed from the memory window, etc. during execution of the user program, execution stops for the memory access and is then resumed. Therefore, realtime emulation cannot be performed.

2. Memory access during user program break:
The program can also be downloaded for the flash memory area by the emulator. Other memory write operations are enabled for the RAM area. Therefore, an operation such as memory write or BREAKPOINT should be set only for the RAM area.

1.3.9 Stack Trace Function

The emulator uses the stack's information to display the name of the calling function for a function at the current program counter. This function can be used only when the load module that has the Dwarf2-type debugging information is loaded.

1.3.10 User-interrupt Open Function during User Program Break

Some devices to be debugged enable all interrupts while executing emulation to the user. During a user program break, it is possible to specify the mode whether or not the interrupt processing is executed.

1.3.11 Online Help

An online help explains the usage of each function or the command syntax that can be entered from the command line window.

Select [Emulator Help] from the [Help] menu to view the emulator help.

1.4 Environmental Conditions

⚠ CAUTION

Observe the conditions listed in tables 1.4 and 1.5 when using the emulator. Failure to do so will cause illegal operation in the user system, the emulator product, and the user program.

Table 1.4 Environmental Conditions

Item	Specifications
Temperature	Operating: +10°C to +35°C Storage: –10°C to +50°C
Humidity	Operating: 35% RH to 80% RH, no condensation Storage: 35% RH to 80% RH, no condensation
Vibration	Operating: 2.45 m/s^2 max. Storage: 4.9 m/s^2 max. Transportation: 14.7 m/s^2 max.
Ambient gases	No corrosive gases may be present

Table 1.5 lists the acceptable operating environments.

Table 1.5 Operating Environments

Item	Windows® 2000 or 32-Bit Editions of Windows® XP	32-Bit Editions of Windows Vista®
Host computer	IBM PC or compatible machine with USB 1.1/2.0 (Full-Speed).	
CPU	Pentium® III (1 GHz) or higher recommended	Pentium® 4 (3 GHz), Core™ 2 Duo (1 GHz), or higher recommended
Minimum memory capacity	128 Mbytes or more (512 Mbytes or more recommended; at least 10 times the size of the load module file)	1.5 Gbyte or more recommended (at least 10 times the size of the load module file)
Hard-disk capacity	Installation disk capacity: 100 Mbytes or more. (Prepare an area at least double the memory capacity (four-times or more recommended) as the swap area.)	
Pointing device such as mouse	Connectable to the host computer; compatible with Windows® 2000, Windows® XP, or Windows Vista®.	
Display	Monitor resolution: 1024 x 768 or higher	
AC-input power supply	Voltage: AC 100 V ± 10% Frequency: 50/60 Hz Consumption power: 48 W	
CD-ROM drive	Required to install the High-performance Embedded Workshop for the emulator or refer to the emulator user's manual.	

Section 2 Setting Up the Emulator

2.1 Flow Chart before Using the Emulator

Unpack the emulator and prepare it for use as follows:

⚠ WARNING

READ the reference sections shaded in figure 2.1 before using the emulator product. Incorrect operation will damage the user system and the emulator product. The USER PROGRAM will be LOST.

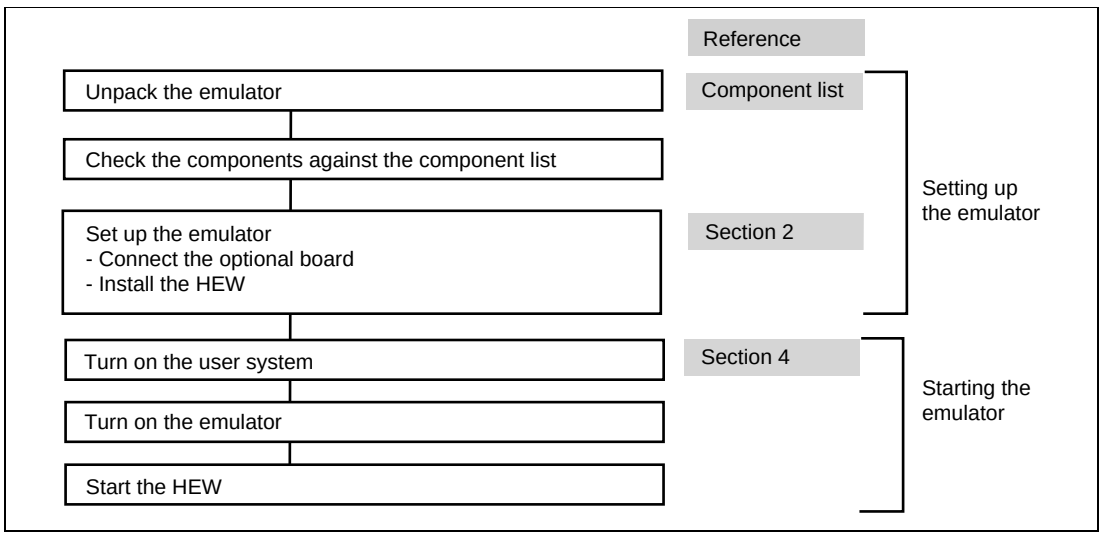


Figure 2.1 Emulator Preparation Flow Chart

2.2 Installing Debugger

2.2.1 CD-R

The root directory of the CD-R contains a setup program for installing the emulator's software. The folders contain the files and programs listed below.

Table 2.1 Contents of the CD-R Directories

Directory Name	Contents	Description
Dlls	Microsoft® runtime library	A runtime library for the High-performance Embedded Workshop. The version is checked at installation and this library is copied to the hard disk as part of the installation process.
Drivers	E200F emulator driver	USB drivers for the E200F emulator.
Help	Online help for the E200F emulator	An online help file. This is copied to the hard disk as part of the installation process.
Manual	E200F emulator manuals	E200F emulator user's manuals. They are provided as PDF files.

Execute HewInstMan.exe from the root directory of the CD-R to start the installation wizard.

Follow the cues given by the installation wizard to install the software.

Note: When a driver is installed in Windows® XP, a warning message on the Windows® logo test may be displayed, but it is not a problem. Select [Continue Anyway] to proceed with driver installation. When executing the program under Windows Vista®, log on with administrative rights.

2.3 Connecting the Optional Units to the Emulator Main Unit Case

Optional units are included in the emulator. This section describes how to connect the optional units that are mainly used to the E200F main unit case.

When the external bus trace unit, EV-chip unit, or emulation memory unit is used, the trace cable (separately purchased) is required.

The connection methods of the optional units differ depending on the supported MCU. For details, refer to the additional document, Supplementary Information on Using the SHxxxx, for each MCU.

2.3.1 Connecting the E200F External Bus Trace Unit to the User System

- Open the cover of TRACE I/F on the side of the main unit case.
- Connect the trace cable provided for the external bus trace unit to the emulator as shown in figure 2.2.

Figure 2.2 Connecting the Trace Cable to E200F

- Connect the external bus trace unit to the trace cable (CN1 side).

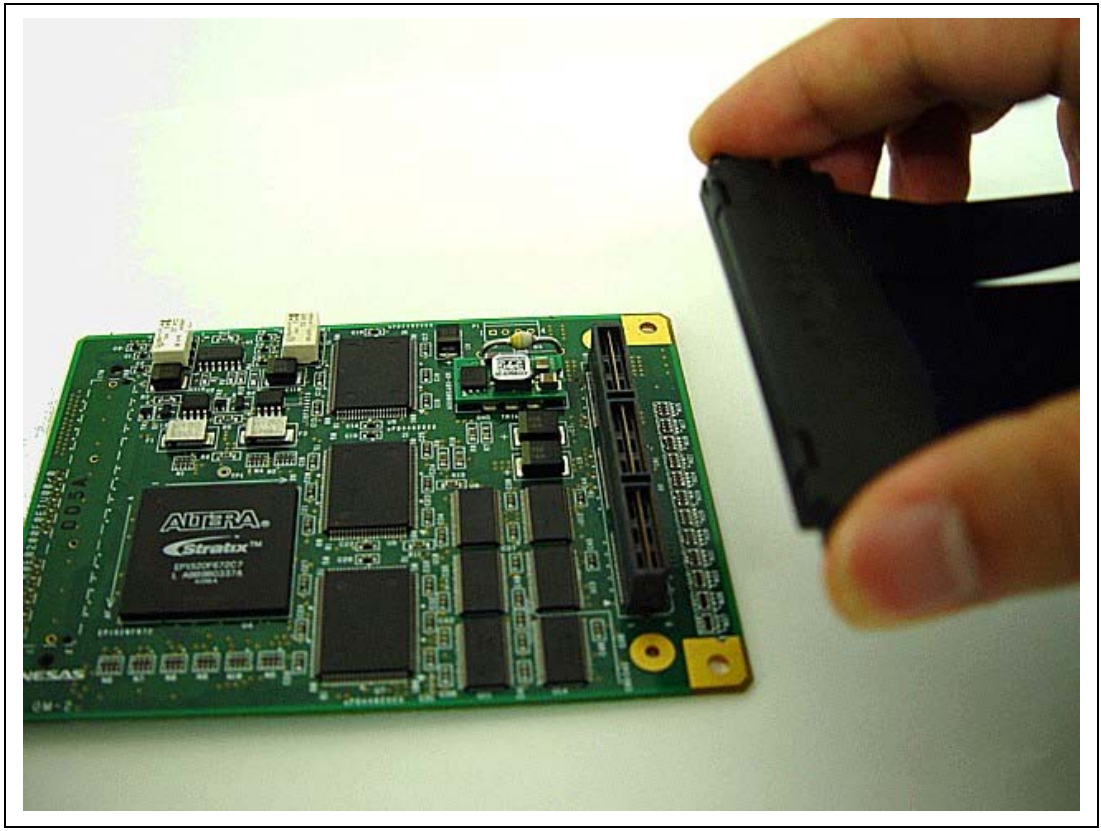


Figure 2.3 Connecting the Trace Cable to the External Bus Trace Unit

- After checking the location of pin 1, connect the user system to the external bus trace unit.

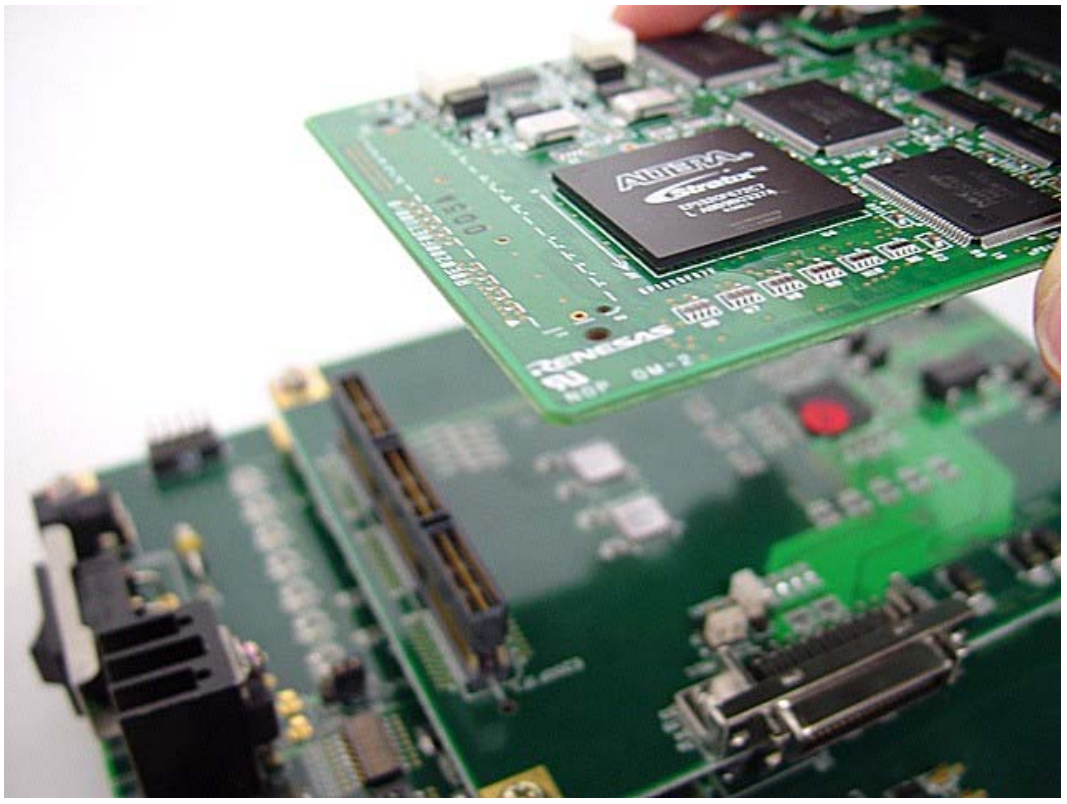


Figure 2.4 Connecting the User System to the External Bus Trace Unit

⚠ CAUTION

Check the location of pin 1 before connecting.

Notes: 1. Connection of the signals differs depending on the MCU used.
2. To connect the signals to the user system, refer to the additional document, Supplementary Information on Using the SHxxxx.

2.3.2 Connecting the E200F Emulation Memory Unit to the Emulator Main Unit

- Open the cover of TRACE I/F on the side of the main unit case.
- Connect the trace cable provided for the external bus trace unit to the emulator as shown in figure 2.5.

Figure 2.5 Connecting the Trace Cable to E200F

- Connect the emulation memory unit to the trace cable (CN1 side).

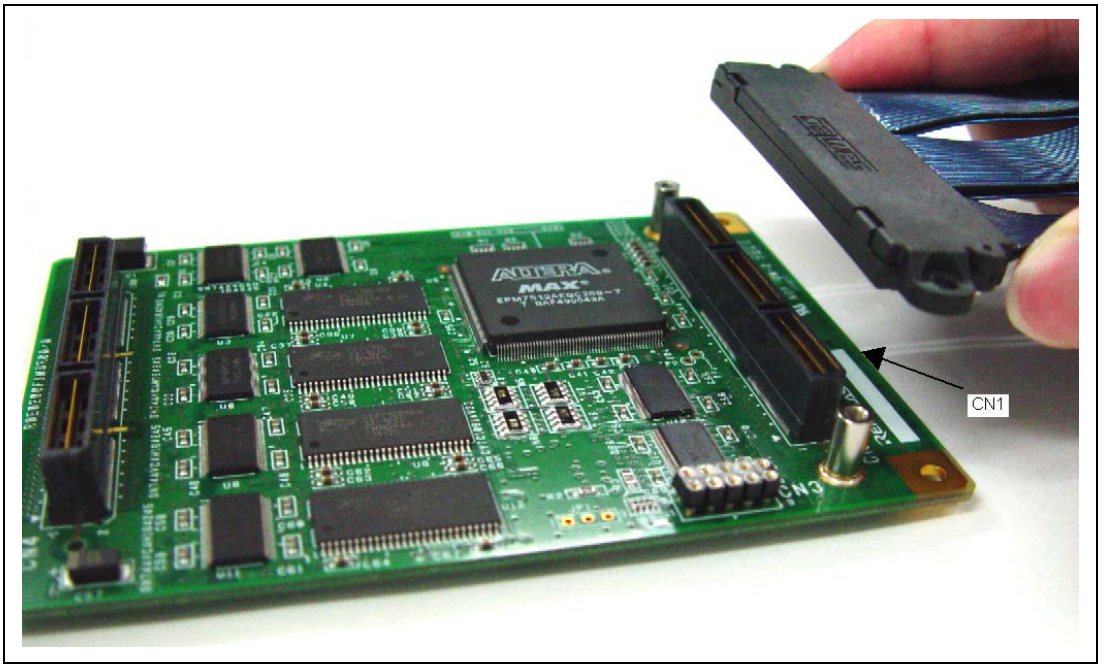


Figure 2.6 Connecting the Trace Cable to the Emulation Memory Unit

2.3.3 Connecting the Emulation Memory Unit to the User System

- After checking the location of pin 1, connect the user system to the emulation memory unit.

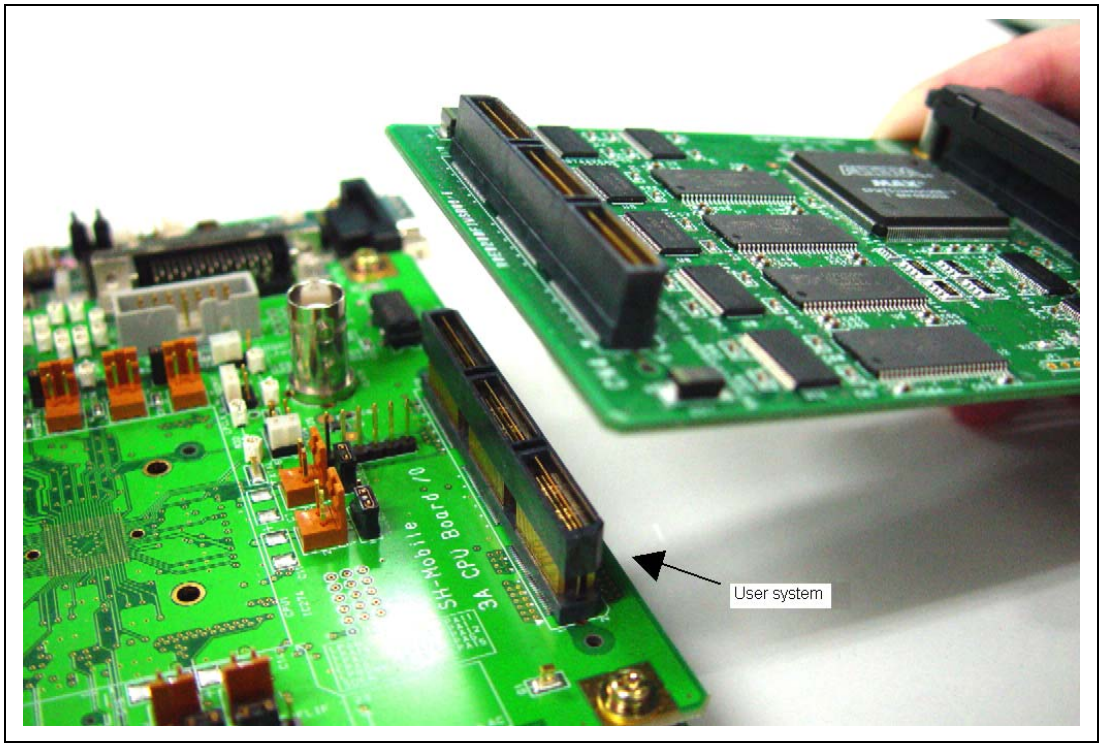


Figure 2.7 Connecting the User System to the Emulation Memory Unit

⚠ CAUTION
Check the location of pin 1 before connecting.

Notes: 1. Connection of the signals differs depending on the MCU used.
2. For connecting signals, refer to the additional document, Supplementary Information on Using the SHxxxx.

2.3.4 Connecting the E200F External Bus Trace Unit, Emulation Memory Unit, and User System

- When the external bus trace unit is used with the emulation memory unit, firstly connect the external bus trace unit to the emulation memory unit (figure 2.8) and then to the user system (figure 2.10).

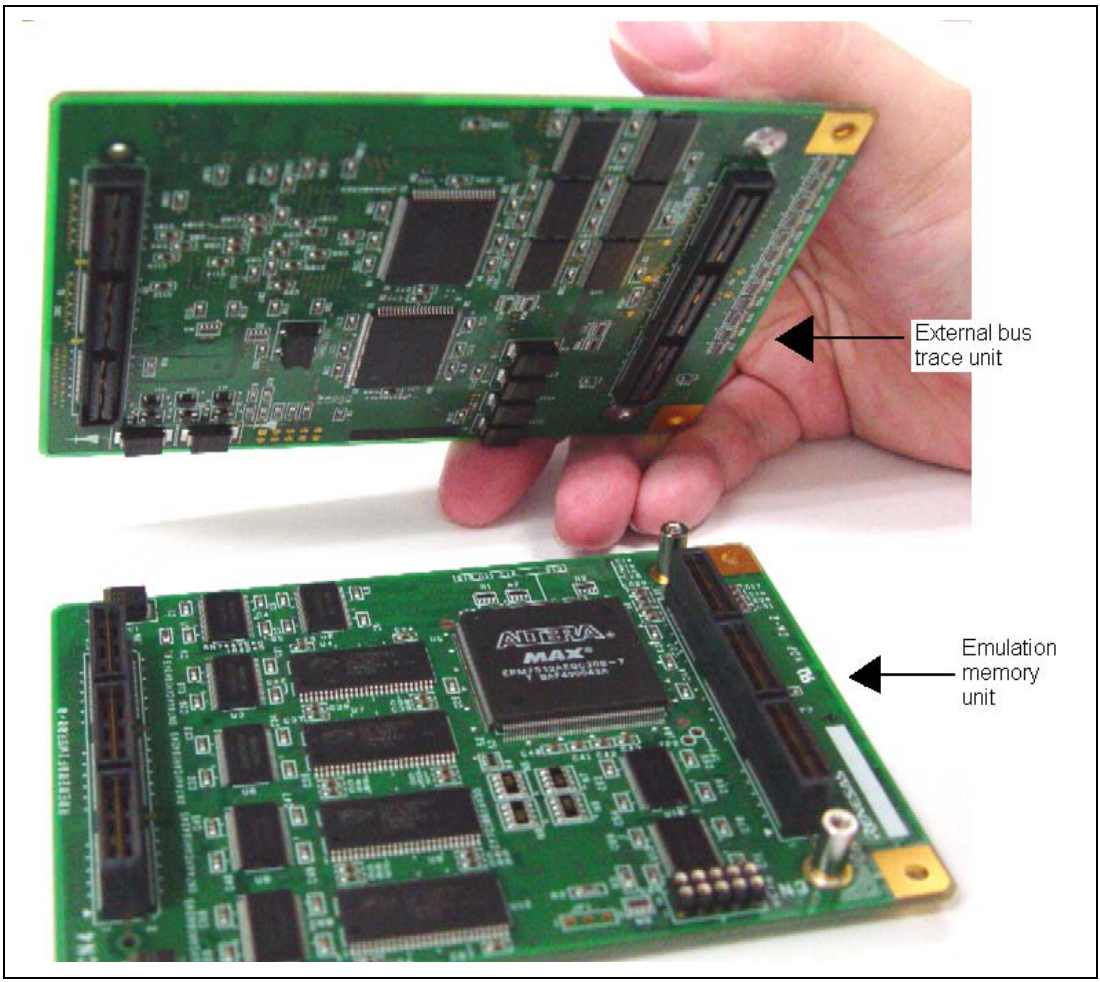


Figure 2.8 Connecting the External Bus Trace Unit to the Emulation Memory Unit

- After checking the location of pin 1, connect the external bus trace unit, emulation memory unit, and trace cable.

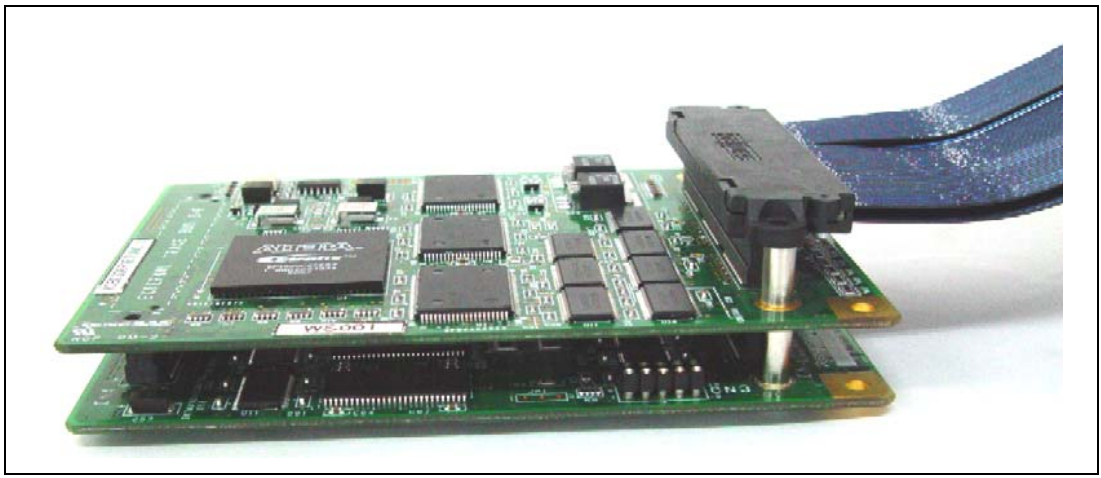


Figure 2.9 Connecting the External Bus Trace Unit, Emulation Memory Unit, and Trace Cable

- After checking the location of pin 1, connect the external bus trace unit, emulation memory unit, and user system.

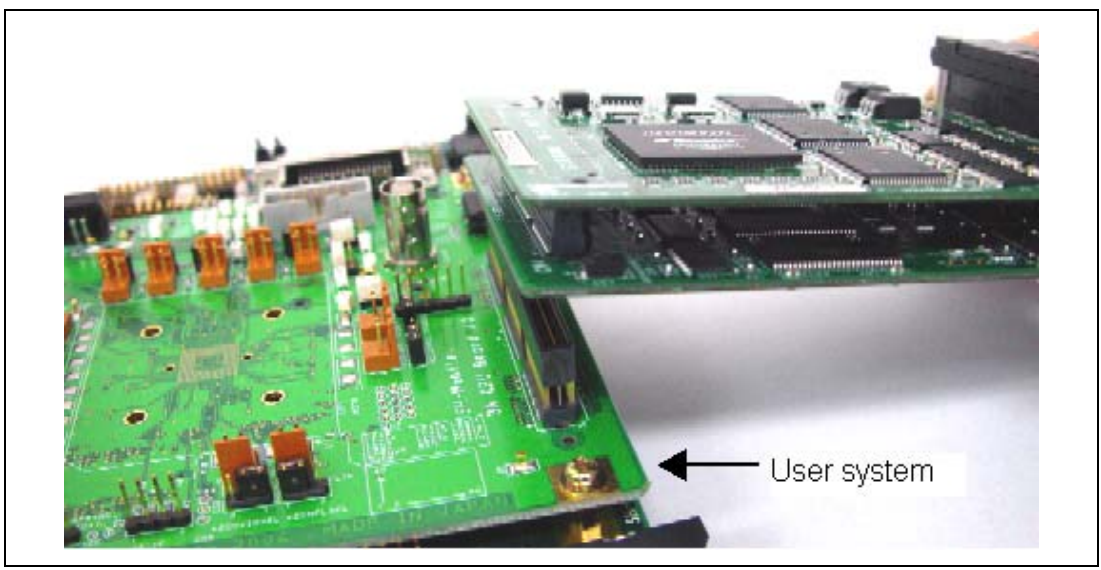


Figure 2.10 Connecting the External Bus Trace Unit, Emulation Memory Unit, and User System

⚠ CAUTION

Check the location of pin 1 before connecting.

Notes: 1. Connection of the signals differs depending on the MCU used.
2. For connecting signals, refer to the additional document, Supplementary Information on Using the SHxxxx.

2.3.5 Connecting the EV-chip Unit to the User System

- Open the cover of TRACE I/F on the side of the main unit case.
- Connect the trace cable to the EV-chip unit as shown in figure 2.11.

Figure 2.11 Connecting the Trace Cable to E200F when Using the EV-chip Unit

- Connect the EV-chip unit to the trace cable (CN1 side).

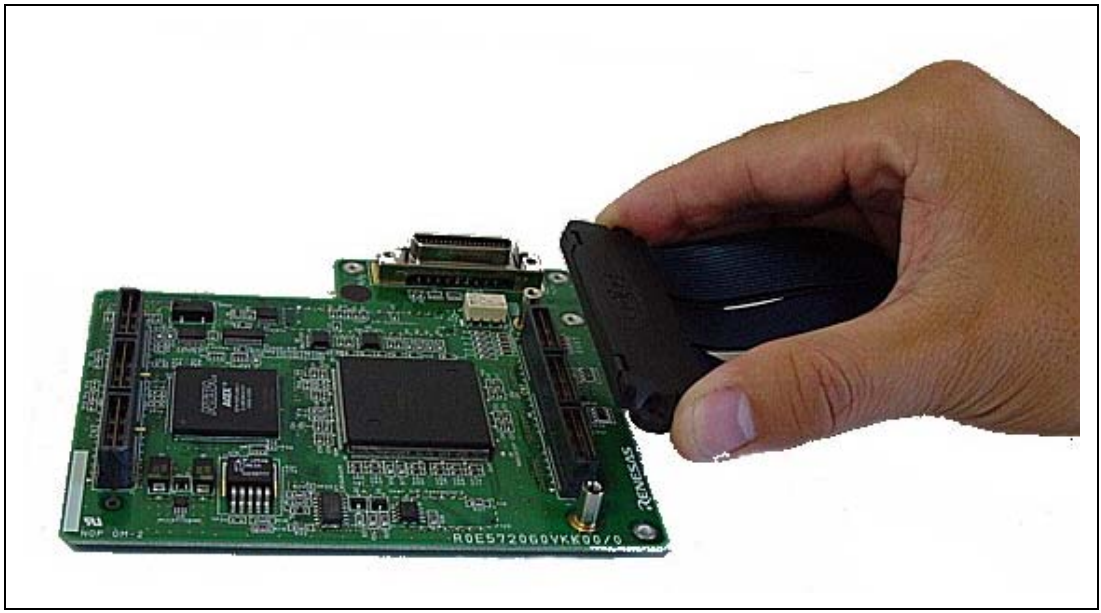


Figure 2.12 Connecting the Trace Cable to the EV-chip Unit

- Install the user system interface board (separately purchased) to connect the user system.

⚠ CAUTION
Check the location of pin 1 before connecting.

2.3.6 Connecting the E200F External Bus Trace Unit to the EV-chip Unit

- When the external bus trace unit is used with the EV-chip unit, connect the external bus trace unit to the EV-chip unit as shown in figure 2.13.

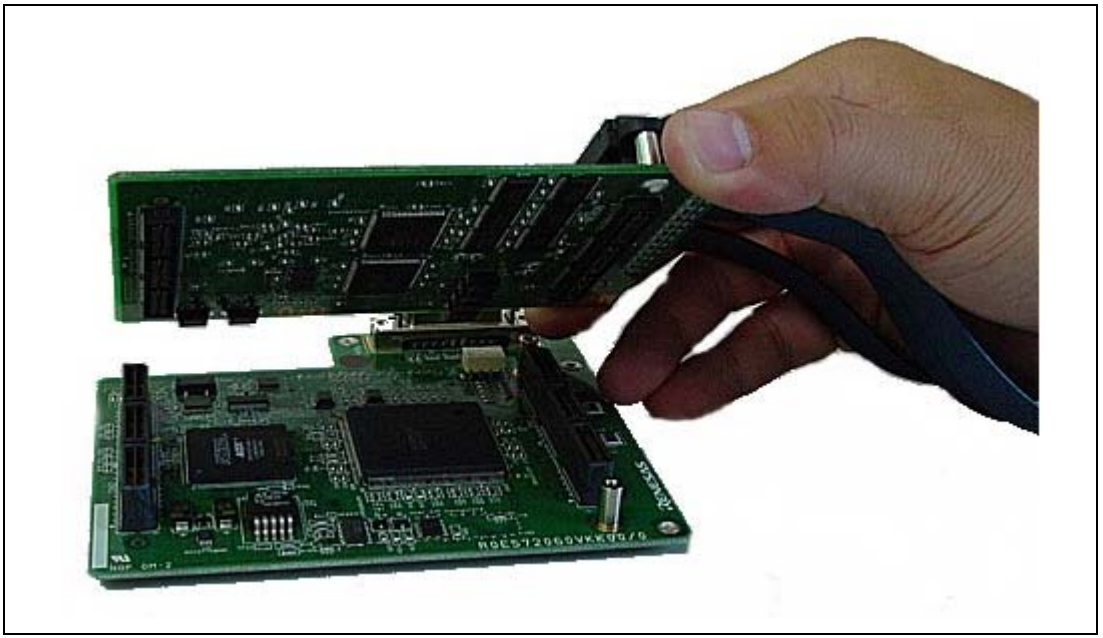


Figure 2.13 Connecting the External Bus Trace Unit to the EV-chip Unit

- After checking the location of pin 1, connect the user system to the external bus trace unit.

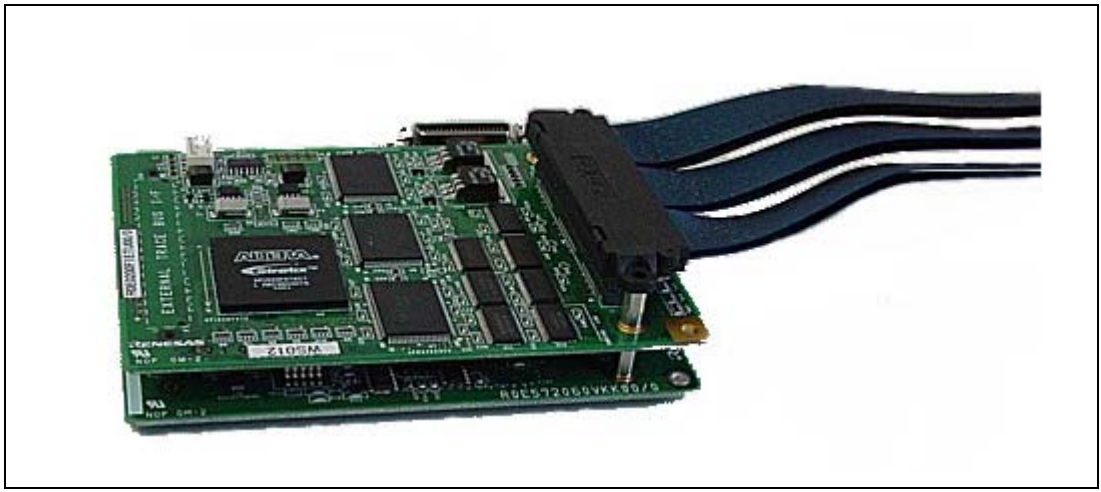


Figure 2.14 Connecting the User System to the External Bus Trace Unit

⚠ CAUTION
Check the location of pin 1 before connecting.

2.3.7 Connecting the E200F Emulation Memory Unit to the EV-chip Unit

- When the emulation memory unit is used with the EV-chip unit, connect the emulation memory unit to the EV-chip unit (figure 2.15).

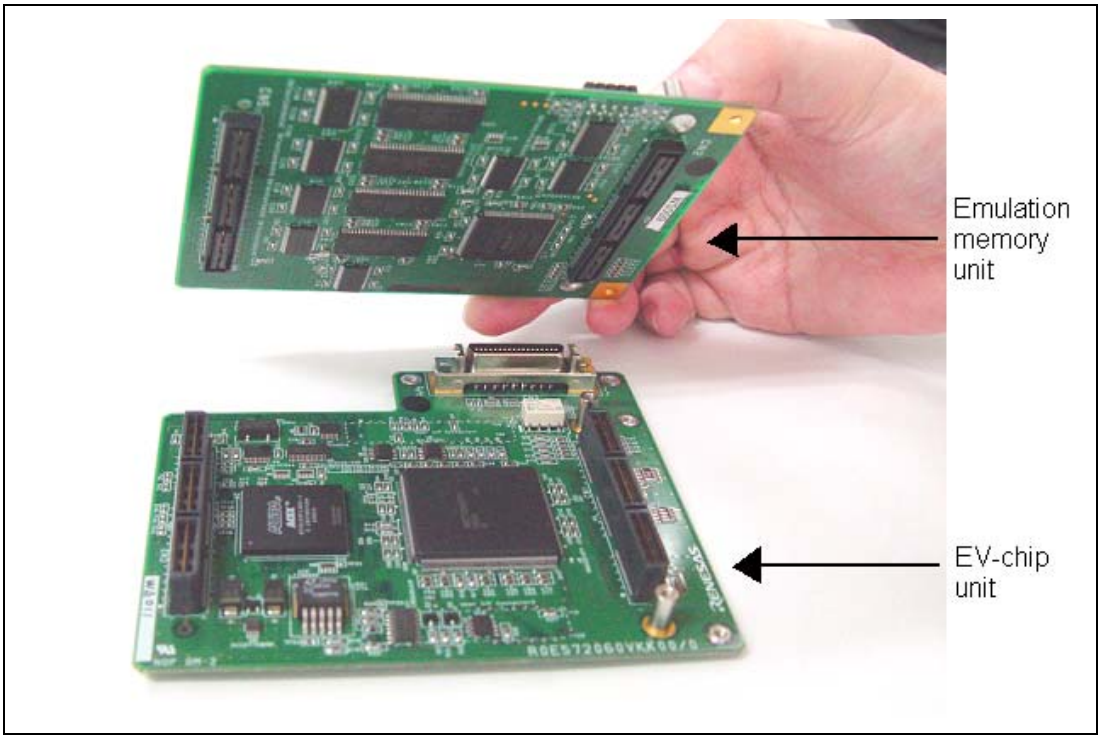


Figure 2.15 Connecting the Emulation Memory Unit to the EV-chip Unit

- After checking the location of pin 1, connect the EV-chip unit, emulation memory unit, and trace cable.

Figure 2.16 Connecting the Emulation Memory Unit, EV-chip Unit, and Trace Cable

⚠ CAUTION
Check the location of pin 1 before connecting.

2.3.8 Connecting the E200F External Bus Trace Unit, Emulation Memory Unit, and EV-chip Unit

- When the external bus trace unit is used with the emulation memory unit and EV-chip unit, as shown in figure 2.17, connect them in the positions of (a), (b), and (c) for the external bus trace unit, emulation memory unit, and EV-chip unit, respectively.
- After checking the location of pin 1, connect the external bus trace unit, emulation memory unit, and EV-chip unit.

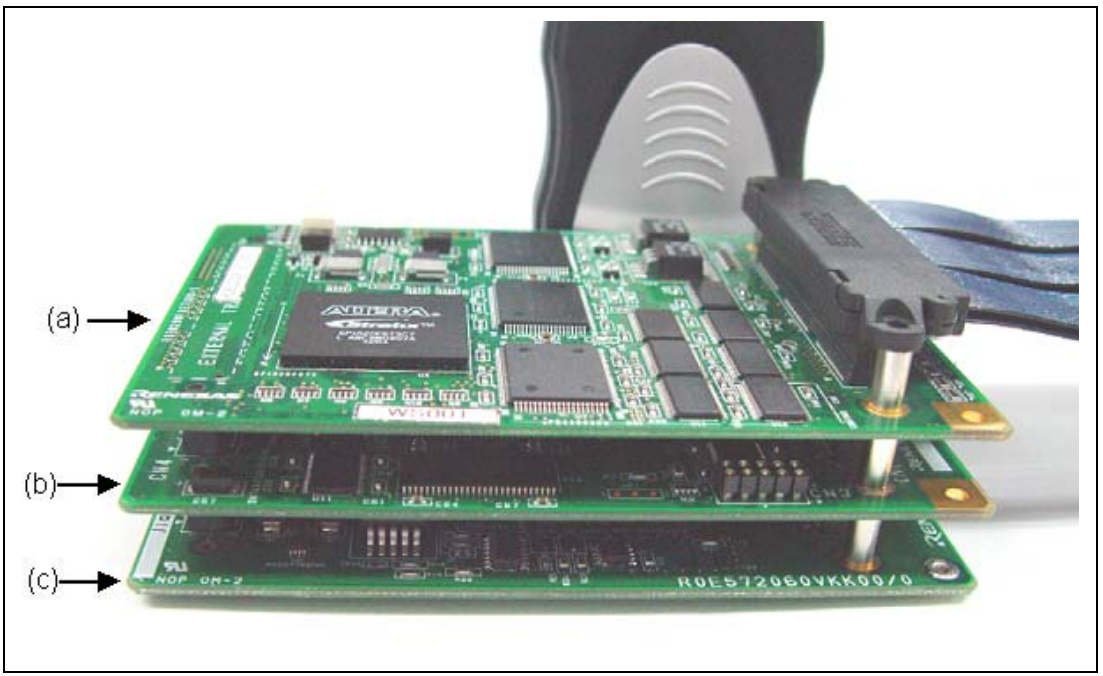


Figure 2.17 Connecting the External Bus Trace Unit, Emulation Memory Unit, and EV-chip Unit

⚠ CAUTION

Check the location of pin 1 and the position of each unit before connecting.

2.3.9 Connecting the Probe H-UDI/AUD to the EV-chip Unit

- Connect the probe H-UDI/AUD to the EV-chip unit as shown in figure 2.18.

Figure 2.18 Connecting the Probe H-UDI/AUD to the EV-chip Unit

⚠ CAUTION
Check the location of pin 1 before connecting.

2.3.10 Connecting the E200F Expansion Profiling Unit to the Main Unit Case

- Remove the screw for fastening the base unit.

Figure 2.19 Screw for the Base Unit for Placing the Emulator Vertically

Figure 2.20 Removing the Base Unit for Placing the Emulator Vertically

- Remove two screws on the rear side of the main unit case.

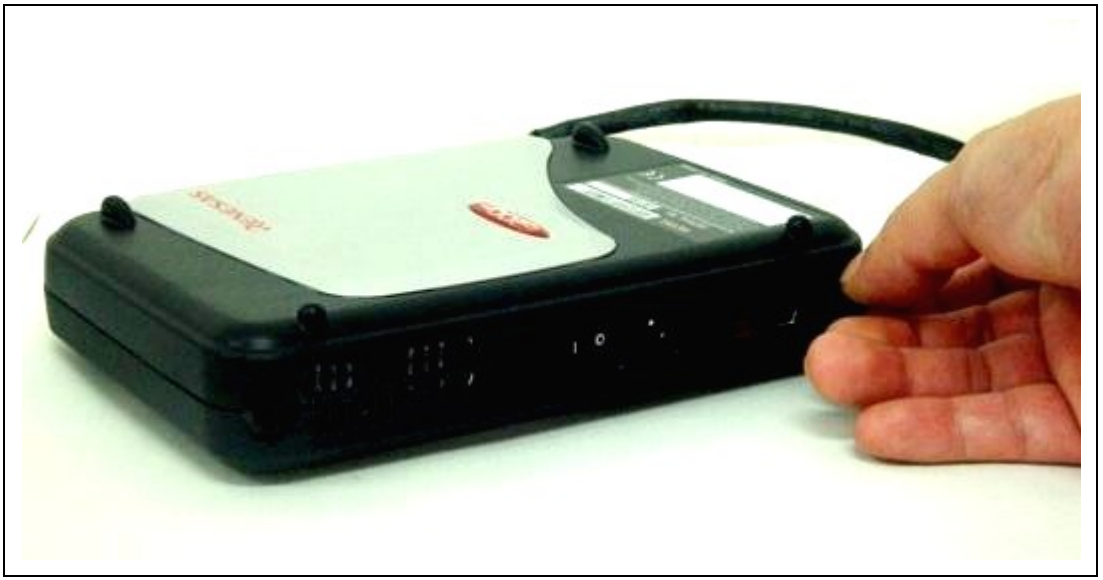


Figure 2.21 Screws for the Main Unit Case

- Remove the main unit case as shown in figure 2.22.

Figure 2.22 Removing the Main Unit Case

- After checking the location of pin 1, connect the expansion profiling unit to the main unit case.

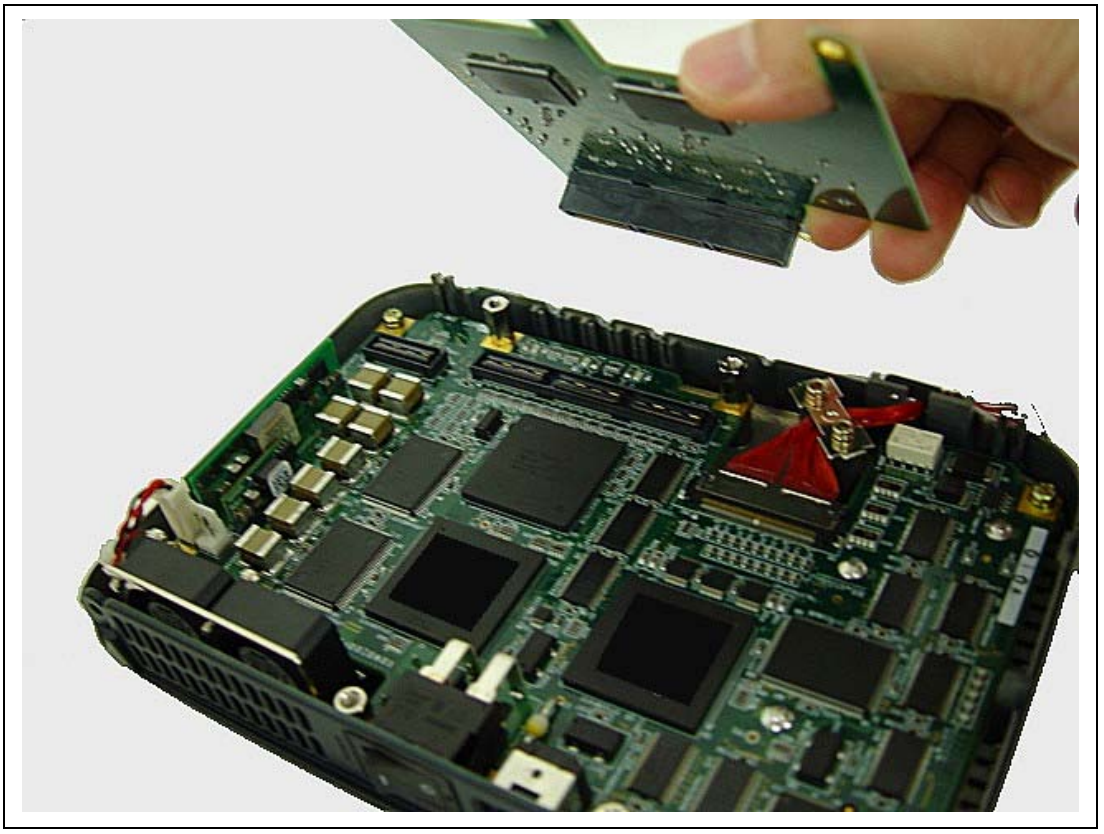


Figure 2.23 Connecting the Expansion Profiling Unit to the Main Unit Case

- Fasten the expansion profiling unit with screws provided.

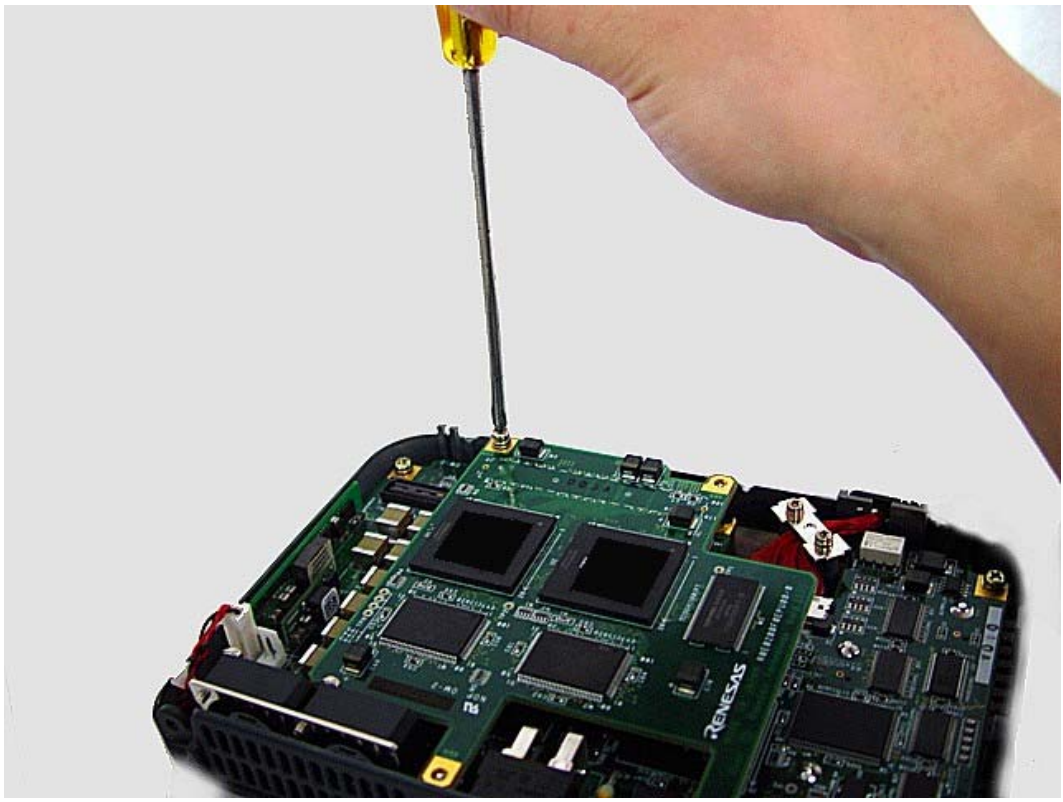


Figure 2.24 Fastening the Expansion Profiling Unit to the Main Unit Case

- Close the cover of the main unit case to be fastened with two screws.
- Fasten the screw of the base unit.

2.3.11 Connecting the AC Adapter to the Emulator Main Unit Case

Connect the provided AC adapter to the main unit case.

Figure 2.25 Connecting the AC Adapter to the Main Unit Case

Connect the provided AC adapter to the connector to input DC (+12 V) of the AC adapter marked 'DC IN'.

⚠ WARNING

Be sure to use the AC adapter dedicated for E200F.
Failure to do so will result in a FIRE HAZARD and will damage the user system or the emulator product.

2.3.12 Connecting the Emulator to the Host Machine

This section describes how to connect the emulator to the host machine. For the position of each connector of the emulator, refer to section 1.2, Emulator Hardware Configuration.

Notes: 1. When [Add New Hardware Wizard] is displayed, select the [Search for the best driver for your device. (Recommended)] radio button and then the [Specify a location] check box to select the path to be searched for drivers. The location must be specified as <Drive>:\DRIVERS. (<Drive> is the CD drive letter.)

2. When a driver is installed in Windows® XP, a warning message on the Window® logo test may be displayed, but it is not a problem. Select [Continue Anyway] to proceed with driver installation.

3. Be sure to install the software for the emulator before putting the emulator in place.

⚠ WARNING

Always switch OFF the emulator product and the user system before connecting or disconnecting any CABLES except for the USB interface cable. Failure to do so will result in a FIRE HAZARD and will damage the user system and the emulator product or will result in PERSONAL INJURY. The USER PROGRAM will be LOST.

The emulator is connected to the host machine via the USB 1.1/2.0. Figure 2.26 shows the system configuration.

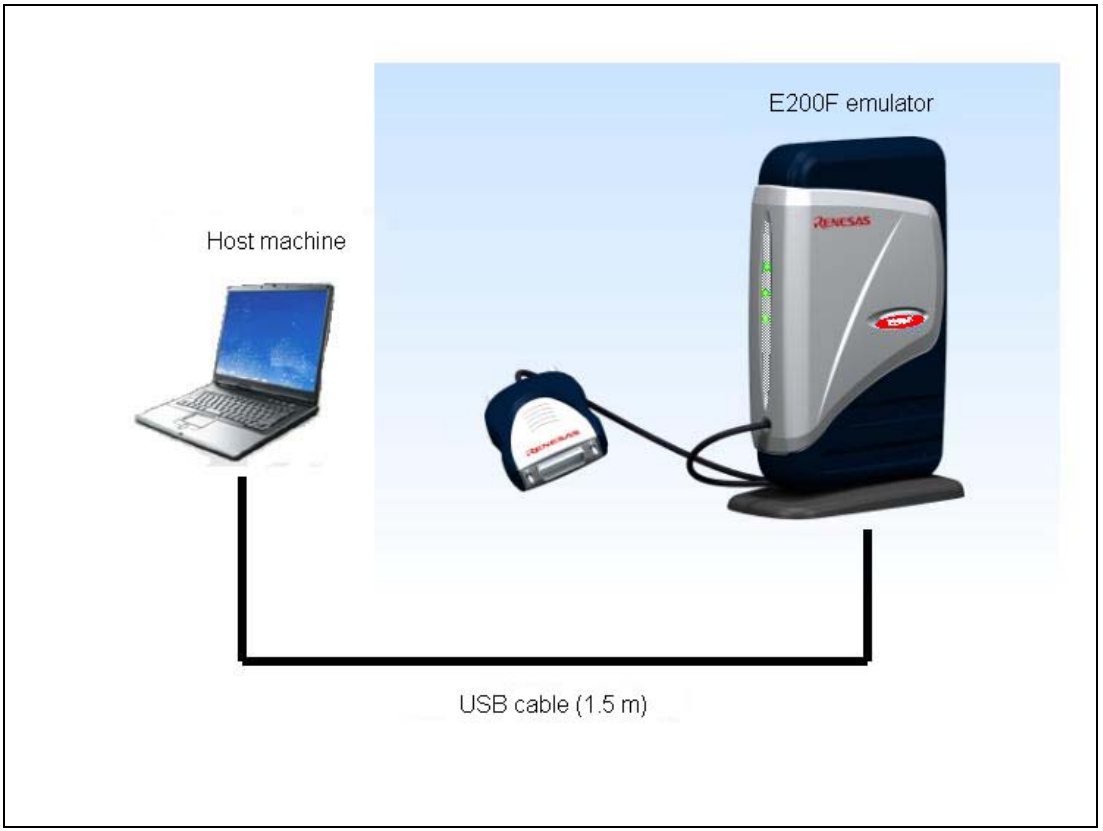


Figure 2.26 System Configuration when Connecting the Emulator to the Host Machine

2.4 Connecting the Emulator to the User System

Use the procedure below to connect the emulator to the user system, or to disconnect them when moving the emulator or the user system.

1. Check that the emulator is turned off.
2. Connect the probe H-UDI/AUD connector to the user system.
3. Fasten the probe H-UDI/AUD to the user system with the screws.

(1) The connector must be installed to the user system. Table 2.2 shows the recommended H-UDI port connector for the emulator.

Table 2.2 Recommended Connector

Connector	Type Number	Manufacturer	Specifications
36-pin connector	DX10M-36S	Hirose Electric Co., Ltd.	Screw type
	DX10M-36SE, DX10G1M-36SE		Lock-pin type

(2) The pin assignments of the connector are shown in section 2 in the additional document, Supplementary Information on Using the SHxxxx.

(3) Connect pins 2, 4, 6, 8, 10, 12, 14, 16, 18, 20, 22, 24, 26, 28, 30, 32, 33, 34, and 36 (when using the 36-pin user system interface cable) of the H-UDI port connector to GND on the PCB. These pins are used as electrical GND and to monitor the connection of the H-UDI port connector. Note the pin assignments of the H-UDI port connector.

2.4.1 Connecting the E200F H-UDI Probe to the User System

Connect the H-UDI probe to the user system as shown in figure 2.27.

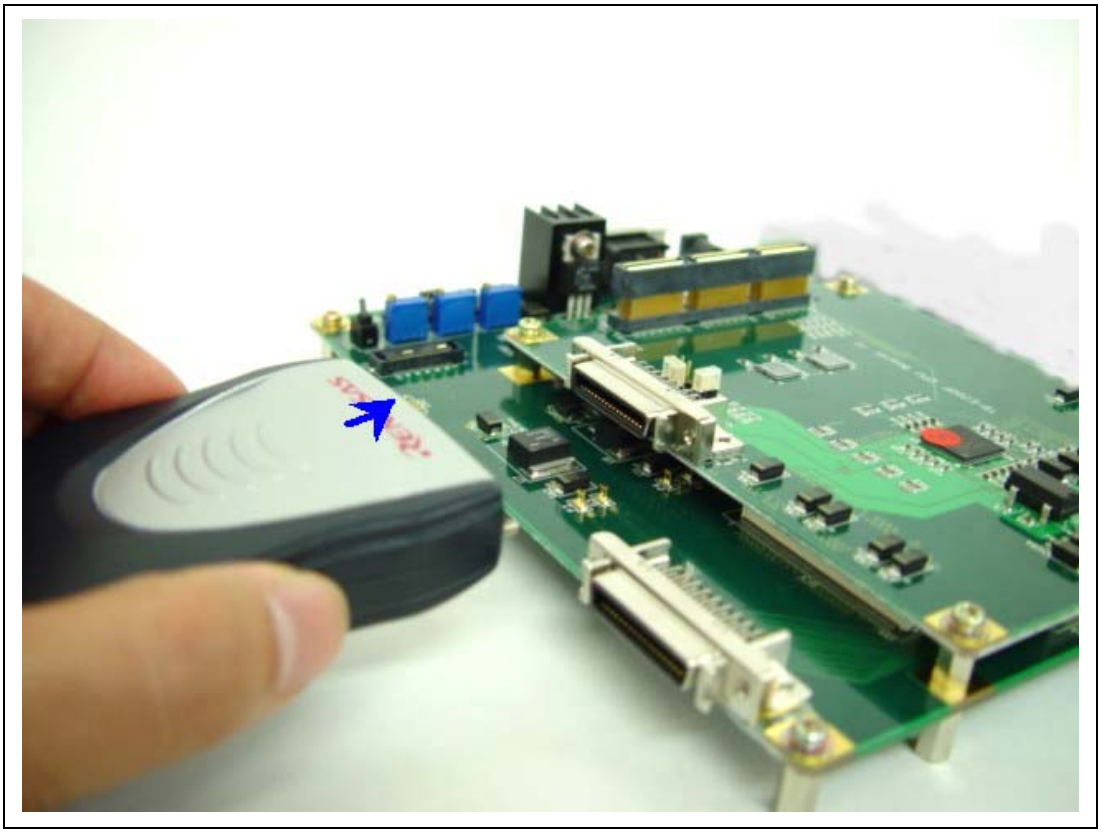


Figure 2.27 Connecting the H-UDI Probe to the User System

Fasten the user system and the H-UDI probe with screws as shown in figure 2.28.

Figure 2.28 Fastening the User System and the H-UDI Probe

⚠ CAUTION

Note that the pin number assignments of the connector differ from those of the connector manufacturer.

Notes:
1. Connection of the signals differs depending on the package. For details, refer to the MCU's pin assignments.
2. The range of communication that the emulator operates at is different depending on the MCU used.
3. To connect the signals from the connector, refer to section 2 in the additional document, Supplementary Information on Using the SHxxxx.

4. When developing user systems, do not connect the TDI and TDO signals of the device to the boundary scan loop, or separate them by using a switch (figure 2.29).

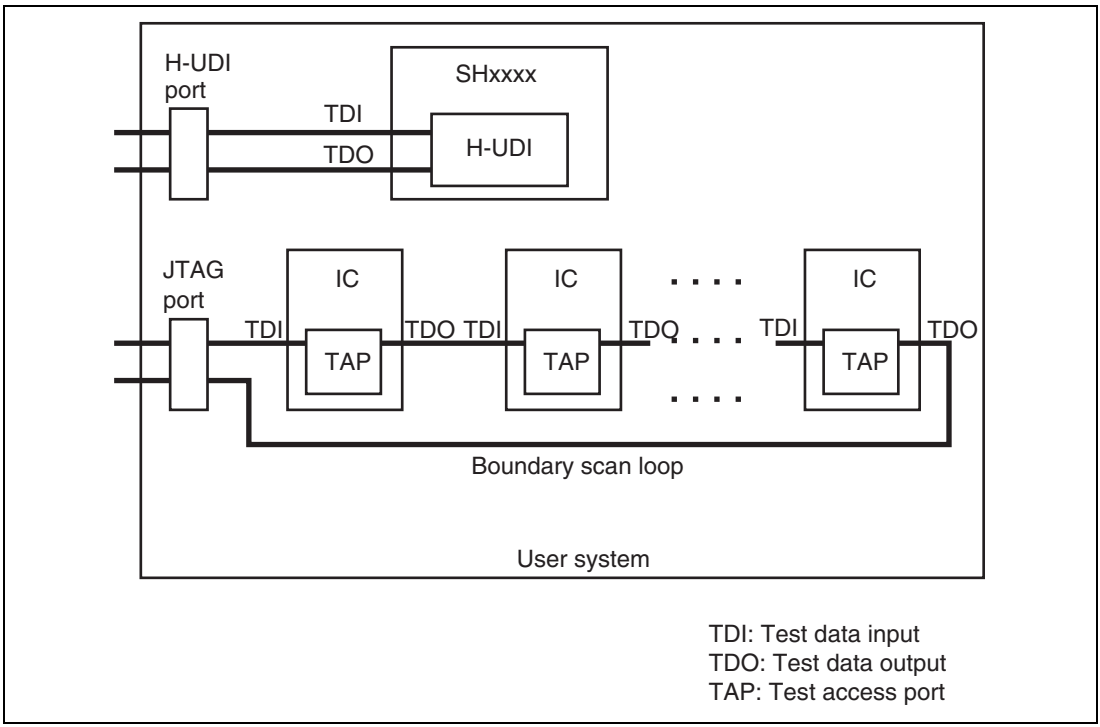


Figure 2.29 User System Example

2.4.2 Connecting System Ground

⚠ WARNING

Separate the frame ground from the signal ground at the user system. Failure to do so will result in a FIRE HAZARD and will damage the user system and the emulator product or will result in PERSONAL INJURY.

The emulator's signal ground is connected to the user system's signal ground. In the emulator, the signal ground and frame ground are connected. In the user system, connect the frame ground only; do not connect the signal ground to the frame ground (figure 2.30).

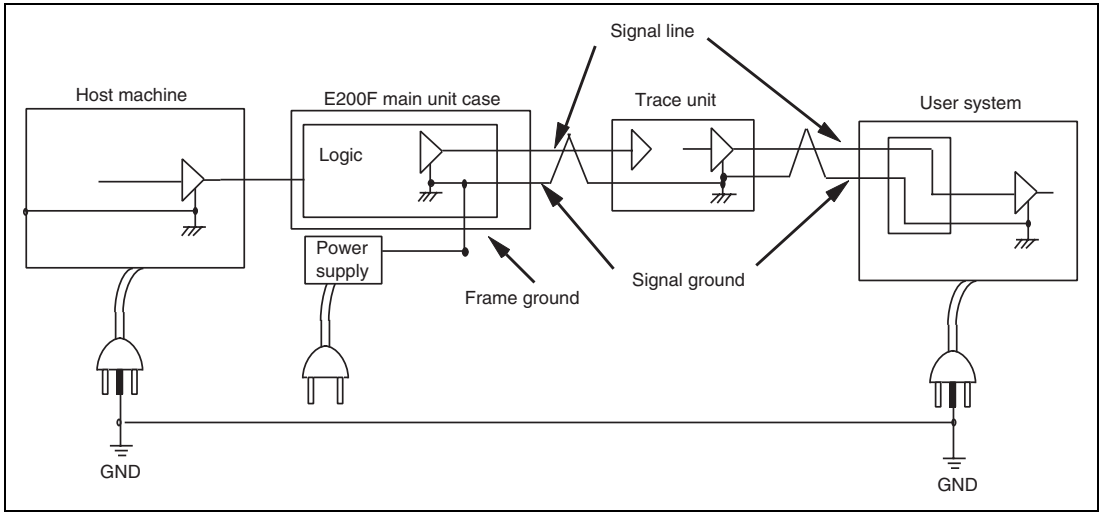


Figure 2.30 Connecting System Ground

2.5 Changing the Settings

In the emulator, it is possible to change the emulator function flexibly depending on the user's request for debugging.

When the High-performance Embedded Workshop is activated and connected to the emulator, the required functions can be selected. At this time, the following dialog box will be displayed.

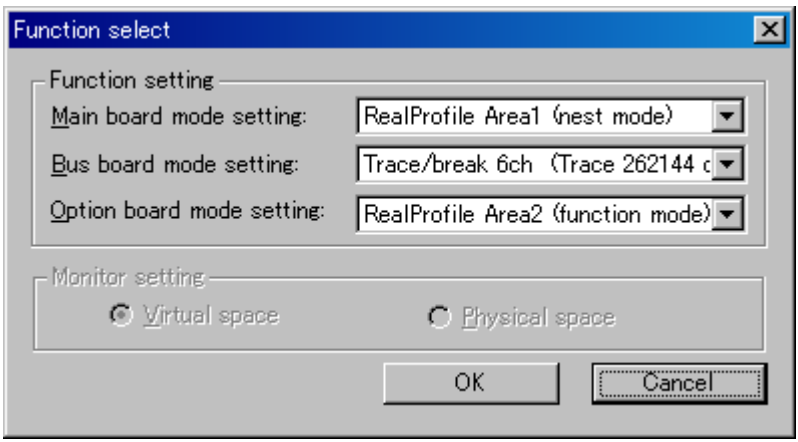


Figure 2.31 [Function select] Dialog Box

The following sections describe the contents that can be selected in this dialog box.

Note: For details on each function, refer to section 1.3, Emulator Functions.

2.5.1 Changing the Functions when Using the E200F Main Unit

Select the item in the [Main board mode setting] combo box of the [Function select] dialog box.

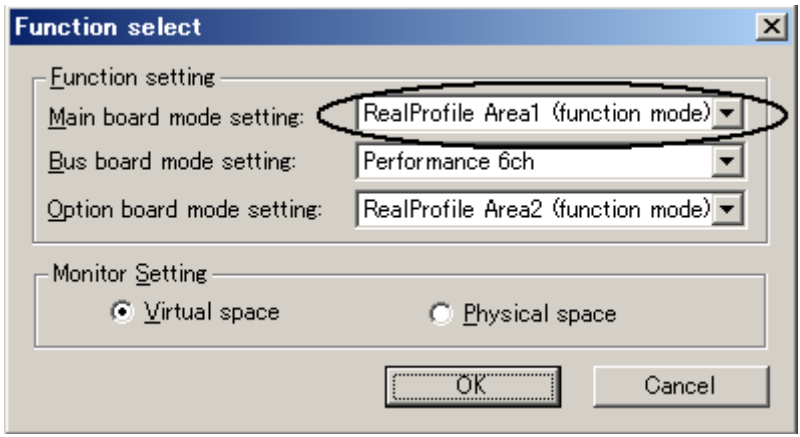


Figure 2.32 [Function select] Dialog Box

- [RealProfile Area1 (function mode)]: Measures accumulation of execution time of each function; the subroutine execution time is not included.
- [RealProfile Area1 (nest mode)]: Measures accumulation of execution time of each function; the subroutine execution time is also included.
- [Coverage (4M)]: Acquires the information on the C0 coverage in the 4-Mbyte areas.

Note: Using the realtime profiling and coverage functions increases the ranges that can be set with the expansion profiling unit.

2.5.2 Changing the Functions when Using the External Bus Trace Unit

Select the item in the [Bus board mode setting] combo box of the [Function select] dialog box.

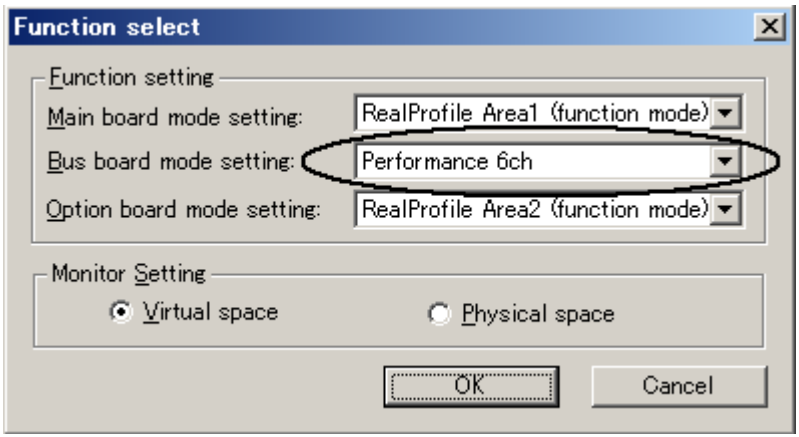


Figure 2.33 [Function select] Dialog Box

- [Trace/break 6ch (Trace 242144 cycles)]: Uses the channel for detecting the external bus event as a break.
- [Emulation memory (4M, Trace 8192 cycles)]: Uses the external emulation memory function (4 Mbytes x 1 block).

Note: When the external bus trace unit is not connected to the emulator, this combo box is displayed in gray.

2.5.3 Changing the Functions when Using the Expansion Profiling Unit

Select the item in the [Option board mode setting] combo box of the [Function select] dialog box.

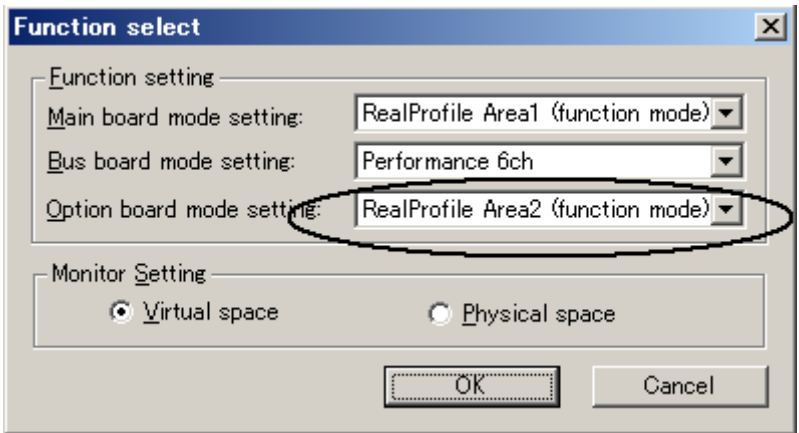


Figure 2.34 [Function select] Dialog Box

- [RealProfile Area2 (function mode)]: Measures accumulation of execution time of each function; the subroutine execution time is not included.
- [RealProfile Area2 (nest mode)]: Measures accumulation of execution time of each function; the subroutine execution time is also included.
- [Coverage (8M)]: Acquires the information on the C0 coverage in the 8-Mbyte areas.

Note: When the expansion profiling unit is not connected to the emulator, this combo box is displayed in gray.

Section 3 Hardware Specifications

3.1 List of Specifications

Table 3.1 lists the external dimensions and mass of the emulator main unit and optional units.

Figure 3.1 shows the external dimensions of the probe head of the emulator main unit.

Table 3.1 External Dimensions and Mass

No.	Item	Specification
1	External dimensions of E200F main unit case	195 x 130 x 45 (mm)
	Mass of E200F main unit case	490 (g)
2	External dimensions of E200F external bus trace unit	90 x 125 x 15.2 (mm)
	Mass of E200F external bus trace unit	83 (g)
3	External dimensions of E200F expansion profiling unit	98 x 115 x 15.2 (mm)
	Mass of E200F expansion profiling unit	52 (g)
4	External dimensions of E200F EV-chip unit	110 x 125 x 15.2 (mm)
	Mass of E200F EV-chip unit	110 (g)
5	External dimensions of user system interface board	60 x 90 x 26 (mm)
	Mass of user system interface board	45 (g)
6	External dimensions of E200F emulation memory unit	90 x 125 x 15.2 (mm)
	Mass of E200F emulation memory unit	R0E0200F1MSR00: 81 (g) R0E0200F1MSR01: 85 (g)

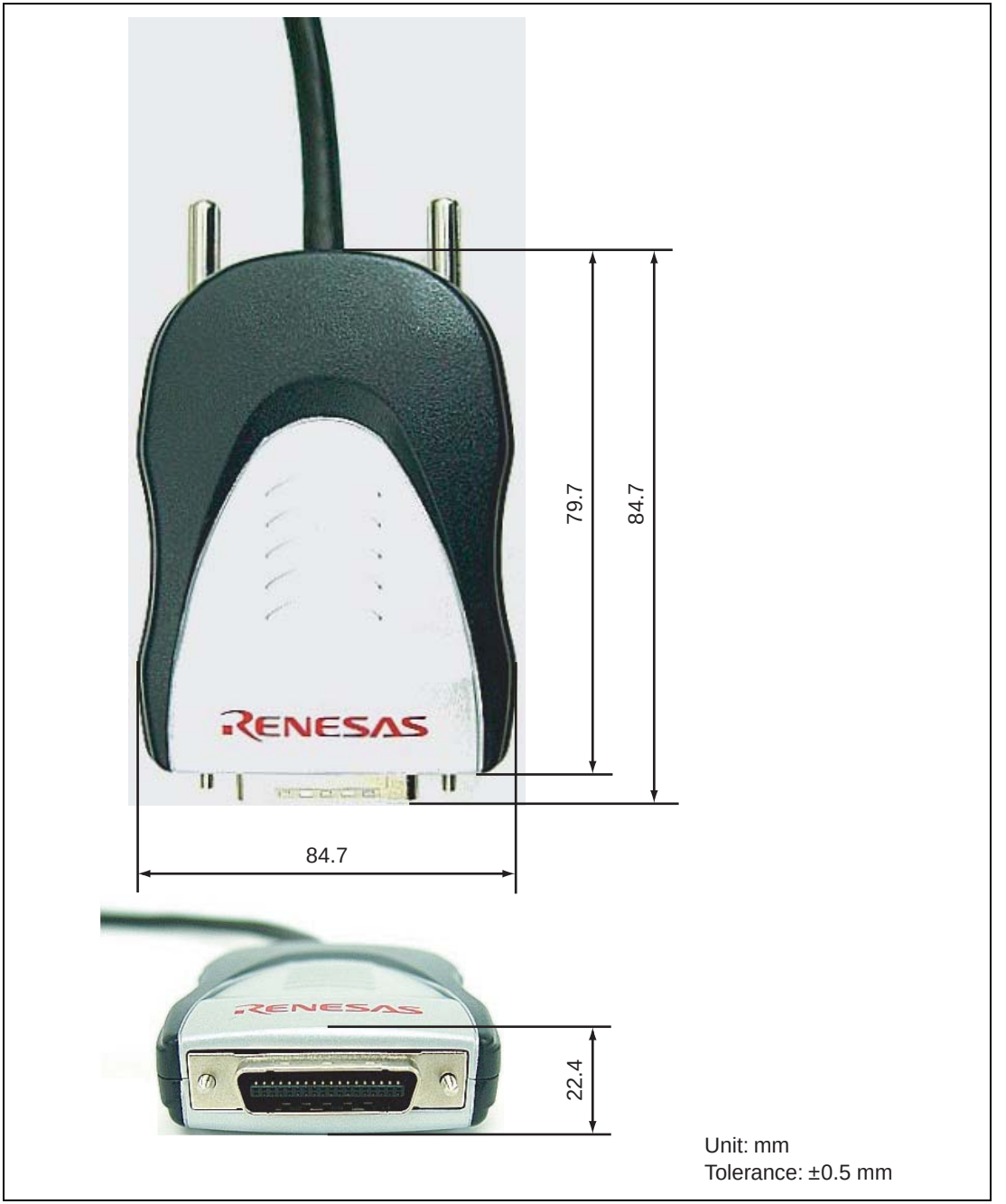


Figure 3.1 External Dimensions of the Probe H-UDI/AUD

3.2 User System Interface Circuits

Figures 3.2 and 3.3 show user system interface circuits. Use them as a reference to determine the value of the pull-up resistance.

Note: The IC with UVCC power supply operates at 3.3 V or VCC (3.3 to 5.0 V) from the H-UDI port connector.

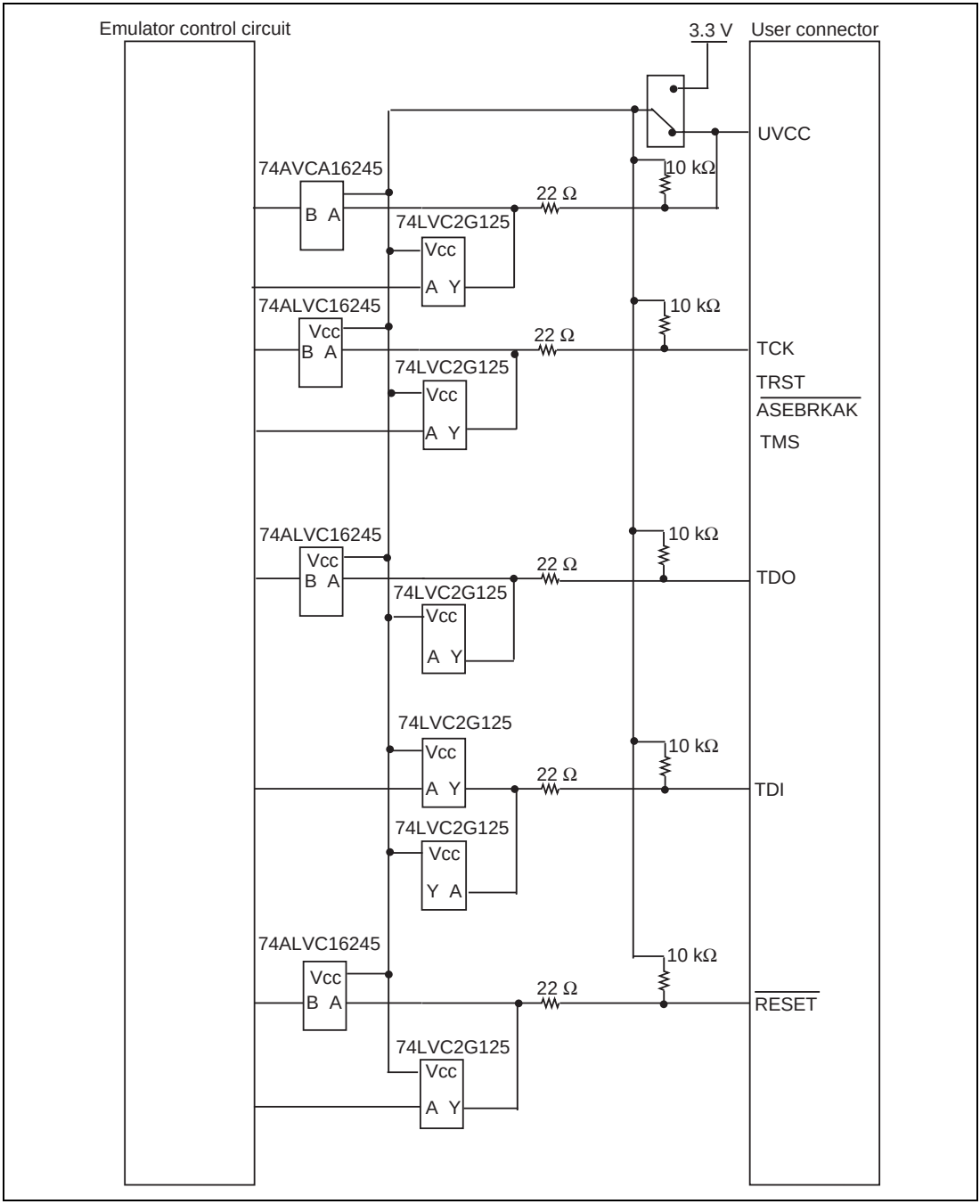


Figure 3.2 User System Interface Circuits (H-UDI)

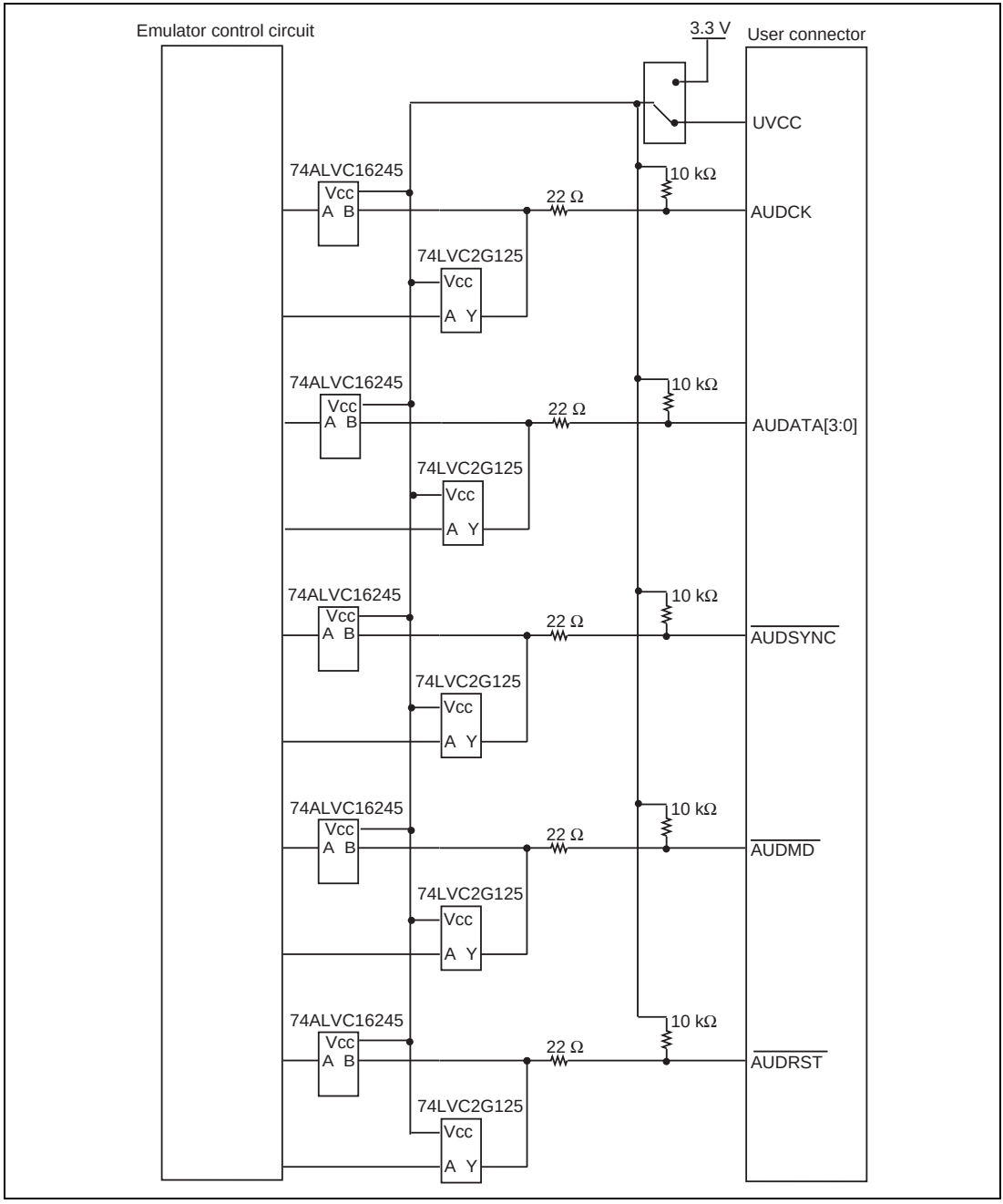


Figure 3.3 User System Interface Circuits (AUD)

3.3 Reducing EMI Noise

To prevent EMI noise, enclose the EV-chip unit in a case at usage, as shown in figure 3.4.

