User's Manual

E8a Emulator

Additional Document for User's Manual

Notes on Connecting the H8S/20103, H8S/20203, H8S/20223, H8S/20115, H8S/20215, H8S/20235, H8S/20103R, H8S/20203R, H8S/20223R, H8S/20323R, H8S/20115R, H8S/20215R, H8S/20235R, and H8S/20335R Group

H8S/Tiny Series

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Table of Contents

Note: This manual applies to the following product versions of the E8a emulator software.

Table E8a Emulator Software

E8a Emulator V.1.05 Release 00 or later
(H8 Tiny/Super Low Power E8a Emulator V.1.03.00 or later)*

Note: This is a revision of the debugger.

Section 1 Inside the E8a Emulator User's Manual

The E8a emulator manual consists of two documents: the E8a User's Manual and the E8a Additional Document for User's Manual (this document). Be sure to read BOTH documents before using the E8a emulator.

(1) E8a Emulator User's Manual

The E8a Emulator User's Manual describes the hardware specifications and how to use the emulator debugger.

- E8a emulator hardware specifications
- Connecting the E8a emulator to the host computer or user system
- Operating the E8a emulator debugger
- Tutorial: From starting up the E8a emulator debugger to debugging

(2) E8a Additional Document for User's Manual

The E8a Additional Document for User's Manual describes content dependent on the MCUs and precautionary notes.

- Example of the E8a emulator connection or interface circuit necessary for designing the hardware
- Notes on using the E8a emulator
- Setting the E8a emulator debugger during startup

Section 2 Connecting the Emulator with the User System

Before connecting an E8a emulator (hereafter referred to as emulator) with the user system, a connector must be installed in the user system so that a user system interface cable can be connected. When designing the user system, refer to the connector and recommended circuits shown in this manual.
Before designing the user system, be sure to read the E8a emulator user's manual and the hardware manual for related MCUs.

The E8a emulator supports the flash MCUs of H8S/20103, H8S/20203, H8S/20223, H8S/20115, H8S/20215, H8S/20235, H8S/20103R, H8S/20203R, H8S/20223R, H8S/20323R, H8S/20115R, H8S/20215R, H8S/20235R, and H8S/20335R group (hereafter referred to as the MCU unless the description is specific to any of them).

Table 2.1 shows the recommended connector for the emulator.

Table 2.1 Recommended Connector

Type Number	Manufacturer	Specifications
7614-6002OO∗	3M Limited	14-pin straight type

Connect pins 2, 4, 6, 10, 12, and 14 of the user system connector to GND firmly on the PCB. These pins are used as electrical GND and to monitor the connection of the user system connector. Note the pin assignments of the user system connector.

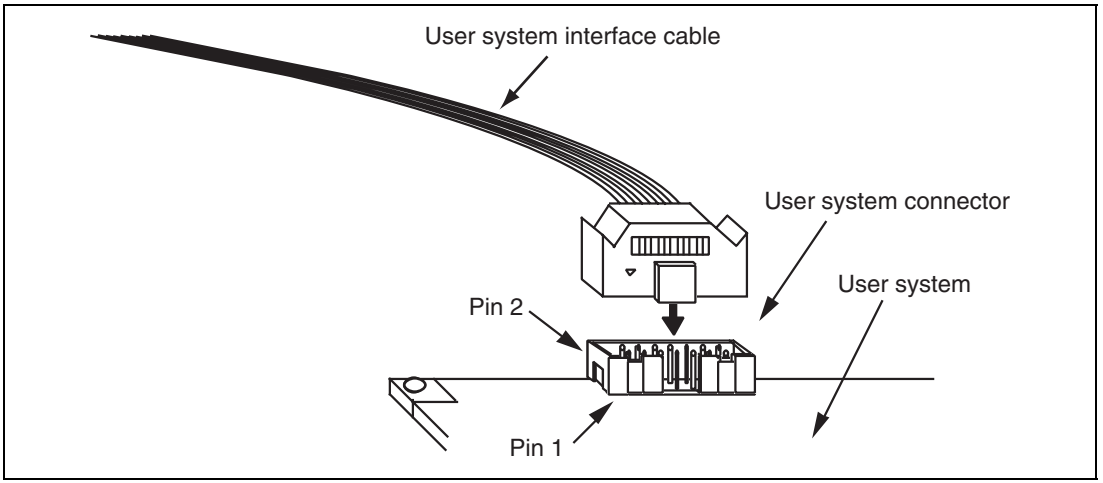
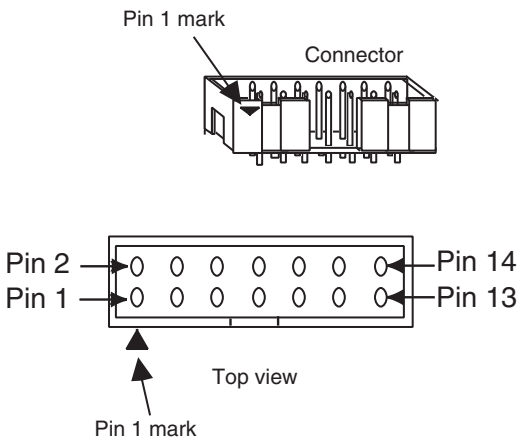


Figure 2.1 Connecting the User System Interface Cable to the User System

Notes: 1. The pin number assignments of the 14-pin connector differ from those of the E10A-USB emulator; however, the physical location is the same.
2. Do not place any components within 3 mm of the connector.
3. When the emulator is used in the [Program Flash] mode, connect the emulator similarly to the user system.

