

Renesas e² studio v2021-10 or higher User's Manual: Quick Start Guide

Renesas Synergy[™]

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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 at the time when power is supplied at the time when power is supplied at 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 pullup 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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1. Overview

Renesas e² studio is the Integrated Development Environment for Renesas Synergy[™] microcontrollers. e² studio is based on the industry-standard open-source Eclipse IDE framework and the C/C++ Development Tooling (CDT) project, covering build (editor, compiler, and linker control) and debug phases with an extended GNU Debug (GDB) interface support.

The e² studio ISDE (Integrated Solution Development Environment) provides support for the Renesas Synergy[™] Software Package (SSP), including Frameworks, Hardware Abstraction Layer (HAL) drivers, and Board Support Package (BSP) drivers for Renesas Synergy[™] projects. The SSP provides a complete driver library for developing Renesas Synergy[™] applications in the e² studio.

The e² studio IDE includes multiple Graphical User Interface (GUI) wizards for auto-generating code, including configuring existing drivers, configuring build and debug options, and running the applications you create. Driver documentation is integrated in the form of tooltips, which are available in the code editor view.

Renesas Synergy[™] support is included in release 4.1 and higher of the Renesas e² studio. Multiple views and editors are available to specifically support Renesas Synergy[™] ARM[®] Cortex[®]-M-based microcontrollers and the open-source GNU ARM toolchain.

The Renesas Synergy[™]-specific add-ons provide easy-to-navigate wizards for configuring hardware and for managing the extensive Renesas Synergy[™] software library.

Note: "Azure RTOS ThreadX" is described in ThreadX. "Azure RTOS TraceX" is described in TraceX.



Figure 1-1. Renesas Synergy[™] in e² studio



Most e² studio features are common to all supported Renesas product lines. Specific to Synergy products are the GCC ARM Embedded and IAR for ARM toolchains support, the Renesas Synergy[™] Project Generator, and the Renesas Synergy[™] Configuration Editor.

Feature	Renesas Synergy™	RX / RL78 / RZ / RH
IDE framework and C/C++ support	Eclipse + CDT	Eclipse + CDT
Code-generating	Synergy Project Generator	Code Generator/Smart Configurator
tools	Synergy Configuration Editor	
Toolchain	GCC ARM Embedded	RX family (GNURX-ELF, Renesas CC-RX and IAR
	IAR toolchain for ARM	build plug-ins)
		RL family (GNURL78-ELF, Renesas CCRL and IAR build plug-ins)
		RZ family (GNUARM-NONE-EABI)
HEW/CS+ project import	Not Supported	Supported for MCUs supporting HEW/CS+ IDE
Target Debuggers	Segger J-Link	E1, E2, E2 Lite, E20, IECUBE, E10A-USB, Segger J- Link
Smart Manual tooltips	Supported (for SSP API)	Supported
Code Analysis (CODAN)	Supported	Supported
Simulator	Not Supported	Supported for selected RX and RL family devices
Debugger	GDB with trace and real-time memory access	GDB with trace and real-time memory access
RTOS	Azure RTOS ThreadX	Various operating systems
ThreadX Configuration	Supported	Not Supported
ThreadX Debug	Supported	Not Supported
Memory Usage view	Supported	Supported
Visual Expressions view	Supported	Supported

Table 1-1. e² studio Features Comparison



1.1 System Configuration

A typical system configuration includes a host machine and a target board as shown below.



Figure 1-2. System configuration

1.2 System Requirements

- Host Computer:
 - Processor: At least 2GHz (with Intel® Core™ family processor)
 - Memory capacity: At least 4GB (8GB or larger is recommended)
 - Hard disk capacity: Minimum 2 GB
 - Display:Resolution at least 1,024 x 768; at least 65,536 colors
 - Interface: USB 2.0 (High-speed/Full-speed). High-speed is recommended.
- Operating System:

The following operating systems on the host computer are supported: Windows 8.1 (64-bit OS) and Windows 10 (64-bit OS).

1.3 Supported Toolchains

GNU ARM® compiler (version: GCC v9.2.1 and GCC v7.2.1)

Note: IAR Embedded Workbench for Synergy is no longer available for download from renesas.com. Contact IAR for access to the Embedded Workbench for Synergy. Licenses for EWSYN are issued by IAR, users can find additional information on licensing Embedded Workbench for Synergy and request a new or updated license key from IAR.

1.4 Supported Emulator Device

Segger J-Link.

1.5 Outline of a Synergy Project Development

This document provides detailed instructions on how to start developing with Renesas Synergy[™]. The main steps are outlined below. By understanding the main steps below, readers can relate better to the procedures described in Chapter 3 and Chapter 4.

- 1. Generating a Synergy project
- 2. Configuring the Synergy project to fit hardware specifications such as clock, ICU, pin functions
- 3. Configuring the Azure RTOS ThreadX
- 4. Configuring the BSP (selecting HAL driver models)
- 5. Adding user code



- 6. Building the project
- 7. Configuring the debugger and launching debugging

2. Installation

The development tools can be installed using either the Platform Installer or Standalone Installer.

The latest version of installer package can be downloaded from the Solutions Gallery of the Synergy Platform website <u>https://www.renesas.com/products/synergy.html</u>.

2.1 Installing with the Platform Installer

The Platform Installer includes the Synergy Software Package (SSP), e² studio ISDE, GCC ARM embedded compiler and J-Link Drivers. To download and install the Platform Installer, follow the steps below:

 Visit the Solutions Gallery of the <u>Synergy Platform</u> website. Select **Download SSP** under **Synergy** Software-> Synergy Software Package (SSP) to go to the SSP page. Select **Download** under Synergy Download to log in to your My Renesas account and then download the platform installer.

DOWNLOAD PLATFORM INSTALLER
Download Standalone Installer

Figure 2-1. Installation – Download the Platform Installer

2. Select e² studio as the development environment.

×Select a Development Environment Select which development environment to include with your download e2studio

Figure 2-2. Installation – Select e² studio Development Environment



Click I AGREE in the License Agreement, and the installation file (for example, setup_ssp<version>_e2s_<version >.zip) will be downloaded.

License Agreement	×
	^
SSP Evaluation License Agreement	
This SSP Evaluation License Agreement ("Agreement") is between you (the entity on whose behalf you are entering into this Agreemer or, if there is no such entity, you as an individual) ("You" or "Your") and Renesas Electronics Corporation ("Renesas"). YOU SHOULD READ THIS AGREEMENT CAREFULLY, AS IT CONSTITUTES A BINDING CONTRACT BETWEEN YOU AND RENESAS.	ıt
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By clicking on the "Laccent" button or other button or mechanism designed to acknowledge agreement to the terms of an electronic	·

Figure 2-3. Installation – Accept the License Agreement

- 3. Unzip and run the installation file.
- 4. In the Select Install Type page, if users would like to customize the components to be installed, choose "Custom Install" then click Next.



Renesas Synergy[™] Platform

We recommend that new users select the **Quick Install** option to minimize the configuration steps. This option will install e² studio, SSP and GCC ARM Embedded by default. If a user selects **Quick Install**, step (1) will not be shown.

🗟 Renesas Synergy Softwa	are Package (SSP) v2.2.0 with e ²	studio 2021-10 Setup		_		×			
Renesas Synergy Software Package (SSP) v2.2.0 with e ² studio 2021-10 Setup									
Install Type									
	Custom Install	of e ² studio, SSP & GC of e ² studio, SSP & GC							
<u>v202201061248</u>	User: All Users	< <u>B</u> ack	<u>N</u> ext >	<u>I</u> nstall	Cance	ł			

Figure 2-4. Installation – Select Install Type



1. In the welcome page, you may use the default folder or change it by clicking **Change...**. Click **Next** to continue.



Figure 2-5. Installation – Welcome Page



- 2. If you specify a custom installation, configure the settings from Figure 2-11 to Figure 2-13
- 3. Tick the checkbox to accept the license agreement, and click **Install** to continue.

Renesas Synergy So Renesas Synergy Sof	ftware Package (SSP) v2.2.0 with e 'tware Package (SSP) v2.2.0 w Please read and accept the follo	ith e ² studio 2021-10 Setup	× 5
Eicenses Shortcuts Installing Results	Renesas e2 studio OpenJDK License Agreemen ARM DS-5 Toolchain Integra GNU ARM Embedded 9.2.1 2	License Terms and Conditions for RENESAS e2 studio This Renesas e2 studio license agreement ("Agreement") is between the entity on whose behalf you are entering into this Agreement ("Client") and Renesas Electronics Corporation, a Japanese company with its registered office at 3-2-24, Toyosu, Koto-ku, Tokyo 135-0061, Japan ("Renesas"). YOU SHOULD READ THIS AGREEMENT CAREFULLY, AS IT CONSTITUTES A BINDING CONTRACT BETWEEN CLIENT AND RENESAS. The Renesas IDE Software (defined below) is intended for commercial use by a company or corporation only and is not designed, developed or produced for any private use or purpose. If you are an individual, or you intend to install the Renesas IDE Software on behalf of an individual, or the Renesas IDE Software is expected to be used for a private purpose directly or indirectly, you should click "No" on the installer. Otherwise, by clicking the "I accept" button or other button or mechanism designed to acknowledge agreement to the terms of an electronic copy of this Agreement, or by installing, accessing, or otherwise copying or using all or any portion of the Renesas IDE Software van accent this Agreement on behalf of the entity for which ftware Agreements Print.	*
<u>v202201061248</u>	User: All Users	< <u>B</u> ack <u>N</u> ext > <u>I</u> nstall Cancel	

Figure 2-6. Installation – Software Agreements



4. Click **OK** to finish the installation.

	oftware Package (SSP) v2.2.0 with e ² studio 2021-10 Setup
Welcome	Installation of Renesas Synergy Software Package (SSP) v2.2.0 with e ² studio 2021-10 is complete.
Licenses	Please click OK to close.
Shortcuts Installing Results	☐ Launch e2 studio? ☑ View Release Notes? ☑ View What's New? ☑ View Renesas SSP User Manual?
	Useful Links: <u>Get Azure RTOS TraceX</u> <u>Get Azure RTOS GUIX Studio</u> <u>Renesas SSP: C:¥Renesas¥Synergy¥e2studio v2021-10 ssp-v2.2.0</u> <u>Renesas SSP User Manual: C:¥Renesas¥Synergy¥e2studio v2021-10 ssp-v2.2.0</u> <u>GCC ARM Embedded: C:¥Renesas¥Synergy¥e2studio v2021-10 ssp-v2.2.0¥toolchains¥gcc arm¥9 2019q4</u>

Figure 2-7. Installation – Complete Installation

2.2 Installing e² studio and SSP Independently

This section describes installation of the following components independently.

- e² studio IDE
- GCC ARM Embedded Compiler
- Renesas Synergy Software Package (SSP)



2.2.1 Installing e² studio

To install e² studio for Synergy, follow these steps:

- 1. Download the offline installer for e² studio (64-bit version) of the version compatible with your SSP from https://www.renesas.com/e2studio.
- 2. Unzip the download file and run the e² studio installer to invoke the e² studio installation wizard page.
- 3. If e² studio was installed in your PC, the options to modify, remove the existing version, and install e² studio to a different location will be shown. It is possible to install multiple versions of e² studio by selecting **Install** to a different location. Click the **Next** button to continue.



Figure 2-8. Install Multiple Versions of e² Studio



4. In the Welcome page, the default installation location is set to: C:\Renesas\e2_studio. You can click Change... to modify it. Click the Next button to continue.

🔜 Renesas e² studio 2021-10	Setup	— 🗆	×
Renesas e ² studio 2021-10	Setup	RENESA	S
Welcome Device Families Extra Features Customise Features Additional	Install directory ready Install Location: C:¥Renesas¥e2 [Change] Prerequisite software already inst		^
Software Licenses Shortcuts	Internet connection available Change Proxy Settings		
Summary Installing Results	Ready to install Software to install: • Renesas e2 studio v21.10.0.1 • Java Runtime v11.0.0 • IAR Plugin Manager v1.10.2	202007251457	¥
<u>v202109161450</u>	User: All Users < <u>B</u> ack	<u>N</u> ext > <u>I</u> nstall Cano	el :

Figure 2-9 Installation – Welcome Page

5. Device Families page:

Check the checkbox for **Renesas Synergy**. Checkboxes of other device families are optional. Click the Next button to continue.

🔜 Renesas e² studio 2021-10 Setup	— 🗆 X
Renesas e ² studio 2021-10 Setup Select the device families you wish to install support for	RENESAS
Welcome	RA Build, Debug & Code Generation support for Renesas RA devices RZ
Extra Features Customise Features	Build, Debug & Code Generation support for Renesas RZ devices
Additional Software	RL78 Build, Debug & Code Generation support for Renesas RL78 devices
Shortcuts	RX Build, Debug & Code Generation support for Renesas RX devices
Summary Installing Results	RH850 Debug support for Renesas RH850 devices
RE	RE Build & Debug support for Renesas RE devices
	Synergy Build, Debug & Code Generation support for Renesas Synergy devices
Select All	
v202109161450 User: All Users	< <u>B</u> ack <u>N</u> ext > Install Cancel

Figure 2-10. Installation – Device Families

6. Extra Features page:

Select **Extra Features** (that is, Language support, Git Integration, RTOS support, and so on) to install. For non-English language users, select the language to support at this step.

Click the **Next** button to continue.

Renesas e ² studio 2021-10 Renesas e ² studio 2021-10 Select the extra features you) Setup	11	
Welcome Device Families		P	Japanese Language Support
Extra Features			Chinese (Simplified) Language Support
Features Additional Software			Chinese (Traditional) Language Support
Licenses Shortcuts		P	Git Integration Git SCM Support
Summary Installing Results		P	Terminals ANSI/vt102 compatible Terminal support for Serial, ssh and Telnet
			RTOS FreeRTOS & OpenRTOS Debug Support
	Select A	11	•
<u>v202109161450</u>	User: All Use	ers	< <u>B</u> ack <u>N</u> ext > Install Cancel

Figure 2-11. Installation – Extra Features Page



7. Customize Features page:

Ensure that Renesas RA Family Support is checked.

Click the Next button to continue.



Figure 2-12. Installation – Components

5. Additional Software

Check the checkbox for the latest version of GCC ARM Embedded in the Additional Software dialog (for example GNU ARM Embedded 9.2.1 or GNU ARM Embedded 7.2). The older versions are optional. Click the **Next** button to continue.



