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E8a Emulator

User's Manual

Supported Devices:

- R8C Family
- M16C Family
- H8S Family
- H8 Family
- 740 Family

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Introduction

This manual describes the followings

- E8a Emulator functions
- Preparation before use
- Debugger functions
- Tutorial
- Appendix: (Components of the E8a Emulator, Notes on High-performance Embedded Workshop, and Diagnostic Test Procedure)

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.

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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.
<u>"enter this string"</u>	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.

IMPORTANT

Before using this product, be sure to read the user's manual (this user's manual) carefully.

Keep this user's manual, and refer to this when you have questions about this product.

Emulator:

The emulator in this document refers to the following products that are manufactured by Renesas Electronics Corporation:

- (1) Emulator
- (2) User system interface cable

The emulator herein does not include the customer's user system and host machine.

Purpose of use of this product:

This emulator is a device to support the development of a system that uses the Renesas MCUs. It provides support for system development in both software and hardware.

Be sure to use this emulator correctly according to said purpose of use. Please avoid using this emulator for other than its intended purpose of use.

For those who use this product:

This emulator can only be used by those who have carefully read the user's manual and know how to use it.

Use of this emulator requires the basic knowledge of electric circuits, logical circuits, and MCUs.

When using this product:

- (1) This product is a development-support unit for use in your program development and evaluation stages. When a program you have finished developing is to be incorporated in a mass-produced product, the judgment as to whether it can be put to practical use is entirely your own responsibility, and should be based on evaluation of the device on which it is installed and other experiments.
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- (7) Renesas Electronics Corporation will not assume responsibility of direct or indirect damage caused by an accidental failure or malfunction in this product.

When disposing of this product:

Penalties may be applicable for incorrect disposal of this waste, in accordance with your national legislation.

Usage restrictions:

This emulator has been developed as a means of supporting system development by users. Therefore, do not use it as a device used for equipment-embedded applications. Also, do not use it for developing the systems or equipment used for the following purposes either:

- (1) Transportation and vehicular
- (2) Medical (equipment where human life is concerned)
- (3) Aerospace
- (4) Nuclear power control
- (5) Undersea repeater

If you are considering the use of this emulator for one of the above purposes, please be sure to consult your local distributor.

About product changes:

We are constantly making efforts to improve the design and performance of this emulator. Therefore, the specification or design of this emulator or its user's manual may be changed without prior notice.

About the rights:

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About diagrams:

The diagrams in this user's manual may not all represent exactly the actual object.

Device names:

Sections 1 through 6 in this user's manual use R8C Family as an example of the device names.

Guarantee:

If your product becomes faulty within one year after its purchase while being used under good conditions by observing "IMPORTANT" and "Precautions for Safety" described in this user's manual, we will repair or replace your faulty product free of charge. Note, however, that if your product's fault is raised by any one of the following causes, we will repair it or replace it with new one with extra-charge:

- Misuse, abuse, or use under extraordinary conditions
- Unauthorized repair, remodeling, maintenance, and so on
- Inadequate user's system or misuse of it
- Fires, earthquakes, and other unexpected disasters

In the above cases, contact your local distributor.

Precautions for Safety

This chapter describes the precautions which should be taken in order to use this product safely and properly. Be sure to read and understand this chapter before using this product.

Contact us if you have any questions about the precautions described here.



WARNING indicates a potentially dangerous situation that will cause death or heavy wound unless it is avoided.



CAUTION indicates a potentially dangerous situation that will cause a slight injury or a medium-degree injury or property damage unless it is avoided.

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

△ means **WARNING** or **CAUTION**.

Example:



⊘ means **PROHIBITION**.

Example:



● means **A FORCIBLE ACTION**.

Example:



 **WARNING****Warnings for Power Supply:**

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.

Before setting up this product and connecting it to other devices, turn off power or remove a power cable to prevent injury or product damage.

Always switch off the host computer and user system before connecting or disconnecting any cables or parts. Failure to do so will result in a fire hazard and will damage the user system and the emulator product. The user program will be lost.

Warnings to Be Taken for Handling:

Do not modify this product. Personal injury due to electric shock may occur if this product is modified. Modifying the product will void your warranty. For repairing this product, contact your local distributor.

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 un-repairable damage.

Warning for Use temperature:

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.

