e² studio
Integrated Development Environment
User’s Manual: Getting Started Guide

Target Device
RX, RL78, RH850 and RZ Family

Renesas Electronics
www.renesas.com

Rev.4.00 May 2016
Notice

1. Descriptions of circuits, software and other related information in this document are provided only to illustrate the operation of semiconductor products and application examples. You are fully responsible for the incorporation of these circuits, software, and information in the design of your equipment. Renesas Electronics assumes no responsibility for any losses incurred by you or third parties arising from the use of these circuits, software, or information.

2. Renesas Electronics has used reasonable care in preparing the information included in this document, but Renesas Electronics does not warrant that such information is error free. Renesas Electronics assumes no liability whatsoever for any damages incurred by you resulting from errors in or omissions from the information included herein.

3. Renesas Electronics does not assume any liability for infringement of patents, copyrights, or other intellectual property rights of third parties by or arising from the use of Renesas Electronics products or technical information described in this document. No license, express, implied or otherwise, is granted hereby under any patents, copyrights or other intellectual property rights of Renesas Electronics or others.

4. You should not alter, modify, copy, or otherwise misappropriate any Renesas Electronics product, whether in whole or in part. Renesas Electronics assumes no responsibility for any losses incurred by you or third parties arising from such alteration, modification, copy or otherwise misappropriation of Renesas Electronics product.

5. Renesas Electronics products are classified according to the following two quality grades: “Standard” and “High Quality”. The recommended applications for each Renesas Electronics product depends on the product’s quality grade, as indicated below.
   “Standard”: Computers; office equipment; communications equipment; test and measurement equipment; audio and visual equipment; home electronic appliances; machine tools; personal electronic equipment; and industrial robots etc.
   “High Quality”: Transportation equipment (automobiles, trains, ships, etc.); traffic control systems; anti-disaster systems; anti- crime systems; and safety equipment etc.

Renesas Electronics products are neither intended nor authorized for use in products or systems that may pose a direct threat to human life or bodily injury (artificial life support devices or systems, surgical implantations etc.), or may cause serious property damages (nuclear reactor control systems, military equipment etc.). You must check the quality grade of each Renesas Electronics product before using it in a particular application. You may not use any Renesas Electronics product for any application for which it is not intended. Renesas Electronics shall not be in any way liable for any damages or losses incurred by you or third parties arising from the use of any Renesas Electronics product for which the product is not intended by Renesas Electronics.

6. You should use the Renesas Electronics products described in this document within the range specified by Renesas Electronics, especially with respect to the maximum rating, operating supply voltage range, movement power voltage range, heat radiation characteristics, installation and other product characteristics. Renesas Electronics shall have no liability for malfunctions or damages arising out of the use of Renesas Electronics products beyond such specified ranges.

7. Although Renesas Electronics endeavors to improve the quality and reliability of its products, semiconductor products have specific characteristics such as the occurrence of failure at a certain rate and malfunctions under certain use conditions. Further, Renesas Electronics products are not subject to radiation resistance design. Please be sure to implement safety measures to guard them against the possibility of physical injury, and injury or damage caused by fire in the event of the failure of a Renesas Electronics product, such as safety design for hardware and software including but not limited to redundancy, fire control and malfunction prevention, appropriate treatment for aging degradation or any other appropriate measures. Because the evaluation of microcomputer software alone is very difficult, please evaluate the safety of the final products or systems manufactured by you.

8. Please contact a Renesas Electronics sales office for details as to environmental matters such as the environmental compatibility of each Renesas Electronics product. Please use Renesas Electronics products in compliance with all applicable laws and regulations that regulate the inclusion or use of controlled substances, including without limitation, the EU RoHS Directive. Renesas Electronics assumes no liability for damages or losses occurring as a result of your noncompliance with applicable laws and regulations.

9. Renesas Electronics products and technology may not be used for or incorporated into any products or systems whose manufacture, use, or sale is prohibited under any applicable domestic or foreign laws or regulations. You should not use Renesas Electronics products or technology described in this document for any purpose relating to military applications or use by the military, including but not limited to the development of weapons of mass destruction. When exporting the Renesas Electronics products or technology described in this document, you should comply with the applicable export control laws and regulations and follow the procedures required by such laws and regulations.

10. It is the responsibility of the buyer or distributor of Renesas Electronics products, who distributes, disposes of, or otherwise places the product with a third party, to notify such third party in advance of the contents and conditions set forth in this document, Renesas Electronics assumes no responsibility for any losses incurred by you or third parties as a result of unauthorized use of Renesas Electronics products.

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

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

(Note 1) “Renesas Electronics” as used in this document means Renesas Electronics Corporation and also includes its majority-owned subsidiaries.

