

Renesas Synergy[™] Platform

Access to External Flash Memory in Renesas Synergy[™] Development Environments

Introduction

This document uses sample projects to describe the procedures for downloading data to the external flash memory and erasing and programming the external flash memory through the execution of a program at debugger start-up. It shows the procedure using the development kit, DK-S7G2 with the Renesas Synergy[™] e² studio Integrated Solution Development Environment (hereafter referred to as the e² studio) or the IAR Embedded Workbench[®] for Renesas Synergy[™] (hereafter referred to as the IAR EW for Synergy). These are the standard Renesas Synergy[™] development environments.

For documents related to the Renesas Synergy[™] development environment, see Renesas Electronics Synergy website (<u>www.renesas.com/synergy/gallery</u>), and select **Support** > **Documentation**, or go to the Renesas Electronics Synergy website documentation (<u>www.renesas.com/synergy/docs</u>).

Environment

Operation was confirmed in the following environments.

- e² studio ISDE v7.3.0 or later
- Synergy Software Package (SSP) v1.6.0 or later
- IAR EW for Synergy v8.23.3 or later
- Renesas Synergy[™] Standalone Configurator (SSC) v7.3.0 or later
- SK-S7G2 or DK-S7G2 v3.1(only).
 Note: This application is not fully supported on DK-S7G2 v4.1 board.

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1. Introduction

This document describes the procedures for downloading data to the QSPI flash memory mounted as external flash memory on the DK-S7G2 board and erasing and programming the external flash memory through the execution of a program.

Figure 1 is an overview of the memory map. The 'Onboard flash area' in the figure shows the area for the external flash memory on the DK-S7G2 board.



Figure 1. Memory Map (Overview)

2. Preparation

This chapter describes how to get the QSPI sample project, modify the linker script file, and set a DIP switch.

2.1 Getting the QSPI Sample Project

The QSPI sample project, which is required for downloading data to the external flash memory and for checking the erasure and programming of the external flash memory through the execution of a program, is included among the compressed files obtained by downloading this application note.

2.2 Linker Script File

The linker script file defines the external flash memory area and section name.

In the linker script file, a 64-MB area is defined as the external flash memory. However, the external flash memory on the DK-S7G2 board has 32 MB. Modify the setting for the area in the way that suits the given development environment.



2.2.1 Modifying the Linker Script File (s7g2.1d) for the e² studio

The linker script file is stored in the following directory:

```
project\script\
```

Modify the underlined sections as shown below.

QSPI_FLASH (rx) : ORIGIN = 0x60000000, LENGTH = 0x4000000 /* 64M, Change in QSPI section below also */

Modify as follows:

QSPI_FLASH (rx) : ORIGIN = 0x60000000, LENGTH = 0x2000000 /* 32M, Change in QSPI section below also */

__qspi_region_max_size__ = <u>0x4000000;</u> /* Must be the same as defined in MEMORY above */

Modify as follows:

```
__qspi_region_max_size__ = <u>0x2000000;</u> /* Must be the same as defined in MEMORY above */
```

Store the modified linker script file in the original directory.

Note: Save the original linker script file with a different name before overwriting it. In this description, the linker script file is modified to be used with the DK-S7G2 board. If you are using another board, modify the linker script file to match the amount of external flash memory on that board.

2.2.2 Modifying the Linker Script File (s7g2.icf) for IAR EW for Synergy

The linker script file is stored in the following directory:

QSPI sample project\script

Modify the underlined section as shown below:

```
define symbol region_QSPI_end = 0x63FFFFFF;
```

```
Modify as follows:
```

define symbol region_QSPI_end = <u>0x61FFFFF;</u>

Store the modified linker script file in the original directory.

- Note: Save the original linker script file with a different name before overwriting it. In this description, the linker script file is modified to be used with the DK-S7G2 board. If you are using another board, modify the linker script file to match the amount of external flash memory on that board.
- Note: For DK-S7G2 v4.1 board, make the following changes in case you come across a download error. You can also use the backup file present in the project root directory.

Modify the underlined section as shown below:

```
place in QSPI_region { block QSPI_NON_RETENTIVE_BLOCK,
section .qspi_flash };
```

Modify as follows:

```
place in QSPI_region { block QSPI_NON_RETENTIVE_BLOCK,
rw section .qspi_flash };
```



2.3 DIP Switch Setting

The external flash memory on the DK-S7G2 board is enabled or disabled through a DIP switch setting. To use the downloading function described in this document, turn on **switch 2** (QSPI) on DIP switch block S5.



Figure 2. DIP Switch Setting

3. **QSPI Sample Project**

The QSPI sample project in the compressed files can be used with both the e^2 studio and IAR EW for Synergy.

