

# RE01 1500KB, 256KB Group QSPI XIP mode (Low Level Code)

## QSPI XIP Sample Code

### Introduction

This application note explains the QSPI sample code which does not use the RE01 1500KB Group, 256KB Group CMSIS driver function.

In this sample code, the registers of Peripheral modules are directly accessed.

This sample code is intended for users who need to:

- Improve performance by eliminating overhead code in the driver.
- Reduce ROM/RAM size.
- Develop simple, easy-to-understand code.
- Implement features not supported by the driver.

### Target Device

RE01 1500KB Group

RE01 256KB Group

### Description of Project

The following sample code projects are provided with this application note.

Sample code project for RE01 1500KB group : r01an5154\_re\_qspi\_write\_program  
r01an5154\_re\_qspi\_xip\_LLCode

Sample code project for RE01 256KB group : r01an5153\_re\_qspi\_write\_LLCode\_256kb  
r01an5154\_re\_qspi\_xip\_LLCode\_256kb

The r01an5154\_re\_qspi\_write\_program and the r01an5154\_re\_qspi\_xip\_LLCode project have been tested using the Evaluation Kit RE01 1500KB. This project is configured to match the settings of R7F0E015D2CFB mounted on the Evaluation Kit RE01 1500KB.

The r01an5153\_re\_qspi\_write\_LLCode\_256kb and the r01an5154\_re\_qspi\_xip\_LLCode\_256kb project have been tested using the Evaluation Kit RE01 256KB. This project is configured to match the settings of R7F0E01182CFP mounted on the Evaluation Kit RE01 256KB.

When using another device, change the device settings in the project to those of the target device.

### Contents

1. Specifications .....	2
1.1 Sample Code Information.....	3
1.2 Linker file settings.....	5
2. Modification of Evaluation Kit RE01 256KB.....	6
Revision History .....	7

## 1. Specifications

This sample code includes two projects. The contents of each project are shown below.

Project Name	Description
r01an5154_re_qspi_write_program r01an5154_re_qspi_write_program_256kb	This project uses the direct communication mode of the QSPI function to write the program to the external flash memory (MX25R6435F) on the Evaluation Kit. The program to be written to the external flash is located in the ".qspi_flash_data" section. Refer to "1.2Linker file settings" for the ".qspi_flash_data" section definition.
r01an5154_re_qspi_xip_LLCode r01an5154_re_qspi_xip_LLCode_256kb	This project uses the XIP mode of the QSPI to execute a function in the external flash memory (MX25R6435F) on the Evaluation Kit. Be sure to use this project after writing a program to the external flash memory with "r01an5154_re_qspi_write_program" or "r01an5154_re_qspi_write_program_256kb".

The operation of the sample code is shown below.

[Project: r01an5154\_re\_qspi\_write\_program, r01an5154\_re\_qspi\_write\_program\_256kb]

- After reset release,the QSPI is initialized in ROM access communication mode.
- When SW2 is pressed, write the program located in the ".qspi\_flash\_data" section to the external flash memory in the direct communication mode. The following programs are located in the ".qspi\_flash\_data" section.
  - led\_operation function : Turns on and off LED0 to LED2 sequentially (For RE01 1500KB)  
: Turns on and off LED0 to LED1 sequentially (For RE01 256KB)
- led\_wait function: Wait for LED lighting interval
- Perform verification. If the data written to the external flash memory matches the program in the ".qspi\_flash\_data" section, turn on LED0; otherwise, turn on LED1.

[Project: r01an5154\_re\_qspi\_xip\_LLCode, r01an5154\_re\_qspi\_xip\_LLCode\_256kb]

- After reset release, QSPI is initialized in ROM access communication mode.
- Transit to XIP mode and execute the function on the external flash memory. Functions on the external flash memory turn on and off LED0 to LED2 (For RE01 256KB, LED0 and LED1) sequentially.

**Note:** RE01 256KB Group To operate with the Evaluation Kit RE01 256KB, which is the target board for the sample code, the modification described in "2 Modification of Evaluation Kit RE01 256KB" is required.