The recommended material of the case is iron plated with nickel or resin internally plated with nickel.

The case must be large enough to include the EV-chip unit, the external bus trace unit, the emulation memory unit, the probe head, and the user system.

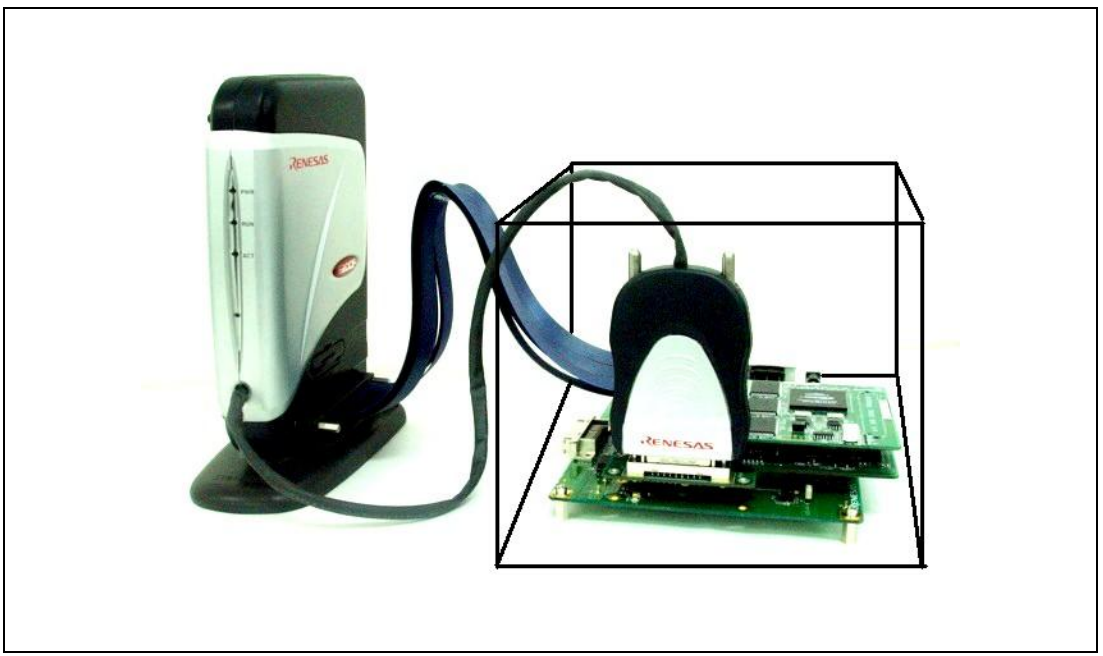


Figure 3.4 Countermeasure for EMI Noise

Note: EMI stands for Electrical Magnetic Interference.

3.4 Diagnostic Procedure

This section describes how to set up and execute the diagnostic program and output the result.

For the SH-2A, SH-2 E200F emulator, when serial numbers 0001 to 0103 are shown on the product management seal, be sure to update the version of the diagnostic program on first execution of that program after it has been installed. This update will be completed at one time. For the products with serial number 0104 or later, the diagnostic program needs not be updated.

3.4.1 Installing the Diagnostic Program

(1) Opening \SOT\TM_MENU.exe

Execute TM_MENU.exe from the sot directory of the CD-R. A screen for selecting the device shown in figure 3.5 is displayed.

(2) Selecting device series

Select the device series in use from the combo box and click the [NEXT] button.

(3) Installing the diagnostic program according to the installation wizard

An installer of the diagnostic program for the selected device series is started.

Follow the cues given by the installation wizard to install the software.
When executing the program under Windows Vista®, log on with administrator rights.

(4) Adding the device series

When several device series are added to the diagnostic program, execute TM_MENU.exe again after the end of program installation to select new device series. At this time, select the same folder for the installation directory as that for initial installation.

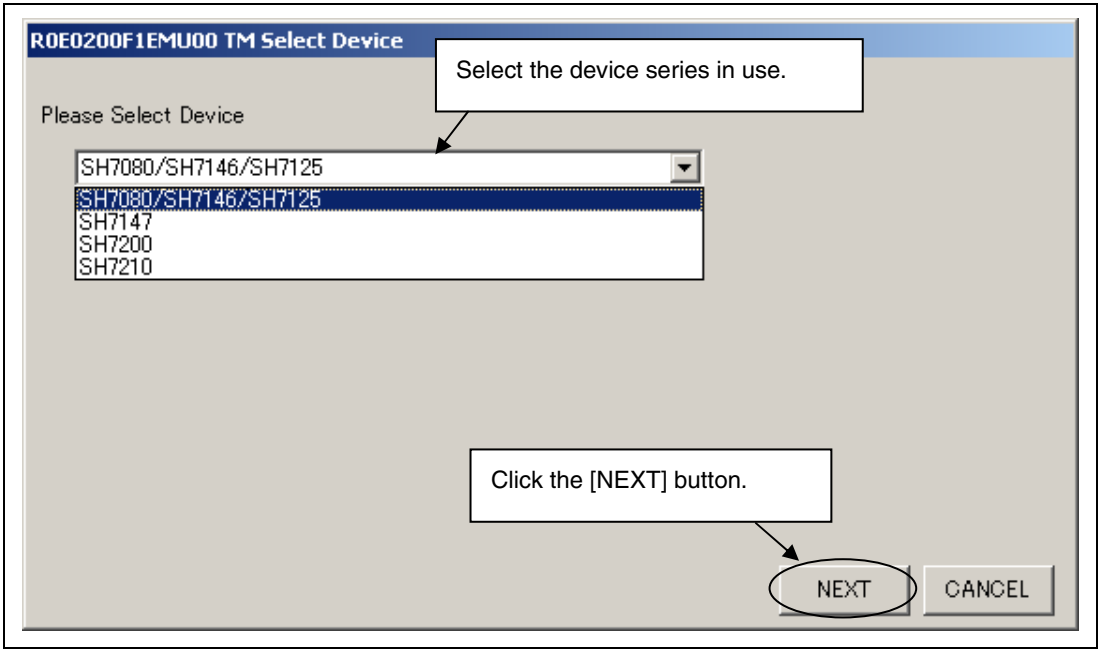


Figure 3.5 Screen for Selecting the Device Series after Executing Setup.exe

3.4.2 Executing the Diagnostic Program

The following describes how to execute the diagnostic program.

1. Connect the emulator to the host machine.

Note: When the diagnostic program is used, do not connect the user system nor user system interface board to the emulator.

2. Turn on the emulator.
3. Select [E200F TM] -> [E200F TM] from [Programs] in the [Start] menu.
4. The diagnostic program of the emulator is started and the initial screen (figure 3.6) is displayed.

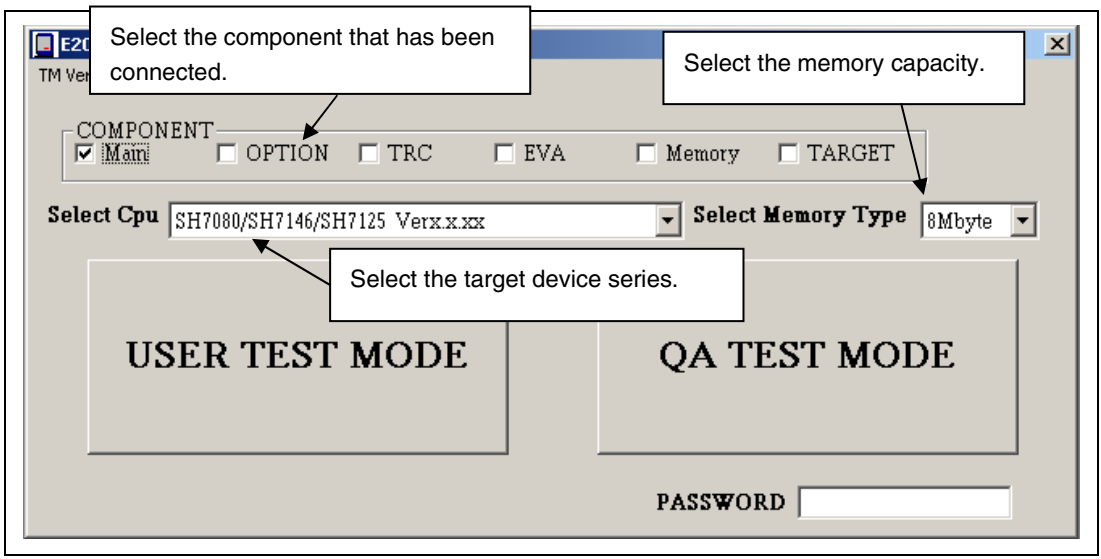


Figure 3.6 Initial Screen of the E200F System Operation Test

5. Select [COMPONENT]. The component to be selected must be connected to the emulator. The check boxes for [COMPONENT] indicate as follows:
   [Main]: Emulator main unit
   [OPTION]: Expansion profiling unit
   [TRC]: External bus trace unit
   [EVA]: EV-chip unit
   [Memory]: Emulation memory unit

Note: Do not select [TARGET] ([TARGET] is used for jigs for the shipment test).

6. When the EV-chip unit has been connected, select the target device series in [Select Cpu].
7. When the emulation memory unit has been connected, select the corresponding memory capacity in [Select Memory Type]. The items for this combo box indicate the products as follows:
   [8Mbyte]: 8-Mbyte emulation memory unit
   [16Mbyte]: 16-Mbyte emulation memory unit
8. Click the [USER TEST MODE] button. Do not select [QA TEST MODE].
9. When the emulator enters USER TEST MODE, the screen shown in figure 3.7 is displayed.
10. When clicking [UNIT ONLY], items that can be tested are selected.
11. Click the [START] button.

12. When loading FPGA is completed, the test will begin.

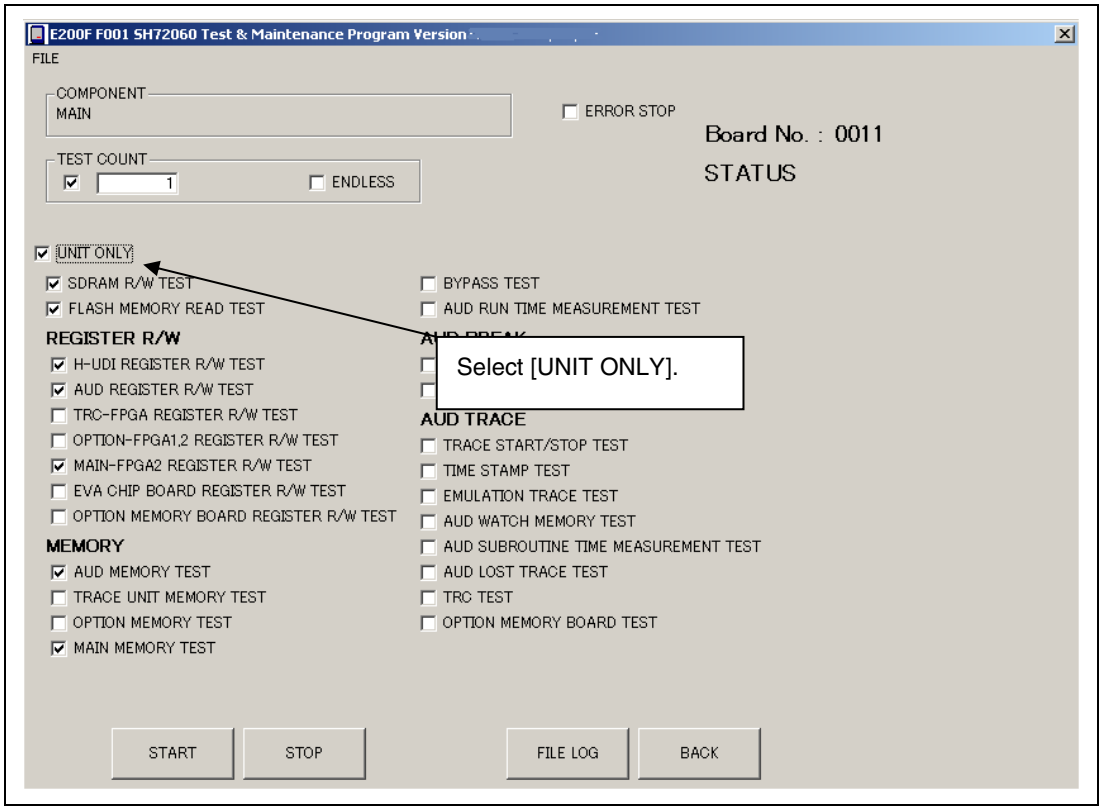


Figure 3.7 Screen for Selecting Test

Note: Do not disconnect the USB cable during the test.

13. When the test is executed, ‘Testing’ is shown at the left of [STATUS].
14. When the test is successfully completed, ‘Test OK!’ is displayed.
15. Select [BACK] to exit the diagnostic program.

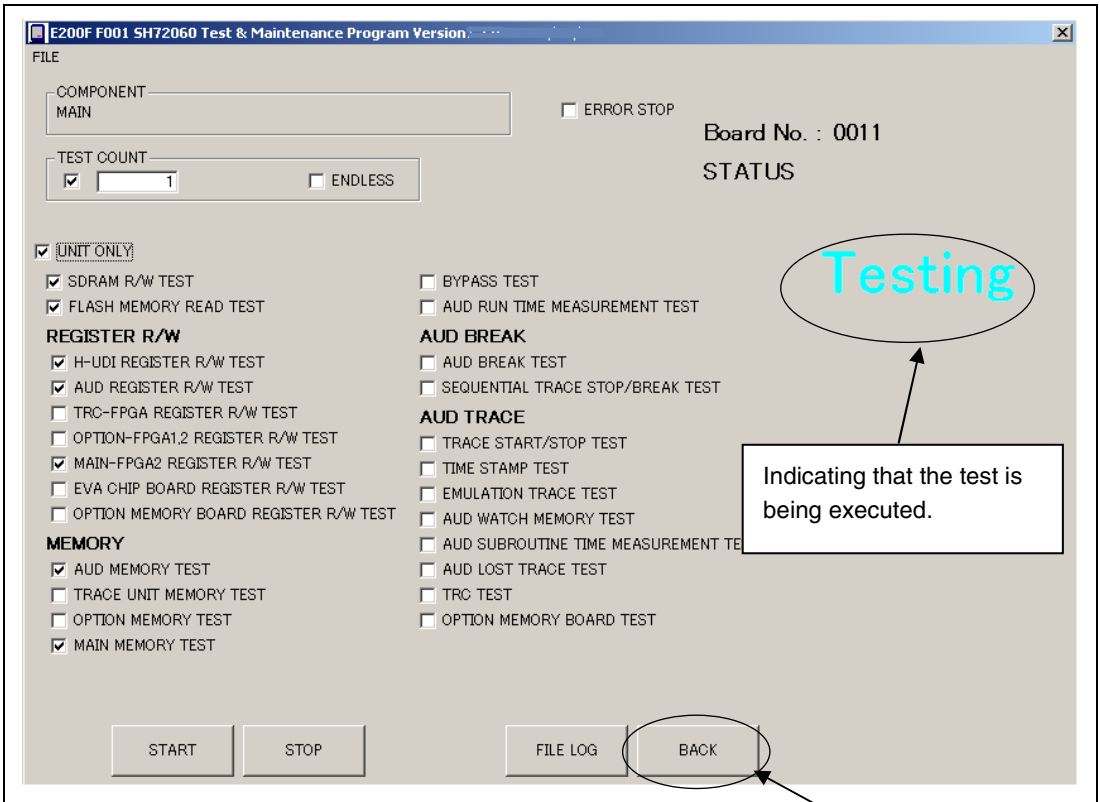


Figure 3.8 Screen Showing ‘Testing’

3.4.3 Creating a Log File

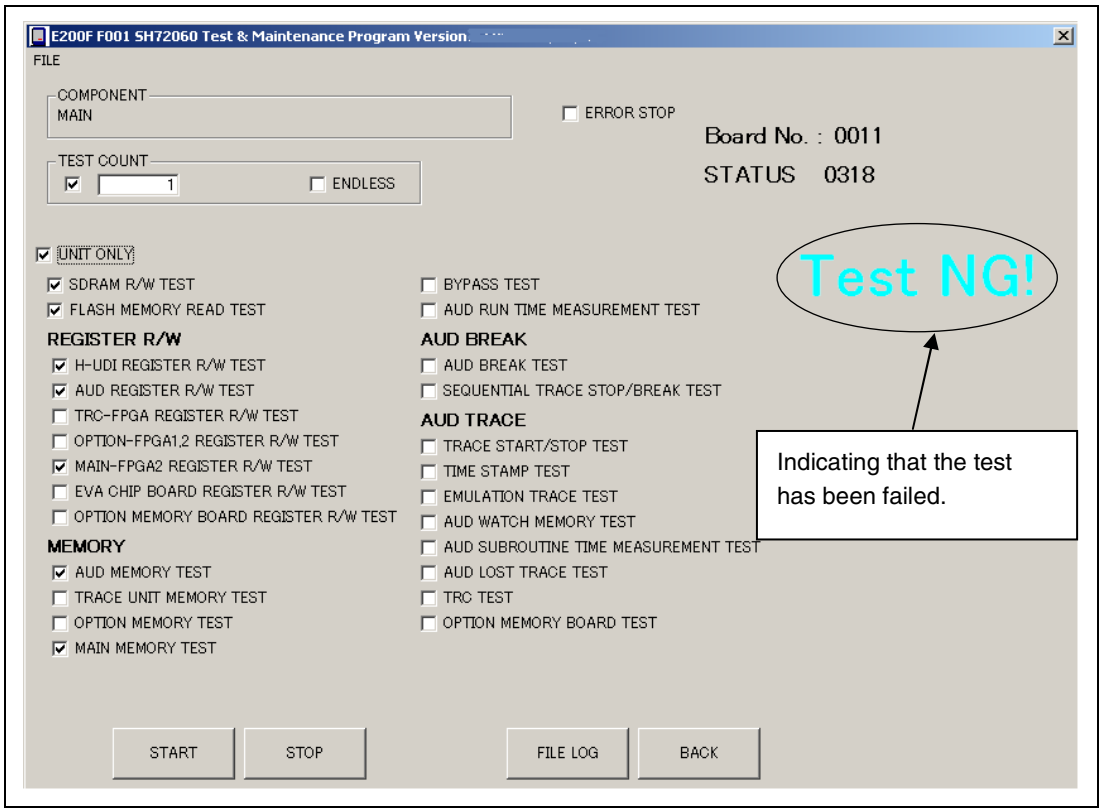


Figure 3.9 Screen Showing Failure of the Test (1)

If the test is failed, 'Test NG!' (figure 3.9) or 'Status = xxxx xxxx Error' (figure 3.10) is shown. In this case, the emulator may be malfunctioned. Send a log file created according to the following procedures and contents of a failure to the sales office.

- How to create a log file

1. Click the [FILE LOG] button.
2. A log file 'F001_SHxxxx.log' is created under the directory for installing the diagnostic program (C:\Program Files\E200F F1 TM, if no directory is specified).
3. Send the log file to the sales office.

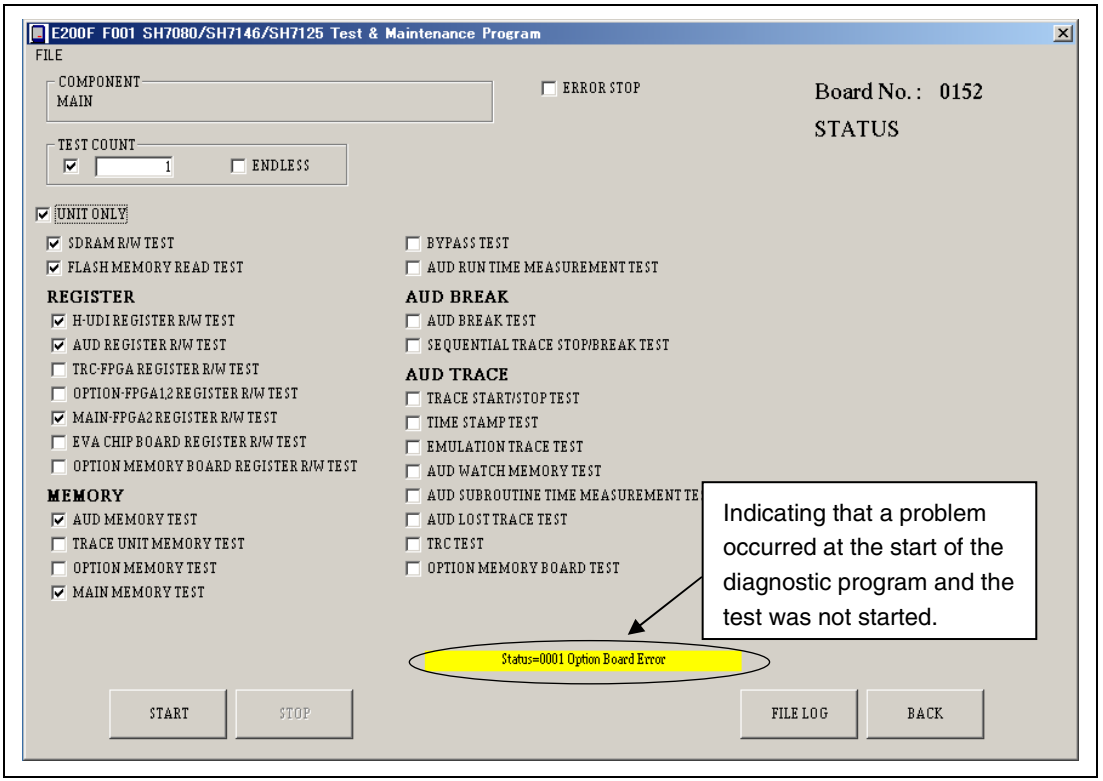


Figure 3.10 Screen Showing Failure of the Test (2)

Example of the E200F TM error log

```
*** E200F Emulator T/M ERROR LOG ***
    TM Version 2.0.00
    ICE CODE F001
    Board Number 0001
    Device SH7200
    Date 2007/01/01
    No.    STATUS    NG Address         NG Data
    03     0318      A8000004           00000040      NG
```

3.4.4 Updating the Diagnostic Program

The following describes how to update the diagnostic program.

1. Connect the emulator to the host machine.
2. Turn on the emulator.
3. Select [E200F TM] -> [E200F TM] from [Programs] in the [Start] menu.
4. The diagnostic program of the emulator is started and the initial screen (figure 3.11) is displayed.
5. Select [TM Version Up].

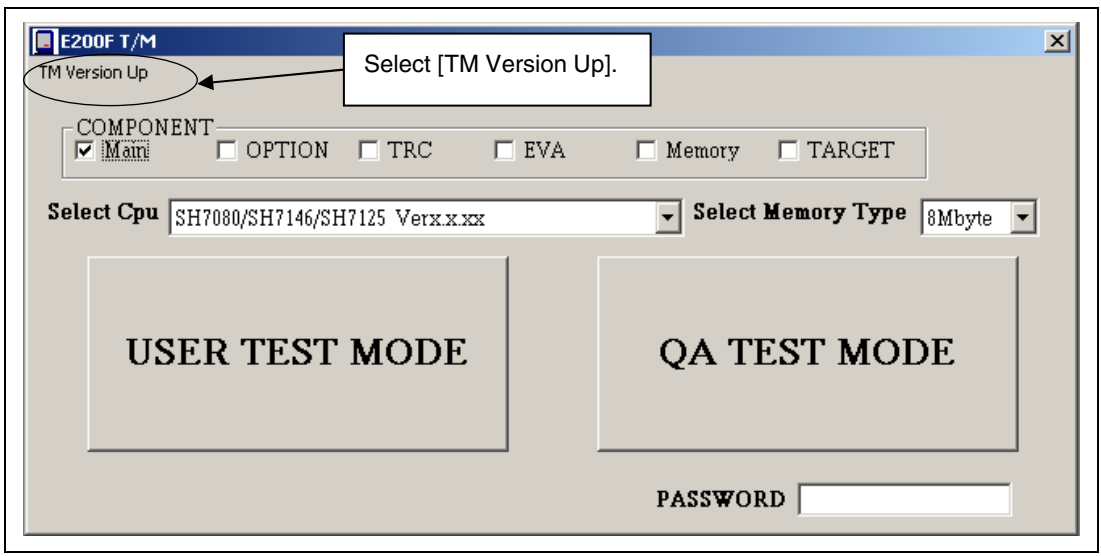


Figure 3.11 Initial Screen of the E200F Diagnostic Program

6. When [TM Version Up] is started, the screen shown in figure 3.12 is displayed.
7. Select [VER UP].
8. When updating the program is executed and completed, the screen shown in figure 3.13 is displayed.
   (If the screen shown in figure 3.14 is displayed, the latest diagnostic program has been updated. In this case, select [CLOSE] and execute the E200F diagnostic program.)
9. Select [CLOSE].
10. The initial screen of the E200F diagnostic program is displayed (figure 3.11).
11. Execute the diagnostic program with the procedure as described in section 3.4.2, Executing the Diagnostic Program.

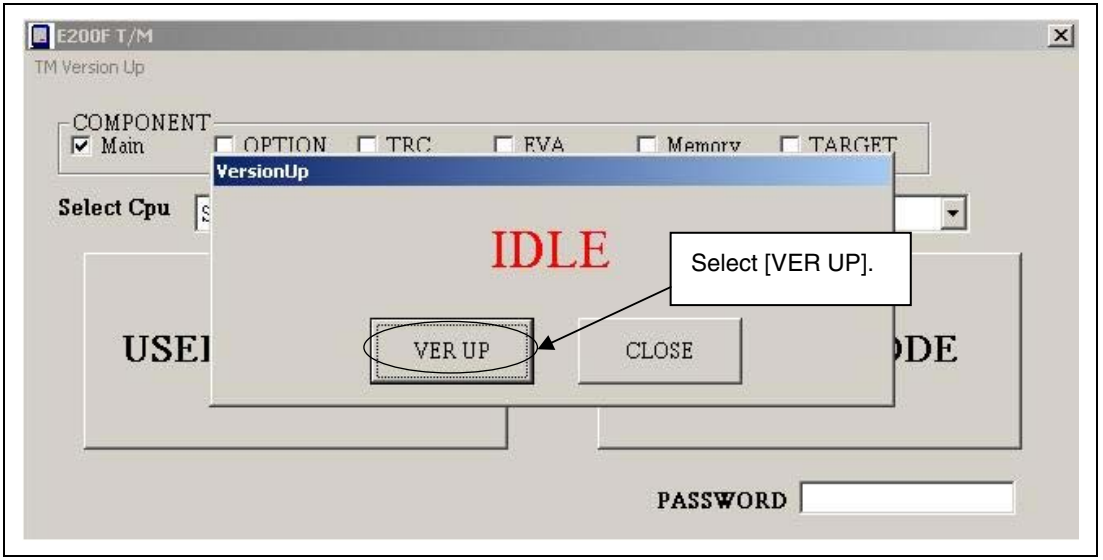


Figure 3.12 Screen after Selecting [VER UP]

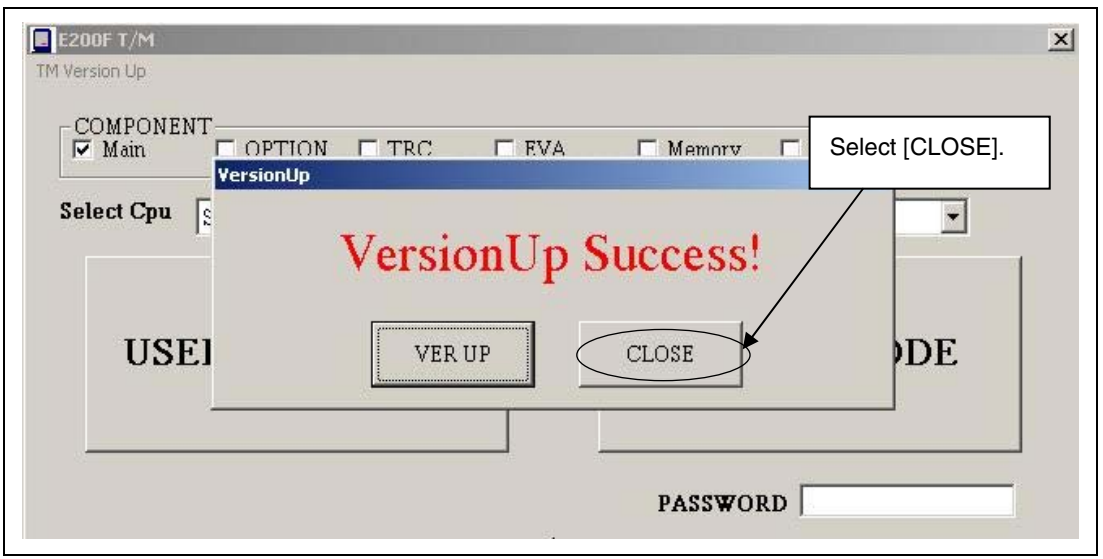


Figure 3.13 Screen when Completing Update

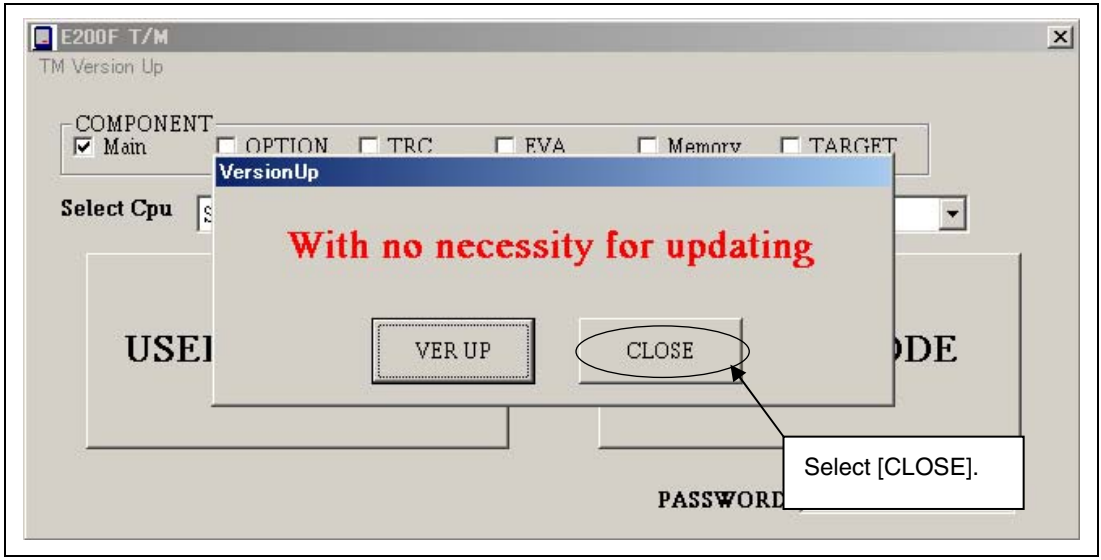


Figure 3.14 Screen Displayed when the Latest Version has been Updated

Section 4 Preparations for Debugging

4.1 System Check

When the software is executed, use the procedure below to check that the emulator is connected correctly. Here, use the workspace for a tutorial provided on the product.

- Connecting the emulator

1. Connect the emulator to the host machine.
2. Connect the user system interface cable to the connector of the emulator.
3. Connect the user system interface cable to the connector in the user system.
4. Turn on the user system.
5. Turn on the emulator.
6. Select [Renesas] -> [High-performance Embedded Workshop] -> [High-performance Embedded Workshop] from [Programs] in the [Start] menu.

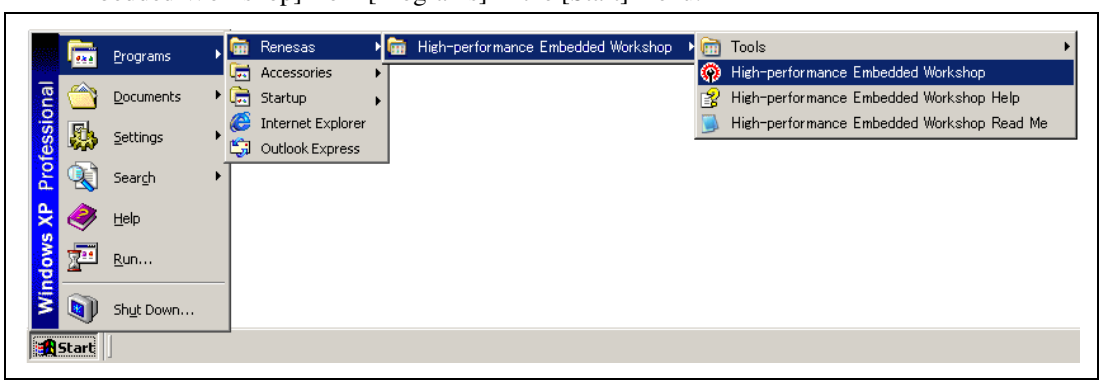


Figure 4.1 [Start] Menu

Note: The [High-performance Embedded Workshop] -> [Tools] is not displayed depending on the user's environment.

7. The [Welcome!] dialog box is displayed.

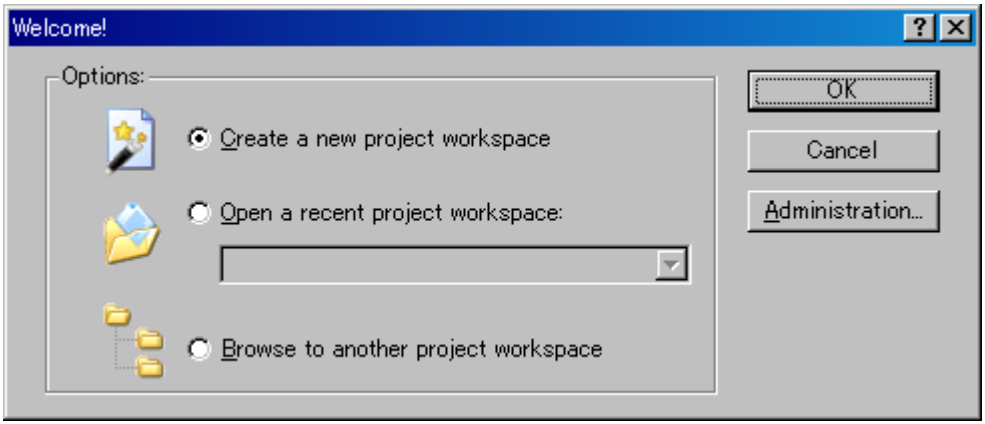


Figure 4.2 [Welcome!] Dialog Box

[Create a new project workspace] radio button:	Creates a new workspace.
[Open a recent project workspace] radio button:	Uses an existing workspace and displays the history of the opened workspace.
[Browse to another project workspace] radio button:	Uses an existing workspace; this radio button is used when the history of the opened workspace does not remain

To use a workspace for the tutorial, select the [Browse to another project workspace] radio button and click the [OK] button.

When the [Open workspace] dialog box is opened, specify the following directory:
<Directory where the OS has been installed>\WorkSpace\Tutorial\E200\xxxx\Tutorial

Here, ‘xxxx’ means the name of the target MCU.

After the directory has been specified, select the following file and click the [Open] button.

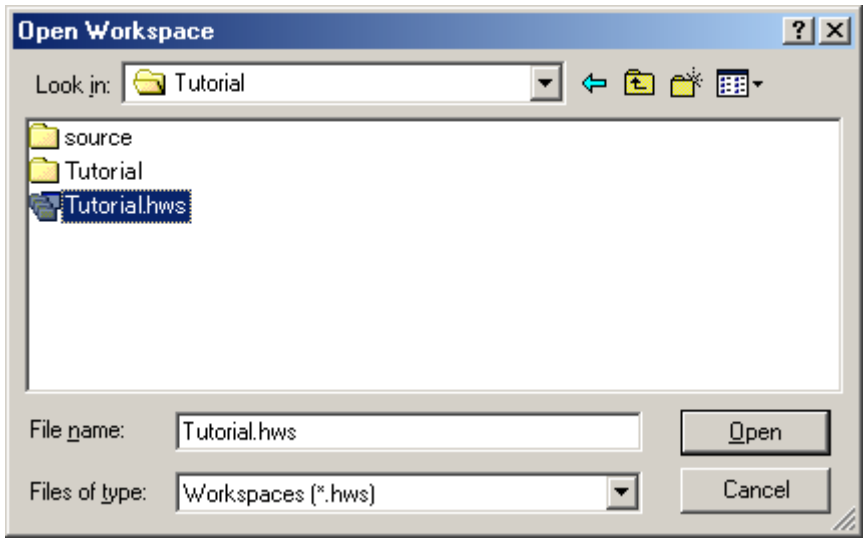


Figure 4.3 [Open Workspace] Dialog Box

8. The [CPU Select] dialog box is displayed.

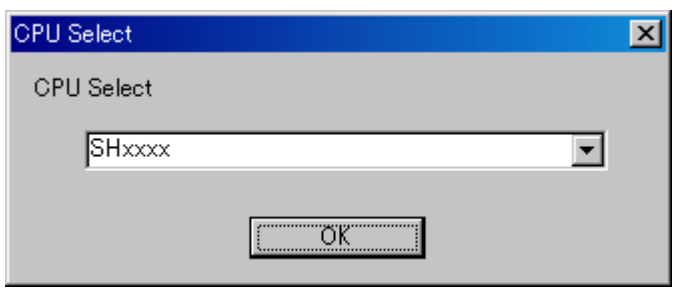


Figure 4.4 [CPU Select] Dialog Box

Select the CPU from the drop-down list and click the [OK] button.

9. The [Select Emulator mode] dialog box is displayed depending on the MCU used.

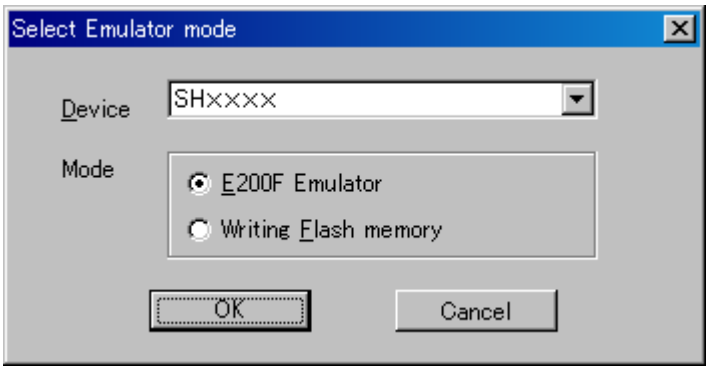


Figure 4.5 [Select Emulator mode] Dialog Box

Select the MCU name in use from the [Device] drop-down list box. The following items are selected in the [Mode] group box.

— E200F Emulator

The E200F emulator for the specified MCU is activated. Debugging the program is enabled.

— Writing Flash memory

The user program is programmed to the flash memory. Debugging the program is disabled. To download the load module, register it in the workspace.

10. The [Function select] dialog box is displayed.

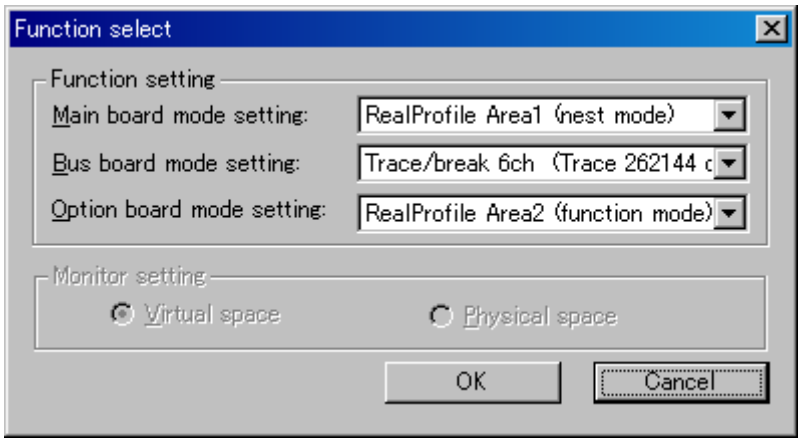


Figure 4.6 [Function select] Dialog Box

Select the emulator function to be used. For the items to be selected, refer to section 2.5, Changing the Settings.

11. The [Connecting] dialog box is displayed and the emulator connection is started.

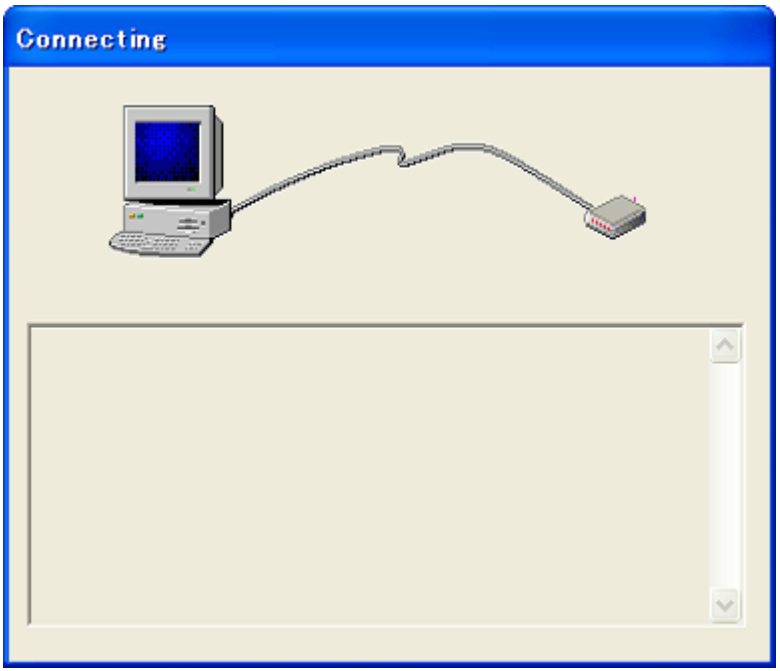


Figure 4.7 [Connecting] Dialog Box

The emulator supports the following two debugging modes:

— Debugging with a connection to the EV-chip unit which connects the emulator main unit and H-UDI port connector to the EV-chip unit

— Debugging without any connection to the EV-chip unit which directly connects the H-UDI port connector to the user system

The system check procedures shown below differ between those modes.

- Debugging without any connection to the EV-chip unit

(1) The dialog box is displayed as shown in figure 4.8.

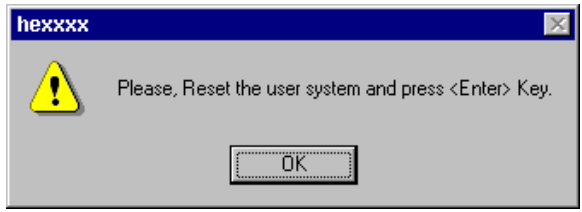


Figure 4.8 Dialog Box of the RESET Signal Input Request Message

(2) Input the reset signal from the user system, and click the [OK] button.
If no reset signal is detected, the following dialog box is displayed.

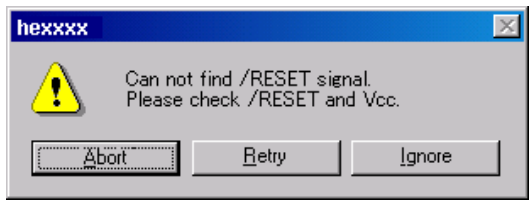


Figure 4.9 [Can not find /RESET signal] Dialog Box

When the [Ignore] button is clicked, the emulator issues a reset in the CPU for initiation. However, this method is unavailable for some products. For details, refer to section 3, Software Specifications when Using the SHxxxx, in the additional document, Supplementary Information on Using the SHxxxx.

(3) When "Connected" is displayed in the [Output] window of the High-performance Embedded Workshop, the emulator initiation is completed.

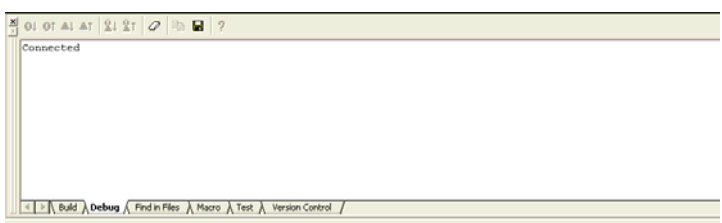


Figure 4.10 [Output] Window

- Debugging with a connection to the EV-chip unit

(1) The dialog box is displayed as shown in figure 4.11.

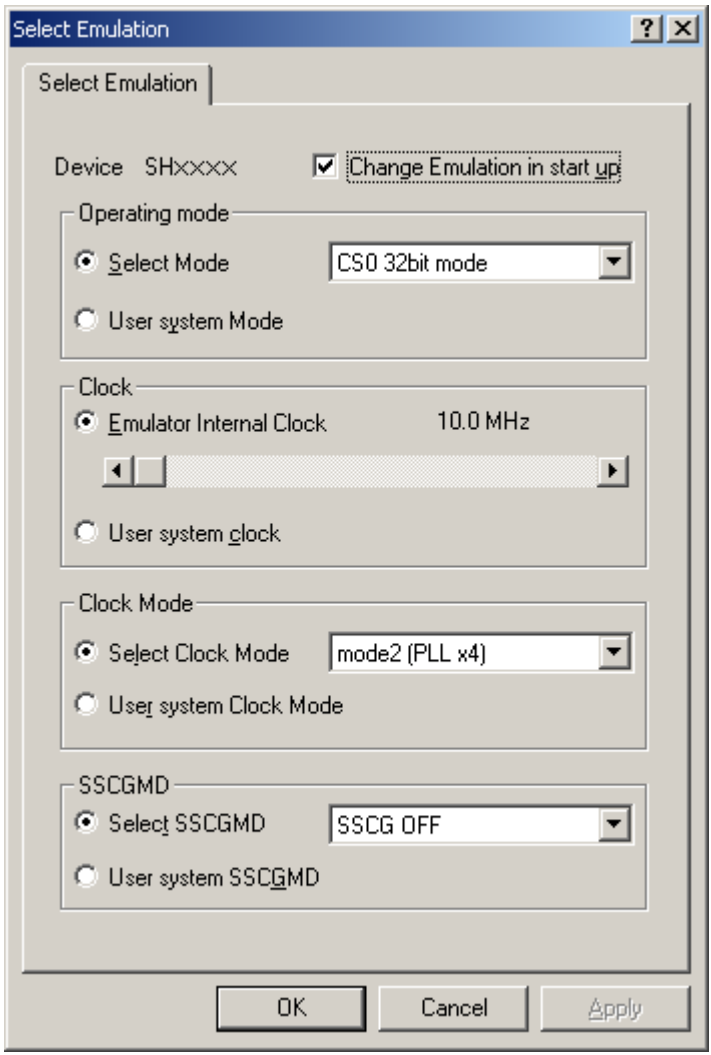


Figure 4.11 [Select Emulation] Dialog Box

Make the required settings for the EV-chip unit. Select the settings to be used and click the [OK] button.

Note: The items that can be set in this dialog box depend on the emulator in use. For details, refer to the online help.

(2) When "Connected" is displayed in the [Output] window of the High-performance Embedded Workshop, the emulator initiation is completed.

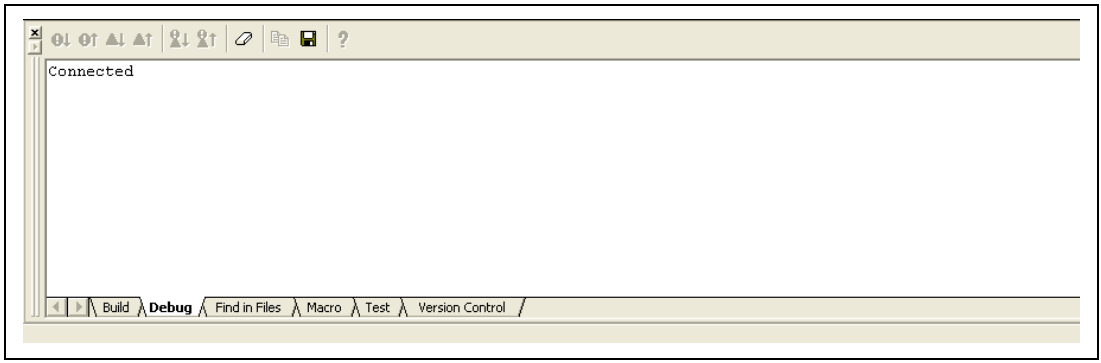


Figure 4.12 [Output] Window

Notes: 1. When using the MCU with flash memory, the dialog box shown in figure 4.13 is opened. Input the clock value.
The clock value is the frequency of the crystal oscillator connected to the target MCU or the external clock that has been input to that MCU.

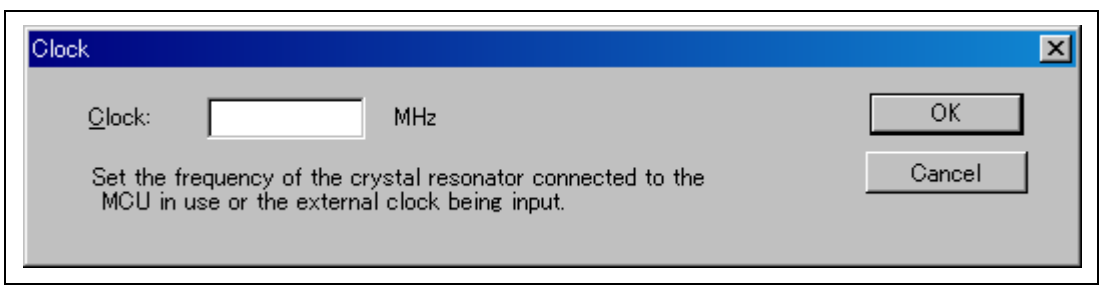


Figure 4.13 [Clock] Dialog Box

2. After the following dialog box is displayed, input the ID code as a security code for the flash memory. However, H'FFFFFFFF is disabled as the ID code.
   Input this ID code when [E200F Emulator] is selected and the [New ID code] check box is unselected on activating the emulator. If the ID code is not matched or the [New ID code] check box is selected, the flash memory contents are erased.

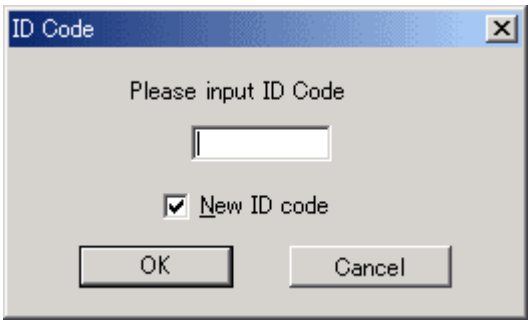


Figure 4.14 [ID Code] Dialog Box

Note: The ID code to be set in the [ID Code] dialog box and setting the ID code differ depending on the product. For details on the specification of each product, refer to the additional document, Supplementary Information on Using the SHxxxx, or the on-line help.

3. If the emulator is not initiated, the following dialog boxes shown in figures 4.15 through 4.18 will be displayed.

(a) If the following dialog box is displayed and method (2) of 'Debugging without any connection to the EV-chip unit' above is unavailable, the power of the user system may not be input or the RESET signal may not be input to the device. Check the input circuits for the power of the user system and the reset pin.

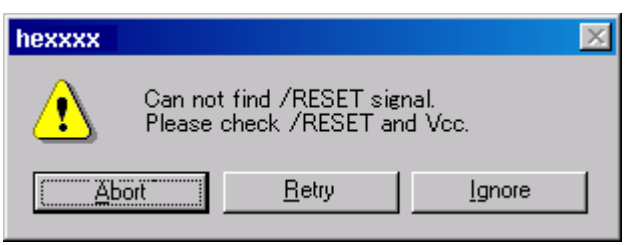


Figure 4.15 [Can not find /RESET signal] Dialog Box

(b) If the following dialog box is displayed, the user system may be turned off or the H-UDI port connector may not be correctly connected. Check that the user system is turned on and the H-UDI port connector is connected.

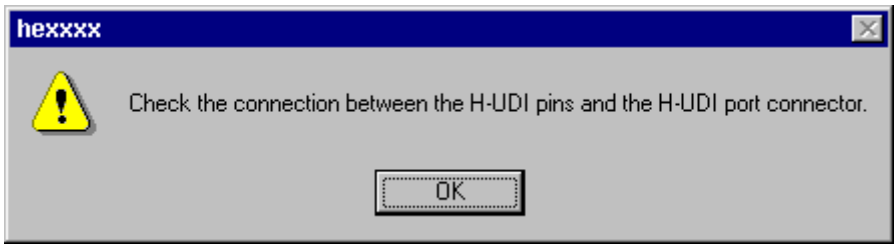


Figure 4.16 [Check the connection] Dialog Box

(c) If the following dialog box is displayed, the device may not correctly operate. Check if there are reasons for illegal device operation.

Figure 4.17 [COMMUNICATION TIMEOUT ERROR] Dialog Box

Figure 4.18 [Error JTAG boot] Dialog Box

4. If the emulator is not activated due to other reasons, a message box corresponding to the status is displayed. Use the message as a reference to check the wiring on the board.

4.2 Method for Activating High-performance Embedded Workshop

To activate the High-performance Embedded Workshop, follow the procedure listed below.

1. Connect the emulator to the host machine and the user system, then turn on the user system.
2. Select [High-performance Embedded Workshop] from [Renesas High-performance Embedded Workshop] of [Programs] in the [Start] menu.
3. The [Welcome!] dialog box is displayed.

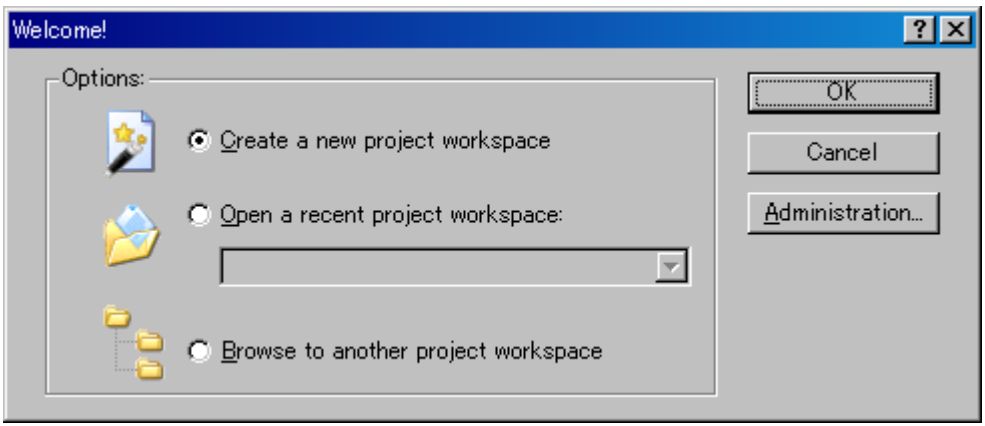


Figure 4.19 [Welcome!] Dialog Box

[Create a new project workspace] radio button:	Creates a new workspace.
[Open a recent project workspace] radio button:	Uses an existing workspace and displays the history of the opened workspace.
[Browse to another project workspace] radio button:	Uses an existing workspace; this radio button is used when the history of the opened workspace does not remain.

In this section, we describe the following three ways to start up the High-performance Embedded Workshop:

- [Create a new project workspace] - a toolchain is not in use
- [Create a new project workspace] - a toolchain is in use
- [Browse to another project workspace]

The method to create a new workspace depends on whether a toolchain is or is not in use. Note that this emulator product does not include a toolchain. Use of a toolchain is available in an environment where the H8S, H8/300 series C/C++ compiler package or the SuperH™ RISC engine C/C++ compiler package has been installed. For details on this, refer to the manual attached to the H8S, H8/300 series C/C++ compiler package or the SuperH™ RISC engine C/C++ compiler package.

4.2.1 Creating the New Workspace (Toolchain Not Used)

1. In the [Welcome!] dialog box that is displayed when the High-performance Embedded Workshop is activated, select [Create a new project workspace] radio button and click the [OK] button.

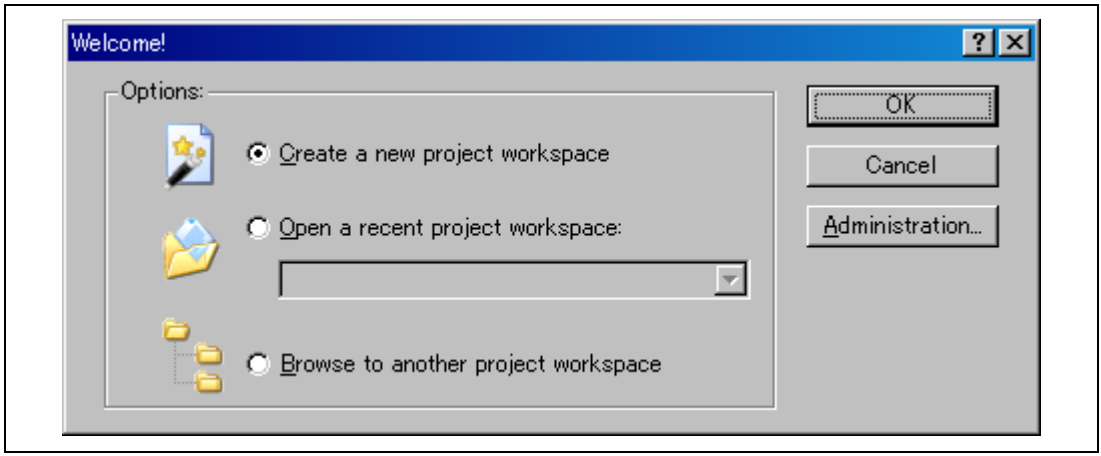


Figure 4.20 [Welcome!] Dialog Box

2. The Project Generator is started. In this section, we omit description of the settings for the toolchain.
   If you have not purchased the toolchain, the following dialog box is displayed.

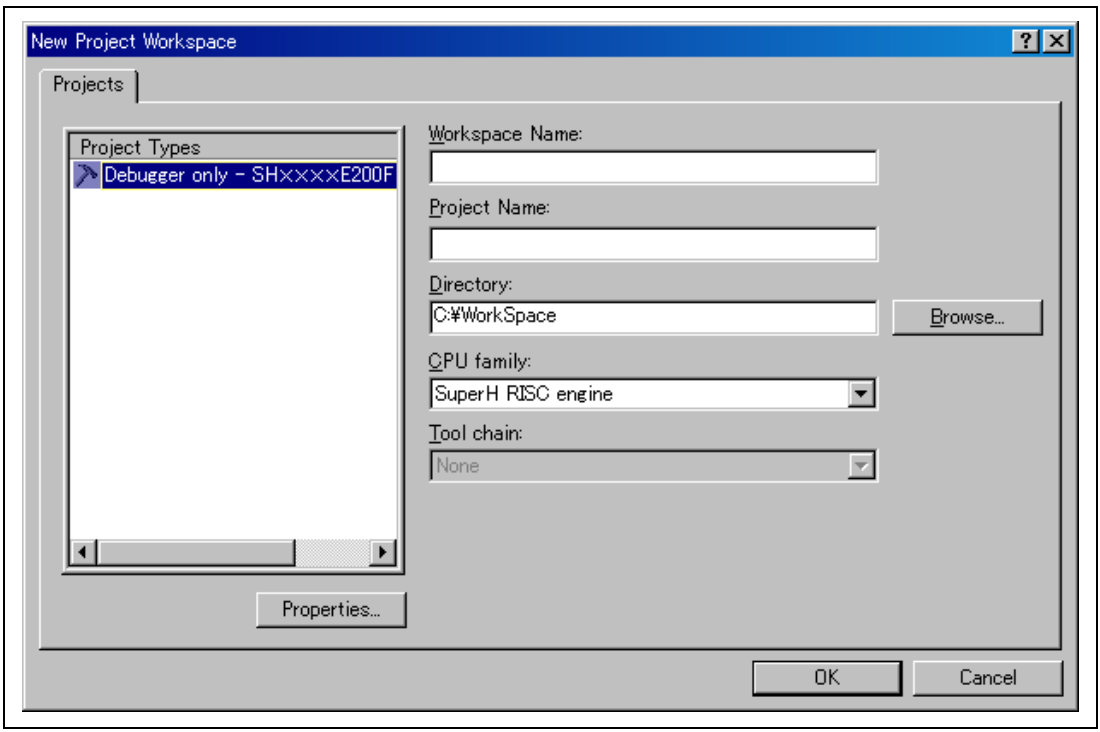


Figure 4.21 [New Project Workspace] Dialog Box

[Workspace Name] edit box:	Enter the new workspace name.
[Project Name] edit box:	Enter the project name. When the project name is the same as the workspace name, it needs not be entered.
[Directory] edit box:	Enter the directory name in which the workspace will be created. Click the [Browse…] button to select a directory.

Other list boxes are used for setting the toolchain; the fixed information is displayed when the toolchain has not been installed.

Click the [OK] button.

3. Select the target platform of the session file. The following dialog box is displayed.

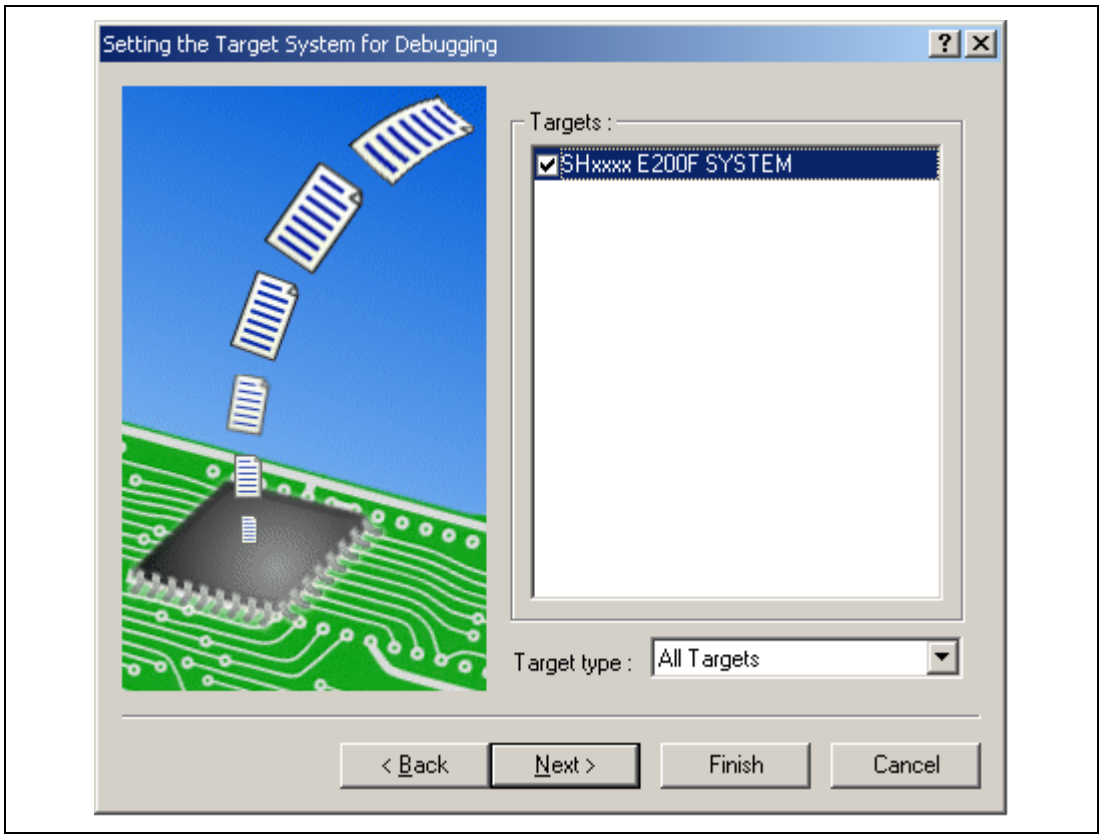


Figure 4.22 [Setting the Target System for Debugging] Dialog Box

The target for the session file used when the High-performance Embedded Workshop is activated must be selected here. Check the box against the target platform and then click the [Next] button.

4. Set the configuration file name. The configuration file saves the state of High-performance Embedded Workshop except for the emulator.

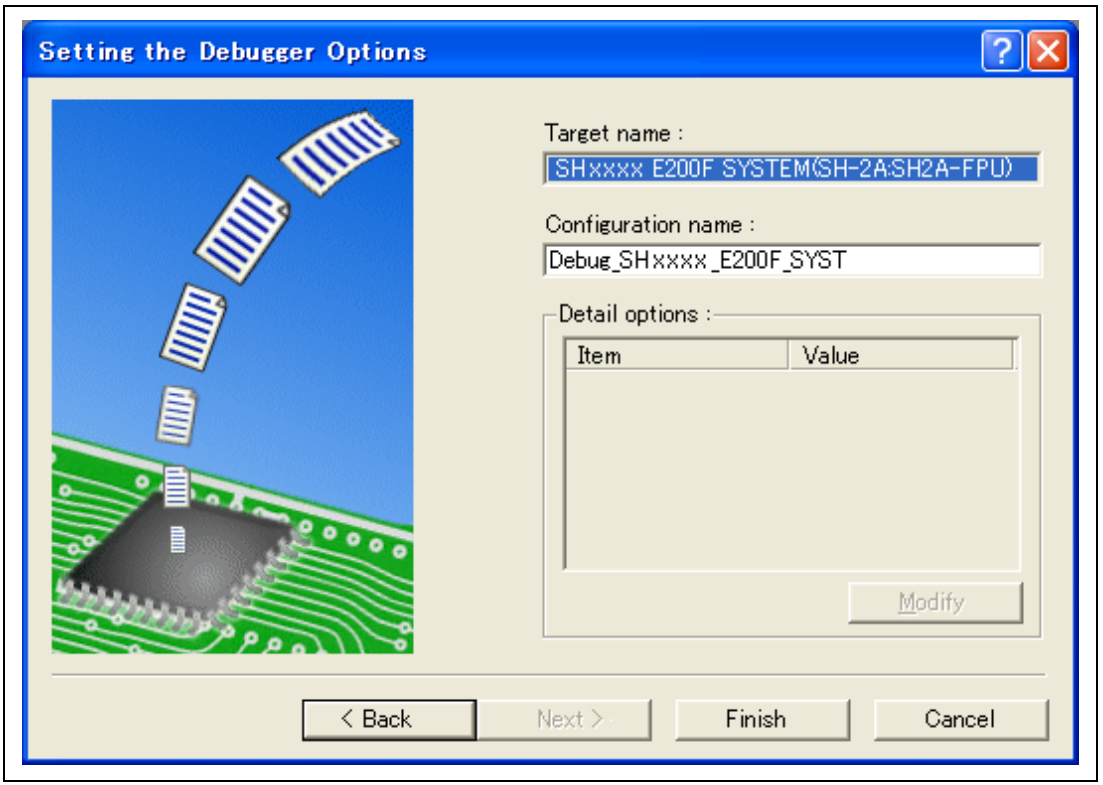


Figure 4.23 [Setting the Debugger Options] Dialog Box

If multiple target platforms were selected in the [Setting the Target System for Debugging] dialog box shown in figure 4.22, set the name of a configuration file for each of them, each time clicking the [Next] button to proceed to the next target.

Setting of the configuration file name is the end of the emulator settings.

Click the [Finish] button to display the [Summary] dialog box. Pressing the [OK] button activates the High-performance Embedded Workshop.

5. After the High-performance Embedded Workshop has been activated, the emulator is automatically connected. The message “Connected” is displayed on the [Debug] tab in the [Output] window to indicate the completion of connection.

4.2.2 Creating the New Workspace (Toolchain Used)

1. In the [Welcome!] dialog box that is displayed when the High-performance Embedded Workshop is activated, select [Create a new project workspace] radio button and click the [OK] button.

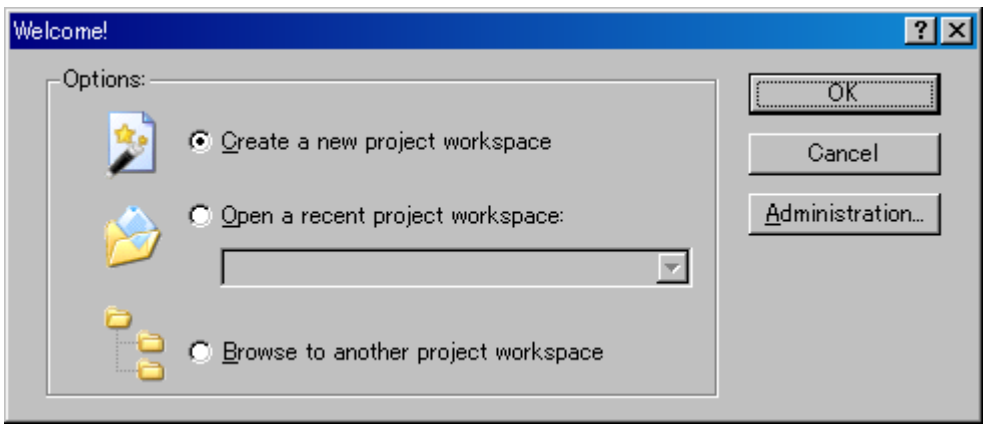


Figure 4.24 [Welcome!] Dialog Box

2. Creation of a new workspace is started. If you have purchased the toolchain, the following dialog box is displayed.

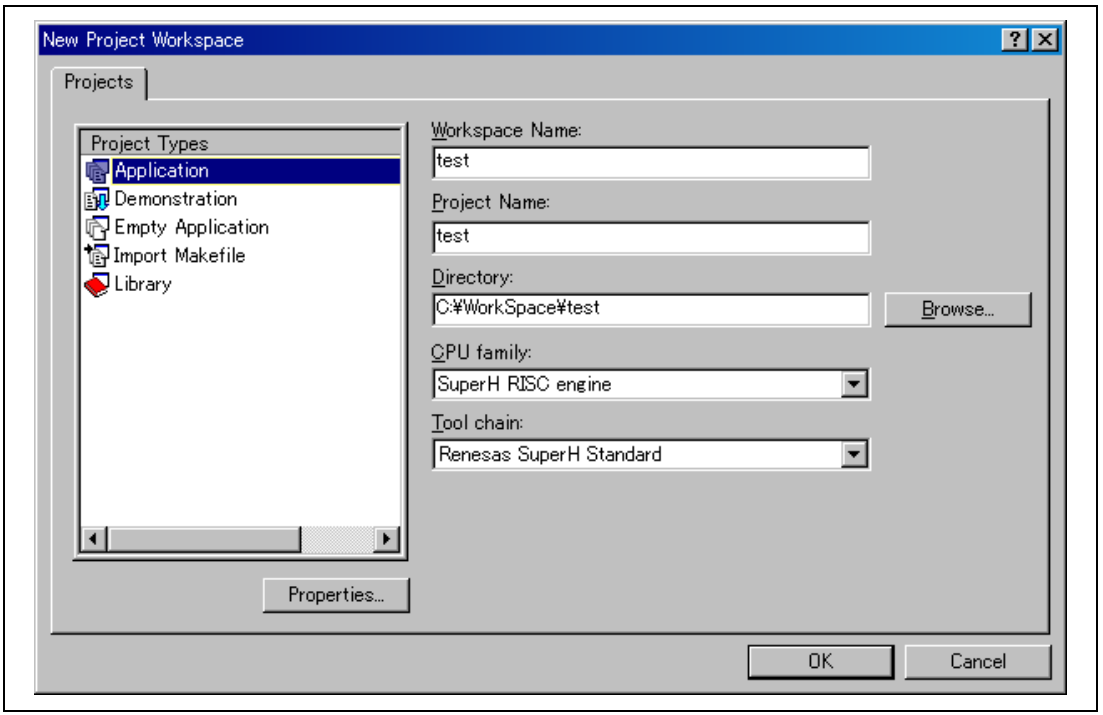


Figure 4.25 [New Project Workspace] Dialog Box

[Workspace Name] edit box:	Enter the new workspace name.
[Project Name] edit box:	Enter the project name. When the project name is the same as the workspace name, it needs not be entered.
[Directory] edit box:	Enter the directory name in which the workspace will be created. Click the [Browse…] button to select a directory.
[CPU family] drop-down list box:	Select the target CPU family.
[Tool chain] drop-down list box:	Select the target toolchain name when using the toolchain. Otherwise, select [None].
[Project type] list box:	Select the project type to be used.

Note: When [Demonstration] is selected in the emulator, note the following:
The [Demonstration] is a program for the simulator. When using a program to be generated, delete the Printf statement.

3. Make the required setting for the toolchain. When the setting has been completed, the following dialog box is displayed.

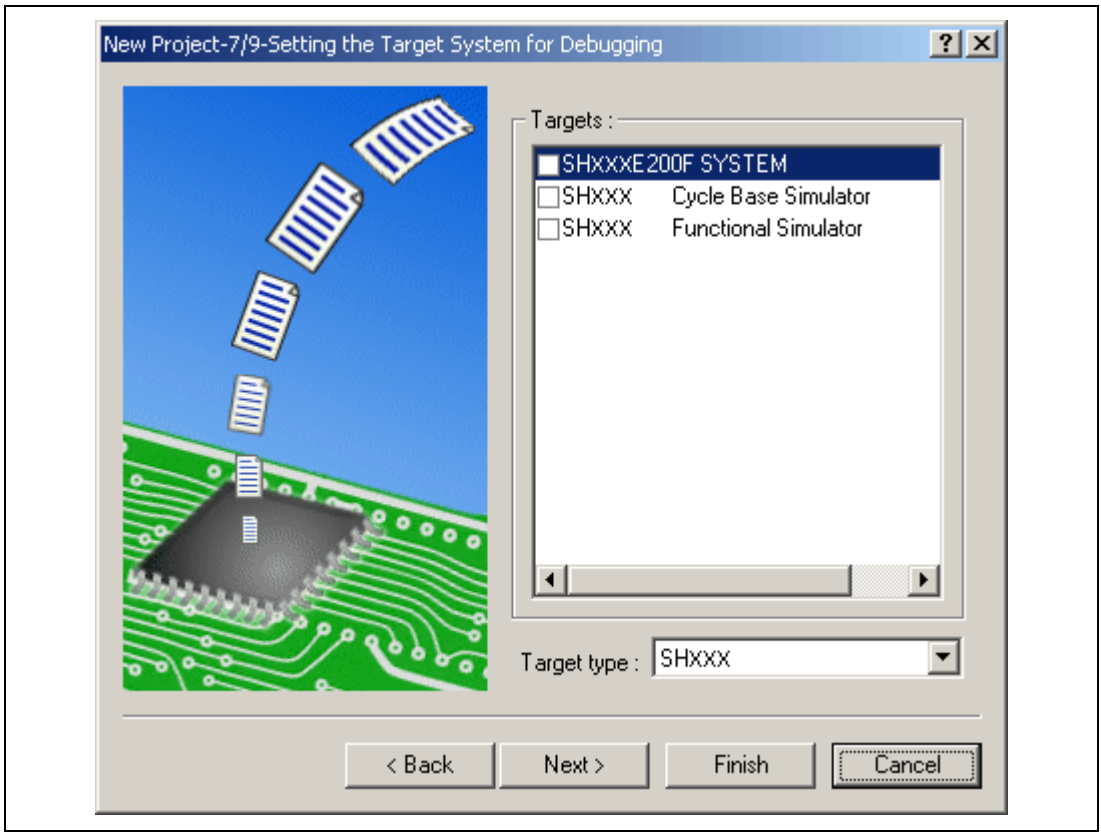


Figure 4.26 [New Project –7/9– Setting the Target System for Debugging] Dialog Box

The target platform for the session file used when the High-performance Embedded Workshop is activated must be selected here. Check the box against the target platform and then click the [Next] button.

4. Set the configuration file name. The configuration saves the state of High-performance Embedded Workshop except for the emulator.