3.1 Overview of the QSPI Sample Project

This section describes the memory map of this sample project.

The blinky() function is allocated to the range starting at 0x60000000 in the external flash memory area (this function causes LED1 and LED2 on the main board to blink on and off at one-second intervals).

The area from 0x60010000 to 0x60017fff is used for erasure and programming of the external flash memory through execution of the program.



Figure 3. Memory Map of the Project



3.2 Operation of the QSPI Sample Project

Operations of this sample project are in the following order. The results are displayed on the debugger by using the semi-hosting¹ function.

- 1. Data in the areas from 0x60000000 to 0x60000010 and from 0x60010000 to 0x60010010 are displayed in the debugger to confirm the downloading of data to the external flash memory when the debugger starts up.
- 2. Data in the areas from 0x60000000 to 0x60000010 and from 0x60010000 to 0x60010010 are again displayed in the debugger to confirm erasing of the sector in the area from 0x6001 0000 to 0x6001 7fff through execution of the program.
- 3. Data in the areas from 0x60000000 to 0x60000010 and from 0x60010000 to 0x60010010 are again displayed in the debugger to confirm the writing of 0x9999, 0x8888, 0x7777, 0x6666, and 0x5555 to the area from 0x60010000 to 0x60010010 through execution of the program.
- 4. The Blinky() function that has been downloaded to the external flash memory is executed.

3.3 Starting the QSPI Sample Project in the e² studio

The QSPI sample project for the e² studio must be imported to be used. This section describes the procedure for importing the QSPI sample project.

To skip the development walkthrough in this document and open a completed project in e² studio, refer to *Importing a Renesas Synergy Project* (r11an0023eu0121-synergy-ssp-import-guide.pdf) for instructions on importing the project into e² studio and building the project. The included Simple_QSPI_Example.zip file contains the completed project.

1. Click on the **Debugger** tab. Select **J-Link ARM** for **Debug hardware** and **R7FS7G2** for **Target Device** and click on the **Debug** button.

Create, manage, and run configurations					3	S
Image: Second Secon	Name: Simple_QSPI_Test Debug Main Debugger Debug hardware: -Link ARM GDB Settings Connection Settings Autostart local GDB server Connect to remote GDB server GDB Command: \${eclipse_home}/DebugComp/arm Enable verbose mode	Target Device: R7FS7G2 ebug Tool Settings Host name or IP address: GDB port number: ADM port number:	localhost 61234 61236	Browse	Variables)	×
Filter matched 9 of 11 items			Apply		Re <u>v</u> ert	

Figure 4. Specifying the Debugger



 $^{^{1}}$ The semi-hosting function used by this sample project displays the result of the <code>printf()</code> function on a debugger.

2. After the debugger starts up, open blinky.c and confirm that the blinky() function has been allocated to the external flash memory area.



Figure 5. Allocation of the Blinky() Function (in the e² studio)

3. Check the data in address 0x60010000 in the **Memory** view. For details on using the **Memory** view, refer to section 3.3.2.



Figure 6. Displaying Data from the External Flash Memory in the Memory View

4. Set a breakpoint at the point where the blinky() function is called from hal_entry.c.



Figure 7. Setting a Breakpoint

- 5. When the program is executed, it stops at the breakpoint that has been set in step 6. Check erasure and programming of the external flash memory. For the results to expect from erasure and programming of the external flash memory, see section 3.3.2.
- 6. When the program is made to start running again, the blinky() function downloaded to the external flash memory area is executed to cause LED1 and LED2 on the board to blink on and off at one-second intervals.



3.3.1 Checking Data in the External Flash Memory

Use the **Memory** view to check the data in the external flash memory. This section describes the procedure for checking the data in the external flash memory by using the **Memory** view.

 Select the Window > Show View > Memory or Window > Show View > Other... > Debug > Memory menu item.



Figure 8. Setting the Display of the Memory View

2. Clicking on the + button shows the **Monitor Memory** dialog box. Enter **0x60010000** and check the displayed data from memory.

Console Memory X Monitors	
	×
Enter address or expression to monitor: 0x60010000 	
OK Cancel	

Figure 9. Setting the Memory View

Data has been written to address 0x60010000 as shown in Figure 10.