Warning for Connecting Cables:

Connect the connectors in the user system and in the user interface cable by confirming the correct direction. Failure to do so will result in a fire hazard and will damage the user system and the emulator product.

 **CAUTION**
Cautions to Be Taken for Turning On the Power:

Turn ON/OFF the power of the emulator and the user system as simultaneously as possible. If you cannot turn on the powers simultaneously, turn on the emulator first and then the user system.

When turning on the power again after shutting off the power, wait about 10 seconds.

Cautions to Be Taken for Handling This Product:

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

Do not touch the connector pins of the emulator and the target MCU connector pins directly. Static electricity may damage the internal circuits.

When attaching and removing the cable, hold the plug of the cable and do not touch the cable. Do not pull the emulator by the communications interface cable or the flexible cable. And, excessive flexing or force may break conductors.

Do not flex the flexible cable excessively. The cable may cause a break.

Place the host computer and user system so that no cable is bent or twisted. A bent or twisted cable will impose stress on the user interface leading to connection or contact failure. Make sure that the host computer and the user system are placed in a secure position so that they do not move during use nor impose stress on the user interface.

Note on Transporting the Product:

When sending your product for repair, use the packing box and cushioning material supplied with the product when it was delivered to you and specify caution in handling (handling as precision equipment). If packing of your product is not complete, it may be damaged during transportation. When you pack your product in a bag, make sure to use the conductive plastic bag supplied with the product (usually a blue bag). If you use a different bag, it may lead to further trouble with your product due to static electricity.

Caution to Be Taken for System Malfunctions:

If the emulator malfunctions because of interference like external noise, do the following to remedy the trouble.

- (1) Exit the emulator debugger, and shut OFF the emulator and the user system.
- (2) After a lapse of 10 seconds, turn ON the power of the emulator and the user system again, then launch the emulator debugger.

Caution to Be Taken for Disposal:

Penalties may be applicable for incorrect disposal of this waste, in accordance with your national legislation.

European Union regulatory notices:

The WEEE (Waste Electrical and Electronic Equipment) regulations put responsibilities on producers for the collection and recycling or disposal of electrical and electronic waste. Return of WEEE under these regulations is applicable in the European Union only. This equipment (including all accessories) is not intended for household use. After use the equipment cannot be disposed of as household waste, and the WEEE must be treated, recycled and disposed of in an environmentally sound manner.

Renesas Electronics Europe GmbH can take back end of life equipment, register for this service at "<http://www.renesas.eu/weee>".

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1. Overview

The High-performance Embedded Workshop is a Graphical User Interface intended to facilitate 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, observing and modifying the debugging platform in which the application is running.

The E8a emulator (hereafter referred to as the emulator) is a software and hardware development support tool for application systems using the Renesas microcomputer. For applicable MCUs, refer to our web site.

The main unit of the emulator 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 anywhere indoors or out. The host computer for controlling the emulator must be an IBM PC compatible machine with USB.

This manual describes the contents that comply with versions of the High-performance Embedded Workshop 4.0 or later.

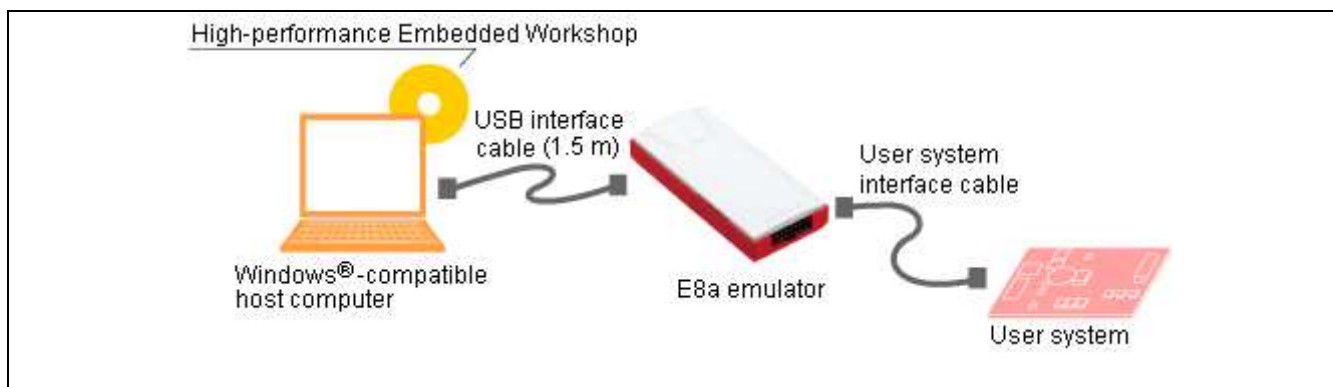


Figure 1.1 System Configuration with the Emulator

The emulator has three activation modes:

(1) Erase Flash and Connect

This mode is used to erase data of the MCU flash memory and activate the debugger. A program for the emulator is also written to at the same time.

(2) Keep Flash and Connect

This mode is used to activate the debugger while retaining data of the MCU flash memory. However, areas for the emulator program and vector areas used by the emulator will be changed.

(3) Program Flash

This mode is used to activate the emulator as a simplified programmer. During the download, the data is written only to the user program and not to the E8a emulator program. Accordingly, in this mode, program debugging is not available.

The emulator provides the following features:

(1) Programming for Renesas' 8- to 32-bit microcomputers

The emulator functions as a flash memory programming tool for Renesas' 8- to 32-bit MCUs.

(2) Operation at low voltage

The minimum operating voltage has been reduced to 1.8 V. Thus, it supports MCUs that require low-voltage programming for their flash memory. (The voltage used for flash memory programming must be compliant with the MCU specifications.).

(3) Highly cost-effective card emulator

Achieves size reduction and USB connection.

(4) Realtime emulation

Realtime emulation can be conducted at the maximum operating frequency of the MCU.

(5) Excellent operability

Pointing devices such as mouse can be used during the debugging of the user program by running High-performance Embedded Workshop on Windows® XP (32-bit edition), Windows Vista® (32-bit edition) or Windows® 7 (32-bit or 64-bit edition).

(6) Comprehensive debugging functions

Various break and trace functions are provided for improved debugging efficiency. You can set break points and break conditions using dedicated windows while displaying trace information in a window. Various command-line functions are also provided.

(7) Debugging of the user system in the final development stage

The user system can be debugged under conditions similar to the actual application conditions.

(8) Compact debugging environment

A laptop computer can be used as a host computer, creating a debugging environment in any place.

1.1 Warnings

**Caution to be taken when using this product:**

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 provided at the rear side of the component box 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 1.2, Environmental Conditions.
- (4) When moving the host computer 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 3, Preparation before Use.
- (6) Supply power to the connected equipment after connecting all cables. Cables must not be connected or removed while the power is on.

1.2 Environmental Conditions



Caution to be taken when using this product:



Observe the conditions listed in Tables 1.1 to 1.3 when using the emulator. Failure to do so may result in improper operation of the user system, the emulator product, and the user program.

Table 1.1 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 1.2 Operating Environments (Windows® XP)

Item	Description
Host computer	IBM PC or compatible
OS	Windows® XP 32-bit edition (64-bit edition not supported)
CPU	Pentium 4 running at 1.6 GHz or more recommended.
Host machine interface	USB (USB1.1, full-speed), also USB 2.0 interface supported Operation with all combinations of host machine, USB device and USB hub is not guaranteed for the USB interface.
Memory	1 Gbyte plus 10 times the file size of the load module or larger recommended.
Pointing device such as mouse	Mouse or any other pointing device usable with the above OS that can be connected to the host machine.
CD drive	Needed to install the emulator debugger or refer to the user's manual.
Hard-disk	Emulator debugger installation needs 600 MB or more free space. (In view of swap area, keep another free space which is more than twice the memory capacity. (More than four times the memory capacity recommended.))
Display resolution	1024 × 768 or greater recommended.