Section 3 Pin Assignments of the E8a Connector

Figure 3.1 shows the pin assignments of the emulator's connector.



Pin No.	MCU Signal
1	P87
2	Vss
3	N.C. *2
4	Vss
5	P86
6	Vss
7	NMI# *1
8	Vcc
9	N.C. *2
10	Vss
11	P85
12	Vss
13	RES# *1
14	Vss

Notes:
1. The symbol (#) means that the signal is active-low.
2. These pins are not used in the H8S/Tiny series. Do not connect anything to these pins.

Figure 3.1 Pin Assignments of the Emulator's Connector

Section 4 Example of Emulator Connection

Figure 4.1 shows an example of emulator connection to the MCU.

Control pins which do not appear in this figure, such as TEST, OSC1, and OSC2, affect the operation of the emulator. For handling of those pins, refer to the H8S/20103, H8S/20203, H8S/20223, H8S/20115, H8S/20215, and H8S/20235 group hardware manual and H8S/20103R, H8S/20203R, H8S/20223R, H8S/20323R, H8S/20115R, H8S/20215R, H8S/20235R, and H8S/20335R group hardware manual.

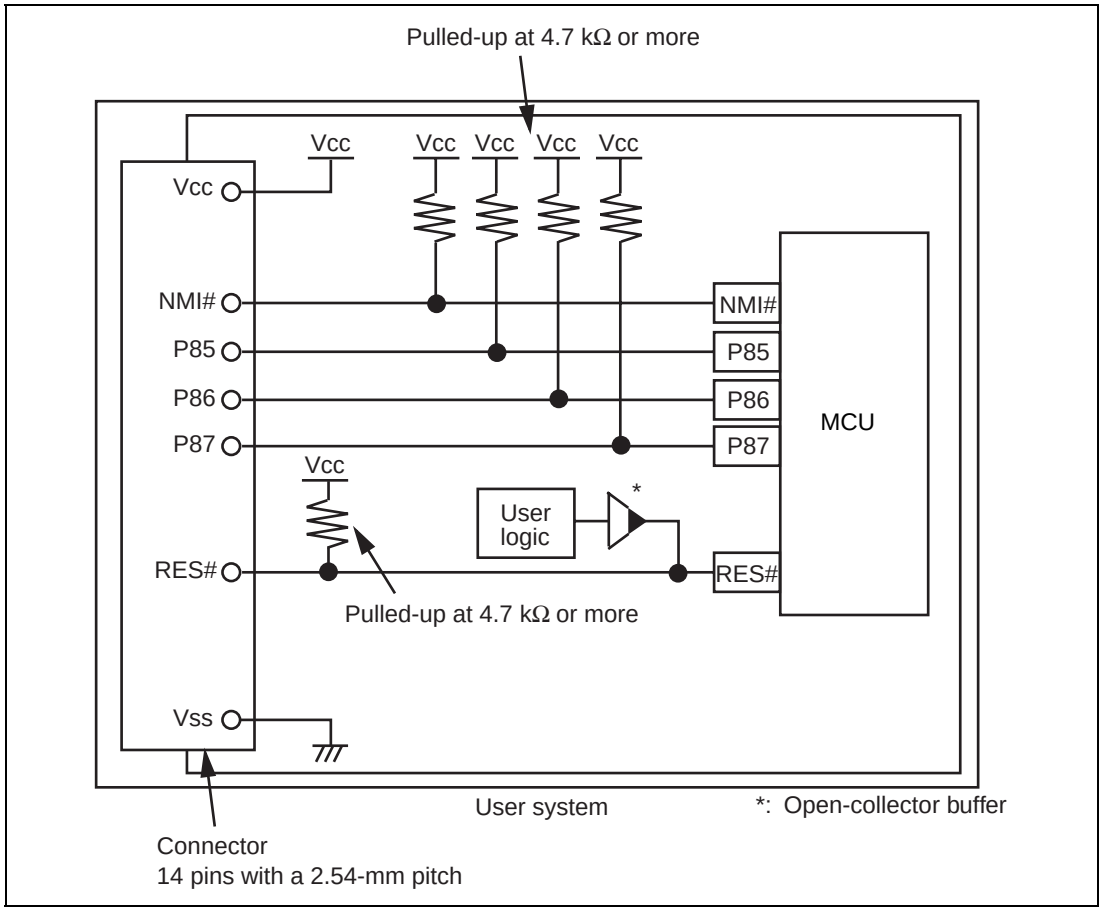


Figure 4.1 Example of Emulator Connection

Notes: 1. P85 to P87 pins are used by the emulator. Pull up and connect the emulator and MCU pins.

