

RL78/L1C Group

Renesas Starter Kit Tutorial Manual
For CubeSuite+

RENESAS MCU
RL78 Family / L1X Series

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Disclaimer

By using this Renesas Starter Kit (RSK), the user accepts the following terms:

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Precautions

The following precautions should be observed when operating any RSK product:

This Renesas Starter Kit is only intended for use in a laboratory environment under ambient temperature and humidity conditions. A safe separation distance should be used between this and any sensitive equipment. Its use outside the laboratory, classroom, study area or similar such area invalidates conformity with the protection requirements of the Electromagnetic Compatibility Directive and could lead to prosecution.

The product generates, uses, and can radiate radio frequency energy and may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment causes harmful interference to radio or television reception, which can be determined by turning the equipment off or on, you are encouraged to try to correct the interference by one or more of the following measures;

- ensure attached cables do not lie across the equipment
- reorient the receiving antenna
- increase the distance between the equipment and the receiver
- connect the equipment into an outlet on a circuit different from that which the receiver is connected
- power down the equipment when not in use
- consult the dealer or an experienced radio/TV technician for help NOTE: It is recommended that wherever possible shielded interface cables are used.

The product is potentially susceptible to certain EMC phenomena. To mitigate against them it is recommended that the following measures be undertaken;

- The user is advised that mobile phones should not be used within 10m of the product when in use.
- The user is advised to take ESD precautions when handling the equipment.

The Renesas Starter Kit does not represent an ideal reference design for an end product and does not fulfil the regulatory standards for an end product.

How to Use This Manual

1. Purpose and Target Readers

This manual is designed to provide the user with an understanding of how to use the CubeSuite+ IDE to develop and debug software for the RSK platform. It is intended for users designing sample code on the RSK platform, using the many different incorporated peripheral devices.

The manual comprises of step-by-step instructions to load and debug a project in CubeSuite+, but does not intend to be a complete guide to software development on the RSK platform. Further details regarding operating the RL78/L1C microcontroller may be found in the Hardware Manual and within the provided sample code.

Particular attention should be paid to the precautionary notes when using the manual. These notes occur within the body of the text, at the end of each section, and in the Usage Notes section.

The revision history summarizes the locations of revisions and additions. It does not list all revisions. Refer to the text of the manual for details.

The following documents apply to the RL78/L1C Group. Make sure to refer to the latest versions of these documents. The newest versions of the documents listed may be obtained from the Renesas Electronics Web site.

| Document Type | Description | Document Title | Document No. |
|-------------------------|---|---|--------------|
| User's Manual | Describes the technical details of the RSK hardware. | RSKRL78L1C User's Manual | R20UT2203EG |
| Tutorial | Provides a guide to setting up RSK environment, running sample code and debugging programs. | RSKRL78L1C Tutorial Manual | R20UT2204EG |
| Code Generator Tutorial | Provides a guide to code generation and importing into the CubeSuite+ IDE. | RSKRL78L1C Code Generator Tutorial Manual | R20UT2887EG |
| Quick Start Guide | Provides simple instructions to setup the RSK and run the first sample, on a single A4 sheet. | RSKRL78L1C Quick Start Guide | R20UT2205EG |
| Schematics | Full detail circuit schematics of the RSK. | RSKRL78L1C Schematics | R20UT2202EG |
| Hardware Manual | Provides technical details of the RL78/L1C microcontroller. | RL78/L1C Group Hardware Manual | R01UH0409EJ |

2. List of Abbreviations and Acronyms

| Abbreviation | Full Form |
|---------------------|---|
| ADC | Analog-to-Digital Converter |
| API | Application Program Interface |
| CPU | Central Processing Unit |
| DVD | Digital Versatile Disc |
| E1 | On-chip Debugger |
| GUI | Graphical User Interface |
| LCD | Liquid Crystal Display |
| LED | Light Emitting Diode |
| MCU | Micro-controller Unit |
| ROM | Read-Only Memory |
| RSK | Renesas Starter Kit |
| SAU | Serial Array Unit |
| UART | Universal Asynchronous Receiver/Transmitter |
| USB | Universal Serial Bus |

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1. Overview

1.1 Purpose

This RSK is an evaluation tool for Renesas microcontrollers. This manual describes how to get the RSK tutorial started, and basic debugging operations.

1.2 Features

This RSK provides an evaluation of the following features:

- Renesas microcontroller programming
- User code debugging
- User circuitry such as switches, LEDs and a potentiometer
- Sample application
- Sample peripheral device initialisation code

The RSK board contains all the circuitry required for microcontroller operation.

2. Introduction

This manual is designed to answer, in tutorial form, the most common questions asked about using a Renesas Starter Kit (RSK). The tutorials help explain the following:

- How do I compile, link, download and run a simple program on the RSK?
- How do I build an embedded application?
- How do I use Renesas' tools?

The project generator will create a tutorial project with three selectable build configurations:

- 'DefaultBuild' is a project with debug support and optimisation level set to two.
- 'Debug' is a project built with the debugger support included. Optimisation is set to zero.
- 'Release' is a project with optimised compile options (level two), producing code suitable for release in a product.

Files referred to in this manual are installed using the project generator as you work through the tutorials. The tutorial examples in this manual assume that installation procedures described in the RSK Quick Start Guide have been completed. Please refer to the Quick Start Guide for details of preparing the configuration.

Some of the illustrative screenshots in this document will show text in the form RL78XXX. These are general screenshots and are applicable across the whole RL78 family. In this case, simply substitute for RL78XXX RL78/L1C

These tutorials are designed to show you how to use the RSK and are not intended as a comprehensive introduction to the CubeSuite+ debugger, compiler toolchains or the E1 emulator. Please refer to the relevant user manuals for more in-depth information.