Monitors	🕂 🗶 🖗	0x60010000 : 0x60010	0000 <hex int<="" th=""><th>teger> 🛛</th><th>🕂 New Rende</th><th>erings</th></hex>	teger> 🛛	🕂 New Rende	erings
0x60010000		Address	0 - 3	4 - 7	8 - B	C - F
		000000060010000	00009999	00008888	00007777	00006666
		000000060010010	00005555	FFFFFFF	FFFFFFFF	FFFFFFF
		000000060010020	FFFFFFF	FFFFFFF	FFFFFFF	FFFFFFF
		000000060010030	FFFFFFF	FFFFFFF	FFFFFFF	FFFFFFF
		000000060010040	FFFFFFF	FFFFFFF	FFFFFFF	FFFFFFFF

Figure 10. Checking the Data in the External Flash Memory



Note: The SEGGER JTAG debugger normally caches the memory area that corresponds to the external QSPI flash device. This caching improves performance by also preventing real-time changes to the QSPI flash device from being visible in this memory window. To view changes to this memory in real-time, we added the following two lines to the Simple_QSPI_Example Debug.jlink file in the source project:

[FLASH] CacheExcludeSize = 0x800000 CacheExcludeAddr = 0x60010000

3.3.2 Checking Erasure and Programming of the External Flash Memory

The code for the erasure and programming of the external flash memory is in the hal_entry() function, which is in the hal_entry.c source file. The semi-hosting function is used to display the results in the **Renesas Debug Virtual Console** view of the debugger. To show the **Renesas Debug Virtual Console** view, select **Renesas Debug Virtual Console** by clicking on the button to open a console while the **Console** view is being displayed.

🗐 Console 🛛 🗻 Memory	
Simple_QSPI_Test Debug [Renesas GDB	Hardware Debugging] C:/Renesas/e2_studio_5_0_0_043_offic 💶 頂 Renesas Debug Virtual Console
Reset_Handler () at/synergy/ssp, 60 {	/src/bsp/cmsis/Device/RENESAS/S762/Source/startup_S 2 C/C++ Build Console 3 New Console View

Figure 11. Showing the Renesas Debug Virtual Console View

The results of execution are displayed as shown in Figure 12.

📮 Console 🙁 🗻 Memory
Renesas Debug Virtual Console
Simple QSPI example
QSPI memory after Jlink programming
0x60000000: 0xb088b580 0x60010000: 0x00000000
0x60000004: 0xf44faf00 0x60010004: 0x00000011
0x60000008: 0x617b737a 0x60010008: 0x00000022
0x600000c: 0x613b2302 0x6001000c: 0x00000033
0x60000010: 0x693b697a 0x60010010: 0x00000000
QSPI memory after sector erase
0x60000000: 0xb088b580 0x60010000: 0xffffffff
0x60000004: 0xf44faf00 0x60010004: 0xffffffff
0x60000008: 0x617b737a 0x60010008: 0xfffffff
0x600000c: 0x613b2302 0x6001000c: 0xffffffff
0x60000010: 0x693b697a 0x60010010: 0xffffffff
QSPI memory after page program
0x60000000: 0xb088b580 0x60010000: 0x00009999
0x60000004: 0xf44faf00 0x60010004: 0x00008888
0x60000008: 0x617b737a 0x60010008: 0x00007777
0x6000000c: 0x613b2302 0x6001000c: 0x00006666
0x60000010: 0x693b697a 0x60010010: 0x00005555
Calling Blinky

Figure 12. Results Shown by Executing the Debug Virtual Console



3.4 Starting the QSPI Sample Project in the IAR EW for Synergy

The QSPI sample project for IAR EW for Synergy can be used by opening a workspace. This section describes how to open a workspace.

1. Select the **File > Open Workspace** menu and open a workspace. Specify QSPI_Example.eww as the workspace from among the QSPI sample project files that have been decompressed.



Figure 13. Opening a Workspace

2. The QSPI sample project has now been registered in the workspace. Open the Renesas Synergy[™] Standalone Configurator (SSC) and set up a configuration. To set up a configuration, right-click on the Synergy icon under the project tree and select **Open Renesas Synergy Configurator...** or click on the **Synergy Configuration** icon. If you are starting the SSC for the first time, you will be required to set the directories where the SSC and SSP have been installed, and the full path to the license file.

🔀 Simple_QSPI_Example - IAR Embedded Workbench IDE	🍬 🕼 🚳 📴 🗟 👷 🤌 🌛
File Edit View Project Tools Window Help	
D 🖨 🖬 🛃 🐰 🖻 💼 🗠 여	
Workspace ×	
Debug	
Files 😤 📴	
🗆 🗇 Simple_QS 🗸	
Bynerod Synerod Open Renesas Synergy Configurator	
Renesas Synergy Settings	
Options	

Figure 14. Starting the SSC



Specify the directory where the SSC is installed, the full path to the license file, and click on the **OK** button to complete the setting.