🗟 Renesas e² studio 2021-1	0 Setup	_		×
Renesas e ² studio 2021-1 Select the additional softwar		NES	57	S
Welcome	Renesas QE (0) Renesas Toolchains & Utilities (0) GCC Toolchains &	Utilities (2)		
Device Families Extra Features Customise Features	GNU ARM Embedded GNU ARM Embedded 9.2.1 2019q4 GNU ARM Embedded 9.2.1 2019q4 Download size: 94.0 MB			*
Additional Software Licenses Shortcuts Summary	GNU ARM Embedded 7.2 2017q4 7.2.0.2017q4 GNU ARM Embedded 7.2 2017q4 Download size: 82.5 MB			
Installing Results		176.6 MB do	wnload re	equired
<u>v202109161450</u>	User: All Users < <u>B</u> ack <u>N</u> ext >	<u>I</u> nstall	Cance	2

Figure 2-13. Installation – Additional Software

6. Licenses

Read and accept the software license agreement to proceed with the **Next** button.

Please note that users must accept the license agreement, otherwise installation cannot proceed.

7. Shortcuts

Select the shortcut name for the start menu and click Next button to continue.

8. Summary

Click the **Install** button to install Renesas e² studio.

9. Installing...

The installation will start. Depending on the items selected in the **Additionak Software** dialog, new dialogs may open to proceed with the installation of these software packages.

2.2.2 Setting Up the GNU ARM Compiler

The GNU ARM toolchain can be installed during e² studio installation. To install the GNU ARM compiler separately, follow these steps:

- Download the latest version of the GNU ARM compiler supported by Renesas Synergy[™] (for example, v9.2.1) from <u>https://developer.arm.com/tools-and-software/open-source-software/developer-tools/gnu-toolchain/gnu-rm/downloads</u>
- 2. Run the installer to install the GNU ARM compiler on the host machine.
- 3. Select the installation language. Click **Yes** in the installation confirmation dialog.
- 4. Keep all default settings in the installation wizard.

5. When the **Install wizard Complete** dialog appears, check the box **Add path to environment variable**. Click **Finish** to complete the installation.

2.2.3 Installing the Renesas Synergy[™] Software Package (SSP)

The e² studio installer does NOT include the Renesas Synergy[™] Software Package (SSP). The SSP must be installed separately unless the Platform Installer is used. The SSP Package Installer includes the driver library, an evaluation license for SSP, HTML User's Manual, and a readme file.

To install the SSP, follow these steps:

- 1. Visit the Solutions Gallery of the Synergy Platform website.
- Select Download SSP under Synergy Software-> Synergy Software Package (SSP) to go to the SSP page.
- 3. Select **Download** under **Synergy Download** to log in to your My Renesas account and then download the standalone installer.
- 4. In the Synergy Software Package page, select **Download Standalone Installer** to download the file SSP_Distribution_<SSP-version>.zip. (You must sign in to My Renesas account to enable the '**Download Standalone Installer**' option)

The release note and User Manual of SSP can also be downloaded from the Synergy Software Package page.

ynergy Download	
SSP 2.2.0	DOWNLOAD PLATFORM INSTALLER
2.2.0	Download Standalone Installer
Current Public Release	
発売日:2022-01-31	
MCUs Supported: S7G2, S3A7, S124, S3A3, S128, S5D9, S5D5, S5D3,	
S3A6, S3A1, S1JA	
MD5: d1fb8dee4d0ff0f52646cef4af16e995	
What's New?	
SSP v2.2.0 is a minor release with new stack updates, enhancements ar	ad quality improvements

Figure 2-14. Installation – Download the standalone SSP package



×

- 1. Make sure that a compatible e^2 studio was installed and closed during this installation.
- 2. Unzip the package and run the SSP_Distribution_<SSP-version>.exe installer.
- 3. Click Next on the installation wizard dialog.
- 4. Read the License Agreement and click I Agree to continue the installation process.

License Agreement

SSP Evaluation License Agreement

This SSP Evaluation License Agreement ("**Agreement**") is between you (the entity on whose behalf you are entering into this Agreement or, if there is no such entity, you as an individual) ("**You**" or "**Your**") and Renesas Electronics Corporation ("**Renesas**"). YOU SHOULD READ THIS AGREEMENT CAREFULLY, AS IT CONSTITUTES A BINDING CONTRACT BETWEEN YOU AND RENESAS.

Pursuant to this Agreement, Renesas is willing to provide You with the Program (defined below) solely for Your own internal business testing and evaluation purposes in a non-production capacity, as set forth below. If You wish to obtain a development and production license or obtain other rights to the Program, please contact Your Renesas representative or visit the Renesas Synergy Gallery website (located at synergygallery.renesas.com/) for more information.

By clicking on the "I accept" button or other button or mechanism designed to acknowledge agreement to the terms of an electronic copy of this Agreement, or by downloading, installing, accessing, or otherwise copying or using all or any portion of the Program, (a) you accept this Agreement on behalf of the entity for which you are authorized to act (e.g., an

I AGREE

CANCEL

Figure 2-15. Installation - License Agreement on Renesas Web



Install the SSP in the root folder (default root folder is C:\Renesas\e2_studio) of e² studio. The default installation folder for the SSP is C:\Renesas\e2_studio. Click Install to start the installation.

😚 Renesas Synergy Software	e Package Setup			_		×
RENESAS Synergy	Choose SSP Ins Choose the folder SSC (2021-10) is	r where the com	npatible e2 s	studio (2	2021-10)	or
Setup will install Renesas Sy dick Browse and select a dif					ent folde	r,
C:¥Renesas¥e2_studio¥e2	_studio2021-10		I	Browse		
Mulleoft Testall Sustan v2 06 1						
Nullsoft Install System v3.06.1		< <u>B</u> ack	<u>I</u> nstall		Cance	el

Figure 2-16. Installation – SSP Installation Folder Selection

6. Click the **Close** button to close the installation wizard when installation is done. After the SSP is installed, the evaluation license file can be found in the directory <e2_studio_base_dir>/internal/projectgen/arm/licenses/.

2.3 Uninstalling e² studio

Users can uninstall e² studio by following typical steps to uninstall a program in the Windows OS.

- 1. Click on Start \rightarrow Control Panel \rightarrow Programs and Features
- 2. From the currently installed programs list, choose e² studio and click the Uninstall button.
- 3. Click **Uninstall** to confirm the deletion in the Uninstall dialog.

At the end of the uninstallation, e² studio will be deleted from the installed location and the Windows shortcut menu is removed.



3. Project Generation

This chapter describes the creation of a new Synergy project. The e² studio includes a wizard to help create a new Synergy project quickly. This is achieved by the ability of the wizard to match the project to a particular Synergy device and board.

The project generator can set up the pin configurations, interrupts, clock configurations and even the necessary driver software.

As a prerequisite, the SSP and the toolchain must be installed on the host machine as described in chapter 2.

3.1 Generating a New Synergy Project

e² studio provides a simple wizard for creating projects. You can create a new Synergy project by specifying the project name, corresponding devices and boards, project type, output object type, and project template.

Start the e² studio application and choose a workspace folder in the Workspace Launcher. To configure a new Synergy project, follow these steps:

1. Select File \rightarrow New \rightarrow Synergy C/C++ Project.

<u>F</u> ile	<u>E</u> dit	<u>N</u> avigate	Se <u>a</u> rch	<u>P</u> roject	Renesas <u>V</u> iews	<u>R</u> un	<u>W</u> indow	<u>H</u> elp	
	New				Alt+Shift+N		Renesas (C/C++ Project	>
	Open	File				Jananus	Synergy (C/C++ Project	
È,	Open	Projects fro	m File Sy	stem			Project		
	Recen	it Files			:	' 🗗	Example.		
		Editor			Ctrl+W		Other		Ctrl+N
	Close	All Editors			Ctrl+Shift+W				
	Save				Ctrl+S				
	Save A	As				5147	C/C++	project	

Figure 3-1. Project Generation – New Project Creation



2. Select the Renesas Synergy C Executable Project template. Click Next to continue.



Figure 3-2. Project Generation – Select executable project template

- 3. In the device selection dialog, enter device and tool information:
 - Board (for example, S7G2 SK)
 - Toolchain version: Latest GNU compiler approved for use with Renesas Synergy[™] (for example, GCC ARM Embedded 9.2.1.20191025)

Note: IAR Embedded Workbench for Synergy is no longer available for download from renesas.com. Contact IAR for access to the Embedded Workbench for Synergy. Licenses for EWSYN are issued by IAR, users can find additional information on licensing Embedded Workbench for Synergy and request a new or updated license key from <u>IAR</u>.

- Keep all other fields as default.
- Click **Next** to continue.



🧧 e2 studio - Pro	oject Configuration (Synergy C Executable	Project)	— 🗆 X
	ect Configuration (Synergy C Execu upport that you require.	table Project)	
Device Selection SSP version: Board: Device:		Board Details	
Select Tools Toolchain: Toolchain vers Debugger:	GNU ARM Embedded 9.2.1.20191025 J-Link ARM	~	Available Tools GNU ARM Embedded 10.3.1.20210824 9.3.1.20200408 9.2.1.20191025 7.2.1.20170904 6.3.1.20170620 Debuggers J-Link ARM RTOS Express Logic ThreadX Smart Manual IO Registers Supported Software Manual Supported
?	< <u>B</u>	ack <u>N</u> ext	:> <u>F</u> inish Cancel

Figure 3-3. Project Generation – Device Selection



4. In the project template dialog, select a project template, Blinky. Click the **Finish** button to create a new project.

	pe of project you wish to create.		
Project Te	mplate Selection		
0	BSP Base Board Support Package for the chosen Synergy family. [Renesas.Synergy.2.2.0.pack]		
•	Blinky Blinky project. [Renesas.Synergy.2.2.0.pack]		
0	Blinky with ThreadX Threaded version of Blinky project. [Renesas.Synergy.2.2.0.pack]		
	eration Settings		

Figure 3-4. Project Generation – Project Template

5. You may be prompted to open the Synergy Configuration perspective. Click Yes to open the perspective.(In Eclipse, a 'perspective' is a predetermined arrangement of panes and views).
e² studio creates a new project with various views, among them are the Project Explorer view, the Synergy Project Configuration editor, and the Package view.

Project Explorer 🛛 📄 🔄	□ ∰ [Synergy] Synergy Configuration ☆		👩 Package 🗙	Q € ▼
✓ [j_5] Synergy > jill includes > 2€ src	Summary	Generate Project Content		^ ^
> 😕 synergy > 🗁 script	Project Summary	Renesas Synergy™ ∧	-	
> >> ynergy_cfg @configuration.xml R75752713400CfCpincfg 5ynergy Debug.launch	Board: S7G2 SK Device: R7FS7G27H3A01CFC Toolchain: GCC ARM Embedded Toolchain Version: 9.2.1.20191025 SSP Version: 2.2.0	S7G2	P400 221 P401 222 P402 223 P402 223 P403 224 P404 225 P405 226	
> ⑦ Developer Assistance	Selected software components	Configuration Editor	P406 22 7 P700 22 8 P701 22 9 P702 22 10 P703 22 11	
Project Explorer View	SSP Common Code Clock Generation Circuit: Provides=[CGC] Event Link Controller: Provides=[ELC] Factory MCU Information Module: Provides=[f I/O Port: Provides=[IO Port]	v2.20 v2.20 v2.20 v2.20 v2.20 v2.20 v2.20	P704 22 12 P705 22 13 P705 22 13 P706 22 14 P707 22 15 P800 22 15 P801 22 17 V8ATT 18	Package View
	Yulue Research Support	220	VCL0 13 XCIN 20 XCOUT 22 VSS 22 P213 22 23 VCC 23 AVCCUSBHS 35	R7F57G27xxxxxxxFC 176LQFP (Top View)
🔲 Properties 🛛 🖹 問題 🍑 スマート・ブラウザー		🖇 🖶 🛄 Pin Conflicts 📮 Console 🔋 Memory Usage 🔀		> > > > > > > > > > > > > >

Figure 3-5. Project Generation – New Project Creation View



3.2 Importing an Existing Synergy Project

To import an existing Synergy Project, please follow the steps below:

1. Click **File** \rightarrow **Import...**

New Alt+Shift+N > Open File Open Projects from File System Recent Files > Close Editor Ctrl+W Close All Editors Ctrl+Shift+W Save Ctrl+S Save All Ctrl+Shift+S Revert Move Rename Rename F2 Refresh F5 Convert Line Delimiters To > Print Ctrl+P Import Export
Open Projects from File System Recent Files Close Editor Ctrl+W Close All Editors Ctrl+Shift+W Save Ctrl+Shift+S Save All Ctrl+Shift+S Revert Ctrl+Shift+S Move F2 Refresh F5 Convert Line Delimiters To > Print Ctrl+P
Close Editor Ctrl+W Close All Editors Ctrl+Shift+W Save Ctrl+S Save All Ctrl+Shift+S Revert Ctrl+Shift+S Move Rename Refresh F5 Convert Line Delimiters To Print Ctrl+P
Close All Editors Ctrl+Shift+W Save Ctrl+S Save All Ctrl+Shift+S Revert Ctrl+Shift+S Move F2 Refresh F5 Convert Line Delimiters To > Print Ctrl+P
Save Ctrl+S Save As Ctrl+Shift+S Revert Move Rename F2 Refresh F5 Convert Line Delimiters To > Print Ctrl+P
Save As Save All Ctrl+Shift+S Revert Move Rename F2 Refresh F5 Convert Line Delimiters To Print Ctrl+P Total Instance Instanc
Image: Save All Ctrl+Shift+S Revert Move Rename F2 Refresh F5 Convert Line Delimiters To Print Ctrl+P Import
Revert Move Rename F2 Refresh F5 Convert Line Delimiters To Print Ctrl+P Import
Move Rename F2 Refresh F5 Convert Line Delimiters To Print Ctrl+P Total Import
Rename F2 Refresh F5 Convert Line Delimiters To > Print Ctrl+P Import
Refresh F5 Convert Line Delimiters To > ▶ Print Ctrl+P ▶
Convert Line Delimiters To > Print Ctrl+P Import
Print Ctrl+P
📐 Import
🗠 Export
Properties Alt+Enter
Switch Workspace >
Restart
Exit

Figure 3-6. Import project



 In the Import dialog, select General → Existing Projects into Workspace. Click Next. Note: To rename the project to be imported, select General → Rename & Import Existing Projects into Workspace instead.



Figure 3-7. Select type of import



3. In the **Import Projects** dialog, select **Select archive file:** then **Browse...** to browse to the compressed file (.zip) containing the project.

If the existing project is stored in a folder, then **Select root directory:** should be selected.