2.1 Application Leading Tool (Applilet)

Applilet for the RL78/L1C has been used to generate the sample code discussed in this document. Applilet is a Windows™ GUI tool for generating template 'C' source code and project settings for the RL78/L1C. When using Applilet, the engineer is able to configure various MCU features and operating parameters using intuitive GUI controls, thereby bypassing the need in most cases to refer to sections of the Hardware Manual.

Once the engineer has configured the project, the 'Generate Code' function is used to generate three code modules for each specific MCU feature selected. These code modules are name 'r_cg_XXX.h', 'r_cg_XXX.c', and 'r_cg_XXX_user.c', where 'XXX' is a three letter acronym for the relevant MCU feature, for example 'adc'. Within these code modules, the engineer is then free to add custom code to meet their specific requirement. Custom code should be added, whenever possible, in between the following comment delimiters:

```
/* Start user code for adding. Do not edit comment generated here */  
/* End user code. Do not edit comment generated here */
```

Applilet will locate these comment delimiters, and preserve any custom code inside the delimiters on subsequent code generation operations. This is useful if, after adding custom code, the engineer needs to re-visit Applilet to change any MCU operating parameters.

Applilet V1.01.00.01 is included with this RSK.

3. Tutorial Project Workspace

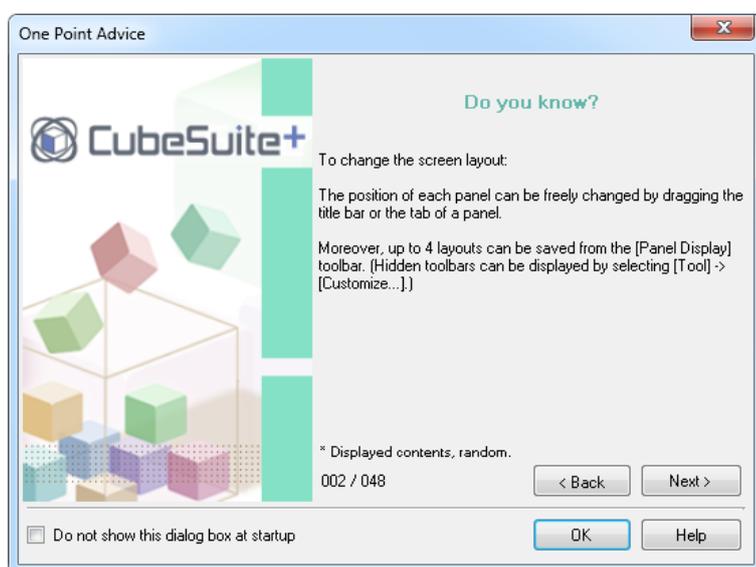
3.1 Introduction

CubeSuite+ is an integrated development tool that allows the user to write, compile, program and debug a software project on the RX, 78K, RL and V850 family of Renesas microcontrollers. CubeSuite+ will have been installed during the installation of the software support for the Renesas Starter Kit product. This manual will describe the stages required to create and debug the supplied tutorial code.

3.2 Starting CubeSuite+ and Connecting the E1 Debugger

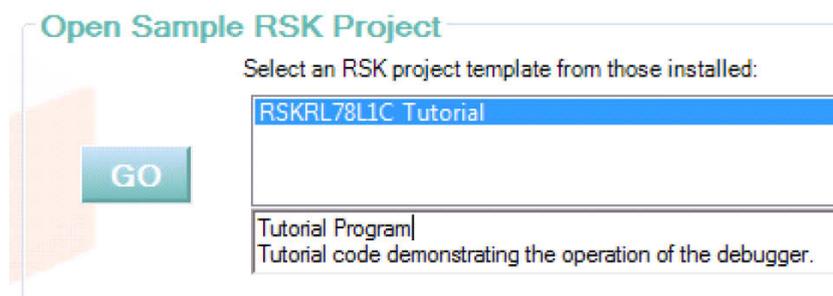
To use the program, start CubeSuite+ from the Windows™ Start Menu.

The first time CubeSuite+ is started, the One Point Advice dialog box will be shown:

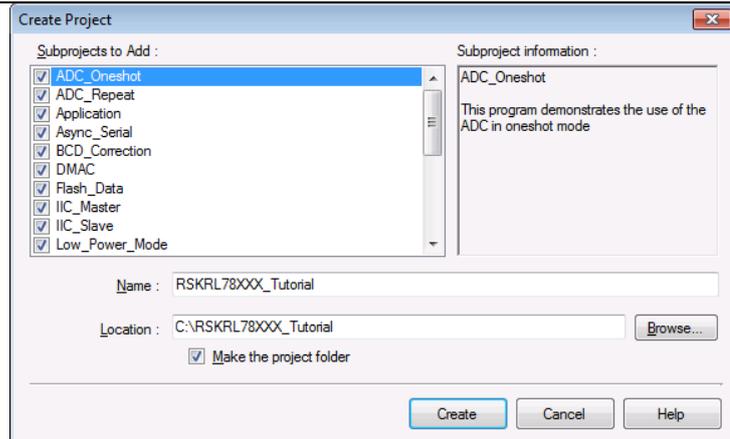


The One Point Advice dialog box provides some useful tips when using CubeSuite+. Press 'OK' to skip the advice and close the One Point Advice dialog. The user will then be presented with the Start panel.

