RL78/G1C

Utilising Safety Functions for Cubesuite+

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Introduction

The purpose of this Application Note is to show the user how to add the associated RL78/G1C sample code to a new or existing CubeSuite+ workspace; as well as give an explanation of what the sample code does.

The sample code demonstrates a number of the safety functions available on the RL78/G1C. The functions demonstrated are as follows:

Cyclic Redundancy Check: Used to check the RAM data using the general CRC peripheral whilst the CPU is running.

Frequency Detection: Used to check whether the oscillation frequency of the main clock is normal or abnormal by comparing the high-speed on-chip oscillator clock or external X1 oscillation clock with the low-speed subsystem clock (32.768 kHz).

A/D Self-Test: Used to perform a self-check of A/D conversion by performing A/D conversion on the internal reference voltage and supply rails.

Invalid Memory Access: Used to detect illegal accesses to invalid memory areas; such as areas where no memory is allocated and areas to which access is restricted. The illegal memory access detection function triggers a reset if a memory space specified as access-prohibited is accessed.

RAM Guard:
Used to prevent RAM data from being rewritten when the CPU freezes.

Target Device

RL78/G1C

Development environment

IDE: Cubesuite+
Compiler: CA78K0R
Hardware: Renesas Starter Kit for RL78/G1C

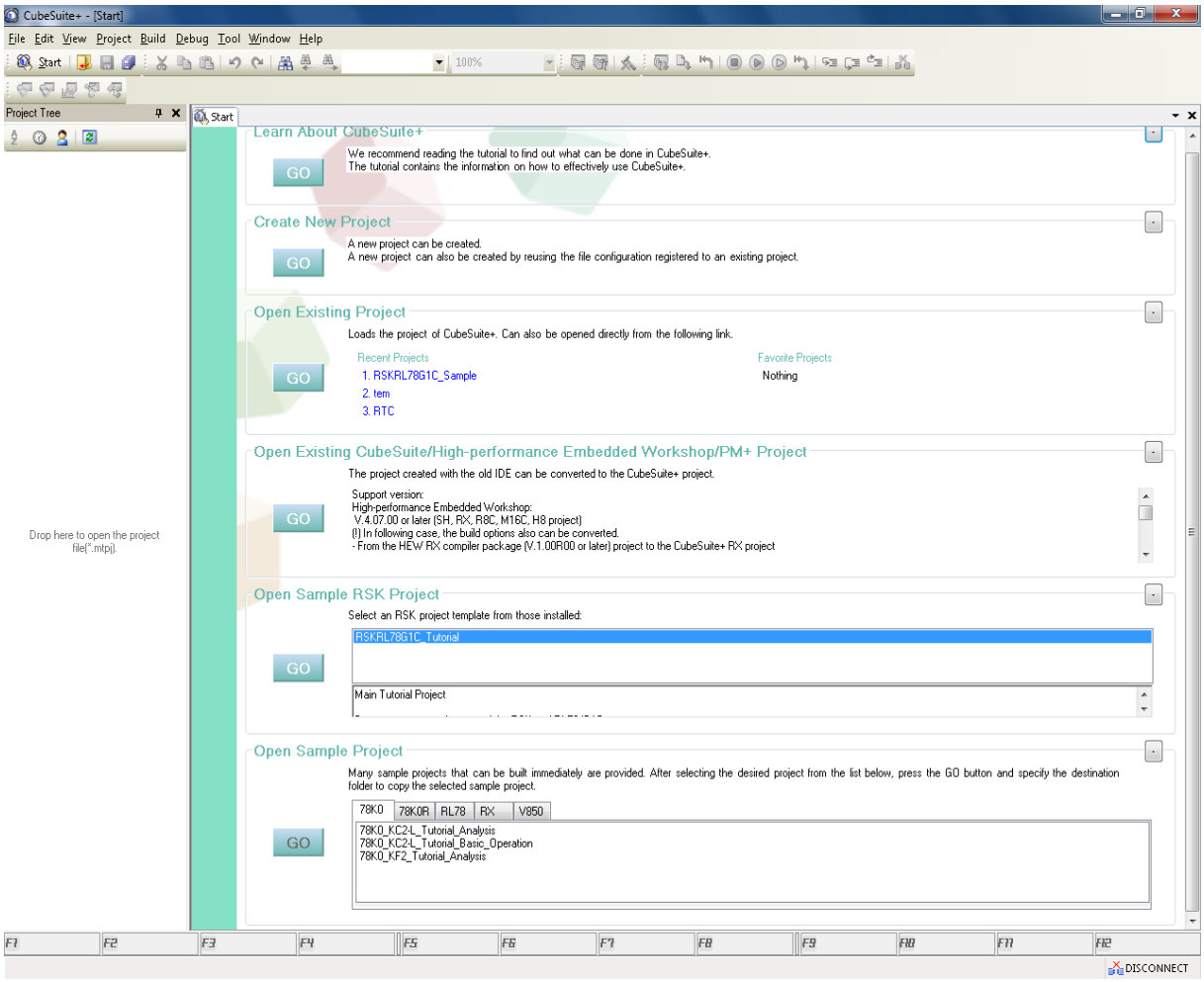
Contents

1. Installation

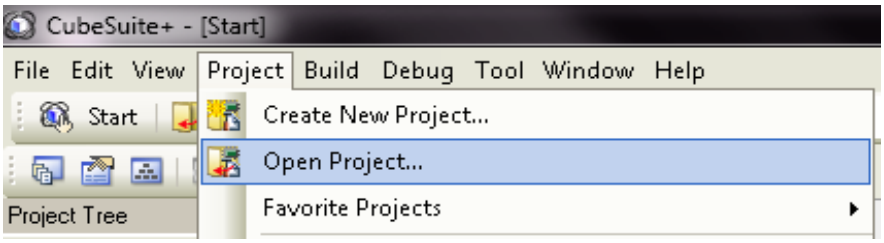
This section assumes CubeSuite+ IDE is already installed on the user's personal computer (PC). Create a new folder and name it as 'RSKRL78G1C_Workspace'. Copy the zipped file 'an_r01an1740eg0100_rl78g1c_safety.zip', available in the Application Note package downloaded from the website, to this folder. Extract the 'an_r01an1740eg0100_rl78g1c_safety.zip' file to the RSKRL78G1C_Workspace folder.

2. Creating the Project Workspace

Open CubeSuite+ IDE by clicking the Windows Start button, select All Programs > Renesas Electronics CubeSuite+ > CubeSuite+.

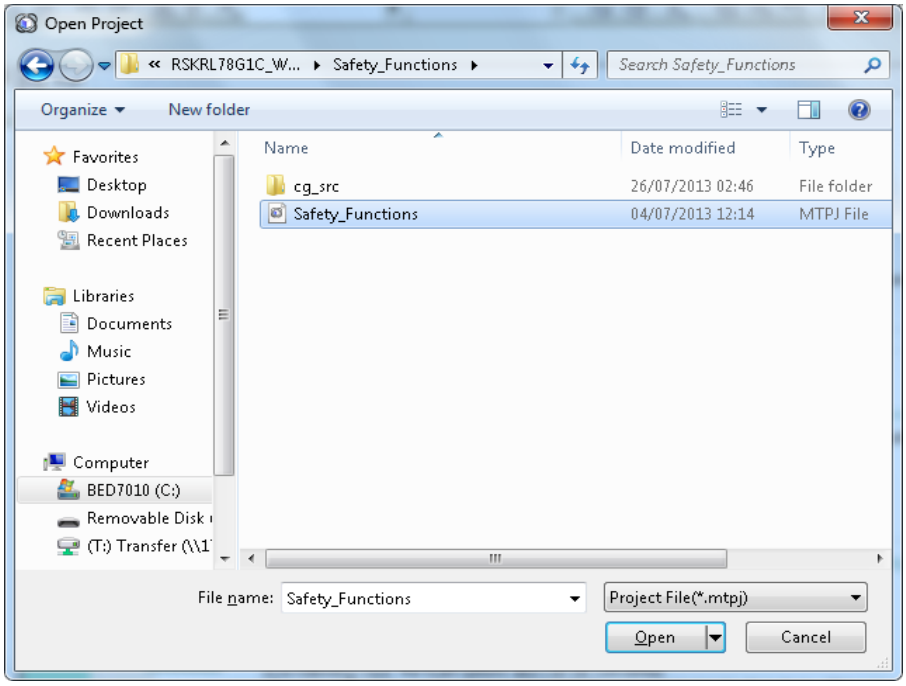


From the menu bar select File > Project > Open Project…

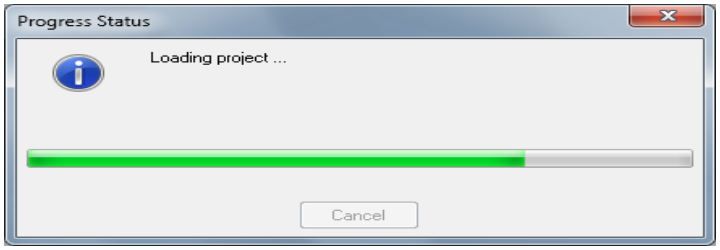


CubeSuite+ will open a dialog.
Navigate to the unzipped Safety_Functions folder located in RSKRL78G1C_Workspace.
Select the Safety_Functions.mtpj file.

