RZ/A1LU Group

Stream it! - RZ Graphics Demonstration

Introduction

This application note uses the Stream it! - RZ kit to run the Graphics Demo. The Stream it! - RZ application demonstrates graphics and touch screen capabilities through four modes; a space invaders game, a notepad, camera display, and user interface.

The hardware needed to follow this application note includes:

- Windows™ 7/ 8/ 8.1/ 10 compatible PC
- Stream it! - RZ V2 Kit including display
- USB to micro USB Cable
- Segger J-Link Lite Debugger

The software components that will be obtained while following this application note include:

- e² studio   (Recommended latest version)
- GNU ARM NONE Embedded Compiler   (Version 16.01)

> This document refers to many third party website resources. These websites are not controlled by Renesas Electronics, and we are therefore unable to offer support for these resources.

The following documents apply to the RZ/A1LU based Renesas Stream it! - RZ V2. Please refer to the latest versions of these documents.

Document Type	Description	Document Title	Available from
Hardware Manual	Provides technical details of the RZ/A1LU microcontroller.	RZ/A1LU Group User's Manual: Hardware	https://www.renesas.com/en-eu/products/microcontrollers-microprocessors/rz/rza/rza1lu.html

Target Device

RZ/A1LU Group

Glossary

ARM	Advanced RISC Machine
FIQ	Fast Interrupt Request
IDE	Integrated Development Environment
IRQ	Interrupt Request
JTAG	Joint Test Action Group
LCD	Liquid Crystal Display
LED	Light Emitting Diode
PC	Personal Computer
QSPI	Quad Serial Peripheral Interface
RAM	Random Access Memory
RGB	Red Green Blue
RISC	Reduced Instruction Set Computing
ROM	Read Only Memory
SPI	Serial Peripheral Interface
UI	User Interface
USB	Universal Serial Bus

Contents

1. Overview

This document aims to guide the user through the Graphics demonstration for the Stream it! - RZ V2 product.
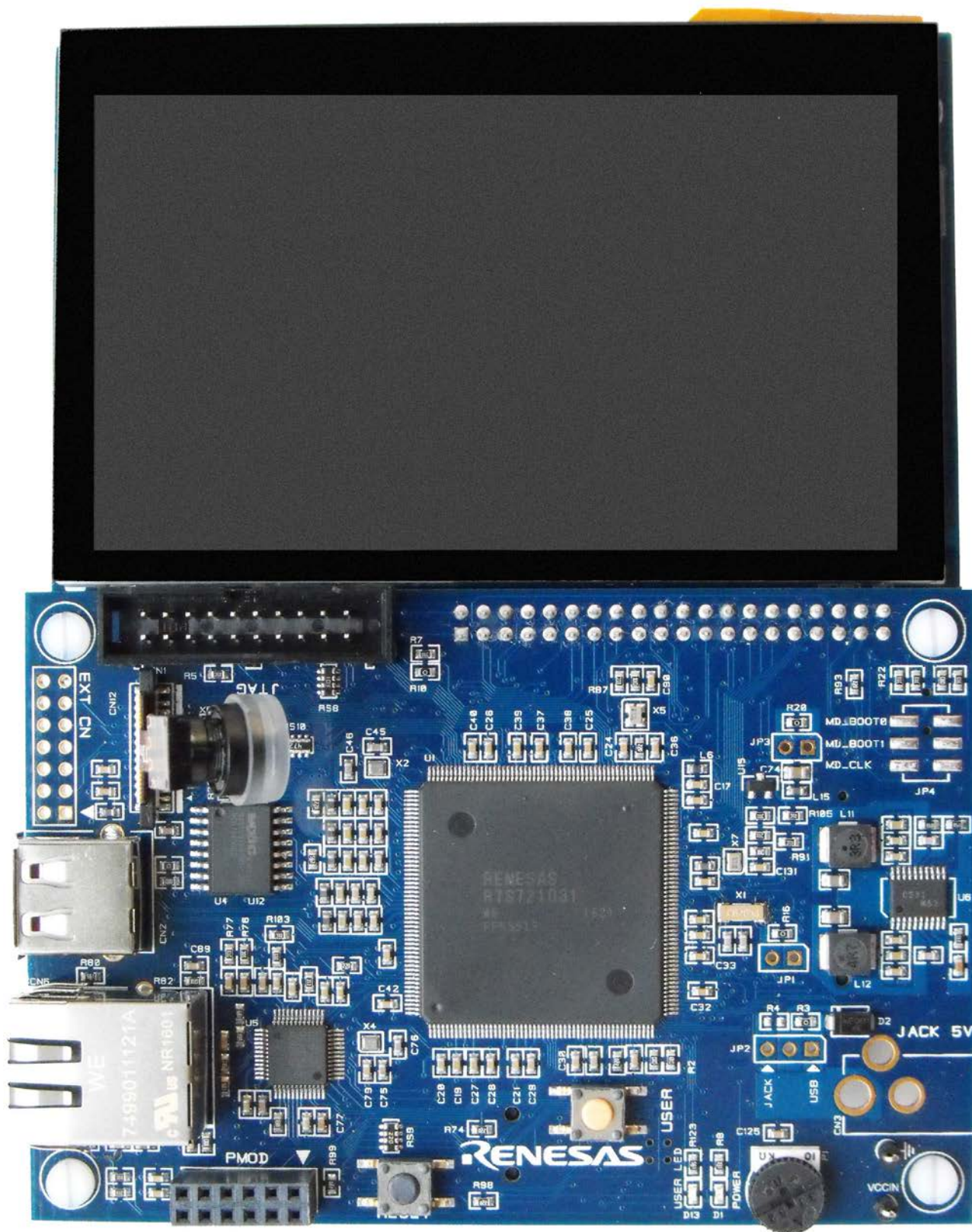

Figure 1 Stream it! - RZ board with LCD display

1.1　Licenses

This sample application does not include any third party code applications.

1.2　Demonstration Operation

Please see section 2.4 for details on how to run the application.

On starting the system, the code initializes the on board peripherals required for the system, including the LCD display, the camera and touch screen.