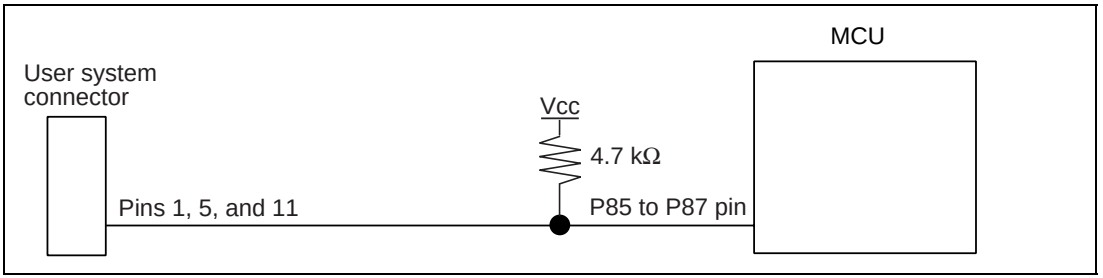


Figure 4.2 Connection of Emulator and P85 to P87 Pins

2. The NMI# signal is used for forced break control by the emulator. Connect the emulator and MCU pins directly.

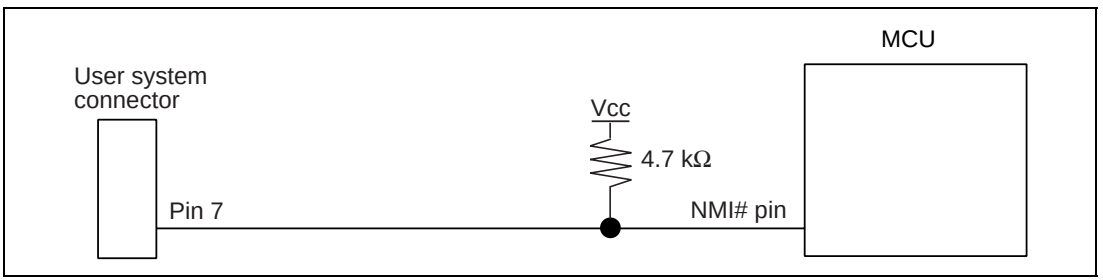


Figure 4.3 Connection of Emulator and NMI# Pin

3. The RES# pin is used by the emulator. If the user system has a reset control circuit (hereafter referred to as user logic), connect pin 13 of the user system connector and the output signal of the user logic via the open-collector buffer as shown below. If there is no user logic, connect pin 13 directly to the RES# pin of the MCU.

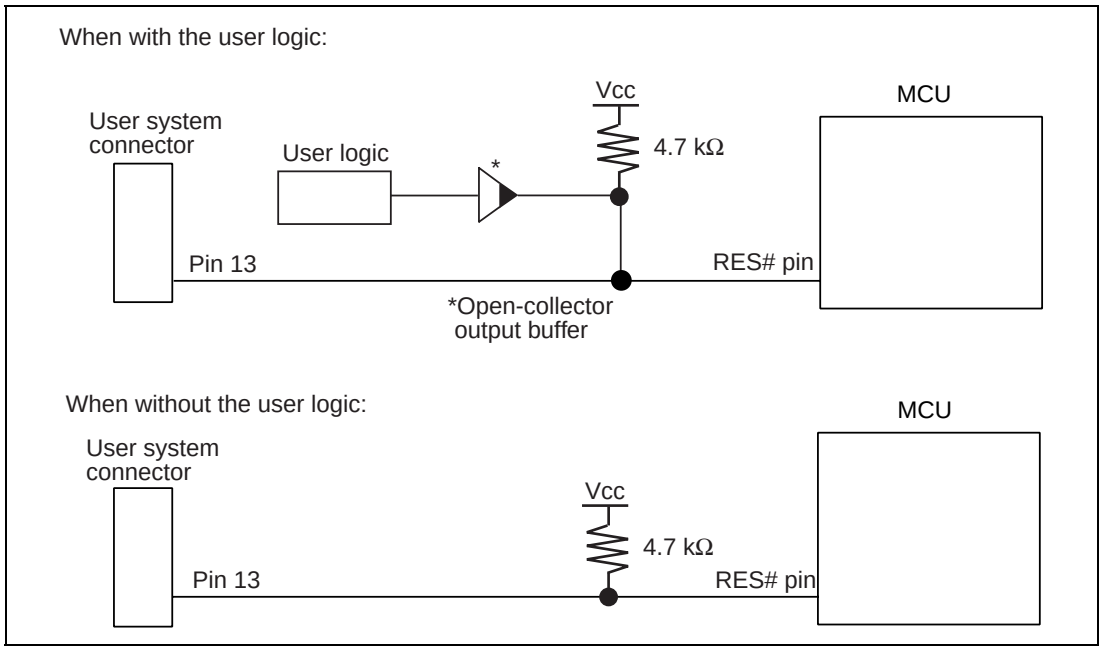


Figure 4.4 Example of a Reset Circuit

4. Connect Vss and Vcc with the Vss and Vcc of the MCU, respectively.
5. Connect nothing with N.C.
6. The amount of voltage permitted to input to Vcc must be within the guaranteed range of the MCU.