Click <Open>

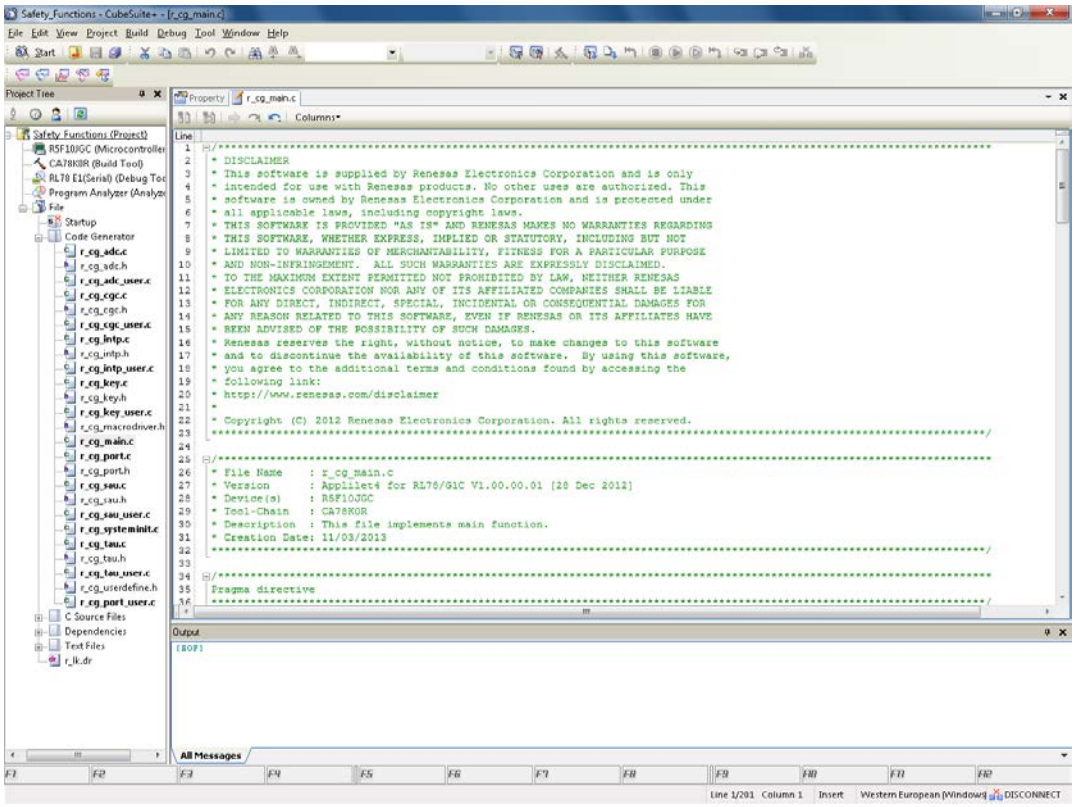


A Progress Status dialog will appear briefly whilst CubeSuite+ loads the project.



3. Opening Sample Code and Source Files

Once the project has been opened, the source code and all dependant files can be opened in the editor by expanding the folders in the Project Tree window and double clicking the files listed. All files have been grouped according to their file type.



4. Source Code Functionality

The source code project is specifically written to run on the appropriate RSK. However this source code can be useful as an example even without the RSK.

The project was written using source files containing API functions generated using Code Generator. The project will contain a C source file ‘r_cg_main.c’. This source file includes the C function main(). All source files and dependant files whose filenames are prefixed with ‘r_’ were generated using Application Leading Tool.

5. Code Execution

The sample code demonstrates a number of the safety functions available on the RL78/G1C.

Instructions:

1. Compile and download the sample code. Click the 'Go' button to start the software.

2. The LCD will initialize and 'SW1, 2, 3' will then be displayed.

3. Press switch SW1 to run the A/D self-test and illegal memory access.

   Press switch SW2 to run the cyclic redundancy check and RAM guard test.

