

# RL78/F Series

## RSA Library: Installation Guide

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### Introduction

This document explains RSA Library for the RL78/F Series.

The RSA library is a software library for digital signature processing using private and public keys and exponentiation processing for RL78/F Series.

Please refer to the User's Manual (R20UW0175) to know how to use this software library.

### Target Device

RL78/F Series

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1. Structure of product

Table 1. RSA Library product files

| Name                              | Description  |
|-----------------------------------|--|
| r20an0690ej0101-r178-fx-rsa <DIR> |  |
| readme-e.txt                      | Package Structure, Release Note (English)                    |
| readme-j.txt                      | Package Structure, Release Note (Japanese)                   |
| Document <DIR>                    |  |
| r20an0690ej0101-r178-fx-rsa.pdf   | RSA Library Installation Guide (this document)               |
| En                                |  |
| r20uw0175ej0101-r178-fx-rsa.pdf   | RSA Library User's Manual (English)                          |
| Ja                                |  |
| r20uw0175jj0101-r178-fx-rsa.pdf   | RSA Library User's Manual (Japanese)                         |
| Workspace <DIR>                   |  |
| libsrc <DIR>                      | Library folder   |
| rsa <DIR>                         | RSA Library folder   |
| src <DIR>                         | RSA Library source folder                                    |
| r_rsa_api.c                       | RSA Library API function                                     |
| r_mc_lib.c                        | RSA Arbitrary Length Integer Calculation library source file |
| r_mc_lib.h                        | RSA Arbitrary Length Integer Calculation library header file |
| r_rsa_internal_header.h           | RSA Library API function internal header file                |
| r_rsa_version.c                   | RSA Livrary version file                                     |
| include <DIR>                     | RSA Library header folder                                    |
| r_rsa.h                           | RSA Library header file                                      |
| r_mw_version.h                    | Version data header file                                     |
| r_stdint.h                        | Typedef header file  |
| sha <DIR>                         | Folder for storing SHA Library (Store Sample SHA library)    |
| CS+ <DIR>                         | CS+ project folder   |
| r178_rsa_library_sample <DIR>     | Sample project for F24                                       |
| src <DIR>                         | Main function folder   |
| main.c                            | Sample code source file                                      |
| main.h                            | Sample code header file                                      |
| r_sample_key.c                    | RSA Key sample source file                                   |
| r_sample_key.h                    | RSA Key sample header file                                   |
| r_sample_modexp.c                 | RSA Modular exponentiation sample program                    |
| r_sample_modexp.h                 | RSA Modular exponentiation sample program header file        |
| r_sample_sig_gen_vrfy.c           | RSASSA-PKCS1-V1_5 sample program                             |
| r_sample_sig_gen_vrfy.h           | RSASSA-PKCS1-V1_5 sample program header file                 |
| cstart.asm                        | Startup processing assembler file                            |
| f24opt.asm                        | Option Byte assembler file                                   |
| RL78_RSA_Library_sample.mtpj      | CS+ Project file   |
| hdwinit.c                         | Peripheral unit initialization source file                   |
| iodefine.h                        | I/O Define header file                                       |
| stkinit.asm                       | Stack area initialization assembler file                     |
| IAR <DIR>                         | IAR project folder   |
| r178_rsa_library_sample <DIR>     | Sample project for F24                                       |
| src <DIR>                         | Main function folder   |
| main.c                            | Sample code source file                                      |
| main.h                            | Sample code header file                                      |
| r_sample_key.c                    | RSA Key sample source file                                   |
| r_sample_key.h                    | RSA Key sample header file                                   |
| r_sample_modexp.c                 | RSA Modular exponentiation sample program                    |
| r_sample_modexp.h                 | RSA Modular exponentiation sample program header file        |
| r_sample_sig_gen_vrfy.c           | RSASSA-PKCS1-V1_5 sample program                             |
| r_sample_sig_gen_vrfy.h           | RSASSA-PKCS1-V1_5 sample program header file                 |
| option_byte.c                     | OPBT Setting file  |
| sanle_linker_file_DF.ipcf         | Sample Linker script file                                    |
| rsa_library_sample.ewp            | IAR Project file   |
| rsa_library_sample.eww            | IAR Project workspace file                                   |

## 2. Product Specifications

### 2.1 API Function

RSA Library for the RL78 supports the following functions.