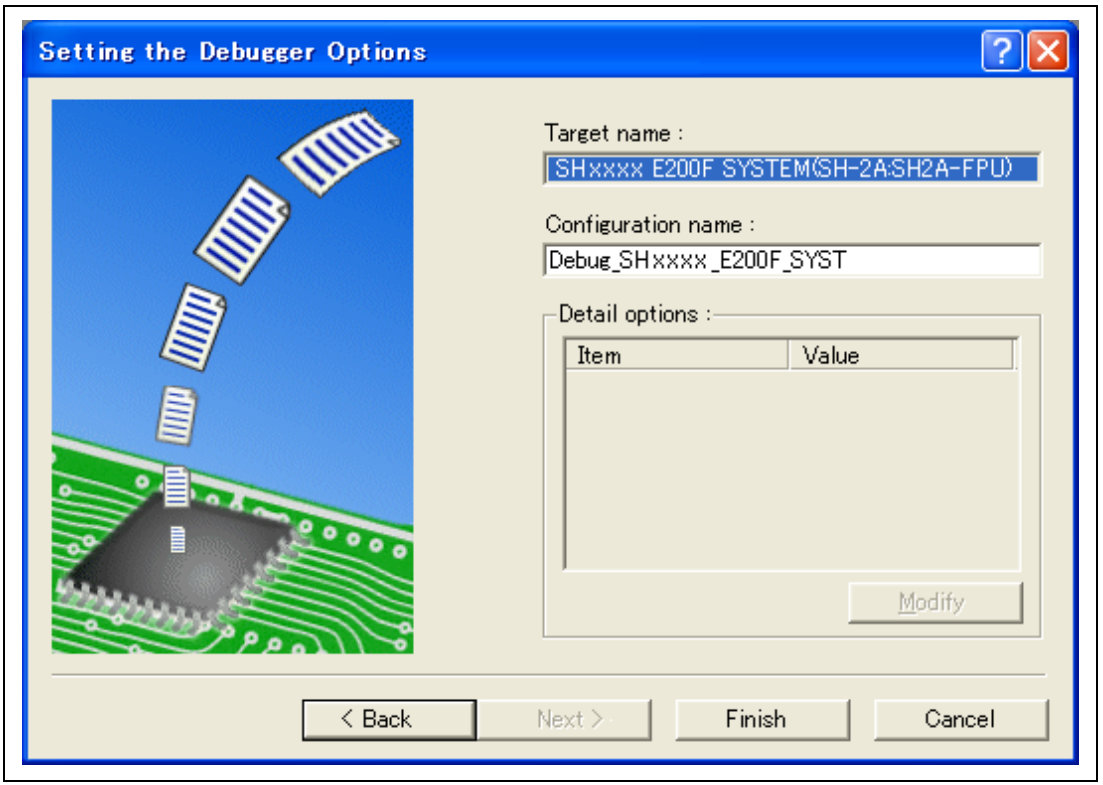


Figure 4.27 [New Project –8/9– Setting the Debugger Options] Dialog Box

This is the end of the emulator setting.

Exit the Project Generator according to the instructions on the screen. The High-performance Embedded Workshop is activated.

5. After the High-performance Embedded Workshop has been activated, connect the emulator. However, it is not needed to connect the emulator immediately after the High-performance Embedded Workshop has been activated.
   To connect the emulator, use one of the methods (a) and (b) below. For operation during connection, refer to section 4.1, System Check.

   (a) Connecting the emulator after the setting at emulator activation

   Select [Debug settings] from the [Options] menu to open the [Debug Settings] dialog box. It is possible to register the download module or the command chain that is automatically executed at activation. For details on the [Debug Settings] dialog box, refer to section 4.3, Setting at Emulator Activation.

   After the [Debug Settings] dialog box has been set, when the dialog box is closed, the emulator is connected.

   (b) Connecting the emulator without the setting at emulator activation

   The emulator can be easily connected by switching the session file that the setting for the emulator use has been registered.

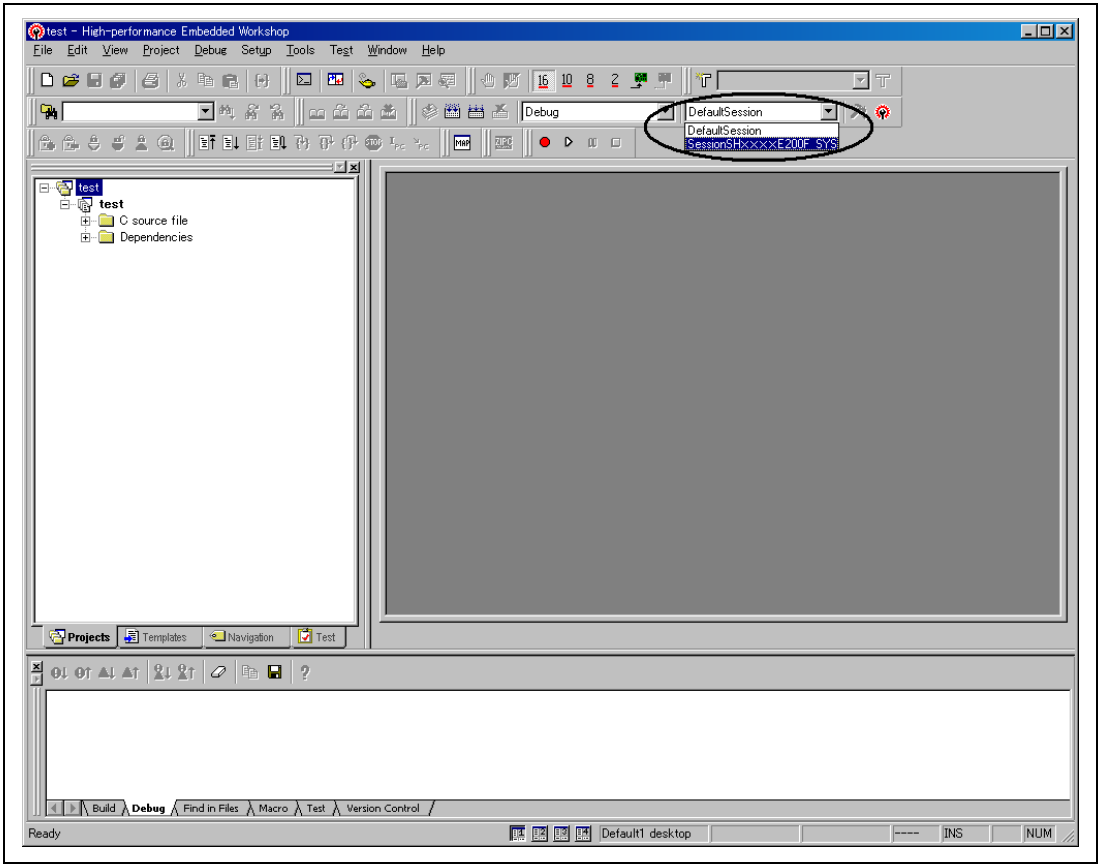


Figure 4.28 Selecting the Session File

In the list box that is circled in figure 4.28, select the session file name including the character string that has been set in the [Target name] text box in figure 4.27, [New Project –8/9– Setting the Debugger Options] dialog box. The setting for using the emulator has been registered in this session file.

After selected, the emulator is automatically connected.

4.2.3 Selecting an Existing Workspace

1. In the [Welcome!] dialog box that is displayed when the High-performance Embedded Workshop is activated, select [Browse to another project workspace] radio button and click the [OK] button.

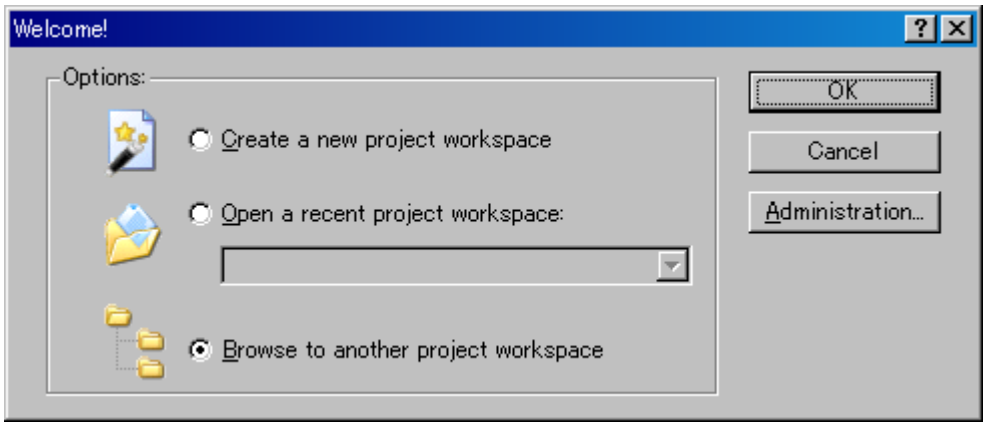


Figure 4.29 [Welcome!] Dialog Box

2. The [Open Workspace] dialog box is displayed. Select a directory in which you have created a workspace.
   After that, select the workspace file (.hws) and press the [Open] button.

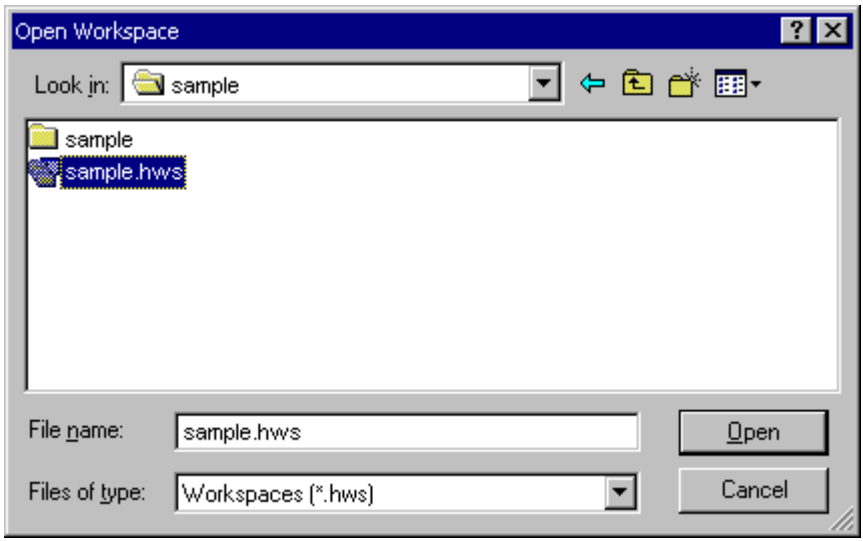


Figure 4.30 [Open Workspace] Dialog Box

3. This activates the High-performance Embedded Workshop and recovers the state of the selected workspace at the time it was saved.
   When the saved state information of the selected workspace includes connection to the emulator, the emulator will automatically be connected. To connect the emulator when the saved state information does not include connection to the emulator, refer to section 4.5, Connecting the Emulator.

4.3 Setting at Emulator Activation

When the emulator is activated, the command chain can be automatically executed. It is also possible to register multiple load modules to be downloaded. The registered load modules are displayed on the workspace window.

1. Select [Debug settings] from the [Options] menu to open the [Debug Settings] dialog box.

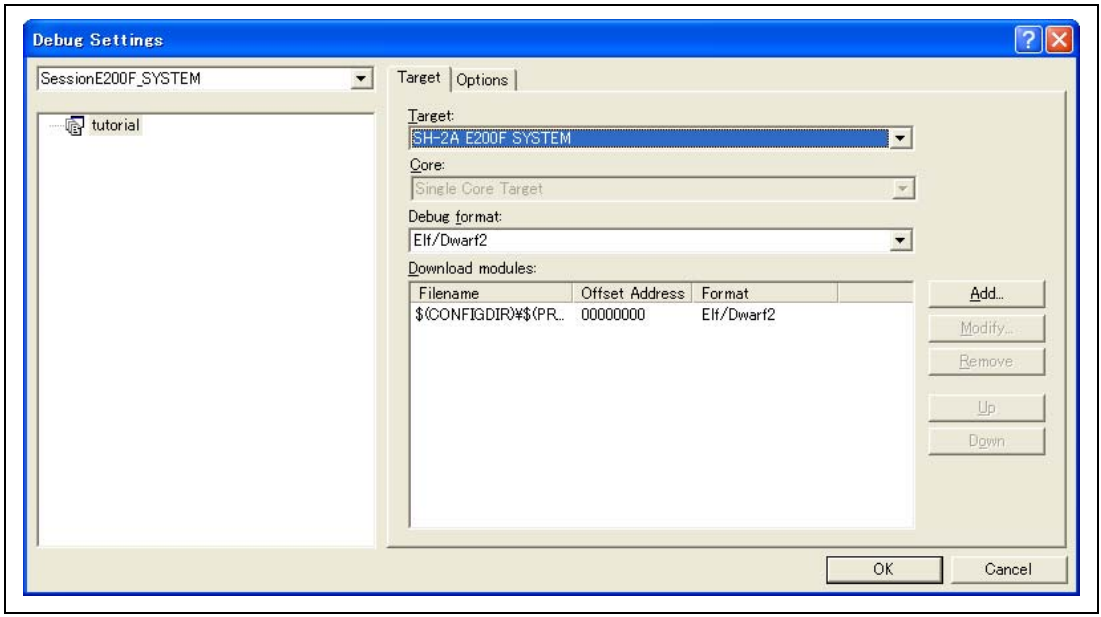


Figure 4.31 [Debug Settings] Dialog Box ([Target] Page)

2. Select the product name to be connected in the [Target] drop-down list box.
3. Select the format of the load module to be downloaded in the [Default Debug Format] drop-down list box, then register the corresponding download module in the [Download Modules] list box.

   Note: Here, no program has been downloaded. For downloading, refer to section 5.2, Downloading a Program.
4. Click the [Options] tab.

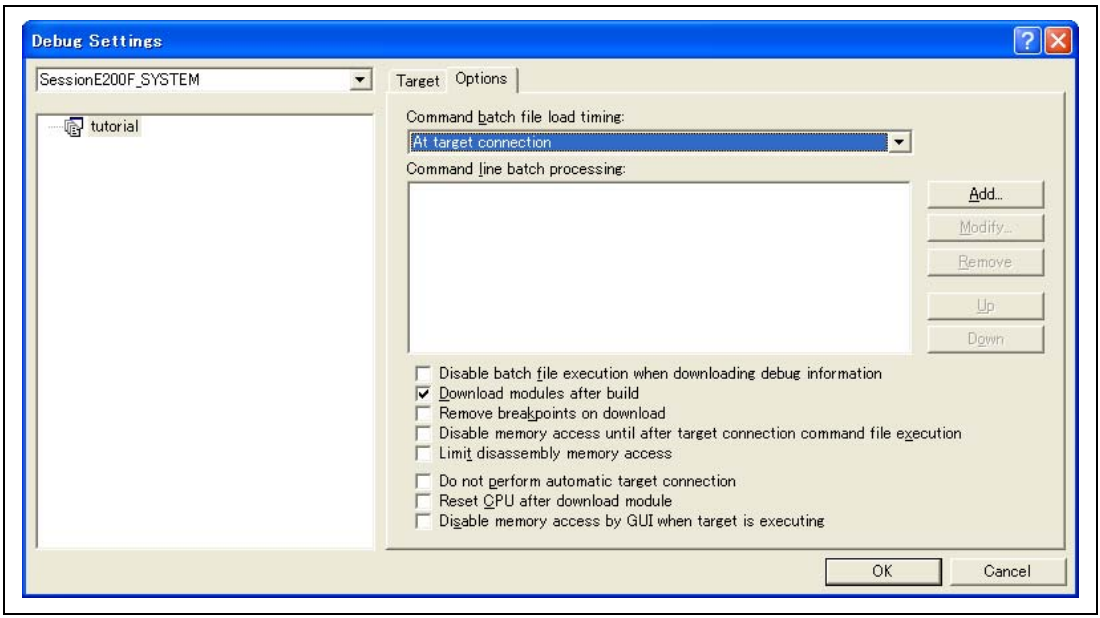


Figure 4.32 [Debug Settings] Dialog Box ([Options] Page)

The command chain that is automatically executed at the specified timing is registered. The following three timings can be specified:

- At connecting the emulator
- Immediately before downloading
- Immediately after downloading

Specify the timing for executing the command chain in the [Command batch file load timing] drop-down list box. In addition, register the command-chain file that is executed at the specified timing in the [Command Line Batch Processing] list box.

4.4 Debug Sessions

The High-performance Embedded Workshop stores all of your builder options into a configuration. In a similar way, the High-performance Embedded Workshop stores your debugger options in a session. The debugging platforms, the programs to be downloaded, and each debugging platform's options can be stored in a session.

Sessions are not directly related to a configuration. This means that multiple sessions can share the same download module and avoid unnecessary program rebuilds.

Each session's data should be stored in a separate file in the High-performance Embedded Workshop project. Debug sessions are described in detail below.

4.4.1 Selecting a Session

The current session can be selected in the following two ways:

- From the toolbar
  Select a session from the drop-down list box (figure 4.33) in the toolbar.

Figure 4.33 Toolbar Selection

- From the dialog box
  1. Select [Debug -> Debug Sessions…]. This will open the [Debug Sessions] dialog box (figure 4.34).

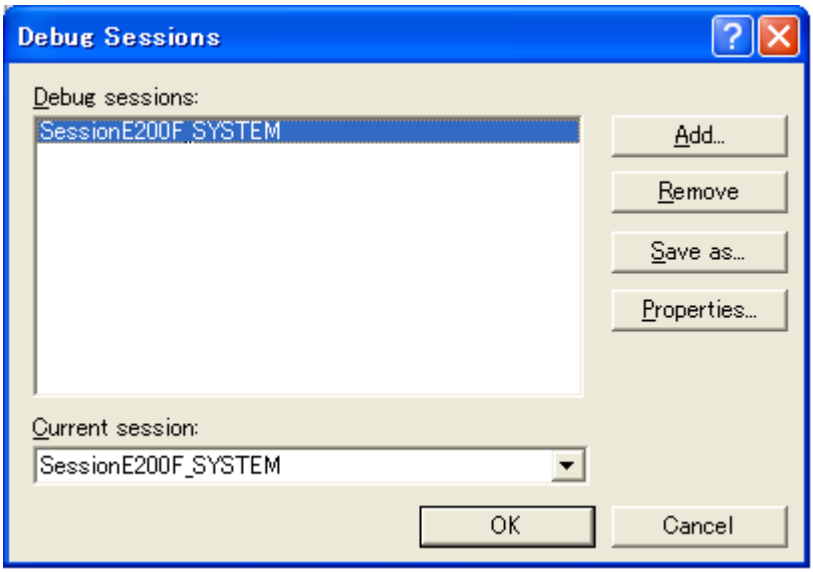


Figure 4.34 [Debug Sessions] Dialog Box

  2. Select the session you want to use from the [Current session] drop-down list.
  3. Click the [OK] button to set the session.

4.4.2 Adding and Removing Sessions

A new session can be added by copying settings from another session or removing a session.

- To add a new empty session
  1. Select [Debug -> Debug Sessions…] to display the [Debug Sessions] dialog box (figure 4.34).
  2. Click the [Add…] button to display the [Add new session] dialog box (figure 4.35).
  3. Check the [Add new session] radio button.
  4. Enter a name for the session.
  5. Click the [OK] button to close the [Debug Sessions] dialog box.
  6. This creates a file with the name entered in step 4. If a file with this name already exists, an error is displayed.

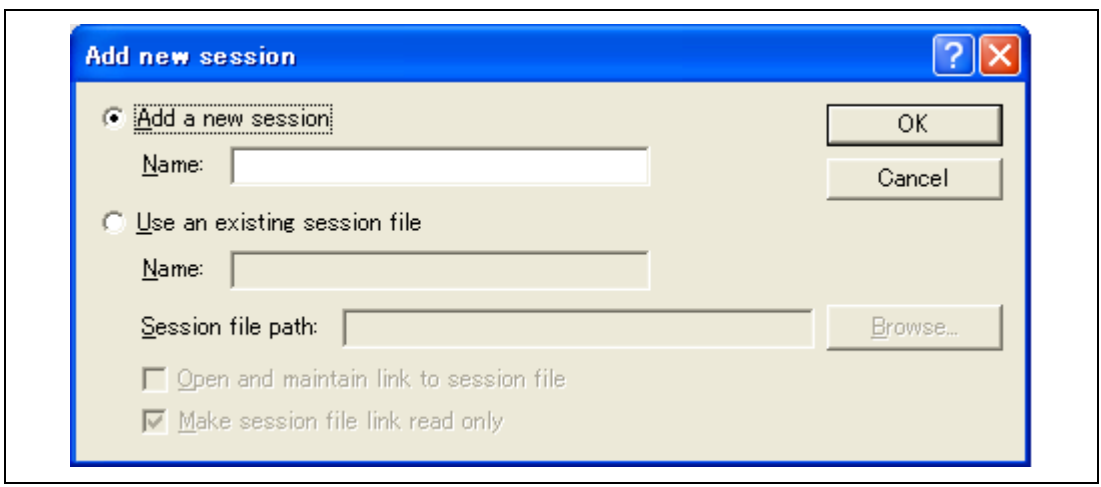


Figure 4.35 [Add new session] Dialog Box

- To import an existing session into a new session file
  1. Select [Options -> Debug Sessions…] to display the [Debug Sessions] dialog box (figure 4.34).
  2. Click the [Add…] button to display the [Add new session] dialog box (figure 4.35).
  3. Check the [Use an existing session file] radio button.
  4. Enter a name for the session.
  5. Enter the name of an existing session file that you would like to import into the existing project or click the [Browse] button to select the file location.

     If the [Open and maintain link to session file] check box is not checked, the imported new session file is generated in the project directory.

     If the [Open and maintain link to session file] check box is checked, a new session file is not generated in the project directory but is linked to the current session file.

     If the [Make session file link read only] check box is checked, the linked session file is used as read-only.
  6. Click the [OK] button to close the [Debug Sessions] dialog box.

- To remove a session
  1. Select [Options -> Debug Sessions…] to display the [Debug Sessions] dialog box (figure 4.34).
  2. Select the session you would like to remove.
  3. Click the [Remove] button.

     Note that the current session cannot be removed.
  4. Click the [OK] button to close the [Debug Sessions] dialog box.

- To view the session properties
  1. Select [Options -> Debug Sessions…] to display the [Debug Sessions] dialog box (figure 4.34).
  2. Select the session you would like to view the properties for.
  3. Click the [Properties] button to display the [Session Properties] dialog box (figure 4.36).

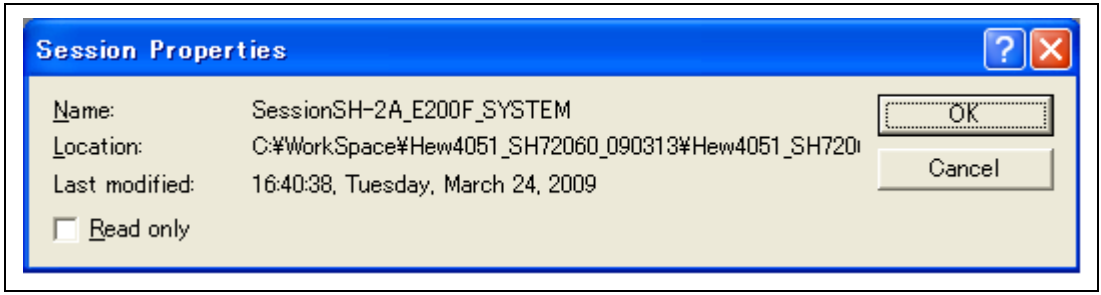


Figure 4.36 [Session Properties] Dialog Box

- To make a session read-only
  1. Select [Options -> Debug Sessions…] to display the [Debug Sessions] dialog box (figure 4.34).
  2. Select the session you would like to make read-only.
  3. Click the [Properties] button to display the [Session Properties] dialog box (figure 4.36).
  4. Check the [Read only] check box to make the link read-only. This is useful if you are sharing debugger-setting files and you do not want data to be modified accidentally.
  5. Click the [OK] button.

- To save a session with a different name
  1. Select [Options -> Debug Sessions…] to display the [Debug Sessions] dialog box (figure 4.34).
  2. Select the session you would like to save.
  3. Click the [Save as…] button to display the [Save Session] dialog box (figure 4.37).
  4. Browse to the new file location.
  5. If you want to export the session file to another location, leave the [Maintain link] check box unchecked. If you would like the High-performance Embedded Workshop to use this location instead of the current session location, check the [Maintain link] check box.
  6. Click the [Save] button.

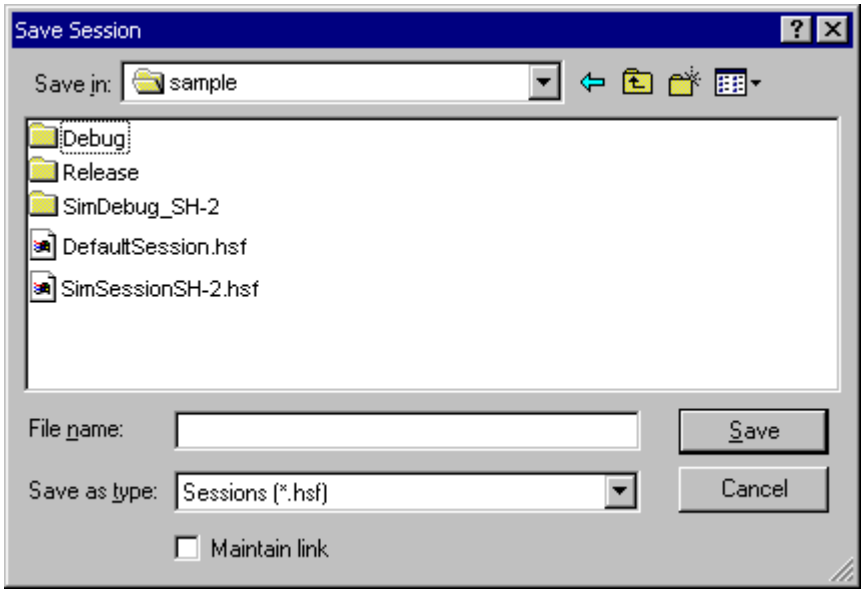


Figure 4.37 [Save Session] Dialog Box

4.4.3 Saving Session Information

- To save a session
  Select [File -> Save Session].

4.5 Connecting the Emulator

Select either of the following two ways to connect the emulator:

(a) Connecting the emulator after the setting at emulator activation

Select [Debug settings] from the [Options] menu to open the [Debug Settings] dialog box. It is possible to register the download module or the command chain that is automatically executed at activation. For details on the [Debug Settings] dialog box, refer to section 4.3, Setting at Emulator Activation.

When the dialog box is closed after setting the [Debug Settings] dialog box, the emulator will automatically be connected.

(b) Connecting the emulator without the setting at emulator activation

Connect the emulator by simply switching the session file to one in which the setting for the emulator use has been registered.

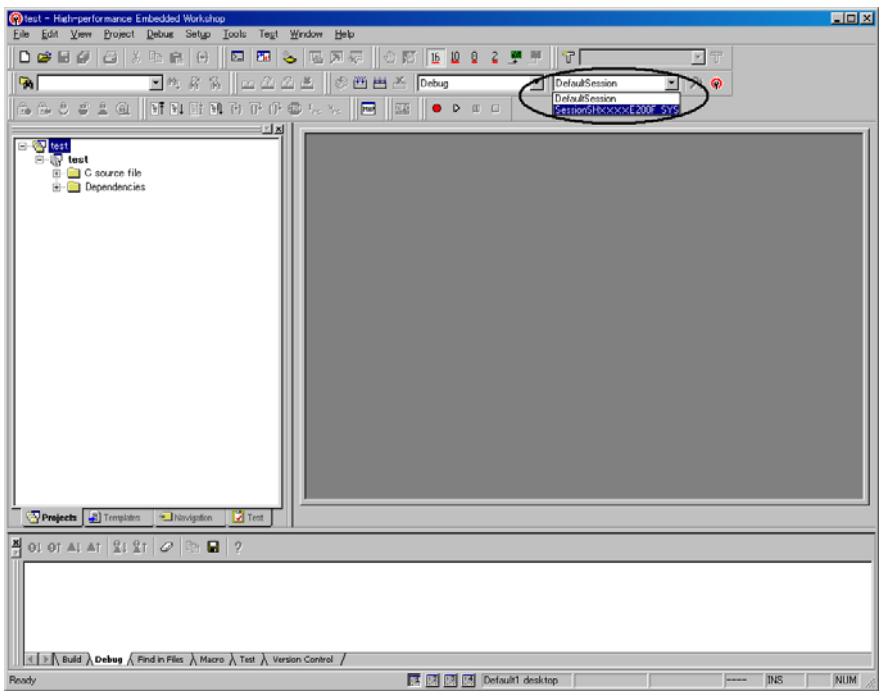


Figure 4.38 Selecting the Session File

In the list box that is circled in figure 4.38, select the session file name including the character string that has been set in the [Target name] text box in figure 4.27, [New Project –8/9– Setting the Debugger Options] dialog box. The setting for using the emulator has been registered in this session file.

After the session file name is selected, the emulator will automatically be connected. For details on the session file, refer to section 4.4, Debug Sessions.

4.6 Reconnecting the Emulator

When the emulator is disconnected, use the following way for reconnection:

Select [Build -> Debug -> Connect] or click the [Connect] toolbar button (). The emulator is connected.

Note: The emulator must be selected in the [Target] drop-down list box of the [Debug Settings] dialog box (see figure 4.32, [Debug Settings] Dialog Box ([Target] Page)) that is opened by selecting [Debug settings] from the [Options] menu.

4.7 Ending the Emulator

When using the toolchain, the emulator can be exited by using the following two methods:

- Canceling the connection of the emulator being activated
- Exiting the High-performance Embedded Workshop

(1) Canceling the connection of the emulator being activated

Select [Disconnect] from the [Debug] menu or click the [Disconnect] toolbar button ().

(2) Exiting the High-performance Embedded Workshop

Select [Exit] from the [File] menu.

A message box is displayed. If necessary, click the [Yes] button to save a session. After saving a session, the High-performance Embedded Workshop exits. If not necessary, click the [No] button to exit the High-performance Embedded Workshop.

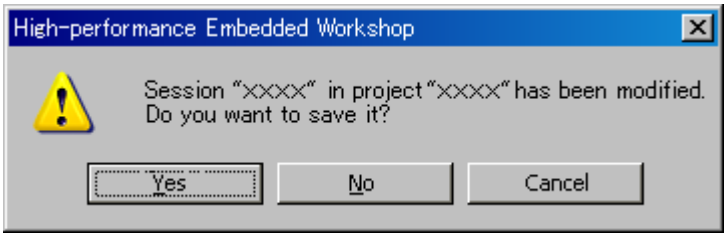


Figure 4.39 Message Box

Section 5 Debugging

This section describes the debugging operations and their related windows and dialog boxes.

5.1 Setting the Environment for Emulation

The method for setting the environment for emulation is described here. This environment must be set correctly before debugging is started.

5.1.1 Opening the [Configuration] Dialog Box

Selecting [Setup -> Emulator -> System…] or clicking the [Emulator System] toolbar button () opens the [Configuration] dialog box.

5.1.2 [General] Page

Sets the emulator operation conditions.

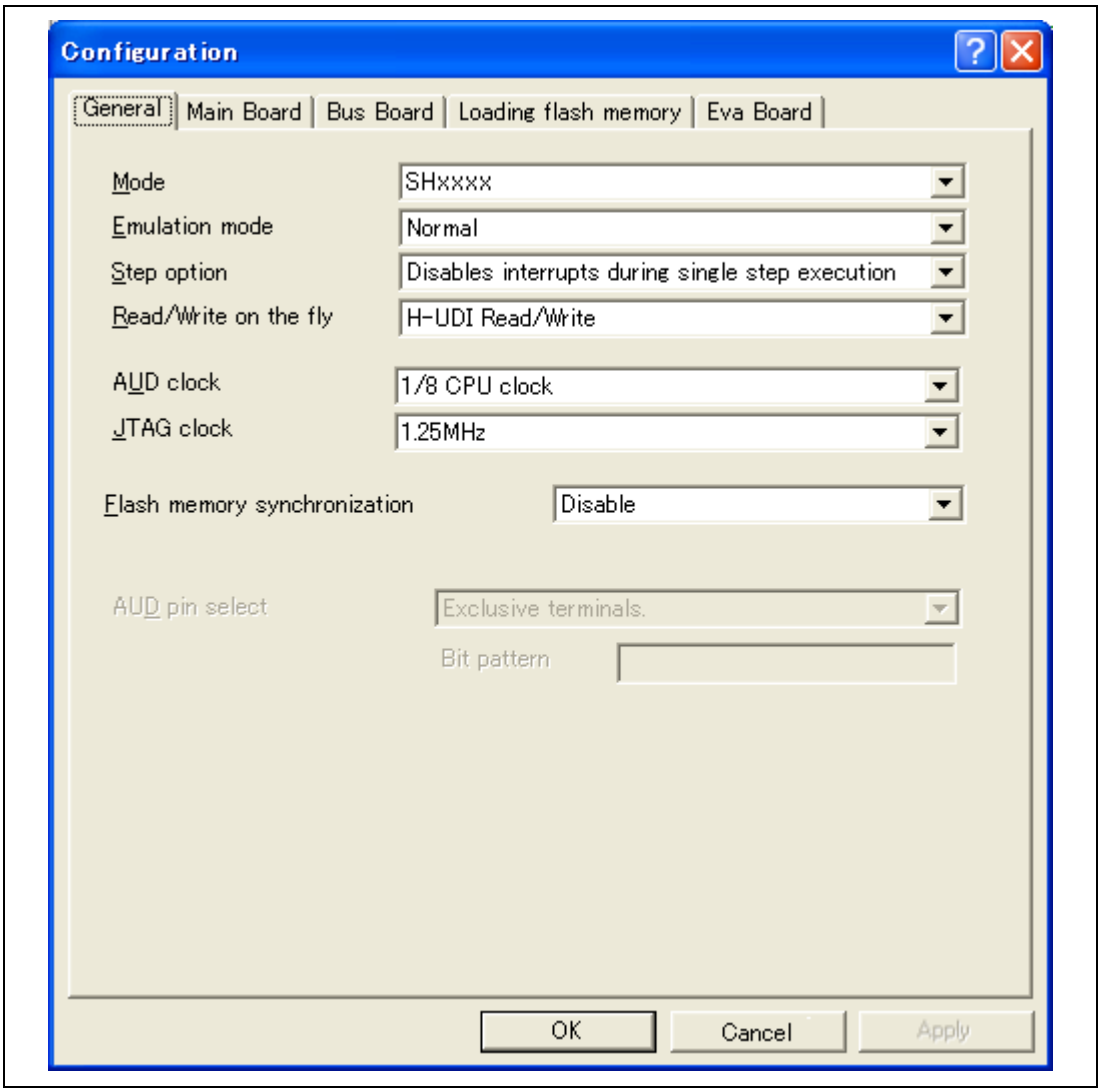


Figure 5.1 [Configuration] Dialog Box ([General] Page)

Items that can be displayed in this page are listed below.

[Mode]	Displays the MCU name.
[Emulation mode]	Selects the emulation mode when user program is executed.
[Step option]	Sets the step interrupt option. [Disable interrupts during single step execution]: Disables interrupts*1 during step execution. [Enable interrupts during single step execution]: Enables interrupts*1 during step execution.
[Read/Write on the fly]	Enables or disables reading from or writing to memory during emulation. [Disable]: Disables reading from and writing to memory during emulation. [H-UDI Read/Write]: Uses the H-UDI to read from or write to memory during emulation. Realtime emulation is slightly affected. [Short Break Read/Write]: A break occurs whenever data are read from or written to memory. Realtime emulation is affected.
[AUD clock]	A clock used in acquiring AUD traces. If its frequency is set too low, complete data may not be acquired during realtime tracing. Set the frequency not to exceed the upper limit for the MCU's AUD clock. The AUD clock is only needed for using emulators that have an AUD trace function. For the upper limit for the AUD clock, refer to section 3.2.3, Notes on Using the JTAG (H-UDI) Clock (TCK) and AUD Clock (AUDCK), in the additional document, Supplementary Information on Using the SHxxxx.
[AUD pin Select]	Sets the pin that is shared with the AUD pin.
[JTAG clock]	A communication clock used except for acquiring AUD trace. If its frequency is set too low, the speed of downloading will be lowered. Set the frequency not to exceed the upper limit for the MCU's guaranteed TCK range. For the upper limit for TCK, refer to section 3.2.3, Notes on Using the JTAG (H-UDI) Clock (TCK) and AUD Clock (AUDCK), in the additional document, Supplementary Information on Using the SHxxxx.

Notes: 1. Includes interrupts in a break.
2. The items that can be set in this dialog box depend on the emulator in use. For details, refer to the online help.

5.1.3 [Main Board] Page

Sets the main unit case operation conditions.

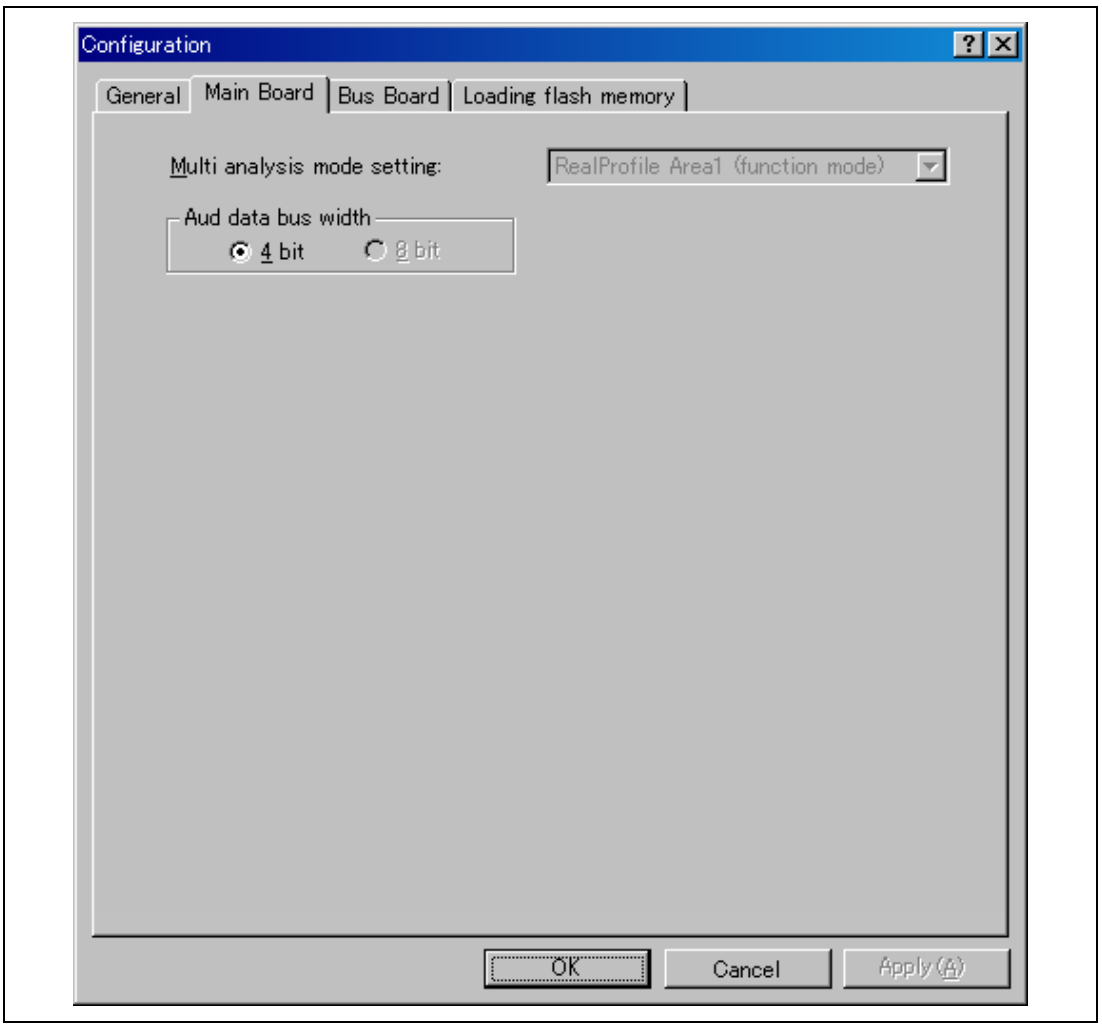


Figure 5.2 [Configuration] Dialog Box ([Main Board] Page)

Items that can be displayed in this page are listed below.

[Multi analysis mode setting]	Displays the emulator functions. Settings cannot be changed; if they are to be changed, the emulator must be activated again. [RealProfile Area 1 (function mode)]: The realtime profiling function (measurement mode: function mode) has been selected. [RealProfile Area 1 (nest mode)]: The realtime profiling function (measurement mode: nest mode) has been selected. [Coverage (4M)]: The coverage function is selected.
[AUD data bus width]	Sets the AUD data bus width.[*1] The bus width can be selected as 4 bits or 8 bits.

Notes: 1. In some products, the bus width will be fixed. For the specifications of each product, refer to the online help.

2. The items that can be set in this dialog box depend on the emulator in use. For details, refer to the online help.

5.1.4 [EVA Board] Page

Sets the EV-chip unit operation conditions.

Note: When the EV-chip unit is not connected to the emulator, this page is not displayed.

Items that can be displayed in this page are listed below.

[Change Emulation in start up]	Displays the [Select Emulation] dialog box when the emulator is activated by connecting the EV-chip unit.
[User Signals]	Enables the reset, NMI, wait, and bus request signals output from the user system.
[Multiplexed pins setting...]	Sets the pins that have been set by the pin function controller (PFC). The following functions can be implemented by correctly setting the pins corresponding to the signals: • Monitoring function • Memory map function • External bus trace function performed by detecting the external bus event • External bus break function performed by detecting the external bus event Select the pin that is set by the PFC.

Note: The items that can be set in this dialog box depend on the emulator in use. For details, refer to the online help.

5.1.5 [Bus Board] Page

Sets the external bus trace unit operation conditions.

Note: When the external bus trace unit is not connected to the emulator, this page is not displayed.

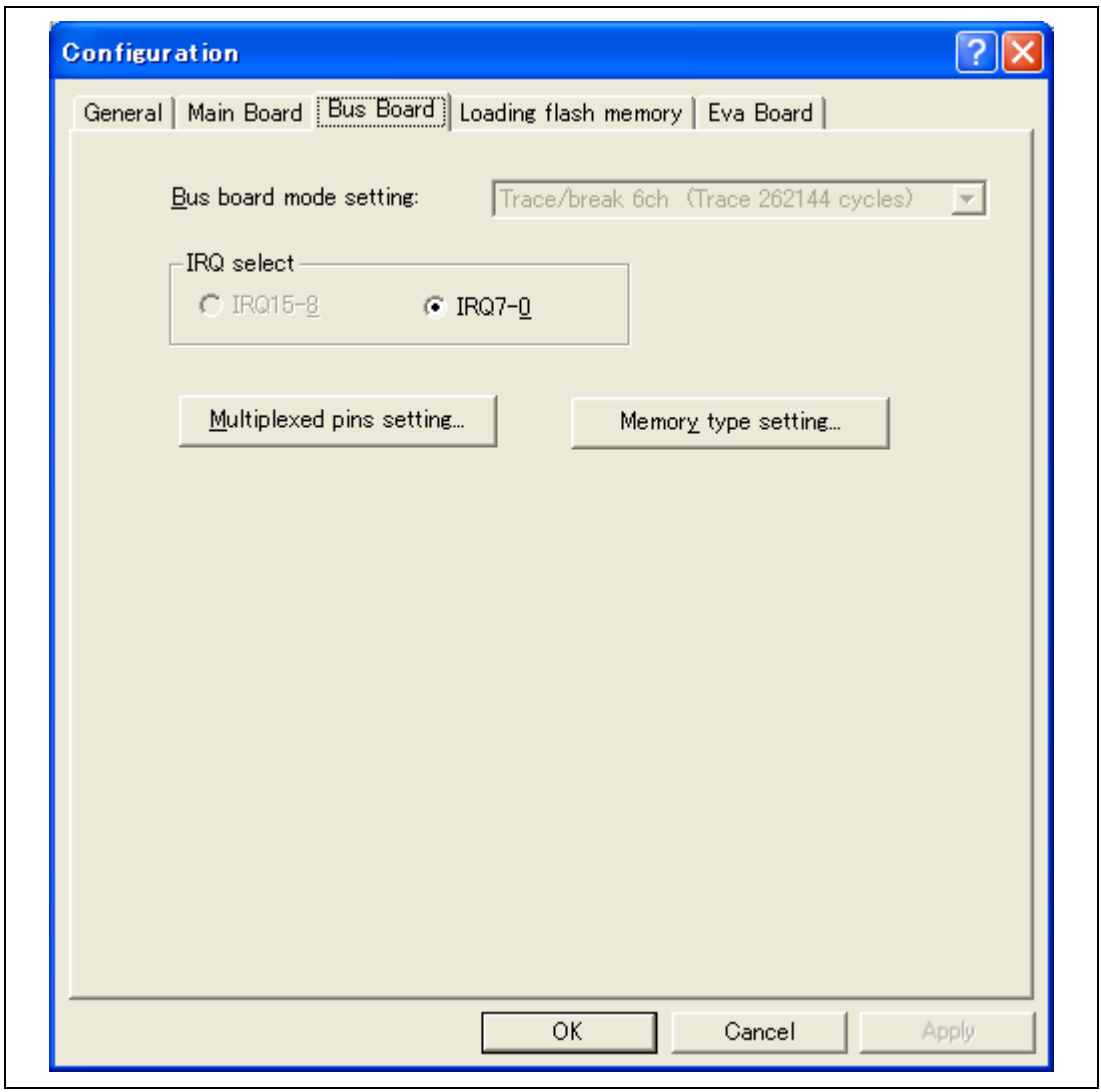


Figure 5.3 [Configuration] Dialog Box ([Bus Board] Page)

Items that can be displayed in this page are listed below.

[Bus board mode setting]	Displays the debugging functions on the external bus trace unit. Settings cannot be changed; if they are to be changed, the emulator must be activated again. [Trace/break 6ch (Trace 262144 cycles)]: The external bus trace or break function (event detection channels: six) has been selected. [Performance 6ch]: The external bus trace function has been selected (measurement channels: six). [Use emulation memory (4M, Trace 8192 cycles)]: The external emulation memory function (4 Mbytes x 1 block) has been selected. The 8192 bys cycles can be acquired by a trace.
[Multiplexed pins setting...]	Selects the state of the multiplexed pins.
[Memory type setting...]	Selects the type of memory for each area. Select [Normal] for other than SRAM with byte control.

Notes: 1. The items that can be set in this dialog box depend on the emulator in use. For details, refer to the online help.

2. When the external bus trace unit is not connected to the emulator, this page is not displayed.

Clicking the [Multiplexed pins setting...] button opens the [Multiplexed pins setting] dialog box. Select the pin name according to the state of the multiplexed pin.

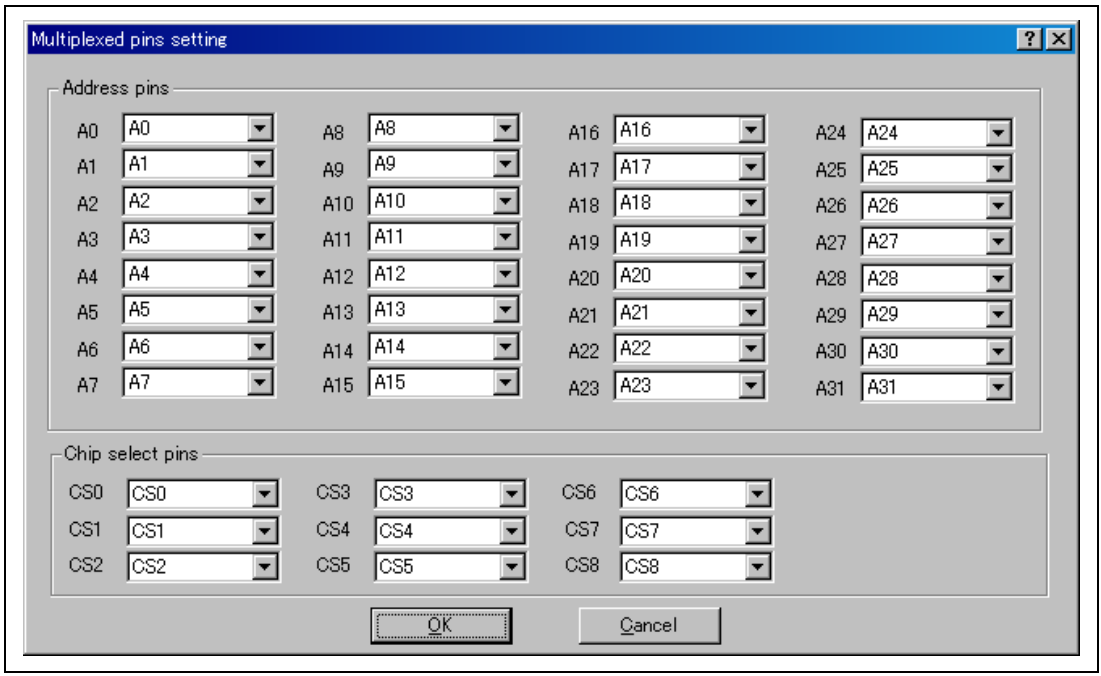


Figure 5.4 [Multiplexed pins setting] Dialog Box

Note: The items that can be set in this dialog box depend on the emulator in use. For details, refer to the online help.

Clicking the [Memory type setting...] button opens the [Memory type setting] dialog box. Set the memory type on the board.

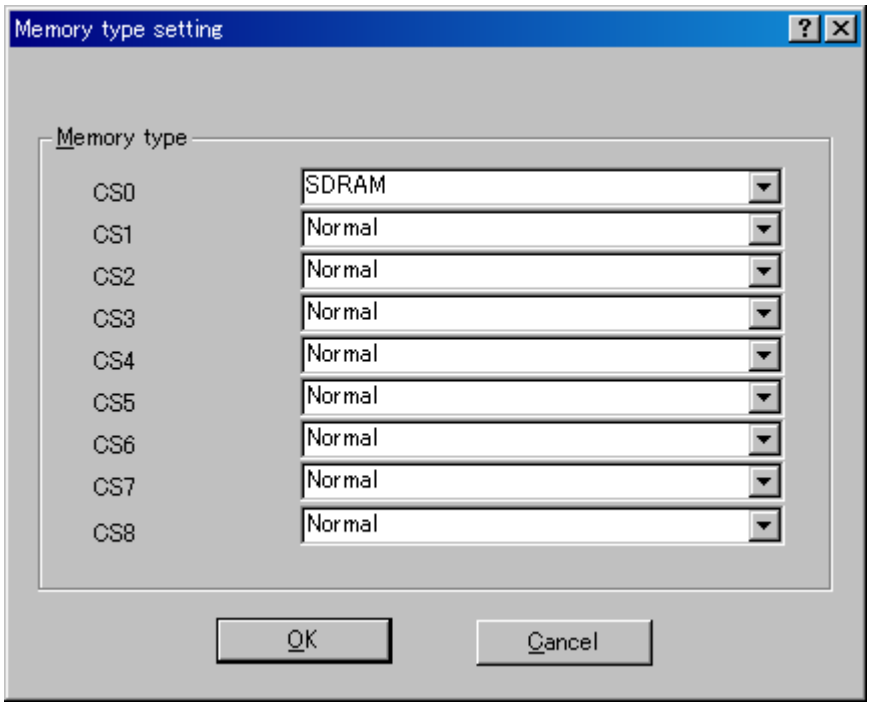


Figure 5.5 [Memory type setting] Dialog Box

Note: This dialog box differs depending on the product. For details, refer to the online help.

5.1.6 [Option Board] Page

Sets the expansion profiling unit operation conditions.

Note: When the expansion profiling unit is not connected to the emulator, this page is not displayed.

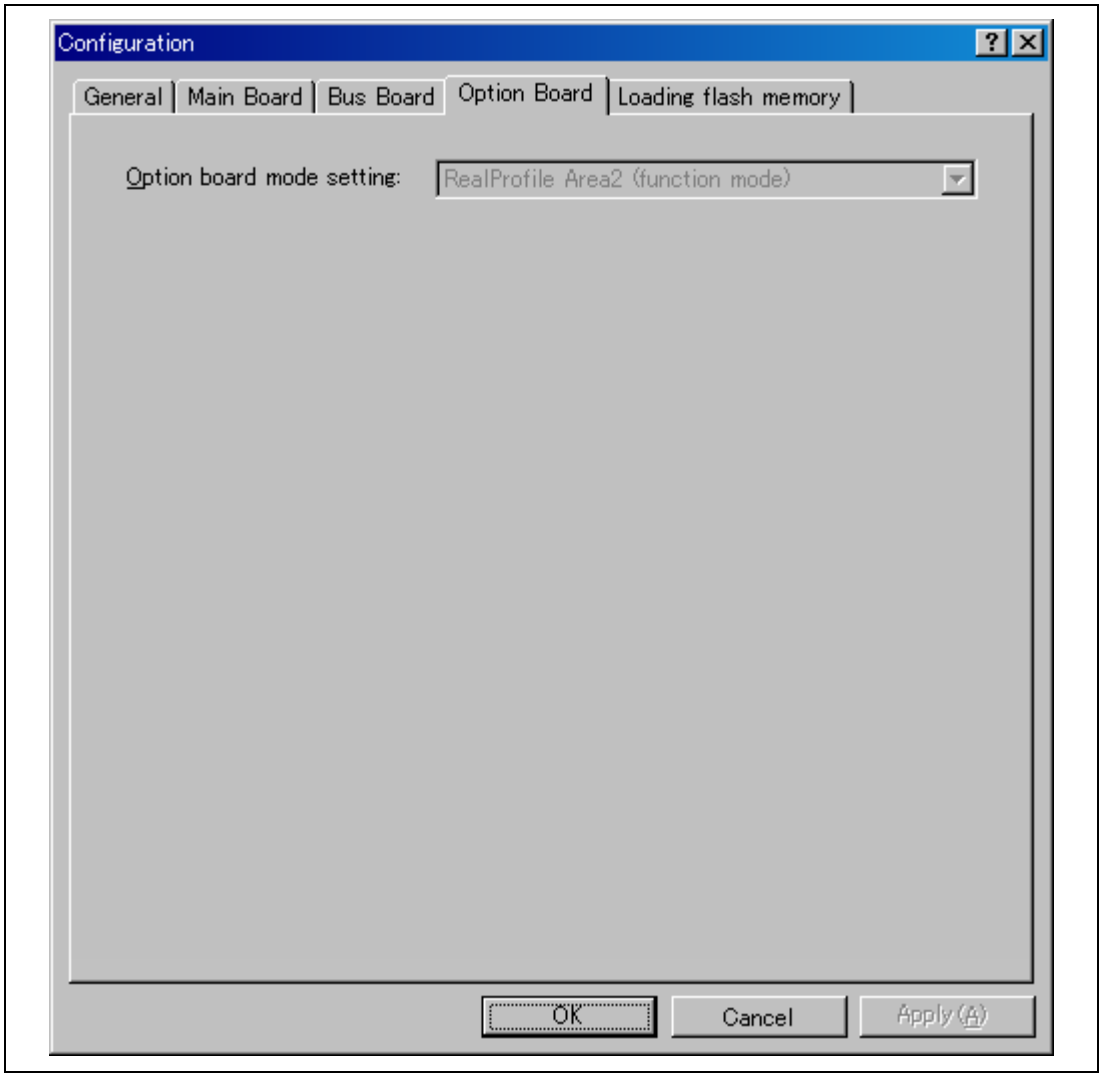


Figure 5.6 [Configuration] Dialog Box ([Option Board] Page)

Item that can be displayed in this page is listed below.

[Option board mode setting]	Displays the functions of the expansion profiling unit. Settings cannot be changed; if they are to be changed, the emulator must be activated again. [RealProfile Area 2 (function mode)]: The realtime profiling function (measurement mode: function mode) has been selected. [RealProfile Area 2 (nest mode)]: The realtime profiling function (measurement mode: nest mode) has been selected. [Coverage (8M)]: The coverage function has been selected. The 8-Mbyte area can be measured.

5.1.7 Downloading to the Flash Memory

Sets the emulator operation conditions for downloading the external flash memory.

For details, refer to section 6.21, Download Function to the Flash Memory Area.

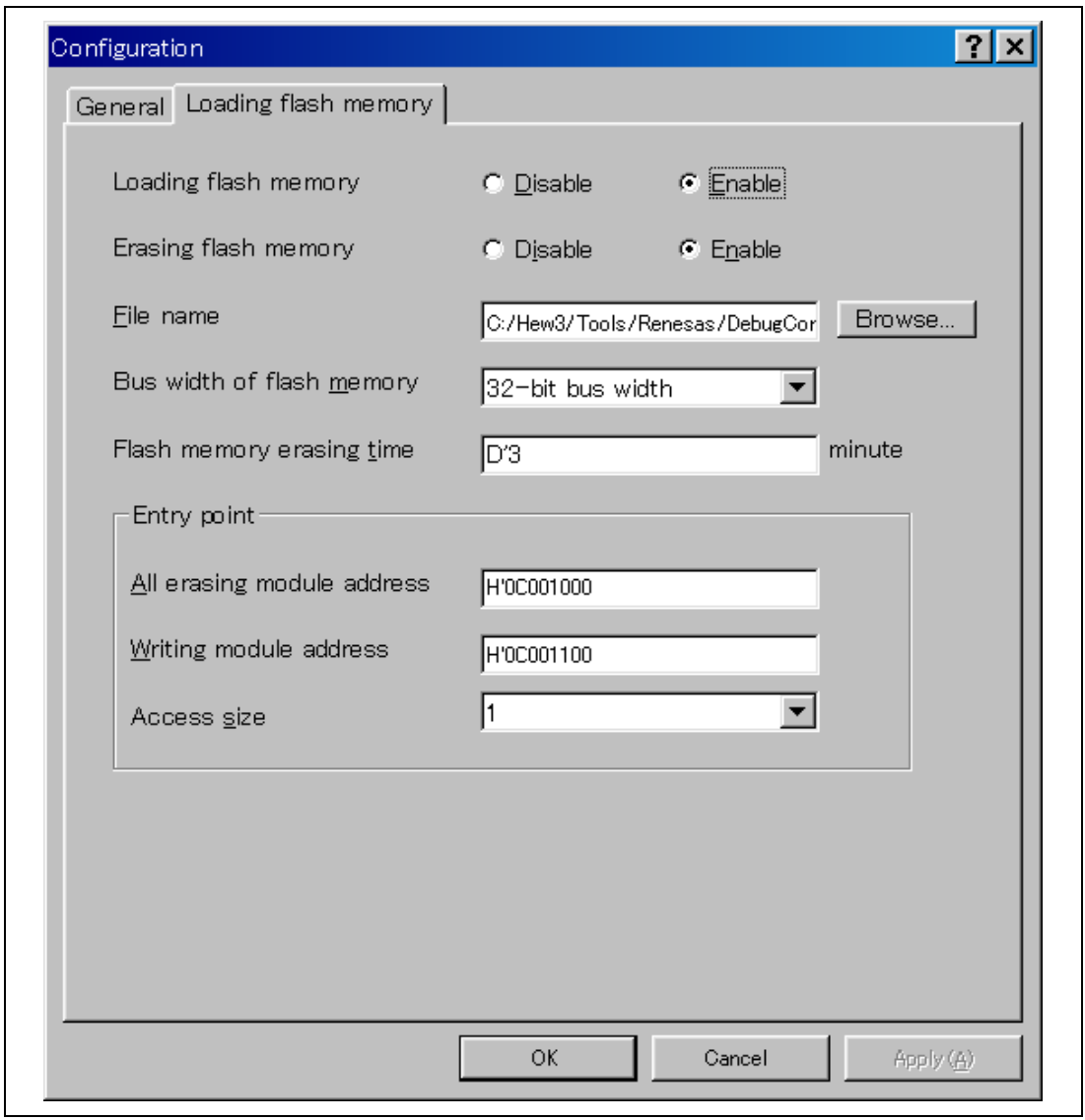


Figure 5.7 [Configuration] Dialog Box ([Loading flash memory] Page)

Items that can be displayed in this page are listed below.

[Loading flash memory]	Sets Enable for flash memory downloading. At Enable, when the flash memory is downloaded on the High-performance Embedded Workshop, the write module is always called. [Disable]: Not download to the flash memory [Enable]: Download to the flash memory
[Erasing flash memory]	Sets Enable for erasing before the flash memory is written. At Enable, the erase module is called before calling the write module. [Disable]: Not erase the flash memory [Enable]: Erase the flash memory
[File name]	Sets the write/erase module name. The file that has been set is loaded to the RAM area before loading to the flash memory.
[Bus width of flash memory]	Sets the bus width of the flash memory.
[Flash memory erasing time]	Sets the TIMEOUT value at flash memory erasing. Increase the value if erasing requires much time although the default time is three minutes. The values that can be set are as follows: D'0 (minimum) and D'65535 (maximum). Only positive integers can be input.
[Entry point]	Sets the calling destination address of the write/erase module. (It must be RAM address.) [All erasing module address]: Enters the calling destination address of the erase module. [Writing module address]: Enters the calling destination address of the write module. [Access size]: Selects the access size of the RAM area that is used for loading the write/erase module.

5.1.8 Opening the [Memory Mapping] Dialog Box

Selecting [Setup -> Emulator -> Memory Resource…] or clicking the [Emulator Memory Resource] toolbar button ( ) opens the [Memory Mapping] dialog box.

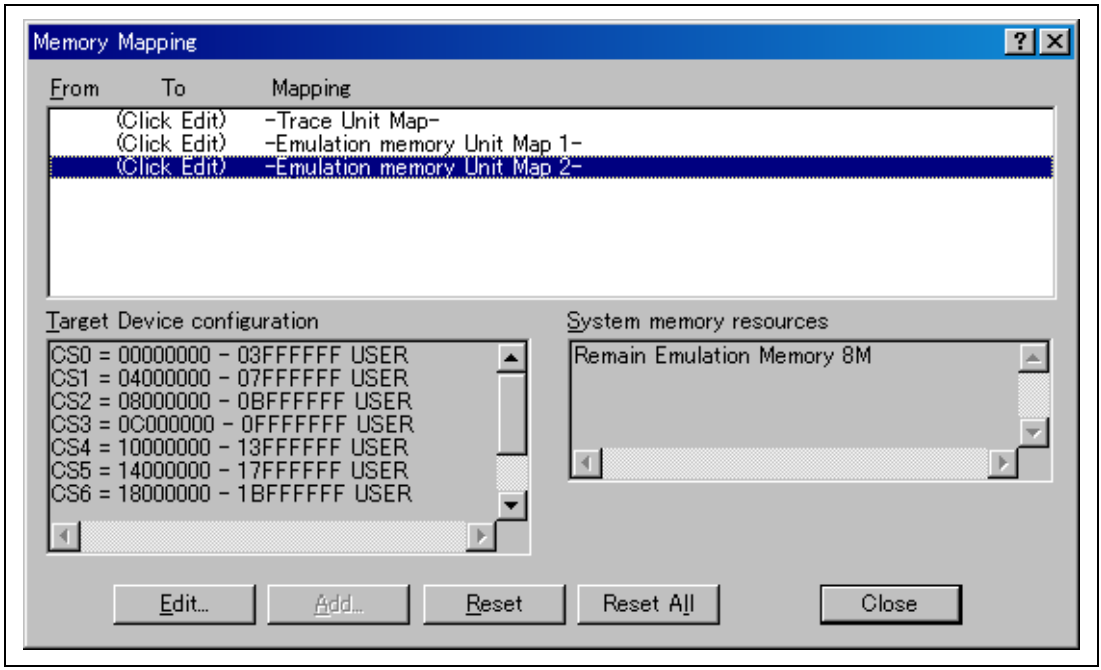


Figure 5.8 [Memory Mapping] Dialog Box

This dialog box displays the current memory map and the state of the emulation memory.

[Edit...]: Displays the [Edit Memory Mapping] dialog box, allowing the user to modify the address range and attributes of a memory map.

[Reset]: Resets the map memory to its default settings.

[Reset All]: Resets all the memory map to its default settings.

[Close]: Closes the dialog box.

The memory configuration of the device being emulated is shown on the [Memory] sheet of the [Status] window.

Notes: 1. When the external bus trace unit or emulation memory unit is not connected to the emulator, this page is not displayed.
2. The items that can be set in this dialog box depend on the emulator in use. For details, refer to the online help.
3. The items to be displayed in this dialog box depend on the emulator in use. For details, refer to the online help.

5.1.9 Changing the Memory Map Setting

Clicking the [Edit…] button on the [Memory Mapping] dialog box after selecting the information on the memory map setting you want to change opens the [Edit Memory Mapping] dialog box.

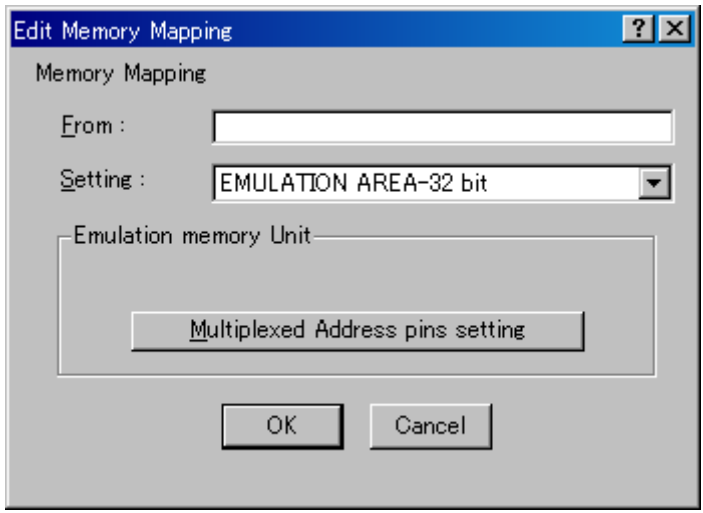


Figure 5.9 [Edit Memory Mapping] Dialog Box

Use this dialog box to change the address range and attributes of a memory map.

[From]: Enter the start address of the map range.

[Setting]: Enter the memory map setting.
The choices given are listed below.

- EMULATION AREA – 32 bit: The data bus width is 32 bits.
- EMULATION AREA – 32 bit Read-Only:
  This area is write-protected and the data bus width is 32 bits.
- EMULATION AREA – 16 bit: The data bus width is 16 bits.
- EMULATION AREA – 16 bit Read-Only:
  This area is write-protected and the data bus width is 16 bits.
- EMULATION AREA – 8 bit: The data bus width is 8 bits.

- EMULATION AREA – 8 bit Read Only:
  This area is write-protected and the data bus width is 8 bits.
- USER AREA: This area is specified as the user area.

[Multiplexed Address pins setting] button:

- The [Multiplexed Address pins setting] dialog box is opened to set the states of the use of multiplexed address pins.
- Selecting [- Emulation memory unit MAP *n* -] in the [Memory Mapping] dialog box enables the [Multiplexed Address pins setting] button.
- The states of the use of multiplexed address pins must be set for each 4-Mbyte emulation memory that has been installed on the emulation memory unit.

Notes: 1. The minimum unit for mapping the memory is fixed to 4 Mbytes.
2. When the external bus trace unit is connected to the emulator, the 4-Mbyte memory can be allocated to one area.
   When the 8-Mbyte emulation memory unit is connected to the emulator, the 4-Mbyte memory can be allocated to two areas.
   When the 16-Mbyte emulation memory unit is connected to the emulator, the 4-Mbyte memory can be allocated to four areas.
   Therefore, the 4-Mbyte memory can be allocated to a maximum of five areas (one area for the external bus trace unit and four areas for the emulation memory unit).
3. When using the emulation memory that has been installed on the emulation memory unit, be sure to set the states of the use of multiplexed address pins.
4. The performance of the emulation memory differs whether it is installed on the external bus trace unit or on the emulation memory unit. Note the settings of the bus state controller (BSC).
5. The external bus trace unit and the emulation memory unit are optional.
6. This dialog box differs depending on the product. For details, refer to the online help.

5.1.10 [Multiplexed Address pins setting] Dialog Box

Set this dialog box depending on the state of the use of multiplexed address pin.

[Address pins] group box: Select the states of the use of address bus pins that depend on the target MCU. Set [MASK] for the multiplexed pins that are not used as the address bus pins.

Note: To set the emulation memory that has been installed on the emulation memory unit, the content of this setting is used. If the [Address pins] group box is illegally set, the emulation memory will not be allocated correctly.

5.2 Downloading a Program

This section describes how to download a program and view it as source code or assembly-language mnemonics.

Note: After a break has occurred, the High-performance Embedded Workshop displays the location of the program counter (PC). In most cases, for example if an Elf/Dwarf2-based project is moved from its original path, the source file may not be automatically found. In this case, the High-performance Embedded Workshop will open a source file browser dialog box to allow you to manually locate the file.

5.2.1 Downloading a Program

A load module to be debugged must be downloaded.

To download a program, select the load module from [Debug -> Download] or select [Download] from the popup menu opened by clicking the right-hand mouse button on the load module in [Download modules] of the [Workspace] window.

Notes: 1. Before downloading a program, it must be registered to the High-performance Embedded Workshop as a load module. For registration, refer to section 4.3, Setting at Emulator Activation.
2. To download a program to the external RAM or emulation memory, the bus controller and ports must be initially set in the area for downloading. Especially, check that the initialization of SDRAM or the setting of the bus width is appropriate for the user system.

5.3 Viewing the Source Code

Select your source file and click the [Open] button to make the High-performance Embedded Workshop open the file in the integrated editor. It is also possible to display your source files by double-clicking on them in the [Workspace] window.

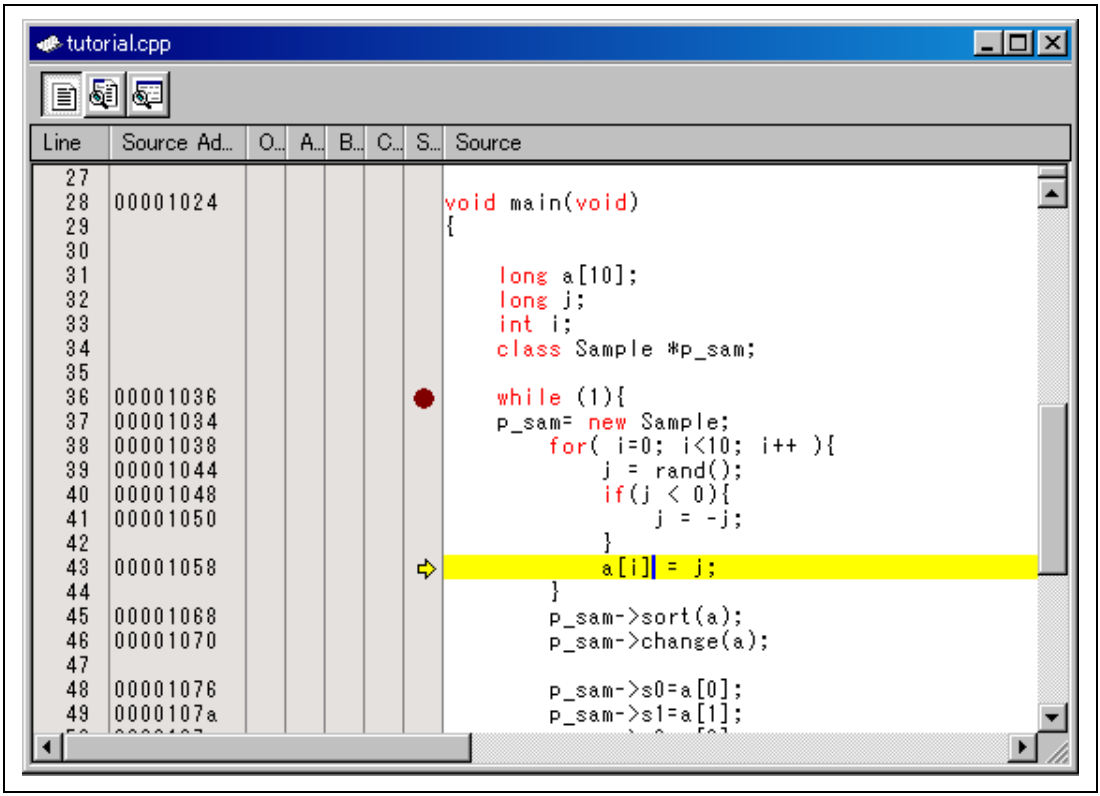


Figure 5.10 [Editor] Window

In this window, the following items are shown on the left as line information.

The first column (Line number): Line number information

The second column (Source address column): Address information

The third column (Onchip event column): On-chip event information

The fourth column (AUD event column): AUD event information

The fifth column (BUS event column): External bus event information

The sixth column (CodeCoverage column): Coverage information

The seventh column (S/W breakpoint column): PC, bookmark, and breakpoint information

Note: When the external bus trace unit is not connected to the emulator, the BUS event column is not displayed.

- **Source address column**

When a program is downloaded, an address for the current source file is displayed on the Source address column. These addresses are helpful when setting the PC value or breakpoints.

- **Onchip event column**

The Onchip event column displays the following item:

●: An address condition for the on-chip event is set. The number of address conditions that can be set is the same as that of on-chip event channels at which the address condition can be set.

The bitmap symbol above is shown by double-clicking the Onchip event column. This is also set by using the popup menu.

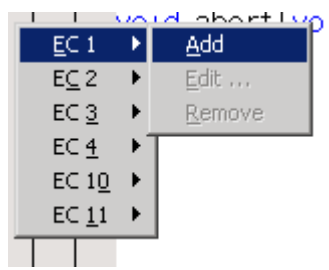


Figure 5.11 Popup Menu for the Onchip Event Column

Note: The contents of the Onchip event column are erased when conditions other than the address condition are added to each channel by using the [Edit] menu or in the [Event] window.

- **AUD event column**

The AUD event column displays the following item:

: An AUD break is set.

: An AUD sequential break is set.

: An AUD trace acquisition is set.

: An AUD trace start is set.

: An AUD trace stop is set.

: An AUD trace sequential stop is set.

: An AUD performance start is set.

: An AUD performance stop is set.

The bitmap symbols for break above are shown by double-clicking the AUD event column. These are also set by using the popup menu.

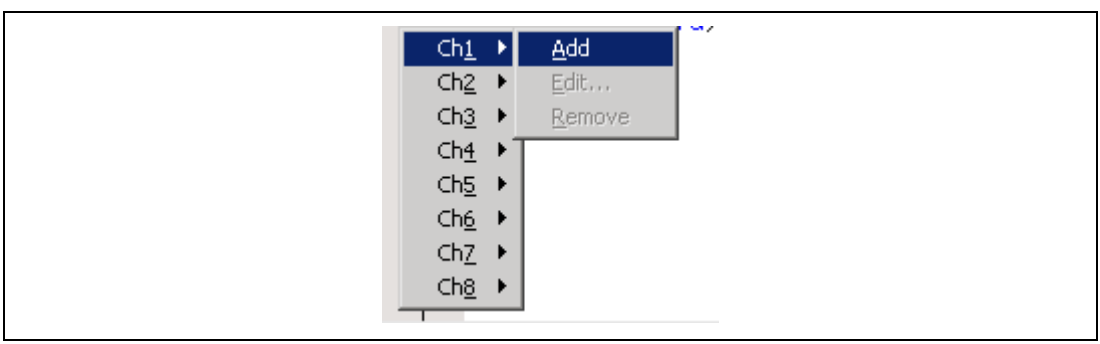


Figure 5.12 Popup Menu for the AUD Event Column

Note: The contents of the AUD event column are erased when conditions other than the address condition are added to each channel by using the [Edit] menu or in the [Event] window.

- **BUS event column**

The BUS event column displays the following item:

: An external bus break is set.

: An external bus sequential break is set.

: An external bus trace acquisition is set.

: An external bus trace start is set.

: An external bus trace stop is set.

: An external bus trace sequential stop is set.

The bitmap symbols for break above are shown by double-clicking the BUS event column. These are also set by using the popup menu.

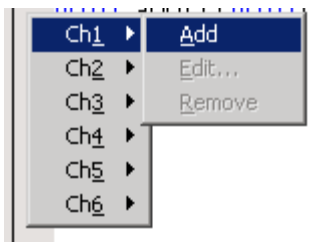


Figure 5.13 Popup Menu for the BUS event Column

Note: The contents of the BUS event column are erased when conditions other than the address condition are added to each channel by using the [Edit] menu or in the [Event] window.

- **S/W Breakpoints column**

S/W Breakpoints column displays the following items:

: A bookmark is set.

: An S/W breakpoint is set.

: PC location

➲ To switch off a column in all source files

1. Click the right-hand mouse button on the [Editor] window.
2. Click the [Define Column Format…] menu item.
3. The [Global Editor Column States] dialog box is displayed.
4. A check box indicates whether the column is enabled or not. If it is checked, the column is enabled. If the check box is gray, the column is enabled in some files and disabled in others. Deselect the check box of a column you want to switch off.
5. Click the [OK] button for the new column settings to take effect.

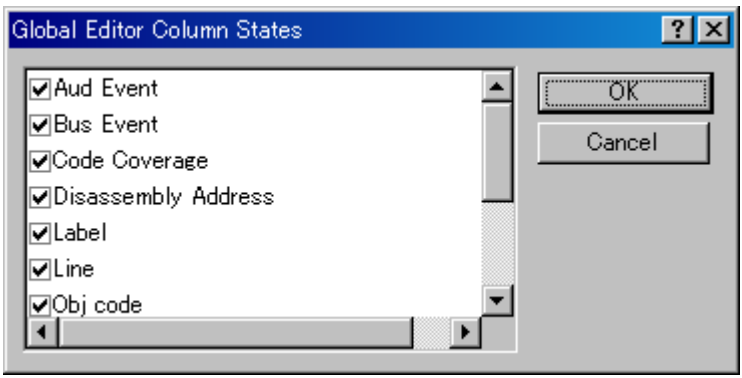


Figure 5.14 [Global Editor Column States] Dialog Box

➲ To switch off a column in one source file

1. Open the source file which contains the column you want to remove and click the right-hand mouse button on the [Editor] window.
2. Click the [Columns] menu item to display a cascaded menu item. The columns are displayed in this popup menu. If a column is enabled, it has a tick mark next to its name. Clicking the entry will toggle whether the column is displayed or not.

5.4 Viewing the Assembly-Language Code

Click the right-hand mouse button on the [Editor] window to open the popup menu and select [Go to Disassembly] to open the [Disassembly] window at the address that corresponds to the current source file.

If you do not have a source file, but want to view code in the assembly-language level, either choose [View -> Disassembly…] or click the [Disassembly] toolbar button ( ). The [Disassembly] window opens at the current PC location and shows [Address] and [Code] (optional) which show the disassembled mnemonics (with labels when available).

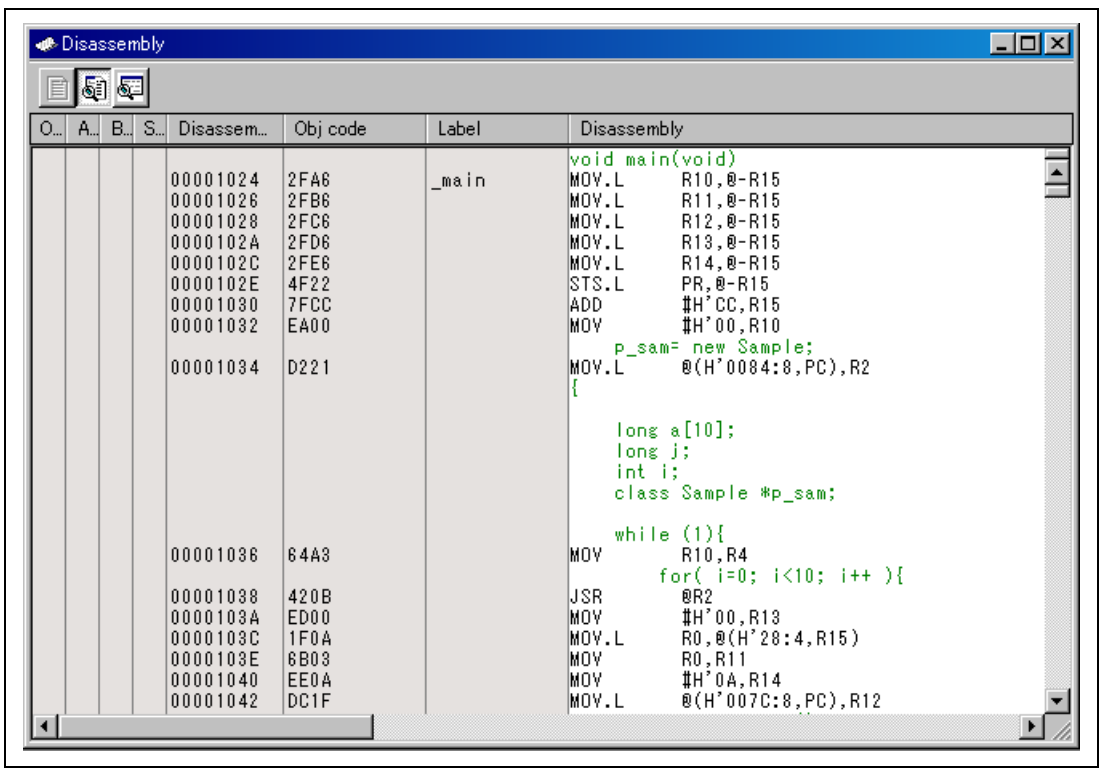


Figure 5.15 [Disassembly] Window

In this window, the following items are shown on the left as information on lines.