   Press switch SW3 to run the frequency detection and SFR guard test

4. The following is required and expected for the different tests:

Illegal Memory Access Test and A/D Self-Test

- IMEM will be displayed on the LCD panel.

Press SW1 to enable invalid memory access detection. Any other switch will leave invalid memory access detection disabled. A write to the reserved memory location (0xF1800) is performed. This will result in a device reset if invalid memory access detection has been enabled. In the event of this reset the user can stop the debugger in the R_CGC_Get_ResetSource()function in r_cg_cgc_user.c and view the RESF register. The register will have its IAWRF flag (bit1) set high. This indicates an illegal memory access has caused the reset.

If disabled, a byte-write to the reserved memory location (0xF1800) will be attempted which will not result in a device reset.

The application continues to the A/D self-test.

ADC will be displayed on the LCD panel.

The A/D self-test will carry out three conversions.

The first conversion is performed on the internal 0V (AVrefm), which should result in AVREFM00' on the display, indicating an 8-bit ADC value of 00h. Press and switch to perform the second conversion on the internal 5V (AVrefp). This should result in 'AVREFPFF' on the display, indicating an 8-bit ADC value of FFh. Press any switch to perform the third conversion on the internal reference voltage of 1.45V. This should result in 'VREF 4D' on the display, indicating an 8-bit ADC value of 4Dh. Press any switch to proceed after each test.

Go to step 3.

Cyclic Redundancy Check and RAM Guard

- RAM will be displayed on the LCD panel.

Press SW1 to enabling RAM guard. Any other switch will leave RAM guard disabled. "CRC-PrOf" or "CRC-PrOn" will be displayed on the first line of the LCD display. Move the RV1 potentiometer and when ready press any switch to perform an ADC conversion

If RAM guard is enabled the first 128 RAM locations are be write-protected. The ADC module is configured to carry out a conversion following a switch press and the result is stored in a buffer array within the first 128 RAM locations.

If disabled, the A/D conversion result following a switch press is successfully stored in the buffer array. Following 5 switch presses, a CRC is carried out on the 5 ADC data and the result is displayed on the alpha-numeric section of the LCD.

If enabled, protection is activated and the ADC results are not written into the buffer array. The A/D conversion results show as 00 and the CRC check result is shown as 0000. Press any switch to complete the test.

Go to step 3.

Frequency Detection and SFR Guard

- SFR will be displayed on the LCD panel.

Press SW1 to enable SFR guard. Any other switch will leave SFR guard disabled. Frequency measurement will then proceed. If SFR guard is enabled, the UART interrupt enable bit (an SFR bit) is prevented from being set to 0.
As a result, no measurement takes place and the program returns to the main menu in step 3 above. If SFR guard is disabled, the UART interrupt will be set to 0 thereby enabling the frequency measurement. The measured frequency will be shown on the LCD panel and will be approximate to 12 MHz. This will be in the format: 12000 KHz. Press any switch to complete the test.

Go to step 3.

For more information on the safety functions please refer to the RL78/G1C hardware manual.

Website and Support

Renesas Electronics Website
http://www.renesas.com/

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Revision History

Rev.	Date	Description	
		Page	Summary
1.00	Nov 11, 2013	—	First edition issued

General Precautions in the Handling of MPU/MCU Products

The following usage notes are applicable to all MPU/MCU 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. Handling of Unused Pins

   Handle unused pins in accord 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 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. Unused pins should be handled as described under Handling of Unused Pins in the manual.

2. Processing at Power-on

   The state of the product is undefined at the moment 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 moment 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 moment 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 moment when power is supplied until the power reaches the level at which resetting has been specified.

3. Prohibition of Access to Reserved Addresses

   Access to reserved addresses is prohibited.

   — The reserved addresses are provided for the possible future expansion of functions. Do not access these addresses; the correct operation of LSI is not guaranteed if they are accessed.

4. Clock Signals

   After applying a reset, only release the reset line after the operating clock signal has become stable. When switching the clock signal during program execution, wait until the target clock signal has 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. Moreover, 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.

5. Differences between Products

   Before changing from one product to another, i.e. to a product with a different part number, confirm that the change will not lead to problems.

   — The characteristics of an MPU or MCU in the same group but having a different part number may differ in terms of the internal memory capacity, layout pattern, and other factors, which can affect the ranges of electrical characteristics, such as characteristic values, operating margins, immunity to noise, and amount of radiated noise. When changing to a product with a different part number, implement a system-evaluation test for the given product.

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