(Note 2) “Renesas Electronics product(s)” means any product developed or manufactured by or for Renesas Electronics.
How to Use This Manual

This manual describes the role of the e² studio integrated development environment for developing applications and systems and provides an outline of its features.

e² studio is an integrated development environment (IDE) for RX family, RL78 family, RZ family and Renesas Synergy integrating the necessary tools for the development phase of software (e.g. design, implementation, and debugging) into a single platform. About Synergy development platform, please refer to the Synergy Gallery documents found at: https://synergygallery.renesas.com/

By providing an integrated environment, it is possible to perform all development using just this product, without the need to use many different tools separately.

Readers
This manual is intended for users who wish to understand the functions of the e² studio and design software and hardware application systems.

Purpose
This manual aims to provide user with the explanation of the functions provided in e² studio when they commence the development of their hardware and software systems using the targeted devices.

Organization
This manual can be broadly divided into the following units.

CHAPTER 1 GENERAL
CHAPTER 2 INSTALLATION
CHAPTER 3 PROJECT GENERATION
CHAPTER 4 BUILD
CHAPTER 5 DEBUG
CHAPTER 6 HELP

How to Read This Manual
It is assumed that the readers of this manual have general knowledge of electricity, logic circuits, and microcontrollers.

Conventions
Data significance: Higher digits on the left and lower digits on the right
Active low representation: XXX (overscore over pin or signal name)
Note: Footnote for item marked with Note in the text
Caution: Information requiring particular attention
Remark: Supplementary information
Numeric representation: Decimal ... XXXX
Hexadecimal ... 0xXXXX
# TABLE OF CONTENTS

CHAPTER 1. GENERAL

1.1. System Configuration ................................................................. 1
1.2. Operating Environment .............................................................. 1

CHAPTER 2. INSTALLATION ...................................................................... 3

2.1. Installation of e² studio IDE .......................................................... 3
2.2. Un-installation of e² studio IDE .................................................... 4
2.3. Upgrade of e² studio IDE .............................................................. 4
2.4. Installation of Compiler Package ................................................. 5

CHAPTER 3. PROJECT GENERATION ...................................................... 7

3.1. New Project Generation .............................................................. 7
3.2. Import Existing Projects Into Workspace ..................................... 11
3.3. HEW Project Import ................................................................. 17
3.4. CS+ Project Import ................................................................. 19

CHAPTER 4. BUILD ............................................................................... 21

4.1. Build Option Settings .............................................................. 21
4.2. Build A Sample Project ............................................................ 23
4.3. Build Configuration Report ....................................................... 24

CHAPTER 5. DEBUG ............................................................................ 25

5.1. Change existing debug configuration ......................................... 25
5.2. Create New Debug Configurations ........................................... 29
5.3. Basic Debugging Features ......................................................... 31

CHAPTER 6. HELP ............................................................................... 48
CHAPTER 1. GENERAL

Renesas eclipse embedded studio (known as “e² studio”) is a complete, state of the art development environment supporting Renesas embedded micro-controllers. It is developed based on a popular open-source Eclipse CDT (C/C++ Development Tooling) project that covers build (e.g. editor, compiler and linker control) and debug phase with an extended GDB interface support.

This chapter describes the system configuration and operating environment for e² studio IDE to develop applications for the RX family series microcontrollers as example. The descriptions e² studio in this document is based on e² studio V5.0, unless otherwise noted.

1.1. System Configuration

Below is an example of a typical system configuration.

![Figure 1-1 System Configuration](image)

1.2. Operating Environment

Below are the system requirements for this product.

1.2.1. System Requirements

PC Hardware Environment:
Processor: At least 1GHz (support hyper-threading/multi-core CPU)
Main Memory: At least 1GB (2GB or larger is recommended, especially for Windows 64-bit OS)
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.

PC Software Environment:
Windows 7 (32/64-bit OS), Windows 8.1 (32/64-bit OS) and Windows 10 (32/64-bit OS)
1.2.2. Supported Toolchain

1.2.2.1. Supported Compiler

Renesas C/C++ compiler package for RX family

Renesas C compiler package for RL family

Renesas GNUARM-NONE Windows Toolchain (ELF)

GCC for Renesas GNURX Windows Toolchain (ELF)

GCC for Renesas GNURL78 Windows Toolchain (ELF)

1.2.2.2. Supported Emulator

E2 emulator Lite (RX, RL78), E1 (RX, RL78, RH850), E20 (RX), IECUBE(RL78) and Segger J-Link (RX, RZ)

1.2.2.3. Supported Simulator

Renesas Simulator (RX, RL78)
CHAPTER 2. INSTALLATION

The latest e² studio IDE installer package can be downloaded from Renesas website for free. User has to login to the Renesas account (in MyRenesas page) for the software download.

This chapter describes the installation and un-installation for the e² studio IDE.

Notes:
1. Two types of installers are available and Web installer (smaller one) requires Internet connection to perform installation.
2. Note 1: e² studio does not support updating between major versions such as from V4.x (any of V4.0.0 to V4.3.1) to V5.x (V5.0.0 or later). Please uninstall the earlier versions before installation. Alternatively, install a new e² studio into a new folder.
3. Note 2: e² studio installer (V4 or later) has a ‘Modify’ function to add or remove features in the existing installation. Please update e² studio with [Help], [Check for Updates] before using the ‘Modify’ function.

