Thank you for using the RL78/L12 simulator.
This document describes restrictions on and points for caution regarding the simulator.
Read this document before using the product.

Contents

Chapter 1. Target Devices and Supported Simulation Functions .............................................. 2

Chapter 2. Change .................................................................................................................. 3
  2.1 Eliminated restriction ....................................................................................................... 3

Chapter 3. Points for Caution ............................................................................................... 4
  3.1 Differences in behavior between the target device and the simulator ............................. 4
  3.2 Usage of simulation functions .......................................................................................... 10
Chapter 1. Target Devices and Supported Simulation Functions

The RL78/L12 simulator supports the following target devices.

<table>
<thead>
<tr>
<th>Device group</th>
<th>Device name</th>
</tr>
</thead>
<tbody>
<tr>
<td>RL78/L12</td>
<td>R5F10RBC</td>
</tr>
<tr>
<td></td>
<td>R5F10RFC</td>
</tr>
<tr>
<td></td>
<td>R5F10RGC</td>
</tr>
<tr>
<td></td>
<td>R5F10RJC</td>
</tr>
<tr>
<td></td>
<td>R5F10RLC</td>
</tr>
<tr>
<td></td>
<td>R5F10RBA</td>
</tr>
<tr>
<td></td>
<td>R5F10RFA</td>
</tr>
<tr>
<td></td>
<td>R5F10RGA</td>
</tr>
<tr>
<td></td>
<td>R5F10RJA</td>
</tr>
<tr>
<td></td>
<td>R5F10RLA</td>
</tr>
<tr>
<td></td>
<td>R5F10RLA</td>
</tr>
<tr>
<td></td>
<td>R5F10RB8</td>
</tr>
<tr>
<td></td>
<td>R5F10RF8</td>
</tr>
<tr>
<td></td>
<td>R5F10RG8</td>
</tr>
<tr>
<td></td>
<td>R5F10RJ8</td>
</tr>
</tbody>
</table>

The RL78/L12 simulator is capable of simulating the following items as well as CPU instructions.

- Peripheral modules such as timers, the serial array unit, and the serial interface
- Virtual target board (simulation via the [I/O panel] window)
- MCU pin signal waveforms (simulation via the [Timing chart] window)
- Current drawn
Chapter 2. Change

This chapter describes a change in the RL78/L12 simulator with the transition from V1.00.00 to V1.01.00.

2.1 Eliminated restriction

2.1.1 Simulation of LCD displays (now supported for CS+ for CC)

Simulation of LCD displays, which was not possible with V1.00.00 and thus indicated as a restriction in the release notes for that revision as shown below, is now supported for CS+ for CC. When you are using V1.01.00 of the simulator, you can check the display of the 8x8-segment LCD for use with the on-chip driver, which is a component available for use in the [Virtual Board] panel. Note that only CS+ supports the [Virtual Board] panel (i.e. the e² studio does not have this panel).

Restriction in the release notes for V1.00.00:
✓ Simulation of LCD displays

[Details] While the RL78/L12 simulator supports simulation of the LCD controller/driver, it does not provide a means to simulate an LCD display.
Chapter 3. Points for Caution

This section lists points for caution on using the RL78/L12 simulator. These points for caution are in the following two categories.

• Differences in behavior between the target device and the simulator due to simulator specifications
• Usage of simulation functions (operations in and configuration of the GUI windows)

3.1 Differences in behavior between the target device and the simulator

3.1.1 Peripheral functions not supported by the simulator

The simulator is not capable of simulating the following peripheral functions of the target device.
- Regulator
- Power-on-reset circuit
- Voltage detector
- Flash self-programming

3.1.2 Peripheral I/O redirection register (PIOR)

The peripheral I/O redirection register (PIOR) can be manipulated by a program or debugger operations to re-assign specific multiplexed pin functions to alternative port pins in the same way as on the actual device. After re-assigning a given pin function by using the PIOR, be sure to select the name of the port pin you are currently using in the [Select Pin] dialog box of the simulator GUI.
3.1.3 Oscillation stabilization time for the clock generator

Since the simulator does not simulate the clock oscillator oscillation stabilization time, stabilization always takes no time. When the oscillation is started, the OSTC register is set to one of the following values (i.e. not incremented).