7. When the MCU in use is connected to the emulator, the pin functions listed below are not available.

Table 4.1 Pin Functions Not Available

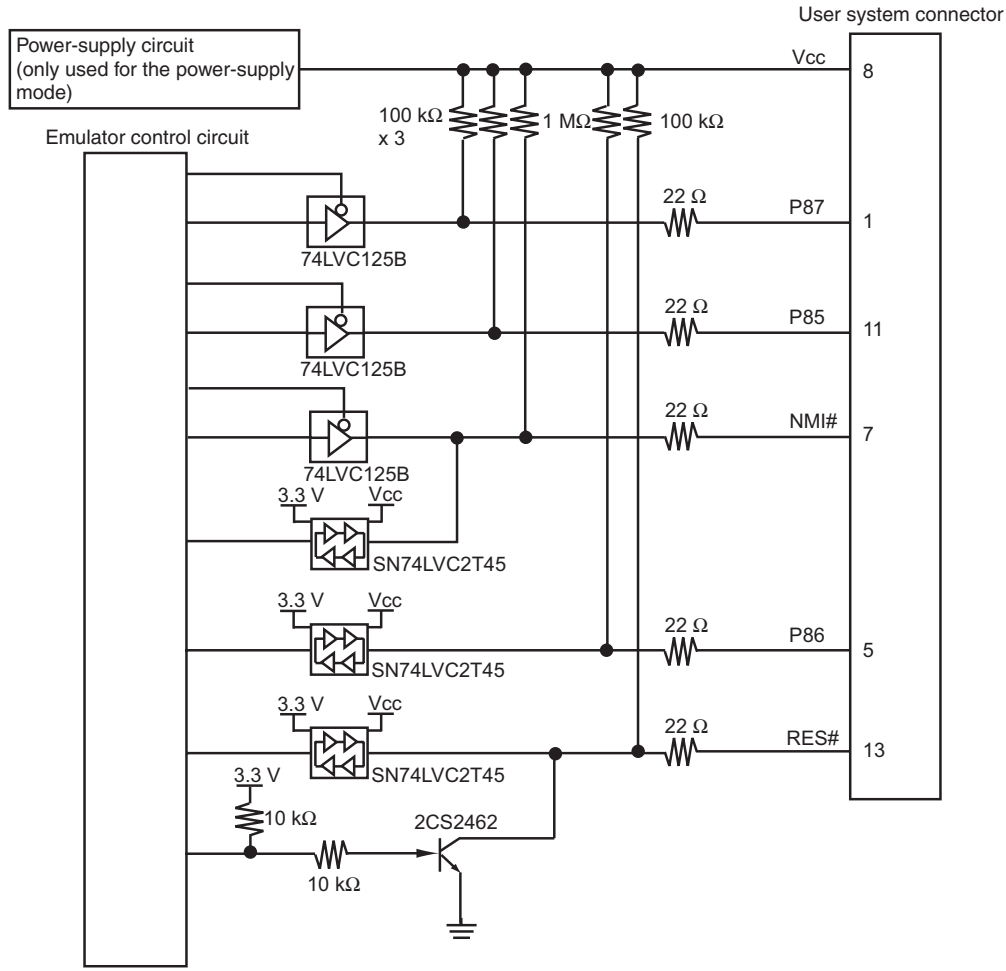
H8S/20103, H8S/20203, H8S/20223, H8S/20115, H8S/20215, H8S/20235, H8S/20103R, H8S/20203R, H8S/20223R, H8S/20323R, H8S/20115R, H8S/20215R, H8S/20235R, and H8S/20335R group
P85-P87
NMI#
TREO, TRBO, and TRAIO

⚠ WARNING

In the power-supply mode, connect the emulator after checking that the power-supply circuit on the user system is not closed or the pin number assignments of the user system connector is correct.

Failure to do so will result in a FIRE HAZARD and will damage the host computer, the emulator, and the user system.

8. Figure 4.5 shows the interface circuit in the E8a emulator. Use this figure as a reference when determining the pull-up resistance value.



Notes:
1. This figure omits the test circuits and pin numbers 2, 3, 4, 6, 9, 10, 12, and 14 for the user connector that are not used when H8S/Tiny series is connected.
2. The power of 74LVC125B is supplied from Vcc in the user connector (or in the power-supply circuit during power-supply mode).

Figure 4.5 Interface Circuit in the E8a Emulator (Reference)

Section 5 Software Specifications when Using the Emulator

5.1 Differences between the MCU (H8S/20103, H8S/20203, H8S/20223, H8S/20115, H8S/20215, H8S/20235, H8S/20103R, H8S/20203R, H8S/20223R, H8S/20323R, H8S/20115R, H8S/20215R, H8S/20235R, and H8S/20335R Group) and the Emulator

This section describes the differences between the emulator and MCU operations.

1. [Emulator Setting] Dialog Box

   The [Emulator Setting] dialog box is provided for setting the items that need to be set when the emulator starts up (settings are saved in the session).