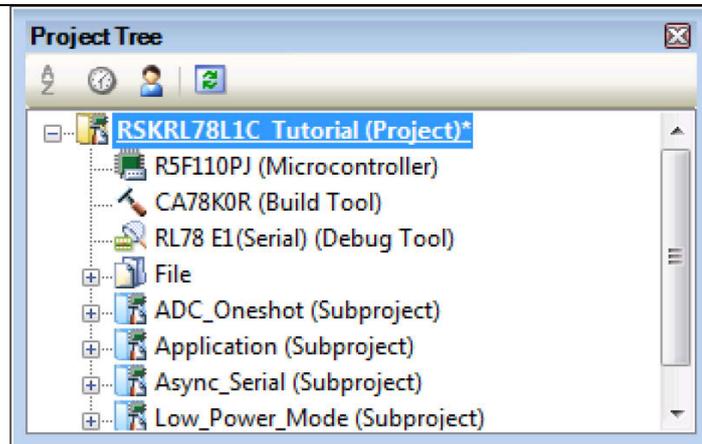
Under the 'Open Sample RSK Project', open a new Tutorial project by selecting the RSKRL78L1C_Tutorial project template and click on 'Go' as shown below. This will save a copy of the RSKRL78L1C_Tutorial project.



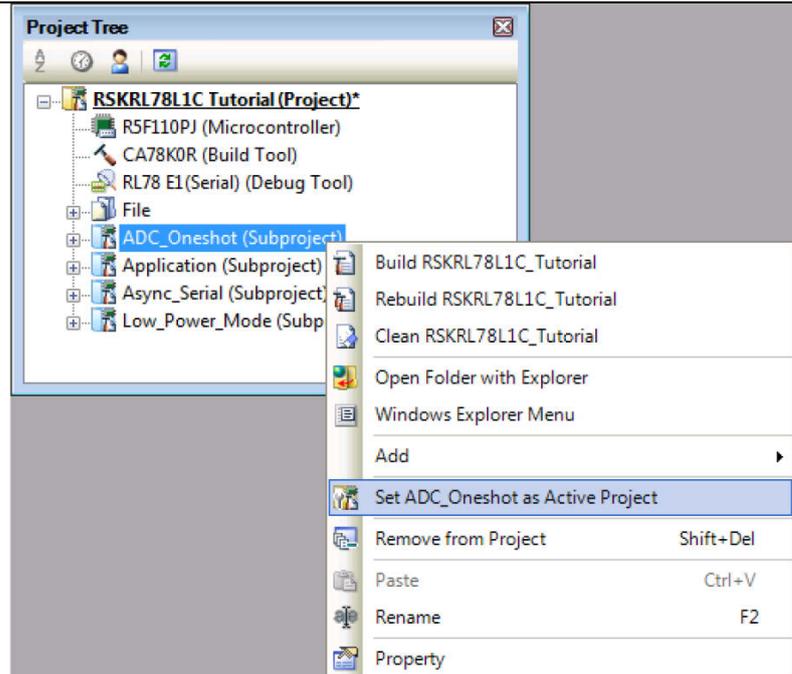
- CubeSuite+ will present a 'Create Project' dialog box.
- Select all sub-projects by clicking on each checkbox and observe the information displayed under the 'Subproject information' heading as you select each project.
- Specify a name and location for the new project and click on 'Create'
- A dialog box will appear if the location specified does not exist; asking to create the folder specified. Click 'OK'.



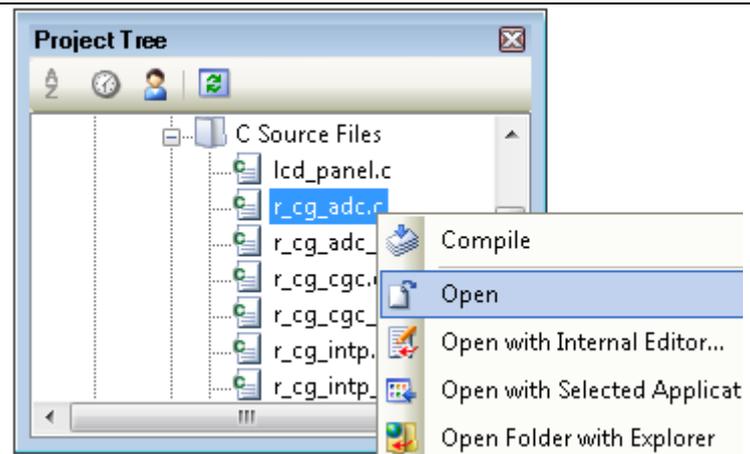
- CubeSuite+ will create and open the project showing the Project Tree as seen in the screenshot opposite.
- RSKRL78L1C_Tutorial (Project) is the master project and includes the tools to modify, build and debug the code.
- The File folder seen in the screenshot belongs to the master project, RSKRL78L1C_Tutorial.
- This folder contains and lists all project source and header files including text files arranged in separate folder structures.
- Folders containing the subprojects, indicated by "(Subproject)", are listed below the File folder.
- Each subproject folder, when expanded, reveals an identical tools and folder structure to that of the master project, RSKRL78L1C_Tutorial.
- By default the RSKRL78L1C_Tutorial project is set as the active project, indicated by the line under the project name.



- To change the active project, right-click on the project/subproject name and select "Set x as Active Project" (x represents the project name).



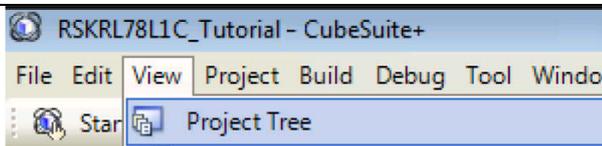
- The File folder contains three subfolders. This structure is common to all projects.
- Some of the source files were generated by Applilet, which are grouped under the 'C Source Files' folder which itself is listed under the File folder in the Project Tree. These files are prefixed with 'r_cg' to indicate that they were generated by a code generator. All other user-generated or user-included source files are listed in this folder.
- To open a file for viewing, right-click on the file and select 'Open'. Alternatively, double-click on the file.