<table>
<thead>
<tr>
<th>OSTS Setting</th>
<th>OSTC Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>0x0 : 2⁰/Hz</td>
<td>0x80</td>
</tr>
<tr>
<td>0x1 : 2¹/Hz</td>
<td>0xc0</td>
</tr>
<tr>
<td>0x2 : 2²/Hz</td>
<td>0xe0</td>
</tr>
<tr>
<td>0x3 : 2³/Hz</td>
<td>0xf0</td>
</tr>
<tr>
<td>0x4 : 2⁴/Hz</td>
<td>0xf8</td>
</tr>
<tr>
<td>0x5 : 2⁵/Hz</td>
<td>0xfc</td>
</tr>
<tr>
<td>0x6 : 2⁶/Hz</td>
<td>0xfe</td>
</tr>
<tr>
<td>0x7 : 2⁷/Hz</td>
<td>0xff</td>
</tr>
</tbody>
</table>

The following figure illustrates this operation.

In the target device, oscillation by the X1 clock starts after operation has passed through states (1) to (4). In the simulator, states (1) through (4) are skipped and oscillation instantly starts.

The OSTC register is set to 0xff at this point.

Release from STOP mode or MSTOP bit = 0
The OSTC register is set to 0xff at this point.
Therefore, pay attention to the code that waits for oscillation stabilization.
There is no problem if a program is created under the condition that execution proceeds after the oscillation stabilization wait period when the OSTC register value becomes the maximum value, or when the OSTC register value exceeds the specified value, but if a program is created under the condition that execution proceeds after the oscillation stabilization wait period when the OSTC register value becomes a value other than the maximum value, execution will enter an endless loop.
The following shows examples of code that causes and does not cause problems.
The examples are when the OSTS is set to 0x07.

**Correct code example (1)**
```
while(OSTC != 0xff)
{
    NOP(); /* wait */
}
```

**Correct code example (2)**
```
while(OSTC <= 0xf0)
{
    NOP(); /* wait */
}
```

**Example of code that may cause problems**
```
while(OSTC != 0xf0)
{
    NOP(); /* wait */
}
```

### 3.1.4 SFRs (AMPH, AMPHS0, AMPHS1, and HIOTRM) in the clock generator
The following SFRs which belong to the clock generator are not simulated. Although read/write access for each register can proceed normally, the operation does not change even if the value is changed.
- Bits 0, 1, and 2 (AMPH, AMPHS0, and AMPHS1) of the clock operating mode control register (CMC)
- High-speed internal oscillator trimming register (HIOTRM)

### 3.1.5 Operating clock of the timer array unit
Do not specify an operating clock that runs at or below 233 Hz. If the operating clock for the timer array unit runs at or below 233 Hz, then the timer array unit will not work properly (it will behave as if operating with a clock that is faster than the one selected).

### 3.1.6 Noise filter of the timer array unit
Although the target device's timer array unit has a function to turn the noise filters on and off in order to reduce noise from the timer input pins, the simulator does not simulate this function since there is no noise in the simulator's signals. That is, whether filtering is on or off makes no difference to the behavior.
3.1.7 1-Hz pin output of the real-time counter
If the waveform of the RTC1HZ pin is checked in the [Timing chart] window to use the 1-Hz pin output of the real-time counter, the output waveform frequency becomes 32.768 KHz or 15 KHz.
In this case, proceed on the assumption that 1 Hz output is being produced without problems.

3.1.8 Interval interrupts generated by the watchdog timer
The timing of the generation of interval interrupts by the watchdog timer differs between the target device and the simulator.
[Target device]
  When 75% + 1/2fL of overflow time is reached
[Simulator]
  When 75% of overflow time is reached

3.1.9 Operating clock of the serial array unit
Do not specify an operating clock that is 233 Hz or lower. If the operating clock of the serial array unit is 233 Hz or lower, then the serial array unit will not operate correctly (it will behave as if operating via a clock that is faster than the one selected).

3.1.10 Noise filter of the serial array unit
Although the target device's serial array unit has a function to turn the noise filter on and off in order to reduce noise on the input pin, the simulator does not simulate this function since there is no noise in the simulator's signals. That is, whether filtering is on or off makes no difference to the behavior.