When running, the application displays a scene which allows the demo to be selected. Swipe the screen left or right to cycle through the four options.
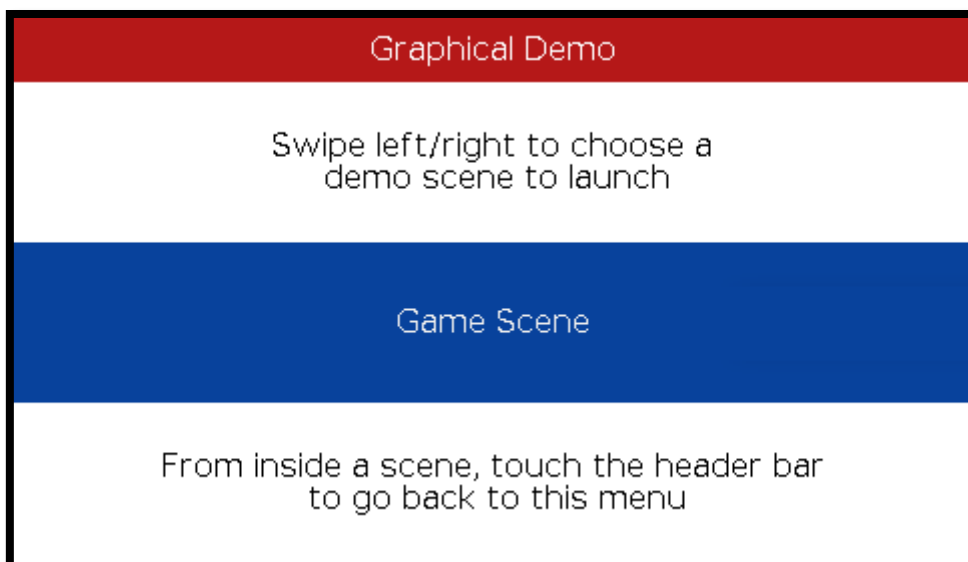

Figure 2 Scene selection

These are:

1)　Game Scene - classic Space Invaders game

2)　Notepad Scene - simple notepad using on screen touch keyboard

3)　Camera Scene - displays the image recorded by the camera

4)　UI Scene - demonstrates several simple UI controls

Touch the option to select it. At any time touching the header bar at the top of the screen will take you back to the main menu.

1.2.1. Game Scene

This is an implementation of the classic space invaders game.

Use the '<<' and '>>' buttons to move the laser left and right, and the '!! Shoot !!' button to fire a photon torpedo.

Shoot all of the invaders before any of them reaches the bottom of the screen to win.
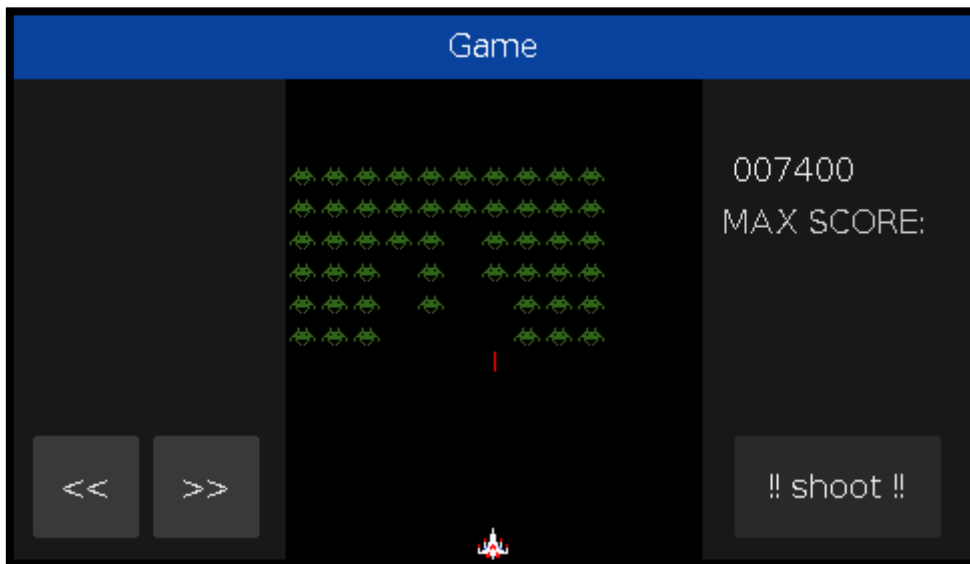

Figure 3 Game scene

1.2.2. Notepad Scene

The notepad scene demonstrates the on-screen keyboard and text area. Touch the screen anywhere in the white area to start typing, and this will bring up the keypad.
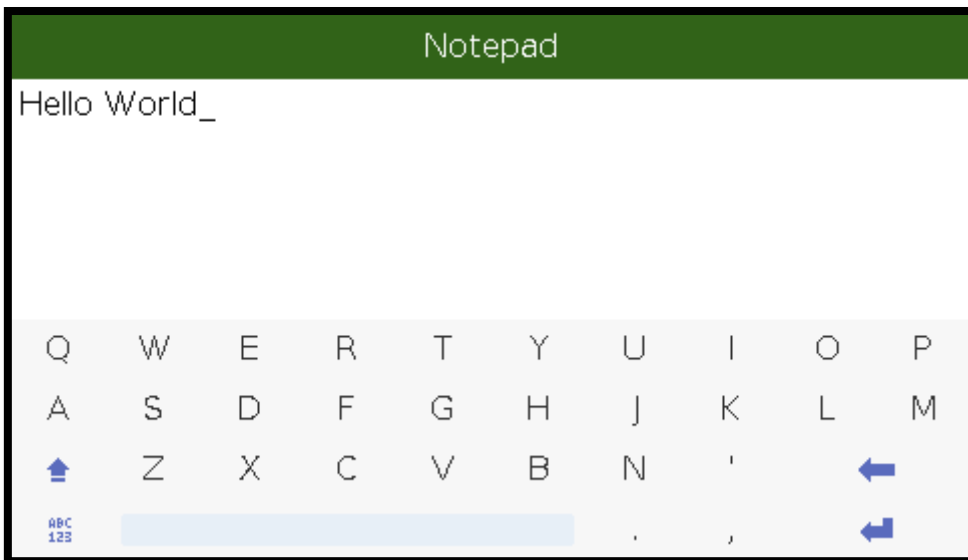

Figure 4 Notepad scene

The contents of the notepad are retained while the demonstration is running, so you can navigate to a different scene, and then back to the notepad without losing the content. However, the content will be lost if you stop and restart the application.