2.1 Installation of e² studio IDE

(1) Double-click on e² studio installer to invoke the e² studio installation wizard page. Click the [Next] button to continue.

(2) Install Folder
The default installation location is set to: “C:\Renesas\e2_studio”. Input install folder directly to textbox or click [Browse…] button to modify it.
Select Windows users that e² studio is installed for.
Click the [Next] button to continue.

(3) Device Families
Select Devices Families to install. Click the [Next] button to continue.

(4) Extra Components
Select Extra Components (i.e. language pack, SVN & Git support, Micrium, RTOS support) to install.
Click the [Next] button to continue.

(5) Components
Select Components and click the [Next] button to continue.

(6) Additional Software
Select additional software (i.e. compilers, utilities) and click the [Next] button to continue.

(7) License Agreement
Read and accept the software license agreement to proceed with the [Next] button.
Please note that user has to accept the license agreement, otherwise installation cannot be continued.

(8) Shortcuts
Select shortcut name for start menu and click [Next] button to continue.

(9) Summary
Click the [Install] button to install the Renesas e² studio IDE.

(10) Installing…
The installation is performed. Based on selected items of Addition Software, new dialogs are opened to proceed with installation for these software.
(11) Results
   Click [Finish] button to complete the installation.

2.2. Un-installation of e² studio IDE

User can uninstall e² studio program following the typical steps to uninstall a program in Window OS.

   (1) Click on [Start] → [Control Panel] → [Programs and Features]
   (2) From the currently installed programs list, choose “e² studio” and click the [Uninstall] button.
   (3) Click the [Uninstall] button to confirm the deletion in the “Uninstall” dialog.

At the end of the un-installation, e² studio IDE will be deleted from the installed location and Windows short-cuts menu are removed.

2.3. Upgrade of e² studio IDE

This section illustrates how to update e² studio with the upgrade function of the installer.

   (1) Download the desired new version of e² studio offline installer from the following Renesas URL:
   \[http://www.renesas.com/e2studio_download\]

   Note 1: Two types of installers are available but Web installer requires Internet connection to perform installation.

   Note 2: Offline version update using ‘Differential Update program’ is only applicable for e² studio Ver3.X and below only.

   (2) Double-click to run the installer file downloaded in step (1). The installer will detect existing version and user can choose to upgrade or install new e² studio version to a different folder.

   Click [Upgrade], [Next] to begin upgrading, or choose [Install] to install into the new location.

![Figure 2-1 Upgrade e² studio with installer](image)
Follow the steps shown in Section 2.1 Installation of e² studio IDE. When Upgrade was chosen, the step (2) Install Folder will be skipped since using the same location of existing e² studio.

Figure 2-2 e² studio – About e² studio panel

Click the [Help] → [About e² studio] to confirm the updated version.

2.4. Installation of Compiler Package

e² studio installer (V4.0 or later) is capable to install compiler packages automatically during e² studio installation with valid Internet connection. However, in situation where Internet connection is not available during e² studio installation, compiler packages can be installed later from compiler package installation files from the web site shown below. This procedure is common with older e² studio than V3.1.

Renesas Compiler Package download sites:

For RX Family: [http://www.renesas.com/rx_c](http://www.renesas.com/rx_c)

For RL78 Family: [http://www.renesas.com/rl78_c](http://www.renesas.com/rl78_c)

GNU Toolchain download site:
[https://gcc-renesas.com/](https://gcc-renesas.com/)

To check for compilers already installed, click ![Installation Details](https://www.renesas.com/support/eclipse/tools/inst/about) from the toolbar or click [Help] → [Add Renesas Toolchains] to open Renesas Toolchain Management as shown below. Check the desired toolchain to integrate it in e² studio.

If desired compiler is not listed, click [Add…] and specify the installed location.
Figure 2-3 Toolchain Management
CHAPTER 3. PROJECT GENERATION

This chapter describes the creation of new project and import of existing \(e^2\) studio project, High-performance Embedded Workshop IDE (described as “HEW” below) project and CS+ project to \(e^2\) studio IDE.

Note: 1. To install and use the \(e^2\) studio on your PC, you must install the compiler package provided separately.

2. Multi-byte characters should be used for \(e^2\) studio installation folder name, workspace folder name, project name and its folder, and source file name. File path to any source files also should not contain any Multi-byte characters.

3.1. New Project Generation

To create a new project with Renesas RXC toolchain, invoke \(e^2\) studio IDE from the Windows ([Start] menu) and specify a workspace directory.

(1) Click [File] → [New] → [C Project] to create a new C Project. New project creation Wizard as shown below will start.

![Figure 3-1 New Project Creation Wizard (1/4)](image_url)
(2) Enter the project name and select toolchains: “Renesas RXC Toolchain”. Click [Next] to continue. If “Renesas RXC Toolchain” is not available, please follow the steps in Section 2.5 to install ‘RX Compiler Package’.