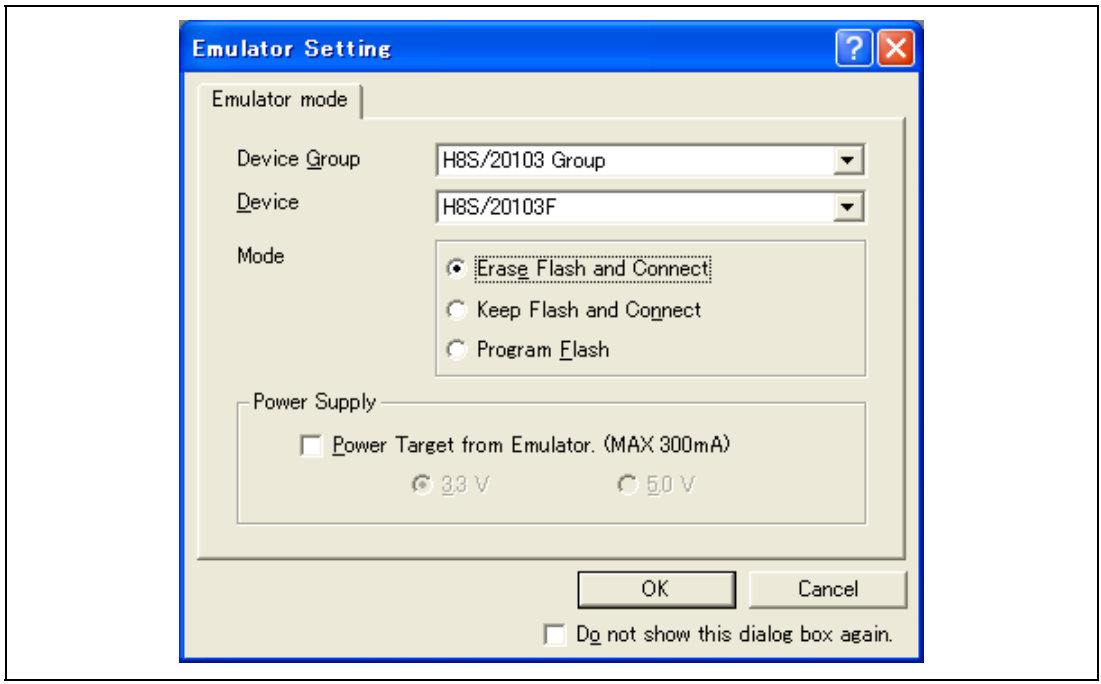


Figure 5.1 [Emulator Setting] Dialog Box

To keep the [Emulator Setting] dialog box closed next time the emulator is started, check "Do not show this dialog box again." at the bottom of the [Emulator Setting] dialog box. You can open the [Emulator Setting] dialog box using either one of the following methods:

— After the emulator gets started, select Menu - [Setup] -> [Emulator] -> [Emulator Setting...].

— Start the emulator while holding down the Ctrl key.

— After the emulator gets started and an error occurred, restart the emulator.

When you check "Do not show this dialog box again.", the emulator doesn't supply power to the user system. To use this check box, start the emulator after turning on the power.

2. Emulator Mode

The selection of the device group, device, the specification of the mode, and the setting of the power supply are done in the [Emulator mode] page of the [Emulator Setting] dialog box.

— Device Group

Select the device group in use from the [Device Group] combo box.

— Device

Select the device name in use from the [Device] combo box. The following items are selected in the [Mode] group box.

— Modes

- Erase Flash and Connect

  This mode is used when there is no emulator program in the flash memory of the target device. In this mode, data of the flash memory of the target device is erased when the emulator is activated. Select this item when the emulator is firstly activated, the version of the emulator’s software is updated, or the ID code is changed.

- Keep Flash and Connect

  This mode is used when there is an emulator program in the flash memory of the target device. Enter the ID code specified above (‘Erase Flash and Connect’). If an incorrect code is entered, all the programs on the flash memory will be erased.

Note: When the emulator gets started in this mode after selecting "Do not show this dialog box again.", the initial values of the ID code are ‘0E8a’ for the E8a emulator. If you use the ID code other than the initial value, do not use "Do not show this dialog box again."

- Program Flash

  This mode is used when the emulator is used for programming the flash memory. Debugging the program is disabled. To download the load module, register it in the workspace.

Note: In the H8S/Tiny series, the ID code is not entered in the Program Flash mode.

— Power Supply

When [Power Target from emulator. (MAX 300mA)] is checked, power will be supplied to the user system up to 300 mA.

3. Emulator Activation and ID Code

In the H8S/Tiny series, the [ID Code] dialog box is set when the emulator is activated.

— Setting the ID code

When the emulator is activated in the [Erase Flash and Connect] mode, enter any hexadecimal four-digit ID code to be set (except for H'FFFF). The initial value is H'0E8A. When the emulator is activated in the [Keep Flash and Connect] mode, enter the correct ID code. If an incorrect ID code is entered, all the contents of the flash memory will be erased. In this case, restart the emulator in the [Erase Flash and Connect] mode.