4. Select the project to import and click **Finish**.

💽 Impo	ort					×
Import F Select a c	Projects directory to search for exist	ing Eclipse projects.				7
Select	t roo <u>t</u> directory: t <u>a</u> rchive file: D:¥Work!	Space¥		¥Synergy.zip ∨	B <u>r</u> owse B <u>r</u> owse	_
Projects:	: Synergy (Synergy/)				<u>S</u> elect Al <u>D</u> eselect A R <u>e</u> fresh	dl
	ns rc <u>h</u> for nested projects by projects into workspace se newly imported projects le projects that already exist					
	ng sets Id projec <u>t</u> to working sets ing sets:			~	Ne <u>w</u> S <u>e</u> lect	
?		< <u>B</u> ack	<u>N</u> ext >	<u> </u>	Cancel	

Figure 3-8. Select the project in the compressed file

5. The project will be imported to e^2 studio.

	Project Explorer 🛛	
~	📂 Synergy	
	> 劑 Includes	
	> 📇 src	
	> 🗁 script	
	🌼 configuration.xml	
	R7FS7G27H3A01CFC.pincfg	
	S7G2-SK.pincfg	
	🧾 Synergy Debug.launch	
	> 🕐 Developer Assistance	

Figure 3-9. The imported project

3.3 Generating and Using a Synergy Static Library

This section describes how to generate a Synergy static library project and an executable project that references to the library project.



3.3.1 Creating the Static Library Project

The following steps show an example of how to create a Synergy static library project:

- 1. Select File \rightarrow New \rightarrow Synergy C/C++ Project.
- 2. Select the Renesas Synergy C Library Project template. Click Next to continue.



Figure 3-10. Project Generation – Select library project template



3. In the **Device and Tool Selection** dialog, select the same device and toolchain as your executable project and click **Next**.

 e2 studio - Project Configuration (Synergy C Library Project) e2 studio - Project Configuration (Synergy C Library Project) Select the board support that you require. 	
Device Selection SSP version: 2.2.0 Board Details Board: S7G2 SK Device: R7FS7G27H3A01CFC	
Select Tools Toolchain: GNU ARM Embedded Toolchain version: 9.2.1.20191025	Available Tools GNU ARM Embedded 10.3.1.20210824 9.3.1.20200408 9.2.1.20191025 7.2.1.20170904 6.3.1.20170620 Debuggers J-Link ARM RTOS Express Logic ThreadX Smart Manual IO Registers Supported Software Manual Supported
? < <u>Back</u> <u>N</u> ex	t > Einish Cancel

Figure 3-11. Select device and toolchain



4. In the project template dialog, select Blinky, then click Finish to create the project.

Select the type of project you wish to create.	
Project Template Selection	
 BSP Base Board Support Package for the chosen Synergy family. [Renesas.Synergy.2.2.0.pack] Blinky Blinky project. [Renesas.Synergy.2.2.0.pack] Blinky with ThreadX Threaded version of Blinky project. [Renesas.Synergy.2.2.0.pack] 	
Code Generation Settings	

Figure 3-12. Select project template for library



- 5. The e² studio may prompt user to switch to Synergy perspective. Click **Yes** to open it.
- 6. Click Generate Project Content.

Summary		Generate Project Cont	ent
Project Summary	'	Renesas Synergy™	^
Board:	S7G2 SK		
Device:	R7FS7G27H3A01CFC	5762	
Toolchain:	GCC ARM Embedded	OTGE	
Toolchain Version:	9.2.1.20191025		
SSP Version:	2.2.0		
Selected software co	omponents		
SSP Common Coo	le	v2.2.0	
Clock Generation	Circuit: Provides=[CGC]	v2.2.0	
Event Link Control	ler: Provides=[ELC]	v2.2.0	
Factory MCU Infor	mation Module: Provides=[FMI]	v2.2.0	
I/O Port: Provides=	[IO Port]	v2.2.0	
S7G2_SK Board S	upport Files	v2.2.0	
Board support pac	kage for R7FS7G27H3A01CFC	v2.2.0	
Board support pac	kage for S7G2	v2.2.0	
Board support pac	kage for S7G2	v2.2.0	
Simple application	that blinks an LED. No RTOS included	v2.2.0	~
You Tube Gallery	Support		

Figure 3-13. Generate library project content



7. From the project explorer window, open hal_entry.c under SynergyLib\src\.

2	⊕ * Copyright [2015-2021] <u>Renesas</u> Electronics Corporation and/or its
20	<pre> * File Name : hal_entry.c. </pre>
23	
24	<pre>#include "hal_data.h"</pre>
25	
27	* @brief Blinky example application.
33	<pre> ovoid hal_entry(void) { </pre>
34	
35	/* Define the units to be used with the software delay function
36	<pre>const bsp_delay_units_t bsp_delay_units = BSP_DELAY_UNITS_MILLI.</pre>
37	<pre>/* Set the blink frequency (must be <= bsp_delay_units */</pre>
38	<pre>const uint32_t freq_in_hz = 2;</pre>
39	<pre>/* Calculate the delay in terms of bsp_delay_units */</pre>
40	<pre>const uint32_t delay = bsp_delay_units/freq_in_hz;</pre>
41	/* LED type structure */
42	<pre>bsp_leds_t leds;</pre>
43	/* LED state variable */

Figure 3-14. Old "hal_entry.c"

8. Then rename the function ${\tt hal_entry()}$ to ${\tt hal_entry_lib()}$ and add a declaration for ${\tt hal_entry_lib()}.$

(Synergy)	Lib] Synergy Configuration 🔂 *hal_entry.c 🗙	
2	● * Copyright [2015-2021] Renesas Electronics Corporatio	n ar
20	⊕ * File Name : hal entry.c.	
23		
24	<pre>#include "hal_data.h"</pre>	
25		
26	<pre>void hal_entry_lib();</pre>	
28	* Mbriet Blinky example application.	
34	<pre>void hal entry lib(void) {</pre>	
34 35 36		
36	/* Define the units to be used with the software de	lay
37	const bsp delay units t bsp delay units = BSP DELAY	
38	<pre>/* Set the blink frequency (must be <= bsp_delay_un</pre>	its
39	<pre>const uint32 t freq in hz = 2;</pre>	
40	/* Calculate the delay in terms of bsp delay units	*/
41	<pre>const uint32_t delay = bsp_delay_units/freq_in_hz;</pre>	
40 41 42	/* LED type structure */	
43	bsp_leds_t leds;	
	14 Ten T. 111 4/	

Figure 3-15. New "hal_entry.c"



9. Build the Library Project. The build outputs a static library file SynergyLib\Debug\libSynergyLib.a.



Figure 3-16. The built static library

3.3.2 Using Static Library in Executable Project

This chapter shows how to use the static library created in the previous chapter (3.3.1) in a Synergy executable project by performing the following steps,

- Create a Synergy executable project
- Modify the source code to call a function (hal_entry_lib()) declared in the static library project
- Modify the build settings to add the static library
- Build the Synergy executable project



Follow the following steps:

1. Create an executable project with template Renesas Synergy C Project Using Synergy Library.



Figure 3-17. Select template for executable project using Synergy library


2. Name the project synergyapp.

0 –		×
C application project to use a Synergy library project		\$
Creates a C application project which uses an existing Synergy library project		-
Project name		
synergyapp		
Use <u>d</u> efault location		
Location: C:¥WorkSpace_for_Synergy¥ws_2021-10_SSP220¥synergyapp	Browse	B
Choose file s <u>y</u> stem: default ~		
Toolchains		
GNU ARM Embedded		
9.2.1.20191025		
Debugger		
J-Link ARM 🗸		
? < <u>B</u> ack <u>Next</u> > <u>F</u> inish	Cancel	

Figure 3-18. Specify project name



3. Select the library project. Click **Finish** to create the project.

Capplication project to use a Synergy library project Creates a C application project which uses an existing Synergy library project Synergy library Select Synergy library project: Synergy library project: Include paths for library access Configuration: S{workspace_loc:/SynergyLib/src/synergy.gen} S{workspace_loc:/SynergyLib/src? S{workspace_loc:/SynergyLib/srcpilib/srnergy/ssp/inc/bsp/cmsis/Include} S{workspace_loc:/SynergyLib/synergy/ssp/inc/bsp} S{workspace_loc:/SynergyLib/synergy/ssp/inc/bsp} S{workspace_loc:/SynergyLib/synergy/ssp/inc/driver/instances} S{workspace_loc:/SynergyLib/synergy/ssp/inc/driver/instances} S{workspace_loc:/SynergyLib/synergy_cfg/ssp_cfg/bsp} S{workspace_loc:/SynergyLib/synergy_cfg/ssp_cfg/driver} Linker script Select Linker script to use: script/r7fs7g27h3a01cfc.ld	Creates a C application project which uses an existing Synergy library project Synergy library Select Synergy library project: SynergyLib Include paths for library access Configuration: Debug S{workspace_loc:/SynergyLib/src/synergy_gen} S{workspace_loc:/SynergyLib/src} S{workspace_loc:/SynergyLib/synergy/ssp/inc/bsp/cmsis/Include} S{workspace_loc:/SynergyLib/synergy/ssp/inc/bsp/cmsis/Include} S{workspace_loc:/SynergyLib/synergy/ssp/inc/bsp/cmsis/Include} S{workspace_loc:/SynergyLib/synergy/ssp/inc/driver/api} S{workspace_loc:/SynergyLib/synergy/ssp/inc/driver/instances} S{workspace_loc:/SynergyLib/synergy/ssp/inc/driver/instances} S{workspace_loc:/SynergyLib/synergy_cfg/ssp_cfg/bsp} S{workspace_loc:/SynergyLib/synergy_cfg/ssp_cfg/driver} Linker script	Creates a C application project which uses an existing Synergy library project Synergy library Select Synergy library project: SynergyLib Include paths for library access Configuration: Debug S{workspace_loc:/SynergyLib/src/synergy_gen} S{workspace_loc:/SynergyLib/src} S{workspace_loc:/SynergyLib/synergy/ssp/inc/bsp/cmsis/Include} S{workspace_loc:/SynergyLib/synergy/ssp/inc/bsp/cmsis/Include} S{workspace_loc:/SynergyLib/synergy/ssp/inc/bsp/cmsis/Include} S{workspace_loc:/SynergyLib/synergy/ssp/inc/driver/api} S{workspace_loc:/SynergyLib/synergy/ssp/inc/driver/instances} S{workspace_loc:/SynergyLib/synergy/ssp/inc/driver/instances} S{workspace_loc:/SynergyLib/synergy_cfg/ssp_cfg/bsp} S{workspace_loc:/SynergyLib/synergy_cfg/ssp_cfg/driver} Linker script	Creates a C application project which uses an existing Synergy library project Synergy library Select Synergy library project: SynergyLib Include paths for library access Configuration: Debug S{workspace_loc:/SynergyLib/src/synergy_gen} S{workspace_loc:/SynergyLib/src} S{workspace_loc:/SynergyLib/synergy/ssp/inc/bsp/cmsis/Include} S{workspace_loc:/SynergyLib/synergy/ssp/inc/bsp/cmsis/Include} S{workspace_loc:/SynergyLib/synergy/ssp/inc/bsp/cmsis/Include} S{workspace_loc:/SynergyLib/synergy/ssp/inc/driver/api} S{workspace_loc:/SynergyLib/synergy/ssp/inc/driver/instances} S{workspace_loc:/SynergyLib/synergy/ssp/inc/driver/instances} S{workspace_loc:/SynergyLib/synergy_cfg/ssp_cfg/bsp} S{workspace_loc:/SynergyLib/synergy_cfg/ssp_cfg/driver} Linker script	—		×
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Figure 3-19. Select the library project

4. After the executable project is created, from project explorer window, open hal_entry.c under synergyapp\src\.



Figure 3-20. Old hal_entry.c



5. Add codes to call the LED blinking library function $hal_entry_lib()$ in the $hal_entry()$ function and add a declaration for the library function.



Figure 3-21. New hal_entry.c

- 6. Build the application project.
- 7. Set a breakpoint where the library function hal_entry_lib() is called. Run the synergyapp project.
- 8. When the program stops at the breakpoint, resume it. Confirm that the library function which blinks the LEDs (for example, hal_entry_lib()) is executed.

 ✓ P synergya ✓ P Threa → ha → ma → arm-non 	□ I → 8 Debug [Renesas GDB Hardware Debugging] pp.elf [1] [cores: 0] d #1 1 (single core) [core: 0] (Suspended : Breakpoint) I_entry() at hal_entry.c:9 0x2b34 sin() at main.c:5 0x2ade e-eabi-gdb (7.8.2) GDB server (Host)		(x)= Variables • Breakpoints 🛛 🛋 Module:
<		>	
.c hal_entry.c	ic hal_entry.c ☆ ic main.c »2		Project Explorer 🔀
1 2 3 4 5 6 7 8 8 9 00002b34 10	<pre>/* HAL-only entry function */ #include "hal_data.h" extern void hal_entry_lib(); void hal_entry(void) { /* TODO: add your own code here */ hal_entry_lib(); }</pre>		 Synergyapp Similaries Includes Debug Debug script src Ind_entry.c synergyapp Debug.jlink

Figure 3-22. Application project executing library function

3.4 Synergy Project Configuration Editor

The Synergy Project Configuration editor view displays the current project configuration settings. The settings are saved in the file configuration.xml. The project configuration settings are grouped into multiple pages that allow you to set several configurable aspects of the project, such as how pins and clocks are set up and which drivers are included. Drivers can range from simple hardware-level drivers to RTOS aware applications. Multi-thread specific components like mutexes, semaphores, and events can be configured.



To edit the project configuration, make sure that:

- Synergy Configuration perspective is selected in the upper right-hand corner of the e² studio window or click Window → Perspective → Open Perspective → Other... → Synergy Configuration
- The configuration.xml file is opened.



Figure 3-23. Synergy Project Configuration – Synergy Project Configuration View

There are 7 pages (or tabs) in the Synergy Project Configuration editor.

The **Summary** page contains a project-specific summary information.

The **BSP** tab allows users to select the SSP version, the type of Synergy board, and the device.

The configuration steps and options for the **Clocks**, **Pins**, **Threads**, **Messaging**, and **Components** pages are discussed in the following chapters.



3.4.1 Summary Page

The **Summary** page contains a project-specific summary which includes details of the currently selected device, board, and Synergy software components, and so on. There are also useful links to the Synergy Platform website, the 'Renesas Presents' YouTube channel, and the SSP user manual.

If a user adds new threads and modules/objects to a thread, this information will be also shown in the **Summary** page.



Figure 3-24. Summary Page

3.4.2 BSP Page

The **BSP** tab allows the user to select the SSP version, board, and device. The user can also import the CMSIS pack from this page.



Figure 3-25. Synergy Project Configuration – BSP Page

3.4.3 Clocks Configuration Page

The **Clocks Configuration** page sets up the initial clocking for the application. Clock sources, PLL settings, and clock divider settings can be selected for each of the output clocks.