Table 1.3 Operating Environments (Windows Vista® and Windows® 7)

Item	Description
Host computer	IBM PC or compatible
OS	Windows® 7 32/64-bit editions Windows Vista® 32-bit edition (64-bit edition not supported)
CPU	Pentium 4 running at 3 GHz or Core 2 Duo running at 1 GHz or more recommended.
Host machine interface	USB (USB1.1, full-speed), also USB 2.0 interface supported Operation with all combinations of host machine, USB device and USB hub is not guaranteed for the USB interface.
Memory	2 Gbytes plus 10 times the file size of the load module or larger recommended (32-bit edition). 3 Gbytes plus 10 times the file size of the load module or larger recommended (64-bit edition).
Pointing device such as mouse	Mouse or any other pointing device usable with the above OS that can be connected to the host machine.
CD drive	Needed to install the emulator debugger or refer to the user's manual.
Hard-disk	Emulator debugger installation needs 600 MB or more free space. (In view of swap area, keep another free space which is more than twice the memory capacity. (More than four times the memory capacity recommended.))
Display resolution	1024 × 768 or greater recommended.

1.3 Components

Check that all of the components are present when unpacking the product. For details on the E8a emulator components, refer to the component list provided at the rear side of the component box. If all of the components are not present, contact your nearest Renesas sales office.

2. E8a Emulator Functions

This section describes the emulator functions. They differ according to the device supported by the emulator.

2.1 Overview

Table 2.1 gives a functional overview of the emulator.

Table 2.1 Emulator Functions

Item	Function
User program execution function	<ul style="list-style-type: none"> Executes a program at an operating frequency guaranteed for the applicable device. Reset emulation Step functions: <ul style="list-style-type: none"> Single step (one step: one instruction) Source-level step (one step: one source) Step over (Break is not set inside a subroutine.) Step out (Executes a function inside the subroutine pointed by PC until it is returned to the calling function.)
Reset function	<ul style="list-style-type: none"> Issues a reset from the High-performance Embedded Workshop to the device during break.
Trace function	<ul style="list-style-type: none"> Branch trace function incorporated in the device (four branches) The support of this function depends on a device.
Break functions	<ul style="list-style-type: none"> Hardware break condition (one condition) The support of this function depends on a device. PC break condition (255 points) Forced break function Address match break function
Memory access function	<ul style="list-style-type: none"> 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
General/control register access function	Reads or writes the general/control register.
Internal I/O register access function	Reads or writes the internal I/O register.
Source-level debugging function	Various source-level debugging functions.
Command line function	Supports command input. Batch processing can be used by creating a file in which each command is sorted in the order of input.
Start/Stop function	Executes the specified routine of the user program immediately before starting and immediately after halting program execution.
Help function	Describes the usage of each function as well as the command syntax that can be entered from the command line window.

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

2.2 Trace Functions

The branch source addresses, mnemonics, operands, and source lines are displayed. Real-time trace acquisition is supported by the trace buffer incorporated in the device.

Note: The MCUs which have no trace function cannot use this function.

2.3 Break Functions

The E8a emulator has the following four break functions.

(1) Hardware break function

Uses a break controller incorporated in the device.

The access address, instruction fetch address, data, or bus cycle condition can be set.

This function can also be set from the [Event] column in the [Source] window. For the setting, refer to section 5.3.1 Address Interrupt Breakpoints.

Note: The MCUs which have no hardware break function cannot use this function.

(2) PC break function (BREAKPOINT)

Breaks when the dedicated instruction at the specified address that has been replaced is executed.

This function can be set on the [Breakpoint] page in the [Eventpoint] dialog box. It can also be set when the [S/W Breakpoints] column for the line to be set is double-clicked in the [Source] or [Disassembly] window.

(3) Forced break function

Forcibly breaks the user program.

(4) Address match break function

Stops the target program immediately before a specified address instruction is executed. This function is featured by the address match interrupt of the MCU. This function can be set from the [Event] column in the Source window. For the setting, refer to section 5.2.2, Viewing the Source Code.

Note: The address match break points vary depending on the device. And, user program operation when device's address match interrupts are used is not guaranteed.

2.4 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. If the memory is written in the [Memory] window, a read 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 Modules] 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.

This function can download debugging information required for source-level debugging with the Elf/Dwarf2 or IEEE695 file having the debugging information.

(3) Memory data uploading function

The specified amount of memory from the specified address can be saved in an S-format file.

(4) Memory data downloading function

The memory contents saved in the S-type-formatted 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. For the usage of the function for displaying the variable contents, refer to the High-performance Embedded Workshop User's Manual.

(6) Other memory operation functions

Other functions are as follows:

- Memory fill
- Memory copy
- Memory save
- Memory verify
- Memory search
- Internal I/O display
- Displaying label and variable names and their contents

Notes: 1. Memory access during user program execution:

When 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 and the BREAKPOINT can be set for the flash memory area by the emulator.