3.3 Configuring the Debug Tool (E1)

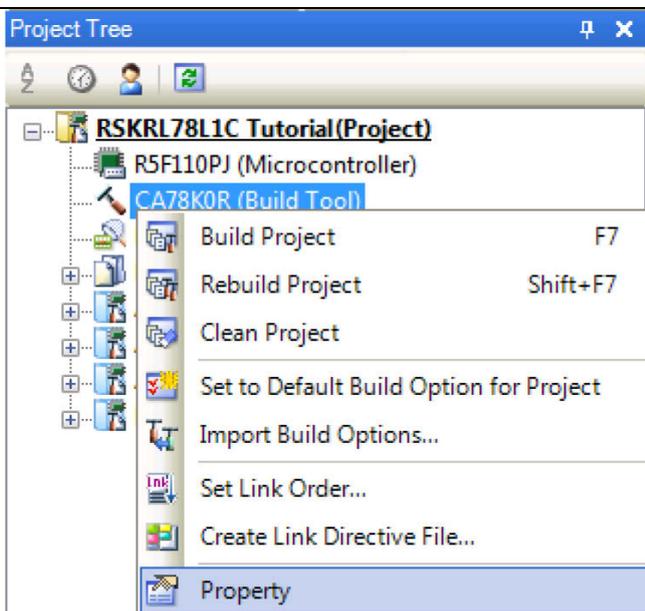
Note: The Tutorial sample project's settings are pre-configured. This section is intended to familiarise the user with the debug tool settings for when they create their own project.

- The Project Tree will be displayed on the left-hand pane of CubeSuite+.
- This can also be invoked from the menu bar [View > Project Tree].

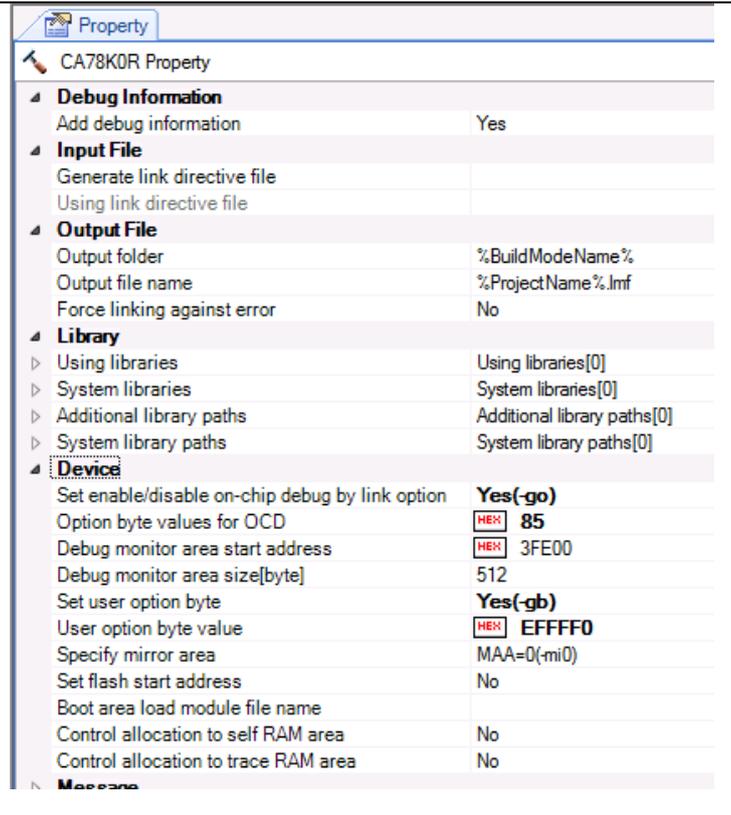


This list contains a number of tools used in configuring the IDE for programming and debugging of the device, as well as listing source code files. Follow the following instructions to verify the pre-configured settings:

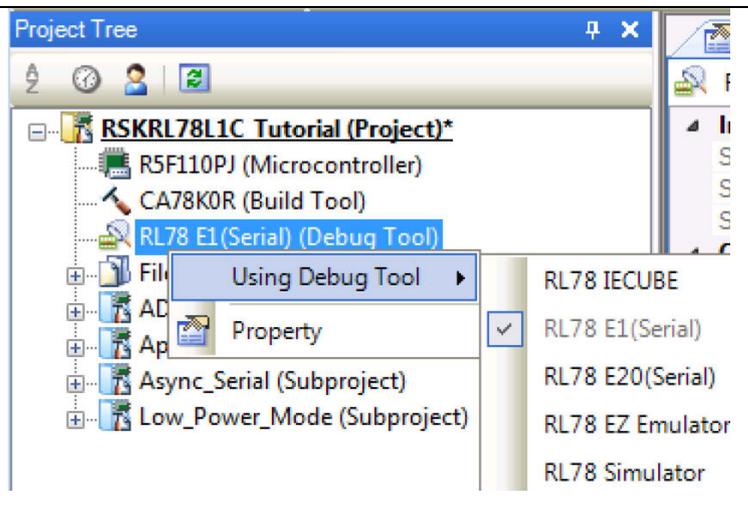
- Right click on CA78K0R (Build Tool).
- Click on Property.



- Click on the Link Options tab to open the sheet.
- Expand the Device entry to reveal the sub-entry options.
- Verify that the Debug monitor area start address is as shown on the opposite screen-shot.



- The opposite screen-shot indicates that the selected Debug Tool is E1.



- Right click on RL78 E1(Serial) (DebugTool).
- Click on Property.
- View the Connect Settings.
- Verify that the settings match the opposite screen-shot.