For details on the Clock Generation Circuit (CGC), see the Synergy hardware user's manual. To update the project, follow these steps:

1. Select a value in the drop-down list for the clock setting on the GUI.

# *[Synergy] Synergy Configuration ¤	
Clocks Configuration	Generate Project Content
	kestore Defaults
XTAL 24MHz	✓ ICLK Div /1 V → ICLK 240MHz
→ PLL Src: XTAL ✓	PCLKA Div /2 → PCLKA 120MHz
PLL Div /2 ~	→ PCLKB Div /4 → PCLKB 60MHz
PLL Mul x20.0 V	PCLKC Div /4 → PCLKC 60MHz
USBMCLK 24MHz PLL 240MHz Clock Src: PLL	→ PCLKD Div /2 → PCLKD 120MHz
HOCO 20MHz Clock Src: HOCO Clock Src: MOCO Clock Src: LOCO	SDCLKout On \checkmark SDCLKout 120MHz
LOCO 32768Hz Clock Src: XTAL	→ BCLK Div /2 → BCLK 120MHz
MOCO 8MHz Clock Src: SUBCLI Clock Src: PLL	$BCK/2 \longrightarrow BCLKout 60MHz$
SUBCLK 32768Hz	→UCLK Div /5 → UCLK 48MHz
	> FCLK Div /4 \sim \rightarrow FCLK 60MHz
Summary BSP Clocks Pins Threads Messaging Components	

Figure 3-26. Synergy Project Configuration – Clocks Configuration

- 2. Save the Project Configuration Settings, for example by using the Ctrl-S shortcut.
- 3. Click the Generate Project Content button Generate Project Content.
- 4. The file <code>bsp_clock_cfg.h</code> is updated with the selected clock configuration.

Project Explorer 🛛 📄 🛱 🍸 🖇		ck_cfg.h 🗙
>		ion header file - do not edit */
> 📋 S7_SK_guix_audio_player	2 ⊖ #ifndef BSP_CLOCK_CFG_H	
✓ 📂 Synergy [Debug]	3 #define BSP_CLOCK_CFG_H	
> 🐰 Binaries		(24000000) /* XTAL 24000000Hz */
> 🔊 Includes		RCE (CGC_CLOCK_MAIN_OSC) /* PLL Src: XTAL */
		EQUENCY (2) /* HOCO 20MHz */
> 🚰 src		(CGC_PLL_DIV_2) /* PLL Div /2 */
> 🔁 synergy		(20.0) /* PLL Mul x20.0 */
> 🗁 Debug		OURCE (CGC_CLOCK_PLL) /* Clock Src: PLL */
> 🗁 script		(CGC_SYS_CLOCK_DIV_1) /* ICLK Div /1 */ V (CGC_SYS_CLOCK_DIV_2) /* PCLKA Div /2 */
✓ → synergy_cfg		V (CGC_SYS_CLOCK_DIV_2) /* PCLKA DIV /2 //
✓ ➢ ssp_cfg		V (CGC SYS CLOCK DIV 4) /* PCLKC Div /4 */
		V (CGC SYS CLOCK DIV 2) /* PCLKD Div /2 */
V 🗁 bsp		UTPUT (1) /* SDCLKout On */
bsp_board_cfg.h		(CGC SYS CLOCK DIV 2) /* BCLK Div /2 */
.c bsp_cfg.h	17 #define BSP_CFG_BCLK_OU	
bsp_clock_cfg.h		(CGC USB CLOCK DIV 5) /* UCLK Div /5 */
bsp_irq_cfg.h		(CGC_SYS_CLOCK_DIV_4) /* FCLK Div /4 */
bsp_mcu_device_cfg.h	20 #endif /* BSP_CLOCK_CFG	_H_ */
bsp_mcu_device_pn_cfg.h	21	





3.4.4 Pins Configuration Page

The **Pins Configuration** page provides a graphical user interface for generating the pin configuration settings for the project.

Pins Configuration		Senerate Project Content
Select pin configuration S7G2-DK.pincfg	(1) ✓ Generate data: g_bsp_pin_cfg	Pins Tutorial 🏂 🔻 🗐
Pin Selection type filter text	Pin Configuration	ſ
 Ports Peripherals 	(3)	
Summary BSP Clocks Pins	Threads Messaging Components	

Figure 3-28. Synergy Project Configuration – Pins Configuration GUI

The Pin Configuration window consists of 3 parts:

- 1. Select **Pin Configuration**: Selects pin-configuration file and specifies the name for the associated data structure. Multiple pin configurations can be set as follows:
 - a. Create a new .pincfg file (for example, NewName.pincfg) in **Project Explorer** by copying an existing one.
 - b. Select the new .pincfg file (for example, NewName.pincfg) in the Select Pin Configuration dialog box.
 - c. Check the **Generate data** checkbox and give the new pin configuration a unique data structure name in the text field.
 - d. The multiple pin configurations will be created in different data structures.
- 2. Pin Selection: Selects pin or peripheral that will be set up.
- 3. Pin Configuration: Set up for function/property of the selected pin / peripheral.

Refer to the tutorial video for pin configuration on YouTube by clicking Pin Tutorial.



The best way to configure pins is to configure the peripherals to be used in the project using the steps below:

- 1. Select a peripheral in the **Pin Selection** pane, for example, **Connectivity:SCI** → **SCI1**. The configuration for this peripheral will be shown in the **Pin Configuration** pane.
- 2. Select an **Operation Mode** for the peripheral, for example, **Simple SPI**.
- 3. Select the pins you would like to use for the **Input/Output** functions of the selected peripheral in the selected mode.

Select pin configuration					Pins Tutorial 🋵 👻 💼
S7G2-SK.pincfg ~	Generate data: g_bsp_	pin_cfo	J		
Pin Selection	Pin Configuration				
type filter text					Ĩ
> 🗸 Ports 🔥	Module name:		SCI2		
✓ ✓ Peripherals	Usage:			ple I2C mode, ensure j	port pins output type is n-ch c
> Analog:ACMP > < Analog:ADC			drain. When switching	between I2C and othe	er modes, first disable.
> Analog:ANALOG			-		in model, mot ensation
> 🗸 Analog:DAC	Pin Group Selection:		Mixed	~	
> < Connectivity:CAN > < Connectivity:ETHERC	Operation Mode:		Simple SPI	~	(2)
> Connectivity:IIC	Input/Output				
✓ ✓ Connectivity:SCI ✓ SCI0	TXD:	~	P302	~	
(1) SCI1	RXD:	~	P301	~	(3)
✓ SCI2 ✓ SCI3	SCK:	~	P202	~	
SCI4	CTS:		None	~	
SCI5	SDA:		None	~	
✓ SCI6 SCI7					
✓ SCI8	SCL:		None	\sim	

Figure 3-29. Synergy Project Configuration – Pin Configuration Setting (by Peripheral)



A single pin can also be set up following the steps below:

- 1. Select a pin in the **Pin Selection** pane, for example, **Ports** → **P0** → **P003**. The configuration for this pin will be shown in the **Pin Configuration** pane.
- 2. Enter properties for this pin, for example:

*[Synergy] Synergy Configuration ☆ Pins Configuration			
guittion		Genera	te Project Content
Select pin configuration	Generate data: g_bsp_pin_cfg	Pins	Tutorial 🍃 🗕
Pin Selection Pin Configur	ration		
type filter text			s de la companya de l
 Ports Poot Poot Symbolic N Comment: 			~
✓ P003 Port Capabi	lities: ADC0: PGAVSS0		
 ✓ P004 ✓ P005 ✓ P006 ✓ Mode: 	Juration	(2)	
P007 Chip input/ ✓ P008 P003:	output	~	
P010 P014			>
ummary BSP Clocks Pins Threads Mes	saging Components		

Figure 3-30. Synergy Project Configuration – Pin Configuration Setting (by single pin)

3. The Package view shows this pin change.



Figure 3-31. Synergy Project Configuration – Package View (Connection Status)



It is possible to migrate a pin configuration from one device to another device on this page. Use the **Import a pin configuration** button on the toolbar to perform this migration. This function allows migration of the pin configuration to the new device while retaining user setup.

To import an existing pin configuration to the current project, click **Import a pin configuration** ^{IIII} and select the pin configuration file to import.

File:	💽 Impor	rt Pin Configuratior	ns from File	_	-	×
	File:					
	0	OK	Cancel	Workspace		

Figure 3-32. Import an existing pin configuration to the current project

The import function might point out conflicts and provide the following options for the user:

- 1. Cancel the import operation.
- 2. Ignore the conflicts and import the conflicting settings anyway.
- 3. Continue the import operation without importing the conflicting settings.

Note: For pin information, a .csv file is created in the project folder $\g\cfg\sp_cfg\sp_cfg\bsp$. No other information is output.



3.4.5 Threads Configuration Page

The Threads Configuration page allows users to:

- Configure threads within a Synergy project.
- Add Synergy modules and objects to a thread.
- Modify module and object properties in the Properties View.

Image: Synergy Synergy Configuration ☆ Threads Configuration			Generate Project Content
Image: Thread Sector of the	HAL/Common Stacks Image: g_elc ELC Driver on r_elc Image: g_ecgc CGC Driver on r_cgc Image: g_ecgc CGC Driver on r_cgc Image: g_ecgc CGC Driver on r_cgc Image: g_ecgc CGC Driver on r_cgc Image: g_ecgc CGC Driver on r_cgc Image: g_ecgc CGC Driver on r_cgc Image: g_ecgc CGC Driver on r_cgc Image: g_ecgc CGC Driver on r_cgc Image: g_ecgc CGC Driver on r_cgc Image: g_ecgc CGC Driver on r_cgc Image: g_ecgc CGC Driver on r_cgc Image: g_ecgc CGC Driver on r_cgc Image: g_ecgc CGC Driver on r_cgc Image: g_ecgc CGC Driver on r_cgc Image: g_ecgc CGC Driver on r_cgc Image: g_ecgc CGC Driver on r_cgc Image: g_ecgc CGC Driver on r_cgc Image: g_ecgc CGC Driver on r_cgc Image: g_ecgc CGC Driver on r_cgc Image: g_ecgc CGC Driver on r_cgc Image: g_ecgc CGC Driver on r_cgc Image: g_ecgc CGC Driver on r_cgc Image: g_ecgc CGC Driver on r_cgc Image: g_ecgc CGC Driver on r_cgc Image: g_ecgc CGC Driver on r_cgc Image: g_ecgc CGC Driver on r_cgc Image: g_ecgc CGC Driver on r_cgc Image: g_ecgc CGC Driver on r_cgc Image: g_ecgc CGC Driver on r_cgc Image: g_ecgc CGC Driver on r_cgc Image: g_ecgc CGC Driver on r_cgc Image: g_ecgc CGC Driver on r_cgc Image: g_ecgc CGC Driver on r_cgc Image: g	 New Stack : g_ioport I/O Port Driver on r_ioport i 	 Extend Stack > Remove g_fmi FMI Driver on r_fmi
Summary BSP Clocks Pins Threads Messaging Compo	onents		1 8 - 1
g_ioport I/O Port Driver on r_ioport			
Settings Property API Info Common Parameter Checking V Module g_ioport I/O Port Driver on r_iopo Name [Fixed]	rt Q_ioport (4)		

Figure 3-33. Synergy Project Configuration – Threads Configuration GUI

The Threads Configuration page consists of 3 panes:

- 1. Threads pane: Add/remove threads. More details are explained in Chapter 6.
- 2. Stacks pane: Add/remove SSP module instances, i.e. I/O port, SCI, UART, etc.
- 3. **Objects** pane: Add/remove kernel objects. More details are explained in Chapter 6.

In addition, the **Properties** view supports the **Threads Configuration** and is used to modify module/object properties.



A module can be added to the existing project following the steps below:

- 1. Select a thread, such as HAL/Common. The modules and objects in this thread are shown.
- 2. In the Stacks pane, click $\stackrel{\text{def}}{=}$ New Stack to add a module to the thread, that is, New Stack \rightarrow Driver \rightarrow Monitoring \rightarrow Clock Accuracy Circuit Driver on r_cac.
- 3. Click the **Generate Project Content** Generate Project Content button to generate the source code content.
- 4. The **Properties** view shows the properties of the selected module. Users can change them according to their requirements.



Figure 3-34. Synergy Project Configuration – Add New Module to Thread

Note: HAL/Common is not a thread. It is used to demonstrate how to add a module to the existing project in this example only. For other example, refer to chapter 6.1, General Purpose Timer Example in ThreadX. This chapter describes the procedure to add GPT module to the Blinky Thread.



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An added module (for example, UART Driver on r_sci_uart) may require dependent modules or configuration settings. Necessary dependent modules will be added automatically. Optional dependent modules are suggested to be added manually by the user. In this case, users should click on the suggested modules to add and to configure its properties.



Figure 3-35. Synergy Project Configuration – Problem of Added Module



A module or a module stack can also be added by performing a copy and paste operation in the **Threads Configuration** page. Right-click on a module and select **Copy** to copy it. Right-click in the stack pane of the same or a different thread in the same project and select **Paste**. A cut and paste operation is also available.



Figure 3-36. Copy and Paste operation



There will be a name conflict between the old module instance and the new one. Renaming one of the module instances will solve the problem.



Figure 3-37. Module Instance name conflict



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A module or a module stack can also be added by performing the export and import operation in the **Threads Configuration** page. Right-click on a module and select **Export...** to export the configuration of the module to an XML file. Right-click in the stack pane of the same or a different thread in the same project and select **Import...** to import the configuration from the exported XML file. The name conflict can be solved by renaming one of the module instances.



Figure 3-38. Export the Synergy stack



e² studio Quick Start Guide

Threads	🛃 New Thread 🔬 Remove 🛛 🥫	HAL/Common Stacks	🕢 New Stack > 🚔 Extend Stack > 🏽 🔬 Remove
* *	AL/Common g_ioport I/O Port Driver on r_ioport g_elc ELC Driver on r_elc g_fmi FMI Driver on r_fmi g_cgc CGC Driver on r_cgc g_cac0 Clock Accuracy Circuit Driver on r_ g_uart1 UART Driver on r_sci_uart q_uart0 UART Driver on r_sci_uart mon Objects New Object >		g_uart0 UART Driver on r_sci_uart Configurations Ctrl+X Ctrl+X Ctrl+V Delete
Proper	BSP Clocks Pins Threads Messaging Com ties 😫 🏦 Problems JART Driver on r_sci_uart Property > Common	 ✓ Export ✓ Export ④ Module R ● As ● As ■ ● ○ ○ ○ ○ ○ ○ ○ ○ ○ ○ ○ ○ ○ ○ ○ ○ ○ ○	> 5 12: Debug ⊠ 😑 🗆 With > 📄 🛬 i • 8
	Baud Rate Data Bits C Imp Fro Sta	g_uart1 Import ergy Stack Import port stacks from a Synergy configuration fragment on the local fil m file: D:¥tmp¥uart.xml cks:]	Browse

Figure 3-39. Import the Synergy stack

3.4.6 Messaging Configuration Page

The **Messaging Configuration** page allows the creation of event classes, events, and subscribers for use with the Synergy messaging framework.