1.2.3. Camera Scene

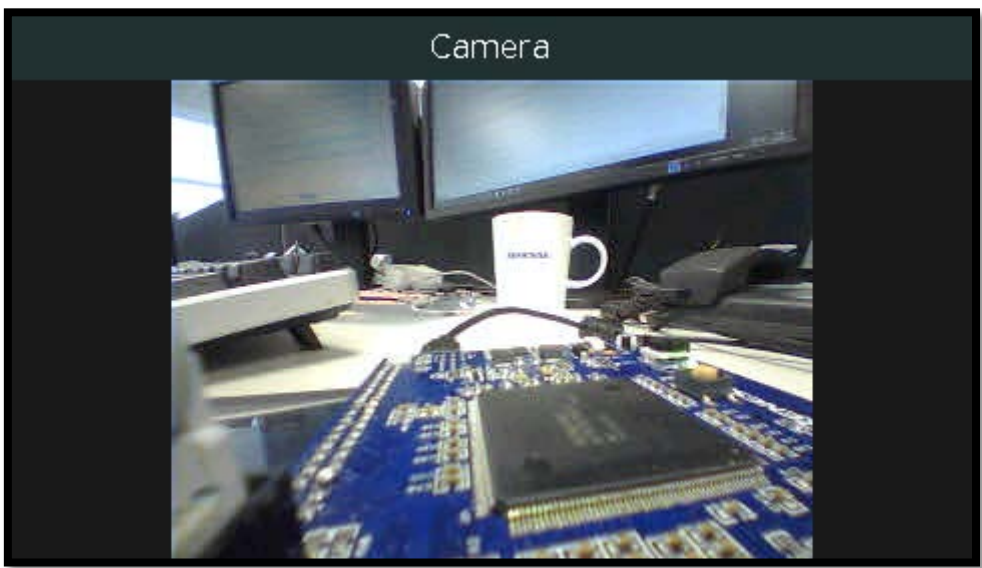The camera scene displays the output from the camera on the LCD.

Figure 5 Camera scene

1.2.4.   UI Demo Scene

The User Interface scene demonstrates UI controls like checkboxes, droplists, sliders and text areas. It has two modes which can be switched between by swiping the screen left and right.

The first mode plots the shape selected from a droplist. There is a checkbox to select double the size, and three sliders to adjust the RGB colour. Pressing the 'Play' button starts and stops an animation of the shape.
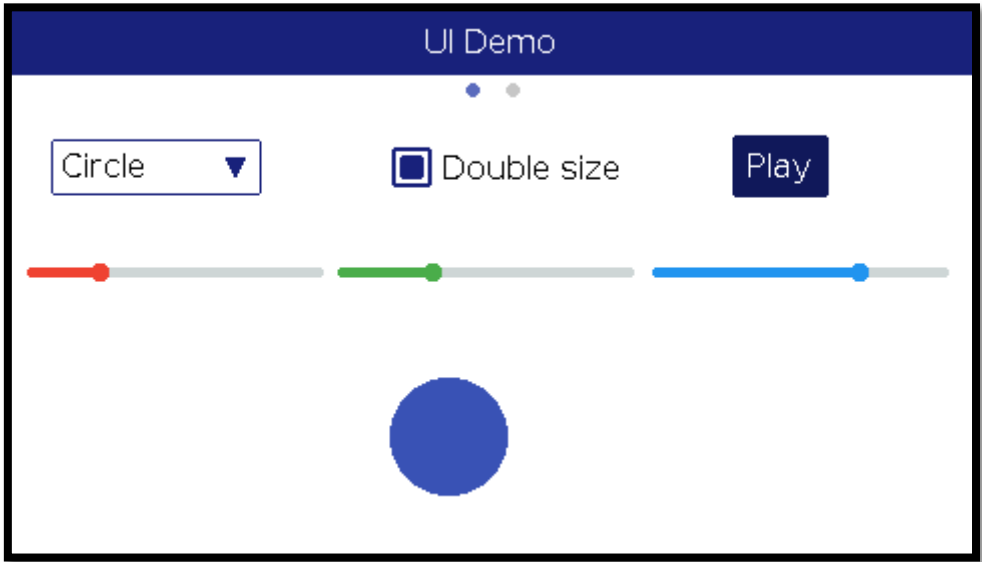

Figure 6 UI Demo scene (shape selection)

Swipe the screen from right to left to switch to the second UI Demo scene. This demonstrates the use of text areas and the on-screen keypad. Swipe the screen from left to right to switch back to the first UI Demo scene.

Figure 7 UI Demo scene (text areas)

2. Evaluation of the Software

This section covers creating the demonstration software; importing the demo project, compiling the software, and downloading the software to the Stream it! - RZ target.

The evaluation source code that has been supplied alongside this application note has been configured to use the Renesas e^2 studio Integrated Development Environment. If you don't already have e^2 studio installed, then please refer to the appendix (section 5) for instructions on how to do so.

2.1 Connecting, Importing, Building and Debugging in e^2 studio

The following instructions describe the process of locating and configuring e^2 studio to build this project.