3. For the MCUs listed below, memory copy and memory search functions are only available from the addresses described in Table 2.2.

<Applicable MCUs>

740 Family

M32C Series

Table 2.2 Restrictions on the Memory Operation Functions

Access Condition	Specifiable Start Address
1-byte access	No restrictions
2-byte access	xxxx0h, xxxx2h, xxxx4h, xxxx6h, xxxx8h, xxxxAh, xxxxC h, xxxxEh
4-byte access	xxxx0h, xxxx4h, xxxx8h, xxxxC h
8-byte access	xxxx0h, xxxx8h

2.5 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. This function can be used only when the load modules that have the following formats are loaded:

- M32C family C complier (M3T-NC308WA): IEEE695
- M16C family C compiler (M3T-NC30WA): IEEE695
- R8C family C compiler (M3T-NC8C): IEEE695
- H8, H8S, H8SX family C/C++ compiler (such as [R0C40008XSW06R]): Elf/Dwarf2

For the usage of this function, refer to section 6.19, Stack Trace Function.

2.6 Start/Stop Function

The emulator executes the specified routine of the user program immediately before starting and immediately after halting program execution. This function is used to control the user system in synchronization with execution and halting of the user program.

For the usage of this function, refer to section 5.6, Using the Start/Stop Function.

Note: The start/stop function is not supported in the H8/Tiny or H8/Super Low Power series, the 740 family, or the R8C/10, R8C/11, R8C/12, or R8C/13 group.

2.7 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.

2.8 Regulatory Compliance Notices

● European Union regulatory notices

This product complies with the following EU Directives. (These directives are only valid in the European Union.)

CE Certifications:

- Electromagnetic Compatibility (EMC) Directive 2014/30/EU
EN 55022 Class A

WARNING: This is a Class A product. This equipment can cause radio frequency noise when used in the residential area. In such cases, the ser/operator of the equipment may be required to take appropriate countermeasures under his responsibility.

EN 55024

- Information for traceability
 - Authorised representative
 - Name: Renesas Electronics Corporation
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 - Manufacturer
 - Name: Renesas System Design Co., Ltd..
 - Address: 5-20-1, Josuihon-cho, Kodaira-shi, Tokyo 187-8588, Japan
 - Person responsible for placing on the market
 - Name: Renesas Electronics Europe GmbH
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 - Trademark and Type name
 - Trademark: Renesas
 - Product name: E8a Emulator
 - Type name: R0E00008AKCE00

Environmental Compliance and Certifications:

- Waste Electrical and Electronic Equipment (WEEE) Directive 2012/19/EU

● United States Regulatory notices

This product complies with the following EMC regulation. (This is only valid in the United States.)

FCC Certifications:

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions:



(1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

CAUTION: Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

3. Preparation before Use

3.1 Emulator Preparation

Unpack the emulator and prepare it for use as follows:

 CAUTION
<p>Caution to be taken when using this product:</p> <p> Read the reference sections shaded in Figure 3.1 before using the emulator product. Incorrect operation will damage the user system and the emulator product. The user program will be lost.</p>