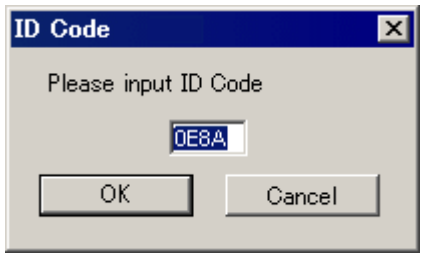


Figure 5.2 [ID Code] Dialog Box

4. When the emulator system is initiated, it initializes the general registers and part of the control registers as shown in table 5.1.

Table 5.1 Register Initial Values at Emulator Power-On

Register	Initial Value
PC	Reset vector value in the vector address table
ER0 to ER6	H'0
ER7 (SP)	H'10
CCR	1 for I mask, and others undefined
EXR	H'7F

5. Operating Clock during Breaks

   To speed up operations during breaks in execution of the user program, the CPU is made to use the high-speed clock for debugging as its operating clock.

6. RES# Signal

   The RES# signal is masked during breaks in execution of the user program. The RES# signal is accepted during user program execution when execution was started by clicking on the Go button or a step-type button.

Note: Do not start user program execution or access the memory while control input signal (RES#) is being low. A TIMEOUT error will occur.

7. System Control Register

   In the emulator, the internal I/O registers can be accessed from the [IO] window. However, be careful when accessing the system control register. The emulator saves the register value of the system control register at a break and returns the value when the user program is executed. Since this is done during a break, do not rewrite the system control register in the [IO] window.

8. Memory Access during Emulation

   If the memory contents are referenced or modified during emulation, realtime emulation cannot be performed because the user program is temporarily halted.

9. The emulator communicates with the MCUs by using the NMI#, RES#, and P85 to P87 pins.

10. Sum Data Displayed in the Program Flash Mode

    Sum data, which is displayed in the ‘Program Flash’ mode, is a value that data in the whole ROM areas has been added by byte.

11. Note on Executing the User Program

    The set value is rewritten since the emulator uses flash memory register during programming (Go, Step In, Step Out, or Step Over) of the flash memory.

12. The power consumed by the MCU can reach several milliamperes. This is because the user power supply drives ICs to make the communication signal level match the user-system power-supply voltage. The emulator does not communicate during execution of the user program, so connecting the emulator only causes a small rise in power consumption. However, it rises more significantly during breaks in user-program execution.

13. Program Area for the Emulator

    The emulator program uses the IO, flash memory, and internal RAM ranges indicated in Table 5.2, so make sure access to locations in these ranges does not proceed. If the contents of the program area for the emulator are changed, the emulator will not operate normally. In this case, restart the emulator in the Erase Flash and Connect mode.

Table 5.2 Program Area for the E8a Emulator

MCU Name	Program Area
H8S/20103F, H8S/20102F, H8S/20203F, H8S/20202F, H8S/20223F, H8S/20222F, H8S/20115F, H8S/20114F, H8S/20215F, H8S/20214F, H8S/20235F, H8S/20234F, H8S/20103RF, H8S/20102RF, H8S/20203RF, H8S/20202RF, H8S/20223RF, H8S/20222RF, H8S/20323RF, H8S/20322RF, H8S/20115RF, H8S/20114RF, H8S/20215RF, H8S/20214RF, H8S/20235RF, H8S/20234RF, H8S/20335RF, H8S/20334RF	Vector, etc.: H'00008 to H'0000F, H'00001C to H'00001F, H'000030 to H'00003F IO, etc.: H'FF0514 to H'FF0517, H'FF05A0 to H'FF05AF, H'FF05D8 to H'FF05DD, H'FF06FC to H'FF071F, H'FF072E to H'FF073F, H'FF074E to H'FF075F

14. Programming Flash Memory during Debugging

    The following functions use breakpoints and so lead to programming of the flash memory:
    - Executing [Go to cursor]
    - Stepping over a subroutine
    - Using step-out operation to execute a subroutine

15. Do not use an MCU that has been used for debugging.

    If the flash memory is rewritten many times, data may be lost due to retention problems after the emulator has been left for a few days and the data will be erased. If an error message is displayed, exchange the MCU for a new one.

16. Forced Break Function

    The vector address of NMI# is rewritten by the emulator program. An error will occur if a file in the host computer and the flash memory contents are verified.

17. Processing When Booting up the Emulator

    When the emulator is booted up, the watchdog timer (WDT) is not active, so the operation of the emulator differs in this way from that of an MCU when the emulator is not in use. When the MCU is initialized by a reset or in some other way after the emulator is booted up, the WDT becomes active. If you intend to use the WDT, set the WDT up as required from the initializing routine, while if you do not intend to use the WDT, stop activation of the WDT from the initializing routine.

    In products of the H8S/Tiny Series, the WDT runs at 125 kHz in its initial state, and a WDT reset occurs by an overflow. Consequently, note that a WDT reset will be generated unless an initializing routine is run right after the MCU is released from the reset state.