2.2 Importing the Project into e^2 studio

1. Start e^2 studio (skip this step if already open):
    Windows^{TM} 7: Start Menu > All Programs > Renesas Electronics e2studio > e2 studio

    Windows^{TM} 8 / 8.1: From Apps View ⬇, click 'e2 studio' icon.
    Windows^{TM} 10: Start Menu > All apps > Renesas Electronics e2studio > e2 studio
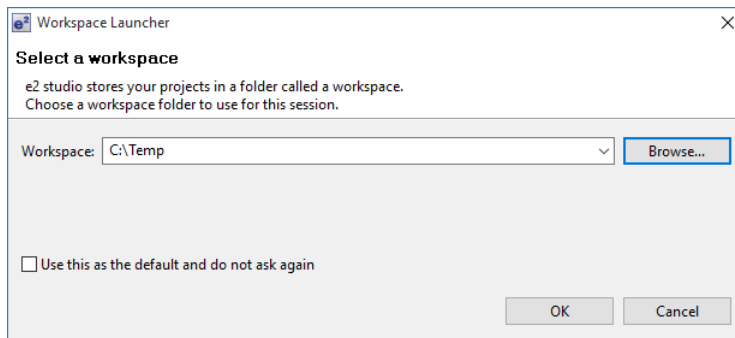
2. Select your desired e^2 studio workspace (C:\Temp in this case) and press 'OK'
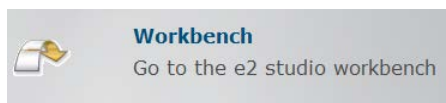
3. On the Welcome Splash Screen press 'Go to the e2 studio workbench'

4. Right-click in the Project Explorer window, and select 'Import…'.
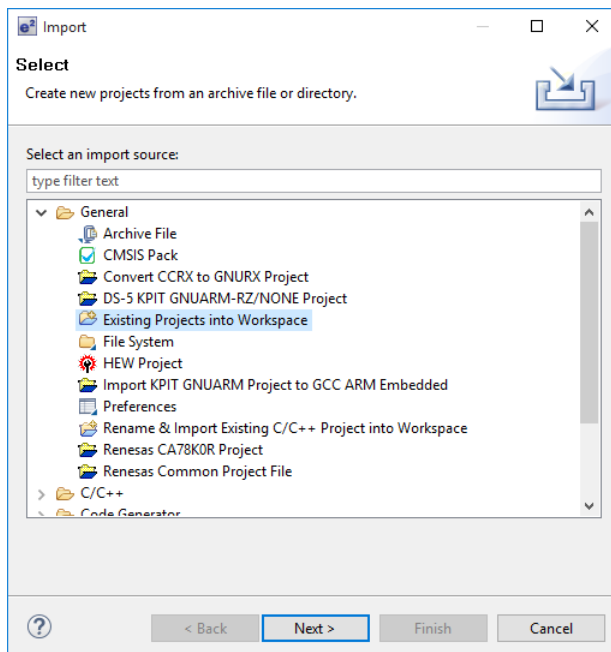
5. Under 'Select an import source', select 'General > Existing Projects into Workspace', and click 'Next'.

6. Select archive file then click the 'Browse' button, and locate the (StreamIt2_Graphics.zip) project on your system.

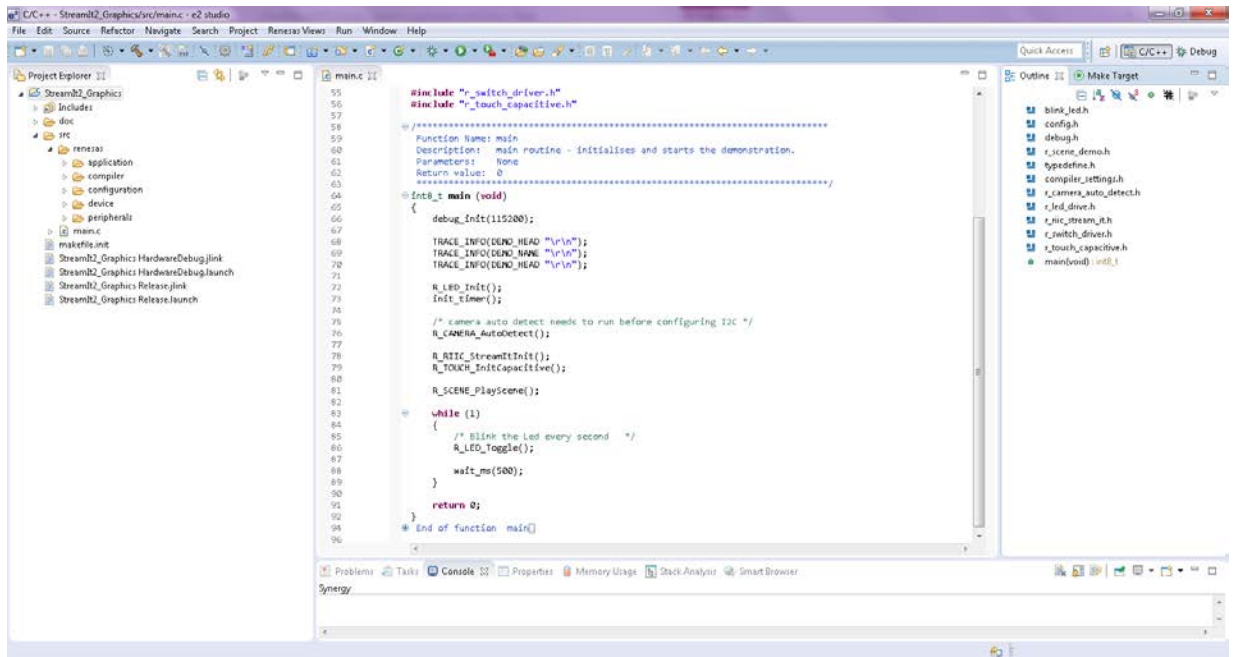7. Ensure the 'Copy projects into workspace' option is ticked and then click 'Finish'.

8. The opened project should look like the image (above)

2.3 Compiling the Software

The software compilation can be started using any 1 of 3 methods:

1. Push the Build button ( )

2. Use the Project | Build-All option in the menu
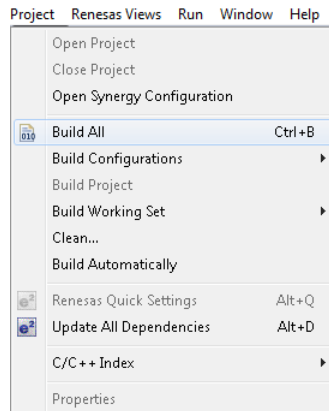
3. Use the Build-All keyboard shortcut CTRL+B

2.4 Running the Software

There are two different methods for running the project; from a batch file, or from e² studio. Firstly, the board needs to be connected up:

- Connect your JLink Lite debugger to the JTAG connector (CN1) on the Stream it! - RZ board

- Connect the USB cable between your PC and the JLink debugger

- Connect a USB cable between your PC and the Stream it! - RZ board

- Apply power to the USB port (CN10 - next to the SD card socket) or press the reset switch (located above the 'A' of the Renesas logo on the board and labelled 'RESET') to reset the device

2.4.1. Running from the Batch File

This method uses the Stream it! - RZ Boot Loader to run the application. It may be necessary to obtain this loader application to use this method. Copy the 'StreamIt2_Graphics.bin' file into the 'StreamIt2_QSPI_Loader\scripts' and rename the bin file to 'StreamIt2_User_App.bin'. Run the batch file 'Program_QSPI_Loader_Application.bat' that is in the project 'scripts' folder.