## 1.1 Sample Code Information

**Table 1-1. Sample Code Information For RE01 1500KB Group**

Item	Description	Remarks
Peripheral Function	QSPI	Fast read Quad I/O 16MHz
Interrupt	IRQ4	SW2
Pins	P602(QSPCLK) P601(QSSL) P500(QIO0) P015(QIO1) P014(QIO2) P013(QIO3) P508(IRQ4) P009(LED0) P008(LED1) P007(LED2)	SCLK CS SI/SIO0 SO/SIO1 WP/SIO2 RESET/SIO3 SW2 input
Environment (IDE, Compiler)	IDE: IAR Embedded Workbench for ARM Version 8.40.2 C compiler : IAR C/C++ Compiler for ARM Version 8.40.2	
	IDE: Renesas e <sup>2</sup> studio Version 7.6.0 C Compiler : GCC ARM Embedded Version 6.3.1.20170620GNU 6-2017-q2-update	
Target Board	Evaluation Kit RE01 1500KB (RTK70E015DSXXXXBE)	
External flash memory	MX25R6435F (included in Evaluation Kit)	QuadEnable mode HighPerformance mode
I/O header Version	Rev1.10	-
Sample code Version	Rev1.02	-

**Table 1-2. Sample Code Information For RE01 256KB Group**

Item	Description	Remarks
Peripheral Function	QSPI	Fast read Quad I/O 16MHz
Interrupt	IRQ4	SW2
Pins	P812(QSPCLK) P807 (QSSL) P811(QIO0) P810 (QIO1) P809(QIO2) P808(QIO3) P508(IRQ4) P210(LED0) P410(LED1)	SCLK CS SI/SIO0 SO/SIO1 WP/SIO2 RESET/SIO3 SW2 input
Environment (IDE, Compiler)	IDE: IAR Embedded Workbench for ARM Version 8.40.2 C compiler : IAR C/C++ Compiler for ARM Version 8.40.2	
	IDE: Renesas e <sup>2</sup> studio 2020-07 C Compiler : GCC ARM Embedded Version 6.3.1.20170620GNU 6-2017-q2-update	
Target Board	Evaluation Kit RE01 256KB (RTK70E0118CXXXXXBJ)	
External flash memory	MX25R6435F (included in Evaluation Kit)	QuadEnable mode HighPerformance mode
I/O header Version	Rev1.00	-
Sample code Version	Rev1.03	-

## 1.2 Linker file settings

"r01an5154\_re\_qspi\_write\_program" and "r01an5154\_re\_qspi\_write\_program\_256kb" In the project, place the program to be written to the external flash memory in the ".qspi\_flash\_data" section. Therefore, the linker file is modified. Figure 1.1 shows the modified contents of the linker file with the GCC compiler and Figure 1.2 with the IAR compiler.

```
SECTIONS
{
    . . .
    __qspi_flash_data_start = .;
    KEEP(*(.qspi_flash_data))
    __qspi_flash_data_end = .;
    . . .
} > FLASH = 0xFF
```

Figure 1.1 Linker file changes (GCC compiler: RE01\_1500KB.ld, RE01\_256kbKB.ld)

```
place in IROM_region { readonly, section .ramfunc_init, block .ramobj_init,
section .ramdata_init, section .ehc_ramfunc_init , section .qspi_flash_data};
```