(3) Select Toolchain Version, Debug Hardware and Target Device. (For e.g., Toolchain Version: “v2.04.00”, Debugger Hardware: “E1” and Target Device: “RX64M [176 pin device, part number: R5F564MLxCFC]”). Click [Next] to proceed.

Note: “E2 Lite” can be selected in the same way as E1 in the Debug Hardware pull down menu.
Check the “Use Peripheral code Generator” or “Use FIT modules” options if available (depends on target device, FIT is available for RX family), otherwise ignore this setting. Click [Finish] to complete it. FIT modules can be downloaded at this dialog, or you can also add modules later.

Note: Please refer to “Renesas device support” tab in “Installation details” dialog.
(5) A project summary is displayed. Click [Ok] to generate the project.

![Figure 3-5 New C Project Created](image)

(6) A brand new C project named “Tutorial” is created as shown above.

This project consists of an application file “Tutorial.c” and standard start-up files (e.g. “dbset.c”, “interrupt_handlers.c”, “sbrk.c” etc.). All these project and source files listed in the [Project Explorer] panel reflects the folder structure of the project, just as seen on the standard file explorer.

**Notes for backing up projects:**

- Project properties are stored in files or folders which filenames or folder names are prefixed with a '.' (dot), for example "project". It is necessary to include these files or folders when archiving the project for back-up purpose.

- In order to restore properties shared among projects, for instance when one project make reference to another project's files, please backup the whole workspace folder.
### 3.2. Import Existing Projects Into Workspace

This section explains how to import existing projects from a directory or an archive into workspaces.

![Figure 3-6 Import Existing Projects Wizard](image)

**Figure 3-6 Import Existing Projects Wizard**

1. In e² studio IDE, click [File] → [Import] to open the HEW Project import wizard. Select “Existing Projects into Workspace” and click [Next] button to open “Import Projects” window.
Figure 3-7 Import Projects Window In e² studio IDE

(2) Browse for a directory or an archive that stores the projects. All existing project are shown. Select projects to be imported and click [Finish] button to complete importing the projects.
(3) The project has been successfully imported to the e² studio IDE.
Instead of import project with the existing project name, e² studio allows the project to be renamed. With this option, only one project can be imported at a time.

![Import and Rename Project Wizard](image)

**Figure 3-9 Import And Rename Project Wizard**

1. In e² studio IDE, click [File] → [Import] to open the HEW Project import wizard. Select “Rename & Import Existing C/C++ Project into Workspace” and click [Next] button to open “Rename & Import Project” window.
(2) Browse for a directory or an archive that stores the projects. All existing project are shown. Select a project, input its new name, and click [Finish] button to import this project.
The project has been successfully renamed and imported to the e² studio IDE.
3.3. HEW Project Import

This section explains HEW import feature to migrate existing project workspace to the e² studio IDE. This enables code re-usability for application codes and workspace created in HEW IDE previously.

![HEW Project Import Wizard](image)

**Figure 3-12 HEW Project Import Wizard**

1. In e² studio IDE, click [File] → [Import] to open the HEW Project import wizard. Select “HEW Project” and click [Next] button to open ‘Import HEW Project(s)’ window.

2. Browse for the HEW Project file (.hwp) and click [Finish] button to import this project.
(3) The HEW project has been successfully imported to the e² studio IDE.

After conversion, all the original project and source files are kept with the newly generated project workspace in e² studio IDE. In addition, “.cproject”, “.*linker”, “.info” and “.project” are created and added. Both the HEW and e² studio project workspaces share the same files in the physical file location.

If HEW project import fails, please check the following two (2) pre-requisite conditions:

(i) HEW project workspace must be of the version, v4.07 and above
(ii) Files e.g. “.cproject”, “.*linker”, “.info” and “.project” must be deleted manually for HEW project re-import.

Tips: In order for HEW project workspace older than v4.07 to be imported, please update this workspace by using HEW v4.07 and above version first.
3.4. CS+ Project Import

For code re-usability purpose, this section explains the CS+ import feature to migrate existing project workspace to the e² studio IDE.

![Figure 3-14 CS+ Project Import Wizard (1/2)](image)

In e² studio IDE, click [File] → [Import]. Select “Renesas Common Project File” and click [Next] button to proceed. “Import Projects” window will open.

1. Browse for the CS+ Project file (.rcpe) and click [Finish] button to import this project.

![Figure 3-15 Project Migration from CS+ to e² studio IDE](image)

2. The CS+ project has been successfully imported to the e² studio IDE.
After conversion, all the original project and source files are kept with the newly generated project workspace in e² studio IDE. In addition, “.cproject”, “*.linker”, “.info” and “.project” are created and added. Both the CS+ and e² studio project workspaces share the same files in the physical file location.
CHAPTER 4. BUILD

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

4.1. Build Option Settings

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 option is necessary (e.g. Toolchain version, Optimization options, etc.), please follow the following steps before building the project.