Table 2. Library Functions (API)

| API                         | Outline                                    |
|-----------------------------|--|
| R_RSA_ModExp                | Modular exponentiation                     |
| R_RSA_SignatureGeneratePkcs | Signature Generation (RSASSA-PKCS1-V1_5)   |
| R_RSA_SignatureVerifyPkcs   | Signature Verification (RSASSA-PKCS1-V1_5) |

### 3. Renesas Development Environment

#### 3.1 Development environment

Please use the same or a later version of the toolchain listed below:

- Integrated Development Environment:  
CS+ for CC V8.07.00
- C compiler:  
CC-RL V1.11.00

#### 3.2 ROM / RAM / Compiler option

The various sizes and processing cycles when building with the following options are described for reference.

`-cpu=S3 -memory_model=medium -Odefault`

Link options

`-NOOptimize`

Table 4. ROM, RAM Size (CC-RL)

| API                         | ROM size [byte]              | RAM size [byte]   |
|-----------------------------|------------------------------|-------------------|
| R_RSA_ModExp                | 2997 (3075)                  | 2                 |
| R_RSA_SignatureGeneratePkcs | 3270 (5634)                  | 2                 |
| R_RSA_SignatureVerifyPkcs   | 3384 (5748)                  | 2                 |
| RSA Library Total Size      | 4419 (13019) <sup>Note</sup> | 2 <sup>Note</sup> |

Note: () is the value including the SHA library (include SHA512 Module).

Since each function includes a common function, the required ROM capacity is smaller than the sum of each function.

Table 5. Stack Size (CC-RL)

| API                         | stack size [byte] |
|-----------------------------|-------------------|
| R_RSA_ModExp                | 130               |
| R_RSA_SignatureGeneratePkcs | 1220              |
| R_RSA_SignatureVerifyPkcs   | 1228              |

## 4. IAR Development Environment

### 4.1 Development environment

Please use the same or a later version of the toolchain listed below:

Integrated Development Environment:

IAR Embedded Workbench for Renesas RL78 version 4.21.4

C compiler:

IAR C/C++ Compiler for Renesas RL78 : 4.21.3.2447 (4.21.3.2447)

### 4.2 ROM / RAM / Compiler option

Library file is built with the following options.

```
--core=S3 --code_model=far --data_model=near --near_const_location=rom0 -e -Oh
--calling_convention=default
```

Table 6. ROM, RAM Size (IAR)

| API                         | ROM size [byte]              | RAM size [byte]   |
|-----------------------------|------------------------------|-------------------|
| R_RSA_ModExp                | 3474 (3623)                  | 2                 |
| R_RSA_SignatureGeneratePkcs | 3743 (6394)                  | 2                 |
| R_RSA_SignatureVerifyPkcs   | 3871 (6522)                  | 2                 |
| RSA Library Total Size      | 4852 (13048) <sup>Note</sup> | 2 <sup>Note</sup> |

Note: () is the value including the SHA library (include SHA512 Module).

Since each function includes a common function, the required ROM capacity is smaller than the sum of each function.

Table 7. Stack Size (IAR)

| API                         | stack size [byte] |
|-----------------------------|-------------------|
| R_RSA_ModExp                | 130               |
| R_RSA_SignatureGeneratePkcs | 1124              |
| R_RSA_SignatureVerifyPkcs   | 1142              |

## Revision History

| Rev. | Date        | Description |                      |
|------|-------------|-------------|----------------------|
|      |             | Page        | Summary              |
| 1.00 | Nov 30,2022 | —           | First edition issued |
| 1.01 | Dec 27,2022 | 2           | Filename change      |
|      |             |             |                      |

# General Precautions in the Handling of Microprocessing Unit and Microcontroller Unit Products

The following usage notes are applicable to all Microprocessing unit and Microcontroller unit products from Renesas. For detailed usage notes on the products covered by this document, refer to the relevant sections of the document as well as any technical updates that have been issued for the products.