The first column (On Chip Break column): On-chip event information

The second column (AUD event column): AUD event information

The third column (BUS event column): BUS event information

The fourth column (S/W breakpoint column): PC and S/W breakpoint information

The fifth column (Disassembly address column): Address information

The sixth column (Object code column): Object code information

The seventh column (Label column): Label information

Usage of these columns is the same as that in the window for display of source codes.

5.4.1 Modifying the Assembly-Language Code

The [Assembler] dialog box opens by double-clicking on the instruction that you want to change. You can modify the assembly-language code.

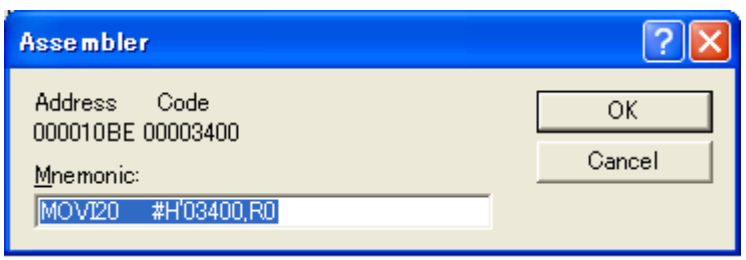


Figure 5.16 [Assembler] Dialog Box

The address, instruction code, and mnemonic are displayed. Enter a new instruction or edit the old instruction in the [Mnemonics] field. Pressing the [Enter] key will replace the memory content with the new instruction and move on to the next instruction. Clicking the [OK] button will replace the memory content with the new instruction and close the dialog box. Clicking the [Cancel] button or pressing the [Esc] key will close the dialog box.

Note: The assembly-language display is disassembled from the actual machine code in the memory. If the memory contents are changed, the dialog box (and the [Disassembly] window) will show the new assembly-language code, but the display content of the [Editor] window will not be changed. This is the same even if the source file contains an assembly codes.

5.4.2 Viewing a Specific Address

When you are viewing your program in the [Disassembly] window, you may want to look at another area of your program's code. Rather than scrolling through a lot of code in the program, you can go directly to a specific address. Select [Set Address…] from the popup menu, and the dialog box shown in figure 5.17 is displayed.

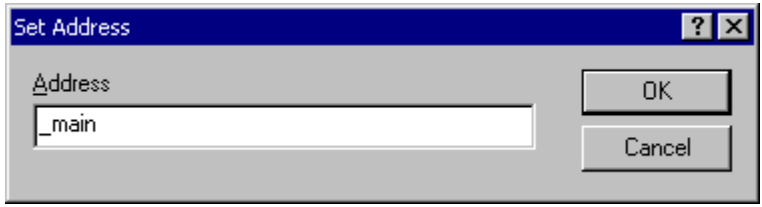


Figure 5.17 [Set Address] Dialog Box

Enter the address or label name in the [Address] edit box and either click on the [OK] button or press the Enter key. A label name can also be specified as the address. The [Disassembly] window will be updated to show the code at the new address. When an overloaded function or a class name is entered, the [Select Function] dialog box opens for you to select a function.

5.4.3 Viewing the Current Program Counter Address

Wherever you can enter an address or value into the High-performance Embedded Workshop, you can also enter an expression. If you enter a register name prefixed by the hash character, the contents of that register will be used as the value in the expression. Therefore, if you open the [Set Address] dialog box and enter the expression #pc, the [Editor] or [Disassembly] window will display the current PC address. It also allows the offset of the current PC to be displayed by entering an expression with the PC register plus an offset, e.g., #PC+0x100.

5.5 Displaying Memory Contents in Realtime

Use the [Monitor] window to monitor the memory contents during user program execution.

5.5.1 Opening the [Monitor] Window

To open the [Monitor] window, select [View -> CPU -> Monitor -> Monitor Setting...] or click the [Monitor] toolbar button ( ) to display the [Monitor Setting] dialog box.

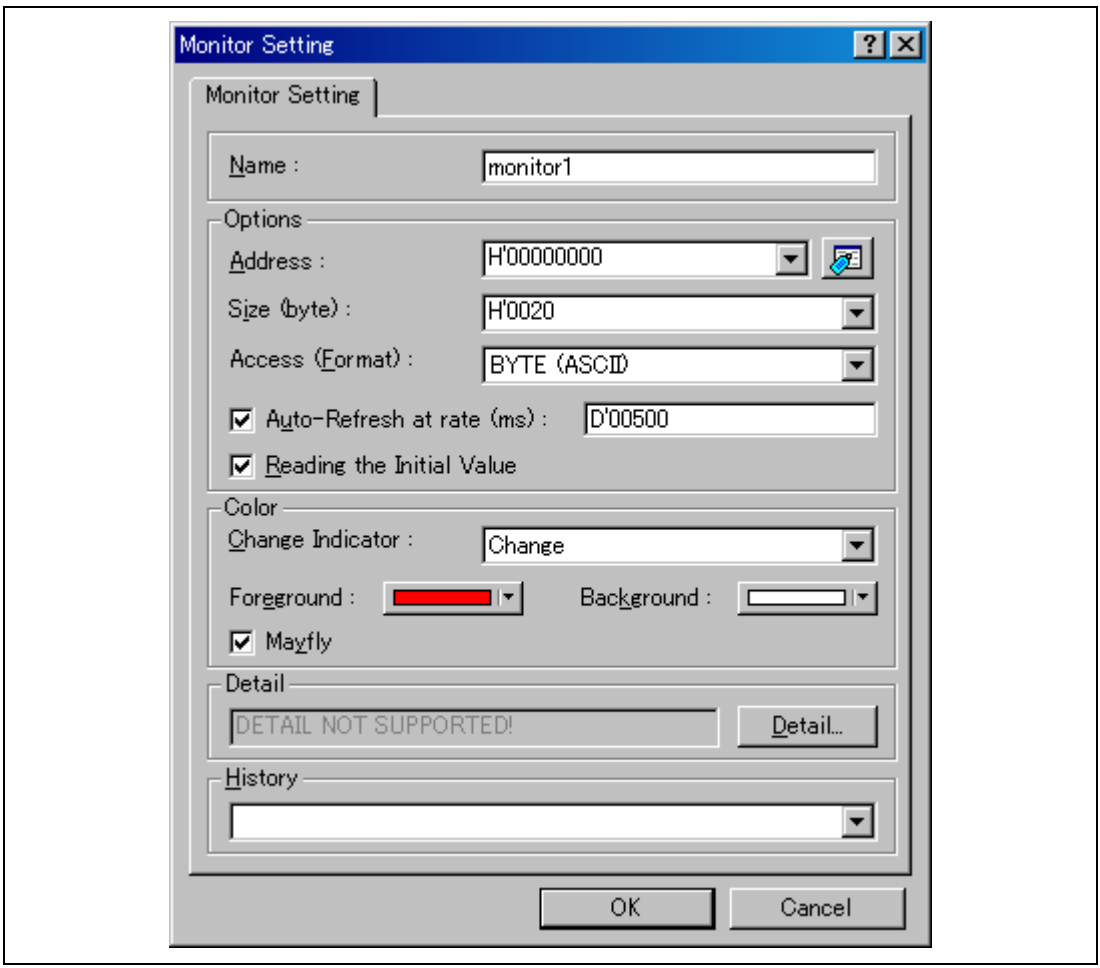


Figure 5.18 [Monitor Setting] Dialog Box

[Name]: Decides the name of the monitor window.

[Options]: Sets monitor conditions.

[Address]: Sets the start address for monitoring.

[Size]: Sets the range for monitoring.

[Access]: Sets the access size to be displayed in the monitor window.

[Auto-Refresh at rate]: Sets the interval for acquisition by monitoring.

[Reading the Initial Value]: Selects reading of the values in the monitored area when the monitor window is opened.

[Color]: Sets the method to update monitoring and the attribute of colors.

[Change Indicator]: Selects how to display the values that have changed during monitoring (available when [Reading the Initial Value] has been selected).

No change: No color change.

Change: Color is changed according to the [Foreground] and [Background] options.

Gray: Those data with values that have not been changed are displayed in gray.

Appear: A value is only displayed after changed.

[Foreground]: Sets the color used for display (available when [Change] has been selected).

[Background]: Sets the background color (available when [Change] has been selected).

[Mayfly]: A check in this box selects restoration of the color of those data which have not been updated in a specified interval to the color selected in the [Background] option. The specified interval is the interval for monitor acquisition (available when [Change], [Gray], or [Appear] has been selected).

[Detail]: Not supported in the emulator.

[History]: Displays the previous settings.

Note: Selection of the foreground or background color may not be available depending on the operating system in use.

After setting, clicking the [OK] button displays the [Monitor] window.

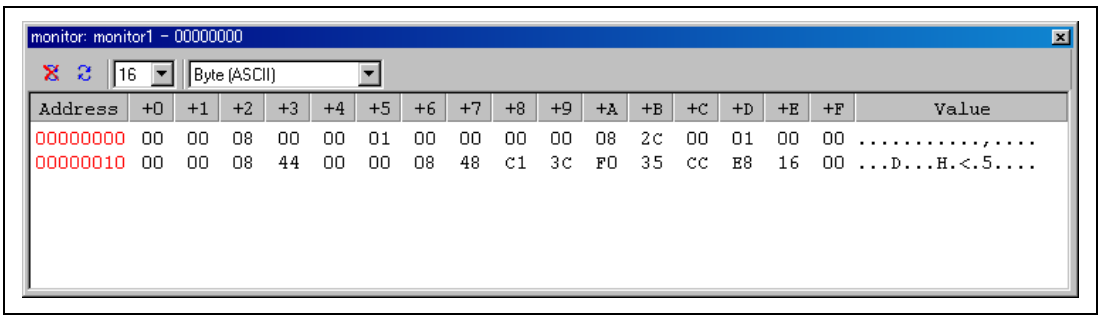


Figure 5.19 [Monitor] Window

During user program execution, the display is updated according to the setting value of the auto-update interval.

Note: Select [Refresh] from the popup menu when data is not displayed correctly after changing the address or content of memory.

5.5.2 Changing the Monitor Settings

Selecting [Monitor Settings...] from the popup menu of the [Monitor] window displays the [Monitor Setting] dialog box, which allows the settings to be changed.

Colors, the size of accesses, and the display format can be easily changed from [Color] or [Access] of the popup menu.

5.5.3 Temporarily Stopping Update of the Monitor

During user program execution, the display of the [Monitor] window is automatically updated according to the auto-update interval. Select [Lock Refresh] from the popup menu of the [Monitor] window to stop the update of display. The characters in the address section are displayed in black, and the update of display is stopped.

Selecting [Lock Refresh] again from the popup menu cancels the stopped state.

5.5.4 Deleting the Monitor Settings

Selecting [Close] from the popup menu of the [Monitor] window to be deleted closes the [Monitor] window and deletes the monitor settings.

5.5.5 Monitoring Variables

Using the [Watch] window refers to the value of any variables.

When the address of the variable registered in the [Watch] window exists within the monitoring range that has been set by the Monitor function, the value of the variable can be updated and displayed.

This function allows checking the content of a variable without affecting the realtime operation.

5.5.6 Hiding the [Monitor] Window

When using the Monitor function to monitor the value of a variable from the [Watch] window, hide the [Monitor] window for the effective use of the screen.

The current monitoring information is listed as the submenu when selecting [Display -> CPU -> Monitor]. The list consists of the [Monitor] window name and the address to start monitoring.

When the left of the list is checked, the [Monitor] window is being displayed.

Selecting items of the [Monitor] window you want to hide from the monitor setting list displays no [Monitor] window and removes the check mark at the left of the list.

To display the [Monitor] window again, select the hidden the [Monitor] window.

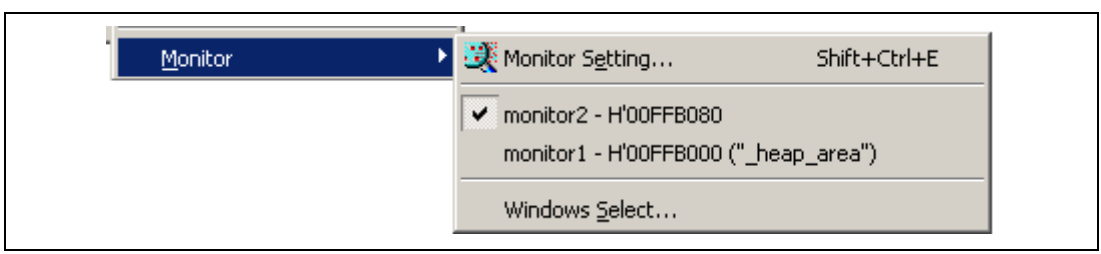


Figure 5.20 Monitor Setting List

5.5.7 Managing the [Monitor] Window

Selecting [Display -> CPU -> Monitor -> Windows Select…] displays the [Windows Select] dialog box. In this window, the current monitoring condition is checked and the new monitoring condition is added, edited, and deleted in succession.

Selecting multiple monitoring conditions enables a temporary stop of update, hiding, and deletion.

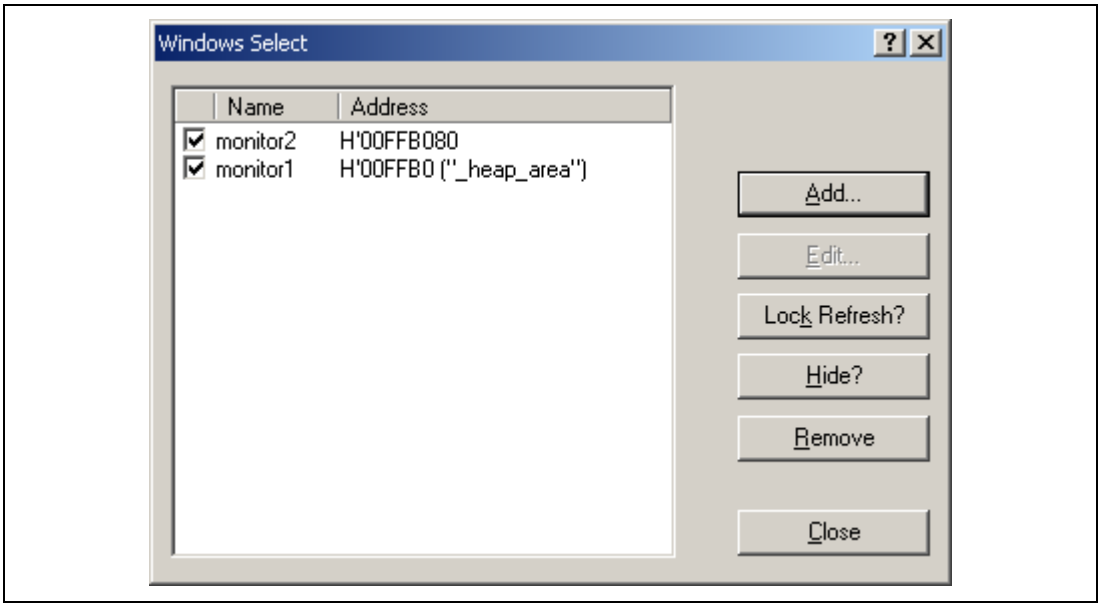


Figure 5.21 [Windows Select] Dialog Box

[Add]: Adds a new monitoring condition.

[Edit]: Changes the settings of the selected [Monitor] window (disabled when selecting multiple items).

[Lock Refresh/Unlock Refresh]:
Automatically updates or stops updating the display of the selected [Monitor] window.

[Hide/UnHide]: Displays or hides the selected [Monitor] window.

[Remove]: Removes the selected monitoring conditions.

[Close]: Closes this dialog box.

5.6 Viewing the Current Status

Choose [View -> CPU -> Status] or click the [View Status] toolbar button ( ) to open the [Status] window and see the current status of the debugging platform.

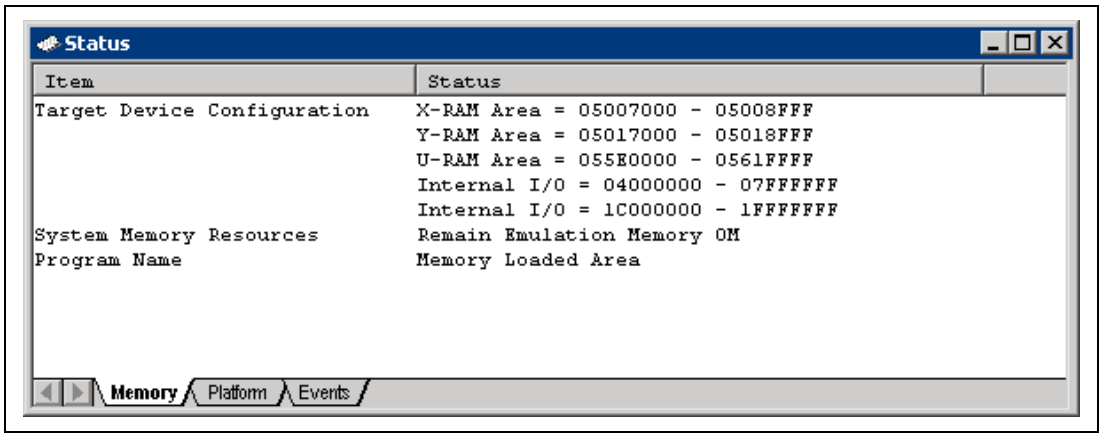


Figure 5.22 [Status] Window

The [Status] window has three sheets:

- [Memory] sheet

  Contains information about the current memory status including the memory-mapping resources and the areas used by the currently loaded object file.
- [Platform] sheet

  Contains information about the current status of the debugging platform, typically including MCU type and emulation mode, and the state of execution.
- [Events] sheet

  Contains information about the current event (breakpoint) status, including resource information.

5.7 Reading and Displaying the Emulator Information Regularly

Use the [Extended Monitor] window to know the changing information on the emulator no matter the user program is running or halted.

Note: The Extended Monitor function does not affect the execution of the user program since it monitors the signal output from the user system or the MCU.

5.7.1 Opening the [Extended Monitor] Window

Selecting [View -> CPU -> Extended Monitor] or clicking the [Extended Monitor] toolbar button ( ) displays this window.

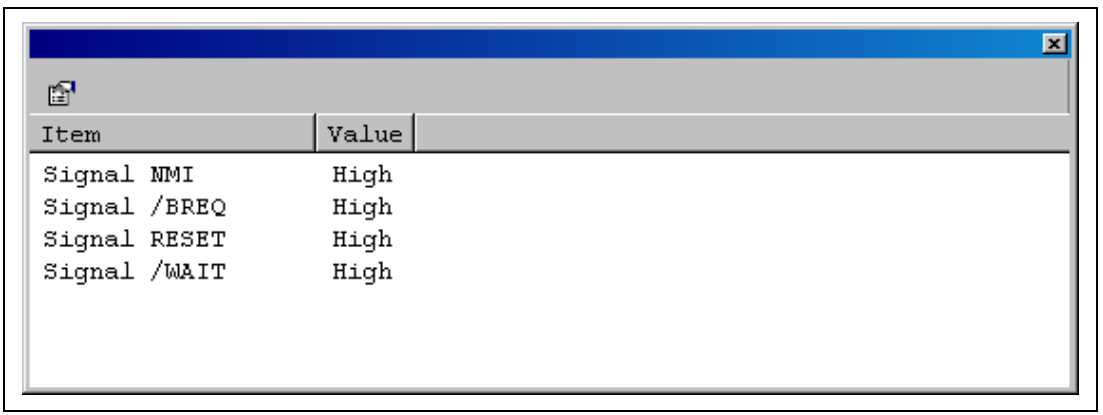


Figure 5.23 [Extended Monitor] Window

Note: The items that can be set in this window depend on the emulator in use. For details, refer to the online help.

5.7.2 Selecting Items to be Displayed

Selecting [Properties…] from the popup menu displays the [Extended Monitor Configuration] dialog box.

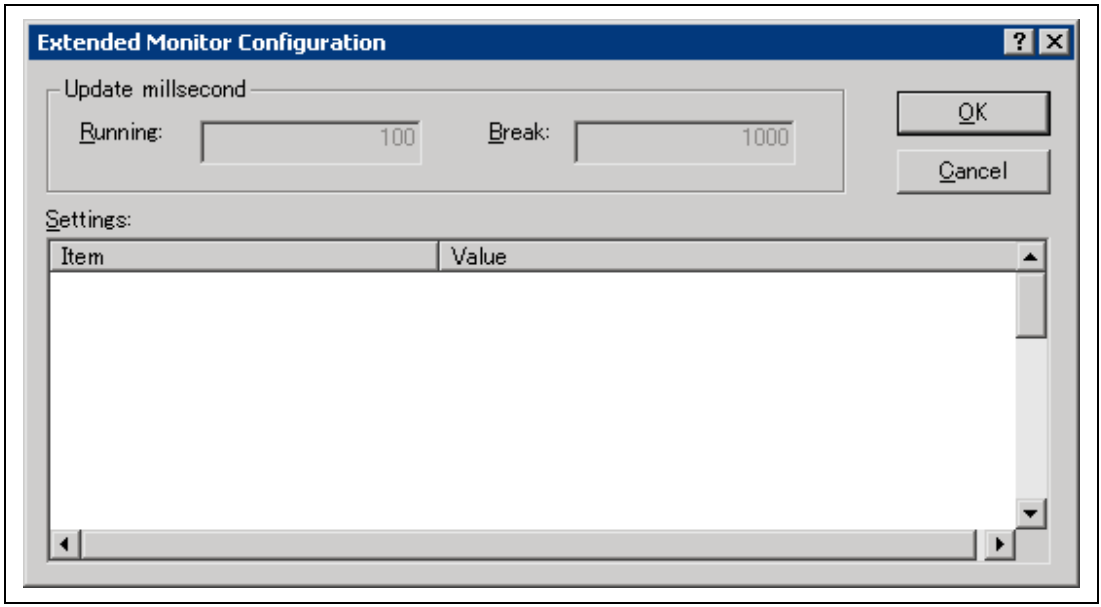


Figure 5.24 [Extended Monitor Configuration] Dialog Box

This dialog box allows the user to set the items to be displayed in the [Extended Monitor] window.

5.8 Using the Eventpoints

The emulator has the eventpoint function that performs breaking, tracing, and execution time measurement by specifying more complex conditions along with the S/W breakpoints standard for the High-performance Embedded Workshop.

5.8.1 S/W Breakpoints

When the instruction of the specified address is fetched, the user program is stopped. Up to 1000 points can be set.

5.8.2 Eventpoints

Eventpoints can be used for higher-level conditions such as the data condition as well as specification of the single address. Up to four eventpoints can be set in the emulator.

(1) Onchip Eventpoint

This is a function that sets eventpoints according to the information in the MCU.

For an operation when an event is detected, break, internal trace acquisition/acquisition start/acquisition stop, or internal performance measurement start/end can be specified.

A combination of one or more of the Onchip Eventpoints enables specifying more complex sequential conditions.

This function can be set in the [Onchip Event] sheet of the [Event] window.

Note: The contents to be set will differ depending on the product. For details, refer to the on-line help for each product.

(2) AUD Eventpoint

This is a function that sets eventpoints according to the information output from the AUD interface. There are eight event detection channels.

For an operation when an event is detected, break, AUD trace acquisition/acquisition start/acquisition stop, or AUD performance measurement start/end can be specified.

A combination of one or more of the AUD evenpoints enables specifying more complex sequential conditions.

This function can be set in the [AUD Event] sheet of the [Event] window.

(3) BUS Eventpoint

This is a function that sets eventpoints according to the external bus of the MCU or information on the pin such as an interrupt pin. There are six event detection channels.

For an operation when an event is detected, break or external bus trace acquisition/acquisition start/acquisition stop can be specified.

A combination of one or more of the BUS evenpoints enables specifying more complex sequential conditions.

This function can be set in the [BUS Event] sheet of the [Event] window.

Notes: 1. When the external bus trace unit is not connected to the emulator, this function is not supported.
2. When the function of the external bus trace unit is changed, the number of event detection channels is changed. For details, refer to section 5.1.5, [Bus Board] Page.

(4) Other Eventpoint

This function can be set in the [Other Event] sheet of the [Event] window.

(a) Execution time eventpoint

Eventpoints can be defined specifying the program execution time as the condition. There is one event detection channel.

For an operation when an event is detected, break can be specified.

(b) External probe eventpoint

Eventpoints can be defined specifying four external probe signals via the probe cable as the condition. There is one event detection channel.

For an operation when an event is detected, break or AUD trace acquisition/acquisition start/acquisition stop can be specified.

5.8.3 Opening the [Event] Window

Select [View -> Code -> Eventpoints] or click the [Eventpoints] toolbar button () to open the [Event] window.

The [Event] window has the following five sheets:

[Breakpoint] sheet:	Displays the settings made for S/W breakpoints. It is also possible to set, modify, and cancel S/W breakpoints.
[Onchip Event] sheet:	Displays or sets the settings made for on-chip event channels.
[AUD Event] sheet:	Displays or sets the settings made for AUD event channels.
[BUS Event] sheet:	Displays or sets the settings made for external bus event channels.
[Other Event] sheet:	Displays or sets the settings made for other event channels.

5.8.4 Setting S/W Breakpoints

It is possible to display, modify, and add S/W breakpoints on the [Breakpoint] sheet.

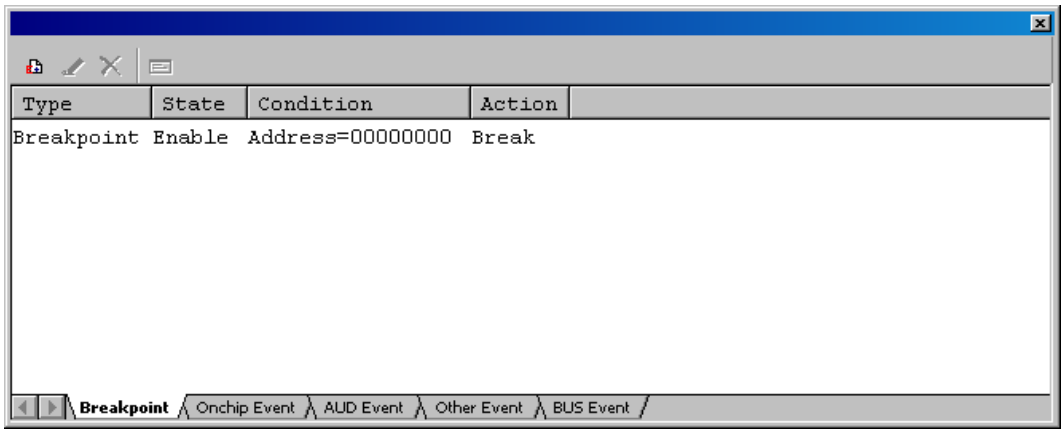


Figure 5.25 [Event] Window ([Breakpoint] Sheet)

Items that can be displayed in the sheet are listed below.

[Type] Breakpoint

[State] Whether the breakpoint is enabled or disabled

[Condition] An address that the breakpoint is set
Address = Program counter (Corresponding file name, line, and symbol name)

[Action] Operation of the emulator when a break condition is satisfied
Break: Breaks program execution

Select [Add...] or the S/W breakpoint displayed in this window and then select [Edit...] from the popup menu to display the [Breakpoint] dialog box.

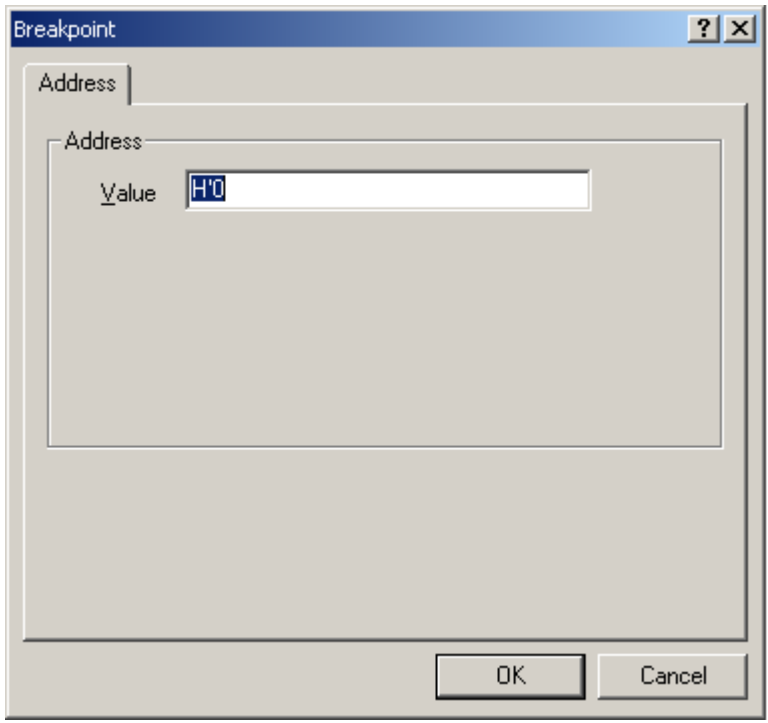


Figure 5.26 [Breakpoint] Dialog Box

This dialog box specifies address conditions of S/W breakpoints.

A breakpoint address to be set is specified in the **[**Value**]** edit box. The PC register can also be specified such as #PC. Up to 1000 breakpoints can be specified.

The contents to be set differ depending on the product. For details, refer to the on-line help for each product.

When [Value] is selected, if an overloaded function or class name including a member function is specified in address, the [Select Function] dialog box opens.

Clicking the [OK] button sets the specified breakpoint conditions. Clicking the [Cancel] button closes this dialog box without setting the break conditions.

5.8.5 Setting Onchip Eventpoints

On the [Onchip Event] sheet, the settings for Onchip Eventpoints are displayed and modified.

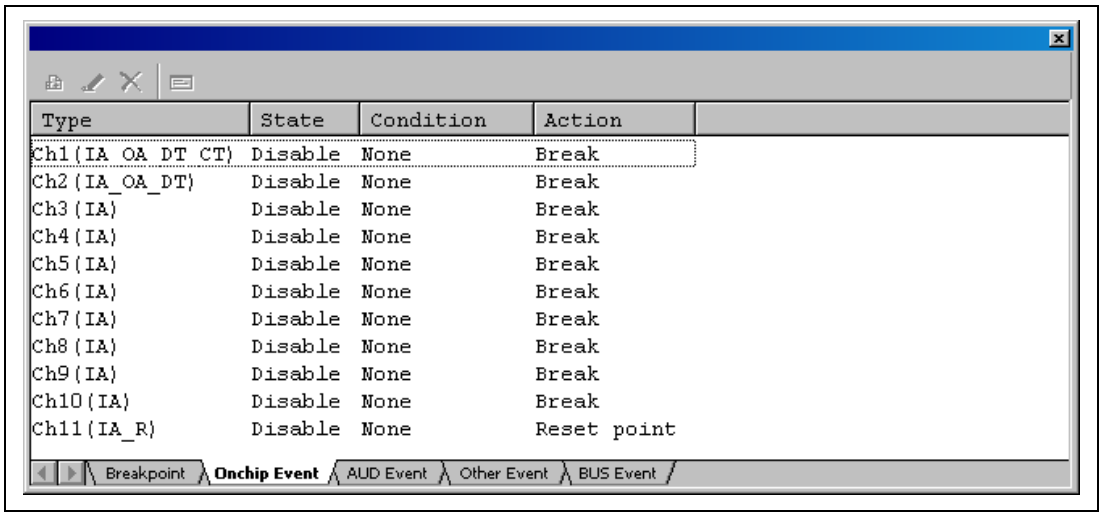


Figure 5.27 [Event] Window ([Onchip Event] Sheet)

Since the number of event detection channels and the contents to be set differ depending on the product, refer to the online help for each product.

Items that can be displayed in the sheet are listed below.

[Type] On-chip event channel number and type

[State] Whether the eventpoint is enabled or disabled

[Condition] A condition that satisfies an eventpoint. The displayed contents differ depending on the channel.

[Action] Operation of the emulator when an eventpoint condition is satisfied. The displayed contents differ depending on the channel.

When an event channel is double-clicked or selected and [Edit...] is selected from the popup menu in this window, the [Event condition x] dialog box is opened and eventpoint conditions can be modified.

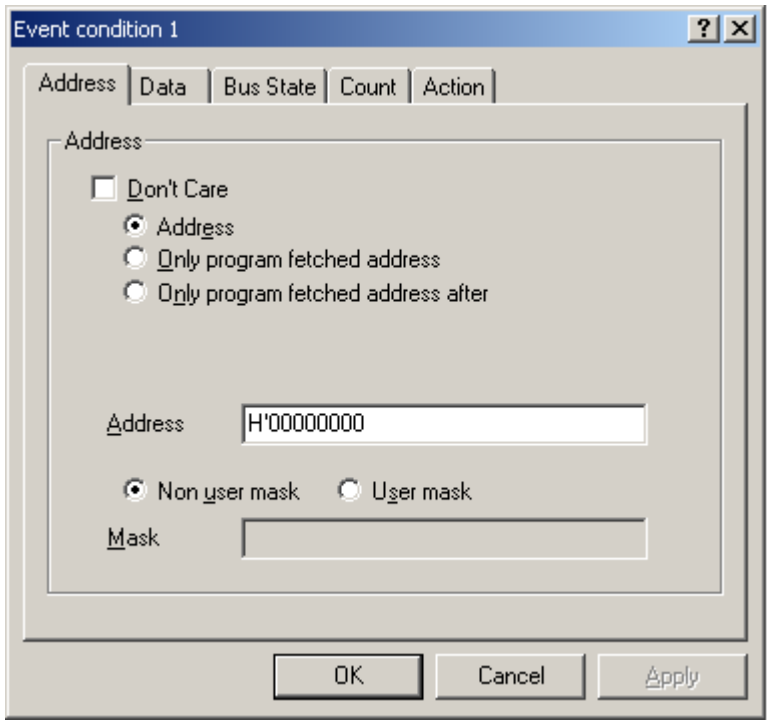


Figure 5.28 [Event condition x] Dialog Box ([Address] Page)

For details on the [Event condition x] dialog box, refer to the online help for each product.

Setting Conditions on [Combination action]:

The user can set a sequential condition as the order of conditions on multiple channels being satisfied. Selecting [Combination action] from the popup menu of the [Onchip Event] sheet opens the [Combination action] dialog box, which allows the user to specify the order of conditions being satisfied.

How to Set [Combination action]:

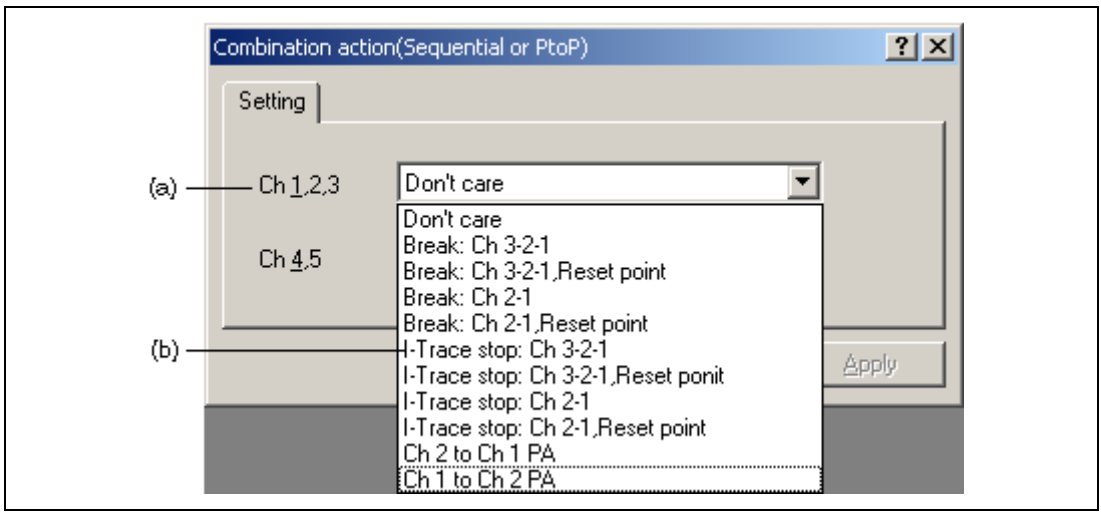


Figure 5.29 [Combination action] Dialog Box ([Ch 1,2,3] Combo Box)

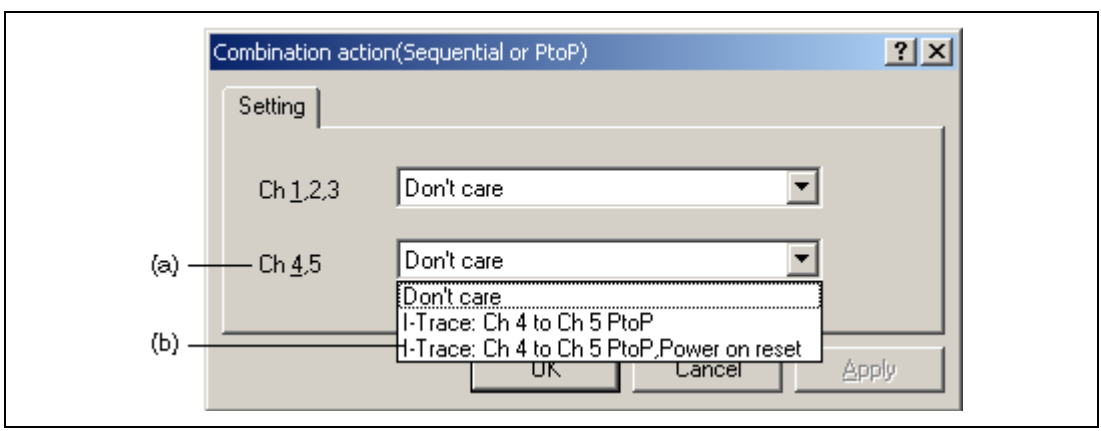


Figure 5.30 [Combination action] Dialog Box ([Ch 4,5] Combo Box)

(a) Indicates the channel name for setting conditions.

(b) Select a condition from the followings.

[Don't care]:	Sets no condition.
[Break:Ch 3-2-1]:	A break occurs when the conditions on channels 3, 2, and 1 are satisfied in this order.
[Break:Ch 3-2-1, Reset point]:	A break occurs when the conditions on channels 3, 2, and 1 are satisfied in this order. This condition is reset when the reset point condition is satisfied.
[Break:Ch 2-1]:	A break occurs when the conditions on channels 2 and 1 are satisfied in this order.
[Break:Ch 2-1, Reset point]:	A break occurs when the conditions on channels 2 and 1 are satisfied in this order. This condition is reset when the reset point condition is satisfied.
[I-Trace stop: Ch 3-2-1]:	Trace acquisition stops when the conditions on channels 3, 2, and 1 are satisfied in this order.
[I-Trace stop: Ch 3-2-1, Reset point]:	Trace acquisition stops when the conditions on channels 3, 2, and 1 are satisfied in this order. This condition is reset when the reset point condition is satisfied.
[I-Trace stop: Ch 2-1]:	Trace acquisition stops when the conditions on channels 2 and 1 are satisfied in this order.
[I-Trace stop: Ch 2-1, Reset point]:	Trace acquisition stops when the conditions on channels 2 and 1 are satisfied in this order. This condition is reset when the reset point condition is satisfied.
[Ch 2 to Ch 1 PA]:	After the condition on channel 2 is satisfied, the emulator analyzes the performance until the condition on channel 1 is satisfied.
[Ch 1 to Ch 2 PA]:	After the condition on channel 1 is satisfied, the emulator analyzes the performance until the condition on channel 2 is satisfied.
[I-Trace: Ch 4 to Ch 5 PtoP]:	After the condition on channel 4 is satisfied, the emulator acquires trace information until the condition on channel 5 is satisfied.
[I-Trace: Ch 4 to Ch 5 PtoP, Power on reset]:	After the condition on channel 4 is satisfied, the emulator acquires trace information until the condition on channel 5 is satisfied. A power-on reset validates this condition.

Set the event condition for each channel in the [Event Condition] dialog box.

Usage Example of Sequential Break Extension Setting: A tutorial program provided for the product is used as an example. For the tutorial program, refer to section 6, Tutorial.

The conditions of Event Condition are set as follows:

1. Ch1

   Breaks address H'00001086 when the condition [Prefetch address break after executing] is satisfied.
2. Ch2

   Breaks address H'00001068 when the condition [Prefetch address break after executing] is satisfied.
3. Ch3

   Breaks address H'00001058 when the condition [Prefetch address break after executing] is satisfied.

   Note: Do not set other channels.
4. Set the contents of the [Ch1, 2, 3] list box for [Break: Ch 3-2-1] on the [Combination action] dialog box.
5. Enable the condition of Event Condition 1 from the popup menu that is opened by right-clicking on the [Event Condition] sheet.

Then, set the program counter and stack pointer (PC = H'00000800, R15 = H'FFF9F000) in the [Registers] window and click the [Go] button. If this does not execute normally, issue a reset and execute the above procedures.

The program is executed up to the condition of Ch1 and halted. Here, the condition is satisfied in the order of Ch3 -> 2 -> 1.

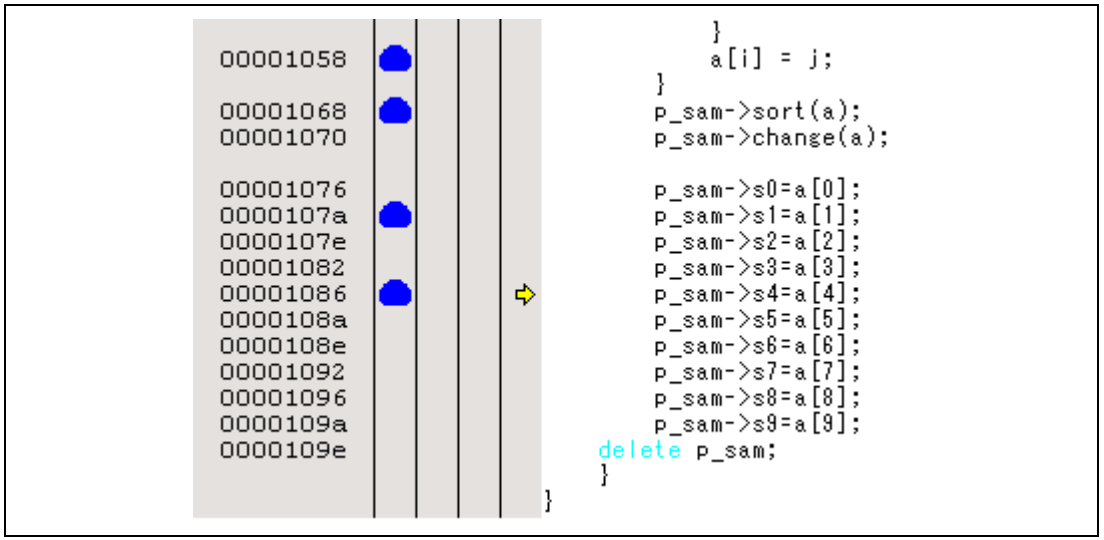


Figure 5.31 [Editor] Window at Execution Halted (Sequential Break)

Note: The items that can be set in the [Combination action] dialog box depend on the emulator in use. For details, refer to the online help.

5.8.6 Setting AUD Eventpoints

On the [AUD Event] sheet, the settings for AUD Eventpoints are displayed and modified.

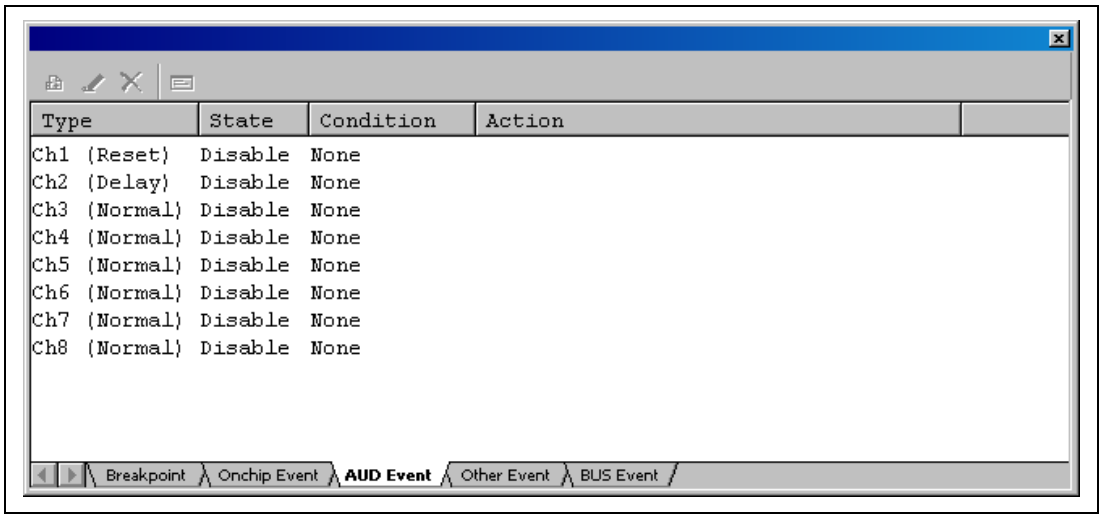


Figure 5.32 [Event] Window ([AUD Event] Sheet)

Using eight event detection channels sets eight eventpoints.

Notes: 1. Since the AUD eventpoint condition is set according to the information in the MCU output from the AUD pin, the AUD trace information acquisition condition must be set. Set the AUD trace information acquisition condition for the AUD eventpoint condition.

2. When debugging is performed without any connection to the EV-chip unit, a break function cannot be selected in AUD event.

Items that can be displayed in the sheet are listed below.

[Type] AUD event channel number and type
Normal: Standard event channel
Delay: Event channel that delay conditions can be set
Reset: Event channel that can be set as the reset point of the AUD sequential event

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

[Condition] A condition that satisfies an eventpoint. The displayed contents differ depending on the channel.

[Action] Operation of the emulator when an eventpoint condition is satisfied. The displayed contents differ depending on the channel.

When an event channel is double-clicked or selected and [Edit...] is selected from the popup menu in this window, the [Chx] dialog box is displayed.

The [Chx] dialog box consists of the [General], [Branch], [Window], [Software], [SystemBus], [Count], [Delay], and [Action] pages.

The combination of the conditions set in each page is set as the detection condition of eventpoints.

(1) [General] page

Specifies AUD trace information used to set the AUD Eventpoint condition.

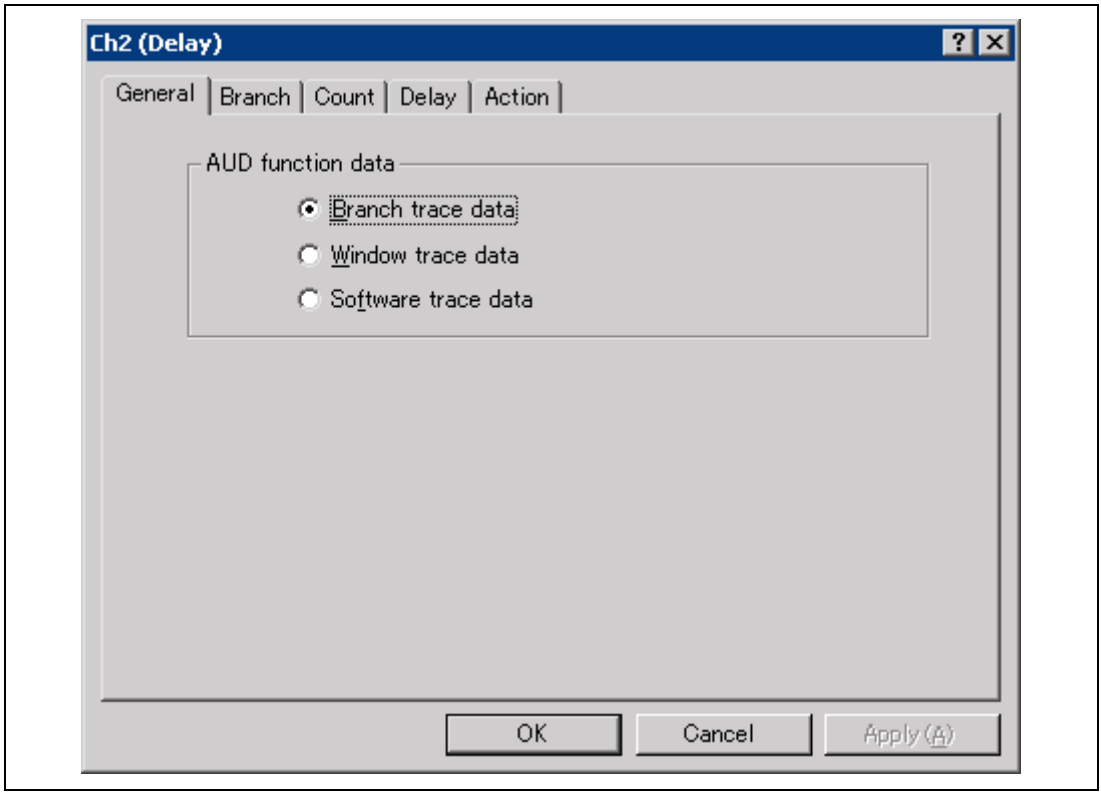


Figure 5.33 [Chx (Delay)] Dialog Box ([General] Page)

[Branch trace data]: Sets the eventpoint condition according to the branch trace information.

[Window trace data]: Sets the eventpoint condition according to the window trace information.

[Software trace data]: Sets the eventpoint condition according to the software trace information.

(2) [Branch] page

Specifies the type and address conditions of the branch trace.

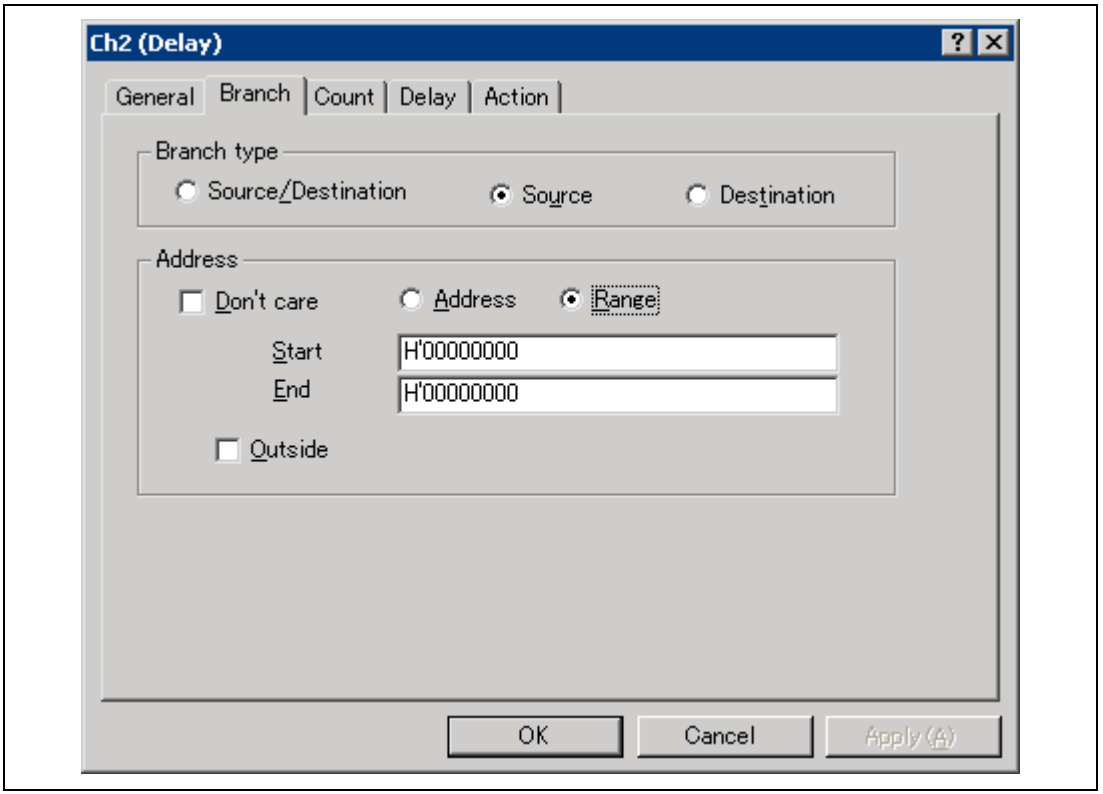


Figure 5.34 [Chx (Delay)] Dialog Box ([Branch] Page)

[Branch type]: Sets branch types.

- [Source/Destination]: Sets no branch type.
- [Source]: Sets the branch-source address condition.
- [Destination]: Sets the branch-destination address condition.

[Address]: Sets address conditions.

- [Don't care]: Sets no address condition.
- [Address]: Sets the single address.
- [Range]: Sets the address range.

[Start]: Sets the single address or the start address of the address range.

[End]: Sets the end address of the address range.

[Outside]: Sets other value than that has been set for the single address or address range as the condition.

Notes: 1. This page is only displayed when [Branch trace data] is specified on the [General] page.
2. The address range can only be specified for AUD event channels Ch1 and Ch2.
3. The mask address can be input for [Start] when the single address is specified.
4. The mask address cannot be input for [Start] and [End] when the address range is specified.

(3) [Window] page

Specifies the address and data conditions of the window trace.

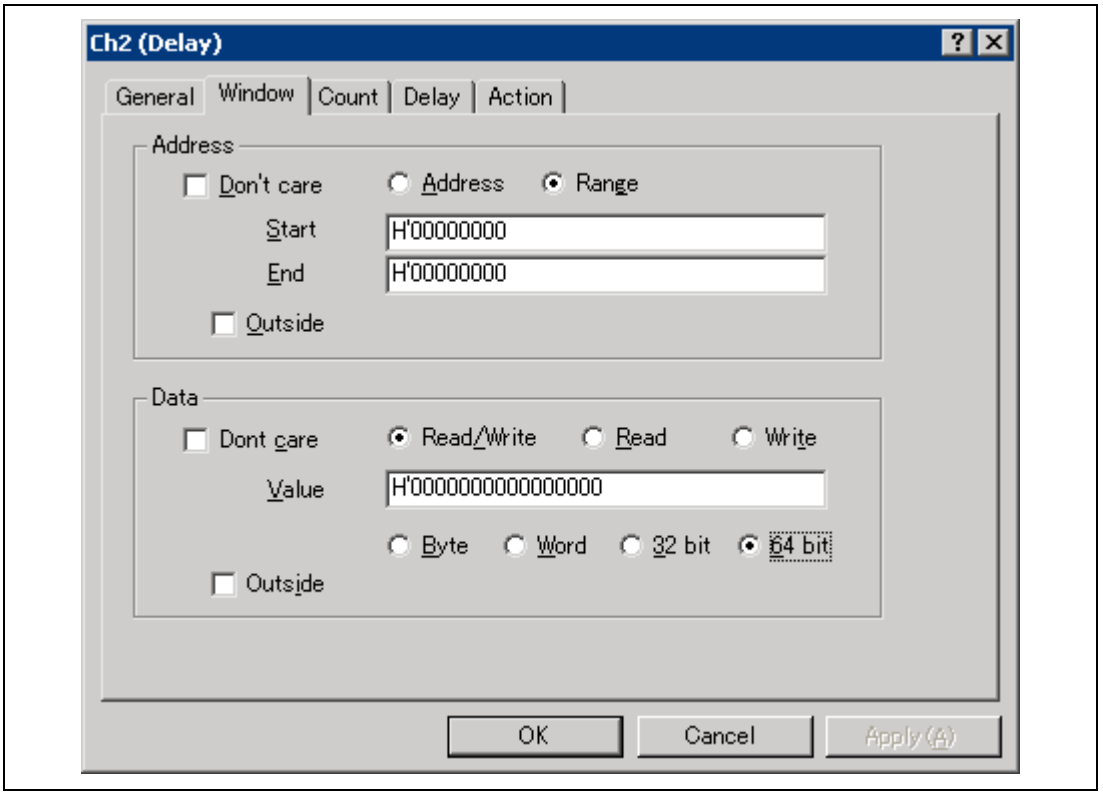


Figure 5.35 [Chx (Delay)] Dialog Box ([Window] Page)

[Address]: Sets the address condition.

- [Don't care]: Sets no address condition.
- [Address]: Sets the single address.
- [Range]: Sets the address range.
- [Start]: Sets the single address or the start address of the address range.
- [End]: Sets the end address of the address range.
- [Outside]: Sets other value than that has been set for the single address or address range as the condition.

[Data]: Sets the data condition.

- [Don't care]: Sets no data condition.
- [Read/Write]: Sets the read or write cycle as the condition.
- [Read]: Sets the read cycle as the condition.
- [Write]: Sets the write cycle as the condition.
- [Value]: Sets the data bus value (mask data can be input).
- [Byte]: Sets the byte access as the condition.
- [Word]: Sets the word access as the condition.
- [32 bit]: Sets the 32-bit access as the condition.
- [64 bit]: Sets the 64-bit access as the condition.
- [Outside]: Sets other value than that has been set for [Value] as the condition.

Notes:
1. This page is only displayed when [Window trace data] is specified on the [General] page.
2. The address range can only be specified for AUD event channels Ch1 and Ch2.
3. The mask address can be input for [Start] when the single address is specified.
4. The mask address cannot be input for [Start] and [End] when the address range is specified.

(4) [Software] page

Specifies the address and data conditions of the software trace.

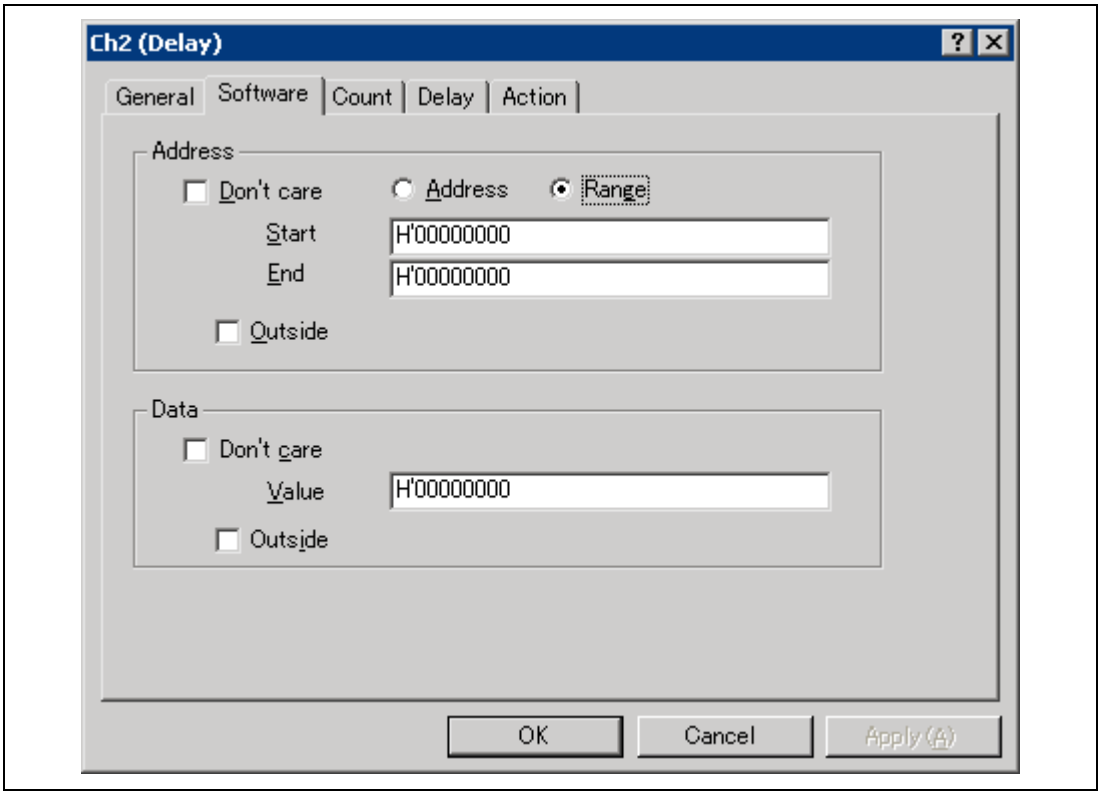


Figure 5.36 [Chx (Delay)] Dialog Box ([Software] Page)

[Address]: Sets the address condition.

- [Don't care]: Sets no address condition.
- [Address]: Sets the single address.
- [Range]: Sets the address range.
- [Start]: Sets the single address or the start address of the address range.
- [End]: Sets the end address of the address range.
- [Outside]: Sets other value than that has been set for the single address or address range as the condition.

[Data]: Sets the data condition.

[Don't care]: Sets no data condition.

[Value]: Sets the data bus value (mask data can be input).

[Outside]: Sets other value than that has been set for [Value] as the condition.

Notes: 1. This page is only displayed when [Software trace data] is specified on the [General] page.
2. The address range can only be specified for AUD event channels Ch1 and Ch2.
3. The mask address can be input for [Start] when the single address is specified.
4. The mask address cannot be input for [Start] and [End] when the address range is specified.

(5) [Count] page

Specifies the satisfaction count conditions.

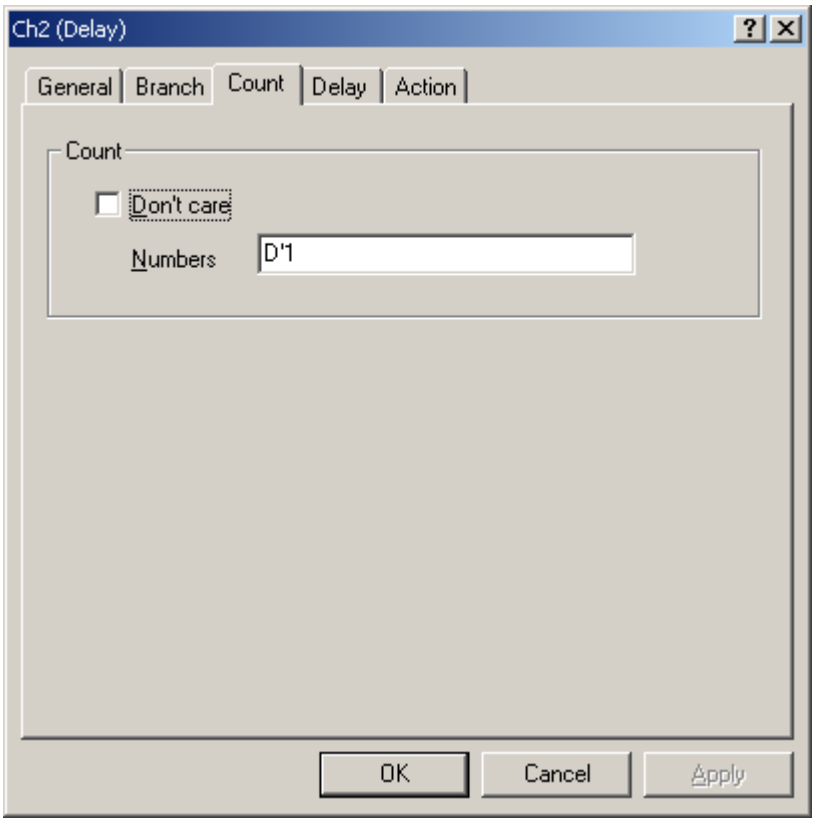


Figure 5.37 [Chx (Delay)] Dialog Box ([Count] Page)

[Don’t care]: Sets no satisfaction count.

[numbers]: Sets a value as the satisfaction count condition; D’1 to D’65535 is available.

Note: If [Trace get] is selected on the [Action] page, this page will not be displayed.

(6) [Delay] page

Sets the delay cycle from the event detection to the AUD trace stop.

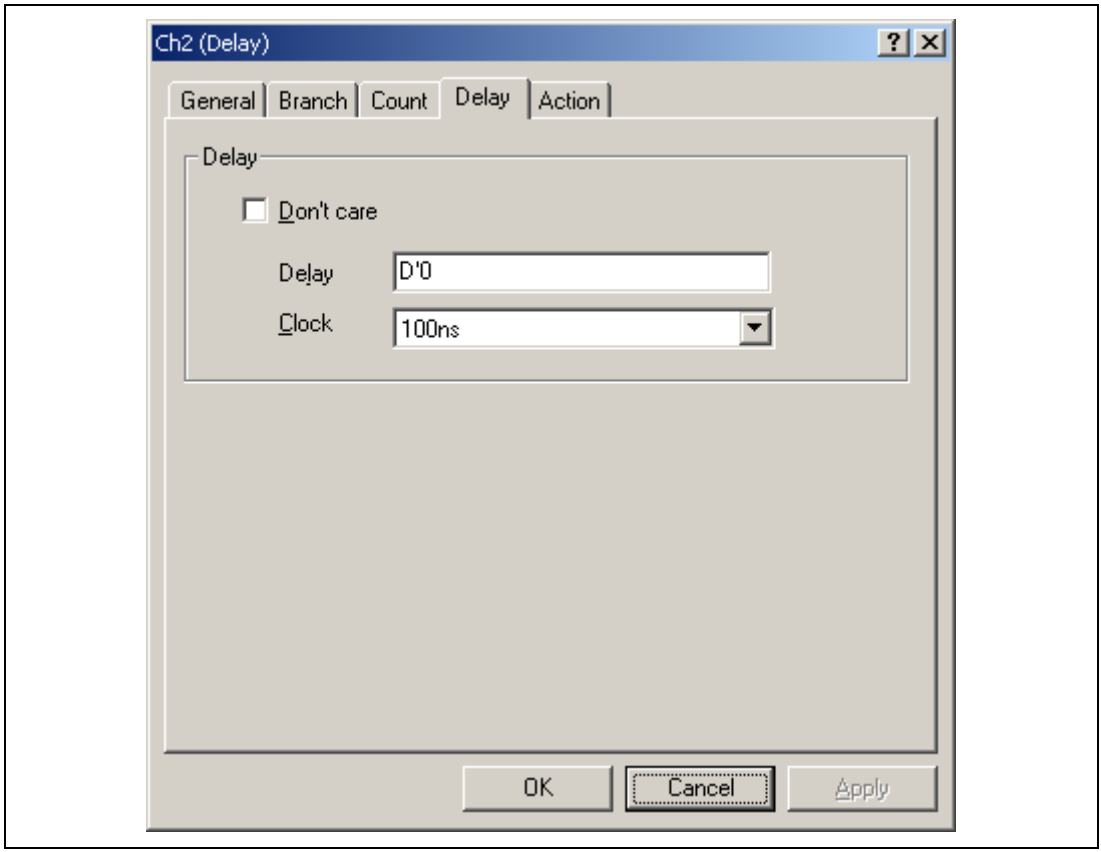


Figure 5.38 [Chx (Delay)] Dialog Box ([Delay] Page)

[Don't care]: Sets no delay condition.

[Delay]: Sets the delay cycle counts; D'1 to D'262143 is available.

[Clock]: Sets a cycle for delay measurement.

[100ns]:	Specifies 100 ns as one cycle.
[number of trace information]:	Specifies a set of AUD trace information as one cycle.

Note: This page is only displayed when AUD event channel Ch2 is selected and [Trace stop] is specified on the [Action] page.

(7) [Action] page

Sets the operation after the condition has been satisfied.

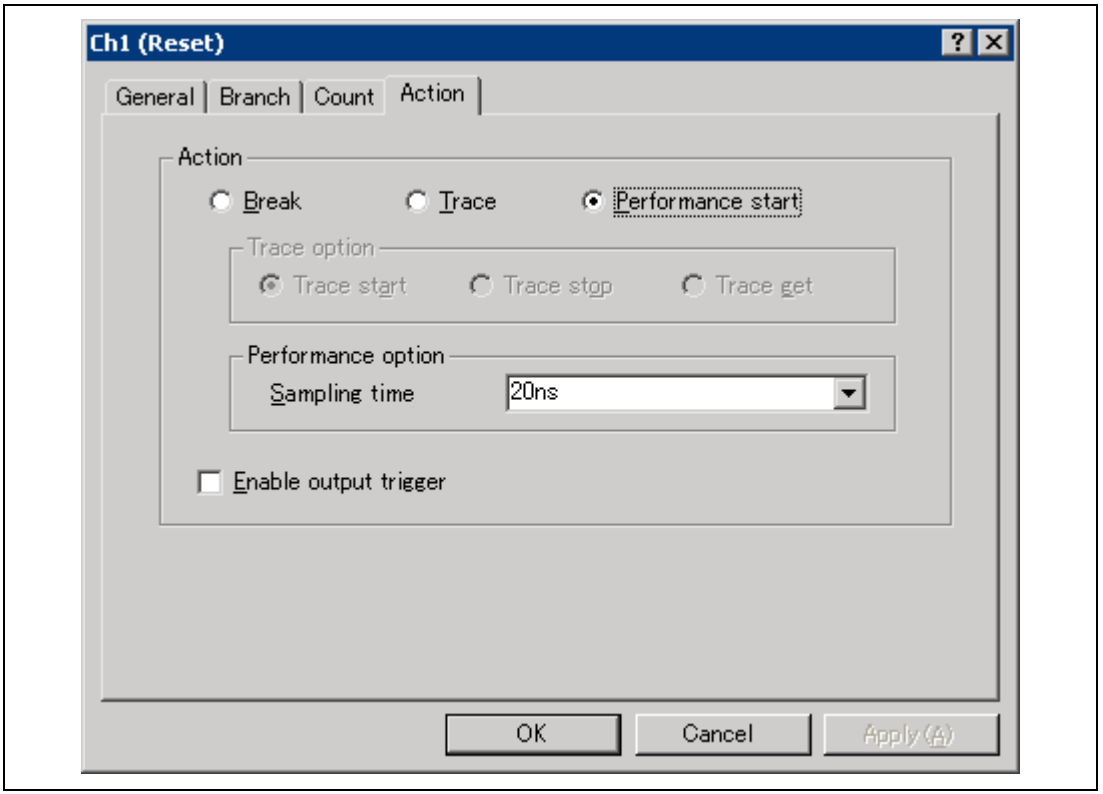


Figure 5.39 [Chx (Reset)] Dialog Box ([Action] Page)

[Break]: Breaks after conditions have been matched.

[Trace]: Enables [Trace option] and sets the AUD trace operation.
[Trace start]: Starts AUD trace after conditions have been matched.
[Trace stop]: Stops AUD trace after conditions have been matched.
[Trace get]: Acquires AUD trace after conditions have been matched.

[Performance start]: Starts or ends AUD performance measurement after conditions have been matched. When this option is selected, [Performance option] is enabled and the time interval of the performance measurement can be specified.
Sampling time: Specifies the time interval of the AUD performance measurement as any of the following values:
20 ns, 100 ns, 400 ns, or 1.6 μs

[Enable output trigger]: Specifies whether or not the trigger is output after conditions have been matched.

Notes: 1. For AUD performance measurement, two AUD event channels are used to start and stop measurement. When an event channel is specified for performance measurement, the related channels (Ch1 to Ch2, Ch3 to Ch4, Ch5 to Ch6, and Ch7 to Ch8) must also be specified.

2. The [Performance option] is only displayed for AUD event channels Ch1, Ch3, Ch5, and Ch7.

(8) [Sequential AUD Event] dialog box

The sequential AUD event occurs when all the AUD Eventpoint conditions are satisfied in the specified order.

AUD event channel Ch1 can be specified as the reset point. When the reset point is passed, the satisfied eventpoint condition is disabled and checking the first eventpoint condition is started.

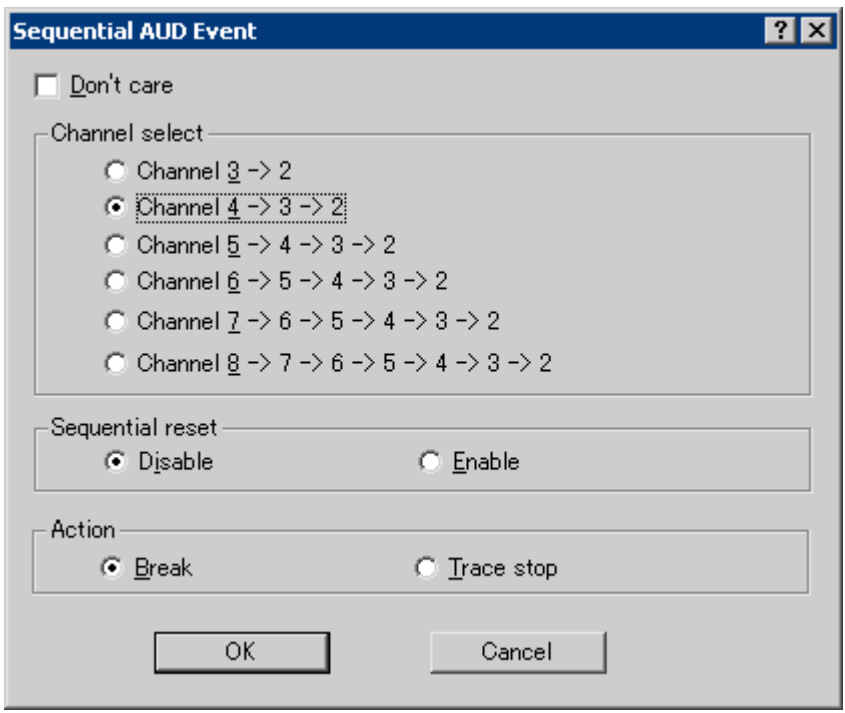


Figure 5.40 [Sequential AUD Event] Dialog Box

[Don't care]: Sets no sequential AUD event condition.

[Channel select]: Specifies the order that the sequential AUD event is satisfied.

[Channel 3 -> 2]:
After conditions have been matched in the order of AUD event channel 3 -> 2, a sequential AUD event occurs.

[Channel 4 -> 3 -> 2]:
After conditions have been matched in the order of AUD event channel 4 -> 3 -> 2, a sequential AUD event occurs.

[Channel 5 -> 4 -> 3 -> 2]:
After conditions have been matched in the order of AUD event channel 5 -> 4 -> 3 -> 2, a sequential AUD event occurs.

[Channel 6 -> 5 -> 4 -> 3 -> 2]:
After conditions have been matched in the order of AUD event channel 6 -> 5 -> 4 -> 3 -> 2, a sequential AUD event occurs.

[Channel 7 -> 6 -> 5 -> 4 -> 3 -> 2]:
After conditions have been matched in the order of AUD event channel 7 -> 6 -> 5 -> 4 -> 3 -> 2, a sequential AUD event occurs.

[Channel 8 -> 7 -> 6 -> 5 -> 4 -> 3 -> 2]:
After conditions have been matched in the order of AUD event channel 8 -> 7 -> 6 -> 5 -> 4 -> 3 -> 2, a sequential AUD event occurs.

[Sequential reset]: Selects whether or not AUD event channel Ch1 is used as the reset point.
[Disable]: Not used as the reset point.
[Enable]: Used as the reset point.

[Action]: Specifies the operation after the sequential AUD event has been detected.
[Break]: Breaks after the sequential AUD event has been detected.
[Trace stop]: Stops AUD trace after the sequential AUD event has been detected.

Note: When the sequential AUD event condition is set and the eventpoint condition is edited with the AUD event channel that has been selected for [Channel select], the [Action] page cannot be modified. To modify the settings of the [Action] page, cancel the sequential AUD event condition.

5.8.7 Setting BUS Eventpoints

On the [BUS Event] sheet, the settings for BUS Eventpoints are displayed and modified.

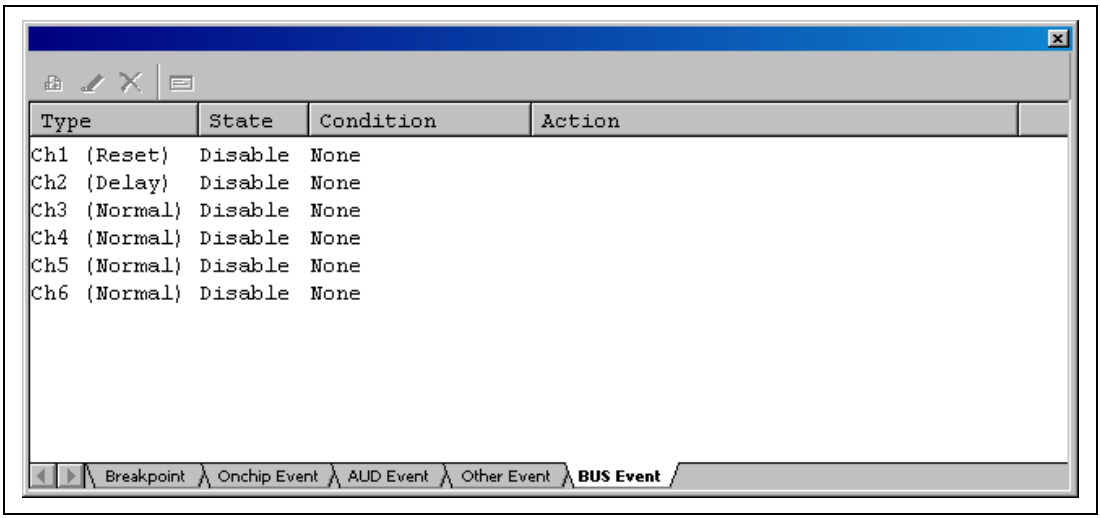


Figure 5.41 [Event] Window ([BUS Event] Sheet)

Using six event detection channels sets six eventpoints.

Notes: 1. When the external bus trace unit is not connected to the emulator, this function is not supported.
2. When the debugging function of the external bus trace unit is set again, the number of event detection channels changes.

Items that can be displayed in the sheet are listed below.

[Type] External bus event channel number and type
Normal: Standard event channel
Delay: Event channel that delay conditions can be set
Reset: Event channel that can be set as the reset point of the external bus sequential event

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

[Condition] A condition that satisfies an eventpoint. The displayed contents differ depending on the channel.

[Action] Operation of the emulator when an eventpoint condition is satisfied. The displayed contents differ depending on the channel.

When an event channel is double-clicked or selected and [Edit...] is selected from the popup menu in this window, the [Chx] dialog box is displayed.

The [Chx] dialog box consists of the [Address], [Data], [Interrupt], [Count], [Delay], and [Action] pages.

The combination of the conditions set in each page is set as the detection condition of eventpoints.

(1) [Address] page

Specifies the address condition.