Figure 4-1 Properties for Tutorial Project and Properties for Tutorial.c Source File

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

(1) Set the focus at the project “Tutorial” or set the focus at the source file Tutorial.c

(2) Click the icon (or right-click to select [Properties], or use shortcut keys [Alt]+[Enter] or [Alt]+[T]) to open properties dialog.
(3) Click “C/C++ Build” option to view or edit the configuration settings.

Properties window is supported at workspace, project, and source level. Properties window for project supports more configuration which applies across all the files within the same project workspace.

![Properties window for Tutorial](image)

**Figure 4-2 Change Toolchain Version**

(1) Click [C/C++ Build] → [Change Toolchain Version] to view or change toolchain version.

You can choose toolchain among the versions listed in “Available Versions” drop down list, based on the configuration of Toolchain management view as mentioned at Figure 2-3.

![Environment settings](image)

**Figure 4-3 Build Settings for Compiler: Environment**

(2) Click [C/C++ Build] → [Environment] to set build option and add or edit the environment variables.

Build option allows user to retain all the toolchain configuration settings, including path name specified by using the environment variables. The current build configuration is “HardwareDebug [Active]”, as shown in Figure 4-3.

The detail of build option is described in compiler user manual which is stored at “{Compiler installation directory}/doc”. For example, it can be found in “C:\Program Files\Renesas\RX\2_3_0\doc\”.
4.2. Build A Sample Project

Figure 4-4 Build a Sample “Tutorial” Project

(1) Under e² studio IDE environment, create a new project named “Tutorial” (or open any existing project).

(2) In [Project Explorer], click at the project to set focus.

(3) Click [Project] → [Build Project] or icon to build this project.

The [Console] pane shows ‘Build complete.’ message to indicate a successful build. At the end of this build, files output to the $CONFIGDIR directory consists of “makefile”, “Tutorial.abs”, “Tutorial.map”, “Tutorial.mot”, “Tutorial.x” etc.

“Tutorial.abs” is a Renesas standard load module in ELF/DWARF format (*.abs) used for the debugging. Because GDB supports a load module format with different ELF/DWARF specification (*.x), hence “Tutorial.abs” is converted to “Tutorial.x” for the debugging in e² studio IDE.
4.3. Build Configuration Report

The Project Reporter feature can export project and build configuration settings from e² studio IDE to a file for easy checking and comparison of project/build environment settings.

Figure 4-5 Project Reporter

(1) Right-click at [Project Explorer] to pop up context menu

(2) Select [Save build setting report] to save build settings report
CHAPTER 5. DEBUG

This chapter describes the usage of debug configuration and key debugging features for e² studio IDE. The following illustration refers to “Tutorial” project built (in Chapter 4.2) and based on hardware configuration: E1 emulator or E2 emulator Lite and RSK RX64M board.

![Debug Perspective](image)

**Figure 5-1 Switch to [Debug] Perspective**

1. Open “Tutorial” project workspace in e² studio IDE and click [Debug] perspective.

Perspective defines purpose-specific window layout of Workbench. Each perspective consists of a combination of views, menus, and toolbars. By switching perspective, views are laid out optimized for each purpose.

For instance, [C/C++] perspective has views that help user to develop C/C++ programs and [Debug] perspective has views that enable user to debug the program. If user attempts to connect the debugger in the [C/C++] perspective, IDE will then prompt users to switch to the [Debug] perspective.

Workbench can have multiple perspectives and user can customize them, or add even more perspectives.

Note: For more information on debug, please refer to “e² studio Debug Help” as described in chapter 6.

5.1. Change existing debug configuration

For the first time of launch debugger of the project, Debug Configuration should be adjusted. Default configuration can be changed as following operations:

![Debug Configurations Window](image)

**Figure 5-2 Open Debug Configurations Window**


Click [Run] → [Debug Configurations…] or icon (downward arrow) → [Debug Configurations…] to open the “Debug Configurations” window.
Figure 5-3 Select Load Module

(2) In “Debug Configurations” windows, expand the “Renesas GDB Hardware Debugging” debug configuration and click on existed debug configuration (e.g. “Tutorial HardwareDebug”).

(3) Go to the [Main] tab and browse to add the load module “Tutorial.x” located in the project build folder.

Figure 5-4 Select Target Device

(4) Switch to the [Debugger] tab, set “E1” as the debug hardware and “R5F564ML” as the target device.

- Debug Hardware: “E1”
- Target Device: “R5F564ML”
Figure 5-5 Change Connection Setting

(5) Under the [Debugger] tab, go to the [Connection Settings] sub tab to configure the following based on the settings in E1 emulator and RSK RX64M board:

- Clock
  - Main Clock Source = “EXTAL”
  - Extal Frequency(MHz) = “24.0000”

- Connection with Target Board
  - Connection Type = “JTag”
  - JTag Clock Frequency [MHz] = “16.5”

- Power
  - Power Target From The Emulator (MAX 200mA) = “No”

- Communication Mode
  - Mode = “Debug Mode”

When “Power Target From The Emulator (MAX 200mA)” is set to “Yes”, the emulator will power up (with current up to 200mA) the target board without an external power source.