The Messaging Configuration page consists of 3 panes:

- 1. The **Event Classes** pane shows a list of event classes that have been provided by instantiated Synergy modules or created manually.
- 2. The **Events** pane provides the events that have been provided by instantiated Synergy modules or created manually.
- 3. The **Subscribers** pane provides a list of subscribers that have been created. The checkbox alongside each subscriber entry indicates whether the subscriber will receive messages for the currently selected event class. A subscriber may be enabled/disabled to receive messages for the currently selected event class by checking/unchecking the checkbox.

Messaging Configura	ation			Ge	nerate Project Content
Event Classes	🛃 New Event Class 🔬 Remove	Subscribers		🛐 New Subs	criber 🔊 Remove
	(1)	Thread		Start	End
Events	New Event Remove (2)		(3)		
Summary BSP Clocks Pins 1	Threads Messaging Components				

Figure 3-40. Synergy Project Configuration – Messaging Configuration Page

An event class, an event, or a subscriber can be created manually by clicking on the button of the corresponding section.

e				
New Event Cla	ss			
Enter new mess	aging event class details			
Name:	Example			
Symbol:	SF_MESSAGE_EVENT_CLASS_EXAMPLE			
Payload:	example_payload			
Payload header:	example_api.h			
Payload type:	example_payload_t			
	OK Cancel			

Figure 3-41. Messaging Configuration Page – Adding a new event class

To remove the item created manually, select the item and click *ki* in the corresponding section (items added by instantiated Synergy modules cannot be removed).



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When a user selects an item, the e² studio **Properties** view displays the properties associated with the currently selected event class, event, or subscriber.

Messag	jing Configuration				Generate Project Conten
Event Cla	sses	🗿 New Event Class	👔 Remove	Example Subscribers	🛃 New Subscriber 📓 Remove
GExan	nple			Thread	Start End
Events		🗿 New Event	🔊 Remove		
Summary	BSP Clocks Pins Threads N	lessaging Components			
1	BSP Clocks Pins Threads N	lessaging Components	™ 80 □	🗇 🔀 Pin Confli 📮 Console 🚺 M	iemory 🖧 RTOS Res 🐐 Debug 🛙 🖓 🖓
Proper	ties 🔀 🖹 Problems	lessaging Components	1 8 -	🗆 🔀 Pin Confli 🚍 Console 🚺 M	lemory 2 RTOS Res 🎋 Debug 😂 🖵 E □ 😤 i i→
Proper	ties 🔀 🖹 Problems	Aessaging Components	C 8	Din Confli 🔄 Console 🚺 M	
Proper	ties 🛛 🔝 Problems	Value		Din Confli 📮 Console 🚺 M	
Proper	ties 🔀 🂽 Problems Property			Din Confli 🔄 Console 🚺 M	
Proper	ties 🛛 🂽 Problems Property Symbol	Value SF_MESSAGE_EVENT_CLASS_E3		Dir Confli 📮 Console 🚺 M	
Proper	ties 🔀 💽 Problems Property Symbol Name	Value SF_MESSAGE_EVENT_CLASS_E2 Example		Pin Confli Console M	

Figure 3-42. Messaging Properties



3.4.7 Components Configuration Page

The **Components Configuration** page enables the individual modules required by the application to be included or excluded.

Modules common to all Synergy projects are preselected (for example HAL Drivers \rightarrow all \rightarrow r_cgc).

All modules that are necessary for the drivers selected in the Threads page are included automatically. Users can include or exclude additional modules by checking the box next to the required component.

Note: The primary way of adding modules to an application is by using the **Threads** page. The **Components** page is primarily used as a list of components available in the installed SSPs.

omponents Configuratio	on		Generate Project Conter
			Filter SSP 2.2.0 V Search
omponent	Version	Description	Variant
🗸 🧳 s7g2			
✓ device	2.2.0	Board support package for R7FS7G27H3A01CFC	R7FS7G27H3A01CFC
device	2.2.0	Board support package for S7G2	
device	2.2.0	Board support package for R7FS7G27G2A01CBD	R7FS7G27G2A01CBD
device	2.2.0	Board support package for R7FS7G27G2A01CBG	R7FS7G27G2A01CBG
device	2.2.0	Board support package for R7FS7G27G2A01CLK	R7FS7G27G2A01CLK
device	2.2.0	Board support package for R7FS7G27G3A01CFB	R7FS7G27G3A01CFB
device	2.2.0	Board support package for R7FS7G27G3A01CFC	R7FS7G27G3A01CFC
device	2.2.0	Board support package for R7FS7G27G3A01CFP	R7FS7G27G3A01CFP
device	2.2.0	Board support package for R7FS7G27H2A01CBD	R7FS7G27H2A01CBD
device	2.2.0	Board support package for R7FS7G27H2A01CBG	R7FS7G27H2A01CBG
device	2.2.0	Board support package for R7FS7G27H2A01CLK	R7FS7G27H2A01CLK
device	2.2.0	Board support package for R7FS7G27H3A01CFB	R7FS7G27H3A01CFB
✓ ssp	2.2.0	Board support package for S7G2	
🗸 🔗 Common			
🗸 🖗 all			
ssp_common	2.2.0	SSP Common Code	
🔊 🛷 Express Logic			
A Framework Services			
AL Drivers			
🗸 🧳 all			
r_acmphs	2.2.0	High Speed Analog Comparator: Provides=[Comparator]	
r_acmplp	2.2.0	Low Power Analog Comparator: Provides=[Comparator]	
r_adc	2.2.0	A/D Converter: Provides=[ADC]	
r_agt	2.2.0	Asynchronous General Purpose Timer: Provides=[TIMER]	
r agt input capture	2.2.0	Asynchronous Timer Input Capture: Provides=[Input Capt	
r_analog_connect	2.2.0	Analog Connections: Provides=[Analog Connect]	
r cac	2.2.0	Clock Accuracy Check: Provides=[CAC]	
r_can	2.2.0	Controller Area Network: Provides=[CAN]	
v_cqc	2.2.0	Clock Generation Circuit: Provides=[CGC]	
	2.2.0	Cyclic Redundancy Check: Provides=[CRC]	
r ctsu	2.2.0	Capacitive Touch Sensing Unit: Provides=[CTSU] , Require	
r_ctsuv2	2.2.0	Capacitive Touch Sensing Unit: Provides=[CTSU] , Require	

Figure 3-43. Synergy Project Configuration – Components Configuration Page



3.5 Editor hover

eź	² studio	supports	hovers in textual	editor. This	function can be	enabled/disabled	via Window -	\rightarrow Preferences \rightarrow
C	/C++ →	Editor -	→ Hovers.					

Figure 3-44. Hover settings

To enable hover, check **Combined Hover**. To disable, uncheck it. This function is enabled by default.

Hover function allows the user to view detailed information about any identifiers in the source code. Hover the mouse over an identifier and check the pop-up.

# *[Synergy] Syr	ergy Configuration	🖻 hal_entry.c 🔀	
44	ioport lev	el_t level = IOPORT_LEVEL_HIGH;	^
45			
46	/* Get LED	information for this board */	
47	R_BSP_Leds	Get(&leds);	
48			
49	⊖ Name: R	BSP_LedsGet	
50			^
51 52		: ssp_err_t R_BSP_LedsGet (bsp_leds_t *p_leds)	
53	Descriptio	n:	
54			
55	Return info	ormation about the LEDs on the current board.	
56			
57			
58	Structure v	vith LED information.	
59			
60			
61			
62	Paramet	ers:	
63	Θ		
64	n leds - Po	inter to structure where LED info is stored.	
65	P_1003 - 1 0	miler to substate where LED mile is stored.	\sim
66			
67			
68	Θ		



3.6 Developer Assistance

Synergy Developer Assistance provides developers with module and API (Application Programming Interface) reference documentation in e² studio. After you have configured the threads and software stacks for a Synergy project with the Synergy Configuration Editor, Developer Assistance helps you quickly get started writing C/C++ application code for the project using the configured stack modules.

1. Expand the project explorer to view Developer Assistance.



Figure 3-46. Synergy Developer Assistance

2. Expand a stack module to show its APIs.



Figure 3-47. API information

3. Drag and drop an API from Develop Assistance to source file helps to write source code quickly.



Figure 3-48. Developer Assistance – Drag and drop an API



4. Building

This chapter describes the build configurations and key build features in e² studio.

4.1 Build Configurations

The default build option is generated when a project is created, and it can usually be used to build the project.

However, if changing build options is necessary (for example, toolchain version or optimization options), please follow the following steps before building the project.





Figure 4-1. Build – Properties for Synergy Project and main.c Source File

Build options can be accessed in the properties window of a project or a source file.

- 1. \bigcirc Set the focus at the project name or \bigcirc set the focus at the source file name.
- 2. Right-click to select **Properties** or use shortcut keys **Alt+Enter** to open the properties dialog.
- 3. Click the C/C++ Build option to view or edit the configuration settings.

The **Properties** window is supported at the project and source level. The **Properties** window for projects supports more configurations which apply across all the files within the same project.

4.2 Building a Sample Project

Follow the steps below to build the project.

- 1. In Project Explorer, click the Synergy project to bring it into focus.
- 2. Click Project \rightarrow Build Project or the 6 icon to build this project.
- 3. Confirm that there are no errors after build is finished.

<u>F</u> ile <u>E</u> dit <u>N</u> avigate Se <u>a</u> rch	<u>P</u> roj	ect Renesas <u>V</u> iews <u>R</u> un <u>W</u>	indow <u>H</u> elp			
🔦 🎋 🔳 🎋 Debu		Open Project Close Project Open Synergy Configuration		· · ◆ ↓ □ ·	- 8 6 8	• 🔨 • 🔜
Project Explorer	010	Build All Build Configurations	Ctrl+Alt+B	.€ hal_entry.c		
ゲ Gynergy [Debug] > 前 ¹ Includes		Build Project	Ctrl+B			
 Src Synergy_gen Ind_entry.c Synergy Synergy Script Synergy_cfg configuration.xml R7FS7G27H3A01CFC.pi 	e ²	Build Working Set Clean Build Automatically C/C++ Index Update All Dependencies Change Device	> Alt+D	New Event Class	Remove	Subscribers
 S7G2-SK.pincfg synergy_cfg.txt Synergy Debug.launch O Developer Assistance 	\$	C/C++ Project Settings Properties	Ctrl+Alt+P	New Event	Remove	

Figure 4-2. Build – Building a Sample Project

4.3 Saving the Build Settings Report

Project build settings in e² studio IDE can be saved to a file using the Project Reporter feature.



- 1. Right-click on the project in the **Project Explorer** view to pop up the context menu.
- 2. Select Renesas C/C++ Project Settings-Save build settings report to save the build settings report.

✓					
> 🐝 Binaries		New	>		Proje
> 🗊 Includes		Go Into			
> 🚰 src > 🔑 synergy		Open in New Window			Board
> 🔁 Debug		Show In	Alt+Shift+W >		Device
> 🗁 script	-				Toolcł Toolcł
> 🗁 synergy_cfg		Сору	Ctrl+C		SSP V
🔅 configuration.xml R7FS7G27H3A01CF	Ē	Paste	Ctrl+V		
S7G2-SK.pincfg	×	Delete	Delete		Selecte
Synergy Debug.lau		Source	>		SSF
> ⑦ Developer Assistant	¢	Move			Cloc
		Rename	F2		Eve
	è	Import			Fact
	്പ	Export			I/O I
		Renesas Synergy Export	>		S7G
		Build Project			Boa
		Clean Project			Boa Boa
	s	Refresh	F5		Sim
	-	Close Project			
		Close Unrelated Project			
		Build Targets	>		
		Index	Ś		
		Build Configurations	Ś		
	0	Run As	>		
	蓉	Debug As	>		
		Team	>		
		Compare With	>		
		Restore from Local History			
		MISRA-C	>		
	\$	C/C++ Project Settings	Ctrl+Alt+P		
		Renesas C/C++ Project Settings	>	Change Device	
	*	Run C/C++ Code Analysis		Change Toolchain Version	
	.	System Explorer		Save build settings report	t
📃 Properties 🛛 🔡 問題	65	Command Prompt			
Synergy		Validate			
		Configure	>		
Resource Property		Source	>	Value	
✓ Info derived		Properties	Alt+Enter	false	
derived		-		raise	

Figure 4-3. Build – Saving the build settings report



5. Debugging

This chapter describes the usage of debug configuration and key debugging features for e² studio. The following illustration refers to the "Synergy" project built in section 4.2,

Building a Sample Project, and based on the following hardware configuration: J-link ARM emulator and Synergy S7G2 DK board.

Debugging of ThreadX projects using TraceX is not included in this chapter. Please refer to the TraceX User's Manual available in Microsoft website <u>https://docs.microsoft.com/en-us/azure/rtos/tracex/about-this-guide</u> for information on debugging ThreadX based projects using TraceX.

Right-click on any perspective icon, select **Show Text** to show the name of each icon.



Figure 5-1. Debug – Switch to Debug Perspective

Open the Synergy project in e² studio and click **Debug** to switch to the **Debug** perspective.

As discussed earlier, a Perspective in Eclipse defines the layout of panes and views in the **Workbench** window. Each perspective consists of a combination of views, menus and toolbars that enable the user to perform a specific task. For instance,

- The **Debug** perspective has views that enable the user to debug the program.
- The **Synergy Configuration** perspective together with configuration.xml in the editor window will open the Synergy configuration, as well as the Package and Properties views for project configuration settings.
- The C/C++ perspective has views that help the user to develop C/C++ programs.

If a user attempts to connect the debugger when not in the Debug perspective, e² studio will prompt the user to switch to the Debug perspective.

One or more perspectives can exist in a single Workbench setup. The user can customize them or add new perspectives.

5.1 Changing an Existing Debug Configuration

A default debug configuration is automatically created the first time a specific Synergy project is built. An existing debug configuration can be changed as follows.



- 1. Click the project name in the **Project Explorer** view to set focus.
- 2. Click **Run** → **Debug Configurations...** or the ^{***} icon (downward arrow) → **Debug Configurations...** to open the **Debug Configurations** window.