Renesas Synergy Settings	×
Location where Renesas Synergy SSC/SSP is installed: C:\Renesas\Synergy\SSC_v5_4_0_023 ~	
License file: C:\Renesas\Synergy\SSC_v5_4_0_023\internal\projectgen\arm\Licenses\SSP_License_Exar <>	
License information:	
CUSTOMER INFORMATION: Company: Renessas Electronics America Inc. UserName: Renessas Synergy E valuation User Email: noreply@renesas.com	^
LICENSE INFORMATION: Issued: 29/06/2016	
SUPPORTED COMPONENTS: Component: Synergy BSP Permissions: Source=yes,Edit=yes,Save=yes,View=yes,Compile=yes	~
Replace encrypted files with decrypted files OK Cance	el

Figure 15. Setting the Directory where the SSC is Installed and the Path to the License File

3. Open the SSC as described in step 2 and generate a project. After the project has been generated, click on the **x** button in the upper right corner of the window to close the window. If the window remains open, control is not returned to IAR EW for Synergy.

e2 studio												×
Run Renesas Views Search												
🤹 💋 🖏 🗸 🖋 🕶 ฎ 👻 🖓 🗸 🏷												
	- E	1 5	Pack	age			0	•	· 🛛 🏢	- Ab	• -	· 🗆
Summary	Generate Project Content)								9 10 /LO VCL		12 *
This editor allows you to modify the Synergy project setting	gs stored in the configuration file (configuration.xml).		-							/LO VSS		
BSP										904 VSS		
+ Allows board and device selection			D VCC	VSS	P113 P30	15 P306	5 F307	P308	P910	903 VCC	P204	PH2
 + The board type is optional + Board properties can be modified in the Properties view 			E P610	P611	P115 P11	14 P914	P915	P908	P909 P	900 731	P414	971
			P614	P612	P613 P60	18 P300	P905	P907	R55 (314 9710	9712	VSS USB
Clocks + Allows configuration of the clock generation circuit			G P813	PA15	PASA PEO	09 PA11	2 PA11	PADB	P615	206 9713	9 PB07	VSS USB
+ Allows conlightation of the clock generation circuit			H VCL	VSS	VCC PAG	09 PA10	PA02	PA13	P913	600 P80	4 P806	vc _
Pins			3 PAD7	PADS	PAOS PAO	DH PAOS	3 PA01	PADO	P703 F	405 7754	P802	PBC
+ Allows editing of the projects pin configuration and set u	qt		× 2605	P604	P603 P10	17 P607	P606	P808	1909 F	515 P40-	F702	PBC
Threads			P602	P601	P600 1910	6 P811	P812	VCC	VSS P	007 P003	e vss	vc
 + Allows configuring of threads within a Synergy project + Synergy modules and objects can be added to individual 	l threads		_				_	_		014 P010		
+ Properties of each thread, module and object can be me										VSS0 P01:		
Messaging			-	<u></u>						REFL POOR		
+ Allows configuration of the messaging framework										0 REFH P009		
ICU										9 10		12
+ Allows configuration of interrupts		-										
Summary BSP Clocks Pins Threads Messaging ICU Com	ponents	-							_			*

Figure 16. Generating a Project and Ending SSC Operation



When control is returned to IAR EW for Synergy, build the project. To build the project, press the F7 key
or select Project > Make.

File Edit View	Add Group
Debug Files ☐ ⑦ Simple_Q: ☐ ◎ Synergy ☐ ◎ Output	rgy
	Options Alt+F7 Version Control System Make F7 Compile Ctrl+F7 Rebuild All

Figure 17. Building the Project

3.4.1 Starting and Checking the Debugger

To start the debugger, select **Project > Download and Debug** or click on the **Download and Debug** icon.



Figure 18. Starting the Debugger



1. When the debugger is started, select **View > Disassembly** to open the **Disassembly** window. By entering 'blinky' in the **Go to** text box in the **Disassembly** window and pressing the **Enter** key, you can confirm that the blinky() function has been allocated to the external flash memory area.



Figure 19. Allocation of the blinky() Function in the IAR EW for Synergy

Check the data in address 0x60010000 in the Memory window. Display the Memory window by selecting View > Memory. By entering 0x60010000 in the Go to text box in the Memory window, you can check the data at those locations in the external flash memory.

