# RL78/L12

## Utilising Safety Functions for e2studio

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## Introduction

The purpose of this Application Note is to show the user how to add the associated RL78/L12 sample code to a new or existing e2studio 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/L12. 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 on-chip oscillator clock (15 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.

**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/L12

## Development environment

IDE: e2studio
Compiler: GNURL78 v12.02 -ELF
Hardware: Renesas Starter Kit for RL78/L12

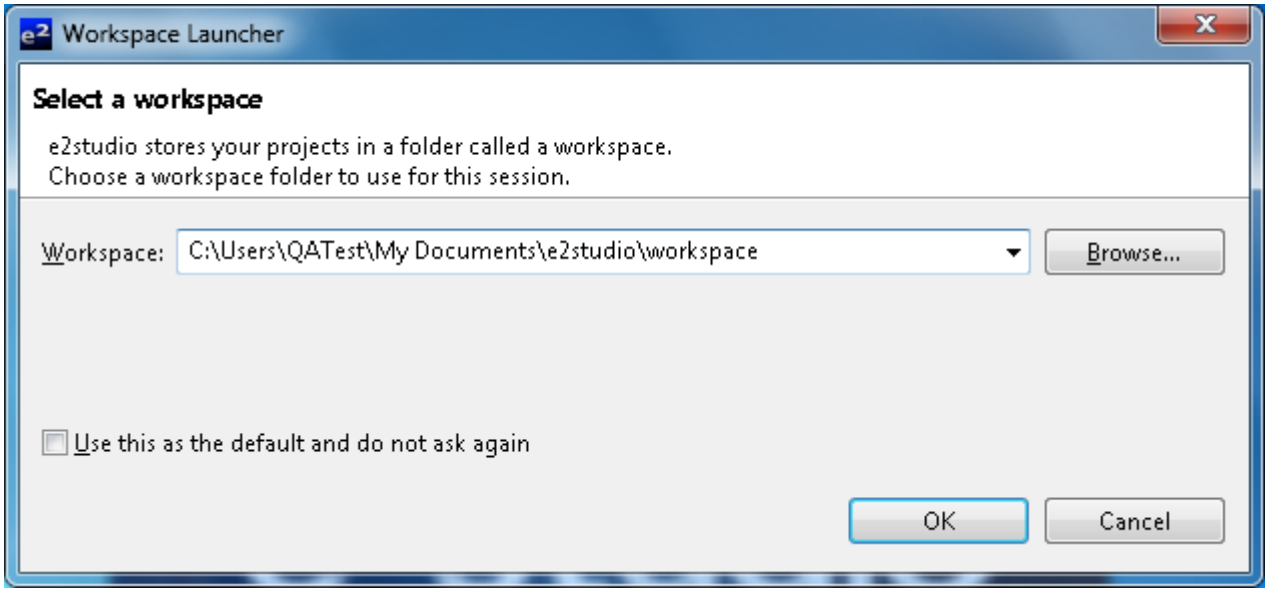
## Contents

## 1. Installation

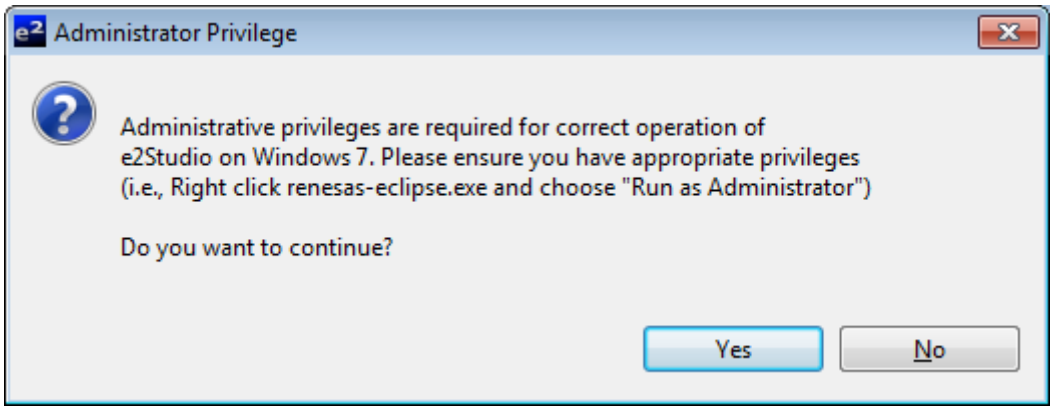
This section assumes e2studio IDE is already installed on the user's personal computer (PC). Create a new folder and name it as 'RSKRL78L12_Workspace'. Copy the zipped file 'an_r01an1589eg0100_rl78l12_safety.zip', available in the Application Note package downloaded from the website, to this folder. Extract the 'an_r01an1589eg0100_rl78l12_safety.zip' file to the RSKRL78L12_Workspace folder

## 2. Creating the Project Workspace

Open e2studio IDE by clicking the Windows Start button, select All Programs > Renesas Electronics e2studio > Renesas e2studio.