A window should pop up for the few seconds that it takes for the binary file to be copied to the flash memory on the Stream it! - RZ board.
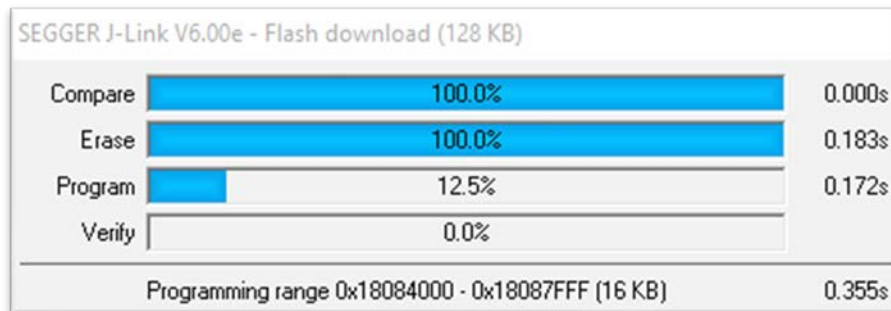
Once the SPI flash has been reprogrammed the new code will be executed on device reset. The boot loader will determine if the user code needs to be relocated into RAM or executed in place from SPI as this is specified in the linker file. Details on the boot loader application can be found in the following document (QSPI Flash Boot Loader) found on the product website.

Unless the application is overwritten with another one, this application will now run automatically each time the board is powered on.

2.4.2. Running from the e² studio

The provided e² studio workspace has two build configurations - 'HardwareDebug' and 'Release'.

Hardware Debug - This default build mode has all optimisation turned off, and provides full debug information. This is the best configuration to use whilst developing code as C code execution will be linear.

Release - This build mode has optimisation turned on, and provides little debug information. The C code execution may appear to be out of order, due to the way compiler optimises the code. This build configuration is intended for final ROM-programmable code.

Select the project by left-clicking on it, then click the arrow next to build button (hammer icon), and select 'Hardware Debug' from the drop down menu. e² studio will now build the project.

Press the 'Debug' button (   ) to open the 'Debug Configurations' dialog.
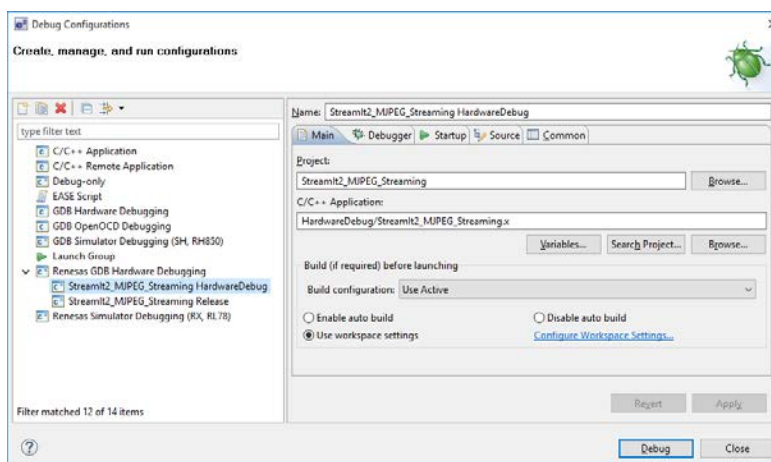
Select the configuration you wish to use (HardwareDebug in this case). Note if the application (.x) file is not available or has errors, then the 'Debug' button on the bottom right will be disabled.

The code can now be run by clicking the arrow next to the debug button (bug icon), and select 'StreamIt2_Graphics HardwareDebug' from the drop down menu. e² studio will now launch the program.

```
start:
20040000    LDR pc, =reset_handler              /* Reset Vector            */
20040004    LDR pc, =undefined_handler
```

The debugger is configured to stop execution at the reset vector (which should look similar to the code segment above), and then again at the start of the main() function. To continue execution in each case press the resume button.

The code should now be running on your target device in RAM.

2.5   Debug Console

A debug console is provided via the power USB connector which is attached to this board.

When the board is powered by a PC then a virtual serial port is provided on the PC.

Using any freely available Terminal Emulation software a connection can be made to this port allowing interaction with the Stream it! - RZ console.

To find the COM port to use, in Windows™ go to the Device Manager dialog box (hold down the 'Windows' button and press break. Then select 'Device Manager' at the top left). Expand 'Ports (COM & LPT)' to find the COM port that the system has allocated for the virtual serial port.

It will be named 'RSK USB Serial port' and in this case allocated COM3:
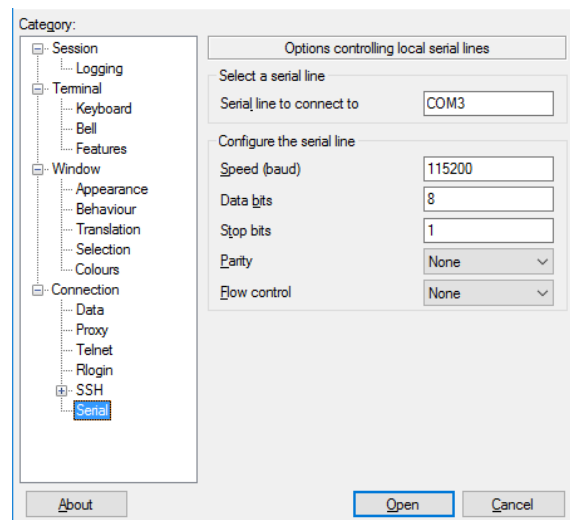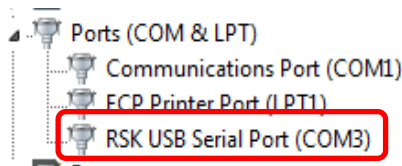
The connection settings shall be as follows:

Baud Rate 115200
Data Rate 8-bit
Parity None
Stop Bit 1
Flow Control None

The debug console will display any output from printf() calls in the application.