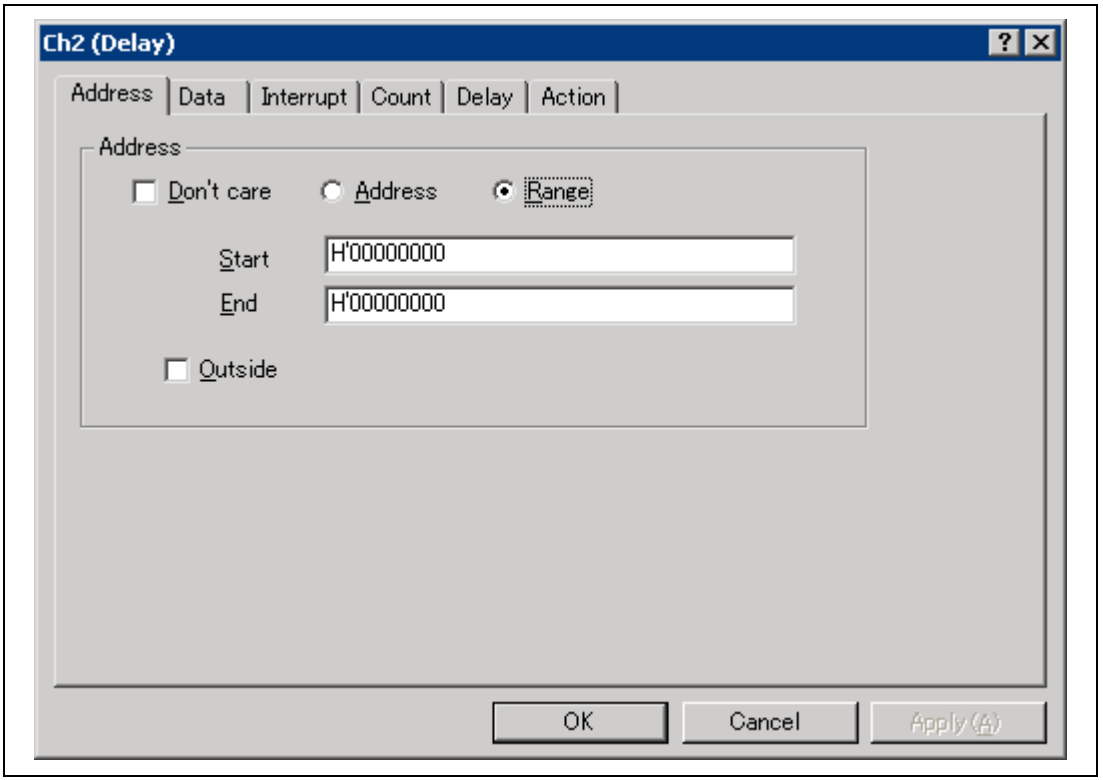


Figure 5.42 [Chx (Delay)] Dialog Box ([Address] Page)

[Address]: Sets the address condition.

- [Don't care]: Sets no address condition.
- [Address]: Sets the single address.
- [Range]: Sets the address range.
- [Start]: Sets the single address or the start address of the address range (mask address can be input).
- [End]: Sets the end address of the address range (mask address can be input).
- [Outside]: Sets other value than that has been set for the single address or address range as the condition.

(2) [Data] page

Specifies the data bus condition.

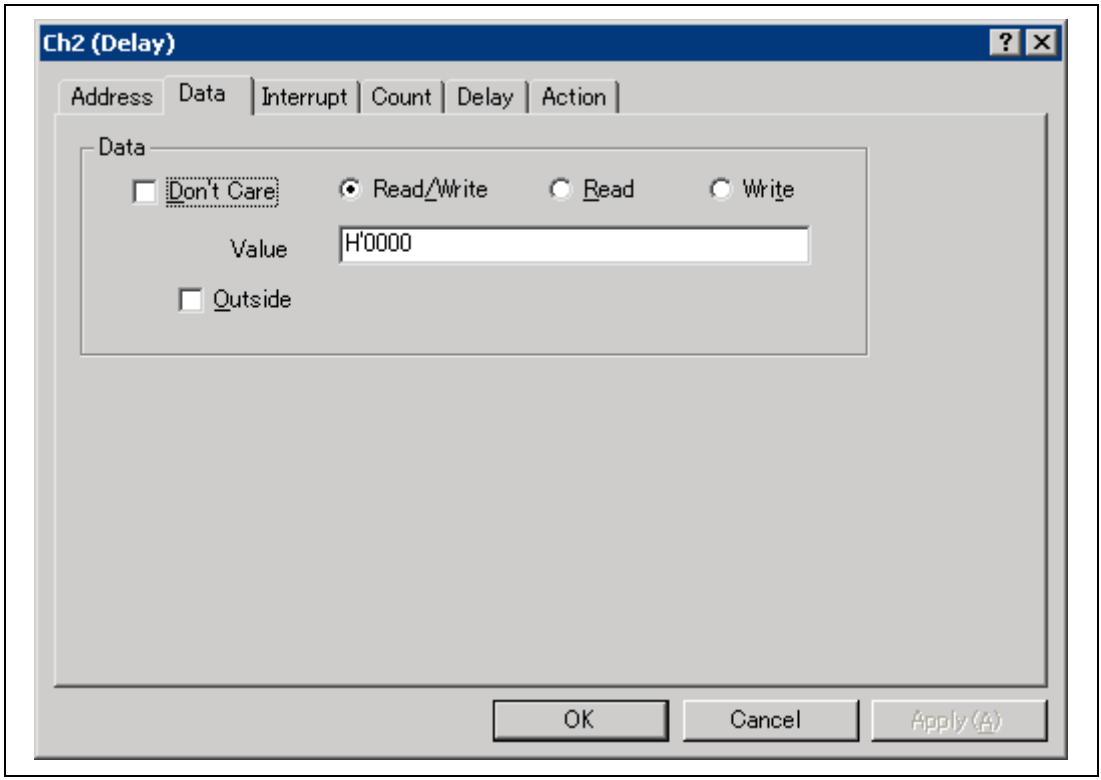


Figure 5.43 [Chx (Delay)] Dialog Box ([Data] Page)

[Data]: Sets the data condition.

[Don't care]: Sets no data condition.

[Read/Write]: Sets the read or write cycle as the condition.

[Read]: Sets the read cycle as the condition.

[Write]: Sets the write cycle as the condition.

[Value]: Sets the data bus value (mask data can be input).

[Outside]: Sets other value than that has been set for [Value] as the condition.

(3) [Interrupt] page

Specifies the signal conditions of NMI and external interrupts.

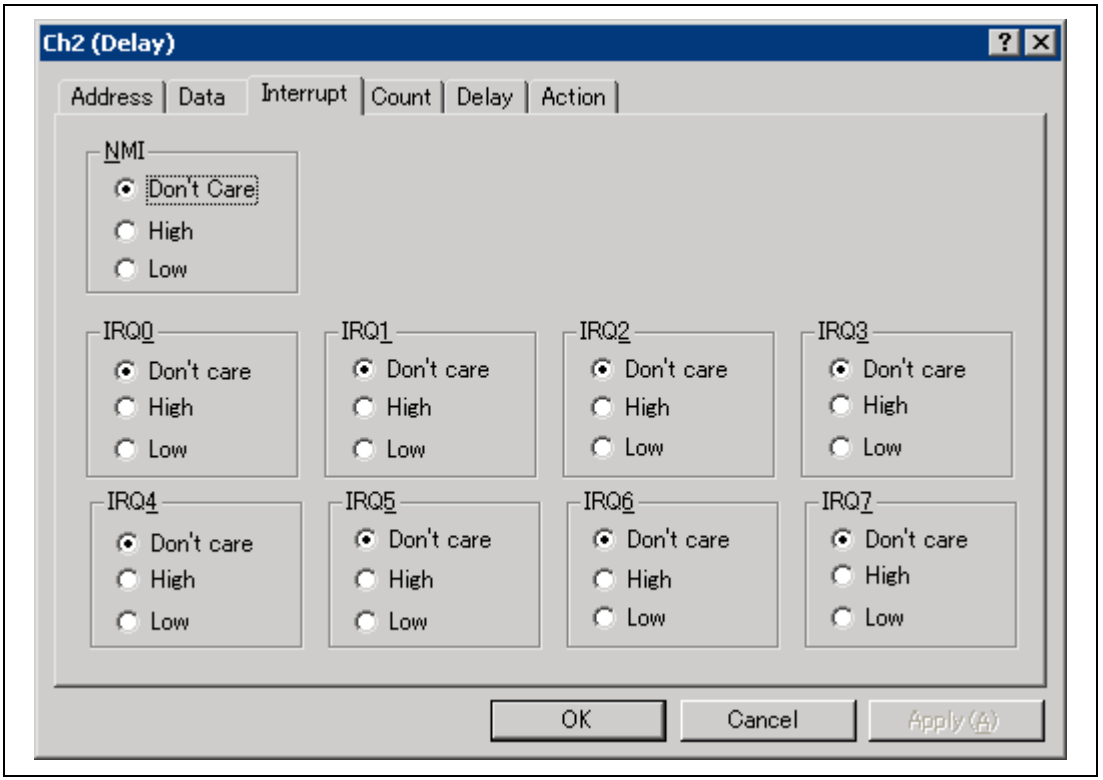


Figure 5.44 [Chx (Delay)] Dialog Box ([Interrupt] Page)

[Don't care]: Sets no signal condition.

[High]: Satisfies a condition when the signal is high.

[Low]: Satisfies a condition when the signal is low.

Note: The external interrupt signal differs depending on the supported MCU. For details, refer to the online help.

(4) [Count] page

Specifies the satisfaction count condition.

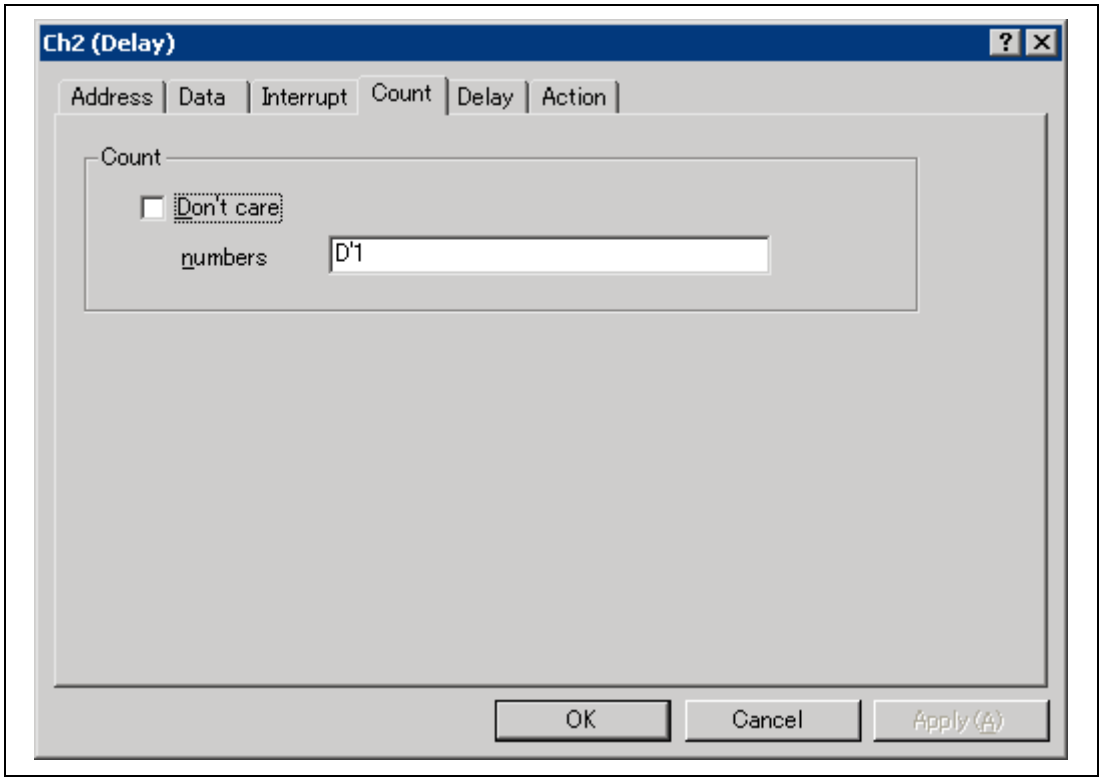


Figure 5.45 [Chx (Delay)] Dialog Box ([Count] Page)

[Don't care]: Sets no satisfaction count.

[numbers]: Sets a value as the satisfaction count condition; D'1 to D'65535 is available.

Note: If [Trace get] is selected on the [Action] page, this page will not be displayed.

(5) [Delay] page

Sets the delay cycle from the event detection to the external bus trace stop.

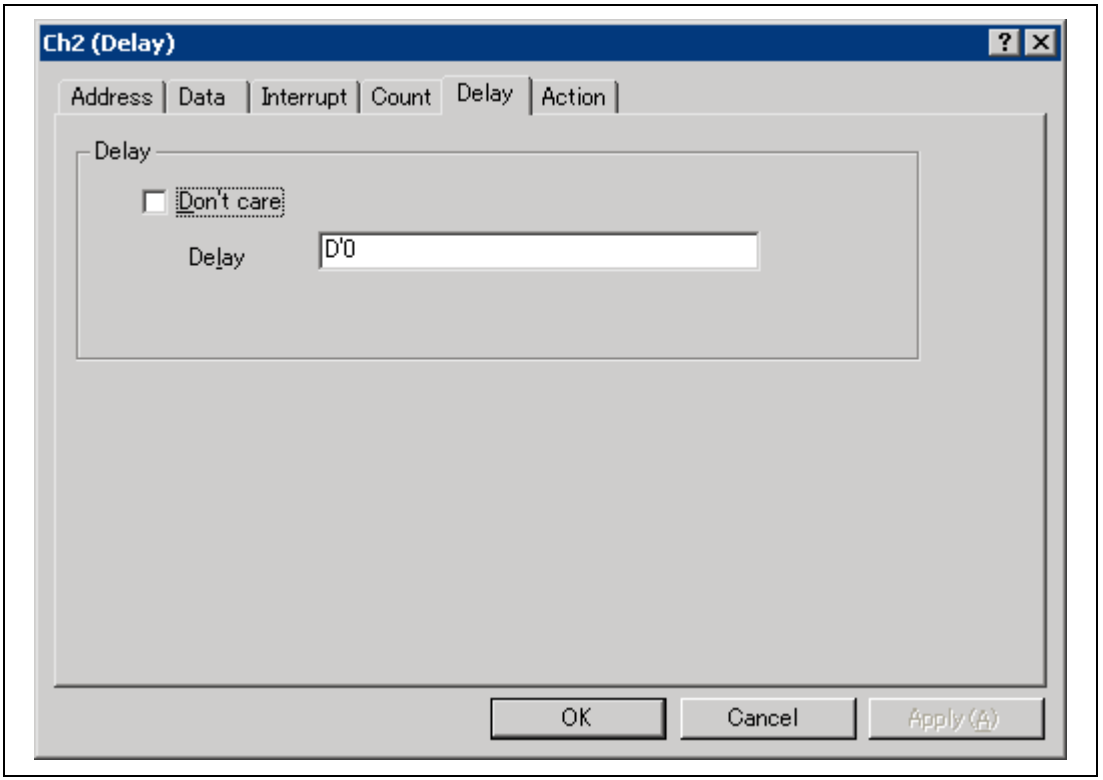


Figure 5.46 [Chx (Delay)] Dialog Box ([Delay] Page)

[Don’t care]: Sets no delay condition.

[Delay]: Sets the delay cycle counts; D’1 to D’262143 is available.

Note: This page is only displayed when external bus event channel Ch2 is selected and [Trace stop] is specified on the [Action] page.

(6) [Action] page

Sets the operation after the condition has been satisfied.

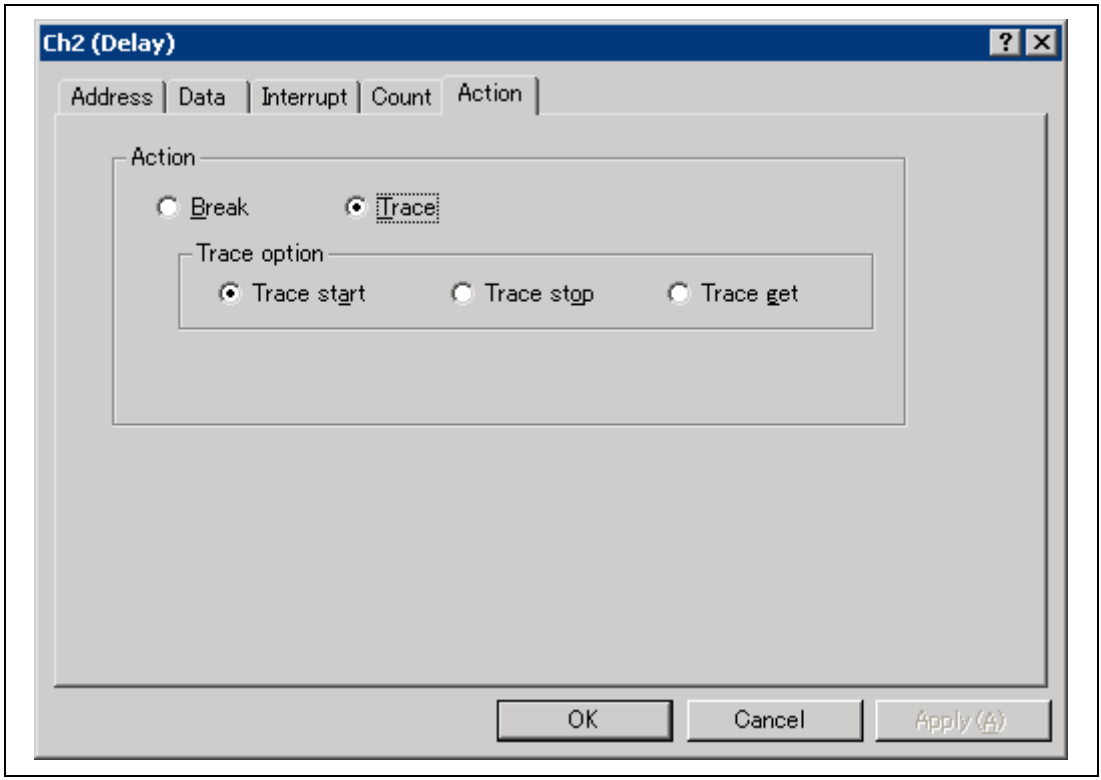


Figure 5.47 [Chx (Delay)] Dialog Box ([Action] Page)

[Break]: Breaks after conditions have been matched.

[Trace]: Enables [Trace option] and sets the external bus trace operation.
[Trace start]: Starts external bus trace after conditions have been matched.
[Trace stop]: Stops external bus trace after conditions have been matched.
[Trace get]: Acquires external bus trace after conditions have been matched.

(7) [Sequential BUS Event] dialog box

The sequential bus event occurs when all the BUS Eventpoint conditions are satisfied in the specified order.

Bus event channel Ch1 can be specified as the reset point. When the reset point is passed, the satisfied eventpoint condition is disabled and checking the first eventpoint condition is started.

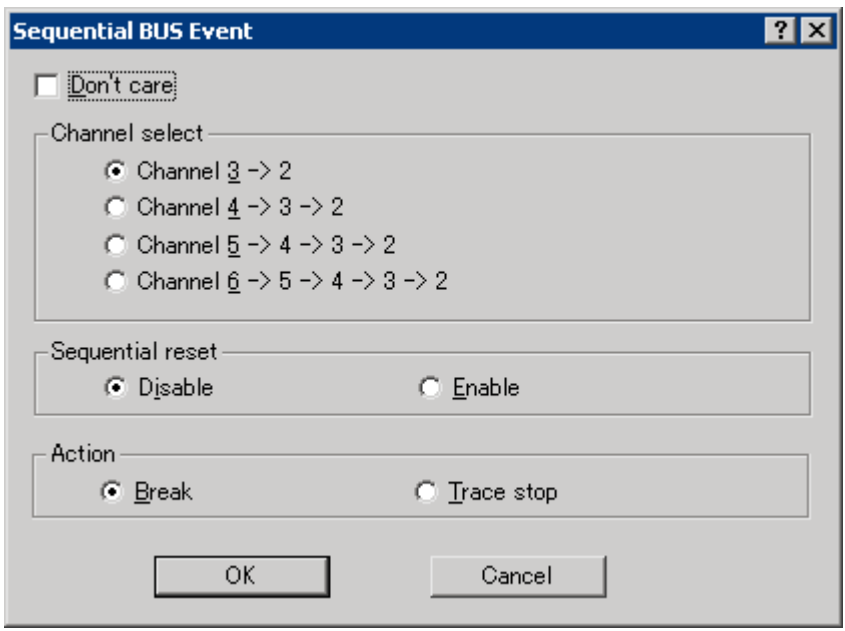


Figure 5.48 [Sequential BUS Event] Dialog Box

[Don't care]: Sets no Sequential BUS Event condition.

[Channel select]: Specifies the order that the Sequential BUS Event is satisfied.

[Channel 3 -> 2]:
After conditions have been matched in the order of bus event channel 3 -> 2, a Sequential BUS Event occurs.

[Channel 4 -> 3 -> 2]:
After conditions have been matched in the order of bus event channel 4 -> 3 -> 2, a Sequential BUS Event occurs.

[Channel 5 -> 4 -> 3 -> 2]:
After conditions have been matched in the order of bus event channel 5 -> 4 -> 3 -> 2, a Sequential BUS Event occurs.

[Channel 6 -> 5 -> 4 -> 3 -> 2]:
After conditions have been matched in the order of bus event channel 6 -> 5 -> 4 -> 3 -> 2, a Sequential BUS Event occurs.

[Sequential reset]: Selects whether or not bus event channel Ch1 is used as the reset point.
[Disable]: Not used as the reset point.
[Enable]: Used as the reset point.

[Action]: Specifies the operation after the Sequential BUS Event has been detected.
[Break]: Breaks after the Sequential BUS Event has been detected.
[Trace stop]: Stops external bus trace after the Sequential BUS Event has been detected.

Note: When the Sequential BUS Event condition is set and the eventpoint condition is edited with the bus event channel that has been selected for [Channel select], the [Action] page cannot be modified. To modify the settings of the [Action] page, cancel the Sequential BUS Event condition.

5.8.8 Setting Other Eventpoints

On the [Other Event] sheet, the settings for Other Eventpoints are displayed and modified.

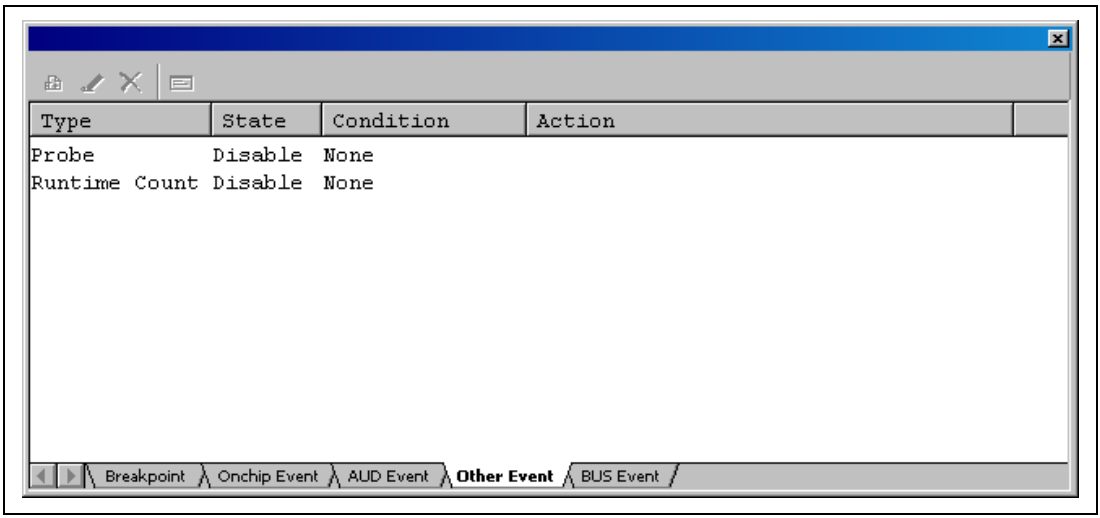


Figure 5.49 [Event] Window ([Other Event] Sheet)

Items that can be displayed in the sheet are listed below. The display content will be added depending on the status of the optional units in use.

[Type] Other event channel
Probe: External probe event channel
Runtime Count: Execution-time event channel

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

[Condition] A condition that satisfies an eventpoint. The displayed contents differ depending on the channel.

[Action] Operation of the emulator when an eventpoint condition is satisfied. The displayed contents differ depending on the channel.

When an event channel is double-clicked or selected and [Edit...] is selected from the popup menu in this window, the dialog box for setting conditions is displayed. The displayed contents of this dialog box differ depending on the event channel.

(1) [Probe] dialog box

Double-clicking the [Probe] event channel displays this dialog box. Conditions of the eventpoint can be set on the [Condition] and [Action] pages.

(a) [Condition] page:
Specifies four external probe signal conditions via the external probe cable.

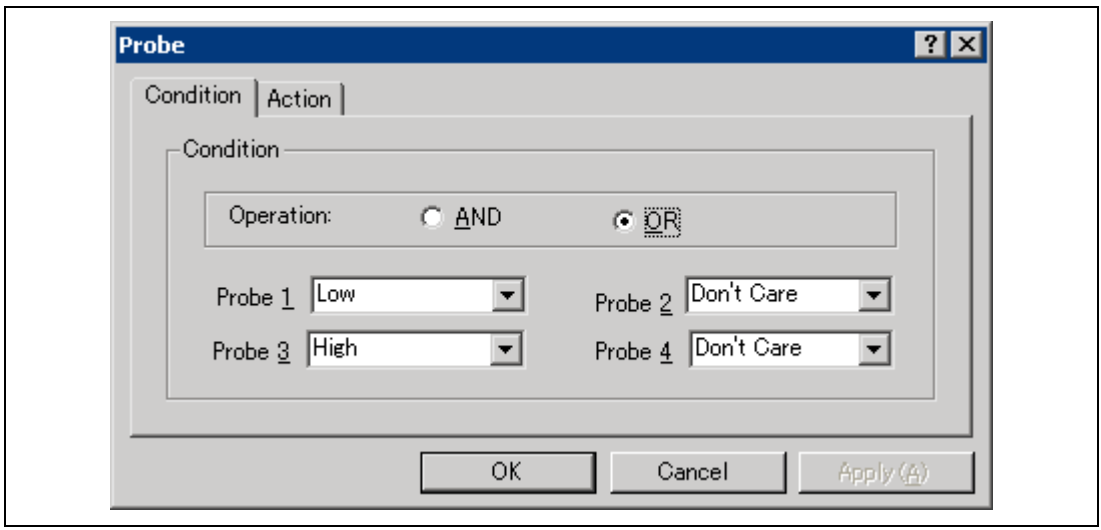


Figure 5.50 [Probe] Dialog Box ([Condition] Page)

[Operation]: Specifies how to combine the probe signal conditions.
[AND]: Determines whether or not the condition is satisfied by AND operation of the probe signal condition.
[OR]: Determines whether or not the condition is satisfied by OR operation of the probe signal condition.

[Probe 1 to 4]: Specifies the probe signal conditions.
[Don't care]: Specifies no probe signal condition.
[High]: Satisfies the condition when the probe signal is high.
[Low]: Satisfies the condition when the probe signal is low.

(b) [Action] page:
Sets the operation after the condition has been satisfied.

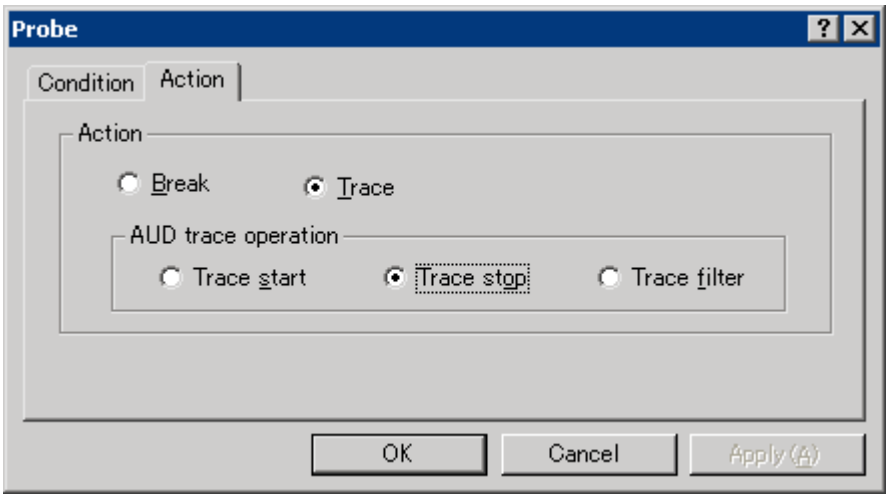


Figure 5.51 [Probe] Dialog Box ([Action] Page)

[Break]: Breaks after conditions have been matched.

[Trace]: Enables [AUD trace option] and sets the AUD trace operation.
[Trace start]: Starts AUD trace after conditions have been matched.
[Trace stop]: Stops AUD trace after conditions have been matched.
[Trace filter]: Sets the filter condition for acquiring AUD trace after conditions have been matched.

(2) [Runtime Count] dialog box

Double-clicking the [Runtime Count] event channel displays this dialog box. Conditions of the eventpoint can be set on the [Condition] and [Action] pages.

(a) [Condition] page:
Specifies the execution time of the user program.

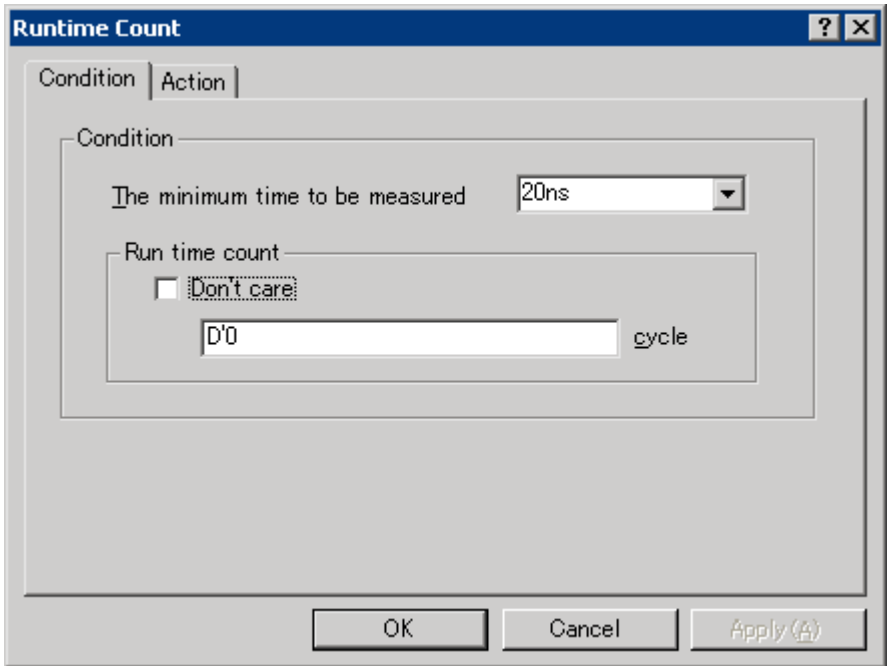


Figure 5.52 [Runtime Count] Dialog Box ([Condition] Page)

[The minimum time to be measured]: Specifies the resolution of the timer for execution time measurement as any of the following values:
20 ns, 100 ns, 400 ns, or 1.6 µs

[Runtime count]: Specifies the execution time conditions.
[Don't care]: Specifies no execution time condition.
[Cycle]: Enters the measurement cycle counts; D'0 to D'1099511627775 is available.

(b) [Action] page:
Sets the operation after the condition has been satisfied.

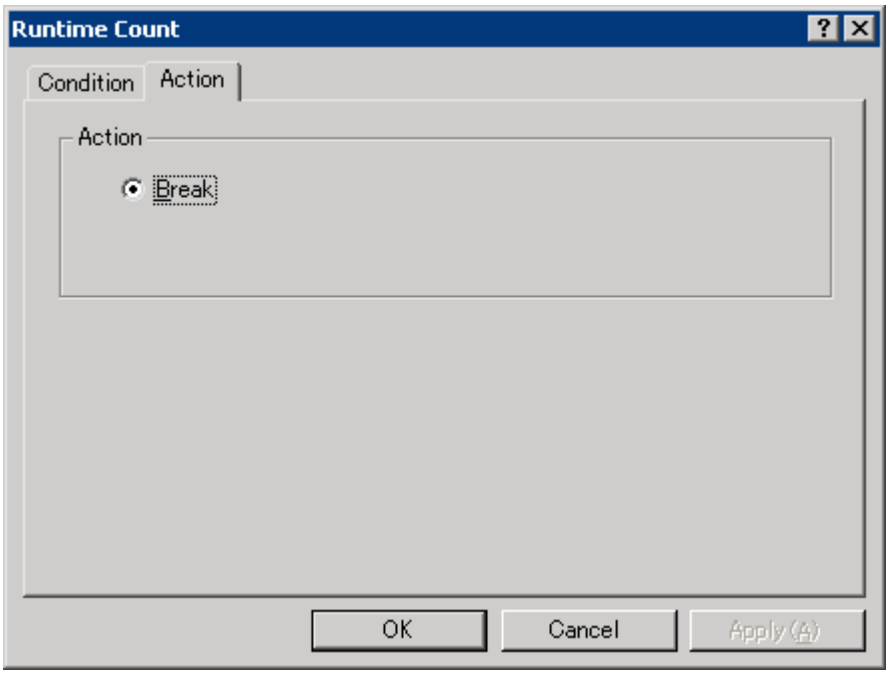


Figure 5.53 [Runtime Count] Dialog Box ([Action] Page)

[Break]: Breaks after conditions have been matched.

5.8.9 Editing Breakpoint or Eventpoint

Select a break condition to be modified, and choose [Edit...] from the popup menu to open the dialog box for the point, which allows the user to modify the breakpoints or eventpoints. The [Edit...] menu is only available when one breakpoint or eventpoint is selected.

5.8.10 Enabling Breakpoint or Eventpoint

Select a breakpoint or an eventpoint and choose [Enable] from the popup menu to enable the selected breakpoint or eventpoint.

5.8.11 Disabling Breakpoint or Eventpoint

Select a breakpoint or an eventpoint and choose [Disable] from the popup menu to disable the selected breakpoint or eventpoint. When a breakpoint or an eventpoint is disabled, a condition will not be satisfied when the specified conditions have been satisfied.

5.8.12 Deleting Breakpoint or Eventpoint

Select a breakpoint or an eventpoint and choose [Delete] from the popup menu to delete the selected breakpoint or eventpoint. To retain the break condition but not have it cause an event when its conditions are met, use the [Disable] option (see section 5.8.11, Disabling Breakpoint or Eventpoint).

5.8.13 Deleting All Breakpoints or Eventpoints

Choose [Delete All] from the popup menu to delete all breakpoints or eventpoints.

5.8.14 Viewing the Source Line for Breakpoints or Eventpoints

Select a breakpoint or an eventpoint and choose [Go to Source] from the popup menu to open the [Editor] or [Disassembly] window at the address of the breakpoint or eventpoint. The [Go to Source] menu is only available when one breakpoint or eventpoint that has the corresponding source file is selected.

5.9 Viewing the Trace Information

In the emulator, there are functions to acquire information within and outside the MCU by a trace. The emulator acquires three types of trace information: internal trace (Internal trace), AUD trace (AUD trace), and external bus trace (BUS trace).

The information on the Internal trace and AUD trace is displayed on the [Internal/AUD] window. The information on the BUS trace is displayed on the [BUS trace] window.

For the description on the trace function, refer to section 6.19, Trace Functions.

5.9.1 Opening the [Internal/AUD] Window

To display the [Trace Window Type] dialog box, choose [View -> Code -> Trace] or click the [Trace] toolbar button ( ).

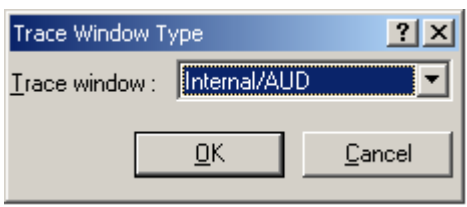


Figure 5.54 [Trace Window Type] Dialog Box

Selecting [Internal/AUD] and clicking the [OK] button displays the [Internal/AUD] window.

(1) Acquiring Internal Trace Information (Internal trace)

Selecting the [Set…] menu in the popup menu of the [Internal/AUD] window displays the [I-Trace/AUD-Trace acquisition] dialog box. When [Internal trace] is selected in [Trace Type] within the dialog box, the trace information is acquired by using the internal trace function.

When the emulator does not set the acquisition condition of the trace information, the trace information is acquired by the internal trace function in default.

The acquired trace information is displayed in the [Internal/AUD] window.

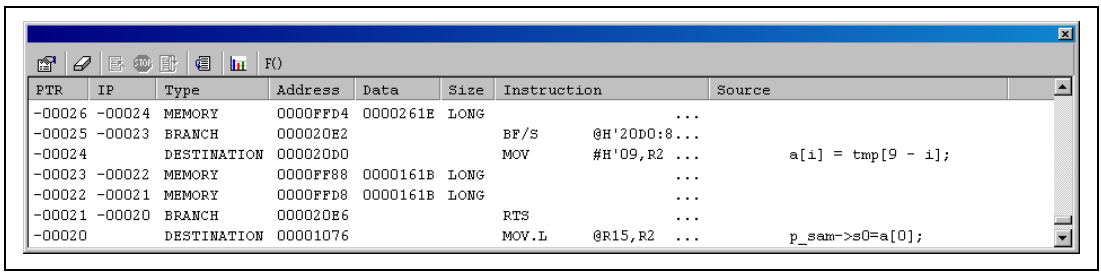


Figure 5.55 [Internal/AUD] Window (Type 1) (Internal Trace)

Some MCUs to be debugged display the items below. For details on the specifications of each product, refer to the additional document, Supplementary Information on Using the SHxxxx, or the online help.

[PTR] The trace buffer pointer (+0 for the last executed instruction)

[IP] The amount of acquired trace information

[Master] (Bus Master) Type of bus master accessed

[Type] Type of trace information:
- BRANCH: Branch source
- DESTINATION: Branch destination
- MEMORY: Memory access
- S_TRACE: Executed Trace(x) function
- LOST: Lost trace information (only in the realtime mode)

[Branch Type] Type of branch (only when the branch trace is acquired):
- GENERAL: General branch
- SUBROUTINE: Subroutine branch
- EXCEPTION: Exception branch

[Bus]	The bus which was being accessed
[R/W]	Whether the generated data is associated with read or write access
[Address]	Address
[Data]	The data of the generated data access. When [Type] is S_TRACE, value x, a variable of function Trace(x), is displayed.
[Instruction]	Instruction mnemonic
[Source]	The C/C++ or assembly-language source program
[Label]	Label information

(2) Acquiring AUD Trace Information (AUD trace)

Selecting the [Set…] menu in the popup menu of the [Internal/AUD] window displays the [I-Trace/AUD-Trace acquisition] dialog box. When [AUD trace] is selected in [Trace Type] within the dialog box, the trace information is acquired by using the AUD trace function.

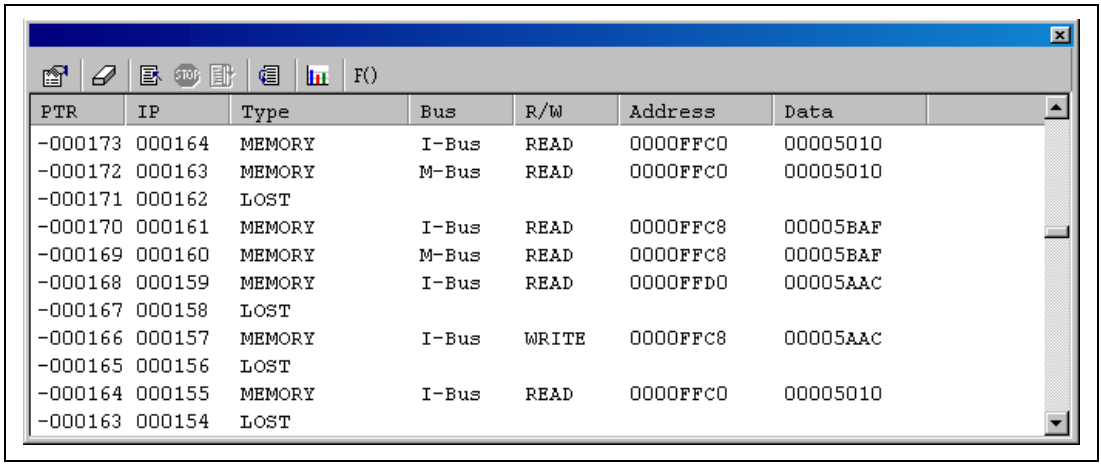


Figure 5.56 [Internal/AUD] Window (Type 2) (AUD Trace)

This window displays the following trace information items (some of this information will not be displayed in some products):

[PTR] The AUD trace buffer pointer (+0 for the last executed instruction)

[IP] The amount of acquired trace information

[Type] Type of trace information:
BRANCH: Branch source
DESTINATION: Branch destination
MEMORY: Memory access
S_TRACE: Executed Trace(x) function
LOST: Lost trace information (only in the realtime mode)

[Bus] The bus which was being accessed

[R/W] Whether the generated data is associated with read or write access

[Address] Address

[Data] The data of the generated data access. When [Type] is S_TRACE, value x, a variable of function Trace(x), is displayed.

[Instruction] Instruction mnemonic

[Timestamp] Time stamp value

[Source] The C/C++ or assembly-language source program

[Label] Label information

[Timestamp-Difference] Difference value of the time stamp

Note: Since the displayed contents differ depending on the product, refer to each product's online help. Some MCUs supported may not have the AUD trace function.

(3) Specifying Conditions or Modes for Acquiring Trace Information

The capacity of the trace buffer is limited. When the buffer becomes full, the oldest trace information is overwritten. Setting the trace acquisition condition allows acquisition of useful trace information and effective use of the trace buffer.

The trace information acquisition conditions are implemented by eventpoints, and acquisition start, acquisition end, and acquisition can be controlled. For setting eventpoints, refer to section 5.8, Using the Eventpoints.

The trace information acquisition mode is set in the [I-Trace/AUD-Trace acquisition] dialog box that is displayed by selecting [Set…] from the popup menu.

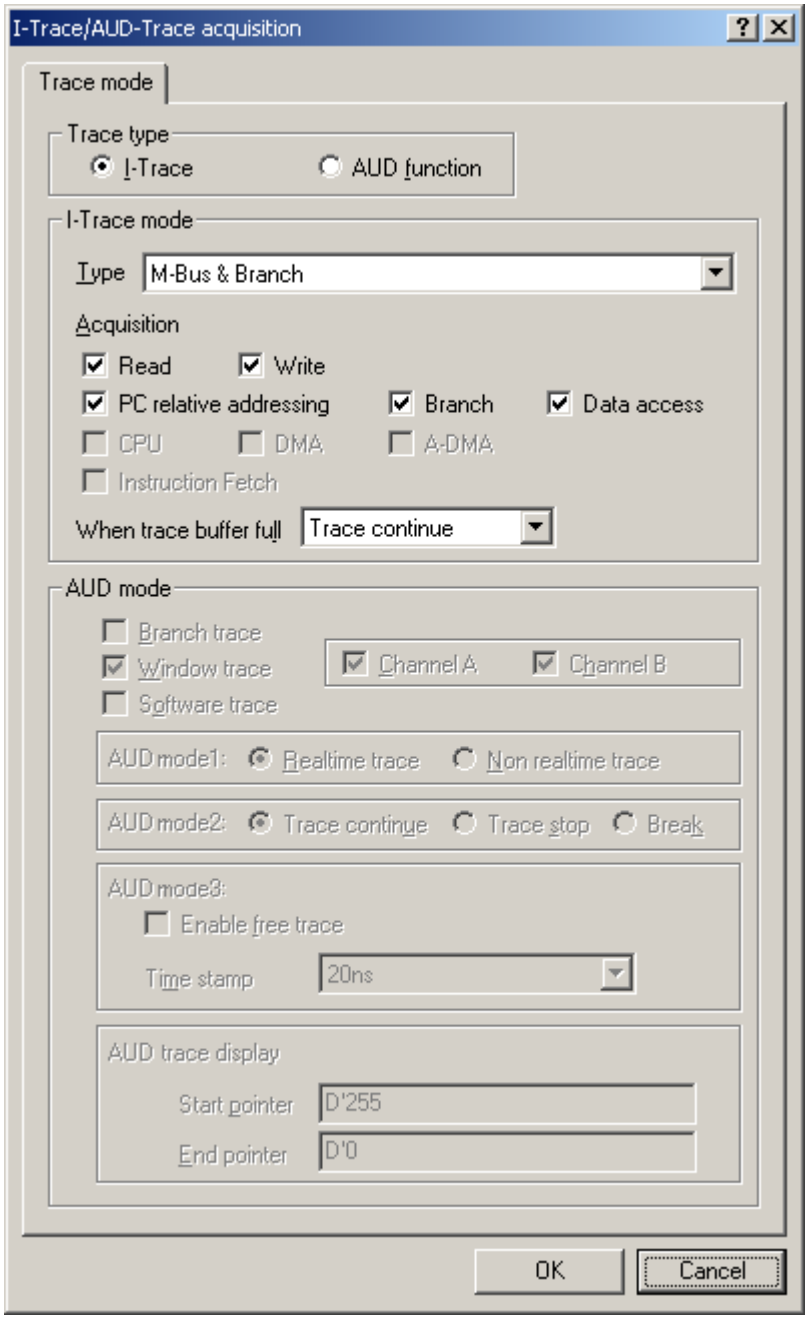


Figure 5.57 [I-Trace/AUD-Trace acquisition] Dialog Box

[Trace type]: Selects the type of trace function.

- [I-Trace] Selects the internal trace function.
- [AUD function] Selects the AUD trace function.

[I-Trace mode]: Sets the mode when the internal trace function is used.

- [Type] When checked, the bus and branch are selected and set as the condition for acquiring trace.
- [Acquisition] When those boxes are checked, only the internal information that matches the checked condition are acquired.
- [When trace buffer full] Selects the operation when the trace buffer becomes full.
  - [Trace continue] Overwrites the old trace information to acquire the latest trace information.
  - [Trace stop] Acquires no information.
  - [Break] A break occurs.

[AUD mode]: Sets the mode when the AUD trace function is used.

- [Branch trace] When checked, the branch source and destination addresses are set as the condition.
- [Window trace] Uses the window trace function. When this box is checked, information on memory accesses within the specified range is acquired.
- [AUD mode 1] Selects the operating mode for consecutive trace acquisition.
  - [Realtime trace] Some trace information are not acquired.
  - [Non realtime trace] The CPU stops operations until the acquisition is completed.
- [AUD mode 2] Selects the operation when the trace buffer becomes full.
  - [Trace continue] Overwrites the old trace information to acquire the latest trace information.
  - [Trace stop] Acquires no information.
  - [Break] A break occurs.
- [AUD mode 3] Sets the mode when the AUD trace function is used.
  - [Enable free trace] When checked, the settings of the AUD eventpoint are ignored and the whole trace information is acquired.
  - [Time stamp clock] Specifies the resolution of the timer for time stamp as any of the following values: 20 ns, 100 ns, 400 ns, or 1.6 μs

[AUD trace display range]: Sets the trace display range when the AUD trace function is used.

[Start pointer]	Enter the numerical start pointer value of the display range.
[End pointer]	Enter the numerical end pointer value of the display range.

Notes: 1. When [Internal trace] is selected, [AUD MODE], [AUD mode 1], [AUD mode 2], [AUD mode 3], and [AUD trace display range] are disabled.
2. [AUD MODE], [AUD mode 1], [AUD mode 2], [AUD mode 3], and [AUD trace display range] are enabled only when [AUD trace] is selected.
3. Refer to the online help of each product because available trace acquisition conditions depend on the product.
4. Some MCUs do not have the AUD trace function.

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

5.9.2 Opening the [BUS trace] Window

To display the [Trace Window Type] dialog box, choose [View -> Code -> Trace] or click the [Trace] toolbar button ( ).

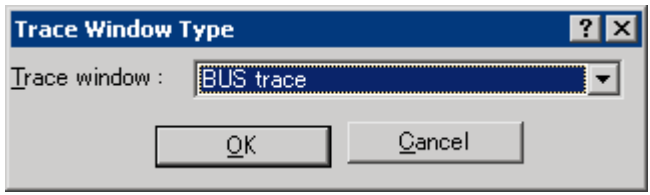


Figure 5.58 [Trace Window Type] Dialog Box

Selecting [BUS trace] and clicking the [OK] button displays the [BUS trace] window.

Notes: 1. When the external bus trace unit is not connected to the emulator, the external bus trace function is not supported.
2. When the function of the external bus trace unit is changed, the number of bus cycles that can be acquired by the external bus trace is changed. For details, refer to section 5.1.5, [Bus Board] Page.
3. Not only the BUS trace but also other trace functions can be displayed in this window depending on the product. For details on the specifications of each product, refer to the online help.

5.9.3 Acquiring External Bus Trace Information (BUS trace)

Selecting the [Set…] menu in the popup menu of the [BUS trace] window displays the [BUS acquisition] dialog box. When [BUS trace] is selected in [Trace Type] within the dialog box, the trace information is acquired by using the external bus trace function.

When the emulator does not set the acquisition condition of the trace information, the trace information is acquired by the external bus trace function in default.

The acquired trace information is displayed in the [BUS trace] window.

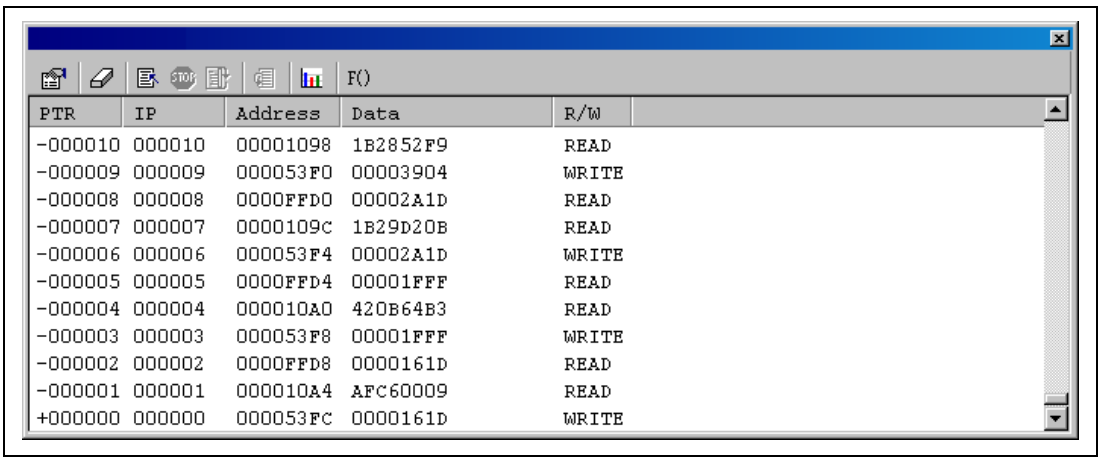


Figure 5.59 [BUS trace] Window (Type 1) (BUS Trace)

Items that can be displayed in this window are listed below. For details on the specifications of each product, refer to the online help.

[PTR] The bus trace buffer pointer (+0 for the last executed instruction)

[IP] The amount of acquired trace information

[R/W] Whether the generated data is associated with read or write access

[Address] Address

[Data] The data bus value

[Timestamp] Time stamp of bus cycle

[Source] The C/C++ or assembly-language source program

[Label] Label information

[Timestamp-Difference] Difference value of the time stamp

5.9.4 Specifying Conditions or Modes for Acquiring Trace Information

The capacity of the trace buffer is limited. When the buffer becomes full, the oldest trace information is overwritten. Setting the trace acquisition condition allows acquisition of useful trace information and effective use of the trace buffer.

The trace information acquisition conditions are implemented by eventpoints and acquisition start, acquisition end, and acquisition can be controlled. For setting eventpoints, refer to section 5.8, Using the Eventpoints.

The trace information acquisition mode is set in the [BUS acquisition] dialog box that is displayed by selecting [Set…] from the popup menu.

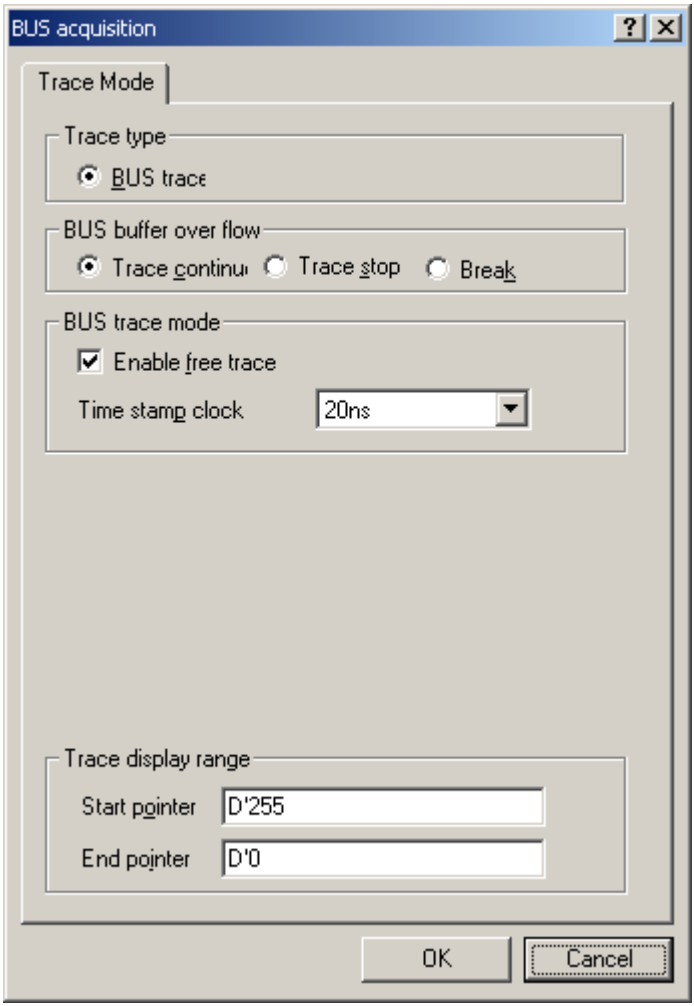


Figure 5.60 [BUS acquisition] Dialog Box

[Trace type]: Selects the type of trace acquisition.

[BUS buffer over flow]: Specifies the operation when the external bus trace buffer of the emulator becomes full.

- [Trace continue] The oldest trace information is overwritten by the latest information.
- [Trace stop] When the trace buffer becomes full, the trace information is no longer acquired.
- [Break] A break occurs.

[BUS trace mode]: Sets the mode when the external bus trace function is used.

- [Enable free trace] Enables external-bus free trace.
- [Time stamp clock] Specifies the resolution of the timer for time stamp as any of the following values:
  20 ns, 100 ns, or 400 ns

[Trace display range]: Sets the trace display range.

- [Start pointer] Enters the numerical start pointer value of the display range.
- [End pointer] Enters the numerical end pointer value of the display range.

Note: In some products, this window allows settings of other trace functions as well as the bus trace function. For specifications of each product, refer to the online help.

5.9.5 Hiding the [Trace] Column

It is possible to hide any column not necessary in the [Trace] window. Selecting a column you want to hide from the popup menu displayed by clicking the right-hand mouse button on the header column hides that column. To display the hidden column, select the column from the said popup menu again. Dragging the column with the mouse changes the display order.

5.9.6 Searching for a Trace Record

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

The [Trace Find] dialog box has the following options:

Table 5.2 [Trace Find] Dialog Box Pages

Page	Description
[General]	Sets the range for searching.
[Address]	Sets an address condition.
[Data]	Sets a data condition.
[Type]	Selects the type of trace information.
[Bus]	Selects the type of a bus.
[R/W]	Selects the type of access cycles.

Note: Items other than [General] and [Address] depend on the emulator in use. For details, refer to the online help.

Clicking the [OK] button after setting conditions in those pages stores the settings and starts searching. Clicking the [Cancel] button closes this dialog box without setting conditions.

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

Only the trace information that satisfies all the conditions set in above pages will be searched.

If a search operation is successful, selecting [Find Next] from the popup menu will move to the next found item.

(1) [General] page

Set the range for searching.

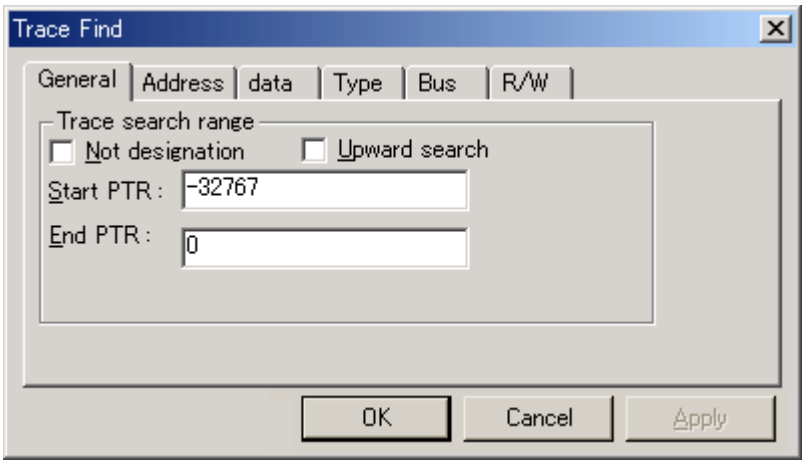


Figure 5.61 [Trace Find] Dialog Box ([General] Page)

[Trace search range]: Sets the range for searching.

[Not designation]: Searches for information that does not match the conditions set in other pages when this box is checked.

[Upward search]: Searches upwards when this box is checked.

[Start PTR]: Enters a PTR value to start a search.

[End PTR]: Enters a PTR value to end a search.

Note: Along with setting the range for searching, PTR values to start and end searching can be set in the [Start PTR] and [End PTR] options, respectively.

(2) [Address] page

Set an address condition.

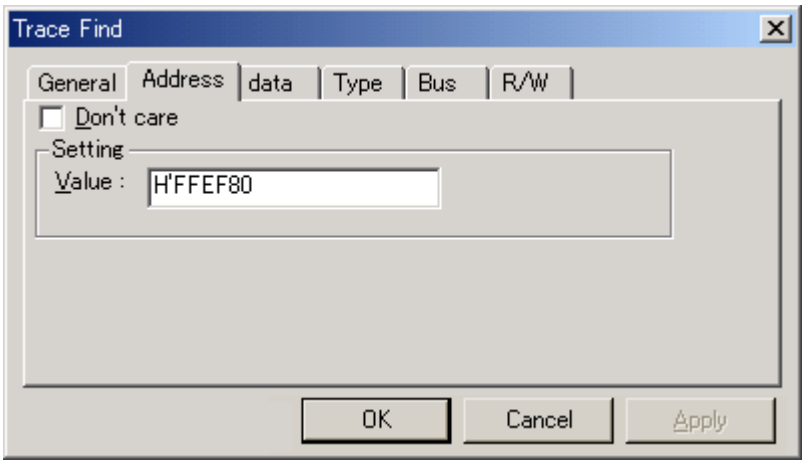


Figure 5.62 [Trace Find] Dialog Box ([Address] Page)

[Don't care]: Detects no address when this box is checked.

[Setting]: Detects the specified address.

[Value]: Enter the address value (not available when [Don't care] has been checked).

(3) [Data] page

Set a data condition.

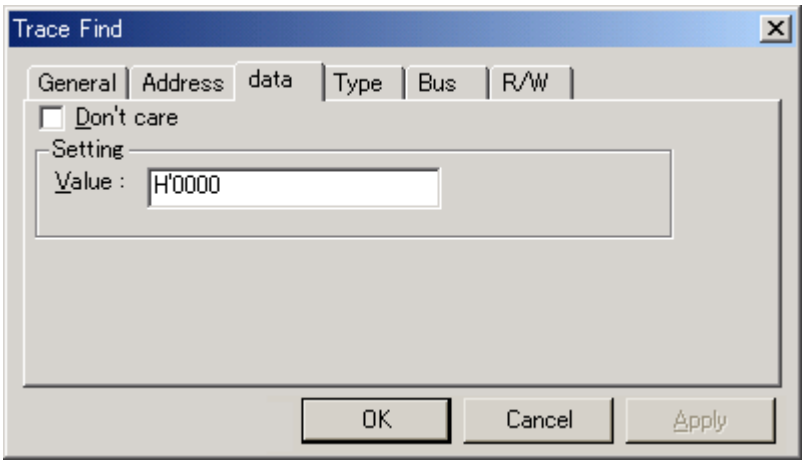


Figure 5.63 [Trace Find] Dialog Box ([data] Page)

[Don't care]: Detects no data when this box is checked.

[Setting]: Detects the specified data.

[Value]: Enter the data value (not available when [Don't care] has been checked).

(4) [R/W] page

Select the type of access cycles.

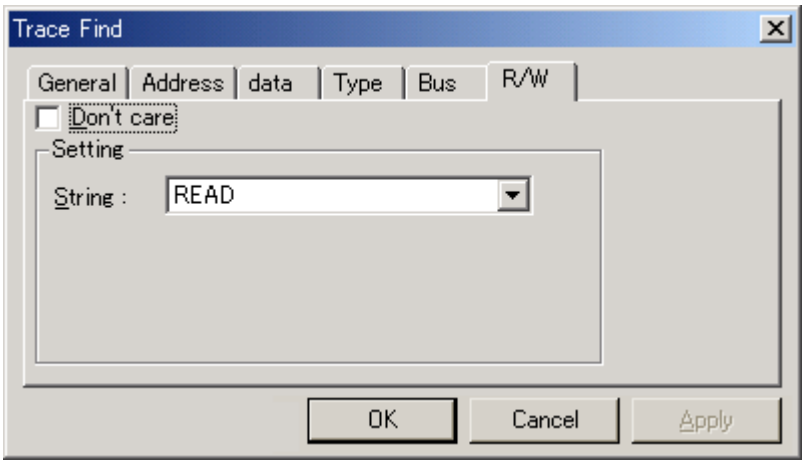


Figure 5.64 [Trace Find] Dialog Box ([R/W] Page)

[Don't care]: Detects no read/write condition when this box is checked.

[Setting]: Detects the specified read/write condition.

[String]: Select a read/write condition (not available when [Don't care] has been checked).

READ: Read cycle

WRITE: Write cycle

(5) [Type] page

Select the type being accessed. The selection is not available when a time stamp is acquired.

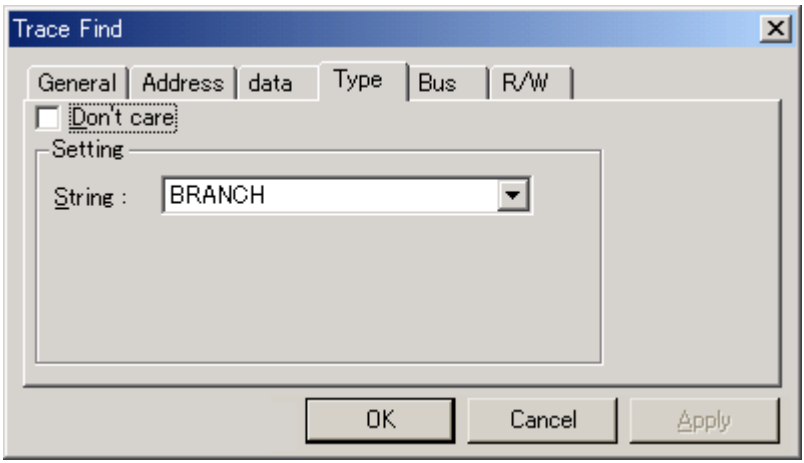


Figure 5.65 [Trace Find] Dialog Box ([Type] Page)

[Don't care]: Detects no type condition when this box is checked.

[Setting]: Detects the specified type condition.

[String]: Select a type condition (not available when [Don't care] has been checked).

(6) [Bus] page

Select the status of a bus.

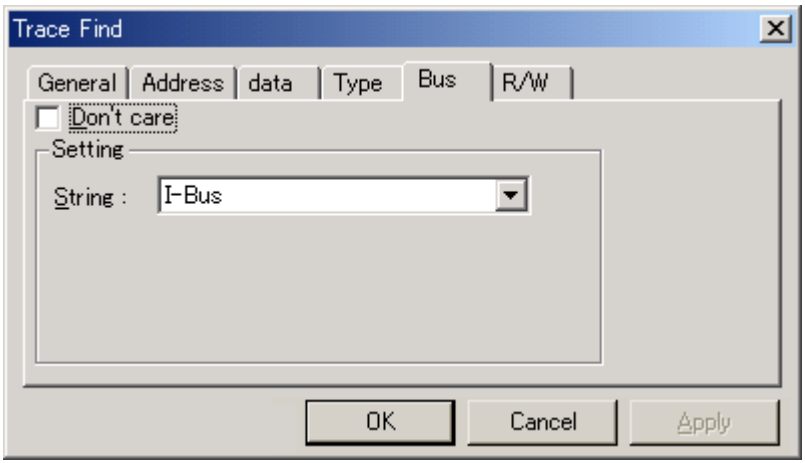


Figure 5.66 [Trace Find] Dialog Box ([Bus] Page)

[Don't care]: Detects no bus condition when this box is checked.

[Setting]: Detects the specified bus condition.

[String]: Select a bus condition (not available when [Don't care] has been checked).

5.9.7 Clearing the Trace Information

When [Clear] is selected from the popup menu, the trace buffer that stores the trace information becomes empty.

5.9.8 Saving the Trace Information in a File

Select [Save...] from the popup menu to open the [Save As] file dialog box, which allows the user to save the information displayed in the [Trace] window as a text file. A range can be specified based on the [PTR] number (saving the complete buffer may take several minutes). Note that this file cannot be reloaded into the [Trace] window.

Note: In filtering of trace information, the range to be saved cannot be selected. All the trace information displayed in the [Trace] window after filtering will be saved. Select a filtering range on the [General] page in the [Trace Filter] dialog box if you want to save the selected range. For details on the filtering function, refer to section 5.9.13, Extracting Records from the Acquired Information.

5.9.9 Viewing the [Editor] Window

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 popup menu.
- Double-click a trace record.

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

5.9.10 Trimming the Source

Choose [Trim Source] from the popup 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.

5.9.11 Temporarily Stopping Trace Acquisition

To temporarily stop trace acquisition during execution of the user program, select [Halt] from the popup menu. This stops trace acquisition and updates the trace display. Use this method to check the trace information without stopping execution of the user program.

5.9.12 Restarting Trace Acquisition

To restart trace acquisition being stopped during execution of the user program, select [Restart] from the popup menu.

5.9.13 Extracting Records from the Acquired Information

Use the filtering function to extract the records you need from the acquired trace information. The filtering function allows the trace information acquired by hardware to be filtered by software. Unlike the settings made in the [Trace Acquisition] dialog box for acquiring trace information by conditions, changing the settings for filtering several times to filter the acquired trace information allows easy extraction of necessary information, which is useful for analysis of data. The content of the trace buffer will not be changed even when the filtering function is used. Acquiring useful information as much as possible by the [Trace Acquisition] settings improves the efficiency in analysis of data because the capacity of the trace buffer is limited.

Use the filtering function in the [Trace Filter] dialog box. To open the [Trace Filter] dialog box, select [Filter…] from the popup menu.

The [Trace Filter] dialog box has the following pages:

Table 5.3 [Trace Filter] Dialog Box Pages

Page	Description
[General]	Selects the range for filtering.
[Address]	Sets address conditions.
[Data]	Sets data conditions.
[Type]	Selects the type of trace information.
[Bus]	Selects the type of a bus.
[R/W]	Selects the type of access cycles.

Note: Items other than [General] and [Address] depend on the emulator in use. For details, refer to the online help.

Set filtering conditions and then press the [OK] button. This starts filtering according to the conditions. Clicking the [Cancel] button closes the [Trace Filter] dialog box, which holds the settings at the time when the dialog box was opened.

In filtering, only the trace information that satisfies one or more filtering conditions set in the above pages will be displayed in the [Trace] window.

Filtering conditions can be changed several times to analyze data because the content of the trace buffer is not changed by filtering.

(1) [General] page

Set the range for filtering.

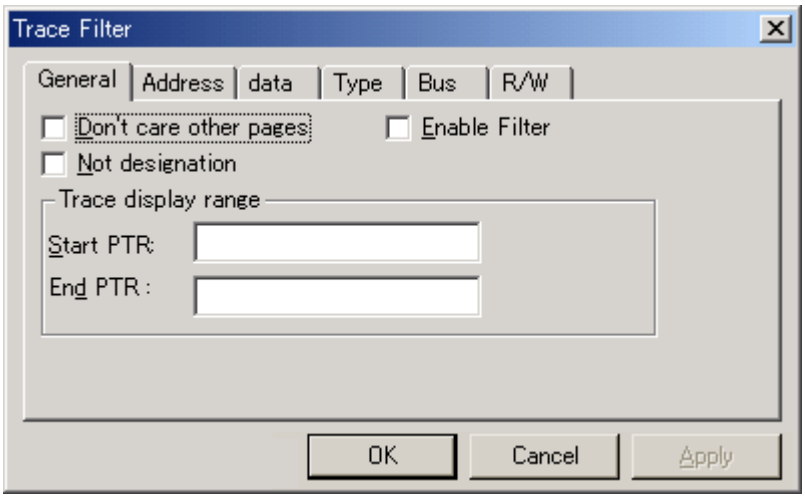


Figure 5.67 [Trace Filter] Dialog Box ([General] Page)

[Don't care other pages]: Only selects the cycle number when this box is checked. Other options become invalid.

[Enable Filter]: Enables the filter when this box is checked.

[Not designation]: Filters information that does not match the conditions set in those pages when this box is checked.

[Trace display range]: Sets the range for filtering.

[Start PTR]: Enters a PTR value to start filtering.
[End PTR]: Enters a PTR value to end filtering.

Note: Along with setting the range for filtering, PTR values to start and end filtering can be set in the [Start PTR] and [End PTR] options, respectively.

(2) [Address] page

Set address conditions.

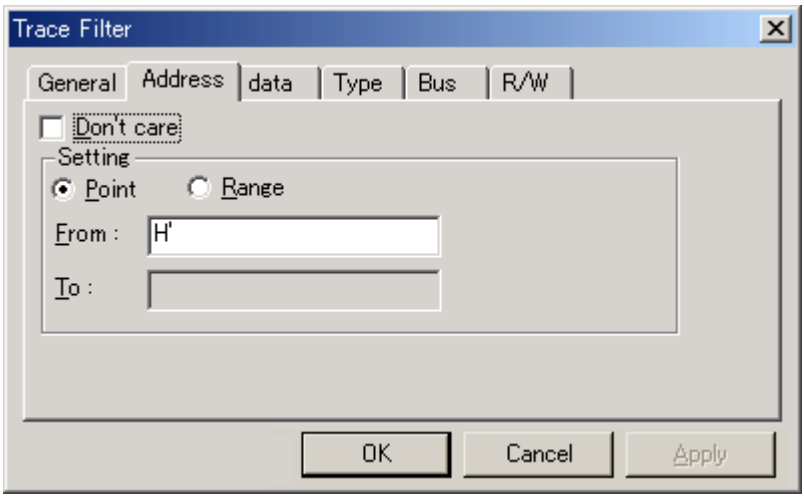


Figure 5.68 [Trace Filter] Dialog Box ([Address] Page)

[Don't care]: Detects no address when this box is checked.

[Setting]: Detects the specified address.

[Point]: Specifies a single address (not available when [Don't care] has been checked).

[Range]: Specifies an address range (not available when [Don't care] has been checked).

[From]: Enter a single address or the start of the address range (not available when [Don't care] has been checked).

[To]: Enter a single address or the end of the address range (only available when [Range] has been selected).

Note: Along with setting the address range, the start and end of the address range can be set in the [From] and [To] options, respectively.

(3) [Data] page

Set a data condition.

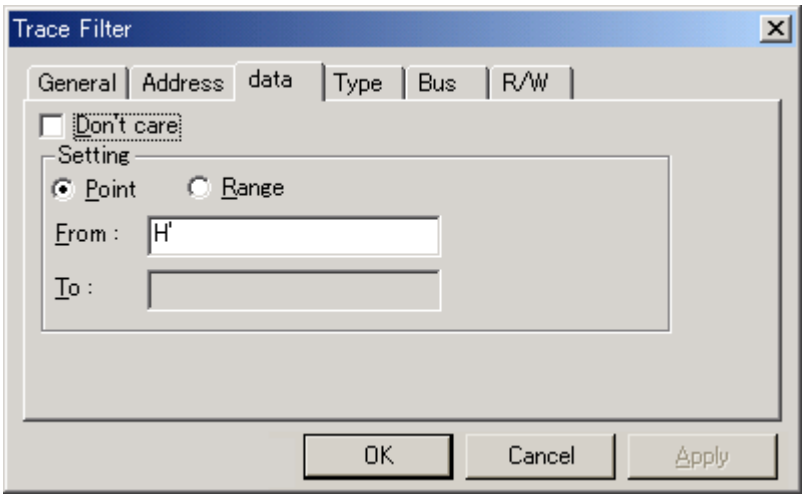


Figure 5.69 [Trace Filter] Dialog Box ([data] Page)

[Don't care]: Detects no data when this box is checked.

[Setting]: Detects the specified data.

[Point]: Specifies single data (not available when [Don't care] has been checked).

[Range]: Specifies a data range (not available when [Don't care] has been checked).

[From]: Enter single data or the minimum value of the data range (not available when [Don't care] has been checked).

[To]: Enter the maximum value of the data range (only available when [Range] has been selected).

Note: Along with setting the data range, the minimum and maximum values can be set in the [From] and [To] options, respectively.

(4) [R/W] page

Select the type of access cycles.

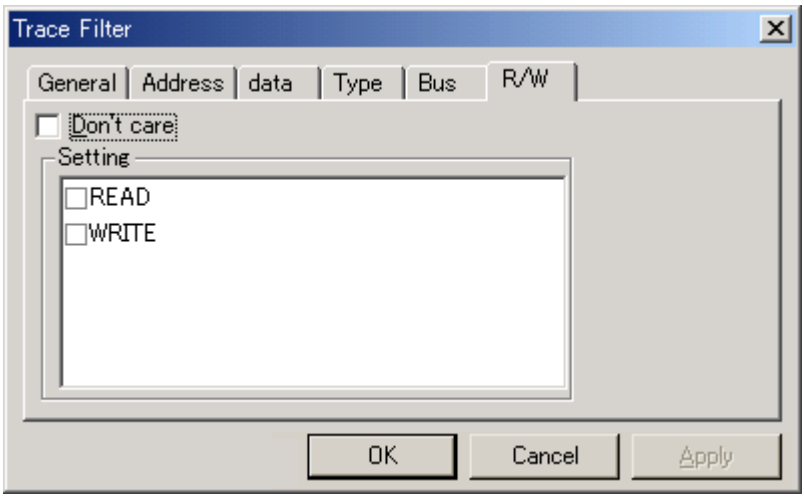


Figure 5.70 [Trace Filter] Dialog Box ([R/W] Page)

[Don't care]: Detects no read/write condition when this box is checked.

[Setting]: Detects the specified read/write condition.

READ: Detects read cycles when this box is checked (not available when [Don't care] has been checked).

WRITE: Detects write cycles when this box is checked (not available when [Don't care] has been checked).

(5) [Type] page

Select the type being accessed. The selection is not available when a time stamp is acquired.

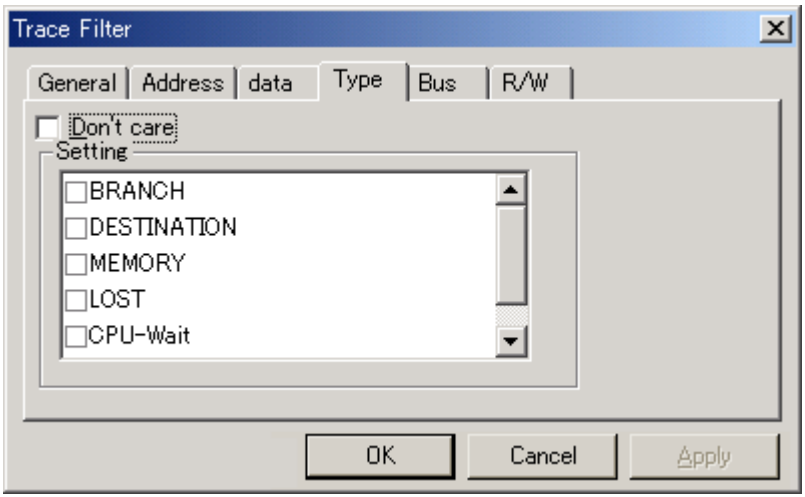


Figure 5.71 [Trace Filter] Dialog Box ([Type] Page)

[Don't care]: Detects no type condition when this box is checked.

[Setting]: Detects the specified type condition (not available when [Don’t care] has been checked).

(6) [Bus] page

Select the status of a bus. The selection is not available when a time stamp is acquired.

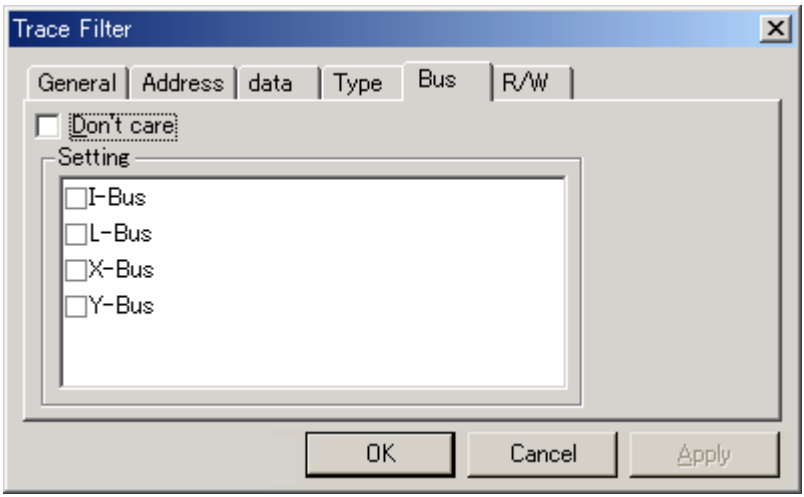


Figure 5.72 [Trace Filter] Dialog Box ([Bus] Page)

[Don't care]: Detects no bus condition when this box is checked.

[Setting]: Detects the specified bus condition (not available when [Don’t care] has been checked).

5.9.14 Analyzing Statistical Information

Choose [Statistic…] from the popup menu to open the [Statistic] dialog box and analyze statistical information under the specified conditions.

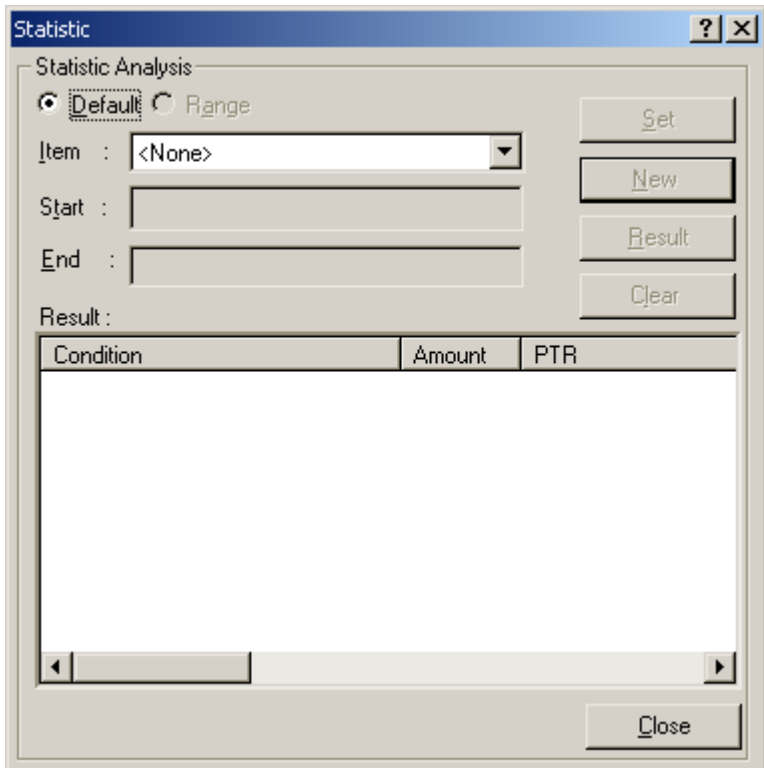


Figure 5.73 [Statistic] Dialog Box

[Statistic Analysis]: Setting required for analysis of statistical information.