Property
RL78 E1(Serial) Property

| | |
|--|---------------------------------|
| Internal ROM/RAM | |
| Size of internal ROM[KBytes] | 256 |
| Size of internal RAM[Bytes] | 16384 |
| Size of DataFlash memory[KBytes] | 8 |
| Clock | |
| Main clock frequency [MHz] | 12.00 |
| Sub clock frequency[kHz] | 32.768 |
| Monitor clock | System |
| Connection with Target Board | |
| Power target from the emulator.(MAX 200mA) | Yes |
| Supply voltage | 3.3V |
| Flash | |
| Security ID | HEX 00000000000000000000 |
| Permit flash programming | Yes |
| Use wide voltage mode | Yes |
| Erase flash ROM when starting | No |

The project is configured to halt code execution on the first instruction of the main function after programming the micro-controller. To specify another function as the entry point:

- View the Download File Settings of the RL78 E1's property.
- Change the 'specified symbol' to another available function.
- Ensure to prefix the function name with an underscore ("_").

Note: Do not specify an interrupt handler as the entry point.

Property
RL78 E1(Serial) Property

| | |
|---|------------------|
| Download | |
| Download files | [1] |
| CPU Reset after download | Yes |
| Download Mode | Speed priority |
| Erase flash ROM before download | No |
| Automatic change method of event setting position | Suspend event |
| Check reserved area overwriting | Yes |
| Debug Information | |
| Execute to the specified symbol after CPU Reset | Yes |
| Specified symbol | _main |
| Startup start symbol | _ @cstart |
| Startup end symbol | _ @cend |

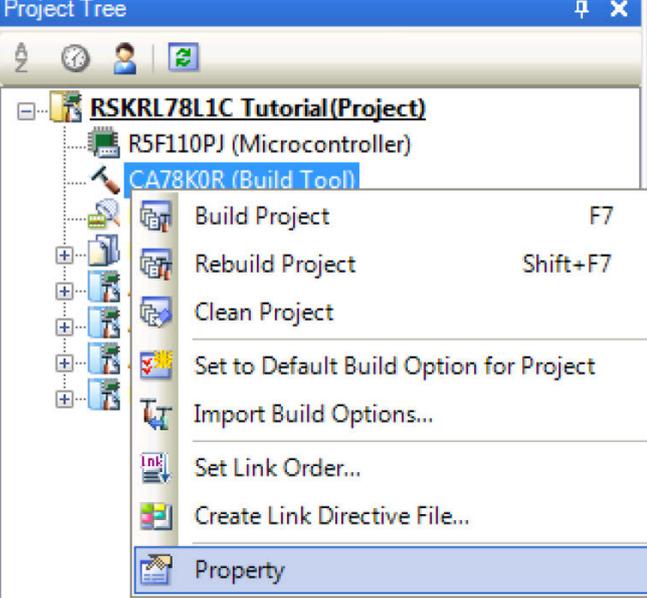
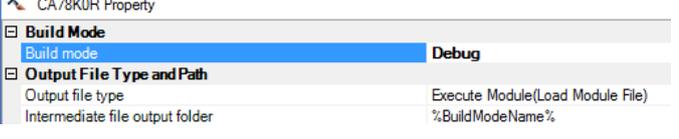
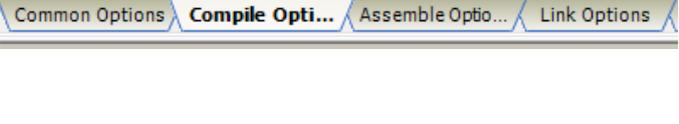
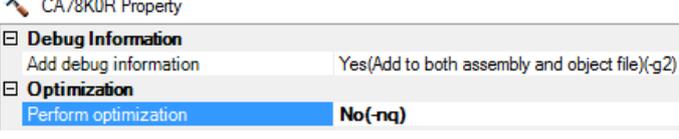
Specified symbol
Specifies the position at which program execution is to be stopped following CPU reset. Specify the label name in case of assembly language and specify the function name in c.

Connect Settings | Debug Tool Settings | **Download File Settings** | Hook

3.4 Build Configuration

The build configurations are selected from the build tool's Property panel. The options available are DefaultBuild, Debug and Release. DefaultBuild and Debug are configured for use with the debugger. Release is configured for the final ROM programmable code.

A common difference between the three builds is the optimisation setting and the addition of debug information. With optimisation turned on, the debugger may seem to execute code in an unexpected order. To assist in debugging it is often helpful to turn optimisation off on the code being debugged.

| | |
|--|--|
| <ul style="list-style-type: none"> Right-click on CA78K0R (Build Tool) from the Project Tree. Select 'Property'. |  |
| <ul style="list-style-type: none"> The Common Options sheet will open by default. Verify that the Build Mode is set to Debug. |  |
| <ul style="list-style-type: none"> Click on the Compile Options sheet to view compiler options. |  |
| <ul style="list-style-type: none"> Ensure the 'Add debug information' entry is set to 'Yes (Add to both assembly and object file)(-g2)'. Ensure the 'Optimization' entry is set to 'No'. |  |

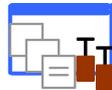
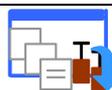
4. Building the Tutorial Program

The tutorial project build settings have been pre-configured in the toolchain options. To view the toolchain options double-click on CA78K0R (Build Tool) from the Project Tree and select the available tabs. It is important when changing settings to be aware of the current configuration before modifying the settings.

| | |
|--|---|
| <ul style="list-style-type: none"> Review the options on each of the tabs to be aware of the options available. For the purposes of the tutorial, leave all options at default. When complete, the Property panel can be closed by clicking [x] on the right-hand corner of the Property window. |  |
|--|---|

4.1 Building the Code

There is a choice of three shortcuts available for building the project:

| | |
|---|---|
| <ul style="list-style-type: none"> Selecting the 'Build Project' toolbar button will build all projects listed in the project tree. |  |
| <ul style="list-style-type: none"> Pressing [F7]. This is equivalent to pressing the 'Build Project' toolbar button. |  |
| <ul style="list-style-type: none"> Selecting the 'Rebuild Project' toolbar button will rebuild all project files. |  |
| <ul style="list-style-type: none"> Selecting the 'Build & Download' toolbar button will only build the active project and download the code to the target device after a successful build. |  |
| <ul style="list-style-type: none"> Pressing [F6]. This is equivalent to pressing the 'Build & Download' toolbar button. |  |

Build the project now by pressing [F7] or pressing one of the build icons as shown above. During the build each stage will be reported in the Output Window. The build will complete with an indication of any errors and warnings encountered during the build.