Eile Edit Navigate Search Project Renesas Views Image: Search Im	_	<u>W</u> indow <u>H</u> elp Renesas Debug Tools	>
Project Explorer 🔀	Q	Run	Ctrl+F11
V 😂 Synergy	椮	Debug	F11
> 🐝 Binaries > 諭 Includes		Run History	>
> 🚰 src	0	Run As	>
> 🔁 synergy		Run Configurations	
> 🗁 Debug > 🗁 script		Debug History	>
> 🗁 synergy_cfg	*	Debug As	>
configuration.xml		Debug Configurations	
R7FS7G27H3A01CFC.pincfg S7G2-SK.pincfg	9	External Tools	>
 Synergy Debug.launch O Developer Assistance 	_		

Figure 5-2. Debug – Opening the Debug Configurations Window

- 3. In the **Debug Configurations** windows, expand the **Renesas GDB Hardware Debugging** debug configuration and click on the existing debug configuration (for example, **Synergy Debug**).
- 4. Go to the **Main** tab and browse to add the load module (that is, Synergy.elf) located in the project build folder.

 Debug Configurations Create, manage, and run configurations 	igurations
C (/C++ Application C (/C++ Remote Applicati E GD8 Hardware Debuggir C GD8 Brandware Debuggir C GD8 Simulator Debuggir Java Applet Java Application Launch Group Remote Java Application C Renesas GDB Hardware [C Synergy Debug C Renesas Simulator Debug	Name: Symergy Debug Main 禁 Debugger Startup Project: Symergy Symergy Browse C/C++ Application: Debug/Symergy.eff Debug/Symergy.eff Baild (if required) before launching Build Configuration: Use Active O Enable auto build O Disable auto build Image: Symergy Configure Workspace Settings
< >> Filter matched 13 of 15 items	Reyert Apply

Figure 5-3. Debug – Selecting the Load Module

- 5. Switch to the **Debugger** tab, set **J-Link ARM** and **R7FS7G2** as the target device.
 - Debug Hardware: "J-link ARM"
 - Target Device: "R7FS7G27H"
- 6. Click the **Apply** button to confirm the settings.
- 7. Click the **Debug** button to execute the debug launch configuration to connect to the J-Link and the Synergy board.

Name: Synergy Debug	
📄 Main 🟇 Debugger 🌘 Startup 🦆 Source 🔲 Common	
Debug hardware: J-Link ARM V Target Device: R7FS7G27H	

Figure 5-4. Debug – Changing the Connection Settings

8. For a successful connection, the **Debug** view shows the target debugging information in a tree hierarchy. The program entry point is set at Reset_Handler() in startup_S7G2.c.



Figure 5-5. Debug – User Target Connection in the Debug view



5.2 Creating a New Debug Configurations

The simplest way to create a new debug configuration is by duplicating an existing one. It can be done by following the steps below.

- 1. Open the **Debug Configurations** window (refer to Figure 5-2. Debug Opening the Debug Configurations Window).
- 2. In the Debug Configurations window, select a debug configuration (for example, Synergy Debug) and

click the *icon* (which duplicates the currently selected launch configuration). A new debug launch configuration (for example, **Synergy Debug (1)**) is created.

Debug Configurations		— 🗆 X
Create, manage, and run configu	rations	TO-
C C/C++ Application C C/C++ Application E ASE Script C GDB Hardware Debugging C GDB OpenOCD Debugging C GDB Simulator Debugging (I Java Applet Java Applet Java Application Launch Group Remote Java Application C Renesas GDB Hardware Deb C Synergy Debug C Synergy Debug C Synergy Debug (1) C Renesas Simulator Debuggir	Build (if required) before launching Build Configuration: Use Active O Enable auto build O Dise	<u>B</u> rowse <u>V</u> ariables Searc <u>h</u> Project B <u>r</u> owse ✓ able auto build <u>pure Workspace Settings</u>
K State Stat		Re <u>v</u> ert Appl <u>v</u>
?		<u>D</u> ebug Close

Figure 5-6. Debug – Duplicating a Selected Debug Launch Configuration

3. The new debug configuration can be configured as described in chapter 0.

5.3 Basic Debugging Features

This section explains the typical Debug views supported in e² studio.

- Standard GDB Debug features (supported by the Eclipse IDE framework): Breakpoints, Expressions, Registers, Memory, Disassembly and Variables (MMU view is not supported in Synergy).
- Renesas Extension to Standard GDB Debug: IO Registers, Eventpoints, Trace, and Fault Status.



To open the **Debug Toolbar**, click the pull-down menu button and click on **Show Debug Toolbar**. The following are some useful toolbars in the **Debug** view:



Figure 5-7. Debug – Useful Toolbars in Debug Views

The program is run by clicking the IIP button or pressing F8.

Program execution can be suspended by breakpoint or by clicking the III button. When program execution is suspended, the user can perform the following operations:

- Resultion or F5 can be used for stepping into the next method call at the currently executing line of code.
- Solution or F6 can be used for stepping over the next method call (executing but without entering it) at the currently executing line of code.
- Use button can be clicked again to resume program execution.

To stop the debugging process, click the <a>button to end the selected debug session and/or process or click the button to disconnect the debugger from the selected process.

The other operations are as follows:

- The ¹ button can be clicked to reset and run the program. It may stop at main() if the breakpoint is configured in the **Debug** configuration.
- The Not button can be clicked to reset the program to its entry point at the PowerOn Reset.
- The use button re-downloads the binary file to the target system.

5.3.1 Breakpoints View

The **Breakpoints** view stores the breakpoints that were set on executable lines of a program. If a breakpoint is enabled during debugging, the execution suspends before that line of code executes. e² studio allows software and hardware breakpoints to be set explicitly in the IDE. Any breakpoints added via double-click on the marker bar are by default hardware breakpoints. If the hardware resources are not there, then the breakpoint setting will fail. In case of a hardware breakpoint setting failure, an error message will prompt the user to switch to a software breakpoint.



To select a hardware or software breakpoint:

 Right-click on the marker bar to pop up the context menu. For a hardware breakpoint, select Breakpoint Types → e² studio Breakpoint. For a software breakpoint, select Breakpoint Types → C/C++ Breakpoints.

To set a breakpoint:

- 1. As an example, in "startup_S7G2.c" at line 62, double-click on the marker bar located in the left margin of the C/C++ Editor pane to set a breakpoint. A dot 20 (Hardware breakpoint) or 20 (Software breakpoint) is displayed in the marker bar depending on the **Breakpoint Type** selected. **Breakpoint Type** is hardware breakpoint by default.
- 2. Alternatively, right-click at the marker bar to choose **Toggle Hardware Breakpoint** or **Toggle Software Breakpoint** to set a hardware breakpoint **and or a software breakpoint and the set a hardware break**
- Click Windows → Show View → Breakpoints or icon ^{So} (or use shortcut key ALT+Shift+Q, B) to open the Breakpoints view to view the corresponding breakpoints set. Breakpoints can be enabled and disabled in the Breakpoints view.

To disable breakpoints, users can choose to disable specific breakpoints or to skip all breakpoints:

- 1. To disable a specific breakpoint, right-click on the Software breakpoint or Hardware breakpoint located in the left margin of the C/C++ Editor pane and select Disable Breakpoint, or uncheck the related line in the Breakpoints view. A disabled breakpoint is displayed as a white dot (or or).
- 2. To skip all breakpoints, click on the kicon in the **Breakpoints** view. A blue dot with a backslash will appear in the editor pane as well as in the Breakpoints view.

(x)= Variables 💁 Breakp	oints 🕮 🛙 Registers 🛎 Modules 🎕 Expressions 🗐 MMU 🔹 Eventpoints 🔓 Peripherals 🖹 IO Registers	
		😫 ▽
✓ ∞ startup_S7G2	c [line: 62] [type: Hardware]	
No details to display f	or the current selection.	
🕸 [Synergy] Synergy C	onfiguration	
60 00002f64	(^
61 0 62 00002 1 66	/* Initialize system using BSP. */ SystemInit();	
6		
64	/* Call user application. */	
65 00002f6a	<pre>main();</pre>	
66 67 ⊜	while (1)	
68		
69	/* Infinite Loop. */	
70 00002f6e	}	
	}	<u> </u>
72		
	<	>

Figure. 5-8 Debug – Breakpoints view

5.3.2 Expressions View

The **Expressions** view monitors the value of global variables, static variables, or local variables during debugging.



Follow the steps below to watch a variable:

- 1. Click Window \rightarrow Show View \rightarrow Expressions or the icon $\frac{6}{2}$ to open the Expressions view.
- Drag and drop a variable (for example, g_cgc_version in r_cgc.c) to the Expressions view. (Alternatively, right-click the variable to select the Add Watch Expression... menu item to add it to the Expressions view).

€ r_cgc.c ⊠ 150 /*LDR	A INSPECTE	D 60 5 */					
				issing-field-initializers"			
152 #prag		Buoscic if	gnoreu -wiii.	issing-field-inicializers			
		a structur	re used by (error logger macro. */			
	<pre>/** Version data structure used by error logger macro. */ static const ssp_version_t g_cgc_version = { .api_version_minor = CGC_API_VERSION_MINOR,</pre>						
455							
	.api_version_major = CGC_API_VERSION_MAJOR, .code_version_major = CGC_CODE_VERSION_MAJOR, .code_version_minor = CGC_CODE_VERSION_MINOR						
158 .							
159 .	code_versi	ou_mruor/=		VERSION_MINOR			
159 160 };	code_versi	on_m1nor-		VERSION_MINOR			
				_			
160 };				3 Kame : g_cgc_version			
(x)= Variables 💁 Breakpoints	Project E	kplorer 6슟 Value	Expressions &	3 Mame : g_cgc_version Details:{version_id = 3355494			
160 }; (x)= Variables • Breakpoints Expression	Project Ex	kplorer 6슟 Value	Expressions ∑ Address	3 Kame : g_cgc_version			
160 }; (x)= Variables • Breakpoints Expression • @ g_cgc_version	Project Ex Type const ssp	xplorer of the second s	Expressions ∑ Address 0x35e4	<pre>3</pre>			
160 }; (x)= Variables • Breakpoints Expression • = g_cgc_version (x)= version_id	Project Ex Type const ssp uint32_t	xplorer ∰ Value {} 33554944	Expressions & Address 0x35e4 0x35e4	<pre>3</pre>			
160 }; (x)= Variables • Breakpoints Expression (x)= g_cgc_version (x)= version_id (x)= code_version_minor	Project E Type const ssp uint32_t uint8_t	xplorer # Value () 33554944 0 '¥0'	Expressions Address 0x35e4 0x35e4 0x35e4	<pre>3</pre>			

Figure 5-9. Debug - Expressions view

5.3.3 Registers View

The **Registers** view lists the information about the general registers in Synergy. Changed values are highlighted when the program stops.

- 1. Click **Window** \rightarrow **Show** View \rightarrow **Registers** or icon ¹⁰⁰/₁₀₀ to open the Registers view.
- 2. Click a register to view the values in a different radix format.

Values that have been changed are highlighted (for example, in yellow) in the **Registers** view when the program stops.



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Name	Value	tion 🖄 🦂 📄 🖄 🛃 🧆
	value	
General Registers	0x64000000	General Purpose and FPU Register Group
1010 rO	0x60000000	
1010 r2	0x64000000	
101 12 1010 r3	0xffffff80	
1010 r4	0x1ffe096c	
1919 r5	0x1ffe09c4	
1010 r6	0x1ffe09c4	
1010 r7	0xb2806e91	
1010 r8	0xa2622ec2	
1910 r9	0xa207cca4	
1010 r10	0x90b68abe	
ame : r0		
Hex:0x64000000		
Decimal:1677721600		
Octal:014400000000		

Figure 5-10. Debug – Registers view

5.3.4 Memory View

The **Memory** view allows users to view and edit the memory presented in "memory monitors". Each monitor represents a section of memory specified by its location called "base address". The memory data in each memory monitor can be presented in different "memory renderings", which are the predefined data formats (for example, Hex integer, signed integer, unsigned integer, ASCII, and image).


To view the memory of a variable (for example, g_ssp_version_build_string):

- 1. Click Window \rightarrow Show View \rightarrow Memory or icon \bigcirc to open the Memory view.
- 2. Click the icon to open the **Monitor Memory** dialog box. Enter the address of the variable &g_ssp_version_build_string.

Monitor Memory Enter address or exp		is pre	global varial esented in n Integer" for	nemory ren	version_build derings of	d_string"
E Console Debug Shell 🔗 Search 🔝 Prob Monitors		· ·	x ex Integer> X	🕂 New Rende	erings	
	Address	0-3	4 . 7	8 - B	C - F	-
f f	00000000003470	1FFE01B4	47704770	6C697542	69772074	
	00000000003480	52206874	73656E65	53207361	72656E79	
	000000000003490	28207967	20294D54	74666F53	65726177	
Memory Monitor for	0000000000034A0	63615020	6567616B	72657620	6E6F6973	
"g_ssp_version_build_string" is	0000000000034B0	302E3220	612D302E	6168706C	622B312E	
specified by the address "&g_ssp_version_build_string"						

Figure 5-11. Debug – Memory view

To add a new rendering format (for example, ASCII) for the variable g_ssp_version_build_string:

Click the tab New Renderings.... to select ASCII to add the rendering. This creates a new tab named &g_ssp_version_build_string <ASCII> next to the tab &g_ssp_version_build_string <Hex Integer>.

🔄 Console 📋 Debug Shell 🛷 Search 🖹	Problems 🏼 🛞 Smart Brow	wser (Memory 2	3	🖇 ¹⁰¹ 2	1010	ا ◄ اي 🕄 🛃 😳 🗞
Monitors 🕂 🐈 💥	g_ssp_version_build_strin	g <hex< td=""><td>Integer></td><td>🔶 Nev</td><td>v Renderin</td><td>gs</td><td></td></hex<>	Integer>	🔶 Nev	v Renderin	gs	
g_ssp_version_build_string	Memory Monitor: g_ssp_	version	_build_string	: 0x3478			
	Select rendering(s) to cre	ate:					
	Image Raw Image Floating Point Traditional Raw Hex ASCII Signed Integer Unsigned Integer						Add Rendering(s)
📃 Console 🕕 Debug Shell 🔗 Search 🖹	Problems 🏼 🛞 Smart Bro	wser (Memory 2	3		1010 0	ا 🕶 📑 🖳 📮 🗞
Monitors 🕂 🙀 💥	g_ssp_version_build_strin	g <hex< td=""><td>Integer></td><td>g_ssp_v</td><td>ersion_bui</td><td>ld_strii</td><td>ng : 0x3478 <ascii> 🔀 🖶 New Rend</ascii></td></hex<>	Integer>	g_ssp_v	ersion_bui	ld_strii	ng : 0x3478 <ascii> 🔀 🖶 New Rend</ascii>
g_ssp_version_build_string	Address	0 - 3	4 - 7	8 - B	C - F		
	00000000003470	Ίþ	pGpG	Buil	t wi		Observation at its and
	00000000003480	th R	enes	as S	yner		Character string of
	00000000003490	gy (TM)	Soft	ware	•	"g_ssp_version_build_string" is
	000000000034A0	Pac	kage	ver	sion		displayed.
	000000000034B0	2.0	.0-a	lpha	.1+b		
	000000000034C0	uild	.f5b	c764	4240		

Figure 5-12. Debug – New Rendering In Memory view



5.3.5 Memory Usage view

Memory Usage will be used to get the information of *.map files or library list files (*.lbp) from a project. It will list out the total memory size, usage of ROM and RAM ratio, and detailed information of sections, objects, symbols, module, vector, and cross references used in project.