Note: This debug configuration in Figure 5-5 is shown as an example. The wrong settings may cause malfunction or damage to the hardware. So, do be cautious to verify the board and emulator settings before connection.
In addition, e² studio also provides the function of duplicating existing project debug configuration for a new project. This is applicable for the projects using the same device and debugger settings.

![Image of Debug Tool Settings]

**Figure 5-6 Change Debug Tool Settings**

(6) Switch to [Debug Tool Settings] sub tab, based on the RSK RX64M board to ensure

- Memory
  
  Endian = “Little Endian”

(7) Click [Apply] button to confirm the settings.

(8) Click [Debug] to execute the debug launch configuration to connect to the E1 (or E2 Lite) and RSK RX64M board.
For a successful connection, [Debug] view to show target debugging information in a tree hierarchy. The program entry point is set at “PowerON_Reset()” in “r_cg_resetprg.c”.

5.2. Create New Debug Configurations

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

(1) Click “Tutorial” Project in [Project Explorer] pane to set focus.

Click [Run] → [Debug Configurations…] or icon (downward arrow) → [Debug Configurations…] to open the “Debug Configurations” window.
(2) In “Debug Configurations” window, select a debug configuration (e.g. “Tutorial HardwareDebug”) and then click icon (Duplicates the currently selected launch configuration). A new debug launch configuration (e.g. “Tutorial HardwareDebug (1)”) is created.

(3) The debug configuration can be configured as described in chapter 5.1.

Notes for RL78 debugging:

- Hot Plug connection is supported for RL78/F1A, F13, F14 and F15 only.
5.3. Basic Debugging Features

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

- Standard GDB Debug (supported by Eclipse IDE framework): Breakpoints, Expressions, Registers, Memory, Disassembly and Variables

- Renesas Extension to Standard GDB Debug: Eventpoints, IO Registers and Trace.

To open “Debug Toolbar”, click the pull down menu button and check on [Show Debug Toolbar]. The following are some useful toolbars exist in the [Debug] view:

The program is run by clicking button or pressing [F8].

The program can be paused by breakpoint, or by clicking button. While program is paused, user can perform the following operations:

- button or [F5] can be used for stepping into the next method call at the currently executing line of code.

- button or [F6] can be used for stepping over the next method call (executing but without entering it) at the currently executing line of code.

- button can be clicked again to resume running.

To stop the debugging process, button is clicked to end the selected debug session and/or process or button is clicked to disconnect the debugger from the selected process.

The other operations are as following:

- button can be clicked to restart program from entry point (same as to press then ).

- button can be clicked to reset the program to entry point at the PowerOn Reset.

- button is used for re-downloading the binary file to target system.
5.3.1. Working with Breakpoints

Breakpoints can be placed at source code line or at specific address while debugger connection established. Breakpoint markers can be placed on editor views or on disassembly views, as shown below. When program counter reached to the corresponding instruction address of an enabled breakpoint, the execution suspends (so called break) before execution of the instruction. e² studio allows software and hardware breakpoint to be set explicitly in IDE. Default type of breakpoints are placed by double-clicking the left gutter of editor view or disassembly view. If the hardware resources are not available, debugger console shows a warning that the breakpoint type has been replaced to “Software”.

There are 2 methods to set breakpoints.

Method 1:

Figure 5-11 [Breakpoint] View – Breakpoint Setting Method 1

To set a breakpoint by method 1,

1. Right-click at the source gutter to choose [Toggle Software Breakpoint] or [Toggle Hardware Breakpoint] to set hardware breakpoint  or software breakpoint  

2. If the hardware resources are not available, debugger console shows a warning that the breakpoint type has been replaced to “Software”.

3. There are 2 methods to set breakpoints.

Method 1:

Figure 5-11 [Breakpoint] View – Breakpoint Setting Method 1

To set a breakpoint by method 1,

1. Right-click at the source gutter to choose [Toggle Software Breakpoint] or [Toggle Hardware Breakpoint] to set hardware breakpoint  or software breakpoint  

2. If the hardware resources are not available, debugger console shows a warning that the breakpoint type has been replaced to “Software”.

3. There are 2 methods to set breakpoints.
Method 2:

![Diagram of e2 studio Breakpoint Types menu]

To set a breakpoint by method 2,

1. Right-click to pop up context menu to choose [Breakpoint Types] → [e2 studio Breakpoint] (hardware breakpoint by default) or [Breakpoint Types] → [C/C++ Breakpoints] (software breakpoint)
2. Double-click at the source gutter to set software or hardware breakpoint
3. Click [Show View] → [Breakpoint] or icon (or use shortcut key [ALT]+[Shift]+[Q], [B]) to open [Breakpoints] view to view the corresponding hardware/software breakpoint set.