4.2 Connecting the Debugger

For this tutorial it is not necessary to provide an external power supply to the board. The power will be obtained from the USB port. Please be aware that if you have too many devices connected to your USB port it may be shut down by Windows. If this happens remove some devices and try again. Alternatively provide an external power source taking care to ensure the correct polarity and voltage.

Other sample code supplied with this RSK will require a variable power supply; in which case an external 0-5V variable power supply should be used. Refer to the RSKRL78L1C User Manual for further details.

The Quick Start Guide provided with the Renesas Starter Kit board gives detailed instructions on how to connect the E1 to the host computer. The following assumes that the steps in the Quick Start Guide have been followed and the E1 drivers have been installed.

- Fit the LCD panel to the board, via the header marked 'JA4'. Ensure all the pins of the connector are correctly inserted in the socket.
- Connect the E1 Debugger to a free USB port on your computer.
- Connect the E1 Debugger to the target hardware ensuring that it is plugged into the connector marked 'E1'.

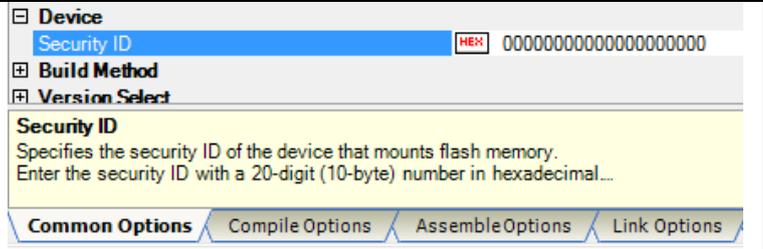
If supplying external power to the board please refer to Section 3.3 to turn off the option of supplying power from the E1 before turning on the external power supply.

4.3 Connecting to the Target with the E1 Debugger

This section will take you through the process of connecting to the device, programming the Flash and executing the code.

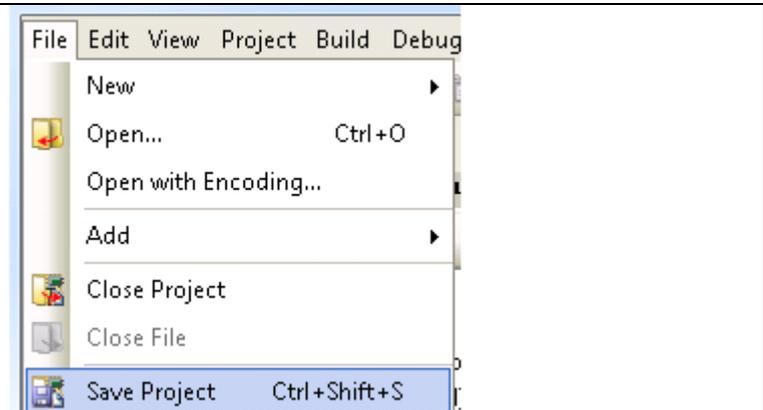
- Double click on CA78K0R (Build Tool) to open the Property view.
- In the Common Options tab; found under the Property view, verify that the Security ID is set to 00000000000000000000 under the 'Device' entry.

Note: The project has been configured not to use the Security ID feature.



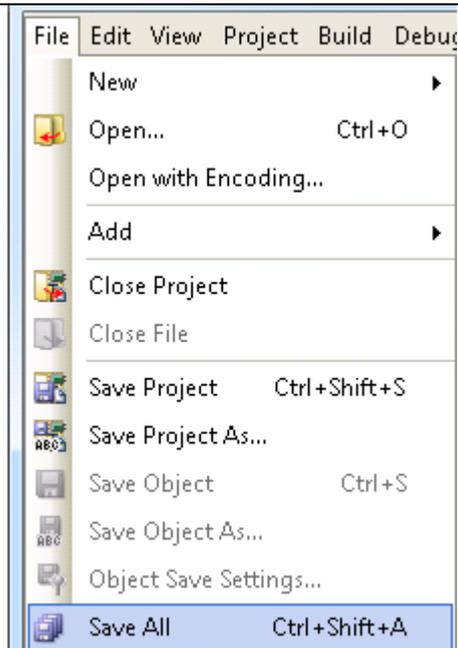
If you have changed any project settings this is a good time to save the project.

- Select 'File' | 'Save Project'.



If you make any changes to files in CubeSuite+ and want to preserve these change, you can save them by:

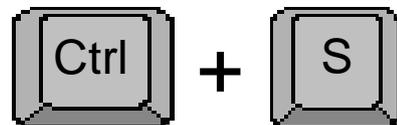
- Select 'File' | 'Save All'.



You can also save files by clicking the 'Save' or 'Save All' buttons from the CubeSuite+ toolbar.