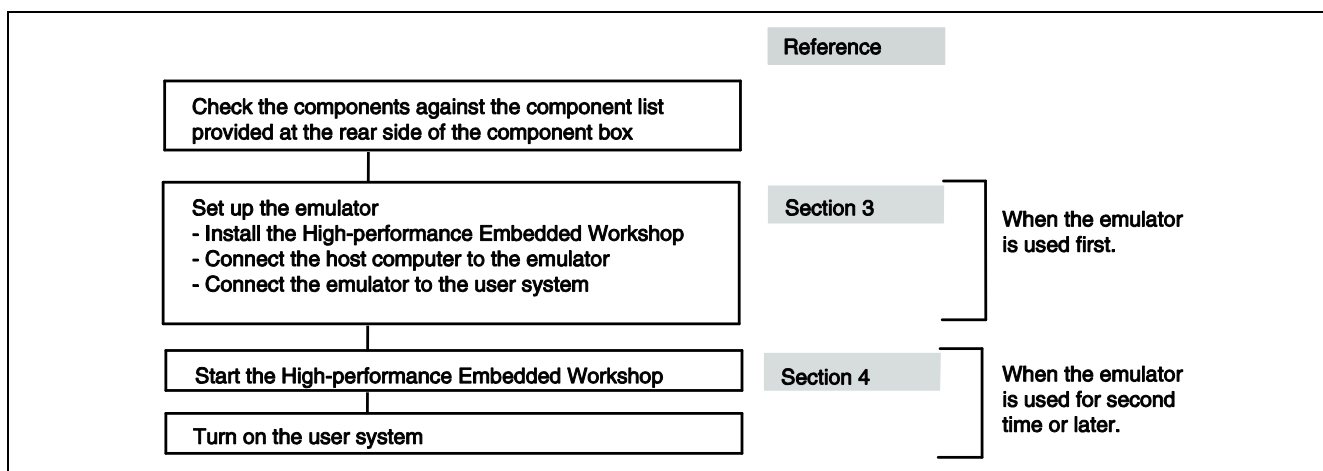


Figure 3.1 Emulator Preparation Flow Chart

3.2 Emulator Hardware Configuration

As shown in Figure 3.2, the emulator consists of an emulator, a USB cable, and a user system interface cable. The emulator is connected to the host computer via USB 1.1, and also to the USB port conforming to USB 2.0.