To disable breakpoints, user can choose to disable breakpoints selectively or to skip all breakpoints.

1. Breakpoints can be enabled and disabled in [Breakpoints] view. A disabled software breakpoint is displayed as a white . A disabled hardware breakpoint is displayed as a white .
2. To skip all breakpoints, click on the icon in the Breakpoints view. A blue dot with a backslash will appear in the editor pane as well as in the Breakpoints view.
5.3.2. Expressions View

Expressions view monitors the value of global variable, static variable or local variable during debugging. The view is refreshed at break and background will be colored in yellow when the value has been changed from last time. Real-time refresh enabled variables (‘R’ marker is shown) are periodically updated at each configured time while running debugger.

To watch a global variable,

1. Click [Show View] → [Expressions] or icon \( \text{ policing } \) to open the [Expressions] view.
2. In “main.c” at line 114, drag and drop a global variable (e.g. “gPeriodic_Delay”) over to the [Expressions] view. (Alternatively, right-click at the global variable to select “Add Watch Expression…” menu item to add it to the [Expressions] view).
3. In the [Expressions] view, right-click to select “Real-time Refresh” menu item. This refresh the expression value in real-time when program is running. The character “R” indicates that this global variable will be updated in real-time.
4. To disable the “Real-time Refresh”, simply right-click to select “Disable Real-time Refresh” menu item.

![Figure 5-13 [Expression] View](image_url)
5.3.3. Registers View

Register view lists the information about the general registers of the target device. Changed values are highlighted when the program stops.

![Figure 5-14 [Registers] View](image)

To view the general register “r0”,

1. Click [Show View] → [Registers] or icon ![Registers icon] to open the [Registers] view.
2. Click “r0” to view the values in different radix format.

Values that have been changed are highlighted (e.g. in yellow) in the [Registers] view when the program stops.
5.3.4. Memory View

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 (e.g. Hex integer, signed integer, unsigned integer, ASCII, image etc).

![Memory View Diagram]

To view memory of a variable (e.g. “Data1”),

1. Click [Show View] → [Memory] or icon to open the [Memory] view.
2. Click the icon to open [Monitor Memory] dialog box. Enter the address of the variable “Data1”.

The global variable “data1” is specified by the address “&Data1”.

The global variable “data1” is presented in memory renderings of “Hex Integer” format.

Figure 5-15 [Memory] View (1/2)
To add new renderings format (e.g. Raw Hex) for the variable “Data1”,

1. Click the tab to select “Raw Hex” to add the rendering.

This creates a new tab named “&Data1 < Raw Hex>” next to the tab “&Data1<Hex Integer>”.
5.3.5. Disassembly View

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

Figure 5-17 [Disassembly] View

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

1. Click [Show View] → [Disassembly] or icon to open the [Disassembly] view
2. Click icon 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”.
4. You can enable source addresses within the editor using the context menu.
Figure 5-18 Source Addresses Menu

Figure 5-19 Source Addresses displayed in Editor
5.3.6. Variables View

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

![Image of switch.c code snippet with highlighted `StartDebounceTimer()` function and `compare_match` variable]

**Figure 5-20 [Variables] View**

To observe a local variable (e.g. “compare_match” for function “StartDebounceTimer()”),

1. Click [Show View] → [Variables] or icon to open the [Variables] view.
2. Step into the function “StartDebounceTimer ()” to view the value of local variable “compare_match”.

```c
void StartDebounceTimer(uint16_t compare_match) {
    /* Declare local static variable to track if the CMT timer has been
    initialised yet */
    static bool timer_initialised = false;
    /* Check if the CMT timer is not initialised (first time function has been
    called). */
    if(timer_initialised)
        /* Disable register protection */
        SYSTEM_PRER.ONLY = 0x050B;
}
```
5.3.7. Eventpoints View

An event refers to a combination of conditions set for executing break or trace features during program execution. [Eventpoints] view enables user to set up or view defined events of different category e.g. trace start, trace stop, trace record, event break, before PC, performance (timer) start and performance (timer) stop.

The number of events that can be set and the setting conditions differ with each MCU. These are two (2) types of events:

- **Execution address**: The emulator detects execution of the instruction at the specified address by the CPU. It can be a “before PC” break (e.g. with event condition is satisfied immediately before execution of the instruction at the specified address) or other events (e.g. with event condition is satisfied immediately after execution of the instruction at the specified address).

- **Data access**: The emulator detects access under a specified condition to specified address or specified address range. This allows to setup complex address and data matching criteria.

Event combination (e.g. OR, AND (cumulative) and Sequential) can be applied to two (2) or more events.

![Figure 5-21 [Eventpoints] View (1/2)](image)

To set an event break for a global variable when address/data is matched (e.g. when gFlashCount = “0xB0”),

1. Click [Show View] → [Eventpoints] or icon to open the [Eventpoints] view.
2. Double-click at “Event Break” option to open [Edit Event Break] dialog box
3. Click [Add...] button to continue.
(4) Select “Data Access” as the eventpoint type.