[Default]: Sets a single input value or character string.

[Range]: Sets the input value or character string as a range.

[Item]: Sets the item for analysis.

[Start]: Sets the input value or character string. To set a range, the start value must be specified here.

[End]: Specify the end value if a range has been set (only available when [Range] has been selected).

[Set]: Adds a new condition to the current one.

[New]: Creates a new condition.

[Result] button: Obtains the result of statistical information analysis.

[Clear]: Initializes the settings.

[Result] list box: Clears all conditions and results of statistical information analysis.

[Close]: Closes this dialog box. All the results displayed in the [Result] list will be cleared.

This dialog box allows the user to analyze statistical information concerning the trace information. Set the target of analysis in [Item] and the input value or character string by [Start] and [End]. Click the [Result] button after setting a condition by pressing the [New] or [Add] button to analyze the statistical information and display its result in the [Result] list.

Note: In this emulator, only [PTR] can be set as a range. Each of other items must be specified as a character string. In analysis of statistical information, character strings are compared with those displayed in the [Trace] window. Only those that completely match are counted. Note, however, that this test is not case sensitive. The number of blanks will not be cared either.

5.9.15 Extracting Function Calls from the Acquired Trace Information

To extract function calls from the acquired trace information, select [Function Call…] from the popup menu. The [Function Call Display] dialog box will be displayed.

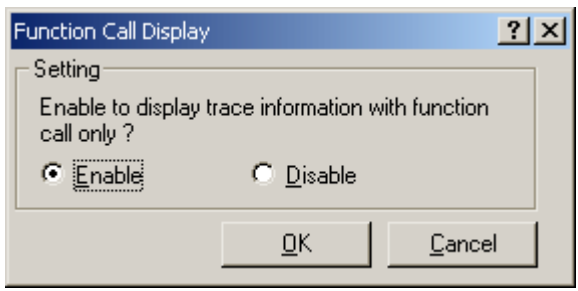


Figure 5.74 [Function Call Display] Dialog Box

[Setting]: Selects whether or not to extract function calls.

[Enable]: Extracts function calls.

[Disable]: Does not extract function calls.

When [Enable] is selected, only the cycles that include function calls are extracted for display from the acquired trace information. The content of the trace buffer is not changed by extraction of function calls. Using this function for the trace information that includes function calls allows the user to know the order of function calls.

5.10 Viewing the Cache Contents

The [Cache] window is used to display the cache contents in an MCU with cache. The [Cache] window differs according to the MCU. Read the description corresponding to the MCU.

5.10.1 Opening the [Cache] Window

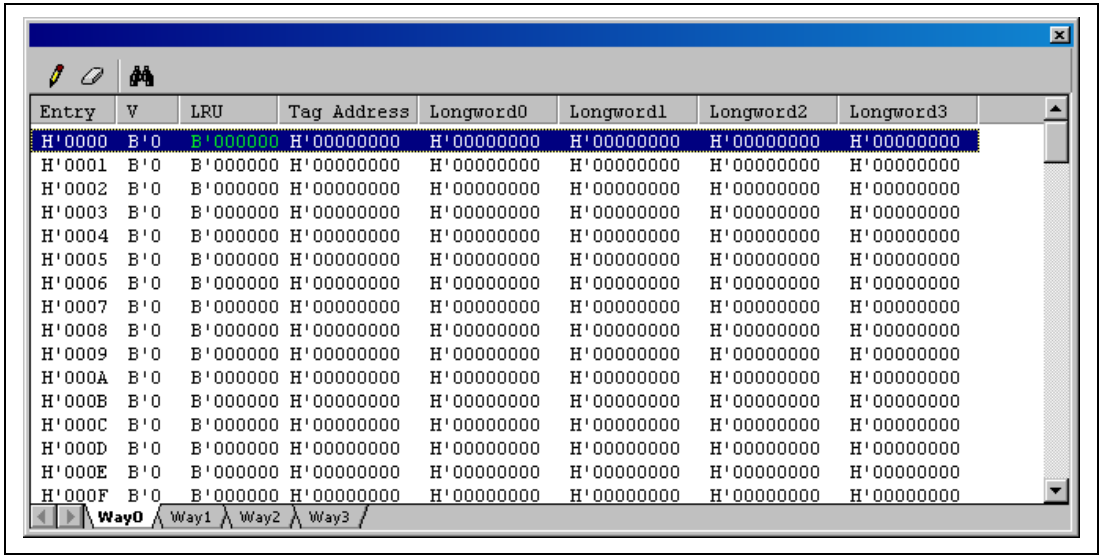


Figure 5.75 [Cache] Window

Choose [View -> CPU -> Cache] or click the [Cache] toolbar button [ ] to open the [Select Cache] dialog box (figure 5.76) for selecting the cache window type to be displayed.

Figure 5.76 [Select Cache] Dialog Box

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

[Instruction cache] Opens the instruction cache window.

[Operand cache] Opens the operand cache window.

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

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.

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

[Tag Address] Tag address

[Longword0] to [Longword4] Longword data 0 to 4 set to the operand cache entry

5.10.2 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.

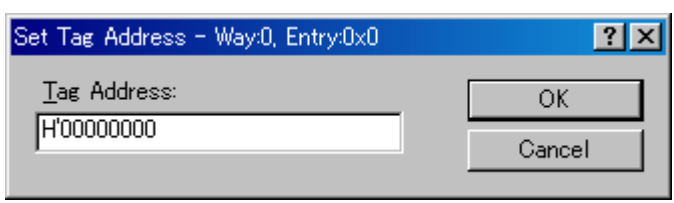


Figure 5.77 [Set Tag Address] Dialog Box

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.

5.10.3 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.

5.10.4 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.

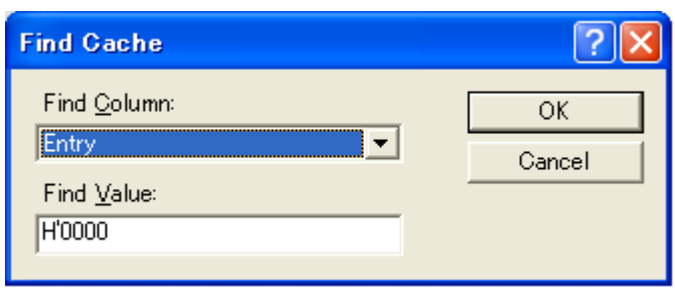


Figure 5.78 [Find Cache] Dialog Box

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.

5.10.5 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.

5.10.6 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.

5.11 Analyzing Performance

Use the performance analysis function to measure execution performance.

The emulator has two types of performance analysis functions: on-chip performance analysis (Onchip Performance Analysis) and AUD performance analysis (AUD Performance Analysis).

5.11.1 Opening the [Onchip Performance Analysis] Window

To open the [Onchip Performance Analysis] window, choose [View -> Performance -> Performance Analysis] or click the [PA] toolbar button ( ) to open the [Select Performance Analysis Type] dialog box.

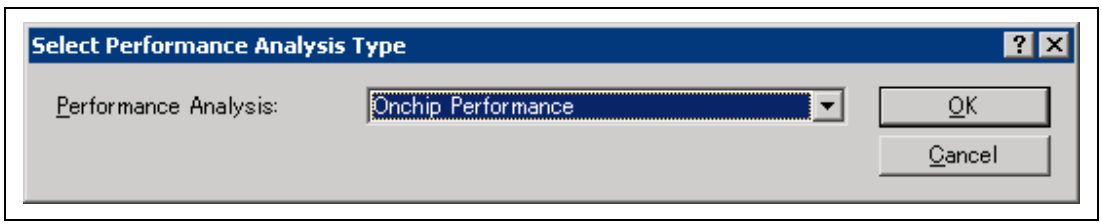


Figure 5.79 [Select Performance Analysis Type] Dialog Box

Select [Onchip Performance] and click the [OK] button to open the [Performance Analysis] window.

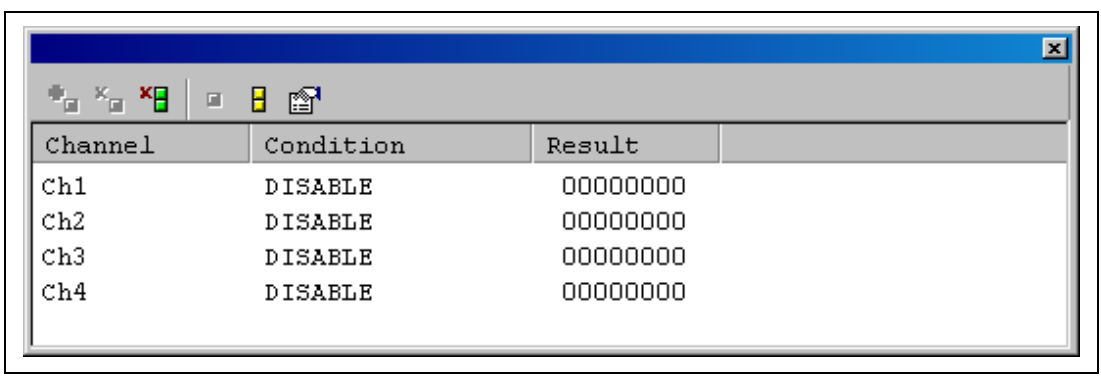


Figure 5.80 [Performance Analysis] Window (Onchip Performance)

The Onchip Performance Analysis function does not affect the realtime operation because it uses the performance measurement function in the MCU.

Note: The measurement conditions and the number of channels for the on-chip performance analysis function differ depending on the product. For details, refer to the online help of each product.

When a measurement channel is double-clicked or selected and [Set...] is selected from the popup menu in this window, the [Performance Analysis] dialog box is opened and measurement conditions can be modified.

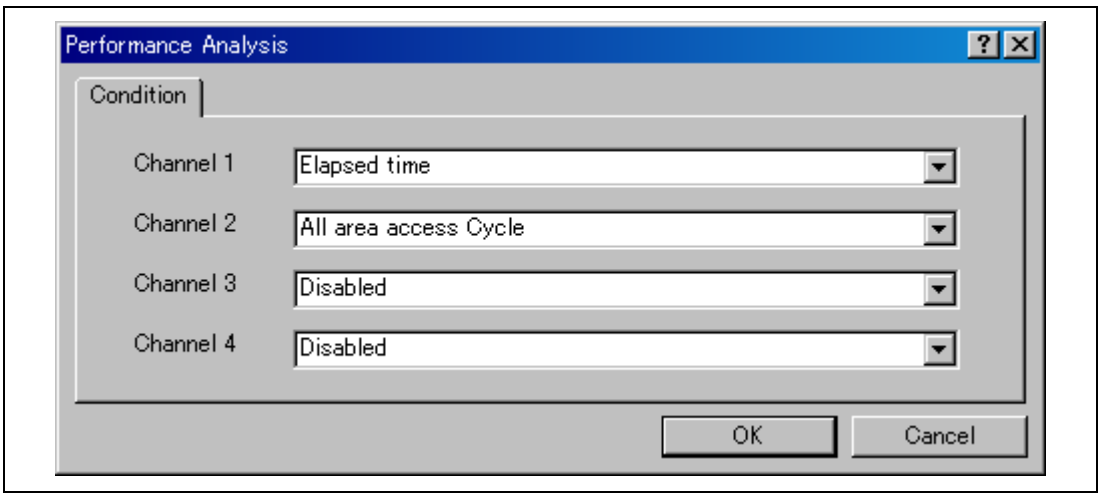


Figure 5.81 [Performance Analysis] Dialog Box

For details on the [Performance Analysis] dialog box, refer to the online help for each product.

5.11.2 Opening the [AUD Performance Analysis] Window

To open the [AUD Performance Analysis] window, choose [View -> Performance -> Performance Analysis] or click the [PA] toolbar button ( ) to open the [Select Performance Analysis Type] dialog box.

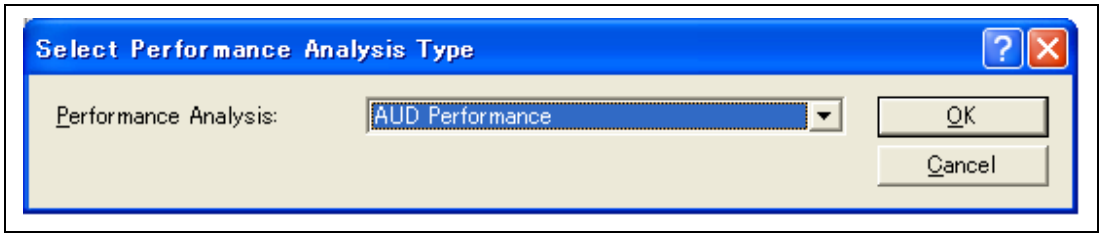


Figure 5.82 [Select Performance Analysis Type] Dialog Box

Select [AUD Performance] and click the [OK] button to open the [Performance Analysis] window.

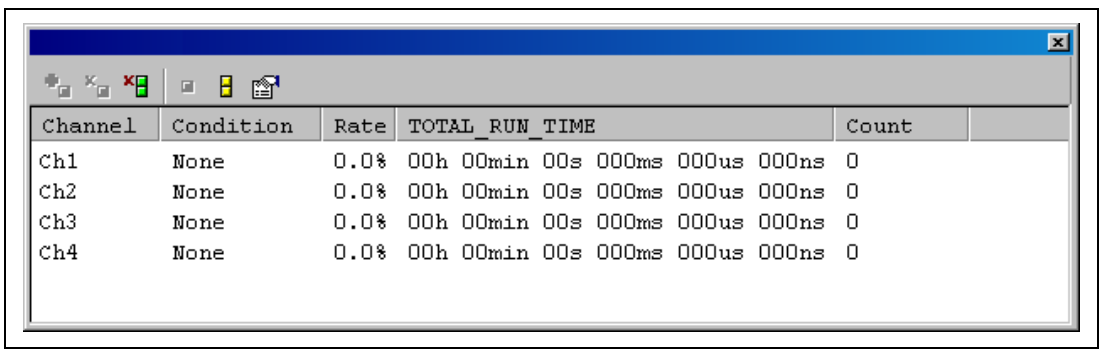


Figure 5.83 [Performance Analysis] Window (AUD Performance)

The AUD Performance Analysis function does not affect the realtime operation because it measures execution performance in the specified range by using the circuit for hardware performance measurement on the emulator main unit case.

The start and end conditions of the measurement channel of the AUD Performance Analysis use one AUD event channel, respectively. Four measurement channels use eight AUD event channels.

Note: Since the AUD performance function is implemented according to the information in the MCU output from the AUD pin, the AUD trace information acquisition condition must be set. Set the AUD trace information acquisition condition.

When a measurement channel is double-clicked or selected and [Set...] is selected from the popup menu in this window, the [Performance Analysis AUD Channel x] dialog box is opened and measurement conditions can be modified.

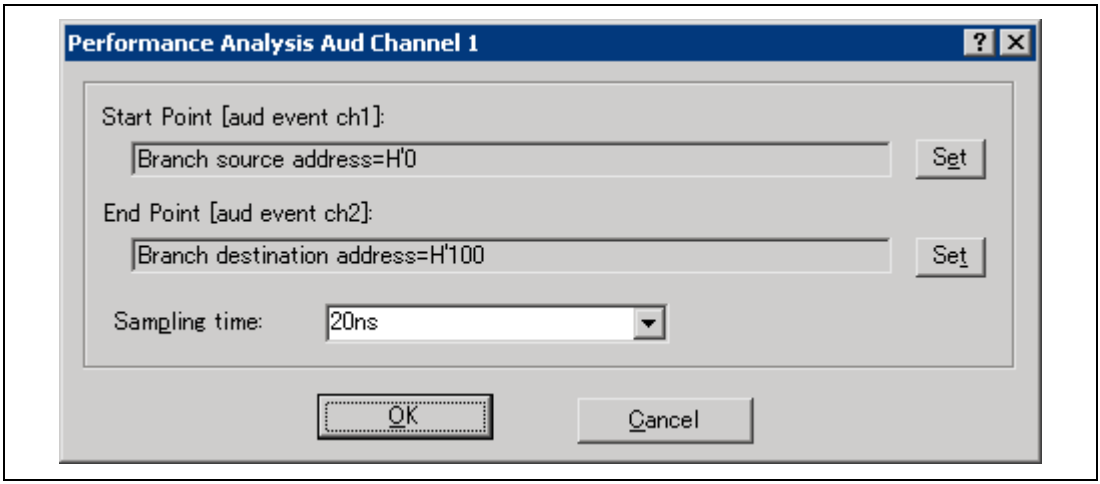


Figure 5.84 [Performance Analysis AUD Channel x] Dialog Box

[Start Point [aud event chx]]:	Displays the start pointer condition of the measurement channel.
[End Point [aud event chx]]:	Displays the end pointer condition of the measurement channel.
[Set]:	Displays the dialog box to set the AUD event channel for the start or end pointer.
[Sampling time]:	Specifies the resolution of the measurement timer as any of the following values: 20 ns, 100 ns, 400 ns, or 1.6 µs

Clicking the [Set] button opens the dialog box to set the corresponding AUD event channel to modify the measurement start or end condition.

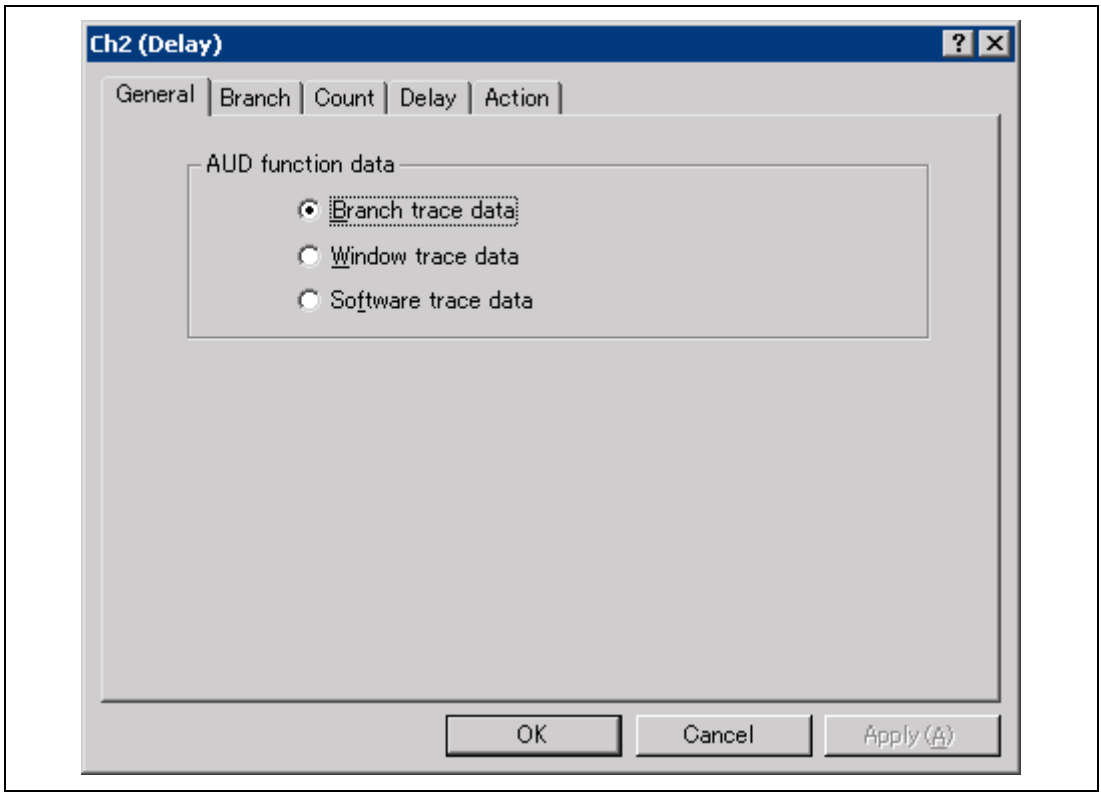


Figure 5.85 Editing the AUD Performance Analysis Measurement Condition (Dialog Box for Setting the AUD Event)

Notes: 1. When the AUD performance analysis function is used, set [Performance start/stop] on the [Action] page of each channel.

2. When the measurement condition is modified, the contents are reflected on the [AUD Event] sheet in the [Event] window.

5.11.3 Hiding the Column

It is possible to hide any column not necessary in the [Performance Analysis] window. Selecting a column you want to hide from the popup menu displayed by clicking the right-hand mouse button on the header column hides that column. To display the hidden column, select the column from the said popup menu again.

5.11.4 Starting Performance Data Acquisition

Executing the user program clears the result of previous measurement and automatically starts measuring execution performance according to the conditions that have been set. Stopping the user program displays the result of measurement in the [Performance Analysis] window.

5.11.5 Deleting a Measurement Condition

Select [Reset] from the popup menu with a measurement condition selected to delete the condition.

5.11.6 Deleting All Measurement Conditions

Select [Reset All] from the popup menu to delete all the conditions that have been set.

5.12 Viewing the Profile Information

The profiling 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 High-performance Embedded Workshop displays the results of measurement in three windows, according to the method and purpose of viewing the profile data.

5.12.1 Stack Information Files

The profiling function allows the High-performance Embedded Workshop to read the stack information files (extension: ".SNI") which are output by the optimizing linker (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 High-performance Embedded Workshop to display this information to do with 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 High-performance Embedded Workshop does not read any stack information files, the data about the functions executed during measurement will be displayed by the profiling function.

To make the linker create a stack information file, choose [Options -> SuperH Risc engine Standard Toolchain...], and select [Other] from the [Category] list box and check the [Stack information output] box in the [Link/Library] page of the [Standard Toolchain] dialog box.

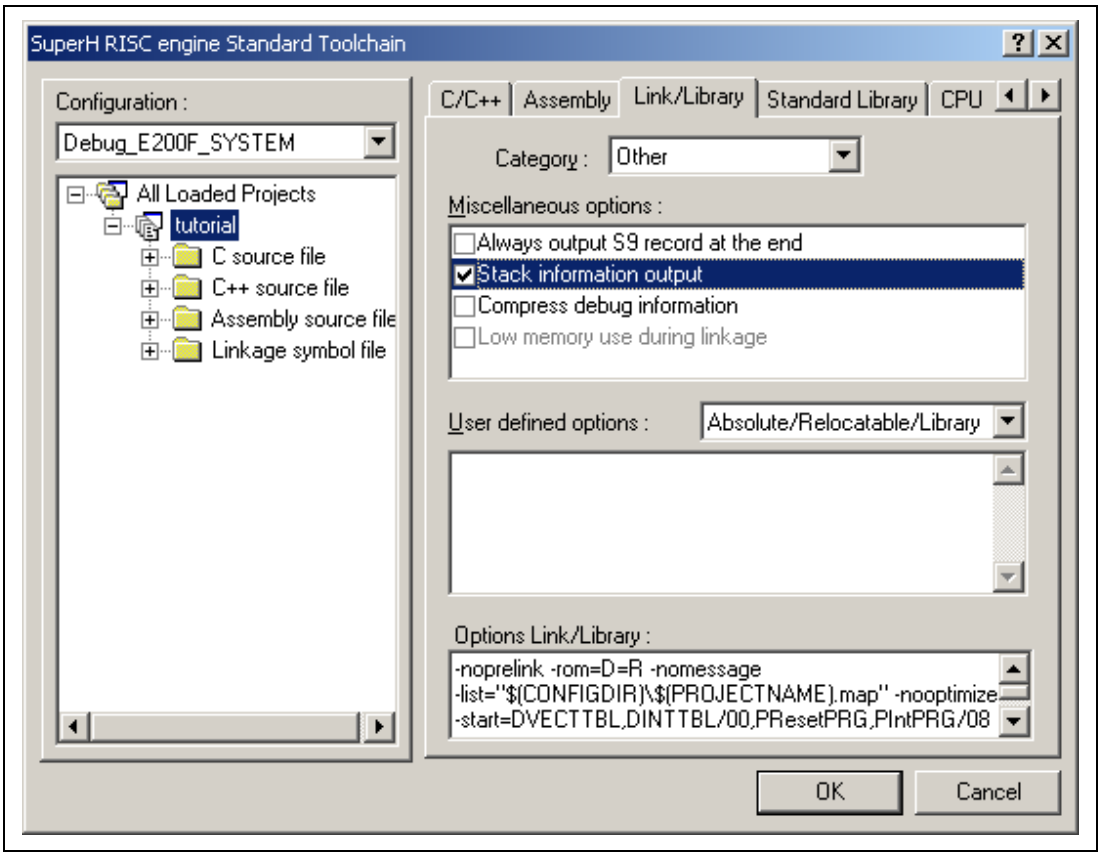


Figure 5.86 [Standard Toolchain] Dialog Box (1)

5.12.2 Profile Information Files

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

This file contains information on the number of times functions are called and global variables are accessed. The optimizing linker (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 status of the actual operation of the program.

To input the profiler information file to the linker, choose [Optimize] from the [Category] list box and check the [Include Profile] box in the [Link/Library] page of the [Standard Toolchain] dialog box, and specify the name of the profile information file.

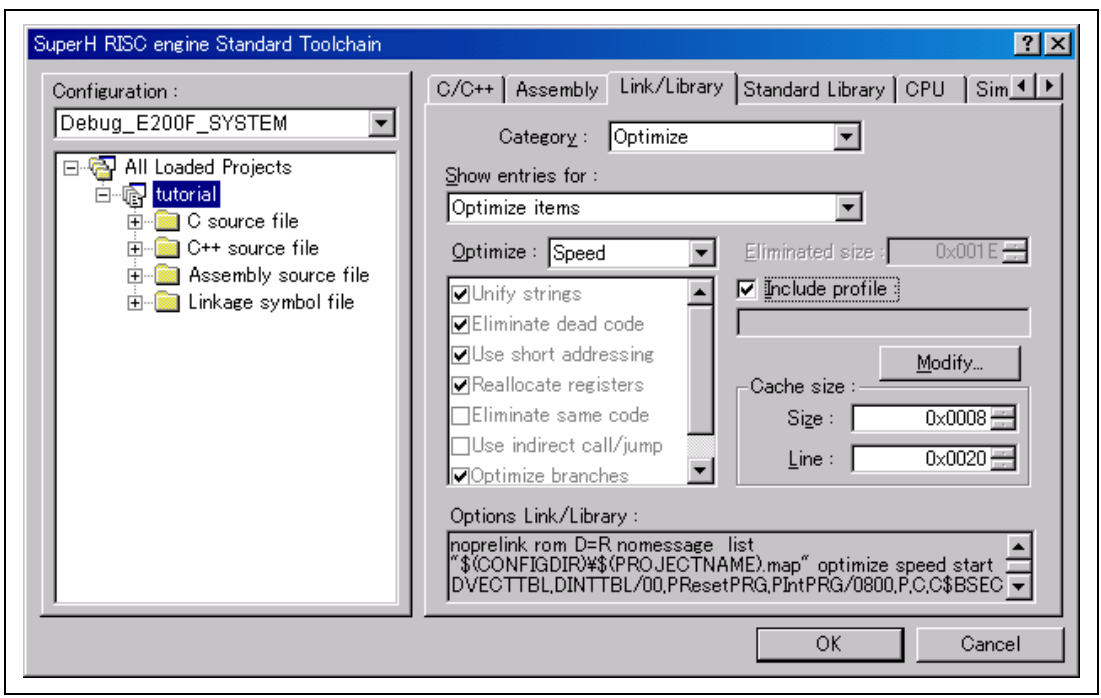


Figure 5.87 [Standard Toolchain] Dialog Box (2)

To enable the settings in the [Include Profile] box, specify the [Optimize] list box as some setting other than [None].

5.12.3 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] page of the [Options] dialog box (figure 5.88) that can be opened by choosing [Tools ->Options…] from the main menu.

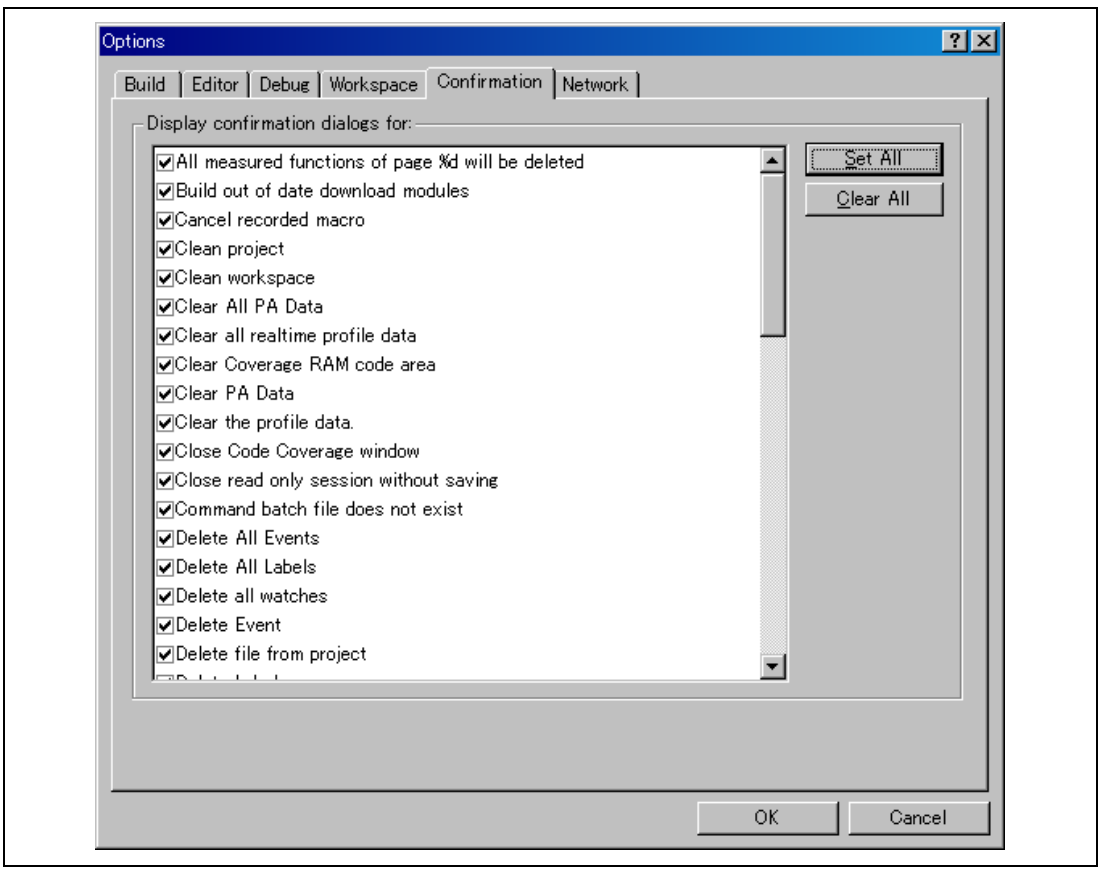


Figure 5.88 [Options] Dialog Box

5.12.4 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.

5.12.5 Specifying Measuring 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 operating system, stop tracing function calls.

5.12.6 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.

5.12.7 [List] Sheet

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

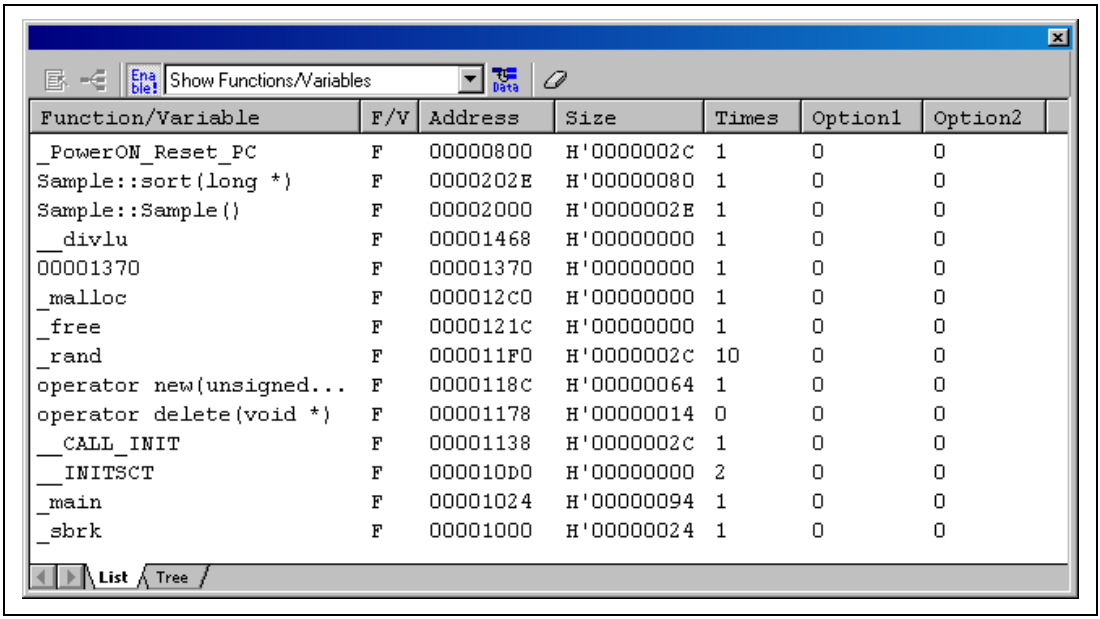


Figure 5.89 [List] Sheet

Clicking the column header sorts the items in an alphabetical or ascending order. Double-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 5.12.8, [Tree] Sheet.

5.12.8 [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.

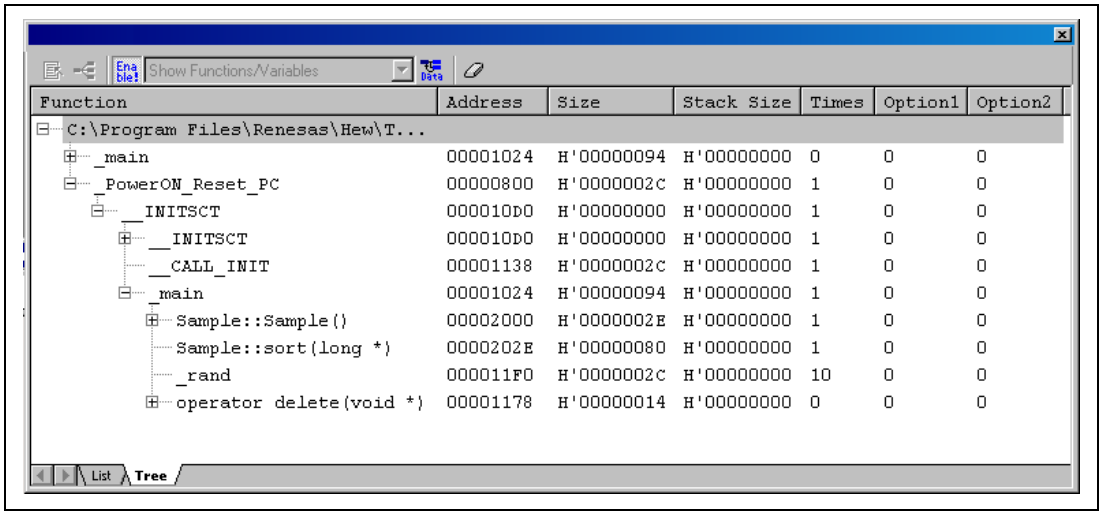


Figure 5.90 [Tree] Sheet

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 on the mouse within the window displays a pop-up menu. Supported menu options are described in the following:

- 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 profile data. When profile data acquisition is active, 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 operating system.

  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 inputting 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.

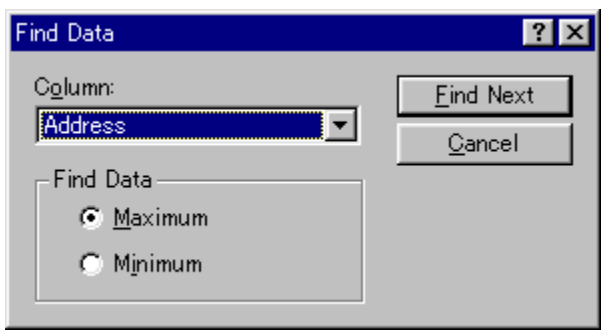


Figure 5.91 [Find Data] Dialog Box

By selecting the column to be searched in the [Column] combo box and the search type in the [Find Data] group and entering [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 the Minimum is specified) is searched for.

- Clear Data

  Clears the number of times functions are called and 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...

  Sets the items to be measured.

5.12.9 [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 called functions or is called by the calling functions are also displayed in this window.

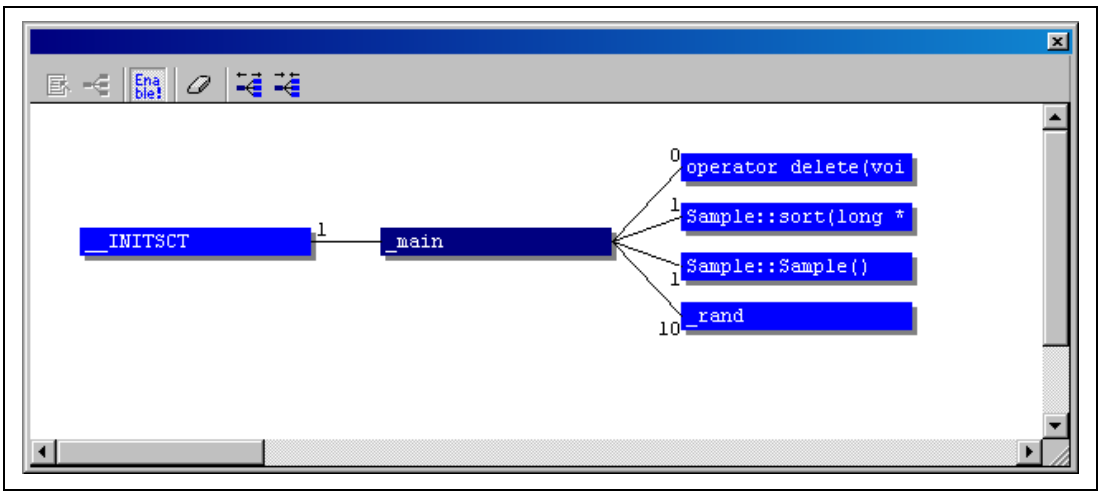


Figure 5.92 [Profile-Chart] Window

5.12.10 Types and Purposes of Displayed Data

The profiling function is able to acquire the following information:

Address	You can see 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 execute larger functions, more of the cache memory will need to be updated. 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.

Times	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 MCU-specific data is also available as well as items that can be measured with the performance measurement function. For details, refer to the online help.

5.12.11 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.

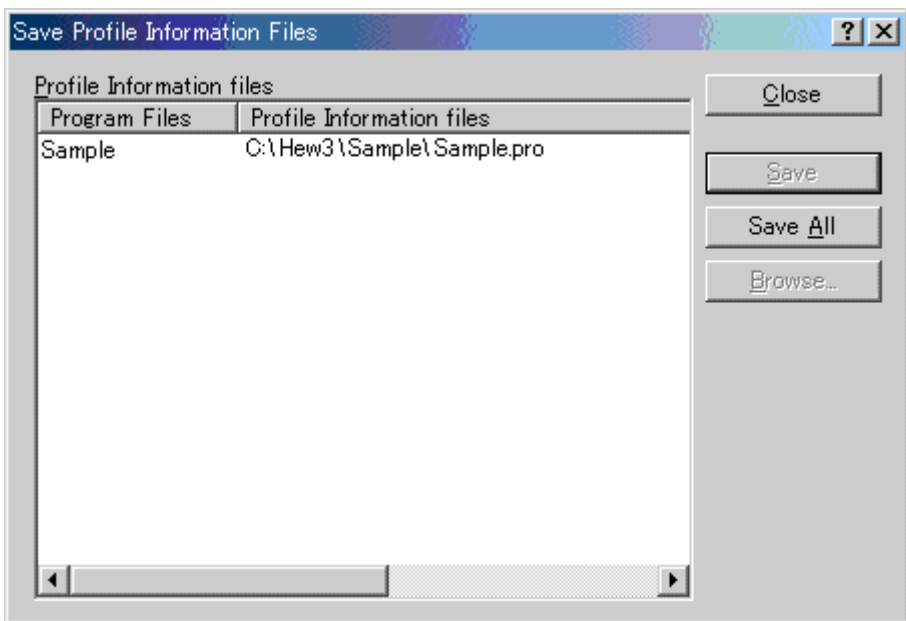


Figure 5.93 [Save Profile Information Files] Dialog Box

5.12.12 Notes

1. Tolerances

   The profiling function internally breaks user program execution, collects the measured data, and re-executes the user program.

   Since the function also counts when the measured item is generated at break or re-execution, tolerances will be included in the measured profile value.

   The measured value of this function should be the reference.

2. Functions that cannot be used while the profiling function is being used

   (a) On-chip performance analysis function

   The on-chip performance analysis function cannot be used when the profiling function is enabled.

   (b) Step function

   When the profiling function is enabled, do not use the step function. The profile data cannot be measured correctly.

   (c) Internal trace function

   When the profiling function is enabled, it is invalid to select the internal trace mode as all items of the internal trace mode are internally selected. Do not use the internal trace when the profiling function is enabled.

   (d) Continuous trace function (only for the supported devices)

   When the profiling function is enabled, do not use the continuous trace function that is used in the internal trace function. The profile data cannot be measured correctly.

   (e) Halt function

   When the profiling function is enabled, do not use the halt function of the internal, AUD, and external bus traces.

   (f) Memory access during user program execution

   When the profiling function is enabled, memory access is disabled during user program execution.

   (g) When the profiling function is used, a break occurs if a branch instruction is generated. Accordingly, the realtime emulation will not be performed. In addition, since the emulator firmware is controlled on generation of a break, the executed result of the branch instruction may be displayed on the [Internal/AUD/Usermemory trace] window when the execution is returned to the user program from the emulator firmware. In this case, **EML** is displayed.

3. Others
   (a) When the profiling function is used, an internal break occurs in the execution of the user program. Therefore, the measurement result of AUD performance analysis will contain errors.
   (b) When the profiling function is used, the contents that have been set in the on-chip performance measurement function or data that has been measured will be deleted.
   (c) Since the profiling function is implemented with the internal break, it takes a long time to start and end the user program execution.

5.13 Viewing Realtime Profile Information

The realtime profiling function is used to measure the execution performance in the specified range of the application program in a function unit. This function is effective to investigate the position and the cause of the lowered performance in the application program.

The realtime profiling function does not affect the realtime operation because it measures the performance by using the profiler measurement circuit on the main unit case and expansion profiling unit of the emulator.

The following shows the realtime profiling measurement modes:

- Function mode
  This function does not include the subroutine execution time when accumulation of the function execution time is displayed.
- Nest mode
  This function includes the subroutine execution time when accumulation of the function execution time is displayed.

Determine which mode is to be used in the [Function select] dialog box that is displayed when the emulator is activated.

Note: There are following restrictions in the realtime profiling function.

(1) Restrictions on all the realtime profiling functions

(i) Areas to be measured

In the emulator, 512 kbytes are considered as a unit to acquire the profiling information on all the functions in the areas of a maximum of 24 blocks.

The hardware of the emulator has a maximum of three types of memory for measuring eight blocks to implement the realtime profiling function.

Note that the adjacent address areas can be set in each block, however, it is impossible to set a function of which address ranges are extended on the eight-block boundaries. If such a function is set, a warning message will be displayed and correct measurement will not be performed.

(ii) Inline expansion

When the functions are inline-expanded in accordance with optimization of the compiler, they are not displayed in the [Realtime Profile] window.

(iii) Recursive function

The execution time of the recursive function can be correctly measured, however, the execution count will be once.

(iv) AUD trace

The realtime profiling function uses the data that is output in AUD trace. Therefore, when the function is used in the realtime trace mode, the trace data may be lost and correct measurement will not be performed. In such a case, it is recommended that the non-realtime trace mode be used.

(2) Restrictions on using the function mode

(i) Tail call

When a tail call is used for a function as shown below, the return value of the callee function becomes the return address of the caller function. The execution time or execution counts of the callee function cannot be measured correctly.

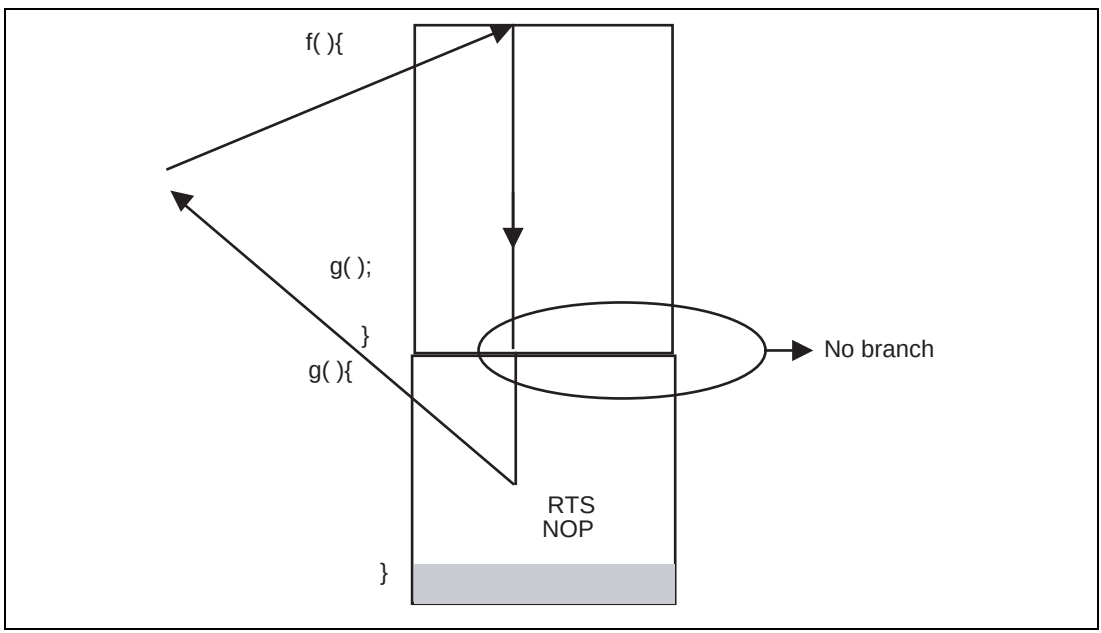


Figure 5.94 Tail Call (Function Mode)

(ii) Relationships between the Go-start address, break address, and measurable ranges

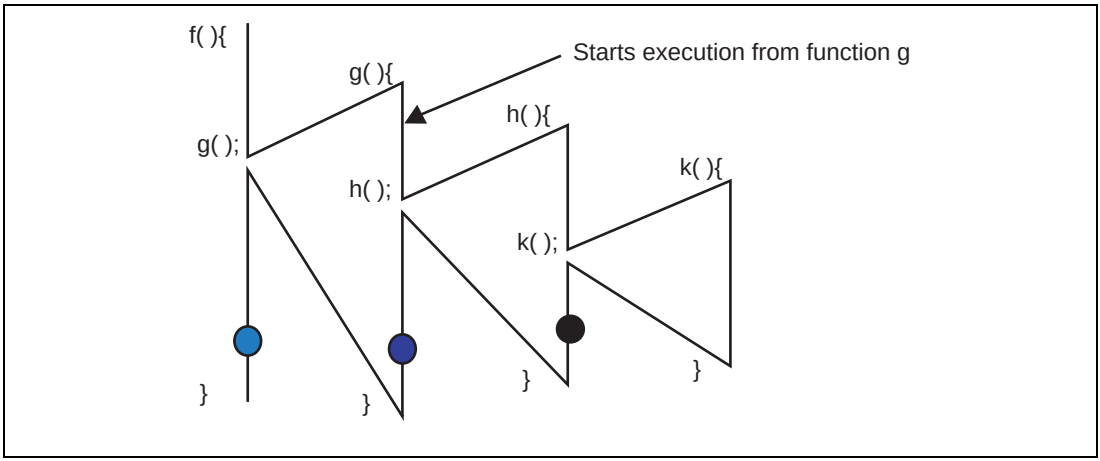


Figure 5.95 Measurable Ranges (Function Mode)

Measurable ranges when a break occurs at the position of black circle:

- Execution time and counts of functions h and k

Measurable ranges when a break occurs at the position of red circle:

- Execution time and counts of functions h and k

Measurable ranges when a break occurs at the position of blue circle:

- Execution time and counts of functions h and k
- Execution time of function g; counts cannot be measured.

It is recommended that a break occur within the function where execution is started. When execution returns to the upper function, the execution counts of the function cannot be measured.

(3) Restrictions on using the nest mode

(i) Tail call

— When a tail call is used for a function as shown below, the return value of the callee function becomes the return address of the caller function. The execution time of the callee function cannot be measured correctly but the execution counts can be measured.

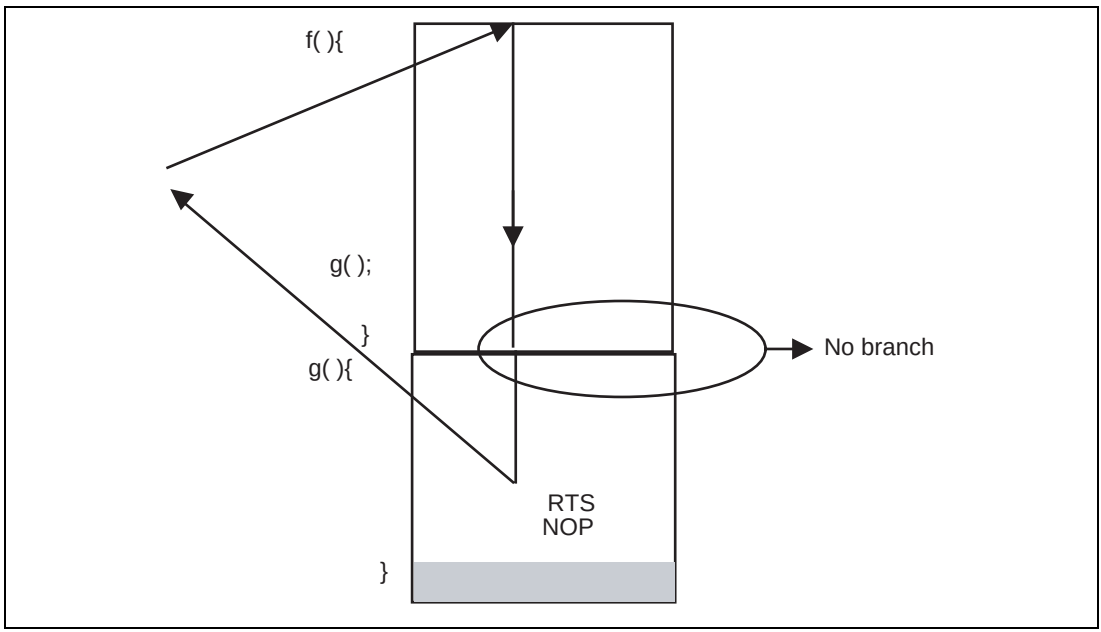


Figure 5.96 Tail Call (Nest Mode)

— There is a restriction when the tail call is used to call another function from the function that has been called by the tail call. If the tail call occurs continuously, three-step measurement will be correctly performed.

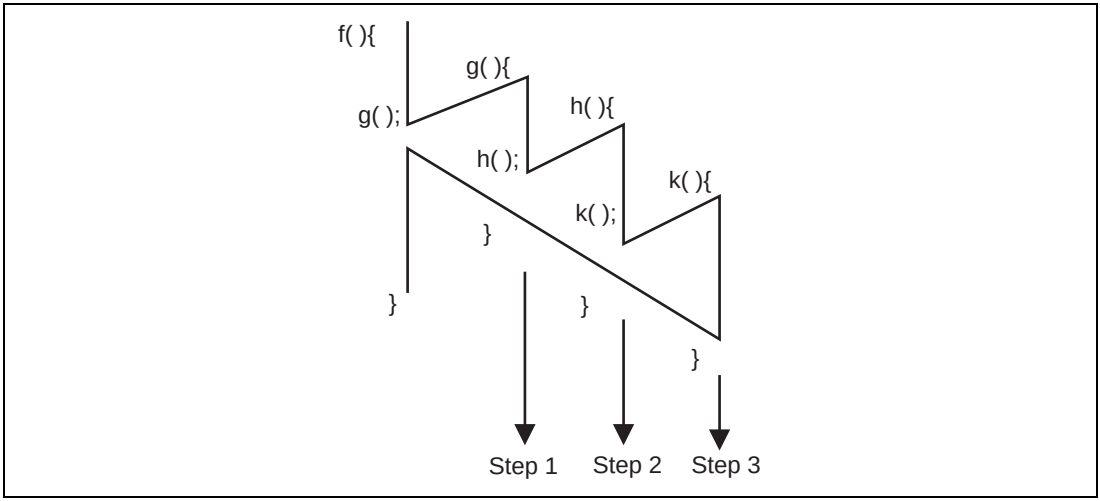


Figure 5.97 Restriction on Call

(ii) Nesting functions

If 32-step or more calls are generated from the top function within the range to be measured, correct measurement will not be performed. A warning message will be displayed.

(iii) Calling from a function outside the measurement range

Correct measurement will not be performed if a function outside the measurement range calls a function to be measured and the callee function cannot return correctly to the caller function.

Even if the callee function returns correctly to the caller function, correct measurement will not be performed if other functions are called within three instructions from the return address.

(iv) Relationships between the Go-start address, break address, and measurable ranges

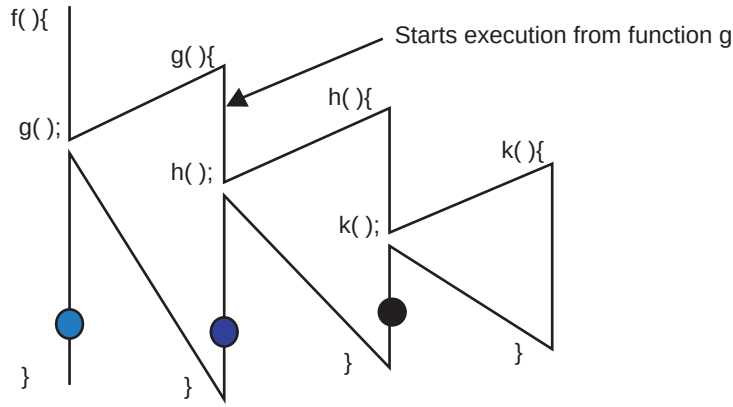


Figure 5.98 Measurable Ranges (Nest Mode)

Measurable ranges when a break occurs at the position of black circle:

- Execution time and counts of function h

  Measurable ranges when a break occurs at the position of red circle:

- Execution time and counts of functions h and k

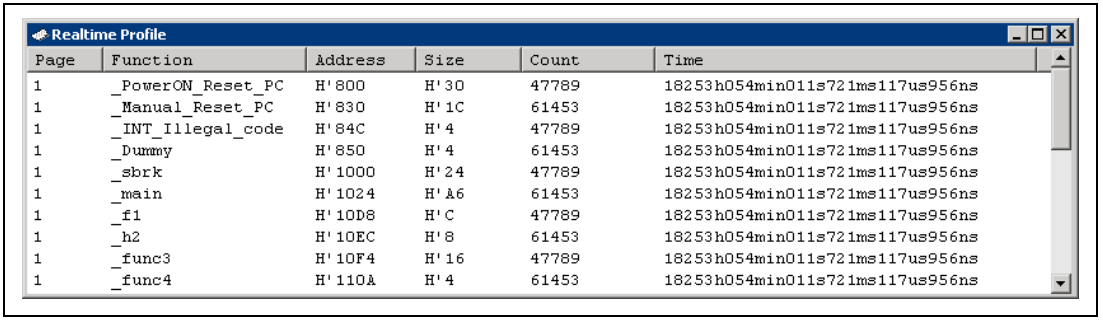
  Measurable ranges when a break occurs at the position of blue circle:

- Execution time and counts of functions h and k

It is recommended that a break occur within the function where execution is started. When execution returns to the upper function, the execution counts of the function cannot be measured.

5.13.1 Opening the [Realtime Profile] Window

Select [View -> Performance -> Realtime Profile] to open the [Realtime Profile] window. Clicking the column header changes the ascending or descending order of items in displayed contents.



Page	Function	Address	Size	Count	Time
1	_PowerON_Reset_PC	H'800	H'30	47789	18253h054min011s721ms117us956ns
1	_Manual_Reset_PC	H'830	H'1C	61453	18253h054min011s721ms117us956ns
1	_INT_Illegal_code	H'84C	H'4	47789	18253h054min011s721ms117us956ns
1	_Dummy	H'850	H'4	61453	18253h054min011s721ms117us956ns
1	_sbrk	H'1000	H'24	47789	18253h054min011s721ms117us956ns
1	_main	H'1024	H'A6	61453	18253h054min011s721ms117us956ns
1	_f1	H'10D8	H'C	47789	18253h054min011s721ms117us956ns
1	_h2	H'10EC	H'8	61453	18253h054min011s721ms117us956ns
1	_func3	H'10F4	H'16	47789	18253h054min011s721ms117us956ns
1	_func4	H'110A	H'4	61453	18253h054min011s721ms117us956ns

Figure 5.99 [Realtime Profile] Window

The following information can be acquired:

Address — You can see the locations in memory to which the functions are allocated.

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 execute larger functions, more of the cache memory will need to be updated. This information allows you to check if those functions that may cause cache misses are frequently called.

Count — The number of times that functions have been called is displayed.

Times — The total execution time is displayed.

5.13.2 Specifying the Measurement Range

Clicking the right-hand mouse button on the window displays the popup menu. When [Add Range] is selected from the popup menu, the [EDIT] dialog box opens to specify the measurement range of realtime profile.

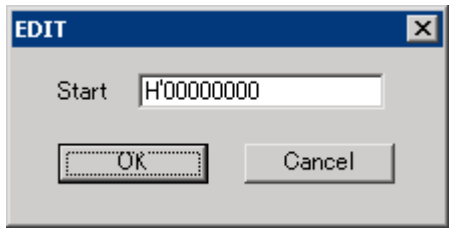


Figure 5.100 [EDIT] Dialog Box

When the expansion profiling unit is connected to the emulator, it is possible to measure the profile information within the 6-Mbyte ranges in total. When the expansion profiling unit is not connected to the emulator, it is possible to measure the profile information within the 2-Mbyte ranges in total.

In the emulator, 512 kbytes are considered as a unit to acquire the profiling information on all the functions in the eight-block areas. Addresses to be specified for each block need not be adjacent. When the expansion profiling unit is connected to the emulator, 16 blocks of 512 kbytes are added and the 24-block areas can be measured in total.

The measured data in each block is displayed on each page of the [Realtime Profile] window. To switch the page to be displayed, select that page and click the [OK] button in the [Select Page] dialog box that is opened by selecting [Select Page] from the popup menu of the [Realtime Profile] window.

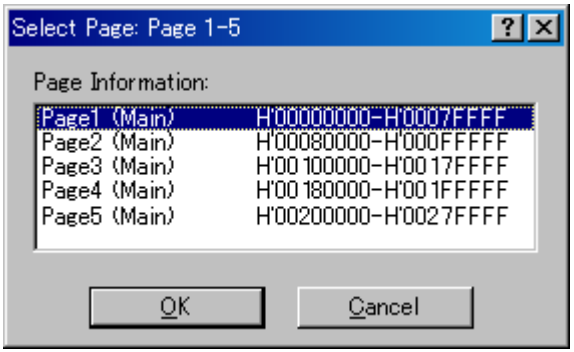


Figure 5.101 [Select Page] Dialog Box

5.13.3 Starting Measurement

When the user program is executed, measurement is started.

When the user program is halted, the measurement result is displayed in the [Realtime Profile] window.

5.13.4 Clearing Measurement Result

Selecting [Clear Data] from the popup menu clears the measurement result of the [Column] and [Time] columns.

5.13.5 Deleting Measurement Range

Selecting [Delete] from the popup menu deletes all the specified measurement range and clears the measurement result.

5.13.6 Setting the Minimum Unit of the Measurement Time

In the emulator, it is possible to change the minimum unit of the measurement time as any of 20 ns, 100 ns, 400 ns, or 1.6 µs.

At 20 ns, the maximum time that can be measured is about three hours.

At 100 ns, the maximum time that can be measured is about 15 hours.

At 400 ns, the maximum time that can be measured is about 61 hours.

At 1.6 µs, the maximum time that can be measured is about 244 hours.

To change the minimum unit, select [Set] from the popup menu of the [Realtime Profile] window and open the [Properties] dialog box.

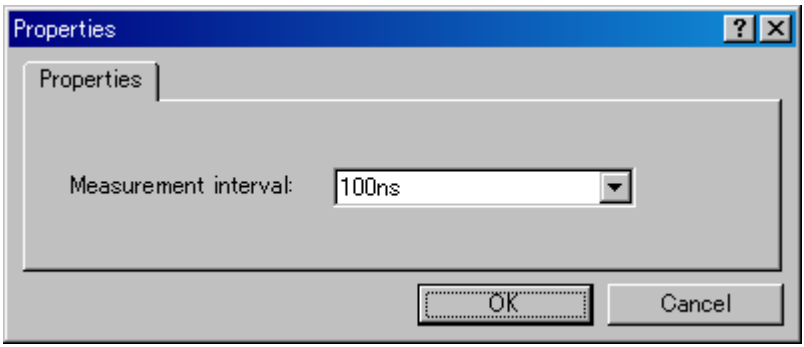


Figure 5.102 [Properties] Dialog Box

Note: Be sure to set the following when using the realtime profiling function:

- [I-Trace/AUD-Trace acquisition] dialog box that is opened by selecting [Set] from the popup menu of the [Trace] window:
  [Trace mode] page
  [Trace type]: Select [AUD Trace].
  [AUD mode]: Select the [Branch trace] check box.
  [AUD Branch trace] page
  [Acquire normal branch instruction trace]: Select this check box.
  [Acquire subroutine branch instruction trace]: Select this check box.
  [Acquire exception branch instruction trace]: Select this check box.

5.14 Using Multiple Debugging Platforms

Multiple debugging platforms can be operated at the same time in the High-performance Embedded Workshop.

When selecting [Renesas High-performance Embedded Workshop] -> [High-performance Embedded Workshop] from [Programs] in the [Start] menu to initiate another High-performance Embedded Workshop, two emulators can be used separately for debugging.

5.14.1 Distinguishing Two Emulators

Connect two emulators to the USB connector. Then, initiate the High-performance Embedded Workshop using the tutorial workspace. The following message is displayed.

Figure 5.103 Message for Driver Selection

Click the [OK] button. The following dialog box will appear.

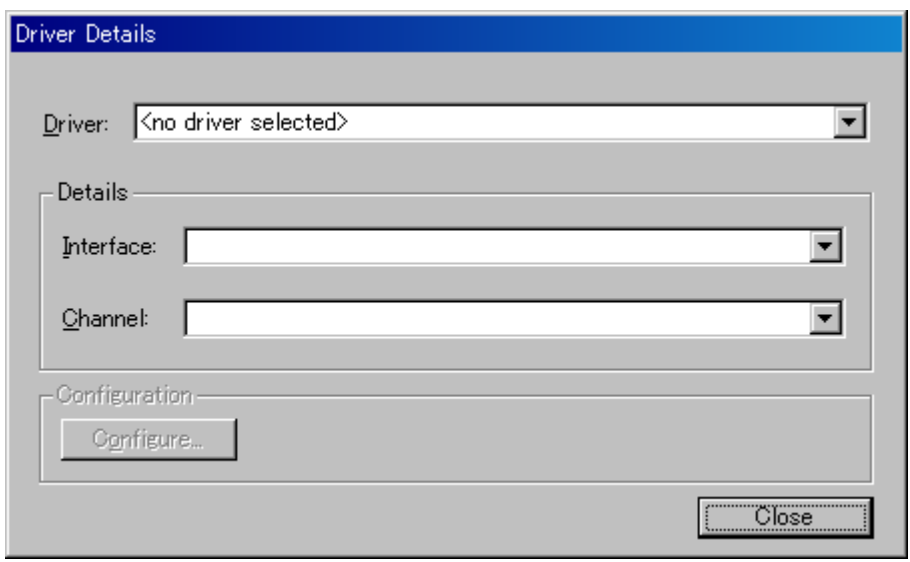


Figure 5.104 [Driver Details] Dialog Box (1)

Select [E7/E10 Emulator USB Driver] from the [Driver] drop-down list box and open the [Channel] drop-down list box. Channel information for two emulators is displayed in the [Channel] drop-down list box as shown below.

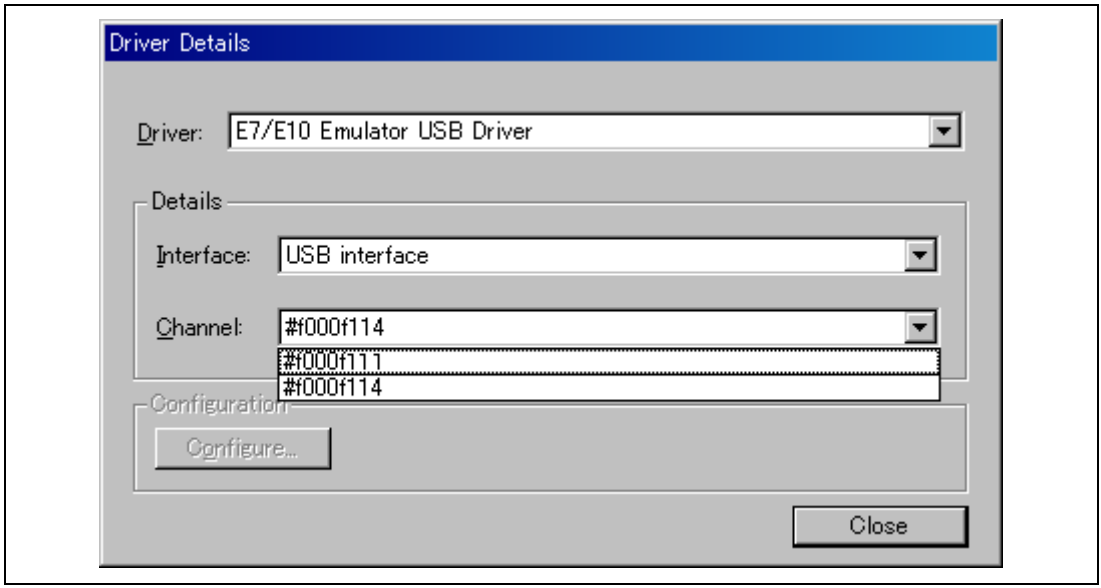


Figure 5.105 [Driver Details] Dialog Box (2)

Information displayed in figure 5.105 is the information of the USB connector to which the emulators are connected.

Note: The displayed character strings of the information depend on the host computer's environment.

Check which of the character strings of information show emulators.

Select [<no driver selected>] in the [Driver] drop-down list box and disconnect one emulator from the USB connector. After that, select [E7/E10 Emulator USB Driver] in the [Driver] drop-down list box. Only information on the USB connector that the emulator is connected to is displayed in the [Channel] drop-down list box.

The above procedures are used to discern which of the emulators are indicated by the displayed character strings of information in the [Channel] drop-down list box.

When initiating the High-performance Embedded Workshop, in the [Channel] drop-down list box, select the information on the USB connector of the emulator that is connected to the master CPU. Initiate the High-performance Embedded Workshop using the normal procedures.

When initiating the slave High-performance Embedded Workshop, in the [Channel] drop-down list box, select the information on the USB connector of the emulator that is connected to the slave CPU.

5.15 Acquiring Code Coverage

The emulator acquires code coverage information (C0 coverage) from the address range specified by the user and displays the results.

Note: Be sure to set the following when measuring the code coverage:

- [I-Trace/AUD-Trace acquisition] dialog box that is opened by selecting [Set] from the popup menu of the [Trace] window:
  [Trace Mode] page
  [Trace mode]: Select [AUD Trace].
  [AUD mode]: Check the [Branch trace] check box.
  [AUD Branch trace] page
  [Acquire normal branch instruction trace]: Check this check box.
  [Acquire subroutine branch instruction trace]: Check this check box.
  [Acquire exception branch instruction trace]: Check this check box.

5.15.1 Opening the [Code Coverage] Window

Select [View -> Code -> Code Coverage…] or click the [Code Coverage] toolbar button (). The following dialog box opens when the coverage function is used for the first time after initiation of the emulator.

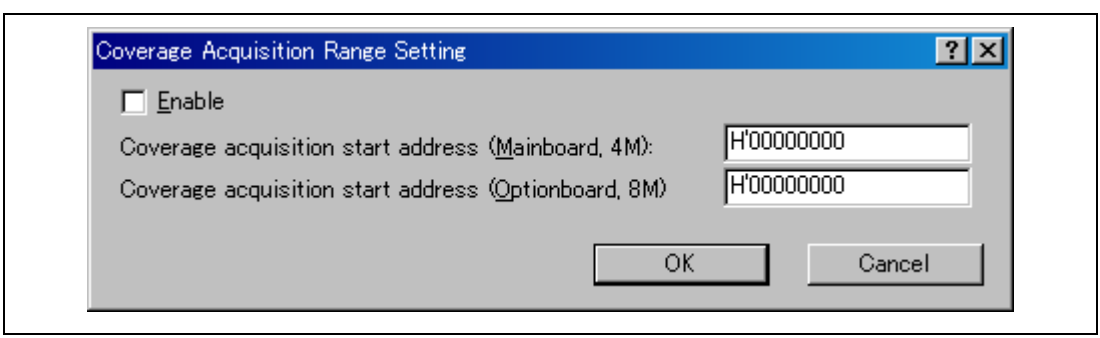


Figure 5.106 [Coverage Acquisition Range Setting] Dialog Box

[Enable]: Checking this box allows acquisition of code coverage information.

[Coverage acquisition start address (Mainboard, 4M)]:
The emulator specifies the measurement start address in the range of 4 Mbytes.

[Coverage acquisition start address (Optionboard, 8M)]:
The emulator specifies the measurement start address in the range of 8 Mbytes. This function is only available when the expansion profiling unit is connected to the emulator.

[OK]: Closes this dialog box by setting the specified condition.

[Cancel]: Closes this dialog box without setting the specified condition.

This dialog box will only be displayed once after initiation of the emulator. To open this dialog box, select [Hardware Settings…] from the popup menu of the [Code Coverage] window. When the [Coverage Acquisition Range Setting] dialog box is closed, the [Open Coverage] dialog box appears.

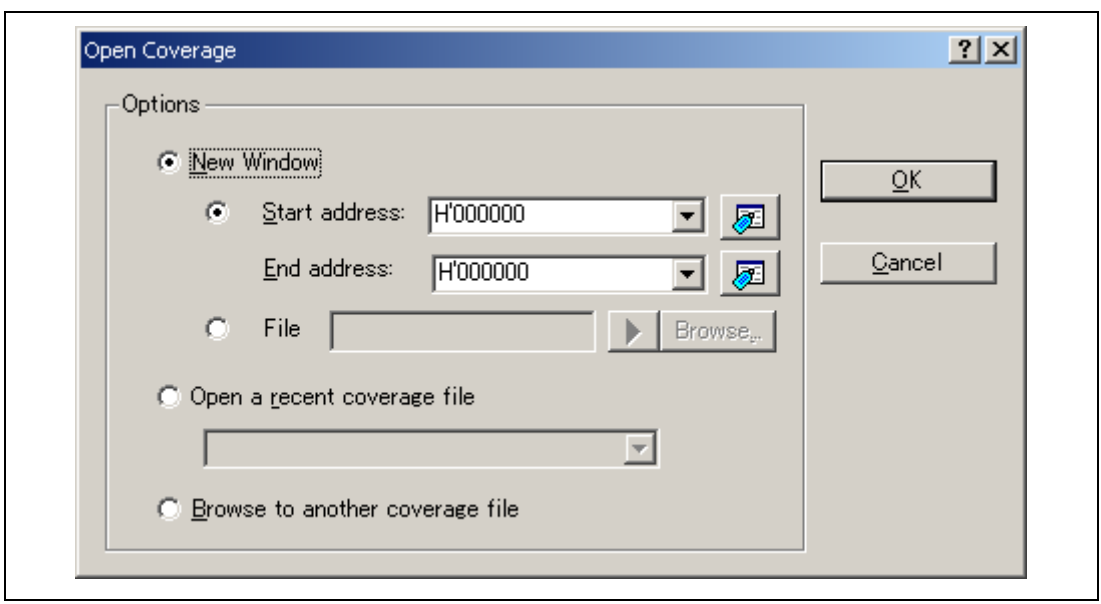


Figure 5.107 [Open Coverage] Dialog Box

In this dialog box, specify a range to be shown in the [Code Coverage] window.

[New Window]: Specifies a new coverage range.

- [Start address]: Enter the start address of coverage information to be displayed (in hexadecimal when the prefix is omitted).
- [End address]: Enter the end address of coverage information to be displayed (in hexadecimal when the prefix is omitted).

[File]: Specifies a source file that has ".C" or ".CPP" as its file type name from the current project. This allows a function included in the specified file to be set as the coverage range. ".C" will be automatically specified if the file type name is omitted. Files with a type name other than ".C" or ".CPP" cannot be specified here. A placeholder or the [Browse…] button can be used.

[Open a recent coverage file]: Lists a maximum of four files that were saved most recently. Select one from the list.

[Browse to another coverage file]: Allows specification of a file that is not included in the list.

Clicking the [OK] button in this dialog box opens the [Code Coverage] window. The display format differs depending on whether the address range or source file is specified.

[Code Coverage] Window (Specifying an Address)

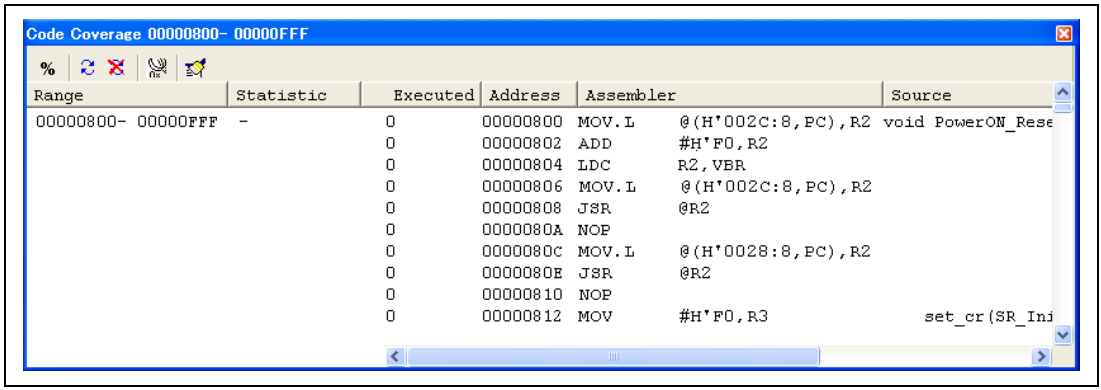


Figure 5.108 [Code Coverage] Window (Specifying an Address)

The [Code Coverage] window is divided into two by the splitter.

- **Left-hand window**

Displays the coverage range and statistical information of the coverage. The items are displayed as follows:

[Range]: Address range

[Statistic]: C0 coverage value (in percentage)

The percentage will be displayed in the [Statistic] column by selecting [Percentage] from the popup menu on the left-hand window.

Figure 5.109 Percentage Shown in the [Code Coverage] Window

- **Right-hand window**

Displays coverage information at the C/C++ or assembly-language level. The items are displayed as follows:

[Executed]: 1 (the instruction was executed) or 0 (the instruction was not executed)

[Address]: Instruction address

[Assembler]: Disassembled program

[Source]: C/C++ or assembly source program

[Code Coverage] Window (Specifying a Source File)

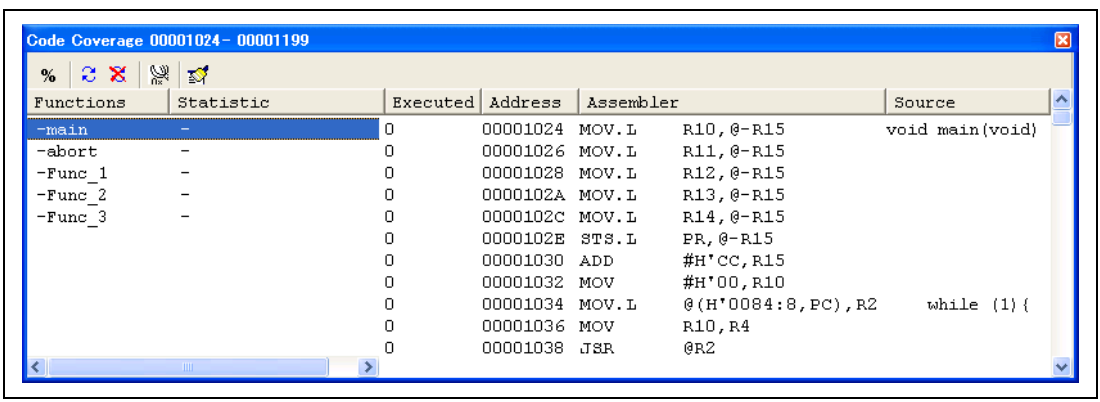


Figure 5.110 [Code Coverage] Window (Specifying a Source File)

This window is divided into two by the splitter.

- **Left-hand window**

Displays the coverage range and statistical information of the coverage. The items are displayed as follows:

[Functions]: Function to be selected for coverage

[Statistic]: C0 coverage value (in percentage)

The percentage will be displayed in the [Statistic] column by selecting [Percentage] from the popup menu in the left-hand window. Clicking the column tab allows the function names or C0 coverage values to be listed in descending or ascending order.

- **Right-hand window**

Displays coverage information of the function selected by double-clicking on the left-hand window at the C/C++ or assembly-language level. The items are displayed as follows:

[Executed]: 1 (the instruction was executed) or 0 (the instruction was not executed)

[Address]: Instruction address

[Assembler]: Disassembled program

[Source]: C/C++ or assembly source program

5.15.2 Displaying a Source File

Selecting [Display a Source File] from the popup menu opens the [Editor] window, which displays the source file for the address at the cursor location on the [Code Coverage] window.

5.15.3 Changing the Address to be Displayed

Selecting [Go To Address…] from the popup menu opens the [Go To Address] dialog box, which allows the user to change the address to be displayed in the [Code Coverage] window.

Figure 5.111 [Go To Address] Dialog Box

5.15.4 Changing the Coverage Range to be Displayed

- **When the coverage range for display has been specified by address**

Selecting [Set Range…] from the popup menu opens the [Coverage Display Range] dialog box, which allows the user to change the condition for acquisition of information on executed instructions.