From version 7.3, e² studio supports the graphical view to show usage in the ROM and RAM memory areas.

To show the **Memory Usage** view, click on the menu **Window** \rightarrow **Show View** \rightarrow **Others...** to open the **Show View** dialog and click **C/C++**, select "**Memory Usage**" and click [**Open**.

Show View			\times
type filter text			
 > General C/C++ C/C++ Index C/C++ Projects C/C++ Projects Call Hierarchy Include Browser Memory Usage Peripheral Register 	Calculat	tor	~
 Problem Details Stack Analysis Type Hierarchy C/C++ Packs Connections Debug Help 			~
<u>O</u> pen		Cancel	

Figure 5-13. Show Memory Usage view



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The **Memory Usage** view has 3 regions: (1) Group size region, (2) Memory Region Usage region (Device Memory Usage region is not supported yet), (3) Detail table region.

ize:				Memory Region U	sage Device Memory I	Jsage		
Program:		16196	5 byte(s)	Memory Region	Usage:	2)		
Constant:		(byte(s)		(-)		
Initialized Da	ita:	216	5 byte(s)	FLASH		1%	4096KB	
Uninitialized	Data:	4256	5 byte(s)	15KB used				
Data:		68	byte(s)					
Stack:		2048	3 byte(s)	RAM		1%	640KB	
Others:		16	5 byte(s)	KAIVI	6KB used	1 70	640KB	
					OVD USED			
	(1)							
				ID_CODES		100 %	16B	L
					16B used			
								,
				<				
tion Object Symb	ol							
tion	Group	Start address (VMA)	End address	Size (byte)	Align	Attribute	Load address (LMA)	
p11_veneer	Constant	0x00003F44		0				
_bx	Constant	0x00003F44		0				
d	Program	0x00000000	0x00003F43	16196				
ack_dummy	Stack	0x1FFE11C0	0x1FFE19BF	2048	(3)			
o_dtc_vector_ta	Others	0x1FFE0000		0				
ram	Uninitialized Data	0x90000000		0				
spi_non_retentive	Others	0x6000000		0			0x0000401C	1

Figure 5-14. Regions of Memory Usage views

Following operations are supported in **Memory Usage** view:

- . Choose a map or library list file for **Memory Usage** display.
- *: Refresh all information of Memory Usage view.
- : Open a * .map or * . 1bp file in the Editor (there is no library list file in the Synergy library project).
- Open Map file output page of selected project.
- 4. Open Section page of selected project.

5.3.6 Disassembly View

The **Disassembly** view shows the loaded program as assembler instructions mixed with the source code for comparison. The currently executing line is highlighted by an arrow marker in the view. In the **Disassembly** view, users can set breakpoints at assembler instructions, enable or disable these breakpoints, step through the disassembly instructions and even jump to a specific instruction in the program.

To view both C and assembly codes in a mixed mode:

- 1. Click Window \rightarrow Show View \rightarrow Disassembly or the icon $\stackrel{\text{III}}{=}$ to open the Disassembly view.
- 2. Click the icon 5 to enable the synchronization between assembly source and the C source (active debug context).
- 3. In **Disassembly** view, right-click at the address column to select **Show Opcodes** and Show **Function Offsets**.



Figure 5-15. Debug – Disassembly view

5.3.7 Variables View

The Variables view displays all the valid local variables in the current program scope.



To observe a local variable (for example, timeout for function R_CGC_Init()):

- 1. Click Window \rightarrow Show View \rightarrow Variables or the icon^{(k)=} to open the Variables view.
- 2. Step into the function R_CGC_Init () to view the local variable timeout value.

	(x)= Variables 🔀	💁 Breakpoints 🛛 📰 D	isassembly Project I	Explorer of Expressions 1010 Registers	
	Name	Туре	Value	Name : timeout	
	> 🍋 ssp_feature		{}	Details:65535	
	> C info	fmi_feature_info_t		Default:65535 Decimal:65535	
	(×)= timeout	volatile uint32 t	65535	Hex:0xffff	
	() timeout	volutile unitort	00000	Binary:1111111111111111	
				Octal:0177777	
	startup_S7G2.c	<mark>le</mark> r_cgc.c ⊠			
	303				^
	304		_t ssp_feature= {{(
	305 00001960		_info_t info = {0U}	;	
	306 307		.channel = 0U;		
	308 0000196e	ssp_feature.	.unit = 00; .id = SSP IP CGC;		
	309 00001970			(&ssp_feature, &info);	_
	310 00001978		eg = (R_SYSTEM_Type		
	311	8P_5/5 cc1	-8 (, <u>, , , , , , , , , , , , , , , , , , </u>	
	312	volatile uir	nt32_t timeout;		
	313 0000197c		AX_REGISTER_WAIT_CO	UNT;	
	314	/* Update HC	DCOWTCR_b.HSTS */		
۰	315	⊖ if(true == r	r_cgc_clock_run_sta	te_get(gp_system_reg, CGC_CLOCK	_HOCC
	316	{			
	317			table before changing wait cont	
	318	⊖ while (((false == r_cgc_clo	ock_check(gp_system_reg, CGC_CLO	оск_но
	210	F			

Figure 5-16. Debug – Variables view

5.3.8 IO Registers View

The IO registers are also known as the Special Function Registers (SFRs). The **IO Registers** view displays all the registers defined in a target-specific IO file. Users can further customize the IO Registers view by adding specific IO registers to the Selected Registers pane.



To view selected IO registers:

- 1. Click Renesas Views \rightarrow Debug \rightarrow IO Registers or icon \square to open the IO Registers view.
- 2. Under the **All Registers** tab, locate a module (for example, CAC) in the **IO Registers** view. Expand its IO register list.
- 3. Drag and drop its registers (for example, **CAICR** and **CASTR**) to the **Selected Registers** pane. A green dot • next to the IO register indicates the status of being a selected register.
- 4. Switch to the **Selected Registers** tab to view the selected IO Registers.

The expanded IO register list may take more time to load in the **All Registers** pane. Hence, it is advisable to customize and view multiple selected IO registers from the **Selected Registers** pane.

Variables 👻 Breakpoir	its 🛋 Modules 👷 Exp	pressions 🧧 Eventpoints		🔲 IO Registers 💥	- M 🗎 🚍 🔕 🍲
o CAC	Value (Hex)	Value (Bin)	Address	Access	
> CACR0	0x00	00000000	0x40044600	RW	
> CACR1	0x00	00000000	0x40044601	RW	
> CACR2	0x00	00000000	0x40044602	RW	
> CAICR	0x00	00000000	0x40044603	RW	
> CASTR	0x00	00000000	0x40044604	R	
> CAULVR	0x0000	000000000000000000000000000000000000000	0x40044606	RW	
> CALLVR	0x0000	000000000000000000000000000000000000000	0x40044608	RW	
Registers Selected Reg (x)= Variables		Expressions e Eventpo Value (Bin)	oints 🛛 🔀 Peripher Address	als 📄 IO Registers	2
Name					_
Name ▼ ○ CAC					
	0x00	00000	000 0x40044603	RW	

Figure 5-17. Debug – IO Registers view



To find IO registers:

- 1. Enter the name of the IO register to search in the search box and click the down arrow button $\stackrel{\P}{\downarrow}$.
- 2. The searched register is displayed in the IO Register view.

		dr	mac 🗸 🗸 🗸		
Name	Value (Hex)	Value (Bin)	Address	Acces	
✓ ○ CAC					
(×)= Variables 🤷 Breakş	points 🛋 Modules 🙀 Exp				
(×)= Variables 🤷 Break	points 🛋 Modules 🙀 Exp		points <u>井</u> Peripheral	Is 📄 IO Registers 💥 🕂 🕆 🕀 🕞 🍣 🔕 🎓	
(×)= Variables 💁 Breakş Name	ooints 🛋 Modules 👾 Expr Value (Hex)				
		dı	mac ~	÷ î 🕀 🖻 🗢 🕉 🎪	0, 🚍 💾 🖻 🕴

Figure 5-18. Debug – IO Registers view(Find IO registers)

5.3.9 Eventpoints View

An 'event' refers to a combination of conditions set for executing break or trace features during program execution. The **Eventpoints** view enables users to set up or view defined events of different categories, such as trace start, trace stop, or event break.

Data access event break is supported for Synergy projects. The emulator detects access under a specified condition to a specified address or a specified address range. This allows complex address and data matching criteria to be set up.

Event combinations (for example, OR, AND (cumulative) and Sequential) can be applied to two or more events.

Table 5-1. Event combinations

Event combination	Explanation
OR	The condition is met when any one of the specified events occurs.
AND (cumulative)	The condition is met when all of the specified events occur regardless of the timing.
Sequential	The condition is met when the specified events occur in a specified order.



To set an event break for a global variable when address/data is matched (for example, when g_bsp_leds is accessed):

- 1. Click **Renesas Views** \rightarrow **Debug** \rightarrow **Eventpoints** or the icon \bullet to open the **Eventpoints** view.
- 2. Double-click the **Event Break** option to open the **Edit Event Break** dialog box.
- 3. Click the **Add...** button to continue.

уре	Address	Data	Cour	t Time	er Ha	andle	Comment	X
🔄 🎁 Trace Start	Sedit Ever	it Break						
Trace Stop							Trigger: OR	- 4 0
Trace Record	Туре	Address	Data	Count	Timer (Channel	Comment	
Event Break Timer Start								
Timer Stop								
- Interstop								
<u> </u>								
	Add	Edit Delete PC	: 0/0 OA: 0/4 All:					

Figure 5-19. Debug – Eventpoints view (1/2)



- 1. The Data Access Eventpoint Type is selected by default.
- 2. Go to the Address Settings tab and click the ... icon to browse for the symbol g_bsp_leds. (The address of this global variable is &g_bsp_leds.)
- 3. Next, switch to the Data Access Settings tab and set the Read/Write selection to Read.
- 4. Click **OK** to proceed.

Add Eventpoint		X 🔄 Add Ev	ventpoint				
ventpoint Type: Data Access	~	Eventpo	oint Type: D	ata Access)	~		
Address Settings Data Access	Settings	Addres	s Settings	Data Acces	s Settings		
Address: &g_b	sp_leds	Data Se	ettings:				
Address Conditions	·	Read/V	Vrite:		R	ead	×
None		Size:			B	/te 🗸	
⊖ Mask		Bus Ma	ister:			PU	· · · · · · · · · · · · · · · · · · ·
Value:	Equals		npare Settin	as:			
○ Range		Compa		2	0		
End Address:	~	Mask V			0		
Type: Incl	usive 🗸	Compa				quals	
		Compa	113011			10013	
Comment:	OK Can	Comme				ОК	Cancel
(x)= Variables 💁 Brea	ikpoints 🛋 Modules 🙀 Expr	ressions e Eventpoints 🕅	3	herals 📘	IO Register	s	
(x)= Variables 💁 Brea Type	akpoints 🛋 Modules 🙀 Expr Address	essions • Eventpoints 🖄 Data	Count	herals 🔲 Timer	IO Register Handle	s Comment	
Type							
Type □ ा ि Trace Start □ 🗃 Trace Stop	Address						
Type □ State Trace Start □ State Trace Stop □ Trace Record	Address						
Type ☐ ௺ Trace Start ☐ 營 Trace Stop ☐ ♂ Trace Record	Address						
Type □ 🎁 Trace Start □ 🗃 Trace Stop □ 👻 Trace Recor ✔ 💟 Cî Event Break	Address d &g_bsp_leds (0x46c4)	Data			Handle		

Figure 5-20. Debug – Eventpoints view (2/2)



- 5. Perform a reset to execute the program from the start.
- 6. Figure 5-21 shows that when the variable g_bsp_leds is accessed (read), the program stops.

c startup_S/G2.c	i main.c i bsp_common_leds.c ☆	
48		~
50	* @ingroup BSP_COMMON_LEDS.	
54		
56	* Public Functions.	
58		
60	Image: Beturn information about the LEDs on the current board.	
64	<pre>ssp_err_t R_BSP_LedsGet(bsp_leds_t * p_leds)</pre>	
65	{	
66	#if BSP_CFG_PARAM_CHECKING_ENABLE	
67 00002d0c	SSP ASSERT (p leds);	
68	#endif	
69		
70 00002d10	<pre>*p_leds = g_bsp_leds; /* Copy over information */</pre>	
→ 71 00002d16	return SSP_SUCCESS;	
72 00002d1c	3	
70	<	`

Figure 5-21. Debug – Execution of Event Break

5.3.10 Trace View

Tracing means the acquisition of bus information per cycle from the trace memory during user program execution. The acquired trace information is displayed in the **Trace** view. It helps users to track the program execution flow to search for and examine the points where problems arise.

The trace buffer is limited, therefore older trace data is overwritten with new data after the buffer has become full.

To set a trace until the program is suspended:

- 1. Click **Renesas Views** \rightarrow **Debug** \rightarrow **Trace** or icon ⁸/₈ to open the **Trace** view.
- 2. Turn on the **Trace** view by selecting the icon.

Co	🖉 Tasks	🖹 Pro	Exe	🖄 Liv	Sm	📮 Ren	₿ De	🛰 Trace 🛛	🖏 Rea	间 Me	■ Ren	🌢 Fau	
							3 🕨 00	中 🔍 🐨	🐺 🈂 🐺	📤 🖄 🐺	₩ 🖌 🖾	÷; 🕛 🗞	1
lo recor	ds												
Record	Label	Addr	Source										

Figure 5-22. Debug – Turn on Trace view

- 1. Execute the program and stop program execution by using a breakpoint or by pressing the Suspend button on the Debug Toolbar. The content stored in trace memory at that point in time is displayed as trace result.
- 2. Select the display mode by clicking on the corresponding button.

Figure 5-23 shows the trace result before the main() function is executed.