3.1.11 SDRmn registers of the serial array unit
The value read from the serial data registers (SDRmn) during serial operation differs between the target device and the simulator.
[Target device]
  0 is read.
[Simulator]
  The value at the time of starting serial operation is read.
3.1.12 IICA serial interface
IICA supports pin waveform generation and the communications through the [Serial] window. The following functions are not supported.
- Digital filter
- Arbitration
- Detection of transmission errors
- Communication reservation

3.1.13 Reset
The behavior differs as follows if a reset signal is input from the RESET pin.
[Target device]
The MCU is reset when the RESET pin goes low. Release from the reset state proceeds when the RESET pin goes high.
[Simulator]
The MCU is not reset when the RESET pin goes low. The simulator is reset momentarily and then released when the RESET pin goes high.

3.1.14 Reset control flag register (RESF)
The simulator only supports the WDTRF bit of the reset control flag register (RESF).
The simulator is not capable of simulating the operations of the other bits (TRAP, RPERF, IAWRF, and LVIRF). Only the default values of these bits are indicated.

3.1.15 A/D converter
When no voltage is being applied to the VDD or AVREFP pin, the default reference voltage of the A/D converter is 5.0 V.
To change the reference voltage, input the desired voltage values for VDD and AVREFP via the [Signal Data Editor] window.
The temperature sensor output voltage is always 1.05 V.

3.1.16 Clock output/buzzer output controller
When f_{MAIN} is selected as an output clock, the [Timing chart] window does not show the clock waveform of the PCLBUZn signal.
When f_{MAIN}/2 or a slower signal is selected as an output clock, the [Timing chart] window shows the clock waveform.

3.1.17 Executing illegal instructions
If an illegal instruction (instruction code: 0xFF) is executed, the target device will be reset, but the simulator will go into an endless loop (the illegal instruction will be executed repeatedly).
3.1.18 DMA controller

The transfer rates of the target device and simulator differ as follows when simulating the DMA controller.

[Target device]
- Completing one DMA transfer takes two clock cycles. The CPU waits during this period.
- In cases of contention with DMA transfer on another channel, one of the DMA transfers will be placed on hold until the other DMA transfer has been completed.

[Simulator]
- Completing one DMA transfer takes zero clock cycles. For this reason, the CPU does not wait.
- Even with contention, transfer on all DMA channels will proceed simultaneously.

3.1.19 LCD controller/driver

The simulator does not support simulation of the following items.
- LCD driver waveforms (waveforms A and B)
- LCD driver voltage generator (external resistance division, internal voltage boosting, and capacitive splitting)
- Blasing methods for LCD panels
- Output waveforms of common and segment signals

Even when no voltage is applied to the VDD pin, the simulator behaves as if 5 V is being applied to the VDD pin. If you wish to avoid this behavior, input a desired voltage value via the [Signal Data Editor] window.

3.1.20 ISCLCD register in the LCD controller/driver

The simulator does not support the functions of the ISCVL3 and ISCCAP bits (to control input through Schmitt trigger buffers) of the LCD input switch control register (ISCLCD).

3.1.21 Registers PFSEG0 to PFSEG4 in the LCD controller/driver

The behavior of the PFSEGxx bits (xx = 04 to 46) of LCD port function registers 0 to 4 (PFSEG0 to PFSEG4) being 1 differs between the target device and the simulator.

[Target device]
- The pin is used as a segment output pin.

[Simulator]
- The pin is used as a segment output or port pin.

3.1.22 Segment signal output pins for use by the LCD controller/driver

When a pin is to be used as a segment signal output pin, registers that control port functions (PUxx, POM1, PIM1, PMCxx, PMSxx, and Pxx) must be set accordingly on the target device.

In the simulator, on the other hand, each pin works as a segment signal output pin without such settings and ports operate according to the settings of registers PUxx, POM1, PIM1, PMCxx, PMxx, and Pxx.
3.2 Usage of simulation functions

3.2.1 Simulation of current drawn
The following notes apply to the function of measuring current.
- The current is calculated roughly as that drawn by the MCU alone based on the typical values (TYP.) for the actual devices. Note that the current values other than for the MCU are not included.
- The number of change points of measurable current is 200,000. The program stops when the number exceeds 200,000.