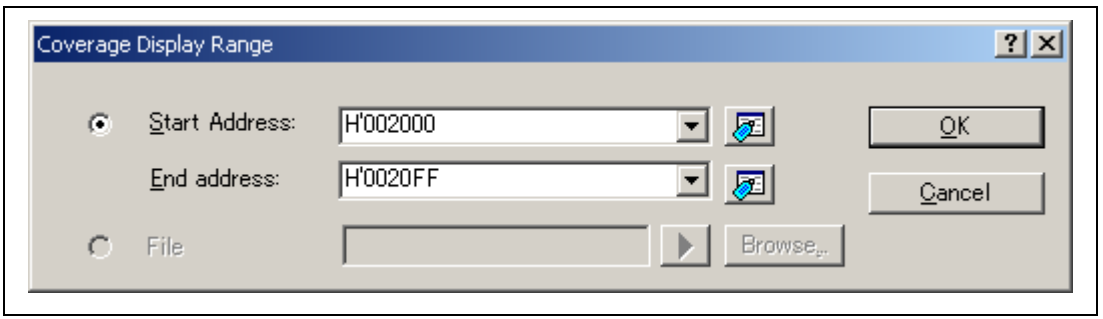


Figure 5.112 [Coverage Display Range] Dialog Box

The following items can be specified.

[Start Address]: Start address (in hexadecimal when the prefix is omitted)

[End Address]: End address (in hexadecimal when the prefix is omitted)

Clicking the [OK] button changes the coverage range to be displayed.

- **When the coverage range for display has been specified by a source file**

Selecting [Set Range…] from the popup menu opens the [Coverage Display Range] dialog box, which allows the user to change the condition for acquisition of information on executed instructions.

Figure 5.113 [Coverage Display Range] Dialog Box (Specifying a Source File)

The following item can be specified.

[File]: Specifies a source file that has ".C" or ".CPP" as its file type name from the current project. This allows a function included in the specified file to be set as the coverage range. ".C" will be provided if the file type name is omitted. Files with a type name other than ".C" or ".CPP" cannot be specified here. A placeholder or the [Browse…] button can be used.

Clicking the [OK] button changes the coverage range to be displayed.

5.15.5 Clearing the Coverage Information

- **Clearing the coverage information of the specified range**

Selecting [Clear Coverage Range…] from the popup menu opens the [Clear Coverage Range] dialog box.

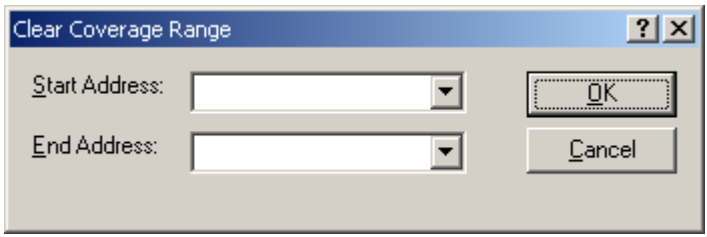


Figure 5.114 [Clear Coverage Range] Dialog Box

Enter the start and end addresses of the range to be cleared. Clicking the [OK] button clears the coverage information of the selected range.

- **Clearing all the coverage information**

Selecting [Clear the Entire Coverage] from the popup menu clears all the coverage information.

5.15.6 Saving the Coverage Information to a File

Selecting [Save Data…] from the popup menu opens the [Save Coverage Data] dialog box.

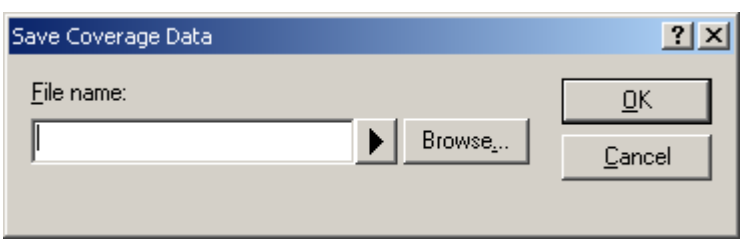


Figure 5.115 [Save Coverage Data] Dialog Box

Specify the location of the coverage information file to be saved and its name. A placeholder or the [Browse…] button can be used. If the file extension is omitted, ".COV" will automatically be added as the file extension. An error message will appear if a file extension other than ".COV" or ".TXT" is entered.

5.15.7 Loading Coverage Information from a File

Selecting [Load Data…] from the popup menu opens the [Load Data] dialog box.

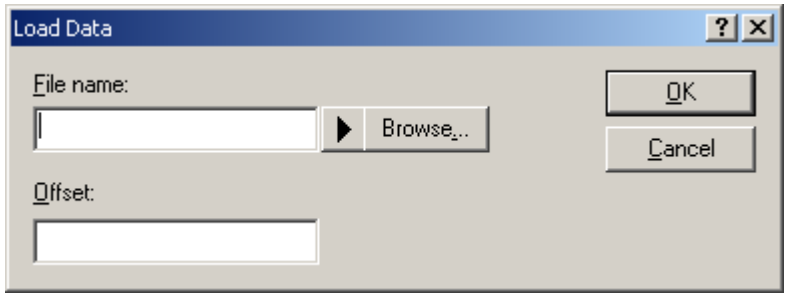


Figure 5.116 [Load Data] Dialog Box

Specify the location of the coverage information file to be loaded. A placeholder or the [Browse…] button can be used. The only file extension available is “.COV”. An error message will appear if any other file extension is entered.

Note: If the coverage range has been specified by a source file, the saved “.COV” file cannot be loaded.

5.15.8 Updating Coverage Information

Selecting [Refresh] from the popup menu updates the content of the [Code Coverage] window.

5.15.9 Preventing Update of Coverage Information

Selecting [Lock Refresh] from the popup menu prevents update of the [Code Coverage] window while the user program execution is stopped. This also prevents access to the emulator for acquisition of coverage information.

5.15.10 [Confirmation Request] Dialog Box

- **Clearing code coverage information or closing the [Code Coverage] window**

A confirmation dialog box appears before clearing code coverage information or closing the [Code Coverage] window.

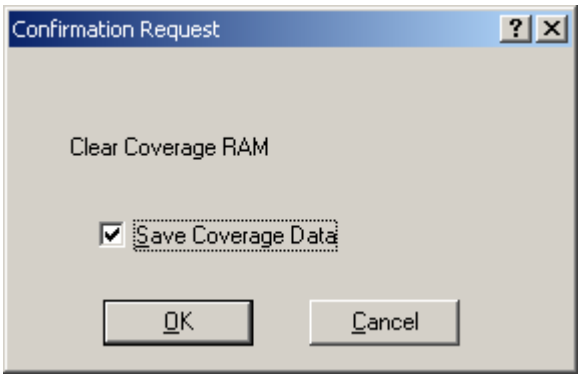


Figure 5.117 [Confirmation Request] Dialog Box

When [Save Coverage Data] is checked, the coverage data can be saved into a file before clearing. Clicking the [OK] button clears the coverage information.

- **When [File -> Save Session] has been selected**

When one or more [Code Coverage] windows are open, the number of [Save Code Coverage] dialog boxes to be opened is the same as that of the [Code Coverage] window(s). The data of the windows can be saved separately or together.

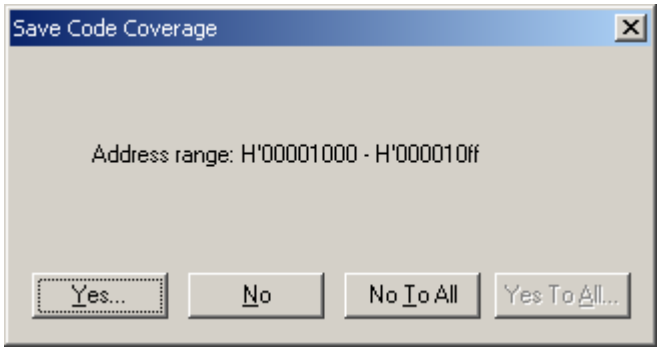


Figure 5.118 [Save Code Coverage] Dialog Box

Clicking [No To All] closes this dialog box without saving any coverage information. Clicking [Yes To All] saves data of all the [Code Coverage] windows into one file.

5.15.11 Displaying Code Coverage Information in the [Editor] Window

Highlighting the Code Coverage column that corresponds to a source line where an instruction has been executed allows the coverage information to also be displayed in the [Editor] window. If the user changes any setting regarding the coverage information in the [Code Coverage] window, the content of the corresponding Code Coverage column will also be updated.

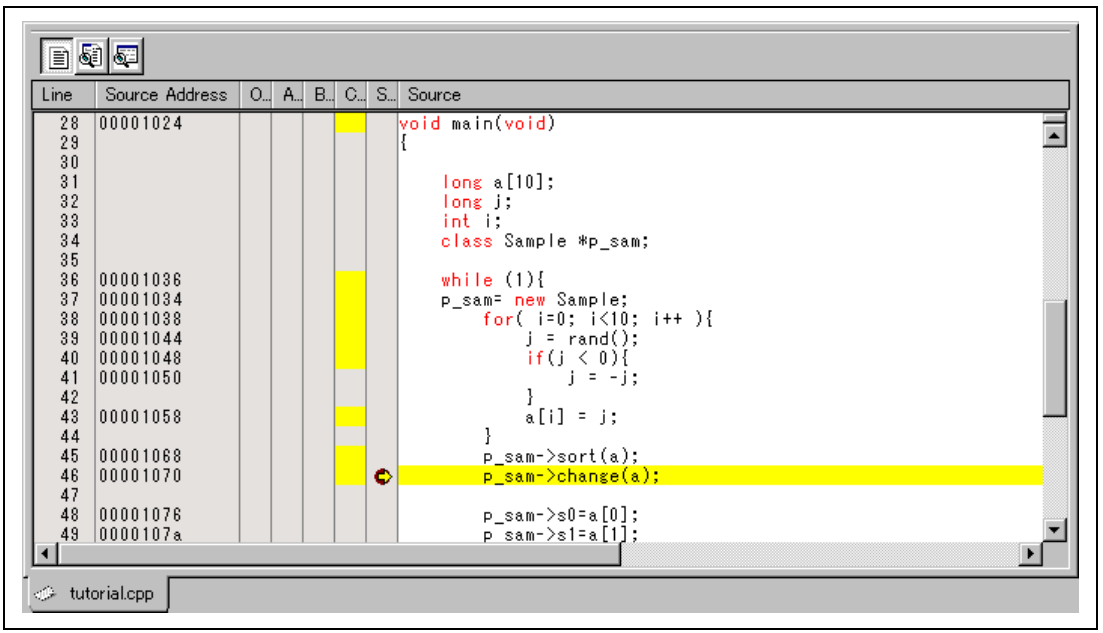


Figure 5.119 [Code Coverage] Column

Section 6 Tutorial

6.1 Introduction

This section describes the main functions of the emulator by using a tutorial program.

The tutorial program is based on the C++ program that sorts ten random data items in ascending or descending order. The tutorial program performs the following actions:

- The `main` function generates random data to be sorted.
- The `sort` function sorts the generated random data in ascending order.
- The `change` function then sorts the data in descending order.

The file `tutorial.cpp` contains source code for the tutorial program. The file `Tutorial.abs` is a compiled load module in the Dwarf2 format.

Notes: 1. Operation of `Tutorial.abs` is big endian. For little-endian operation, `Tutorial.abs` must be recompiled. After recompilation, the addresses may differ from those given in this section.

2. This section describes general usage examples for the emulator. For the specifications of particular products, refer to the additional document, Supplementary Information on Using the SHxxxx, or the online help.
3. The operation address of `Tutorial.abs` attached to each product differs depending on the product.

6.2 Running the High-performance Embedded Workshop

To run the High-performance Embedded Workshop, refer to section 4.1, System Check.

6.3 Setting up the Emulator

The clocks which are used for data communications must be set up on the emulator before the program is downloaded.

- AUD clock
  A clock used in acquiring AUD traces.
  If its frequency is set too low, complete data may not be acquired during realtime tracing.
  Set the frequency not to exceed the upper limit for the MCU's AUD clock.
  The AUD clock is only needed for using emulators that have an AUD trace function.
- JTAG (H-UDI) clock (TCK)
  A communication clock used except for acquiring AUD trace.
  If its frequency is set too low, the speed of downloading will be lowered.
  Set the frequency not to exceed the upper limit for the MCU's guaranteed TCK range.

For details of the limitations on both clocks, refer to the section of Notes on Using the JTAG (H-UDI) Clock (TCK) and AUD Clock (AUDCK), in the additional document, Supplementary Information on Using the SHxxxx. The following is a description of the procedure used to set the clocks.

6.4 Setting the [Configuration] Dialog Box

- Select [Emulator] then [Systems…] from the [Options] menu to set a communication clock. The [Configuration] dialog box is displayed.

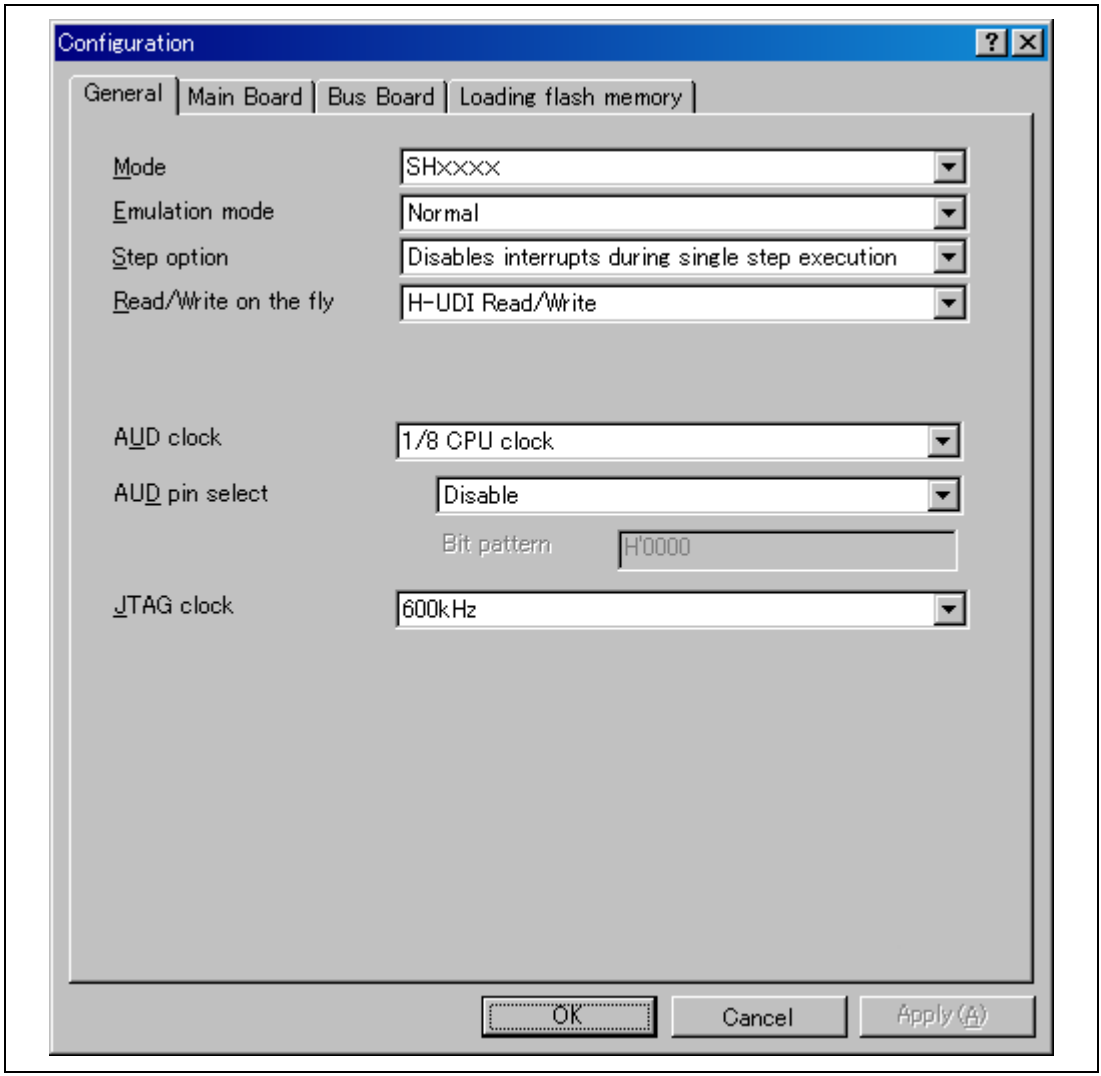


Figure 6.1 [Configuration] Dialog Box

- Set appropriate values in the [AUD clock] and [JTAG clock] combo boxes. The clock also operates with the default value.

Note: The items that can be set in this dialog box differ depending on the product. For details on the settings for each product, refer to the online help.

- Click the [OK] button to set a configuration.

6.5 Checking the Operation of the Target Memory for Downloading

Check that the destination memory area for downloading is operating correctly.

When the destination memory is SDRAM or DRAM, a register in the bus controller of the target microcomputer must be set before downloading. Set the bus controller correctly in the [IO] window according to the memory type to be used.

When the required settings, such as the settings for the bus controller, have been completed, display and edit the contents of the destination memory in the [Memory] window to check that the memory is operating correctly.

Note: The above way of checking the operation of memory may be inadequate. It is recommended that a program for checking the memory be created.

- Select [Memory…] from the [CPU] submenu of the [View] menu and enter ***H'00000000*** in the [Display Address] edit box.

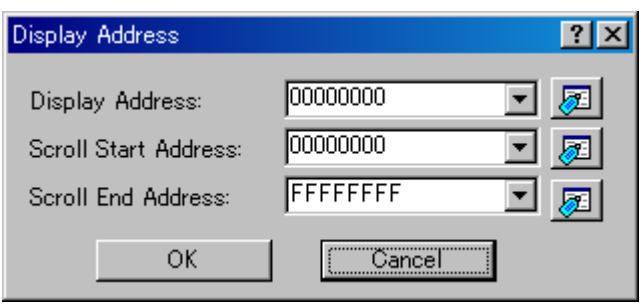


Figure 6.2 [Format] Dialog Box

- Click the [OK] button. The [Memory] window is displayed and shows the specified memory area.

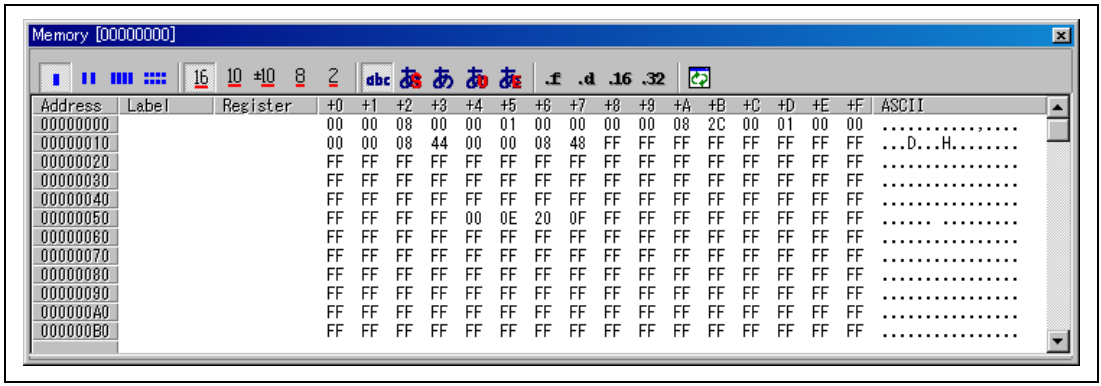


Figure 6.3 [Memory] Window

- Placing the mouse cursor on a point in the display of data in the [Memory] window and double-clicking allows the values at that point to be changed. Data can also be directly edited around the current position of the text cursor.

6.6 Downloading the Tutorial Program

6.6.1 Downloading the Tutorial Program

Download the object program to be debugged.

- Select [Download module] from [Tutorial.abs] under [Download modules].

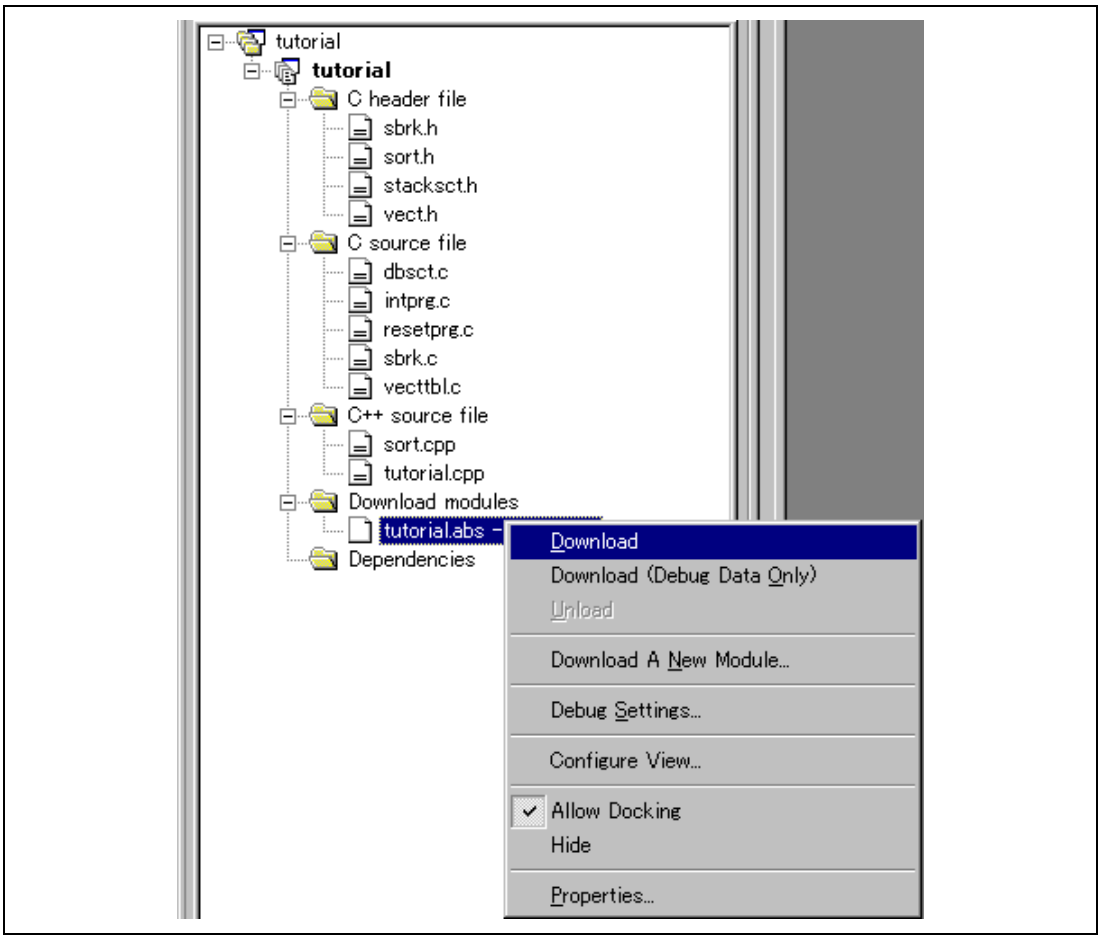


Figure 6.4 Downloading the Tutorial Program

6.6.2 Displaying the Source Program

The High-performance Embedded Workshop allows the user to debug a user program at the source level.

- Double-click [tutorial.cpp] under [C++ source file].

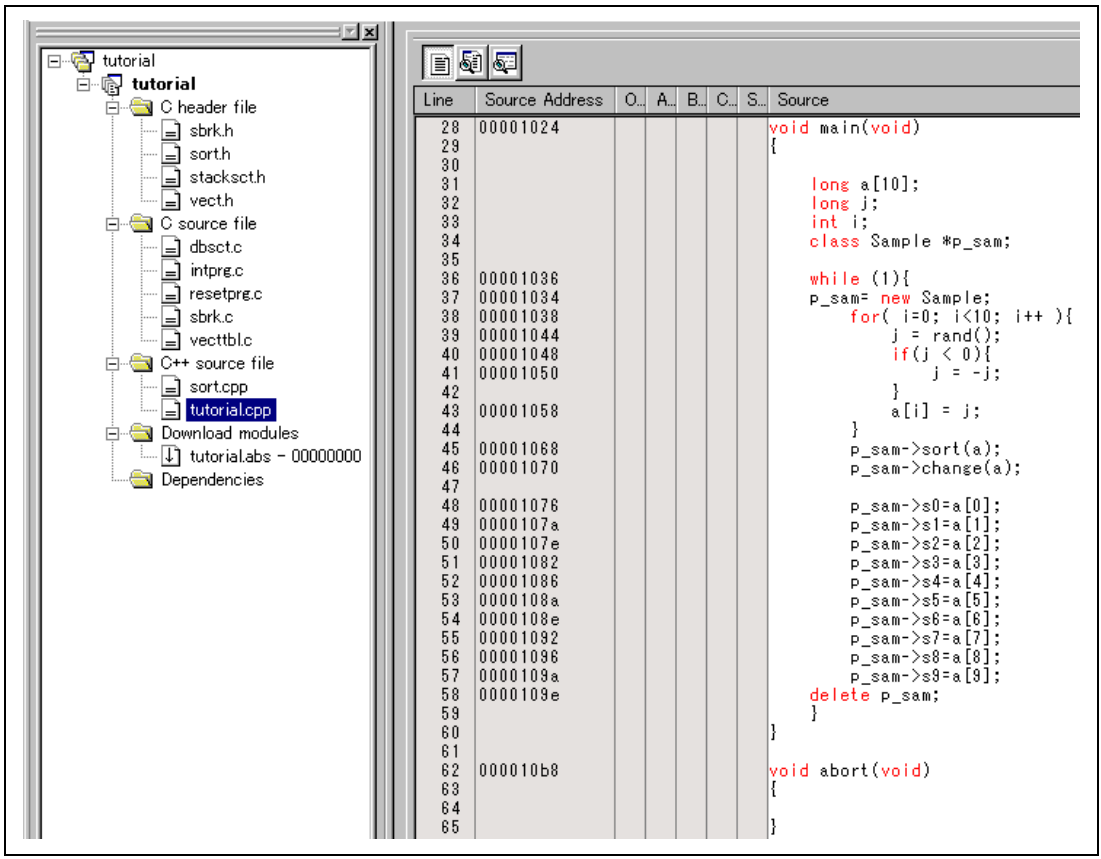


Figure 6.5 [Editor] Window (Displaying the Source Program)

- Select a font and size that are legible from the [Format…] option in the [Setup] menu if necessary.

Initially the [Editor] window shows the start of the user program, but the user can use the scroll bar to scroll through the user program and look at the other statements.

6.7 Setting an S/W Breakpoint

An S/W breakpoint is a simple debugging function.

The [Editor] window provides a very simple way of setting an S/W breakpoint at any point in a program. For example, to set an S/W breakpoint at the `sort` function call:

- Select by double-clicking the [S/W Breakpoints] column on the line containing the `sort` function call.

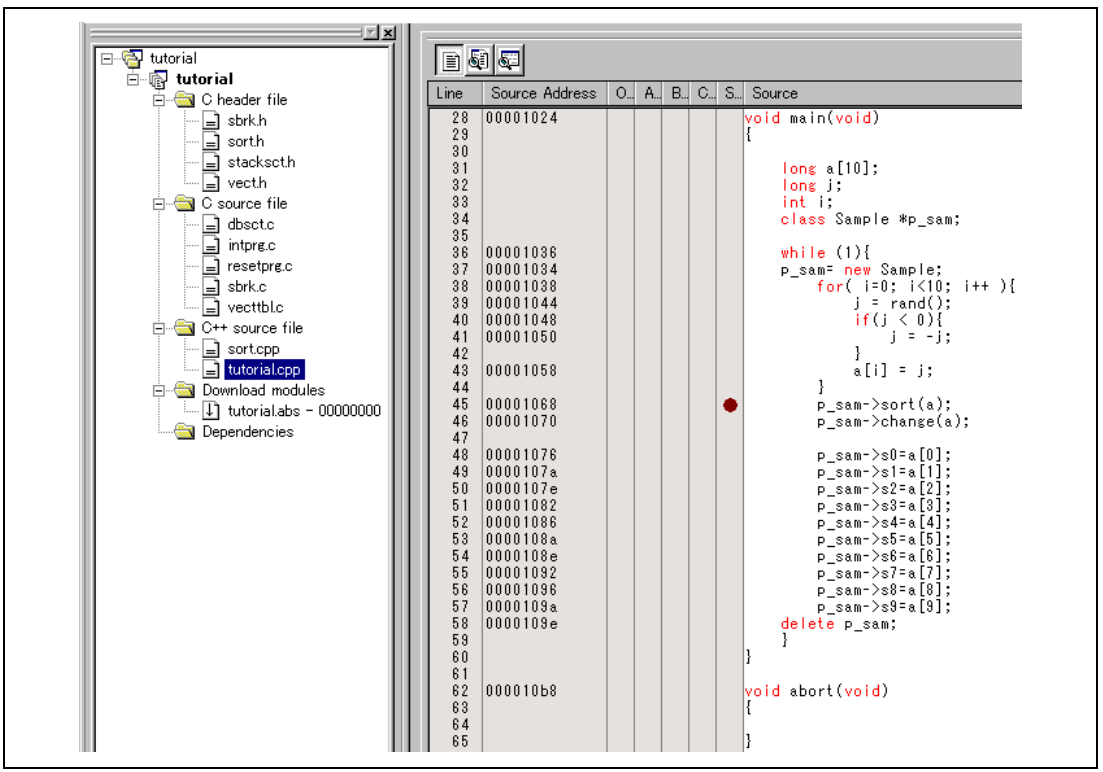


Figure 6.6 [Editor] Window (Setting an S/W Breakpoint)

The symbol • will appear on the line containing the `sort` function. This shows that an S/W breakpoint has been set.

Note: The S/W breakpoint cannot be set in the ROM area.

6.8 Setting Registers

Set values of the program counter and the stack pointer before executing the program.

- Select [Registers] from the [CPU] submenu of the [View] menu. The [Register] window is displayed.

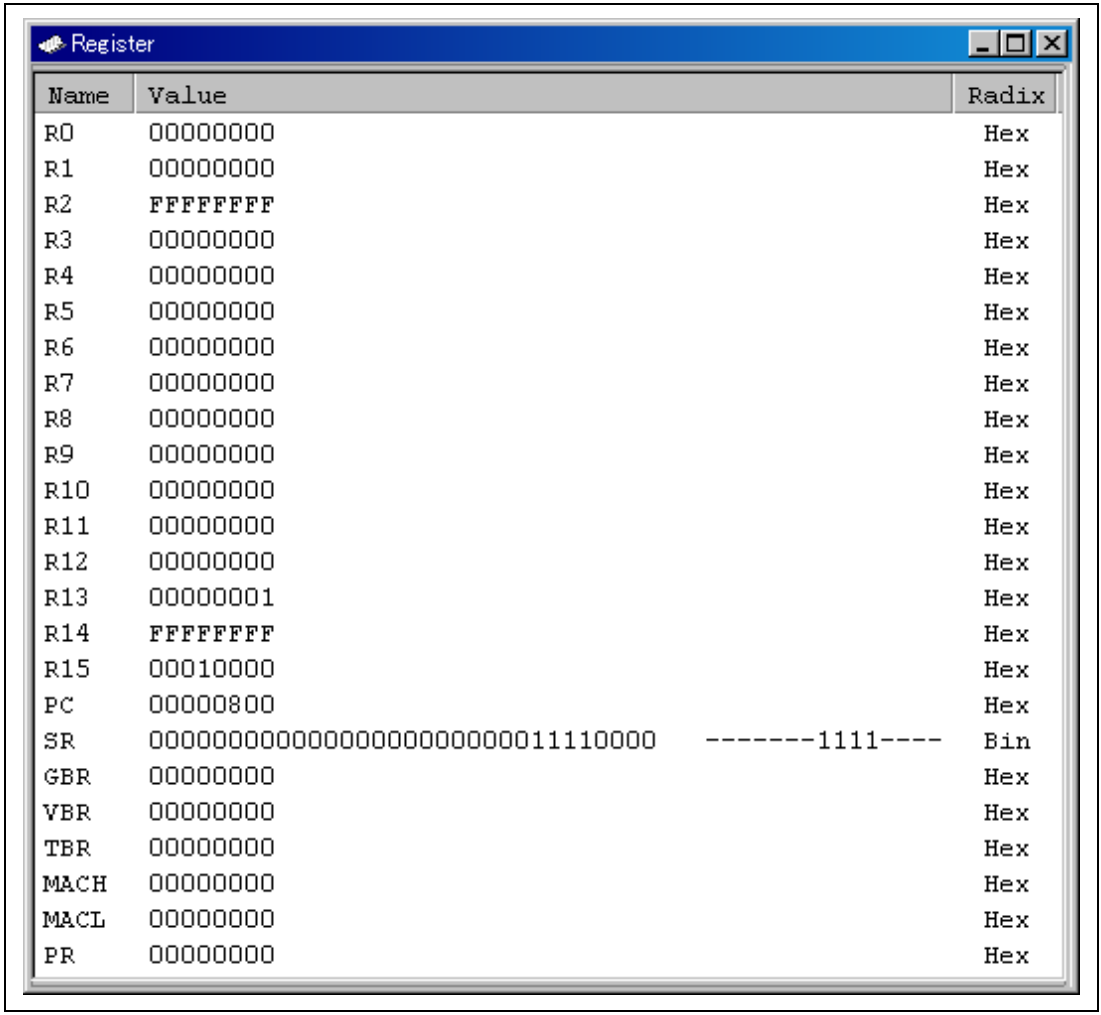


Figure 6.7 [Register] Window

- To change the value of the program counter (PC), double-click the value area in the [Register] window with the mouse. The following dialog box is then displayed, and the value can be changed. Set the program counter to H'00000800 in this tutorial program, and click the [OK] button.

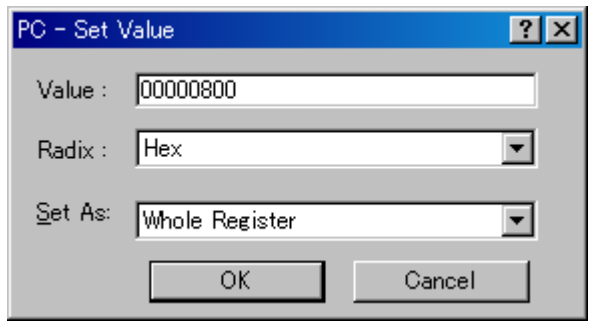


Figure 6.8 [Register] Dialog Box (PC)

- Change the value of the stack pointer (SP) in the same way. Set H'FF9F000 for the value of the stack pointer in this tutorial program.

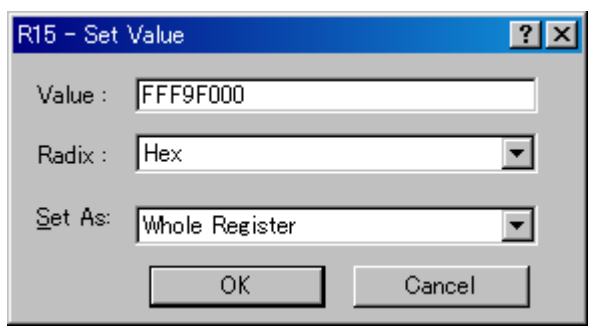


Figure 6.9 [Register] Dialog Box (R15)

6.9 Executing the Program

Execute the program as described in the following:

- To execute the program, select [Go] from the [Debug] menu, or click the [Go] button on the toolbar.

Figure 6.10 [Go] Button

When the program execution is started, `'**RUNNING'` is displayed on the status bar, and then the executed PC address is displayed in the products that support the MCU status acquisition function. The program will be executed up to the breakpoint that has been set, and an arrow will be displayed in the [S/W Breakpoints] column to show the position that the program has halted, with the message `[BREAKPOINT]` in the status bar.

Notes: 1. When the source file is displayed after a break, a path of the source file may be inquired. The location of the source file is as follows:
<Directory where the OS has been installed>\WorkSpace\Tutorial\E200\xxxx\Tutorial.
2. If program execution is failed, select [Reset CPU] from the [Debug] menu, reset the device, and restart the procedure from figure 6.8.

```
28  00001024                    void main(void)
29                              {
30
31                                  long a[10];
32                                  long j;
33                                  int i;
34                                  class Sample *p_sam;
35
36  00001036                        while (1){
37  00001034                        p_sam= new Sample;
38  00001038                            for( i=0; i<10; i++ ){
39  00001044                                j = rand();
40  00001048                                if(j < 0){
41  00001050                                    j = -j;
42                                          }
43  00001058                                a[i] = j;
44                                      }
45  00001068                            p_sam->sort(a);
46  00001070                            p_sam->change(a);
47
48  00001076                            p_sam->s0=a[0];
49  0000107a                            p_sam->s1=a[1];
50  0000107e                            p_sam->s2=a[2];
51  00001082                            p_sam->s3=a[3];
52  00001086                            p_sam->s4=a[4];
53  0000108a                            p_sam->s5=a[5];
54  0000108e                            p_sam->s6=a[6];
55  00001092                            p_sam->s7=a[7];
56  00001096                            p_sam->s8=a[8];
57  0000109a                            p_sam->s9=a[9];
58  0000109e                        delete p_sam;
59                                  }
60                              }
61
62  000010b8                    void abort(void)
63                              {
64
65                              }
```

Figure 6.11 [Editor] Window (Break State)

The user can see the cause of the break that occurred last time in the [Status] window.

- Select [Status] from the [CPU] submenu of the [View] menu. After the [Status] window is displayed, open the [Platform] sheet, and check the `Status` of `Cause of last break`.

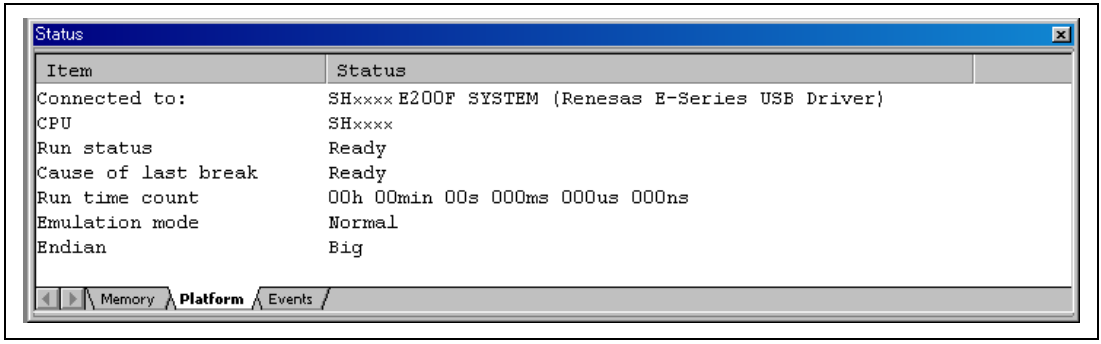


Figure 6.12 [Status] Window

Note: The items that can be displayed in this window differ depending on the product. For the items that can be displayed, refer to the online help.

6.10 Reviewing Breakpoints

The user can see all the breakpoints set in the program in the [Event] window.

- Select [Eventpoints] from the [Code] submenu of the [View] menu. The [Event] window is displayed. Select the [Breakpoint] sheet.

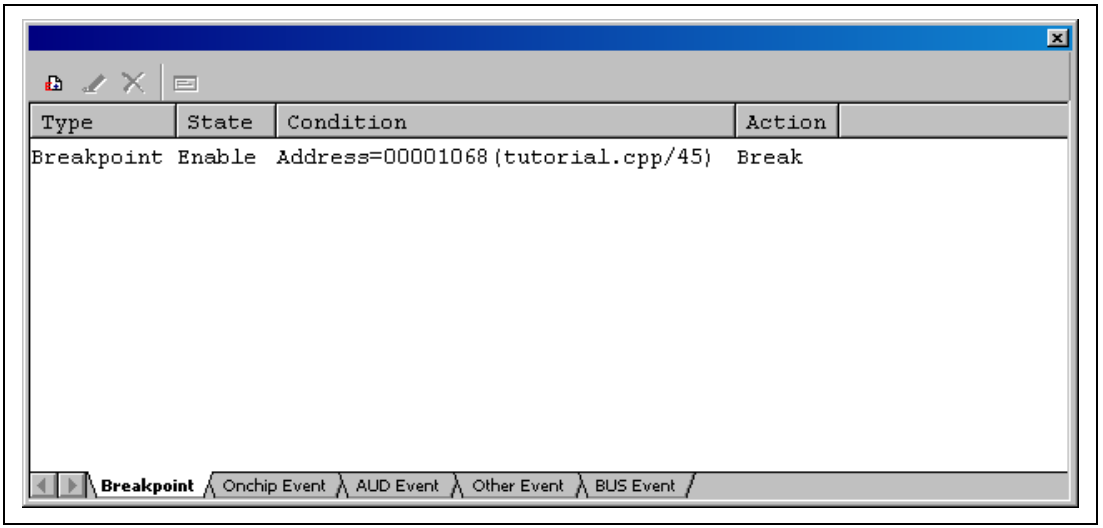


Figure 6.13 [Event] Window

The popup menu, opened by clicking the [Event] window with the right-hand mouse button, allows the user to set or change breakpoints, define new breakpoints, and delete, enable, or disable breakpoints.

6.11 Referring to Symbols

The [Label] window can be used to display the information on symbols in modules.

Select [Label] from the [Symbol] submenu of the [View] menu. The [Label] window is displayed so that the user can refer to the addresses of symbols in modules.

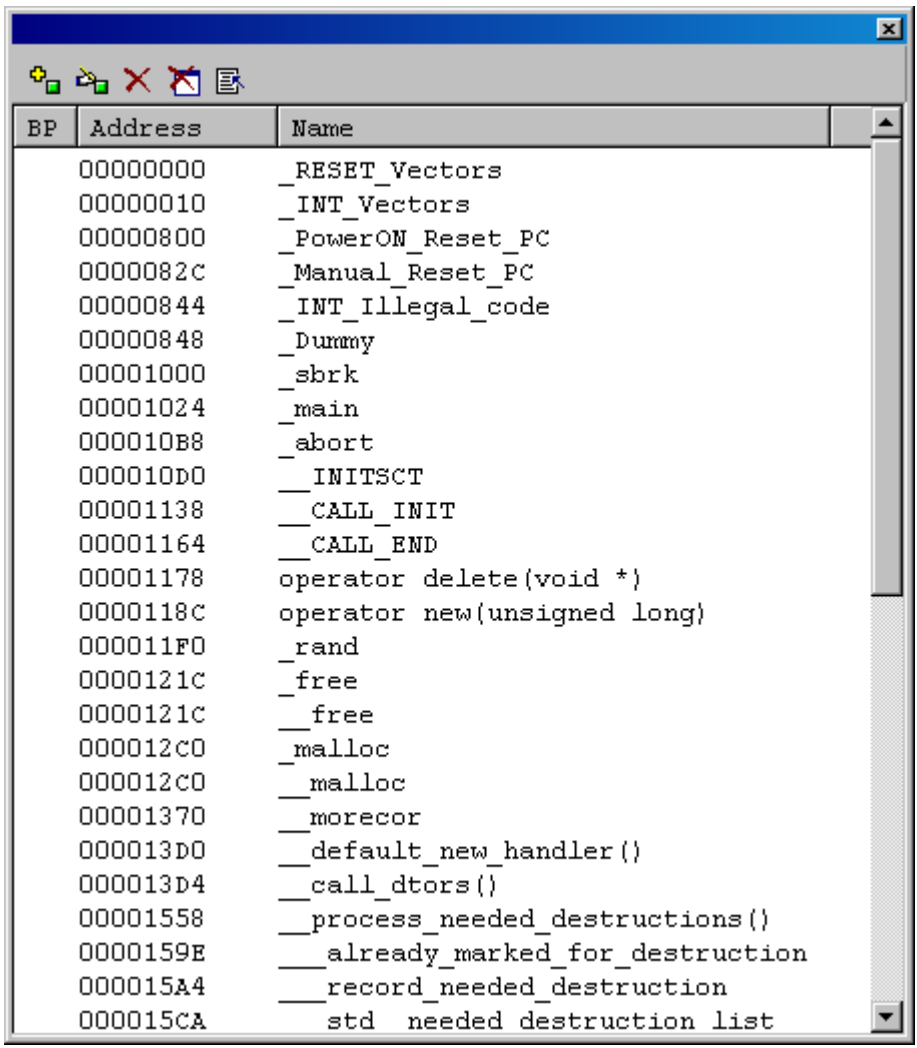


Figure 6.14 [Label] Window

6.12 Viewing Memory

When the label name is specified, the user can view the memory contents that the label has been registered in the [Memory] window. For example, to view the memory contents corresponding to `_main` in word size:

- Select [Memory …] from the [CPU] submenu of the [View] menu, enter ***_main*** in the [Display Address] edit box.

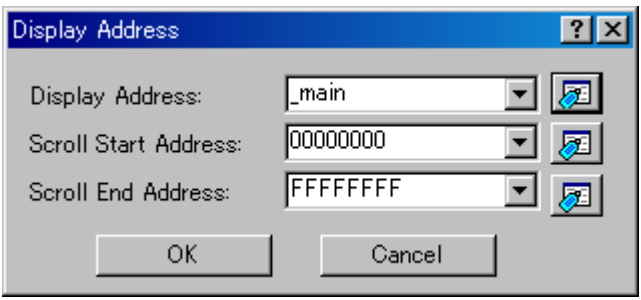


Figure 6.15 [Format] Dialog Box

- Click the [OK] button. The [Memory] window showing the specified area of memory is displayed.

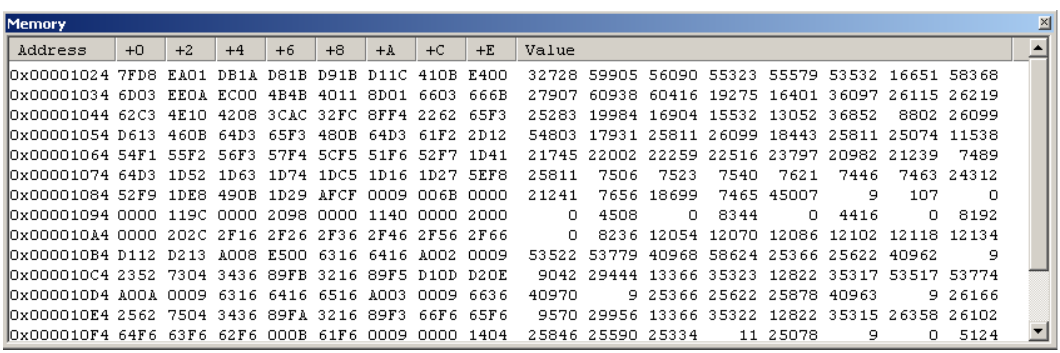


Figure 6.16 [Memory] Window

6.13 Watching Variables

As the user steps through a program, it is possible to watch that the values of variables used in the user program are changed. For example, set a watch on the long-type array a declared at the beginning of the program, by using the following procedure:

- Click the left of displayed array a in the [Editor] window to position the cursor.
- Select [Instant Watch...] with the right-hand mouse button.

The following dialog box will be displayed.

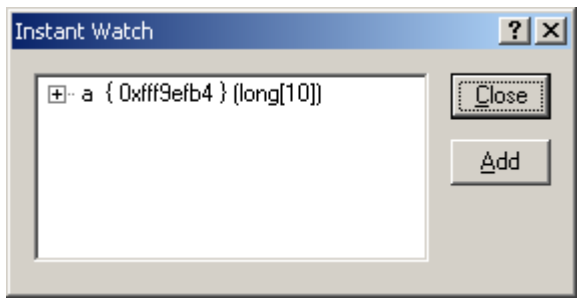


Figure 6.17 [Instant Watch] Dialog Box

- Click the [Add] button to add a variable to the [Watch] window.

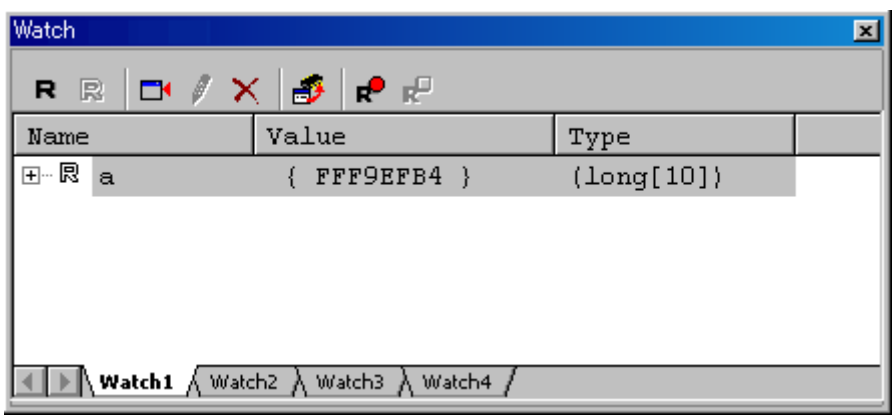


Figure 6.18 [Watch] Window (Displaying the Array)

The user can also add a variable to the [Watch] window by specifying its name.

- Click the [Watch] window with the right-hand mouse button and select [Add Watch…] from the popup menu.

The following dialog box will be displayed. Enter variable `i`.

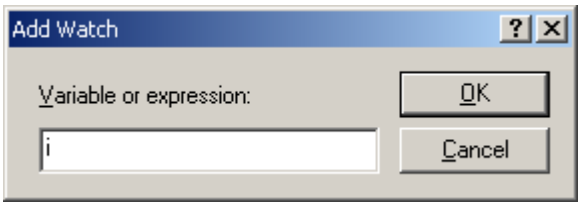


Figure 6.19 [Add Watch] Dialog Box

- Click the [OK] button.

The [Watch] window will now also show variable `i`.

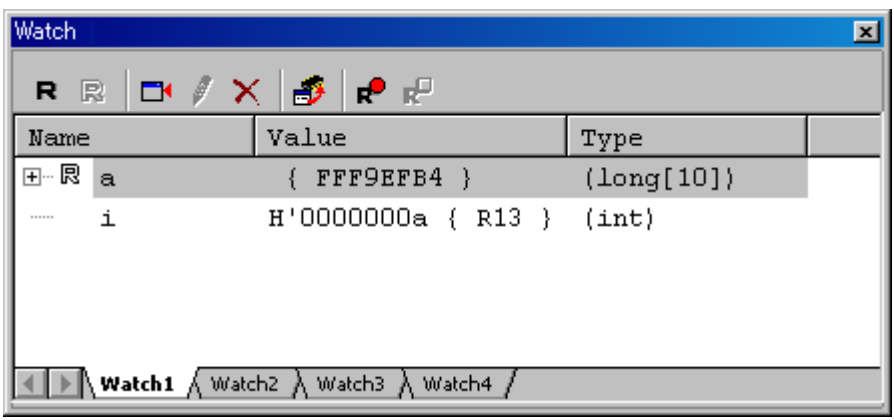


Figure 6.20 [Watch] Window (Displaying the Variable)

The user can click mark '+' at the left side of array a in the [Watch] window to watch all the elements.

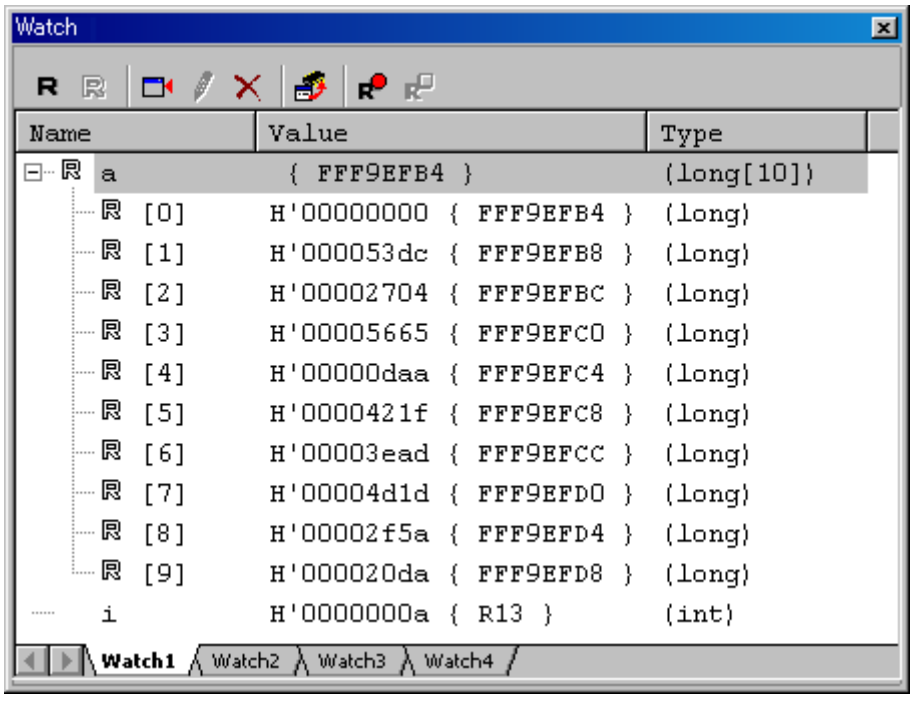


Figure 6.21 [Watch] Window (Displaying Array Elements)

6.14 Displaying Local Variables

The user can display local variables in a function using the [Locals] window. For example, we will examine the local variables in the `main` function, which declares four local variables: `a`, `j`, `i`, and `p_sam`.

- Select [Locals] from the [Symbol] submenu of the [View] menu. The [Locals] window is displayed.

The [Locals] window shows the local variables in the function currently pointed to by the program counter, along with their values. Note, however, that the [Locals] window is initially empty because local variables are yet to be declared.

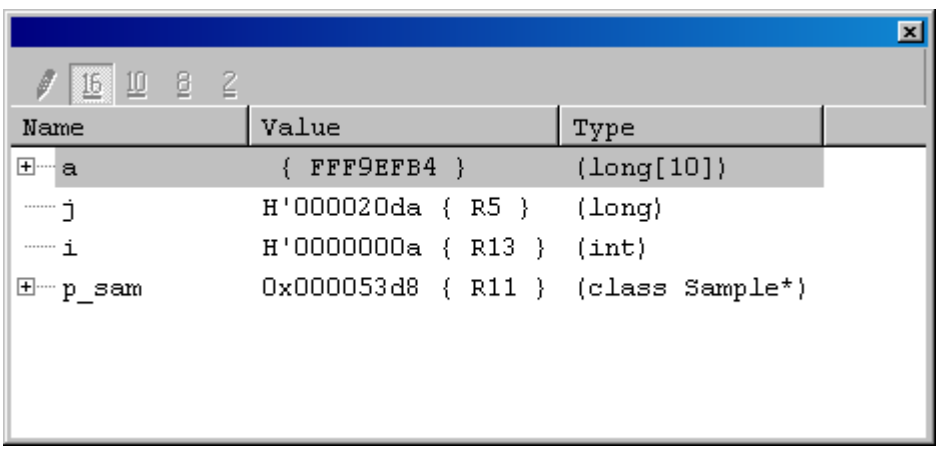


Figure 6.22 [Locals] Window

- Click mark '+' at the left side of array `a` in the [Locals] window to display the elements.
- Refer to the elements of array `a` before and after the execution of the `sort` function, and confirm that random data is sorted in descending order.

6.15 Stepping Through a Program

The High-performance Embedded Workshop provides a range of step menu commands that allow efficient program debugging.

Table 6.1 Step Option

Menu Command	Description
Step In	Executes each statement, including statements within functions.
Step Over	Executes a function call in a single step.
Step Out	Steps out of a function, and stops at the statement following the statement in the program that called the function.
Step…	Steps the specified times repeatedly at a specified rate.

6.15.1 Executing [Step In] Command

The [Step In] command steps into the called function and stops at the first statement of the called function.

- To step through the `sort` function, select [Step In] from the [Debug] menu, or click the [Step In] button on the toolbar.

Figure 6.23 [Step In] Button

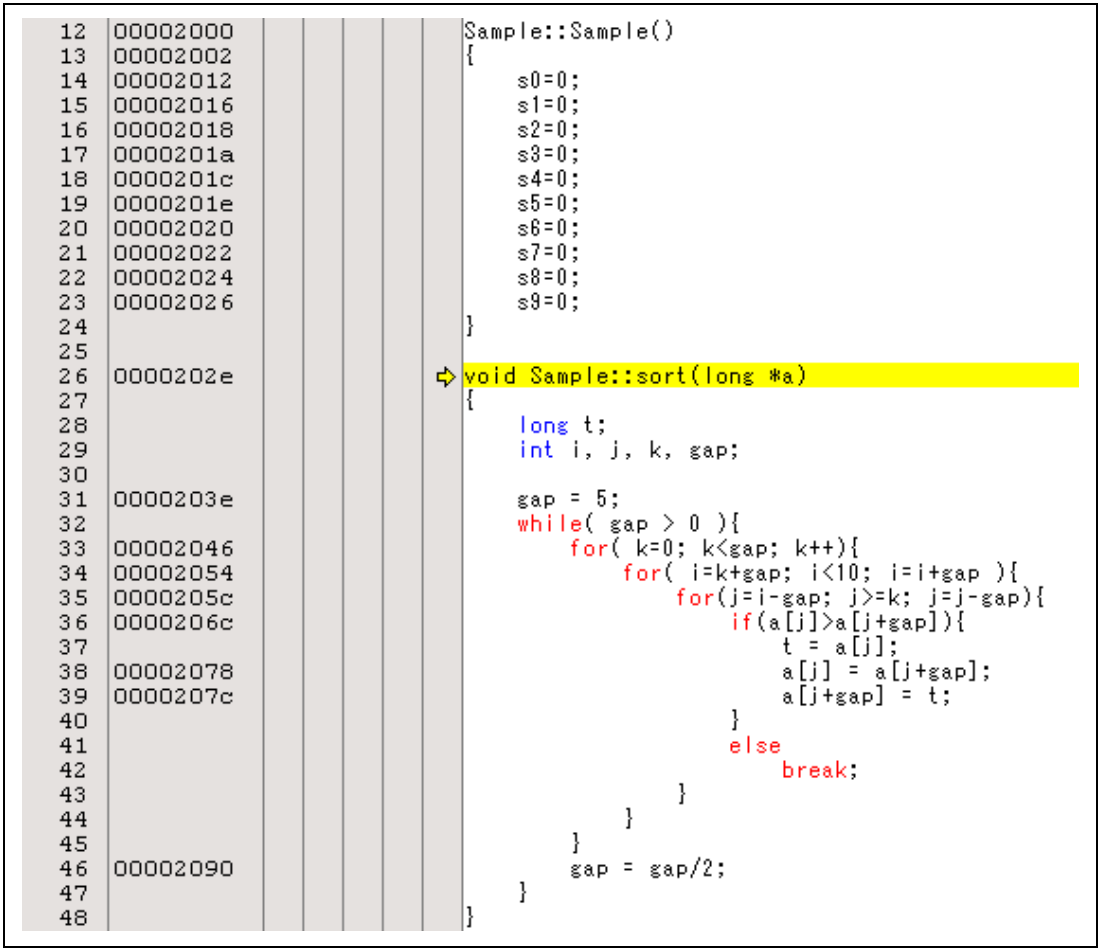


Figure 6.24 [Editor] Window (Step In)

- The highlighted line moves to the first statement of the `sort` function in the [Editor] window.

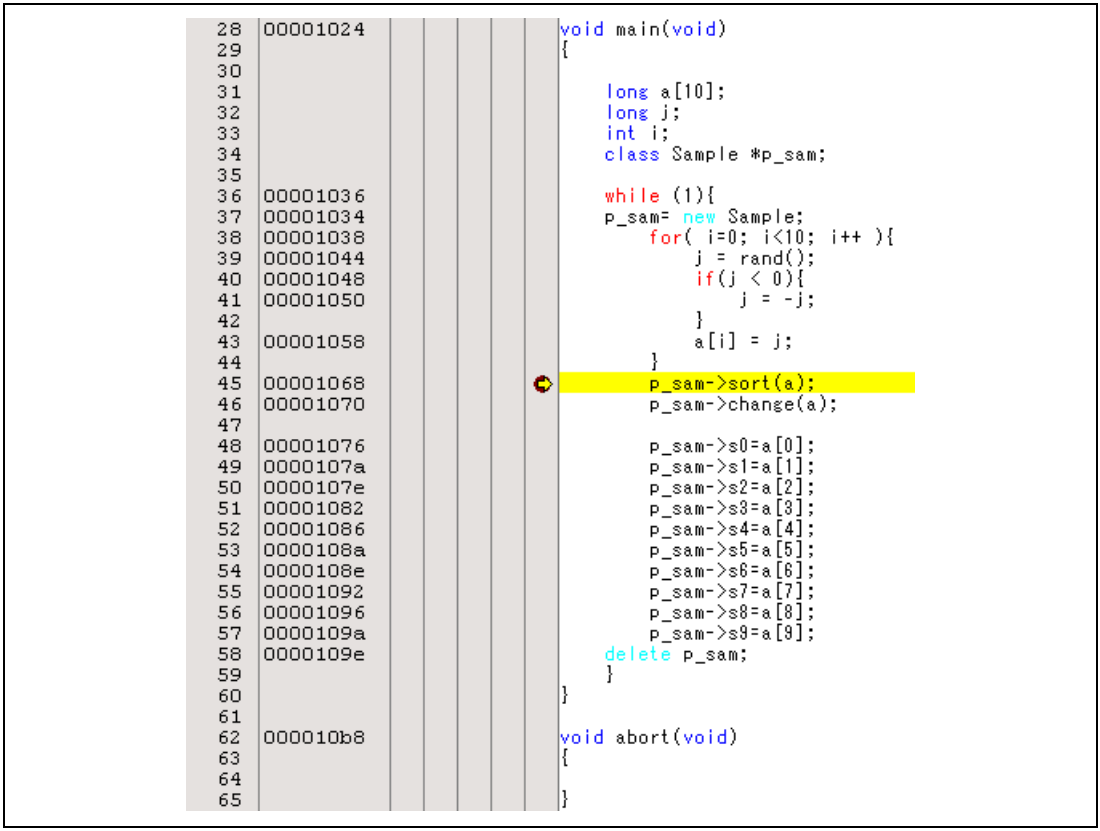
6.15.2 Executing [Step Out] Command

The [Step Out] command steps out of the called function and stops at the next statement of the calling statement in the main function.

- To step out of the `sort` function, select [Step Out] from the [Debug] menu, or click the [Step Out] button on the toolbar.

Note: It takes time to execute this function. When the calling source is clarified, use [Go To Cursor].

Figure 6.25 [Step Out] Button



```
28  00001024                    void main(void)
29                              {
30
31                                  long a[10];
32                                  long j;
33                                  int i;
34                                  class Sample *p_sam;
35
36  00001036                        while (1){
37  00001034                        p_sam= new Sample;
38  00001038                            for( i=0; i<10; i++ ){
39  00001044                                j = rand();
40  00001048                                if(j < 0){
41  00001050                                    j = -j;
42                                          }
43  00001058                                a[i] = j;
44                                      }
45  00001068                            p_sam->sort(a);
46  00001070                            p_sam->change(a);
47
48  00001076                            p_sam->s0=a[0];
49  0000107a                            p_sam->s1=a[1];
50  0000107e                            p_sam->s2=a[2];
51  00001082                            p_sam->s3=a[3];
52  00001086                            p_sam->s4=a[4];
53  0000108a                            p_sam->s5=a[5];
54  0000108e                            p_sam->s6=a[6];
55  00001092                            p_sam->s7=a[7];
56  00001096                            p_sam->s8=a[8];
57  0000109a                            p_sam->s9=a[9];
58  0000109e                        delete p_sam;
59                                  }
60                              }
61
62  000010b8                    void abort(void)
63                              {
64
65                              }
```

Figure 6.26 [HEW] Window (Step Out)

The data of variable a displayed in the [Watch] window is sorted in ascending order.

6.15.3 Executing [Step Over] Command

The [Step Over] command executes a function call as a single step and stops at the next statement of the main program.

- Move to the change function following the procedures described in section 6.15.1, Executing [Step In] Command.
- To step through all statements in the change function at a single step, select [Step Over] from the [Debug] menu, or click the [Step Over] button on the toolbar.

Figure 6.27 [Step Over] Button

```
 28  00001024                    void main(void)
 29                              {
 30
 31                                  long a[10];
 32                                  long j;
 33                                  int i;
 34                                  class Sample *p_sam;
 35
 36  00001036                        while (1){
 37  00001034                        p_sam= new Sample;
 38  00001038                            for( i=0; i<10; i++ ){
 39  00001044                                j = rand();
 40  00001048                                if(j < 0){
 41  00001050                                    j = -j;
 42                                          }
 43  00001058                                a[i] = j;
 44                                      }
 45  00001068                            p_sam->sort(a);
 46  00001070                            p_sam->change(a);
 47
 48  00001076                            p_sam->s0=a[0];
 49  0000107a                            p_sam->s1=a[1];
 50  0000107e                            p_sam->s2=a[2];
 51  00001082                            p_sam->s3=a[3];
 52  00001086                            p_sam->s4=a[4];
 53  0000108a                            p_sam->s5=a[5];
 54  0000108e                            p_sam->s6=a[6];
 55  00001092                            p_sam->s7=a[7];
 56  00001096                            p_sam->s8=a[8];
 57  0000109a                            p_sam->s9=a[9];
 58  0000109e                        delete p_sam;
 59                                  }
 60                              }
 61
 62  000010b8                    void abort(void)
 63                              {
 64
 65                              }
```

Figure 6.28 [HEW] Window (Step Over)

6.16 Forced Breaking of Program Executions

The High-performance Embedded Workshop can force a break in the execution of a program.

- Cancel all breaks.
- To execute the remaining sections of the `main` function, select [Go] from the [Debug] menu or the [Go] button on the toolbar.

Figure 6.29 [Go] Button

- The program goes into an endless loop. To force a break in execution, select [Halt] from the [Debug] menu or the [Stop] button on the toolbar.

Figure 6.30 [Stop] Button

6.17 Break Function

The emulator has S/W break functions and break functions by eventpoints. With the High-performance Embedded Workshop, an S/W breakpoint can be set using the [Breakpoint] sheet of the [Event] window. The eventpoint condition setting can be set by the event type using the [Onchip Event], [AUD Event], [Other Event], and [BUS Event] sheets.

An overview and setting of the break function are described below.

6.17.1 S/W Break Function

The emulator can set S/W breakpoints. Other methods for setting an S/W breakpoint than in section 6.7, Setting an S/W Breakpoint, are described below.

- Select [Eventpoints] from the [Code] submenu of the [View] menu. The [Event] window is displayed.
- Select the [Breakpoint] sheet.

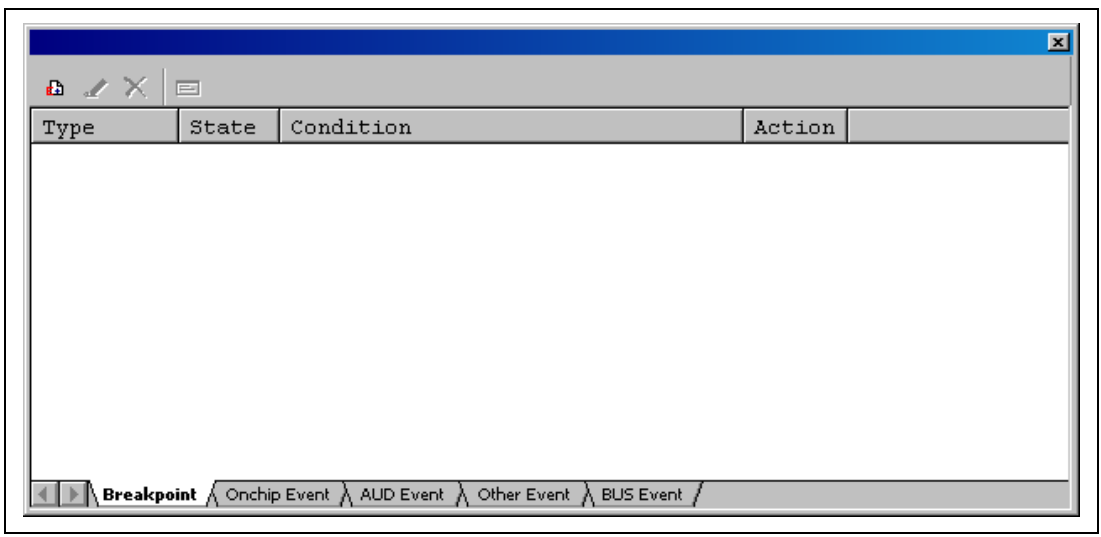


Figure 6.31 [Event] Window (Before S/W Breakpoint Setting)

- Click the [Event] window with the right-hand mouse button and select [Add…] from the popup menu.
- Enter the address on the line that has ‘p_sam->s0=a[0];’ in the [Address] edit box.

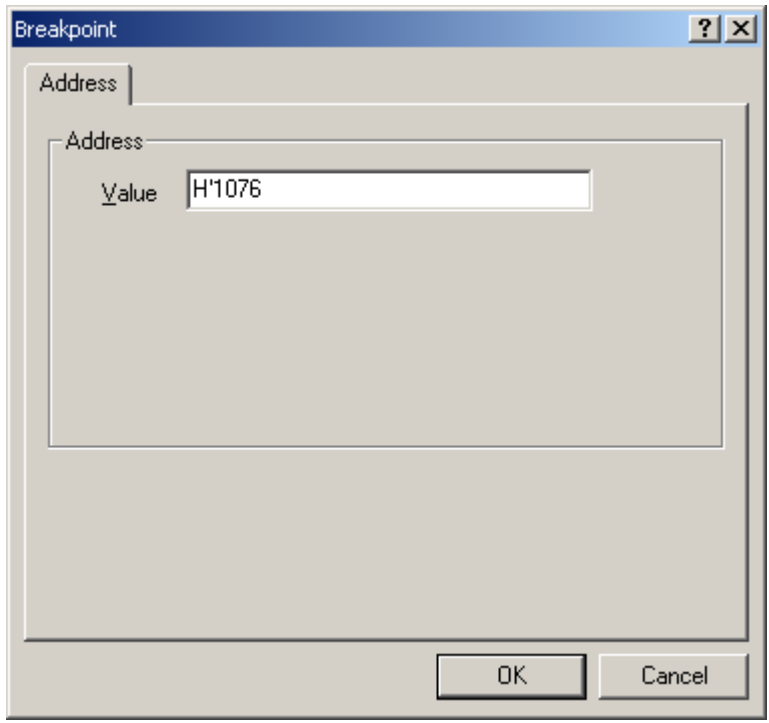


Figure 6.32 [Breakpoint] Dialog Box

Notes: 1. This dialog box differs with the product. For the items of each product, refer to the online help.

2. For some MCUs, the address value to be entered in the [Address] edit box is not ***H'1076***. In such cases, specify the address where “p_sam->s0=a[0];” (tutorial.cpp/48) is located.

- Click the [OK] button.

The S/W breakpoint that has been set is displayed in the [Event] window.

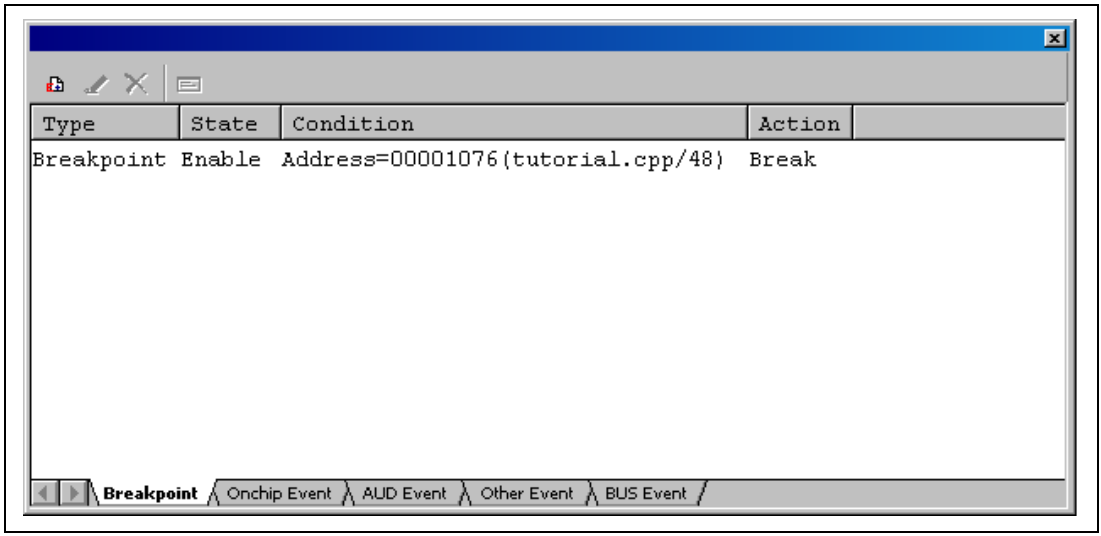


Figure 6.33 [Event] Window (S/W Breakpoint Setting)

Note: The items that can be displayed in this window differ depending on the product. For the items that can be displayed, refer to the online help.

To stop the tutorial program at the S/W breakpoint, the following procedure must be executed:

- Set the program counter and stack pointer values (PC = H'00000800 and R15 = H'FF9F000) that were set in section 6.8, Setting Registers, in the [Register] window. Click the [Go] button.
- If program execution is failed, reset the device and execute again the procedures above.

The program runs, and stops at the set S/W breakpoint.

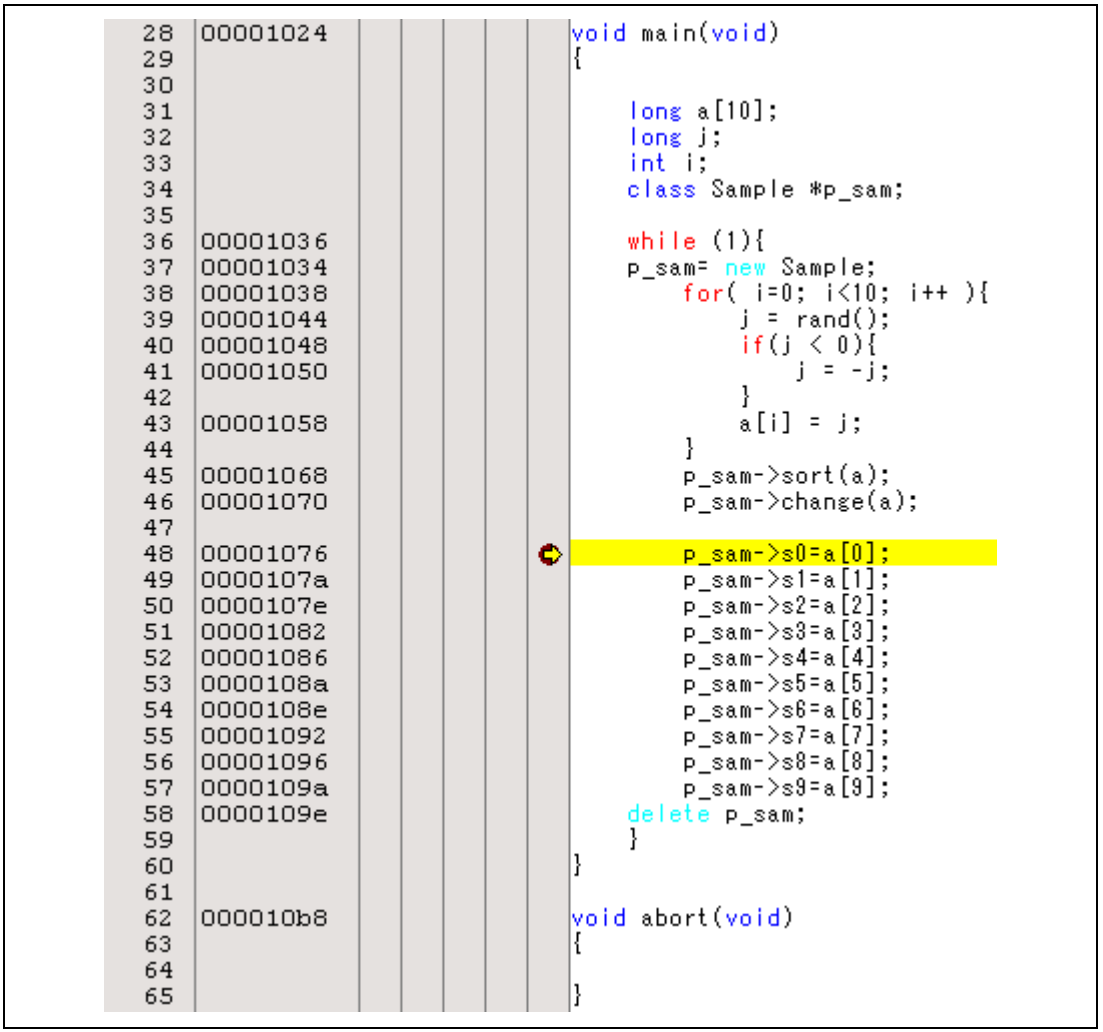


Figure 6.34 [Editor] Window at Execution Stop (S/W Break)

The [Status] window displays the following contents.

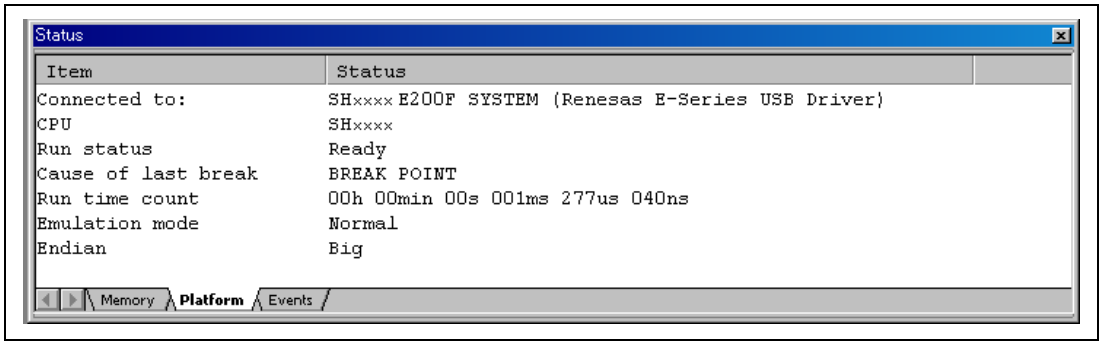


Figure 6.35 Displayed Contents of the [Status] Window (S/W Break)

Note: The items that can be displayed in this window differ depending on the product. For the items that can be displayed, refer to the online help.

6.18 Break Function by an Eventpoint

With this emulator, an Onchip Eventpoint, AUD Eventpoint, Other Eventpoint, and BUS Eventpoint can be set. An example of how to set a break using an Onchip Eventpoint is shown below. For other eventpoint setting methods, refer to section 5.8, Using the Eventpoints.

6.18.1 Setting the Break by an Onchip Eventpoint

A method is given below in which the address bus condition is set under event channel 1 of the Onchip Eventpoint.

- Select [Eventpoints] from the [Code] submenu of the [View] menu. The [Event] window is displayed.
- The S/W breakpoint that has been previously set is deleted. Click the [Event] window with the right-hand mouse button and select [Delete All] from the popup menu to cancel all S/W breakpoints that have been set.
- To set an Onchip Eventpoint, click on [Onchip Eventpoint]. Here, event channel 1 is set.

Note: The number of event channels of the Onchip Eventpoint differs according to the product. For the number that can be specified for each product, refer to the online help.

- Select a line of Ch1 in the [Event] window. When highlighted, double-click this line.