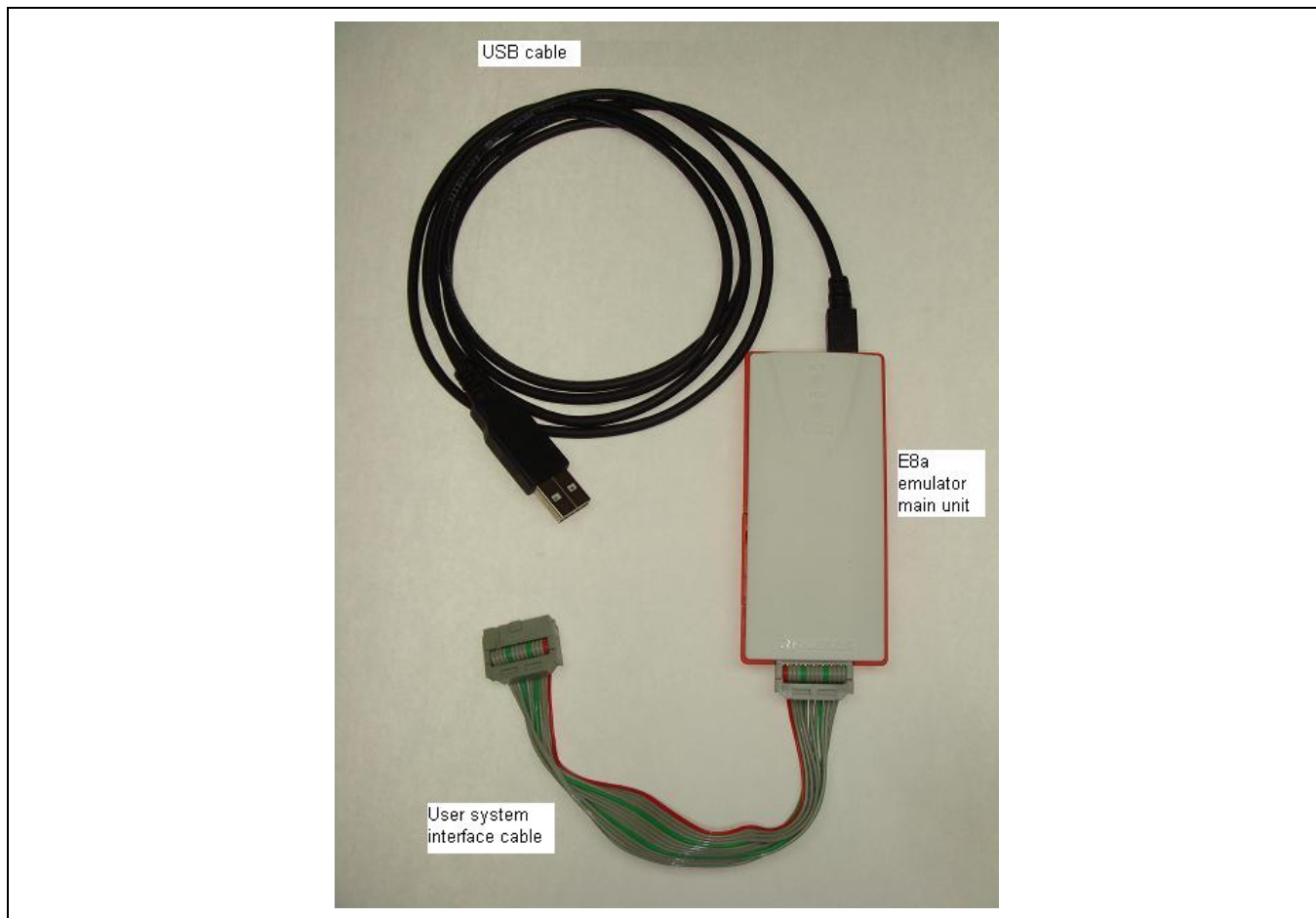


Figure 3.2 Emulator Hardware Configuration

The names of each section of the emulator are explained next.

Emulator Upper-side Panel:

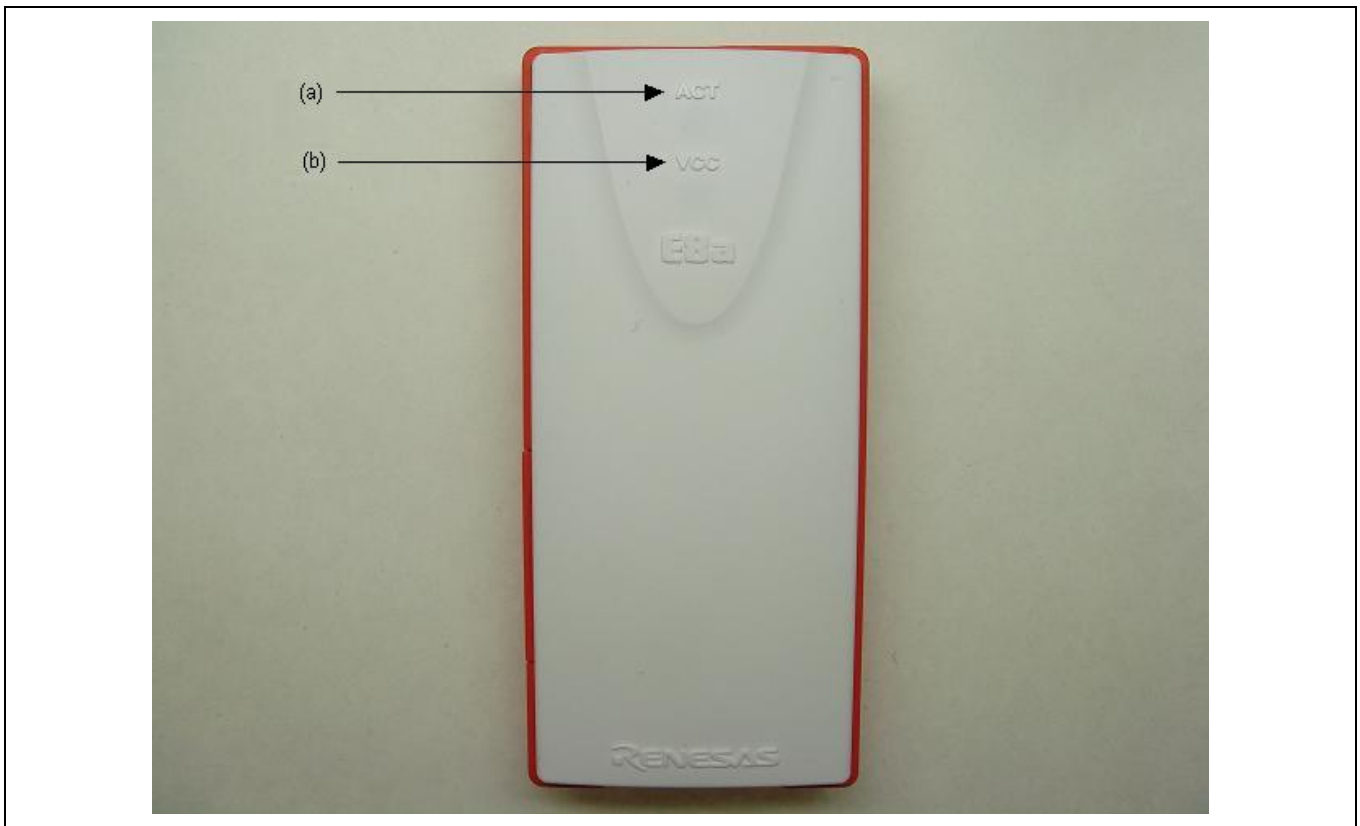


Figure 3.3 Emulator Upper-side Panel

- | | |
|--------------|--|
| (a) ACT LED: | An LED to show the operating state of the emulator software.
When this LED is lit (yellow-green), the E8a control software is in operation. |
| (b) VCC LED: | An LED to show the power state of the user system.
When power is supplied from the emulator to the user system, this LED is lit in orange.
When power is supplied from the user system to the emulator, this LED is lit in yellow-green. |

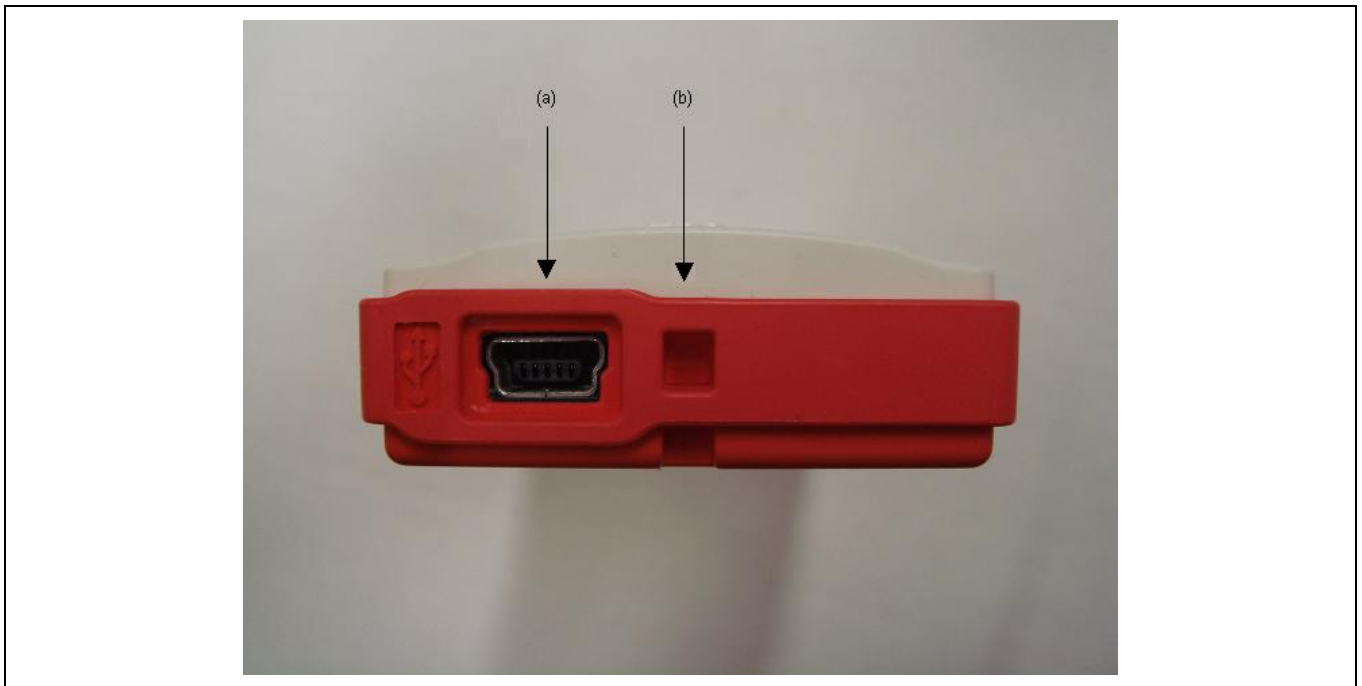
Emulator Host-Computer-Side Panel:

Figure 3.4 Side view of the emulator (host computer side)

- (a) Host-side connector: A USB cable connector for connecting the emulator to the host computer. Be sure to use the attached USB cable.
- (b) Portable strap hole: A hole for the strap (No strap is provided for this product).