E8a Emulator

Additional Document for User’s Manual


H8S/Tiny Series

R0E00008AKCE00EP51

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Table of Contents

Section 1 Inside the E8a Emulator User’s Manual ................................................................. 1
Section 2 Connecting the Emulator with the User System ....................................................... 3
Section 3 Pin Assignments of the E8a Connector ................................................................. 5
Section 4 Example of Emulator Connection .......................................................................... 7
Section 5 Software Specifications when Using the Emulator ................................................ 13

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

<table>
<thead>
<tr>
<th>Table</th>
<th>E8a Emulator Software</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>E8a Emulator V.1.05 Release 00 or later</td>
</tr>
<tr>
<td></td>
<td>(H8 Tiny/Super Low Power E8a Emulator V.1.03.00 or later)*</td>
</tr>
</tbody>
</table>

Note: This is a revision of the debugger.
Section 1  Inside the E8a Emulator User’s Manual


(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.


Table 2.1 shows the recommended connector for the emulator.

Table 2.1 Recommended Connector

<table>
<thead>
<tr>
<th>Type Number</th>
<th>Manufacturer</th>
<th>Specifications</th>
</tr>
</thead>
<tbody>
<tr>
<td>7614-600200*</td>
<td>3M Limited</td>
<td>14-pin straight type</td>
</tr>
</tbody>
</table>
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](image)

**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.

<table>
<thead>
<tr>
<th>Pin No.</th>
<th>MCU Signal</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>P87</td>
</tr>
<tr>
<td>2</td>
<td>Vss</td>
</tr>
<tr>
<td>3</td>
<td>N.C. *2</td>
</tr>
<tr>
<td>4</td>
<td>Vss</td>
</tr>
<tr>
<td>5</td>
<td>P86</td>
</tr>
<tr>
<td>6</td>
<td>Vss</td>
</tr>
<tr>
<td>7</td>
<td>NMI# *1</td>
</tr>
<tr>
<td>8</td>
<td>Vcc</td>
</tr>
<tr>
<td>9</td>
<td>N.C. *2</td>
</tr>
<tr>
<td>10</td>
<td>Vss</td>
</tr>
<tr>
<td>11</td>
<td>P85</td>
</tr>
<tr>
<td>12</td>
<td>Vss</td>
</tr>
<tr>
<td>13</td>
<td>RES# *1</td>
</tr>
<tr>
<td>14</td>
<td>Vss</td>
</tr>
</tbody>
</table>

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](image)
Section 4 Example of Emulator Connection

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

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

![Diagram of Emulator and P85 to P87 Pins](image1)

**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.

![Diagram of Emulator and NMI# Pin](image2)

**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.

![Diagram of Reset Circuit](image)

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

<table>
<thead>
<tr>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>P85-P87</td>
</tr>
<tr>
<td>NMI#</td>
</tr>
<tr>
<td>TREO, TRBO, and TRAIO</td>
</tr>
</tbody>
</table>

**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.

![Interface Circuit in the E8a Emulator (Reference)](image)

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).
Section 5   Software Specifications when Using 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).

![Emulator Setting Dialog Box](image)

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

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

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

<table>
<thead>
<tr>
<th>MCU Name</th>
<th>Program Area</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>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</td>
</tr>
</tbody>
</table>

R20UT0999EJ0500 Rev. 5.00 Page 17 of 26
Feb 14, 2013

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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.

![Configuration Dialog Box (Emulator System Page)](image)

**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
- 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 during step execution.
  - Enable interrupts during single step execution: Enables interrupts 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.
[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**

<table>
<thead>
<tr>
<th>Items</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Address bus condition</td>
<td>Breaks when the MCU address bus value matches the specified value.</td>
</tr>
<tr>
<td>Data bus condition</td>
<td>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.</td>
</tr>
<tr>
<td>Read or write condition</td>
<td>Breaks in the read or write cycle.</td>
</tr>
</tbody>
</table>

**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**

<table>
<thead>
<tr>
<th>Dialog box</th>
<th>Address Bus Condition</th>
<th>Data Condition</th>
<th>Read or Write Condition</th>
</tr>
</thead>
<tbody>
<tr>
<td>[Break condition 1]</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>[Break condition 2]</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>[Break condition 3]</td>
<td>O</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>[Break condition 4]</td>
<td>O</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>[Break condition 5]</td>
<td>O</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>[Break condition 6]</td>
<td>O</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>[Break condition 7]</td>
<td>O</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>[Break condition 8]</td>
<td>O</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>[Break condition 9]</td>
<td>O</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>[Break condition 10]</td>
<td>O</td>
<td>X</td>
<td>X</td>
</tr>
</tbody>
</table>

**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**

<table>
<thead>
<tr>
<th>Channel</th>
<th>Address Bus Condition (&lt;addropt&gt; option)</th>
<th>Data Condition (&lt;dataopt&gt; option)</th>
<th>Read or Write Condition (&lt;r/wopt&gt; option)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Break condition 1</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>Break condition 2</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>Break condition 3</td>
<td>O</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Break condition 4</td>
<td>O</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Break condition 5</td>
<td>O</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Break condition 6</td>
<td>O</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Break condition 7</td>
<td>O</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Break condition 8</td>
<td>O</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Break condition 9</td>
<td>O</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Break condition 10</td>
<td>O</td>
<td>X</td>
<td>X</td>
</tr>
</tbody>
</table>

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

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