Note:

The Windows drivers required to create a USB virtual serial COM port are available on the CD.

3. Project Details

This section details the sample project layout, components used and execution cycle.

3.1   Project Layout

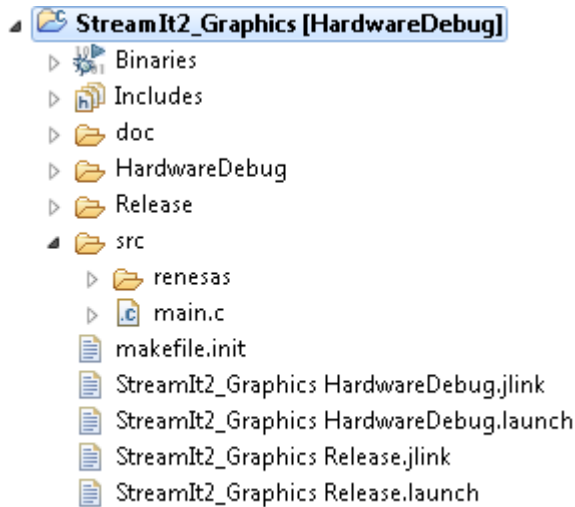The project layout as shown in e^2 studio is as below:


The following folders contain useful or user modifiable contents:
- doc   Text file detailing simple download instructions and links to documentation
- HardwareDebug   When built, stores the build files for the debug configuration
- Release   When built, stores the build files for release configuration
- src   Source code for project. All user modifiable code is located in this sub folder

Note the configuration folders also store a bin file which can be used in conjunction with the StreamIt2_QSPI_Loader.
Please refer to the relevant documentation on the RZ/A1LU QSPI Flash Boot Loader for details.

The src (sources) folder:
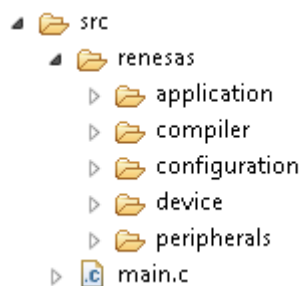
The layout of the src (sources) folder is as follows:

Name	Overview
main.c	Contains the start of the user level application (main() function)
application	Stores all the application specific files
compiler	Stores any files specific to the startup procedure and compiler specific code
configuration	Stores any configuration files, grouped together for ease of access
device	Stores any platform specific device files
peripherals	Stores the peripheral drivers required for this board.
	Internal folder stores the microcontroller peripheral drivers
	External folder stores the non-microcontroller peripheral drivers (e.g. LED, LCD panel, capacitive touch, camera etc.)

3.2 Runtime Environment

The following resources are used in the application:

Resource	Device	Function/Description	Source file
MTU2	Multi Function Timer Pulse Unit 2	Used for delays	src\renesas\peripherals\internal\ r_mtu2.c
JCU	JPEG Codec Unit	Compression of images from the camera	src\renesas\peripherals\internal\ r_jcu.c
CEU	Capture Engine Unit	Capturing image data from the camera	src\renesas\peripherals\internal\ r_ceu.c
VDC5	Video Display Controller 5	Driving the LCD display	src\renesas\peripherals\internal\ r_vdu5.c

3.3 Startup Sequence

The following table gives a brief overview of the boot process for the device (executed before first call to main()):

File	Action	Details
src\renesas\compiler\asm\start.s	Program start	Creates initial vector table, calls reset vector
src\renesas\compiler\asm\reset_handler.s	Reset code	Performs system reset, initialises ARM stacks, memory manager, etc.
		Call peripheral_init_basic to initialise board
		Final action to call resetprg() in resetprg.c
src\renesas\compiler\init\resetprg.c	'C' level code initialisation	Initialises any library code, enables IRQs and FIQs
		Calls 'C' level main()
src\main.c	Start application	Initialise the rest of the in use board peripherals

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4. Appendix

This section gives instructions on installing e^2 studio version 5.2. It is recommended to use the latest version of e^2 studio as available on the web site.

4.1   e^2 studio Installation

1. The latest e^2 studio installer can be acquired from the Renesas website at https://www.renesas.com/en-eu/products/software-tools/tools/ide/e2studio.html

2. Once downloaded, double click on the application. A window will then pop-up, asking if you want to install e^2 studio (note the version number in the dialog will change). Click 'Yes'.