## 1. Precaution against Electrostatic Discharge (ESD)

A strong electrical field, when exposed to a CMOS device, can cause destruction of the gate oxide and ultimately degrade the device operation. Steps must be taken to stop the generation of static electricity as much as possible, and quickly dissipate it when it occurs. Environmental control must be adequate. When it is dry, a humidifier should be used. This is recommended to avoid using insulators that can easily build up static electricity. Semiconductor devices must be stored and transported in an anti-static container, static shielding bag or conductive material. All test and measurement tools including work benches and floors must be grounded. The operator must also be grounded using a wrist strap. Semiconductor devices must not be touched with bare hands. Similar precautions must be taken for printed circuit boards with mounted semiconductor devices.

## 2. Processing at power-on

The state of the product is undefined at the time when power is supplied. The states of internal circuits in the LSI are indeterminate and the states of register settings and pins are undefined at the time when power is supplied. In a finished product where the reset signal is applied to the external reset pin, the states of pins are not guaranteed from the time when power is supplied until the reset process is completed. In a similar way, the states of pins in a product that is reset by an on-chip power-on reset function are not guaranteed from the time when power is supplied until the power reaches the level at which resetting is specified.

## 3. Input of signal during power-off state

Do not input signals or an I/O pull-up power supply while the device is powered off. The current injection that results from input of such a signal or I/O pull-up power supply may cause malfunction and the abnormal current that passes in the device at this time may cause degradation of internal elements.

Follow the guideline for input signal during power-off state as described in your product documentation.

## 4. Handling of unused pins

Handle unused pins in accordance with the directions given under handling of unused pins in the manual. The input pins of CMOS products are generally in the high-impedance state. In operation with an unused pin in the open-circuit state, extra electromagnetic noise is induced in the vicinity of the LSI, an associated shoot-through current flows internally, and malfunctions occur due to the false recognition of the pin state as an input signal become possible.

## 5. Clock signals

After applying a reset, only release the reset line after the operating clock signal becomes stable. When switching the clock signal during program execution, wait until the target clock signal is stabilized. When the clock signal is generated with an external resonator or from an external oscillator during a reset, ensure that the reset line is only released after full stabilization of the clock signal. Additionally, when switching to a clock signal produced with an external resonator or by an external oscillator while program execution is in progress, wait until the target clock signal is stable.

## 6. Voltage application waveform at input pin

Waveform distortion due to input noise or a reflected wave may cause malfunction. If the input of the CMOS device stays in the area between  $V_{IL}$  (Max.) and  $V_{IH}$  (Min.) due to noise, for example, the device may malfunction. Take care to prevent chattering noise from entering the device when the input level is fixed, and also in the transition period when the input level passes through the area between  $V_{IL}$  (Max.) and  $V_{IH}$  (Min.).

## 7. Prohibition of access to reserved addresses

Access to reserved addresses is prohibited. The reserved addresses are provided for possible future expansion of functions. Do not access these addresses as the correct operation of the LSI is not guaranteed.

## 8. Differences between products

Before changing from one product to another, for example to a product with a different part number, confirm that the change will not lead to problems. The characteristics of a microprocessing unit or microcontroller unit products in the same group but having a different part number might differ in terms of internal memory capacity, layout pattern, and other factors, which can affect the ranges of electrical characteristics, such as characteristic values, operating margins, immunity to noise, and amount of radiated noise. When changing to a product with a different part number, implement a system-evaluation test for the given product.

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## Corporate Headquarters

TOYOSU FORESIA, 3-2-24 Toyosu,  
Koto-ku, Tokyo 135-0061, Japan  
[www.renesas.com](http://www.renesas.com)

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