Figure 5-23. Debug – Select display mode in Trace view

1. The trace records are displayed from oldest data to latest data by default. The display order can be changed by clicking button.

Listin	g from record 1 of	f 9464	🗒 🕪 💷 🐳 🔍 🗐 🔚 😂 두 🛓 🕁 두	III V @ 🍫 😃 👒 🖻 .
	rd Label	Address	Source	T .
0		2E8A		
1	bsp_qspi.c	590 2E8A 2E88	} pop{r4, r5, r6, pc}	Click to change display order
Ì	bsp_qspi.c	590 2E88	} addsp, #8	
2	bsp_qspi.c	2FD0 588 2FD0	R_QSPI->SFMCMD_b.DCOM = (uint32_t)0; b.n0x2e88 <bsp init+116="" qspi=""></bsp>	
Suspe	ended 🔶 0x00002	2b1e Ø0ns	🕡 DWT 🛛 🗞 0	
			<u>ê</u>	

Figure 5-24. Display order is changed

2. The trace result can be filtered by clicking on the [♯] button. User can select to filter by **Record** and/or **Address**.

	1e [™] Ren [©] Me [◆] Fau
SI 🗃 🔎 🚝 III 🖉	; ╤ 솔 ☆ 주 ₩ ♥ @ � Ů ♥ ▼
e ² Filter	
Address	Address 0
	Range
	0 Exclude
	OK Cancel

Figure 5-25. Debug – Filter trace result

3. Trace result can be saved to a .csv file (with the inclusion of bus, assembly, and source information). **Trace** view also allows to load trace result from a .csv file.

👒 Trace 🛛 🖏 Rea 🖣 M	e ≇ Ren 🛈 Me 🚸 Fau 🖓 🕻
Save trace result	Load trace result

Figure 5-26. Debug – Save and load trace result

5.3.11 Fault Status View

The **Fault Status** view shows the bit status of several fault status registers and the value of the key register to the user when a hardware fault crash occurs. When a hardware fault occurs, the bits of the register related to the cause of the fault are checked and the r0, r1, r2, r3, r12, lr, pc, and psr register values are displayed. This is shown in Figure 5-27 below. This function is available in e² studio v5.2 and above.



HFSR 0x0		
MMFSR 0x0		
BFSR 0x0		
UFSR 0x0	ß	
Registers	UsageFault Status Register	



Fault Status 83	
▼ HFSR 0x40000000	
VECTTBL [1]	
FORCED [30]	
DEBUGEVT [31]	
MMFSR 0x0	
► BFSR 0x0	
✓ UFSR 0x1	
UNDEFINSTR [0]	
INVSTATE [The processor has attempted to execute an undefined instruction	
INVPC [2]	1
■ NOCP [3] When mouse is hovered over the bit name,	
UNALIGNED [8] the description of the bit is displayed.	
DIVBYZERO [9]	- .
▼ Registers	
- registers	0x1ffe093c
រះរះ៖ rO រះរះ៖ r1	0x4001e3fe
888 rO 888 r1 888 r2	0x0
8181 rO 8181 r1 8010 r2 8010 r3	0x0 0x4001e0a0
1010 rO 1010 r1 1010 r2 1010 r3 1010 r12	0x0 0x4001e0a0 0x1ffe08b0
8181 rO 8181 r1 8010 r2 8010 r3	0x0 0x4001e0a0

Figure 5-28. Fault Status Hardware fault occurred

5.3.12 Run Break Timer

The Run Break Timer feature allows the user to see the last execution performance on the status bar. When the program is suspended, user can check the current program counter (PC), the last execution timing either in time or CPU cycles and the accuracy or measurement method used.



🌾 🔳 🎋 Debug 🗸 🗹 Synergy Debug 🗸 🄅 🗂 🕶 🗟 🗞 V 💩 🕅 💌 🖷 🕺 🗞 🔹 🤹 V	
	<u>v</u>
फ ▾ फ ┉ ш 🗑 வ & ∅ ∅ थ फ ▾ फ ▼ 💁 🗢 🗁 🖉 🕶 🕼 🖌 ▼ 🚺 ▼	
Quick Access 🗄 🖻 🗟 C/C++ 🏟 Synergy Configuration 🂠 🛙	ebug
🎋 Debug 🛛 🧏 🛸 🖩 💌 🛢 💉 🗟 🔅 ≂ 🕸 🖄 🏟 🗢 🗉 🕼 🕬 🖉 🕸 🖉 🕸 🕸 🕸 🖉 🕫 🕫 🕫 🐼 🗰 Re 📽 Ex ● Ev 🖧 Pe 🖬 I	
🕆 🔀 Synergy.elf [1] 🔨 🔺 🕷 🕾 🗟 🗟 🔌 🔅 🖻 🖻	\$£} ▽
✓ Inread #1 1 (single core) (Suspended : Step)	
■ hal_entry() at hal_entry.c:47 0x3474	
■ main() at main.c:5 0x346a	
Bynergy] Synergy Con Startup_S7G2.c main.c bsp_delay.c hal_entry.c T B C T C T C S C S C S S S	- 8
[Synergy] Synergy Con as startup_57 dz.e. a thanke a bsp_delay.e. a hai_entry.e. a	
	×.
44 00003482 10port_level_t level = 10PORT_LEVEL_HIGH;	
46 /* Get LED information for this board */	06816
<pre> 47 00003474 R_BSP_LedsGet(&leds); 00003476: 0xfff 00003476: 0xfff</pre>	
48 0000347a: 0xbd	
49 /* If this board has no LEDs then trap here */	NO JOL 4
	_
🖳 Console 🛿 🖉 Tasks 🖺 Problems 🖄 Live Trace Console 👒 Trace 🔋 Memory Usage 🏮 Memory 🔶 Fault Status	
	📑 🔻
Synergy Debug [Renesas GDB Hardware Debugging] Renesas GDB server (Host)	_
Option Function Select, writing to address 0x00000400 with data fffffffffffffffffff	^
SECMPUxxx, writing to address 0x00000408 with data ffffffffffffffffffffffffffffffffff	
Hardware breakpoint set at address 0x3474	
	~
	>
Suspended → 0x00002474	>
Suspended $\rightarrow 0_{\pm}000003474$ $\bigcirc 292 \text{ ns}$ $\bigcirc DWT$ $\bigcirc 7$ Cycle count	>
Suspended $\rightarrow 0_{x00003474}$ $\bigcirc 292 \text{ ns}$ $\bigcirc DWT$ $\bigcirc 7$ Cycle count	>
Suspended \rightarrow 0x00003474 \bigcirc 292 ns \bigcirc DWT \bigcirc 7 \bigcirc Cycle count \bigcirc Cycle count	>

Figure 5-29. Run Break Timer shows the last execution performance

Table 5-2 shows the support of Run Break Timer feature available for various Synergy devices.

 Table 5-2 Support for Run Break Timer

Device	Debugger	Support
Synergy S1 Series (Cortex M0+/M23)	J-Link	System Time
Synergy S3, S5, S7, Series	J-Link	Data Watchpoint and Trace Unit (DWT) – Cycle Count and number of overflows calculated using the System Time

The Run Break Timer feature is supported in e² studio v7.3.0 and higher version. For updates in the specification, refer to e² studio release note in this link. <u>https://www.renesas.com/us/en/software-tool/e-studio</u>



6. Setting Up a ThreadX Application

This example demonstrates how to generate and build a Synergy project to include ThreadX objects and General-Purpose Timer (GPT) module using the project template "Blinky with ThreadX".

6.1 General Purpose Timer Example in ThreadX

In the "Blinky with ThreadX" Synergy project from Project Template Selection, LEDs are caused to blink by putting the task to sleep for a while before toggling the LEDs state.

In this example, instead of a sleep delay, the Blinky Thread waits for a semaphore and a timer interrupt (generated by GPT) which puts out this semaphore every 1 second so that thread can resume.



Figure 6-1. Setting up a ThreadX Application – Introduction



6.2 Creating the Sample Project

To create a sample ThreadX project with GPT and semaphore, configure the Synergy project as follows:

1. Invoke the **New Project** editor and follow the steps in Chapter 3.1 (Generating a New Synergy Project) to generate a new project. However, in the last dialog (**Project Template** dialog), select **Blinky with ThreadX**.



Figure 6-2. Setting up a ThreadX Application – Blinky with ThreadX template selection

- 2. Open the **Threads Configuration** page in the **Synergy Project Configuration**. Please refer to Chapter 3.4.5.



Figure 6-3. Setting up a ThreadX Application – Adding the GPT module

1. Configure the GPT module as follows.



- Name: g_timer
- Mode: Periodic
- Period Value: 1
- Period Unit: Seconds
- Callback: gpt_callback
- Overflow Interrupt priority: 2

			-			
	Threads Configuration		Generate Project Cor	nte		
	Threads 🛛 New Thread 🗟 Remove 🕒	g_timer Timer Driver on r_gpt Stacks € New Stack > [▲] Exten		•		
	<pre></pre>	 g_timer Timer Driver on r_gpt ① 	Kemove			
	g_timer Timer Driver on r_gpt Objects					
	Summary BSP Clocks Pins Threads Messaging Components					
Propertie	es 🛿 😰 Problems 🦇 Smart Browser					
g_timer	Timer Driver on r_gpt					
Settings	Property	Value		^		
API Info	✓ Common					
API Into	Parameter Checking	Default (BS	Default (BSP)			
	 Module a timer Timer Driver on r apt 	· · · · · · · · · · · · · · · · · · ·				
	Name	g_timer				
	Channel	0				
	Mode	Periodic				
	Duty Cycle Range (only applicable in PWM)		PCLK, Longest: (Period - 1) PCLK			
	Period Value	1				
	Period Unit	Seconds				
	Duty Cycle Value	50				
	Duty Cycle Unit	Unit Raw C	Unit Raw Counts			
	Auto Start	True				
	GTIOCA Output Enabled	False				
	GTIOCA Stop Level	Pin Level Lo	w			
	GTIOCB Output Enabled	False				
	GTIOCB Stop Level	Pin Level Lo	w			
	Callback	gpt_callbac				
	Overflow Interrupt Priority	Priority 2				
		i noncy E		×		
	<			>		

Figure 6-4. Setting up a ThreadX Application – GPT module configuration



Add a semaphore object to the Blinky Thread by selecting the Blinky Thread in the Threads panel and select
 → Semaphore in the Objects panel.



Figure 6-5. Setting up a ThreadX Application – Adding a Semaphore Object



- 3. Configure this newly created semaphore as follows:
 - Name: Blinky Semaphore
 - Symbol: g_blinky_semaphore
 - Initial count: 0

Threads Configuration	Generate Project	Content
_	-	
Threads 🛛 🗟 New Thread 🔹 Remove	■ Blinky Thread Stacks	lemove
 A HAL/Common Blinky Thread g_timer Timer Driver on r_gpt 	 [⊕] g_timer Timer Driver on r_gpt 	
Blinky Thread New Object > Objects Remove g_blinky_semaphore Semaphore		
Objects 🔊 Remove	saging Components	
Objects Remove Image: Summary BSP Clocks Pins Threads Mess		
Objects Remove g_blinky_semaphore Semaphore Summary BSP Clocks Pins Threads Mess Properties XX Properties XX	owser 🖸	▽ □ □
Objects Remove g_blinky_semaphore Semaphore Summary BSP Clocks Pins Threads Mess Properties 🛛 Problems 🏶 Smart Brogg_blinky_semaphore Semaphore	e E	
Objects Remove g_blinky_semaphore Semaphore Summary BSP Clocks Pins Threads Mess Properties 🛛 Problems 🏶 Smart Brogg_blinky_semaphore Semaphore Settings Property	e Value	▽ □ □
Objects Remove g_blinky_semaphore Semaphore Summary BSP Clocks Pins Threads Mess Properties 🛛 Problems 🏶 Smart Brogg_blinky_semaphore Semaphore	e E	

Figure 6-6. Setting up a ThreadX Application – Semaphore Object Configuration

Press **Ctrl+S** to save the setting and click the **Generate Project Content** Generate Project Content button to generate source code content.

- 4. Open blinky_thread_entry.c and implement the following contents:
 - Add source code to initialize the GPT module before the while(1) loop in blinky_thread_entry().

g_timer.p_api->open(g_timer.p_ctrl, g_timer.p_cfg);

 Delete the thread sleep instruction and add code to wait for the semaphore in blinky_thread_entry().

tx_semaphore_get(&g_blinky_semaphore, TX_WAIT_FOREVER);

- Implement the gpt_callback() function to signal the semaphore for the Blinky thread.

```
void gpt_callback(timer_callback_args_t * p_args){
```

tx_semaphore_put(&g_blinky_semaphore);

}





Figure 6-7. Setting up a ThreadX Application – Adding User Source Code

 Build and run the project on the Synergy SK-S7G2 board. Confirm that the LEDs are turned ON/OFF every 1 second.



7. Help

The help system allows users to browse, search, bookmark and print help documentation from a separate **Help** window or **Help** view within the workbench. Users can also access an online forum dedicated to the e² studio from here.

Click on Help tab to open the Help menu.

<u>H</u> elp	2		
3	Welcome	(1)	
?	Help Contents	(2)	
2	Search		
	Show Contextual Help	(3)	
	Show Active Keybinding	S	Ctrl+Shift+L
	Cheat Sheets		
	Renesas Help		>
Ø	Add Renesas Toolchains		
2	Perform Setup Tasks		
~ _	Check for Updates		
₽.	Install New Software		
	IAR Embedded Workben	ch plugin manager	
•	About e ² studio		

Figure 7-1. Help – Help Menu

Quick Help Tips:

- (1) Click **Welcome** for an overview of the e² studio and to view Release Notes.
- (2) Click **Help Contents** to open a separate **Help** window with a search function.
- (3) Click **Show Contextual Help** to open the **Help** view within the workbench.

Under the **Help Contents** window, there are many useful topics such as:

• The "e² studio Debug Help" topic which provides useful information such as debug configuration, supported number of breakpoints, etc.

It can be launched by clicking on the Help menu \rightarrow Help Contents \rightarrow e² studio Debug Help.

The "Synergy Contents" topic which provides information about Synergy project creation, using the Synergy Configuration Editor and FAQs.

It can be launched by clicking on the Help menu \rightarrow Help Contents \rightarrow Synergy Contents.



Renesas Synergy™ Platform

Revision History

Renesas Synergy™ e² studio User's Manual: Quick Start Guide

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		Page	Summary
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1.10	Apr.29.2022	- 16 84	Fixed by version upgrade of e ² studio and SSP. Removed "2.4 Confirmation of Synergy license" (SSP 2.2.0 no longer requires license keys) "3.1 Generating a New Synergy Project" changed due to e2 studio updates. Help menu changed due to e2 studio updates.



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