3. Once fully extracted, the e^2 studio installation wizard will guide you through the installation process. On the 'Welcome' tab click 'Next >'.
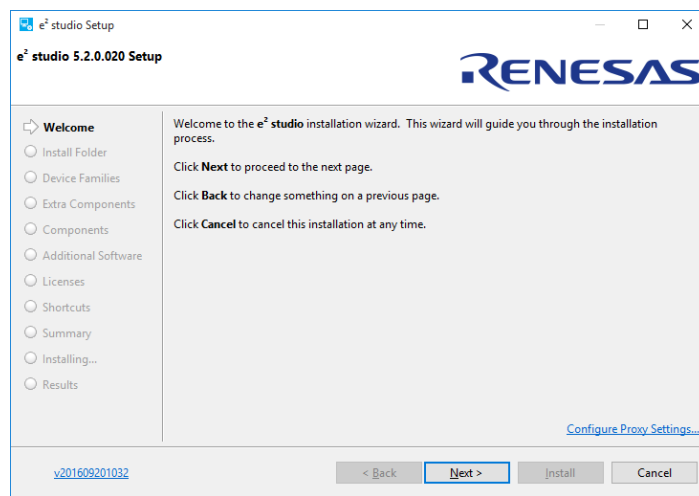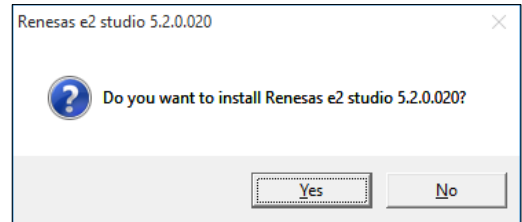
4. In the 'Install Folder' page, insert the path of a folder in which it is desired to be the root location for e^2 studio. It is suggested to keep the default path. To continue click 'Next >'.
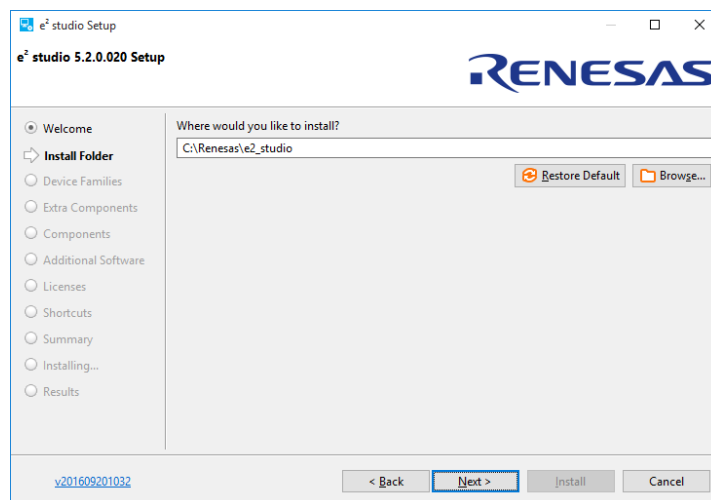
5. In the 'Device Families' page, ensure that the RZ family has been selected. It may also be desired
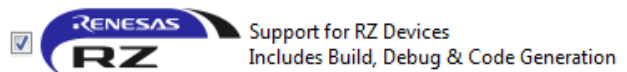
to select support for other devices. Once selected, click 'Next >'.

6. In the 'Extra Components' page you can select support needed for your development needs. To continue click 'Next >'.

7. The 'Components' page will give the option to install optional components. It is recommended to ensure all are selected and to click 'Next >'.

8. In the 'Additional Software' tab, ensure that 'GCC ARM Embedded 4.9 2015q3' is selected. Click 'Next >'.
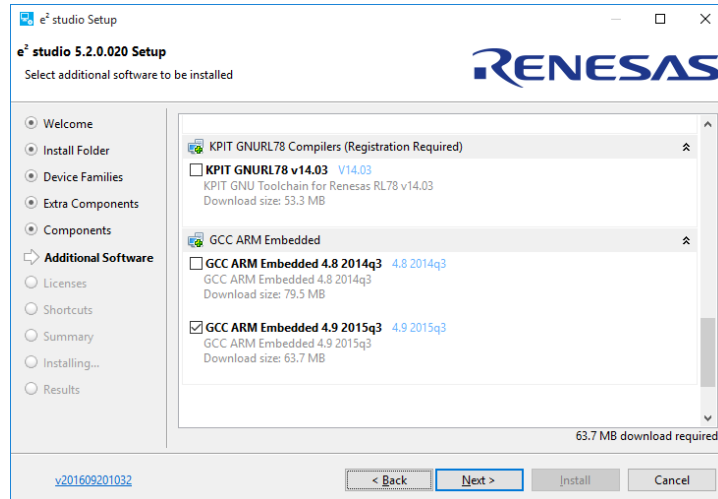

9. In the 'Licenses' page ensure to read and accept the Software Agreement to continue. Click 'Install'.

10. The 'Summary' page will give an overview of the components of the installation. Click 'Install' to start the installation process.
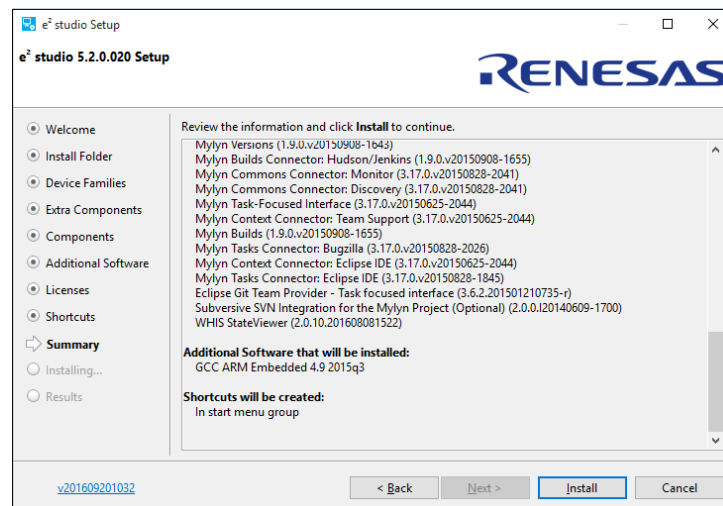
11. Once the installation process has finished click 'OK'.
To open e² studio please follow the instructions below.

- Start e² studio
  Windows™ 7: Start Menu > All Programs > Renesas Electronics e2studio > e2 studio
  Windows™ 8 / 8.1: From Apps View ⊕, click 'e² studio' icon.
  Windows™ 10: Start Menu > All apps > Renesas Electronics e2studio > e2 studio

- In the 'Select a workspace' dialog box, browse to a suitable location and enter a folder name to save your new workspace. Click 'OK' to continue.

- On the 'There are no new toolchains available for integration' message box, click 'OK'.
- In the e^2 studio 'Welcome' screen, click the 'Go to the workbench' arrow icon, on the far right.
- Code Generator Registration window will pop up to register code generator. Click 'OK'.
- Once registered, another pop-up window will ask you to restart e^2 studio. Click 'OK'. e^2 studio will restart.

4.2   e^2 studio Update

To update e^2 studio both RZ support and the GNU ARM Embedded v4.9.3 compiler are to be installed. This is recommended to be done on e^2 studio version 4.3 or later.