* Go to	0x6001	10000	• M	lemory		•		1	m			
6000)ffc0	00 00 0	0 00	00 00	00 (00 00	00 0	00 0	0 00	00 00	0 00	
		00 00 0	0 00	00 00	00 (00 0	00 0	00 0	00 00	00 0		
6000	lffel	00 00 0	0 00	00 00	00 (00 0	00 0	00 0	00 00	00 0	0 00	
		<u>on nn n</u>	0 00	00 00	00	00 0	1 00	00 0	0 00	00 0	0 00	and the second second second second
	LOOOO 👖	00 00 0	0 00	11 00	00 (00 2	2 00	00 0	0 33	00 0	0 00	" 3
	L0010	<u> </u>	0 00	00 00	00	00 0	J UU	UU (0 00	00 0	0 00	
6001	10020	00 00 0	0 00	00 00	00 (00 01	00 0	00 0	10 ff	ff f:	f ff	
E 6001	10030	ff ff f	f ff	ff ff	ff	ff f	f ff	ff f	f ff	ff f:	f ff	
6001	L0040	ff ff f	f ff	ff ff	ff	ff f:	f ff	ff f	f ff	ff f:	f ff	
6001	L0050	ff ff f	f ff	ff ff	ff	ff f:	f ff	ff f	f ff	ff f:	fff	

Figure 20. Displaying the External Flash Memory Area in the Memory Window

- 3. To use the semi-hosting function to check the results of executing the program, use the **Terminal I/O** window. Select **View** > **Terminal I/O** to open the **Terminal I/O** window.
- 4. Set a breakpoint at the point where the blinky() function is called from hal_entry.c.



Figure 21. Setting a Breakpoint



5. While the program executes up to the breakpoint, the data in the external flash memory are displayed in the **Terminal I/O** window. A break then occurs at the breakpoint that was set in step 4. The data is displayed in the **Terminal I/O** window as shown in Figure 22 by using the semi-hosting function.

Simple QSPI example QSPI memory after Jlink programming 0x60000000: 0xf000f8df 0x60010000: 0x00000001 0x60000008: 0xf000f8df 0x60010008: 0x00000022 0x60000000: 0x000037cd 0x6001000c: 0x00000000 QSPI memory after sector erase 0x60000000: 0xf000f8df 0x60010000: 0xffffffff 0x60000008: 0xf000f8df 0x60010008: 0xffffffff 0x60000008: 0xf000f8df 0x60010008: 0xffffffff 0x60000000: 0xf000f8df 0x60010000: 0xffffffff 0x60000001: 0xb083b5f0 0x60010010: 0xffffffff 0x60000001: 0xb083b5f0 0x60010000: 0xffffffff 0x60000001: 0xb083b5f0 0x60010000: 0x00009999 0x60000001: 0xf000f8df 0x60010000: 0x00009999 0x60000004: 0x0000301d 0x60010004: 0x00008888 0x60000004: 0x0000301d 0x60010004: 0x00008888 0x60000004: 0x000037cd 0x60010008: 0x00007777 0x6000000c: 0x00037cd 0x60010000: 0x00005555 Calling Blinky Input: Ctil codes Input Mode
Input: [Input Mode]

Figure 22. Display in the Terminal I/O Window

6. When continuous execution of the program resumes, the blinky() function downloaded to the external flash memory area is executed to cause LED1 and LED2 on the board to blink on and off at one-second intervals.



Website and Support

Visit the following vanity URLs to learn about key elements of the Synergy Platform, download components and related documentation, and get support.

Synergy Software	www.renesas.com/synergy/software			
Synergy Software Package	www.renesas.com/synergy/ssp			
Software add-ons	www.renesas.com/synergy/addons			
Software glossary	www.renesas.com/synergy/softwareglossary			
Development tools	www.renesas.com/synergy/tools			
Synergy Hardware	www.renesas.com/synergy/hardware			
Microcontrollers	www.renesas.com/synergy/mcus			
MCU glossary	www.renesas.com/synergy/mcuglossary			
Parametric search	www.renesas.com/synergy/parametric			
Kits	www.renesas.com/synergy/kits			
Synergy Solutions Gallery www.renesas.com/synergy/solutionsgallery				
Partner projects	www.renesas.com/synergy/partnerprojects			
Application projects	www.renesas.com/synergy/applicationprojects			
Self-service support resources:				
Documentation	www.renesas.com/synergy/docs			
Knowledgebase	www.renesas.com/synergy/knowledgebase			
Forums	www.renesas.com/synergy/forum			
Forums Training	www.renesas.com/synergy/forum www.renesas.com/synergy/training			



Revision History

		Description	
Rev.	Date	Page	Summary
1.00	Mar.28.17	-	Initial version
1.01	Aug.24.17	-	Updated to SSP v1.3.0
1.02	Sep.27.17	1	Environment of SSP version changed
1.03	Jan.19.18	-	Updated for SSP v1.4.0
1.04	May.07.19	-	Added note for DK-S7G2 v4.1. Updated for SSP v1.6.0.



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