18. Updating the I/O Register Window and Memory Window during Debugging

    Registers such as the SSRDR of the Synchronous Serial Communications Unit (SSU), the ICDRR of the IIC Bus Interface Controller 2 (IIC2), and the RDR of Serial Communications Interface 3 (SCI3) are affected by the generation of read cycles. Displaying the contents of such peripheral function registers in the I/O register window or the memory window can lead to malfunctions of the peripheral function.

19. Items Set in the [Configuration] Dialog Box

The emulator operation conditions are set in the [Configuration] dialog box.

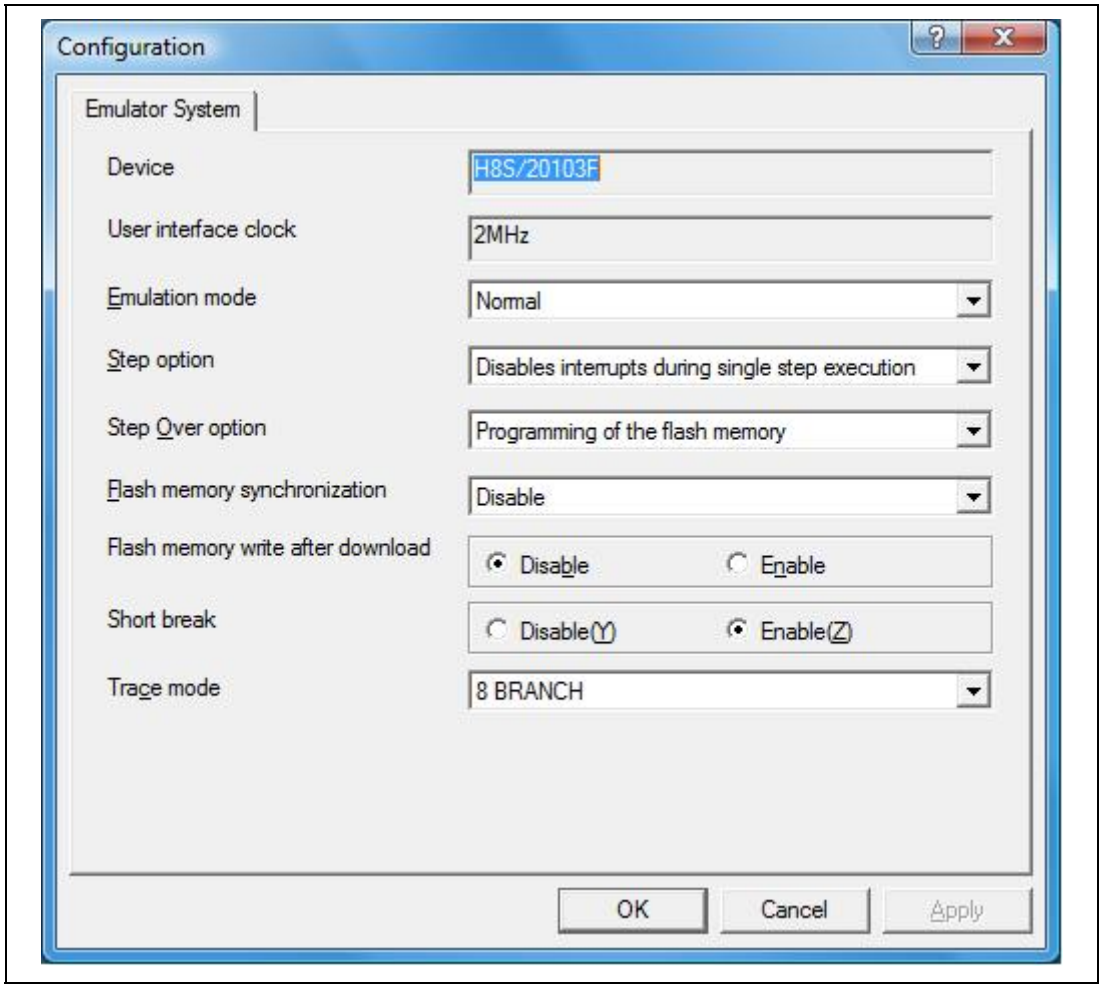


Figure 5.3 [Configuration] Dialog Box ([Emulator System] Page)

Note: Online help has a description of [NMI signal group box] in [Windows] -> [Configuration] -> [Configuration dialog box – Emulator System page], but it is not supported by the H8S/Tiny series.

Items that can be displayed in this dialog box are listed below.

[Device] edit box	Displays the MCU name.
[User interface clock] edit box	Displays the transfer clock of the user interface.
[Emulation mode] combo box	Selects the emulation mode at user program execution. Select Normal to perform normal emulation. Select No break to disable PC breakpoint or break condition settings during emulation.
[Step option] combo box	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.
[Step Over option] combo box	Enables or disables programming of the flash memory while executing step operation. Programming of the flash memory: Uses a software break for step operation (e.g. Step Over) and enables programming of the flash memory. No Programming of the flash memory: Uses Break Condition for step operation (e.g. Step Over) and disables programming of the flash memory[*2].

[Flash memory synchronization] combo box

Selects whether or not the contents of the flash memory are acquired by the emulator when the user program is stopped or the position where the PC break is set is put back as the original code.