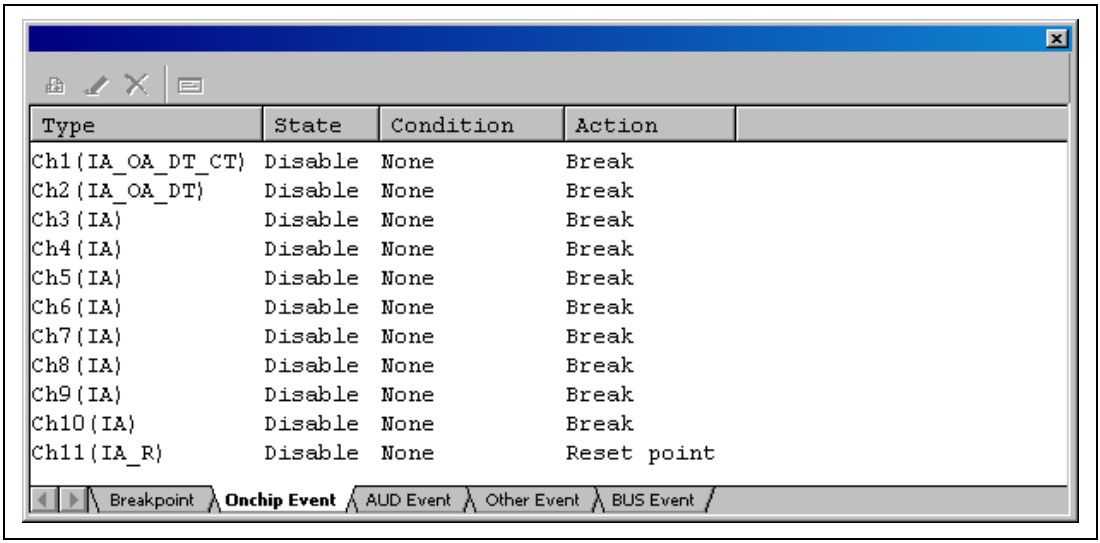


Figure 6.36 [Event] Window ([Onchip Event] Sheet)

- The [Event condition 1] dialog box is displayed.
- Clear the [Don't care] check box in the [Address] page.
- Select the [Only program fetched address after] radio button and enter an address of the column including ***`p_sam->sort(a);`*** of the `main` function.

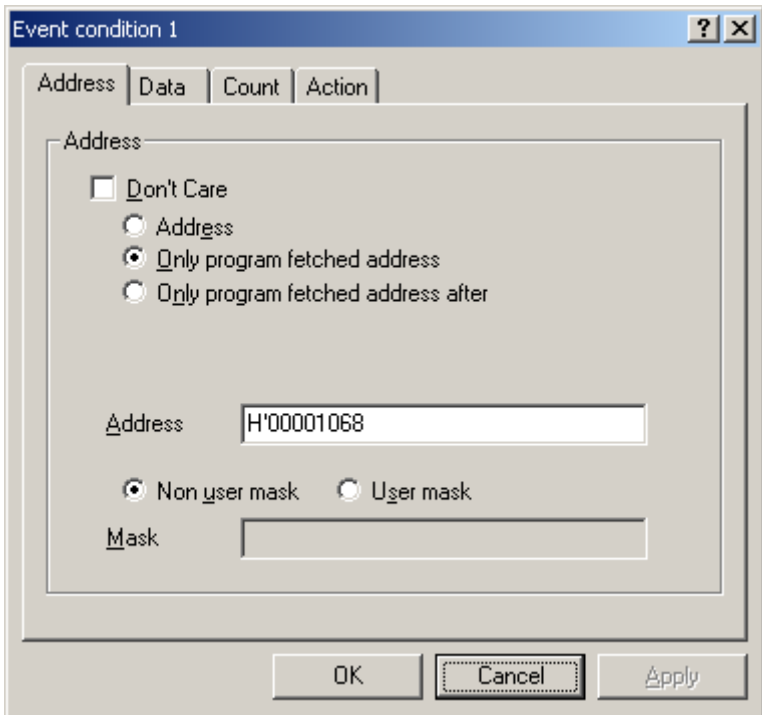


Figure 6.37 [Address] Page ([Event condition 1] Dialog Box)

Note: The items that can be set in this dialog box differ depending on the product. For details on the settings for each product, refer to the online help.

- Click the [OK] button.
- The first point display in the State line changes from `Disable` to `Enable`.
- The first point display in the Condition line changes from `None` to `Address = H'xxxxxxxx pc` Break.
- Set the program counter and stack pointer values (PC = H'00000800 and R15 = H'FFF9F000) that were set in section 6.8, Setting Registers, in the [Register] window. Click the [Go] button.
- If program execution is failed, reset the device and execute again the procedures above.

The program runs and then stops at the condition specified under event channel 1.

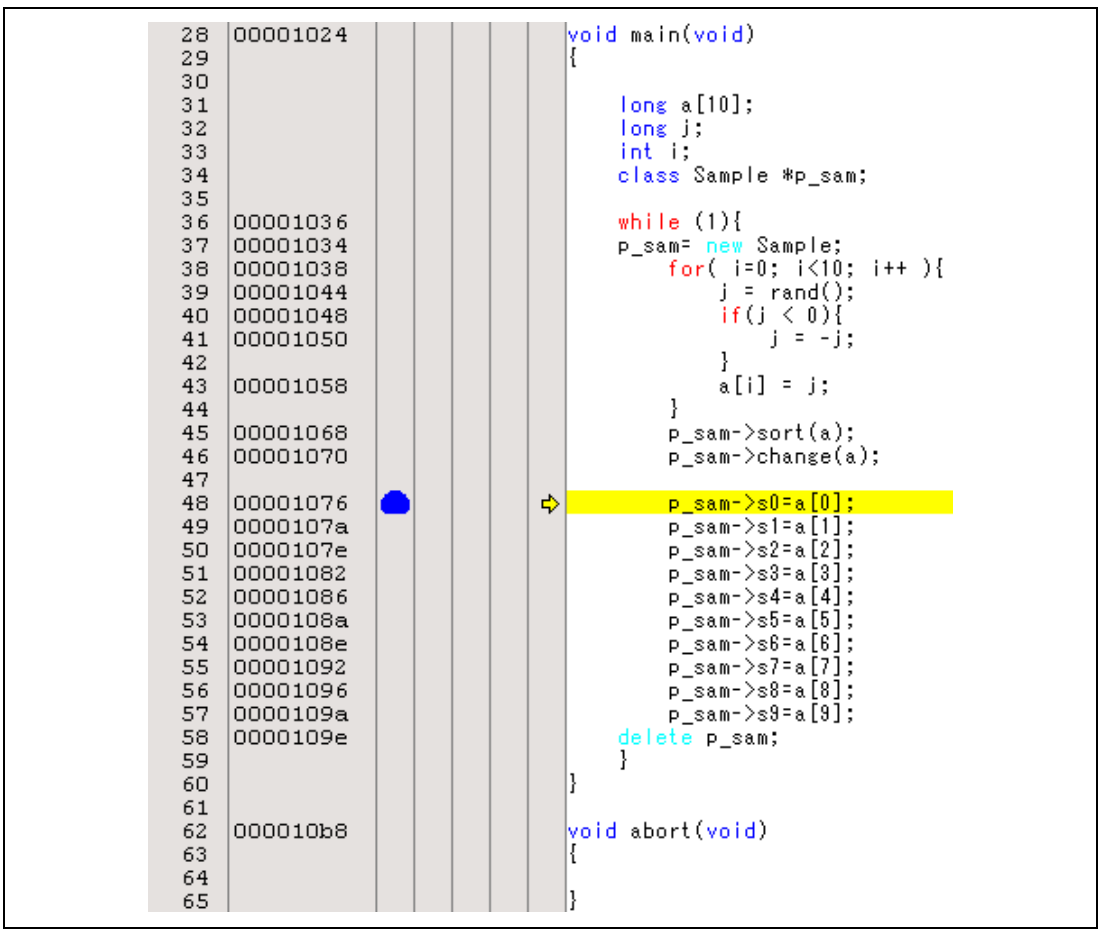


Figure 6.38 [Editor] Window at Execution Stop (Onchip Eventpoint Channel 1)

The [Status] window displays the following contents.

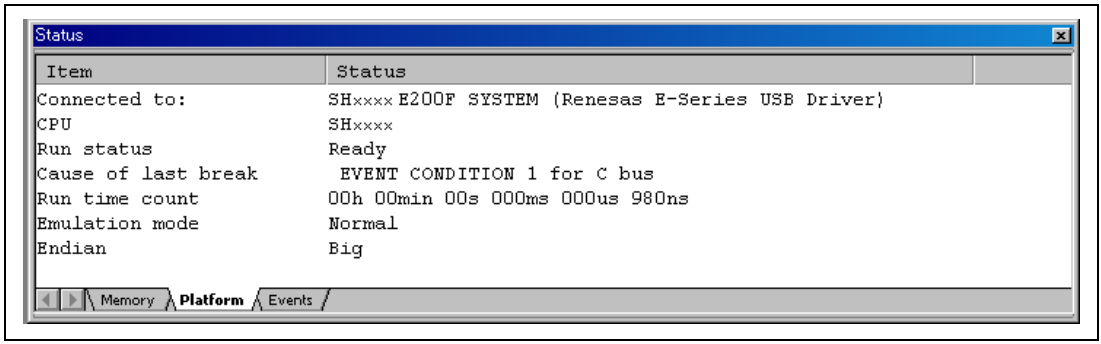


Figure 6.39 Displayed Contents of the [Status] Window (Onchip Event Ch1)

Note: The items that can be displayed in this window differ depending on the product. For the items that can be displayed, refer to the online help.

6.18.2 Setting the Sequential Onchip Eventpoint

The sequential break is enabled by the combination of Onchip Eventpoints.

Set the satisfaction conditions of Onchip Eventpoint as follows:

Ch1(IA_OA): When an address of the column including `p_sam->sort(a);` of the `main` function is accessed in a read cycle, a break condition is satisfied.

Ch2(IA_OA_DT_CT): When an address of the column including `a[i]=j;` of the `main` function is accessed in a read cycle, a break condition is satisfied.

Follow the setting method described in the previous section.

To set these eventpoints as sequential:

- Select [Combination action] from the popup menu by clicking the [Event] window with the right-hand mouse button. The [Combination action] dialog box will open.

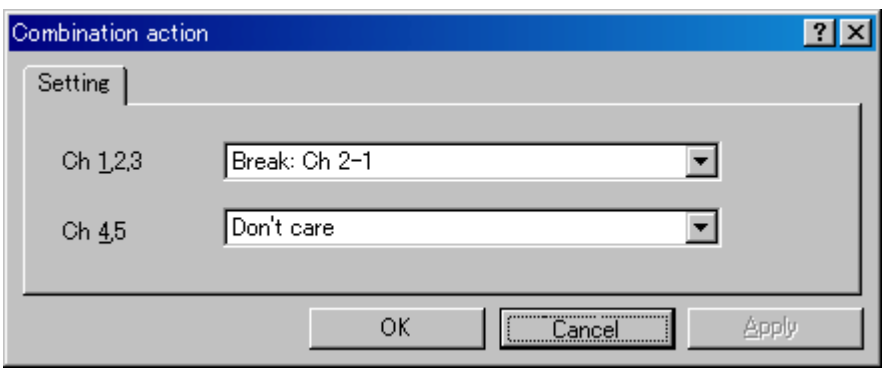


Figure 6.40 [Combination action] Dialog Box

Note: The items that can be displayed in this dialog box differ depending on the product. For the items that can be displayed, refer to the online help.

- Select [Break:Ch2-1] in [Ch1,2,3], and click the [OK] button.
- Activate the condition of Event Condition 1 from the popup menu that is opened by clicking the [Event Condition] sheet with the right-hand mouse button.

When the setting is completed, the [Event] window will be as shown in figure 6.41.

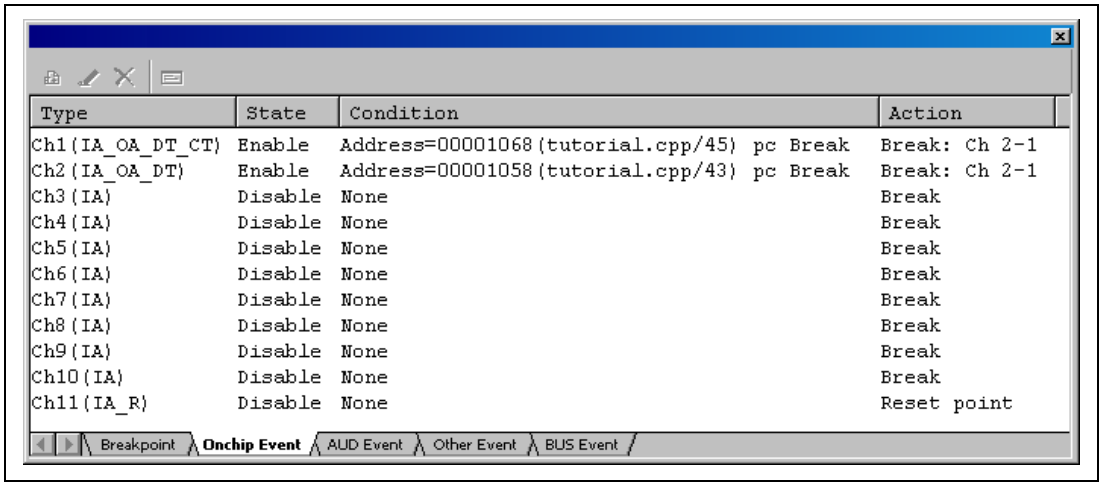


Figure 6.41 [Onchip Event] Sheet

Note: The items that can be displayed in this dialog box differ depending on the product. For the items that can be displayed, refer to the online help.

- Set the program counter and stack pointer values (PC = H'00000800 and R15 = H'FFF9F000) that were set in section 6.8, Setting Registers, in the [Register] window. Click the [Go] button.
- If program execution is failed, reset the device and execute again the procedures above.

The program runs and then stops at the condition specified under event channel 1.

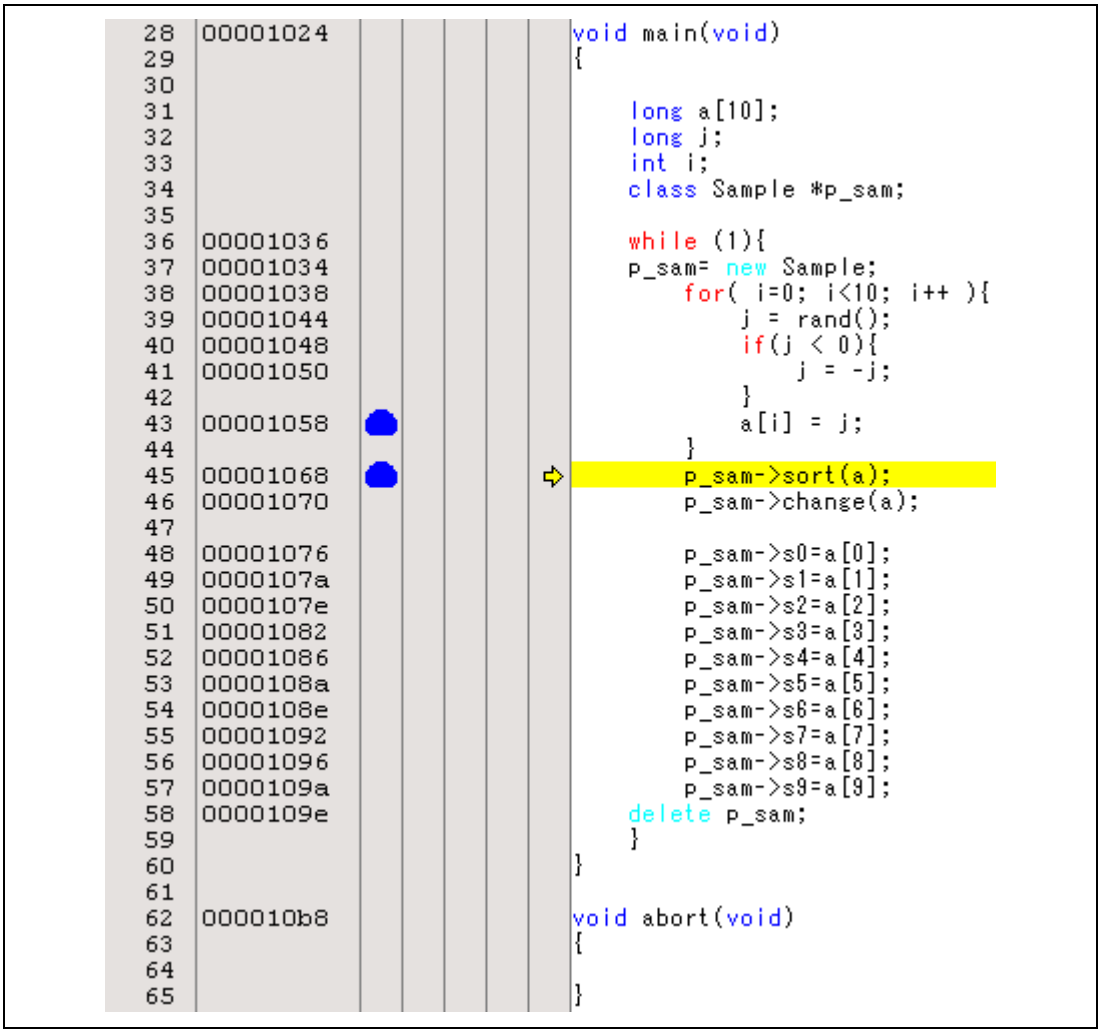


Figure 6.42 [Editor] Window at Execution Stop (Sequential Break)

The [Status] window displays the following contents.

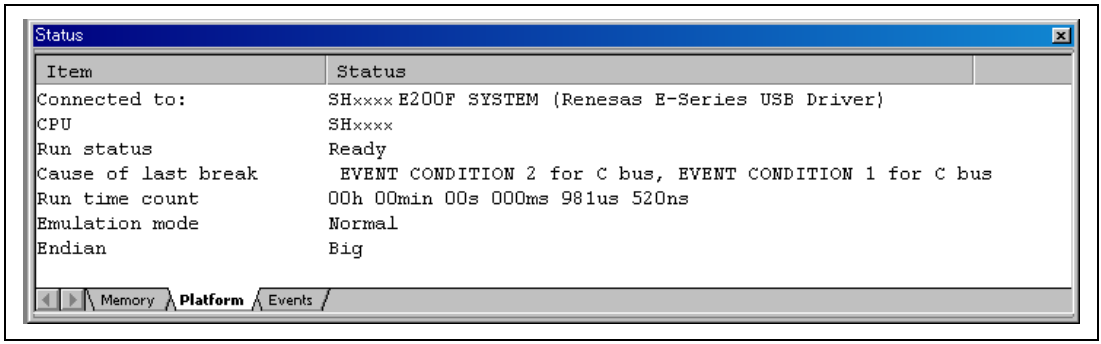


Figure 6.43 Displayed Contents of the [Status] Window (Sequential Break)

Note: The items that can be displayed in this window differ depending on the product. For the items that can be displayed, refer to the online help.

- The sequential break conditions that have been previously set are deleted. Click the [Event] window with the right-hand mouse button and select [Delete All] from the popup menu to cancel all eventpoint conditions that have been set.
- Select [Combination action] from the popup menu by clicking the [Event] window with the right-hand mouse button. The [Combination action] dialog box will open (figure 6.40).
- Select the [Don't care] radio button and click the [OK] button.

6.19 Trace Functions

The emulator has the five trace functions listed below.

- Internal Trace Function

  Since this function uses the trace buffer built into the MCU, a realtime trace can be acquired.

The following information can be acquired:

- Types of trace information: Branch information, memory access information from the CPU, and PC or Rn value during the Trace Rn instruction execution
- Trace acquisition address values
- Data values
- Mnemonics
- Operands
- Source lines

Notes: 1. The number of branch instructions that can be acquired by a trace differs according to the product. For the number that can be specified for each product, refer to the online help.
2. The internal trace function is not supported for all products. For details on the specifications of each product, refer to the online help.
3. The internal trace function is not extended for all products. For details on the specifications of each product, refer to the online help.

- AUD Trace Function

  This is the large-capacity trace function that is enabled when the AUD pin is connected to the emulator. When a set of the branch source and branch destination instructions is one branch, the maximum amount of information acquired by a trace is 262,144.

The following information can be acquired:

- Types of trace information: Branch information, memory access information from the CPU, and PC or Rn value during the Trace Rn instruction execution
- Trace acquisition address values
- Data values
- External probe pin states
- Time stamp values
- Mnemonics

- Operands
- Source lines

Notes: 1. The AUD trace function is not supported for all products. For details on the specifications of each product, refer to the online help.
2. The types of trace information that can be acquired by an AUD trace function differ depending on the product. For details on the specifications of each product or the number of acquired branches, refer to the online help.
3. When multiple loops are performed to reduce the number of AUD trace displays, only the IP counts up according to the product.

- Memory Output Trace Function

  This function is used to write the trace result to the specified memory range. The data is read from the memory range written in the [Trace] window and the result is then displayed. This is large-capacity trace function that is valid when the AUD pin of the device is not connected to the emulator.

Note: Some products do not support the memory output trace function. For details on the specifications of each product, refer to the online help.

- External Bus Trace Function

  This is a large-capacity trace function that is valid when the external bus pin of the MCU is connected to the emulator.
  The external bus trace function can acquire the information of a maximum of 262,144 cycles per bus cycle.

The following information can be acquired:

- External bus address values
- External bus data values
- Interrupt signal states
- Time stamp values
- Mnemonics
- Operands
- Source lines

Note: The types of trace information that can be acquired differ depending on the product. For details on the specifications, refer to the online help.

6.19.1 Displaying the [Internal/AUD] Window

Select [Trace] from the [Code] submenu of the [View] menu. The [Trace Window Type] dialog box is displayed.

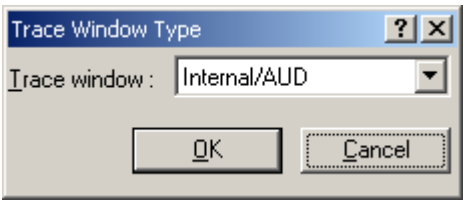


Figure 6.44 [Trace Window Type] Dialog Box

Select [Internal/AUD] and click the [OK] button. The [Internal/AUD] window will appear.

(1) Internal trace function

The methods to acquire the internal trace are described below.

(a) Setting the trace acquisition mode

Click the [Internal/AUD] window with the right-hand mouse button and select [Settings…] from the popup menu to display the [I-Trace/AUD-Trace acquisition] dialog box.

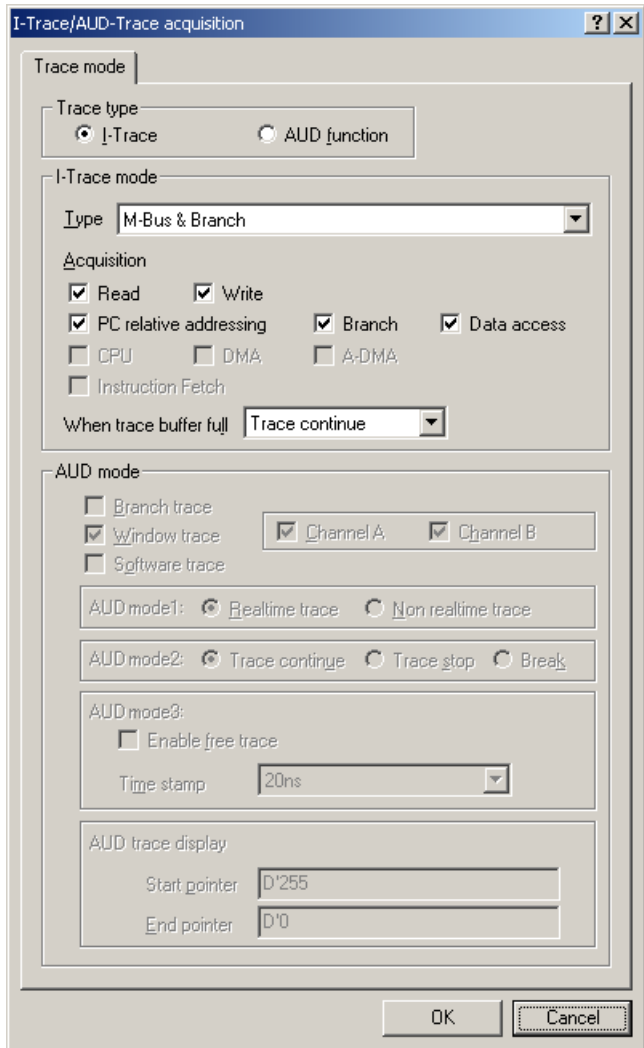


Figure 6.45 [I-Trace/AUD-Trace acquisition] Dialog Box

Select [I-Trace] for [Trace Type] and click the [OK] button.

(b) Setting the trace acquisition condition

Select acquisition of information in the branch source or branch destination in the [I-Trace/AUD-Trace acquisition] dialog box. After selecting the condition to be acquired in [Acquisition], click the [OK] button in the [I-Trace/AUD-Trace acquisition] dialog box.

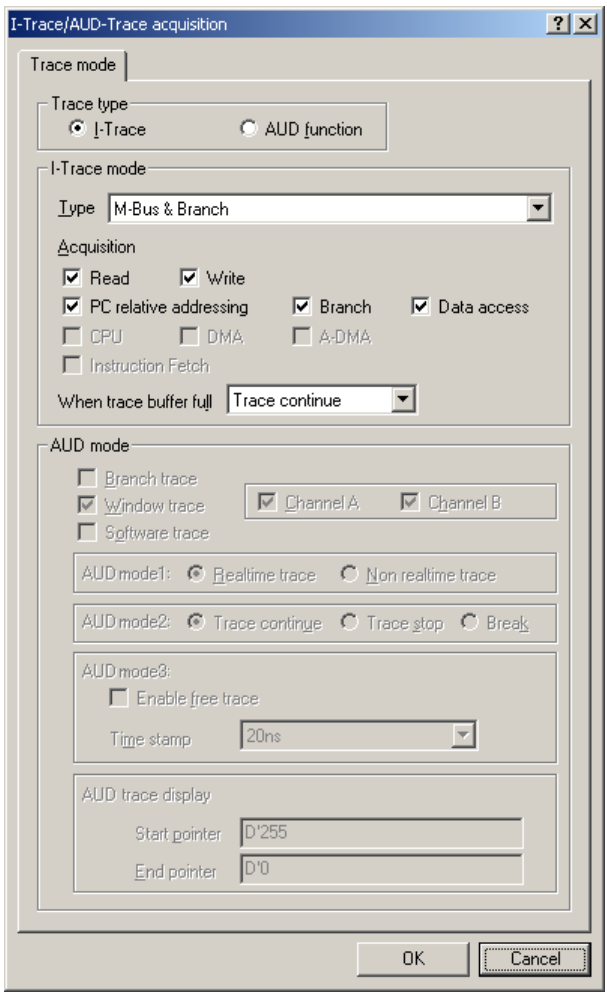
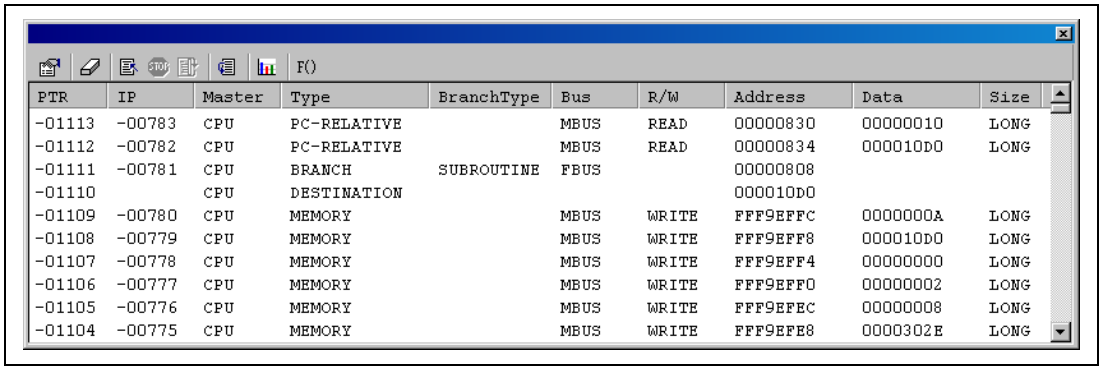


Figure 6.46 [I-Trace/AUD-Trace acquisition] Dialog Box

Note: The items that can be set in this dialog box differ depending on the product. For details on the settings for each product, refer to the online help.

(c) Displaying the trace result

Run the program as shown in the example of section 6.17.1, S/W Break Function. The internal trace results are displayed in the [Internal/AUD] window after the program execution is completed.



PTR	IP	Master	Type	BranchType	Bus	R/W	Address	Data	Size
-01113	-00783	CPU	PC-RELATIVE		MBUS	READ	00000830	00000010	LONG
-01112	-00782	CPU	PC-RELATIVE		MBUS	READ	00000834	000010D0	LONG
-01111	-00781	CPU	BRANCH	SUBROUTINE	FBUS		00000808		
-01110		CPU	DESTINATION				000010D0		
-01109	-00780	CPU	MEMORY		MBUS	WRITE	FFF9EFFC	0000000A	LONG
-01108	-00779	CPU	MEMORY		MBUS	WRITE	FFF9EFF8	000010D0	LONG
-01107	-00778	CPU	MEMORY		MBUS	WRITE	FFF9EFF4	00000000	LONG
-01106	-00777	CPU	MEMORY		MBUS	WRITE	FFF9EFF0	00000002	LONG
-01105	-00776	CPU	MEMORY		MBUS	WRITE	FFF9EFEC	00000008	LONG
-01104	-00775	CPU	MEMORY		MBUS	WRITE	FFF9EFE8	0000302E	LONG

Figure 6.47 [Internal/AUD] Window

- If necessary, adjust the column widths by dragging borders in the header bar (immediately below the title bar).

Note: The type and the amount of information that can be acquired by a trace differ depending on the product. For details on the specifications of each product, refer to the online help.

(2) AUD trace function

This function is available when the AUD pin of the MCU is connected to the emulator.

The following is an example of acquiring memory access information from addresses H'1000 to H'10FF.

The following is the procedure for setting the AUD trace function.

(a) Setting the AUD trace condition

Set the condition so that the AUD trace condition can be set to the execution information on the MCU that is output from the AUD pin.

- Set [AUD function] of [Trace type] in the [I-Trace/AUD-Trace acquisition] dialog box.
- Select the [Window trace] and [Channel A] check boxes.
- Select the [Window trace] page. In the [Channel A] group box, set Read/Write for [Read/Write], H'1000 for [Start address], H'10FF for [End address], and M-BUS for [Bus state].
- Click the [OK] button in the [I-Trace/AUD-Trace acquisition] dialog box.

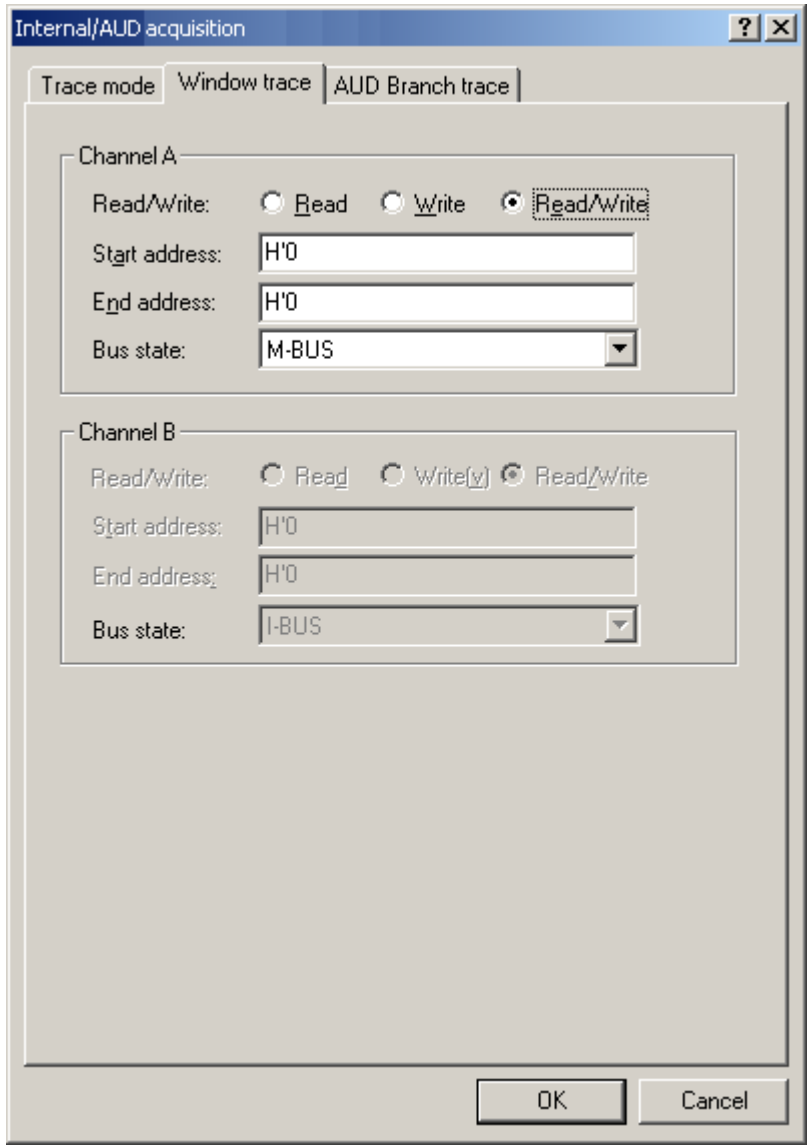


Figure 6.48 Setting the [I-Trace/AUD-Trace acquisition] Dialog Box ([Window trace] Page)

(b) Setting the trace acquisition mode

Select the [Trace mode] page of the [I-Trace/AUD-Trace acquisition] dialog box. Click this dialog box with the right-hand mouse button and select [Settings…] from the popup menu to display the [I-Trace/AUD-Trace acquisition] dialog box.

The AUD trace acquisition condition is set.

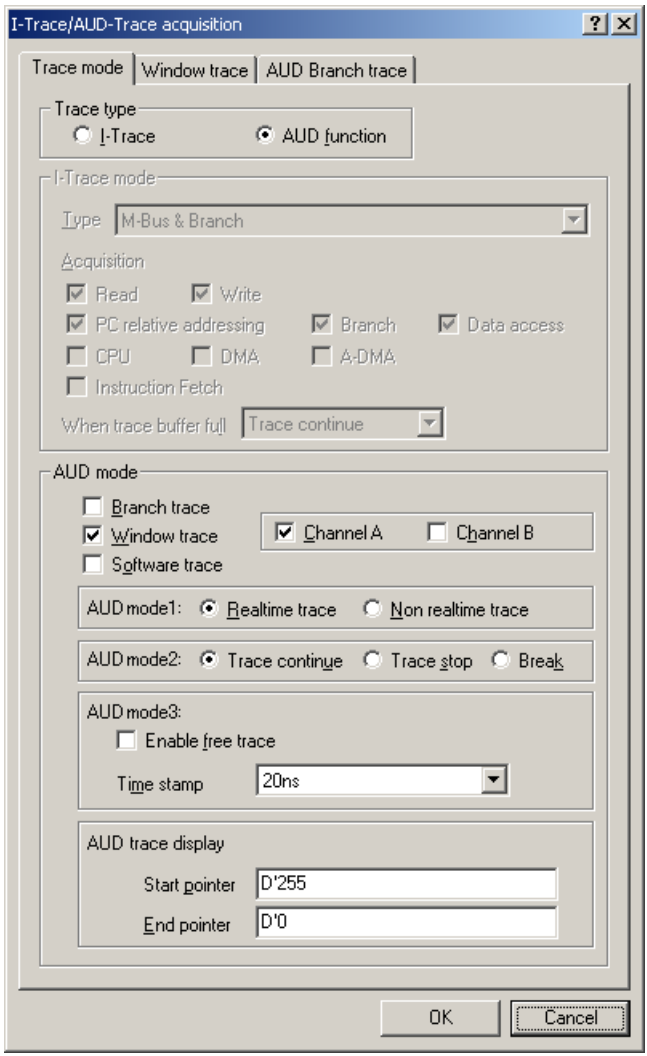
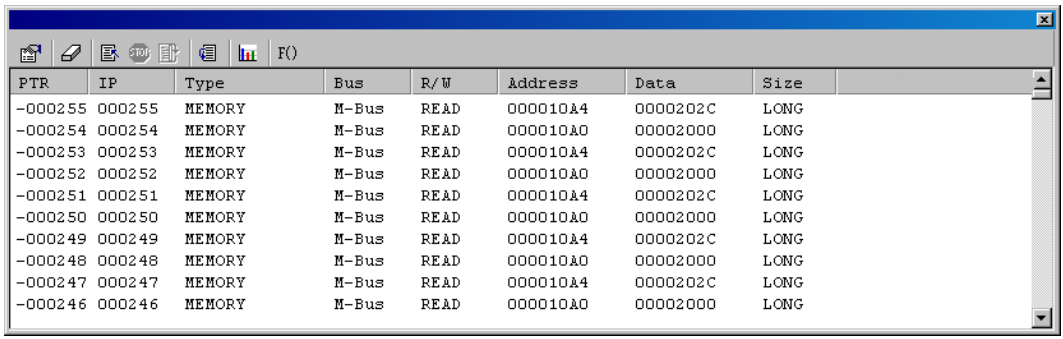


Figure 6.49 Setting the [I-Trace/AUD-Trace acquisition] Dialog Box ([Trace mode] Page)

Note: The items that can be set in this window differ depending on the product. For details on the settings for each product, refer to the online help.

(c) Displaying the trace result

Run the program as shown in the example of section 6.17.1, S/W Break Function. The trace results are displayed in the [Internal/AUD] window after the program execution is completed.



PTR	IP	Type	Bus	R/W	Address	Data	Size
-000255	000255	MEMORY	M-Bus	READ	000010A4	0000202C	LONG
-000254	000254	MEMORY	M-Bus	READ	000010A0	00002000	LONG
-000253	000253	MEMORY	M-Bus	READ	000010A4	0000202C	LONG
-000252	000252	MEMORY	M-Bus	READ	000010A0	00002000	LONG
-000251	000251	MEMORY	M-Bus	READ	000010A4	0000202C	LONG
-000250	000250	MEMORY	M-Bus	READ	000010A0	00002000	LONG
-000249	000249	MEMORY	M-Bus	READ	000010A4	0000202C	LONG
-000248	000248	MEMORY	M-Bus	READ	000010A0	00002000	LONG
-000247	000247	MEMORY	M-Bus	READ	000010A4	0000202C	LONG
-000246	000246	MEMORY	M-Bus	READ	000010A0	00002000	LONG

Figure 6.50 [Internal/AUD] Window (Example)

6.19.2 Displaying the [BUS trace] Window

Select [Trace] from the [Code] submenu of the [View] menu. The [Trace Window Type] dialog box is displayed.

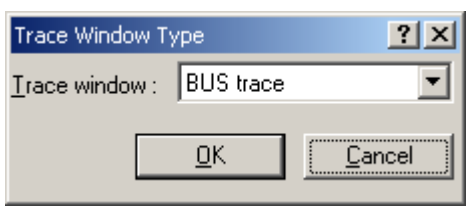


Figure 6.51 [Trace Window Type] Dialog Box

Select [BUS trace] and click the [OK] button. The [BUS trace] window will appear.

(1) External bus trace function

This function is enabled when the external bus pins of the MCU are connected to the emulator. The methods to acquire the external bus trace are described below.

(a) Setting the bus trace

Set the multiplexed state of the bus pins or the connected memory, referring to section 2.5.2, External Bus Trace/Break Function.

(b) Setting the trace acquisition mode

Click the [BUS trace] window with the right-hand mouse button and select [Acquisition…] from the popup menu to display the [BUS acquisition] dialog box. Set the acquisition mode for the external bus trace as shown in figure 6.52.

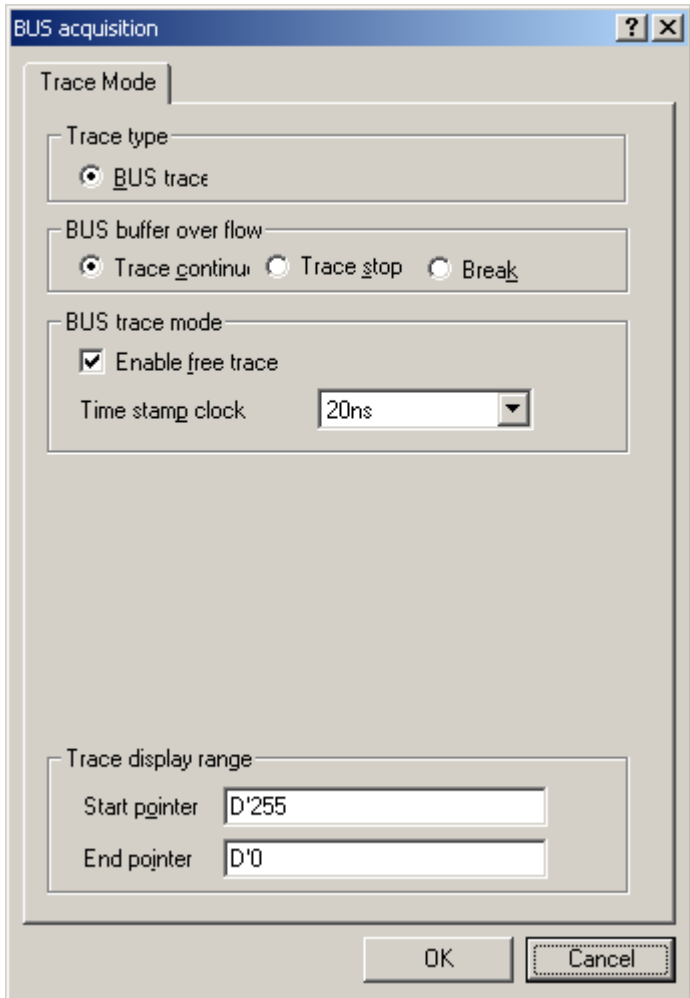


Figure 6.52 [BUS acquisition] Dialog Box

(c) Setting the trace acquisition condition

The following is an example of setting the address condition.

For setting other trace conditions, refer to section 5.8, Using the Eventpoints.

Select and double-click [Ch3 (Normal)] on the [BUS Event] sheet of the [Event] window. The [Ch3 (Normal)] dialog box will appear.

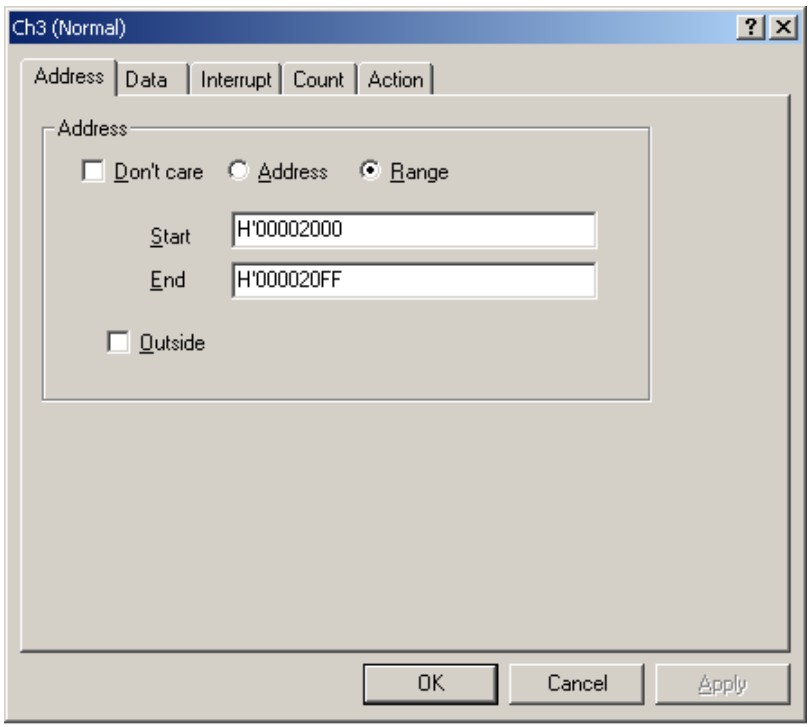


Figure 6.53 [Ch3 (Normal)] Dialog Box ([Address] Page)

- Select [Range].
- Input H’2000 and H’20FF into [Start] and [End], respectively.
- Select [Trace get] in the [Action] page and click the [OK] button.
- The trace information when external memory H’2000 to H’20FF has been accessed is acquired.

(d) Displaying the trace result

Run the program as shown in the example of section 6.17.1, S/W Break Function. The internal trace results are displayed in the [BUS trace] window after the program execution is completed.

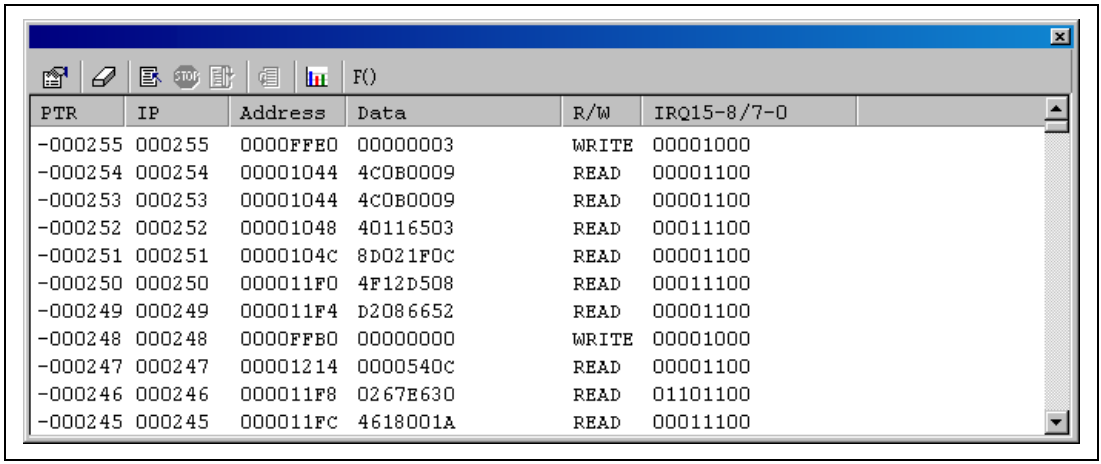


Figure 6.54 [BUS trace] Window

- If necessary, adjust the column width by dragging the header bar immediately below the title bar.

Note: The type and the amount of information that can be acquired by a trace differ depending on the product. For details on the specifications of each product, refer to the online help.

6.20 Stack Trace Function

The emulator uses the information on the stack to display the names of functions in the sequence of calls that led to the function to which the program counter is currently pointing.

Note: This function can be used only when the load module that has the Dwarf2-type debugging information is loaded. Such load modules are supported in SHC/C++ compiler (including OEM and bundle products) V7.0 or later.

- Double-click the [S/W Breakpoints] column in the `sort` function and set an S/W breakpoint.

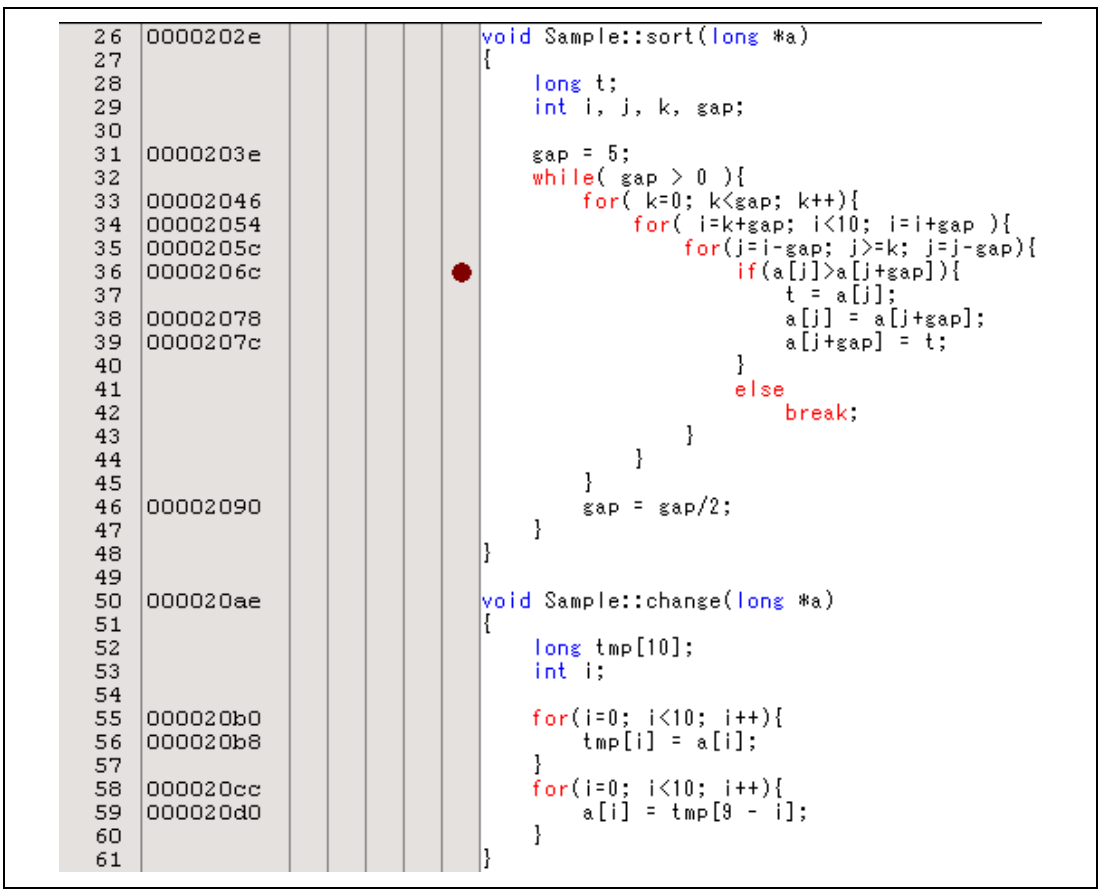


Figure 6.55 [Editor] Window (S/W Breakpoint Setting)

- Set the same program counter and stack pointer values (PC = H'00000800 and R15 = H'FFF9F000) as were set in section 6.8, Setting Registers (again, use the [Register] window). Click the [Go] button.
- If program execution is failed, reset the device and execute again the procedures above.
- After the break in program execution, select [Stack Trace] from the [Code] submenu of the [View] menu to open the [Stack Trace] window.

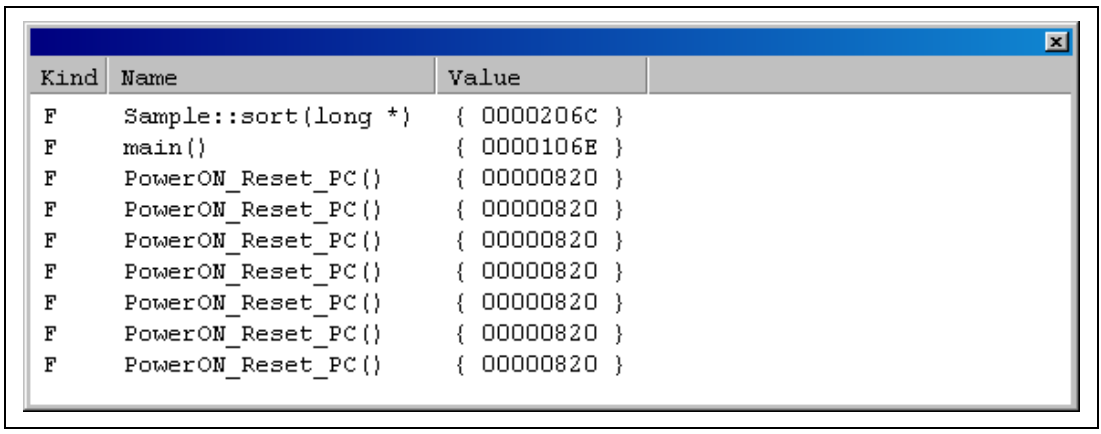


Figure 6.56 [Stack Trace] Window

Figure 6.56 shows that the position of the program counter is currently at the selected line of the `sort()` function, and that the `sort()` function is called from the `main()` function.

To remove the S/W breakpoint, double-click the [S/W breakpoints] column in the `sort` function again.

Note: For details on this function, refer to the online help.

6.21 Download Function to the Flash Memory Area

The emulator enables downloading to the flash memory area. This function requires a program for writing the flash memory (hereinafter referred to as a write module), a program for erasing the flash memory (hereinafter referred to as an erase module), and the RAM area for downloading and executing these modules.

Note: The write and erase modules must be prepared by the user.

- Interface with write and erase modules and emulator firmware

  The write and erase modules must be branched from the emulator firmware. To branch from the emulator firmware to the write and erase modules, or to return from the write and erase module to the emulator firmware, the following conditions must be observed:

  — Describe all the write and erase modules with the assembly language.

  — Save and return all the general register values and control register values before and after calling the write or erase module.

  — Return the write or erase module to the calling source after processing.

  — The write and erase module must be a Motorola-type file.

  The module interface must be as follows to pass correctly the information that is required for flash memory accessing.

Table 6.2 Module Interface

Module Name	Argument	Return Value
Write module	R4(L): Write address R7(L): Verify option 0 = no verify, 1 = verify R5(L): Access size 0x4220 = byte, 0x5720 = word, 0x4C20 = longword R6(L): Write data	R0(L): End code Normal end = 0, Abnormal end = other than 0, Verify error = BT
Erase module	R4(L): Access size 0x4220 = byte, 0x5720 = word, 0x4C20 = longword	None

Note: The (L) means the longword size.

Note: Write module: The write data for the access size is set to the R6 register. When the access size is word or byte, 0 is set to the upper bits of the R6 register.

- Flash memory download method

  For downloading to the flash memory, set the items on the [Loading flash memory] page in the [Configuration] dialog box, which is opened from [System…], then [Emulator] from the [Options] menu.

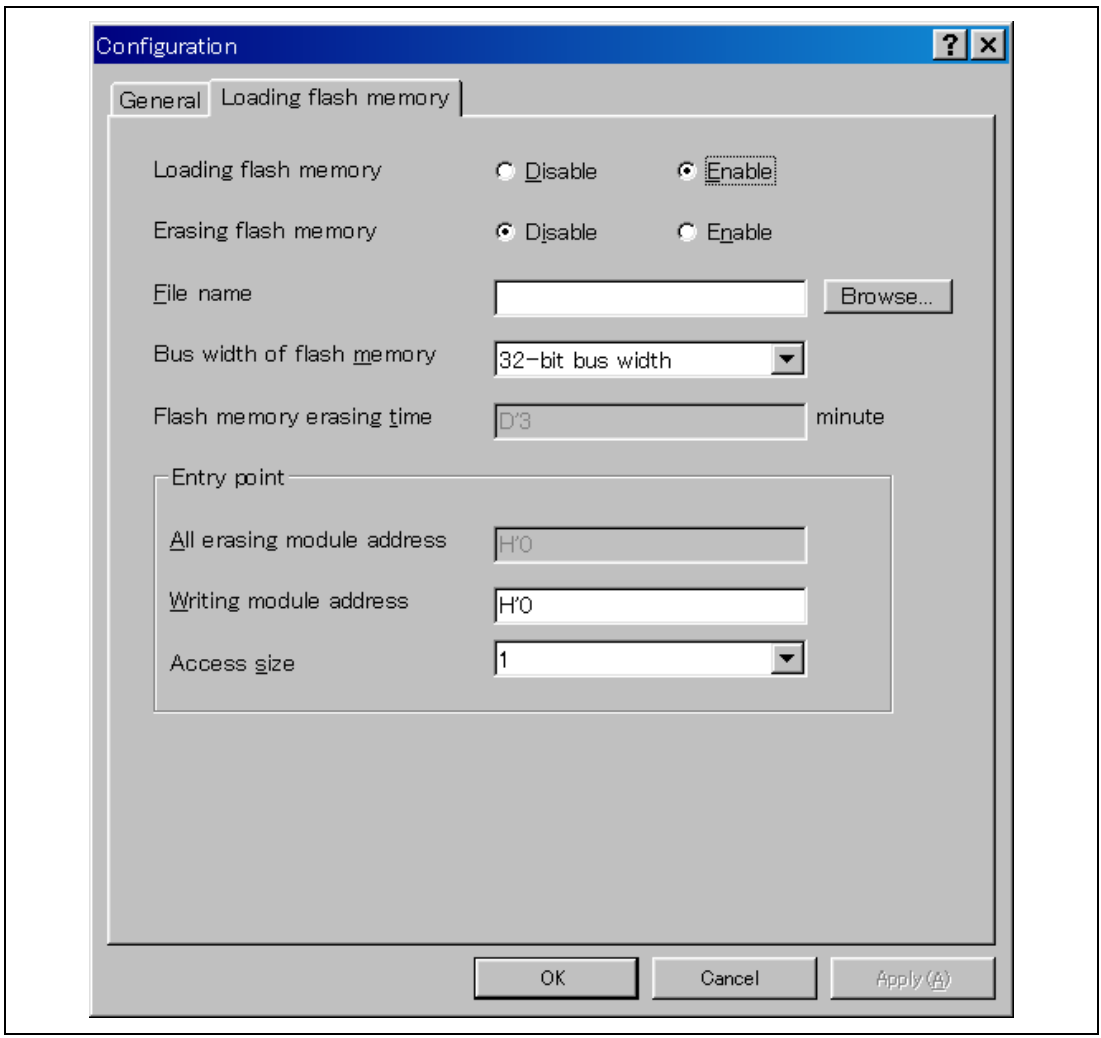


Figure 6.57 [Loading flash memory] Page

Table 6.3 shows the options for the [Loading flash memory] page.

Table 6.3 [Loading flash memory] Page Options

Option	Description
[Loading flash memory] radio button	Sets Enable for flash memory downloading. When Enable is selected, and [File load] is selected from the [File] menu for downloading, the write module is always called. Enable: Download to the flash memory Disable: Not download to the flash memory
[Erasing flash memory] radio button	Sets Enable for erasing before the flash memory is written. When Enable is selected, the erase module is called before calling the write module. Enable: Erase the flash memory Disable: Not erase the flash memory
[File name] edit box	Sets the file name of the S-type load module including the write and erase modules. The file that has been set is loaded to the RAM area before loading to the flash memory. A maximum of 128 characters can be input for the file name.
[Bus width of flash memory] list box	Sets the bus width of the flash memory.
[Flash memory erasing time] edit box*	Sets the TIMEOUT value for erasing the flash memory. Set a larger value if erasing requires much time; the default time is three minutes. The radix for the input value is decimal. It becomes hexadecimal by adding H'.
[Entry point] group box	Sets the calling destination address of the write and erase modules. [All erasing module address] edit box: Enters the calling destination address of the erase module. [Writing module address] edit box: Enters the calling destination address of the write module. [Access size] combo box: Selects the access size of the RAM area that is used for loading the write/erase module.

Note: Although the values that can be set are D'1 to D'65535, the TIMEOUT period may be extended according to the set value. Therefore, it is recommended to input the minimum value by considering the erasing time of the flash memory in use.

- Notes on using the flash memory download function

  The following are notes on downloading to the flash memory.

  — When the flash memory download is enabled, downloading to areas other than the flash memory area is disabled.

— Downloading is only enabled to the flash memory area. Perform memory write or S/W break only to the RAM area.

— When the flash memory erase is enabled, the [Stop] button cannot stop erasing.

- An example of downloading to the flash memory

  The following is an example of downloading to the flash memory manufactured by Intel Corporation (type number: G28F640J5-150) that has been connected as shown in figure 6.58. A sample is provided in the \Fmtool folder in the installation destination folder. Create a program that suits the user specifications by referring to this sample.

Table 6.4 Board Specifications

Item	Contents
SDRAM address	H'0C000000 to H'0FFFFFFF
Flash memory address	H'00000000 to H'01FFFFFF
Bus width of flash memory	32 bits
Operating environment Endian	Big endian

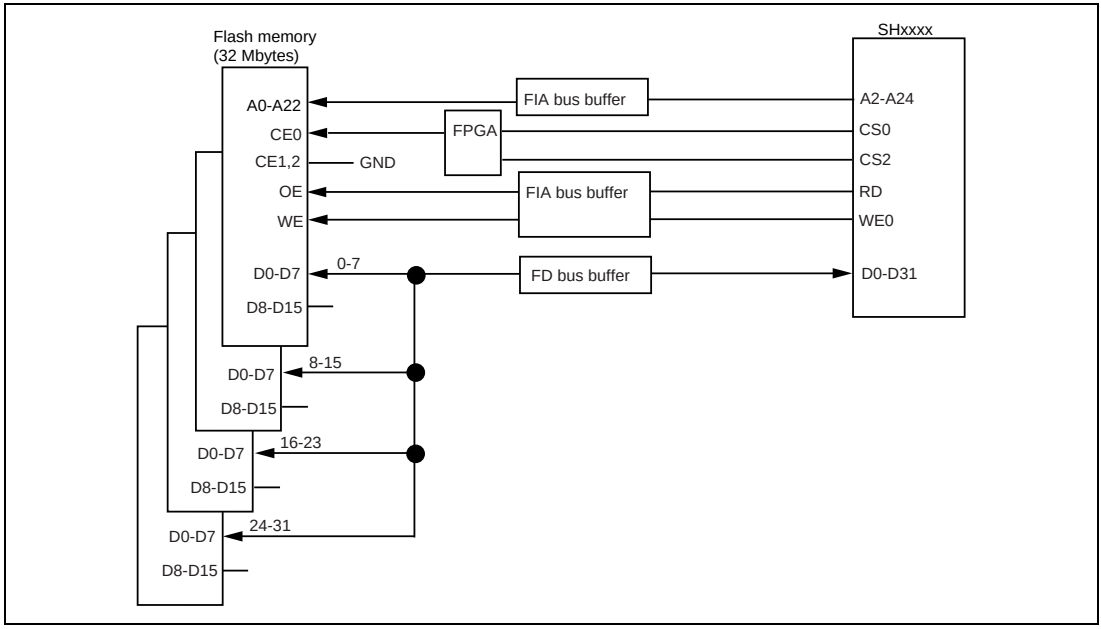


Figure 6.58 Flash Memory Wiring

Table 6.5 Sample Program Specifications

Item	Contents
RAM area to be used	H'0C001000 to H'0C0015BF
Write module start address	H'0C001100
Erase module start address	H'0C001000

- Since the SDRAM is used, the bus controller must be set.
- Set the options on the [Loading flash memory] page in the [Configuration] dialog box as follows:

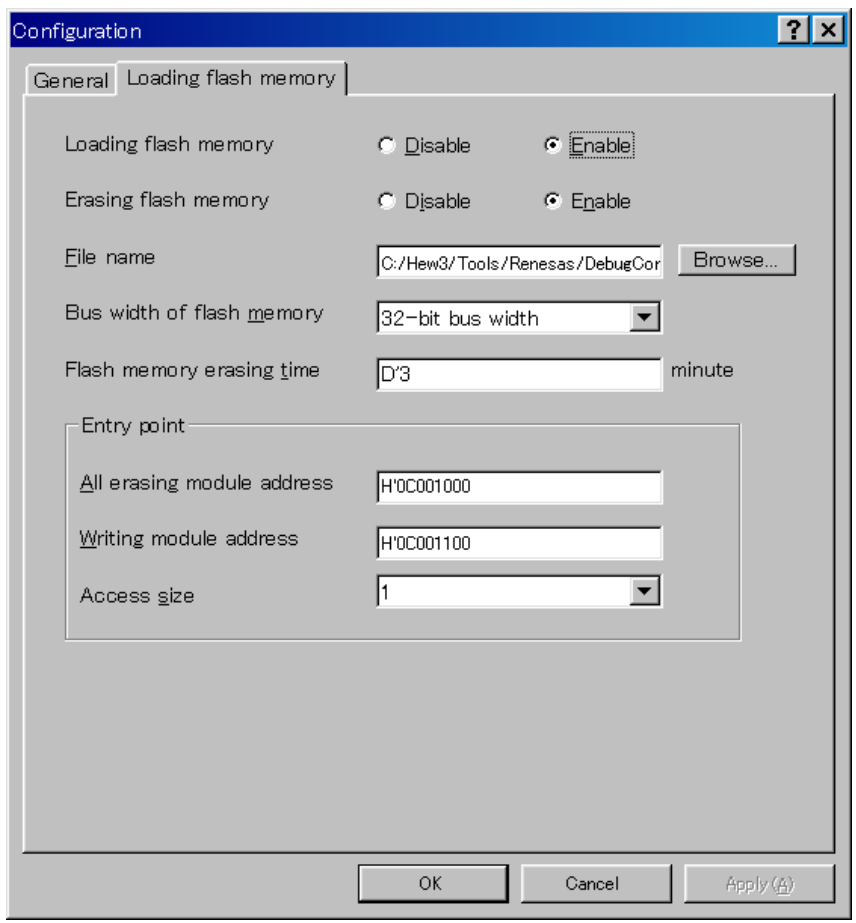


Figure 6.59 [Loading flash memory] Page

Notes: 1. When the data has already been written in the flash memory, be sure to select [Enable] for [Erasing flash memory]. If [Disable] is selected, a verify error occurs.
2. When [Erasing flash memory] is selected, it takes about one minute to erase the flash memory (in this example).

- Select the object for downloading to the flash memory area.

6.22 What Next?

This tutorial has described the major features of the emulator and the use of the High-performance Embedded Workshop.

Sophisticated debugging can be carried out by using the emulation functions that the emulator offers. This provides for effective investigation of hardware and software problems by accurately isolating and identifying the conditions under which such problems arise.

Section 7 Troubleshooting

1. ***I have a text file open in the editor but syntactic color-coding is not being displayed.***

   Ensure that you have named the file (i.e. saved it) and that the "Syntax coloring" check box is set on the "Editor" tab of the "Options" dialog box, which is launched via **[Setup -> Options...]**. The High-performance Embedded Workshop looks up the filename extension to determine the group to which the file belongs and decides whether or not coloring should be applied to the file. To view the currently defined filename extensions and file groups, select **[Project -> File Extensions...]** to launch the "File Extensions" dialog box. To view the coloring information, select **[Setup -> Format]** to display the "Color" tab of the "Format" dialog box (for further details, see the "Syntax Coloring" section in Chapter 4, "Using the Editor," of the volume on the High-performance Embedded Workshop).

2. ***I want to change the settings of a tool but the [Tools->Administration…] menu option is not selectable.***

   [Tools->Administration...] is not selectable while a workspace is open. To open the "Tool Administration" dialog box, close the current workspace.

3. ***I opened a workspace from my PC, and one of my colleagues opened the same workspace simultaneously from another PC. I changed the settings of the workspace and saved it. My colleague saved the workspace after me. I opened the workspace again and found that the settings of the workspace differed from those I had made.***

   The last settings to be saved are effective. While a workspace is open in the High-performance Embedded Workshop, updating of the workspace is within the memory. The settings are not saved in a file unless the user intentionally saves the workspace.

In addition to above, refer to FAQs on the emulator and High-performance Embedded Workshop on the Renesas web site (www.renesas.com).

Appendix A Menus

Table A.1 shows GUI menus.

Table A.1 GUI Menus

Menu	Option			Shortcut	Toolbar Button	Remarks
View	Disassembly			Ctrl + D		Opens the [Disassembly] window.
	Command Line			Ctrl + L		Opens the [Command Line] window.
	TCL toolkit			Ctrl + Shift + L		Opens the [Console] window.
	Workspace			Alt + K		Opens the [Workspace] window.
	Output			Alt + U		Opens the [Output] window.
	Difference					Opens the [Difference] window.
	CPU	Registers		Ctrl + R		Opens the [Register] window.
		Memory…		Ctrl + M		Opens the [Memory] window.
		IO		Ctrl + I		Opens the [IO] window.
		Status		Ctrl + U		Opens the [Status] window.
		Cache		Shift + Ctrl + C		Opens the [Cache] window.
		TLB		Shift + Ctrl + X		Opens the [TLB] window.
		Monitor	Monitor Setting…	Shift + Ctrl + E		Opens the [Monitor Setting] dialog box.
			Window Select…			Opens the [Window Select] dialog box.
		Extended Monitor				Opens the [Extended Monitor] window.

Table A.1 GUI Menus (cont)

Menu	Option		Shortcut	Toolbar Button	Remarks
View (cont)	Symbol (cont)	Labels	Shift + Ctrl + A		Opens the [Labels] window.
		Watch	Ctrl + W		Opens the [Watch] window.
		Locals	Shift + Ctrl + W		Opens the [Locals] window.
	Code	Eventpoints	Ctrl + E		Opens the [Event] window.
		Trace	Ctrl + T		Opens the [Trace] window.
		Code Coverage	Shift + Ctrl + H		Opens the [Code Coverage] window and shows the result acquired by this function.
		Stack Trace	Ctrl + K		Opens the [Stack Trace] window.
	Graphic	Image…	Shift + Ctrl + G		Opens the [Image] window.
		Waveform…	Shift + Ctrl + V		Opens the [Waveform] window.
	Performance	Performance Analysis	Shift + Ctrl + P		Opens the [Performance Analysis] window.
		Profile	Shift + Ctrl + F		Opens the [Profile] window.
		Realtime Profile	Shift + Ctrl + Q		Opens the [Realtime Profile] window.
Setup	Radix	Hexadecimal			Uses a hexadecimal for displaying a radix in which the numerical values will be displayed and entered by default.
		Decimal			Uses a decimal for displaying a radix in which the numerical values will be displayed and entered by default.

Table A.1 GUI Menus (cont)

Menu	Option		Shortcut	Toolbar Button	Remarks
Setup (cont)	Radix (cont)	Octal			Uses an octal for displaying a radix in which the numerical values will be displayed and entered by default.
		Binary			Uses a binary for displaying a radix in which the numerical values will be displayed and entered by default.
	Emu-lator	System…			Opens the [Configuration Properties] dialog box allowing the user to modify the debugging platform settings.
		Memory Resource…			Opens the [Memory Mapping] dialog box to set memory mapping.
Debug	Debug Sessions…				Opens the [Debug Sessions] dialog box to list, add, or remove the debug session.
	Debug Settings…				Opens the [Debug Settings] dialog box to set the debugging conditions or download modules.
	Reset CPU				Resets the target hardware and sets the PC to the reset vector address.
	Go		F5		Starts executing the user program at the current PC.
	Reset Go		Shift + F5		Resets the target microcomputer and executes the user program from the reset vector address.
	Go To Cursor				Starts executing the user program at the current PC until the PC reaches the address indicated by the current text cursor position.
	Set PC To Cursor				Sets the PC to the address at the row of the text cursor.

Table A.1 GUI Menus (cont)

Menu	Option	Shortcut	Toolbar Button	Remarks
Debug (cont)	Run…			Launches the [Run Program] dialog box allowing the user to enter the PC or S/W breakpoint during executing the user program.
	Step In	F11		Executes a block of user program before breaking.
	Step Over	F10		Executes a block of user program before breaking. If a subroutine call is reached, then the subroutine will not be entered.
	Step Out	Shift + F11		Executes the user program to reach the end of the current function.
	Step…			Launches the [Step Program] dialog box allowing the user to modify the settings for stepping.
	Step Mode Auto			Steps only one source line when the [Editor] window is active. When the [Disassembly] window is active, stepping is executed in a unit of assembly instructions.
	Assembly			Executes stepping in a unit of assembly instructions.
	Source			Steps only one source line.
	Halt Program	Esc		Stops the execution of the user program.
	Connect			Connects the debugging platform.
	Initialize			Disconnects the debugging platform and connects it again.
	Disconnect			Disconnects the debugging platform.
	Download Modules			Downloads the object program.
	Unload Modules			Unloads the object program.

Appendix B Command-Line Functions

The emulator supports the commands that can be used in the command-line window.

For details, refer to the online help.

Appendix C Notes on High-performance Embedded Workshop

1. Note on Moving Source File Position after Creating Load Module

   When the source file is moved after creating the load module, the [Open] dialog box may be displayed to specify the source file during the debugging of the created load module. Select the corresponding source file and click the [Open] button.

2. Source-Level Execution

   — Source file

   Do not display source files that do not correspond to the load module in the program window. For a file having the same name as the source file that corresponds to the load module, only its addresses are displayed in the program window. The file cannot be operated in the program window.

   — Step

   Even standard C libraries are executed. To return to a higher-level function, enter Step Out. In a for statement or a while statement, executing a single step does not move execution to the next line. To move to the next line, execute two steps.

3. Operation During Accessing Files

   Do not perform other operations during downloading the load module, operating [Verify Memory] or [Save Memory] in the [Memory] window, or saving in the [Trace] or [Code Coverage] window because this will not allow correct file accessing to be performed.

4. Watch

   — Local variables at optimization

   Depending on the generated object code, local variables in a C source file that is compiled with the optimization option enabled will not be displayed correctly. Check the generated object code by displaying the [Disassembly] window.
   If the allocation area of the specified local variable does not exist, displays as follows.

   Example: The variable name is asc.

   asc = ? - target error 2010 (xxxx)

   — Variable name specification

   When a name other than a variable name, such as a symbol name or function name, is specified, no data is displayed.

Example: The function name is main.

main =

5. Line Assembly

— Input radix

Regardless of the Radix setting, the default for line assembly input is decimal. Specify H' or 0x as the radix for a hexadecimal input.

6. Command Line Interface

— Batch file

To display the message "Not currently available" while executing a batch file, enter the sleep command. Adjust the sleep time length which differs according to the operating environment.

Example: To display "Not currently available" during memory_fill execution:

sleep d'3000

memory_fill 0 ffff 0

7. File specification by commands

The current directory may be altered by file specifications in commands. It is recommended to use absolute paths are recommended to be used to specify the files in a command file so that the current directory alteration is not affected.

Example: FILE_LOAD C:\HEW\Tools\Renesas\DebugComp\Platform\E200F
\Tutorial\Tutorial\Debug_SHxxxx_E200F_SYSTEM\tutorial.abs

8. Memory Save During User Program Execution

Do not execute memory save or verifying during user program execution.

9. Load of Motorola S-type Files

This High-performance Embedded Workshop does not support Motorola S-type files with only the CR code (H'0D) at the end of each record. Load Motorola S-type files with the CR and LF codes (H'0D0A) at the end of each record.

10. Note on [Register] Window Operation During Program Execution

The register value cannot be changed in the [Register] window during program execution. Even if the changed value is displayed, the register contents are not changed actually.

11. Break Function

— BREAKPOINT cancellation

When the contents of the BREAKPOINT address is modified during user program execution, the following message is displayed when the user program stops.

BREAKPOINT IS DELETED A=xxxxxxxx

If the above message is displayed, cancel all BREAKPOINT settings with the [Delete All] or [Disable] button in the [Event] window.

12. Number of BREAKPOINT and [Stop At] Settings in the [Run...] Menu

The maximum number of BREAKPOINTs and [Stop At] settings allowed in the [Run...] menu is 1000. Therefore, when 1000 BREAKPOINTs are set, specification by [Stop At] in the [Run...] menu becomes invalid. Use the BREAKPOINTs and [Stop At] in the [Run...] menu with 1000 or less total settings.

13. Note on RUN-TIME Display

The execution time of the user program displayed in the [Status] window is not a correct value since the timer in the host computer has been used.

14. Note on Displaying `Timeout error`

If `Timeout error` is displayed, the emulator cannot communicate with the target microcomputer. Turn off the user system and connect the USB connector of the emulator again by using the High-performance Embedded Workshop.

15. Note on Using the [Run Program] Dialog Box

When [Run...] is selected from the [Debug] menu to specify the stop address, there is the following note:

— When the breakpoint that has been set as Disable is specified as the stop address, note that the breakpoint becomes Enable when the user program stops.

16. BREAKPOINT Setting for SLEEP Instruction

When a break is set for the SLEEP instruction, use the Break Condition not the BREAKPOINT.

17. Host Computer in the Sleep or Hibernating Mode

The host computer must not enter the sleep or hibernating mode while the emulator is in use: otherwise the emulator will not be operable. In such a case, re-connect the emulator after the host computer has left the sleep or hibernating mode.

18. Manual Navigator

Use the following procedure before running a program on Windows Vista®.

(1) Be logged on as an administrator.

(2) Open the properties of the man_navi.exe file in the [Manuals] folder, which is under the folder where the High-performance Embedded Workshop has been installed.

(3) Select [Run this program as an administrator] on the [Compatible] tabbed page.

Note: The 64-bit editions of Windows Vista® have not been supported.

Appendix D Repair Request Sheet

Thank you for purchasing the E200F emulator (R0E0200F1EMU00).

In the event of a malfunction, fill in the repair request sheet on the following pages and send it to your distributor.

Repair Request Sheet

To Distributor

Your company name:

Person in charge:

Tel.:

Item	Symptom
1. Date and time when the malfunction occurred	Month/Day/Year {at system initiation, in system operation} *Circle either of items in the braces { }.
2. Frequency of generation of the malfunction	( ) times in ( ) {day(s), week(s), or month(s)} *Enter the appropriate numbers in the parentheses ( ) and circle one of the three items in the braces { }.
3. System configuration when the malfunction occurred	System configuration of the emulator: • E200F emulator (R0E0200F1EMU00): Serial No.: Revision: The above items are written on the label for product management on the base of the emulator unit: the four-digit number is the serial no. and the string of letters following that is the revision. • External bus trace unit (R0E200F1ETU00): Serial No.: Revision: The above items are written on the board. • Emulation memory unit (R0E0200F1MSR00, R0E0200F1MSR01): Serial No.: Revision: The above items are written on the board. • EV-chip unit (R0E57xxxxVKK00): Serial No.: Revision: The above items are written on the board. • Expansion profiling unit (R0E0200F0EPU00) Serial No.: Revision: The above items are written on the board. • Provided CD-R (R0E0200F1EMU00S): Version: V. Shown as 'V.x.xx release xx' on the CD-R (x: numeral). • Host computer in use: Manufacturer: Type number: OS: (Windows® 2000, Windows® XP, or Windows Vista®)

Item	Symptom
4. Settings when the malfunction occurred	(1) Operating mode: mode (2) Target system voltage: V (3) The clock in use: (Circle any of followings, the Xtal oscillator, external clock input, or emulator clock.) (4) Operating frequency: MHz
5. Failure phenomenon	
6. Error in debugging	
7. Error in the diagnostic program	
8. The High-performance Embedded Workshop does not link-up with the emulator.	Content of the error message

For errors other than the above, fill in the box below.

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RENESAS SALES OFFICES

http://www.renesas.com

Refer to "**http://www.renesas.com/en/network**" for the latest and detailed information.

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, AZIACenter, No.1233 Lujiazui Ring Rd, Pudong District, Shanghai, China 200120
Tel: <86> (21) 5877-1818, Fax: <86> (21) 6887-7858/7898

Renesas Technology Hong Kong Ltd.
7th Floor, North Tower, World Finance Centre, Harbour City, Canton Road, Tsimshatsui, Kowloon, Hong Kong
Tel: <852> 2265-6688, Fax: <852> 2377-3473

Renesas Technology Taiwan Co., Ltd.
10th Floor, No.99, Fushing North Road, Taipei, Taiwan
Tel: <886> (2) 2715-2888, Fax: <886> (2) 3518-3399

Renesas Technology Singapore Pte. Ltd.
1 Harbour Front Avenue, #06-10, Keppel Bay Tower, Singapore 098632
Tel: <65> 6213-0200, Fax: <65> 6278-8001

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, Jln Persiaran Barat, 46050 Petaling Jaya, Selangor Darul Ehsan, Malaysia
Tel: <603> 7955-9390, Fax: <603> 7955-9510

SH-2A, SH-2 E200F Emulator
User's Manual

Renesas Electronics Corporation
1753, Shimonumabe, Nakahara-ku, Kawasaki-shi, Kanagawa 211-8668 Japan

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