In addition files can be saved using the keyboard shortcut [Ctrl + S]:



5. Downloading and Running the Tutorial

5.1 Downloading the Program Code

Now that the code has been built in CubeSuite+ it needs to be downloaded to the RSK.

| | |
|--|--|
| <ul style="list-style-type: none"> Click on the program download button. Alternatively, select Debug from the Menu bar and click on Download. |  |
| <ul style="list-style-type: none"> On completion of program download, the debugger and code are ready to be executed. The program counter indicator will point to first line of code inside the main function; this is the program's entry point. | <pre> /***** * Function Name: main * Description : This function implements main function. * Arguments : None * Return Value : None *****/ void main(void) { R_MAIN_UserInit(); /* Start user code. Do not edit comment generated here */ /* Initialise the switch module */ Switch_Init(); /* Set the call back function when SW3 is pressed */ SetSwitchPressCallback(cb_switch_press); /* Enable and configure LCD display. */ Init_Display_Panel(); /* Display the device family name on LCD.*/ Display_Panel_String(PANEL_LCD_LINE1, " RL78"); /* Set up UART1 receive buffer */ R_UART1_Receive((uint8_t *)&g_rx_char, 1); /* Enable UART1 operations */ R_UART1_Start(); </pre> |

Before proceeding, it is necessary to connect the RSK SERIAL connection to a PC COM port and open a terminal; emulation program, such as HyperTerminal, with the settings 19200, 8, N, 1.

5.2 Running the Tutorial

| | |
|---|---|
| <p>Once the program has been downloaded onto the RSK device, the program can be executed. Click the 'Go' button or press F5 to begin the program from the current program counter position. It is recommended that you run through the program once first, and then continue to the review section.</p> |  |
|---|---|

6. Reviewing the Tutorial Program

This section will look at each section of the tutorial code and basic debugging functionality in CubeSuite+.

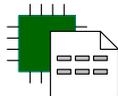
6.1 Program Initialisation

Before the main program can run, the microcontroller must be configured. Due to the debugger configuration used for the Tutorial project and the rest of the sample projects, the user will not be able to step through the hardware initialisation code. Please refer to Section 3.3 to change the entry point after programming the microcontroller. Specify '_R_Systeminit' as the function name if viewing of hardware initialisation is desired. The initialisation code is executed every time the device is reset via the reset switch or from a power reboot. The user is advised not to use the 'step' feature of the debugger to exit the R_Systeminit function.

Ensuring the Tutorial program has been downloaded onto the RL78/L1C; press the 'CPU Reset' button on the Debug Toolbar.



- From the Menu bar select View > Disassemble > Disassemble1. Alternatively, use the Display Disassemble button to open and view the 'source and disassembly'.
- To make the Display Disassemble button available on the toolbar, right-click on the toolbar and select 'View Panels'.



Revert back to the source by clicking on the file containing the function pointed to by the program counter indicator. Alternatively, right click in the Disassemble1 window and click "Jump to Source".

```

98: void main(void)
99: {
main:
➔ 00781 c7 PUSH HL
00782 c1 PUSH AX
00783 fbf8ff MOVW HL,SP
100: R_MAIN_UserInit();
00786 fced0700 CALL !!_R_MAIN_UserInit
101: /* Start user code. Do not edit comment generated here */
102:
103: /* Initialise the switch module */
104: Switch_Init();
0078a fcd30c00 CALL !!_Switch_Init
105:
106: /* Set the call back function when SW3 is pressed */
107: SetSwitchPressCallback(cb_switch_press);
0078e 30f107 MOVW AX,#7F1H
00791 5200 MOV C,#0H
00793 f3 CLRB B
00794 fcd90c00 CALL !!_SetSwitchPressCallback
108:
109: /* Enable and configure LCD display. */
110: Init_Display_Panel();
00798 fc500e00 CALL !!_Init_Display_Panel
111:
112: /* Display the device family name on LCD.*/
113: Display_Panel_String(PANEL_LCD_LINE1, " RL78");
0079c 300030 MOVW AX,#3000H

```

6.2 Main Functions

This section will look at the program code called from with the main() function, and how it works.

- Right click the 'R_UART1_Receive()' function call and select 'Go to Here' to execute the program up to this line. The 'Init_Display_Panel()' function call enables and configures the LCD panel, and 'Display_Panel_String()' will write "RL78" onto the bottom line.

```
void main(void)
{
    R_MAIN_UserInit();
    /* Start user code. Do not edit comment generated here */

    /* Initialise the switch module */
    Switch_Init();

    /* Set the call back function when SW3 is pressed */
    SetSwitchPressCallback(cb_switch_press);

    /* Enable and configure LCD display. */
    Init_Display_Panel();

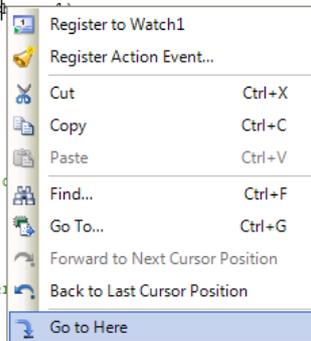
    /* Display the device family name on LCD.*/
    Display_Panel_String(PANEL_LCD_LINE1, " RL78");

    /* Set up UART1 receive buffer */
    R_UART1_Receive((uint8_t *)&g_rx_char, 1);

    /* Enable UART1 operations */
    R_UART1_Start();

    while (1U)
    {
        /* Wait for user requested A/D conversion */
        if (TRUE == g_adc_trigger)
        {
            uint16_t adc_result;

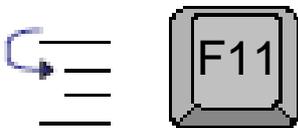
            /* Call the function to perform the A/D conversion */
            adc_result = get_adc();
        }
    }
}
```



- Set a breakpoint on the 'R_UART1_Start()' function call by clicking on the On-Chip Breakpoint column to the left of the number column.
- Click the 'Step In' button to step into the 'R_UART1_Receive()' function. Alternatively, press [F11].

```
/* Set up UART1 receive buffer */
R_UART1_Receive((uint8_t *)&g_rx_char, 1);

/* Enable UART1 operations */
R_UART1_Start();
```



- The program counter should now move into the R_UART1_Receive function definition. This function is an API function provided by the Application Leading Tool (Applilet) Code Generator. It sets up the UART interrupt handler code to receive a specified number of bytes into a receive buffer. Once the specified number of bytes has been received, the interrupt handler code calls a callback function as shown later on in this section.
- For full details on how to configure a project using Applilet refer to the Code Generator Tutorial Manual.