When the flash memory is not programmed by the user program, its contents need not be acquired by the emulator.

If there is no problem with the state that the program in the flash memory has been replaced as the PC break code, the position where the PC break is set needs not be put back as the original code.

Disable: Read or program is not performed for the flash memory except when the emulator is activated, the flash memory area is modified, and the settings of the PC break to the flash memory area are changed.

PC to flash memory: When the user program is stopped, the specified PC break code is replaced as the original instruction. Select this option if there is a problem with the state that the program in the flash memory has been replaced as the PC break code.

Flash memory to PC: When the user program is stopped, the contents of the flash memory are read by the emulator. Select this option if the flash memory is reprogrammed by the user program.

PC to flash memory, Flash memory to PC:

When the user program is stopped, the contents of the flash memory are read by the emulator and the specified PC break code is replaced as the original instruction. Select this option if the flash memory is reprogrammed by the user program and there is a problem with the state that the program in the flash memory has been replaced as the PC break code.

[Flash memory write after download] group box	Enables or disables programming of the flash memory after downloading the program. Disable: Disables programming of the flash memory after downloading the program. Enable: Enables programming of the flash memory after downloading the program.
[Short break] group box	Enables or disables memory access during user program execution. Disable: Disables memory access during user program execution. Enable: Enables memory access during user program execution.
[Trace mode] combo box	[8 branch source] Displays the branch-source address or the mnemonic, operand, and source line. [4 branch source and 4 branch destination] Displays the branch-source and destination address or the mnemonic, operand, and source line.

Notes: 1. Includes interrupts in a break.

2. When Step Over is performed after selecting [No Programming of the flash memory] for [Step Over option], the instruction that follows a JSR, BSR, or TRAPA instruction will also be executed. If there are consecutive JSR, BSR, or TRAPA instructions, execution proceeds until it reaches an instruction that is not JSR, BSR, or TRAPA. (When there are consecutive function calls in C language, the program steps all of these functions.)

20. [Break condition] Functions

In the H8S/Tiny series E8a emulator, conditions of Break Condition 1,2,3,4,5,6,7,8,9,10 can be set. Table 5.3 lists the items that can be specified.

Table 5.3 Hardware Break Condition Specification Items

Items	Description
Address bus condition	Breaks when the MCU address bus value matches the specified value*.
Data bus condition	Breaks when the MCU data bus value matches the specified value. High or low byte or word can be specified as the access data size.
Read or write condition	Breaks in the read or write cycle.

Note: Break Condition 1 and 2 can decide mask setting for the address from lower 4 bits to 12 bits.

Table 5.4 lists the combinations of conditions that can be set in the [Break condition] dialog box.

Table 5.4 Conditions Set in [Break condition] Dialog Box

	Condition		
Dialog Box	Address Bus Condition	Data Condition	Read or Write Condition
[Break condition 1]	O	O	O
[Break condition 2]	O	O	O
[Break condition 3]	O	X	X
[Break condition 4]	O	X	X
[Break condition 5]	O	X	X
[Break condition 6]	O	X	X
[Break condition 7]	O	X	X
[Break condition 8]	O	X	X
[Break condition 9]	O	X	X
[Break condition 10]	O	X	X

Note: O: Can be set by checking the radio button in the dialog box.

Table 5.5 lists the combinations of conditions that can be set by the BREAKCONDITION_ SET command.

Table 5.5 Conditions Set by BREAKCONDITION_SET Command

	Condition		
Channel	**Address Bus Condition (<addropt> option)**	**Data Condition (<dataopt> option)**	**Read or Write Condition (<r/wopt> option)**
Break condition 1	O	O	O
Break condition 2	O	O	O
Break condition 3	O	X	X
Break condition 4	O	X	X
Break condition 5	O	X	X
Break condition 6	O	X	X
Break condition 7	O	X	X
Break condition 8	O	X	X
Break condition 9	O	X	X
Break condition 10	O	X	X

Note: O: Can be set by the BREAKCONDITION_SET command.

- Notes on Setting the Break Condition

1. When [Step In], [Step Over], or [Step Out] is selected, the settings of Break Condition are disabled.
2. The settings of Break Condition are disabled when an instruction to which a BREAKPOINT has been set is executed.
3. When step over function is used, the settings of BREAKPOINT and Break Condition are disabled.

(21) Description on Online Help

- About Command line List and NMI_MODE of each command line interface

  Do not select the User type when the H8S/Tiny device is in use. When the user program is executed while the User type has been set, there is a possibility that the E8a emulator becomes uncontrollable.

- About note

  Even though there is a description that “When the NMI signal is used, set NMI to be used in the user program in the [NMI signal] group box of the [Configuration] dialog box or with the NMI_MODE command.”, do not set the NMI_MODE command.

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Additional Document for User's Manual
Notes on connecting the H8S/20103, H8S/20203, 8S/20223, H8S/20115, H8S/20215, H8S/20235, H8S/20103R, H8S/20203R, H8S/20223R, H8S/20323R, H8S/20115R, H8S/20215R, H8S/20235R, and H8S/20335R Group

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