3.2.2 Simulation speed
The simulation speed of RL78/L12 simulator depends on the number of operating peripheral functions. If many peripheral functions are operating, the simulation speed becomes from several to ten times slower than the actual device. Note
With the use of only a few, or even no peripheral functions, the simulation speed may become faster than the actual device.
Note: The measurement environment for simulation speed is as follows.
CPU: 3.20 GHz (Quad-Core); memory: 8 Gbytes; OS: Windows10 64-bit edition

3.2.3 Pin waveforms in the [Timing chart] window
The maximum length of a pin waveform is 4096 signal-level changing points. After reaching this maximum length, the data will be overwritten from the oldest value. If this length is not sufficient, use the following methods.
- Reduce the number of registered pins
- Stop the user program at the place where you want to confirm the waveform by using a breakpoint

3.2.4 Controlling windows
The following keyboard operations are not available in the simulator windows ([Signal Data Editor], [I/O panel], and [Serial]).
- Navigation via tab or arrow keys (←, ↑, →, ↓)
- Deletion via the Del or Backspace keys
- Cut & paste and other operations via the Ctrl + C, V, X, A, or Z keys.
Perform the above operations as follows.
- Navigation: Navigate by using the mouse.
- Deletion: Right-click and perform the action from the context menu.
- Cut & paste, etc.: Right-click and perform the action from the context menu.
3.2.5  Closing the [Simulator GUI] window

The [Simulator GUI] window can only be closed by disconnecting from the debugging tool, or by closing CS+ in proper manner. The [X] button cannot be used.

Additionally, although it appears that the [X] button can be pressed if Aero is enabled in Windows, pressing this button will not close the [Simulator GUI] window.

3.2.6  Disconnecting the debug tool

CS+ may be closed if the debugging tool is disconnected while any of the following dialog boxes is open from the [Simulator GUI] window. Be sure that the following dialog boxes have been closed before disconnecting the simulator.

- Save As
- Open
- New
- Color
- Font
- Customize
- Loop
- Select Pin
- Search Data
- Format (UART)
- Format (CSI)
- Format (IIC)
- Message (e.g. Error)
- Parts Button Properties
- Analog Button Properties
- Parts Key Properties
- Parts Level Gauge Properties
- Parts Led Properties
- Parts Segment LED Properties
- Parts Matrix Led Properties
- Parts Buzzer Properties
- Pull up / Pull down
- Entry Bitmap
- Object Properties

3.2.7  [Serial] window

When using the [Serial] window as the data receiver for IICA, only ACK can be generated after receiving the data. NACK cannot be generated.
Notice

1. Descriptions of circuits, software and other related information in this document are provided only to illustrate the operation of semiconductor products and application examples. You are fully responsible for the incorporation or any other use of the circuits, software, and information in the design of your product or system. Renesas Electronics disclaims any and all liability for any losses and damages incurred by you or third parties arising from the use of these circuits, software, or information.

2. Renesas Electronics hereby expressly disclaims any warranties against and liability for infringement or any other claims involving patents, copyrights, or other intellectual property rights of third parties, by or arising from the use of Renesas Electronics products or technical information described in this document, including but not limited to, the product data, drawings, charts, programs, algorithms, and application examples.

3. No license, express, implied or otherwise, is granted hereby under any patents, copyrights or other intellectual property rights of Renesas Electronics or others.

4. You shall not alter, modify, copy, or reverse engineer any Renesas Electronics product, whether in whole or in part. Renesas Electronics disclaims any and all liability for any losses or damages incurred by you or third parties arising from such alteration, modification, copying or reverse engineering.

5. Renesas Electronics products are classified according to the following two quality grades: “Standard” and “High Quality”. The intended applications for each Renesas Electronics product depend on the product’s quality grade, as indicated below.

   “Standard”: Computers; office equipment; communications equipment; test and measurement equipment; audio and visual equipment; home electronic appliances; machine tools; personal electronic equipment; industrial robots; etc.