To install the 'RZ support' please follow the instructions below:

1. The RZ support can be installed through Renesas' tool support link. This can be achieved through

   Help -> Install New Software…

   Followed by inserting the following link in the 'Work with' box.

   http://tool-support.renesas.com/e2studio/e2studio5

2. Select the 'Renesas RZ Family Support' and click 'Next >'.
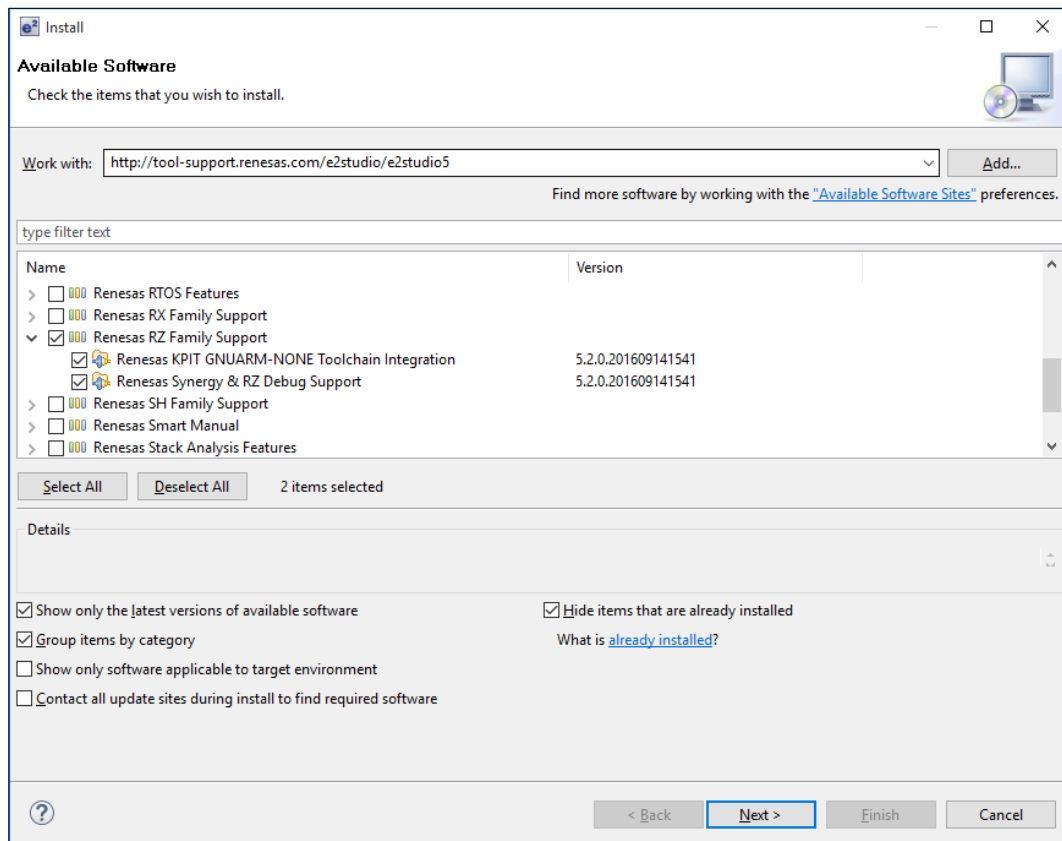
3. Installation details will then be shown. Click 'Next >'.

4. Read the 'License text' and select 'I accept the terms of the license agreement' to continue.

   A pop-up window will then ask you to restart e^2 studio. Click 'Yes'.

5. Once restarted the installation process is complete.
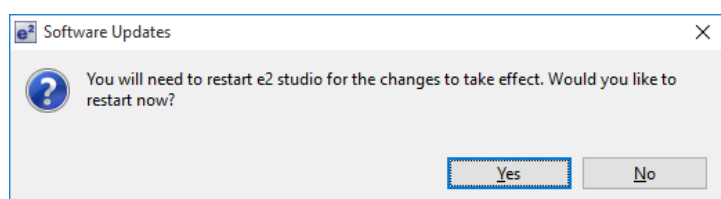
5. Additional Information

Technical Support

For details on how to use e^2 studio, refer to the help file by opening e^2 studio, then selecting Help > Help Contents from the menu bar.
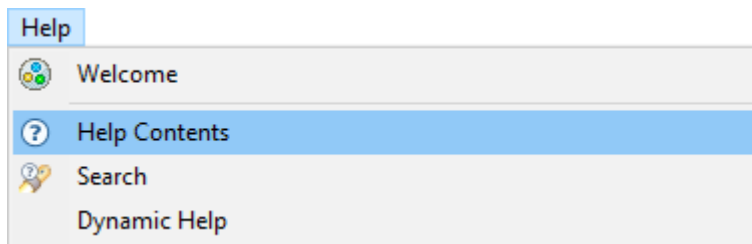
For information about the RZA1L series microcontrollers refer to the RZA1L Group Hardware Manual.

Technical Contact Details

Please refer to the contact details listed in section 5 of the Stream it! - RZ **"Quick Start Guide" (r12qs0013eg0100-rza1lu.pdf).**

General information on Renesas microcontrollers can be found on the Renesas website at:
https://www.renesas.com/

Inquiries
https://www.renesas.com/contact/

This product's homepage, where additional documentation and source code can be found, is located at:
https://www.renesas.com/en-eu/solutions/key-technology/human-interface/rz-stream-it.html

Revision History

Rev.	Date	Description	
		Page	Summary
1.00	20 Mar 2017	All	Original release
1.10	16 Nov 2020	All	Application Note Software Update

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

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

1. Precaution against Electrostatic Discharge (ESD)

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

2. Processing at power-on

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

3. Input of signal during power-off state

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

4. Handling of unused pins

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

5. Clock signals

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

6. Voltage application waveform at input pin

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

7. Prohibition of access to reserved addresses

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

8. Differences between products

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

Notice

1. Descriptions of circuits, software and other related information in this document are provided only to illustrate the operation of semiconductor products and application examples. You are fully responsible for the incorporation or any other use of the circuits, software, and information in the design of your product or system. Renesas Electronics disclaims any and all liability for any losses and damages incurred by you or third parties arising from the use of these circuits, software, or information.

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Corporate Headquarters

TOYOSU FORESIA, 3-2-24 Toyosu,
Koto-ku, Tokyo 135-0061, Japan
www.renesas.com

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