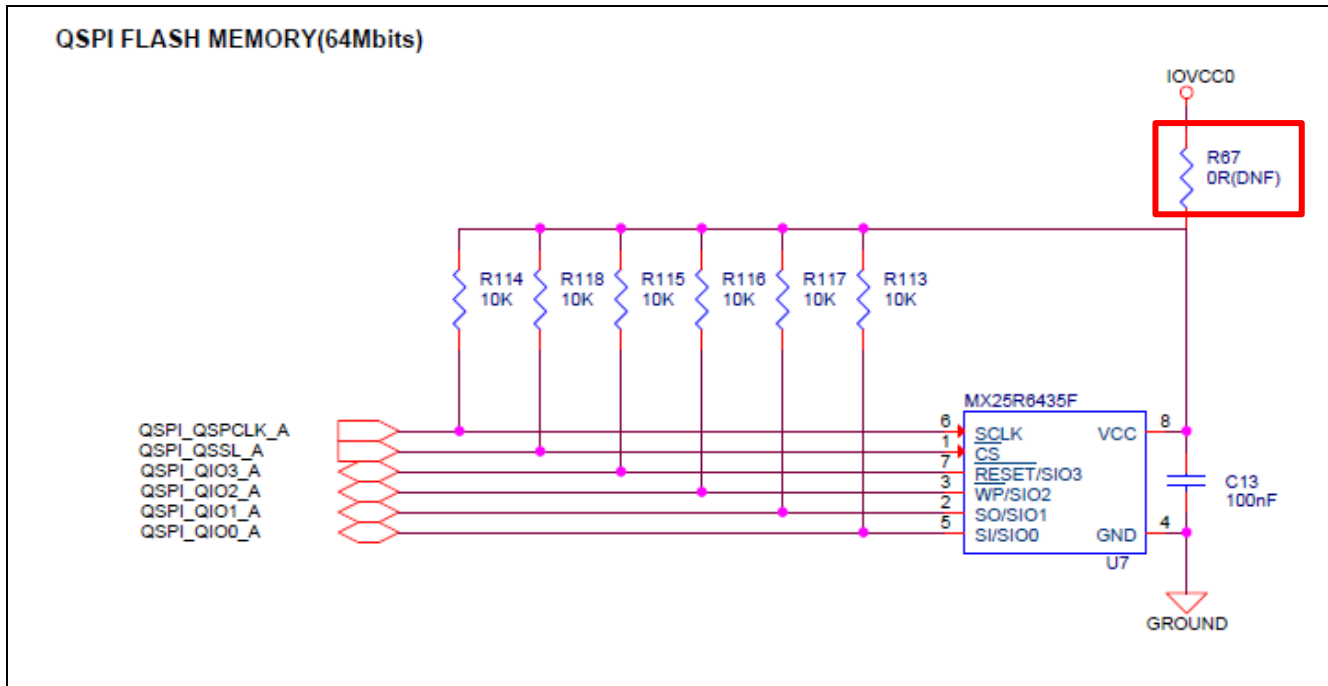
Figure 1.2 Linker file changes (IAR compiler: RE01\_1500KB.icf, RE01\_256kbKB.icf)

## 2. Modification of Evaluation Kit RE01 256KB

With the default settings of the Evaluation Kit RE01 256KB mainboard, the Flash memory (MX25R6435F) cannot be used. When using the flash memory included in the board, a 0Ω resistor is used on R67 of the main board as shown in Table 3. For details, refer to the user's manual: Evaluation Kit RE01 256KB main board layout.

**Table 3. Evaluation Kit RE01 256KB main board modifications**

Modification point	Detail
R67	Solder a 0Ω resistor to R67



**Figure 2.1 Schematic diagram of Evaluation Kit RE01 256KB main board (R67 part)**

**Revision History**

Rev.	Date	Description	
		Page	Summary
1.00	Dec.26.2019	-	First edition issued
1.02	Mar.19.2020	- Program	Add RE01 256KB group. Change to start operation by SW2 input during initial operation. Replaced CMSIS Driver Package - RE01 1500KB: CMSIS Driver Package Rev.1.10 - RE01 256KB: CMSIS Driver Package Rev.0.80
1.03	Jun.01.2020	1 4 1,6  Program (256KB)	Change the name of the sample code project Updated " Sample Code Information " Added the description of the modification of Evaluation Kit RE01 256KB. Replaced CMSIS Driver Package - RE01 256KB: CMSIS Driver Package Rev.1.00

# 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.



## 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 depends 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.

(Rev.4.0-1 November 2017)

## Corporate Headquarters

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

## Trademarks

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

## 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/](http://www.renesas.com/contact/).