- Press the button to resume program execution.

```
MD_STATUS R_UART1_Receive(uint8_t * const rx_buf, uint16_t rx_num)
{
    MD_STATUS status = MD_OK;

    if (rx_num < 1U)
    {
        status = MD_ARGERROR;
    }
    else
    {
        g_uart1_rx_count = 0U;
        g_uart1_rx_length = rx_num;
        gp_uart1_rx_address = rx_buf;
    }

    return (status);
}
```

- The program counter should come to a halt at the R_UART1_Start function.
- Step over the function by clicking the 'Step Over' button. Alternatively, press F10.



The R_UART1_Start() function enables the UART interrupts. The program then proceeds to the main while() loop. The code inside the loop waits for user input from either the UART or RSK switches, and then performs an A/D conversion.

```
/* Set up UART1 receive buffer */
R_UART1_Receive((uint8_t *)&g_rx_char, 1);

/* Enable UART1 operations */
R_UART1_Start();

while (1U)
{
```

| | |
|---|---|
| <ul style="list-style-type: none"> • Locate the function call to 'lcd_display_adc()' inside the while loop. • Set a breakpoint on the 'lcd_display_adc()' function call by on the On-Chip Breakpoint column to the left of the number column. • In the Project Tree pane, locate the file 'r_cg_sau_user.c' and double-click to open the source file. Scroll down to the function r_uart1_callback_receiveend(). | <pre> /* Enable UART1 operations */ R_UART1_Start(); while (1U) { /* Wait for user requested A/D conversion if (TRUE == g_adc_trigger) { uint16_t adc_result; /* Call the function to perform an A/ adc_result = get_adc(); /* Display the result on the LCD */ lcd_display_adc(adc_result); } } </pre> |
| <ul style="list-style-type: none"> • Set a breakpoint on the line of code inside the r_uart1_callback_receiveend function as shown opposite. • Continue to execute the program by pressing the  button. | <pre> static void r_uart1_callback_receiveend(void) { /* Start user code. Do not edit comment generated here */ /* Check the contents of g_rx_char */ if (('c' == g_rx_char) ('C' == g_rx_char)) { g_adc_trigger = TRUE; } /* Set up UART1 receive buffer and callback function again */ R_UART1_Receive((uint8_t *)&g_rx_char, 1); /* End user code. Do not edit comment generated here */ } </pre> |
| <ul style="list-style-type: none"> • In the terminal; emulation window, press the 'c' button on the keyboard. • The program will halt at the breakpoint in the r_uart1_callback_receiveend function as shown opposite. Remove the breakpoint by clicking on the breakpoint column. • Continue to execute the program by pressing the  button. • The program will halt at the breakpoint in the main while loop. • Remove the breakpoint by clicking on the breakpoint column. Continue to execute the program by pressing the  button. | <pre> static void r_uart1_callback_receiveend(void) { /* Start user code. Do not edit comment generated here */ /* Check the contents of g_rx_char */ if (('c' == g_rx_char) ('C' == g_rx_char)) { g_adc_trigger = TRUE; } /* Set up UART1 receive buffer and callback function again */ R_UART1_Receive((uint8_t *)&g_rx_char, 1); /* End user code. Do not edit comment generated here */ } /* Display the result on the I lcd_display_adc(adc_result); /* Increment the adc_count and if (16 == ++adc_count) { adc_count = 0; } led_display_count(adc_count); </pre> |

The program proceeds to display the result of the A/D conversion on the LCD and in the terminal window. In addition, the running count of A/D conversions performed is displayed in binary form using LEDs 0-3 on the RSK. Adjust the potentiometer and press SW3 on the RSK and an additional A/D conversion will be performed.

- Press the 'Stop' button to halt program execution.
- This is the extent of the tutorial code.



For further details regarding hardware configuration, please refer to the RL78 Series Software Manual and the RL78/L1C Group Hardware Manual.

The E1 emulator features advanced logic-based event point trigger system, and full instruction on its use is outside the scope of this tutorial. For further details, please refer to the E1 Emulator User's Manual

7. Additional Information

Technical Support

For details on how to use CubeSuite+, refer to the manual available on the DVD or from the web site.

Parts of the sample code provided with the RSKRL78L1C can be reproduced using the Application Leading Tool (Applilet) code generator tool. Applilet can be downloaded from the Renesas website.

Source files and functions generated by Applilet are prefixed with 'r_' and 'R_', respectively.

For information about the RL78/L1C series microcontrollers refer to the RL78/L1C Group Hardware Manual.

For information about the RL78 assembly language, refer to the RL78 Series Software Manual.

Technical Contact Details

Please refer to the contact details listed in section 9 of the “Quick Start Guide”

General information on Renesas microcontrollers can be found on the Renesas website at:

<http://www.renesas.com/>

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| REVISION HISTORY | RSK RL78L1C Tutorial Manual |
|-------------------------|------------------------------------|

| Rev. | Date | Description | |
|------|--------------|-------------|--|
| | | Page | Summary |
| 1.00 | Jan 16, 2014 | — | First Edition issued |
| 1.01 | Mar 19, 2014 | — | Hardware Manual document number of [How to Use This Manual] was fixed. |
| | | — | [2. List of Abbreviations and Acronyms] was updated. |
| | | 15 | Explanation “A common difference between the two builds is...” of Section 3.4 was fixed. |
| | | 17 | Explanation of LCD connection was fixed. |
| 1.02 | Apr 04, 2014 | — | [2. List of Abbreviations and Acronyms] was updated. |
| | | — | [Table of Contents] was updated. |
| | | 8 | Optimisation level was added to ‘Release’ build configuration. |
| | | 10 to 24 | Frames were added to some explanations and figures. |

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