   “High Quality”: Transportation equipment (automobiles, trains, ships, etc.); traffic control (traffic lights); large-scale communication equipment; key financial terminal systems; safety control equipment; etc.

Unless expressly designated as a high reliability product or a product for harsh environments in a Renesas Electronics data sheet or other Renesas Electronics document, Renesas Electronics products are not intended or authorized for use in products or systems that may pose a direct threat to human life or bodily injury (artificial life support devices or systems; surgical implantations; etc.), or may cause serious property damage (space system; undersea repeaters; nuclear power control systems; aircraft control systems; key plant systems; military equipment; etc.). Renesas Electronics disclaims any and all liability for any damages or losses incurred by you or any third parties arising from the use of any Renesas Electronics product that is inconsistent with any Renesas Electronics data sheet, user’s manual or other Renesas Electronics document.

6. When using Renesas Electronics products, refer to the latest product information (data sheets, user’s manuals, application notes, “General Notes for Handling and Using Semiconductor Devices” in the reliability handbook, etc.), and ensure that usage conditions are within the ranges specified by Renesas Electronics with respect to maximum ratings, operating power supply voltage range, heat dissipation characteristics, installation, etc. Renesas Electronics disclaims any and all liability for any malfunctions, failure or accident arising out of the use of Renesas Electronics products outside of such specified ranges.

7. Although Renesas Electronics endeavors to improve the quality and reliability of Renesas Electronics products, semiconductor products have specific characteristics, such as the occurrence of failure at a certain rate and malfunctions under certain use conditions. Unless designated as a high reliability product or a product for harsh environments in a Renesas Electronics data sheet or other Renesas Electronics document, Renesas Electronics products are not subject to radiation resistance design. You are responsible for implementing safety measures to guard against the possibility of bodily injury, injury or damage caused by fire, and/or danger to the public in the event of a failure or malfunction of Renesas Electronics products, such as safety design for hardware and software, including but not limited to redundancy, fire control and malfunction prevention, appropriate treatment for aging degradation or any other appropriate measures. Because the evaluation of microcomputer software alone is very difficult and impractical, you are responsible for evaluating the safety of the final products or systems manufactured by you.

8. Please contact a Renesas Electronics sales office for details as to environmental matters such as the environmental compatibility of each Renesas Electronics product. You are responsible for carefully and sufficiently investigating applicable laws and regulations that regulate the inclusion or use of controlled substances, including without limitation, the EU RoHS Directive, and using Renesas Electronics products in compliance with all these applicable laws and regulations. Renesas Electronics disclaims any and all liability for damages or losses occurring as a result of your noncompliance with applicable laws and regulations.

9. Renesas Electronics products and technologies shall not be used for or incorporated into any products or systems whose manufacture, use, or sale is prohibited under any applicable domestic or foreign laws or regulations. You shall comply with any applicable export control laws and regulations promulgated and administered by the governments of any countries asserting jurisdiction over the parties or transactions.

10. It is the responsibility of the buyer or distributor of Renesas Electronics products, or any other party who distributes, disposes of, or otherwise sells or transfers the product to a third party, to notify such third party in advance of the contents and conditions set forth in this document.

11. This document shall not be reprinted, reproduced or duplicated in any form, in whole or in part, without prior written consent of Renesas Electronics.

12. Please contact a Renesas Electronics sales office if you have any questions regarding the information contained in this document or Renesas Electronics products.

(Note1) “Renesas Electronics” as used in this document means Renesas Electronics Corporation and also includes its directly or indirectly controlled subsidiaries.

(Note2) “Renesas Electronics product(s)” means any product developed or manufactured by or for Renesas Electronics.

Corporate Headquarters
TOYOSU FORESIA, 3-2-24 Toyosu,
Koto-ku, Tokyo 135-0061, Japan

www.renesas.com

Contact information
For further information on a product, technology, the most up-to-date version of a document, or your nearest sales office, please visit:

www.renesas.com/contact/.

Trademarks
Renesas and the Renesas logo are trademarks of Renesas Electronics Corporation. All trademarks and registered trademarks are the property of their respective owners.

© 2020 Renesas Electronics Corporation. All rights reserved.