(5) Go to the [Address Settings] tab, click the icon to browse for the symbol “_gFlashCount”. (The address of this global variable is “&_gFlashCount”)

(6) Next, switch to the [Data Access Settings] tab, enable the [Compare Settings] checkbox and set the compare value equals to “0xB0”. Click [Ok] to proceed.

(7) Ensure that the event break for “gFlashCount = 0xB0” is set and enabled in the [Eventpoints] view. Reset to execute the program from the start.
Figure 5-23 Execution of Event Break

Figure 5-23 shows that when gFlashCount reaches the value of 176 (or 0xB0), the program stops at code line no. 76.
5.3.8. IO Registers View

IO Registers is also known as the Special Function Registers (SFR). The [IO Register] view displays all the registers set defined in a target-specific IO file, including their address, hex and binary value. User can further customize own [IO registers] view by adding IO registers selectively to the [Selected Registers] pane.

Figure 5-24 [IO Registers] View

To view selected IO registers (e.g. PDR and PCR in PORT0),

1. Click [Windows] → [Show View] → [Others…]. In “Show View” dialog, click [IO Registers] under [Debug] or icon to open the [IO Registers] view

2. Under the [All Registers] tab, locate [PORT0] in the [IO Registers] view. Expand the PORT0 IO register list.

3. Drag and drop the “PDR” and “PCR” to the [Selected Registers] pane. A green dot besides the IO register indicates the status of being the selected register(s).

4. Switch to the [Selected Registers] tab to view “PDR” and “PCR” of the “PORT0” IO register

The expanded IO register list may take a longer 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.
5.3.9. 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 user to track the program execution flow to search for and examine the points where problems arise.

The trace buffer is limited (with size of 1 to 32 Mbytes), oldest trace data is overwritten with the new data after the buffer has become full.

![Image of Trace View](image_url)

**Figure 5-25 [Trace] View (1/2)**

To set a point-to-point trace between the two (2) functions (e.g. tracing from function “main()” to “sort()”),

- Click [Windows] → [Show View] → [Others…]. In “Show View” dialog, click [Trace] under [Debug] or icon to open the [Trace] view.
- Turn on the Trace view by selecting the icon.
- Click icon (Acquisition) to set
  - Trace Mode: “Fill until stop”
  - Trace Type: “Branch”
- Click [OK] to proceed.
Figure 5-26 [Trace] View (2/2)

- Click (Edit Trace Event Points) to open [Trace Eventpoints] dialog box.
- Under the [Start] tab, add the 1st event point at “main()” function (by the execution address “&main”, or 0xFFFFC8228).
- Then, switch to [Stop] tab, add the 2nd event point at “Display_LCD()” function (by the execution address “&Display_LCD”, or 0xFFFFC816F).
- Next, execute the program after reset.
Figure 5-27 Point-to-Point Trace between Two Functions

The figure above shows the trace result from function “main()” to “Display_LCD()”. The trace result can be filtered by the key trace parameters (e.g. branch type, address range) and saved to a .xml format (with the inclusion of bus, assembly and source information).
CHAPTER 6. HELP

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

Click on [Help] tap to pull down Help menu.

Quick Help Tips

① Click [Welcome] for Overview of e² studio, link to access IDE tutorial and sample, and to view Release Notes.

② Click [Help Contents] to open a separate Help window with search function.

③ Click [Dynamic Help] to open Help view within the workbench.

④ Click [RenesasRulz Community Forum] to go online forum that is dedicated to topics and discussion related to e² studio IDE. Internet connection is required.
Under the [Help Contents] window, there are many useful topics. One of them is the “e\(^2\) studio Debug Help” topic, which provides useful information such as debug configuration, supported number of breakpoints, usage of emulator etc. It can be launched by clicking on [Help] menu → [Help Contents] → “e\(^2\) studio Debug Help”.
## Revision Record

<table>
<thead>
<tr>
<th>Rev.</th>
<th>Date</th>
<th>Description</th>
<th>Summary</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.00</td>
<td>Sep 30, 2013</td>
<td>- First Edition issued</td>
<td></td>
</tr>
<tr>
<td>2.00</td>
<td>Apr 15, 2014</td>
<td>- Supporting e² studio IDE v3.0.0.022</td>
<td></td>
</tr>
<tr>
<td>2.10</td>
<td>Dec 08, 2014</td>
<td>- Supporting e² studio IDE v3.1.2.009</td>
<td></td>
</tr>
<tr>
<td>3.00</td>
<td>June 16, 2015</td>
<td>- Supporting e² studio IDE v4.0.0.023</td>
<td></td>
</tr>
<tr>
<td>4.00</td>
<td>May 27, 2016</td>
<td>- Supporting e² studio IDE v5.0.0.043</td>
<td></td>
</tr>
</tbody>
</table>
Refer to "http://www.renesas.com/" for the latest and detailed information.
e² studio