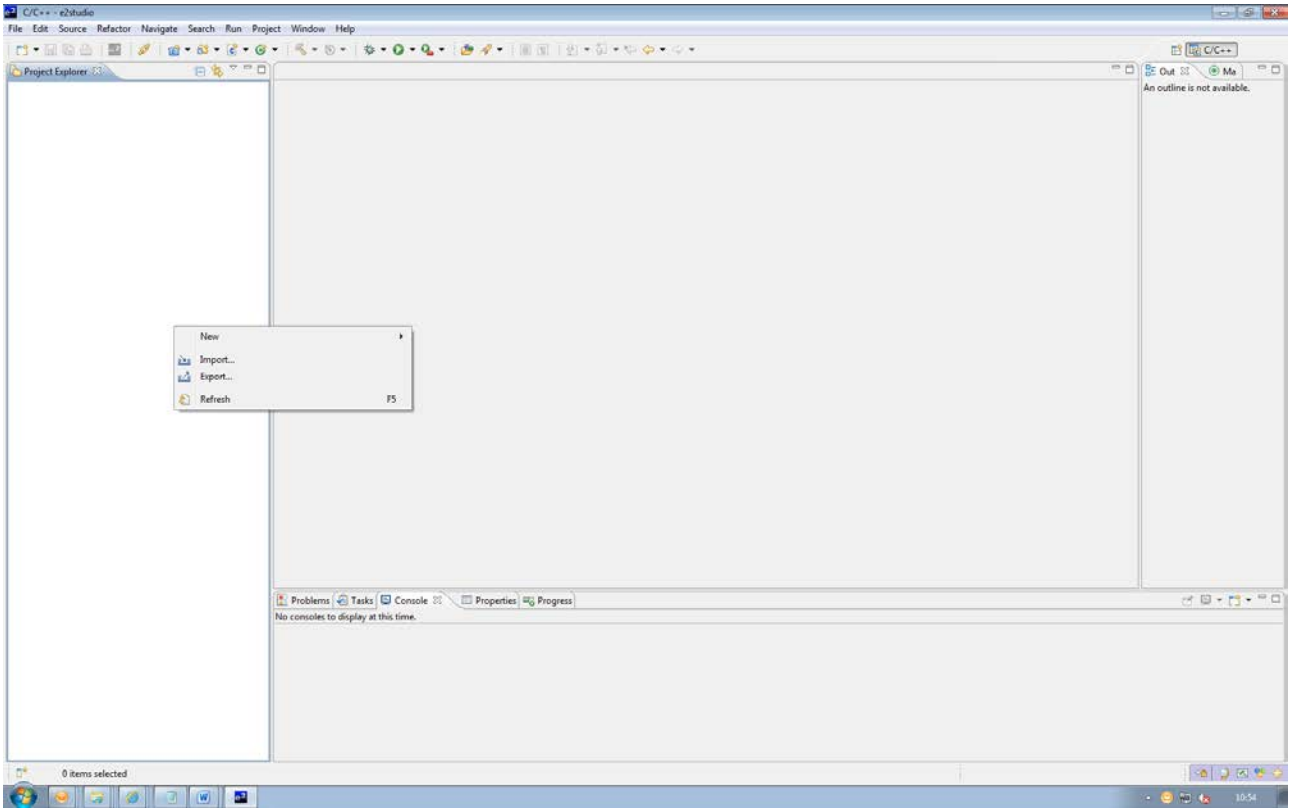

Select <OK>.



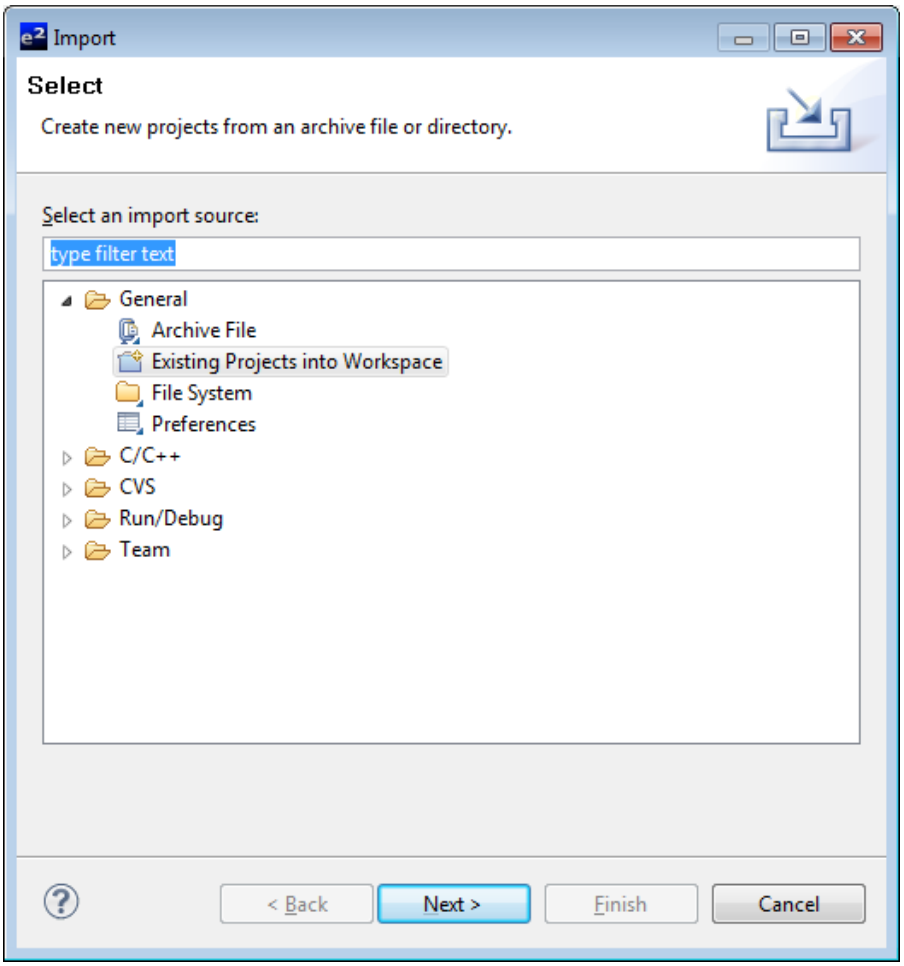

Select <Yes> to Administrator Privilege dialog.


On the welcome screen select ‘Go to the Workbench’ icon as shown above.

1. Once the e2studio environment has initialised, right click in the project explorer window and click <Import…>



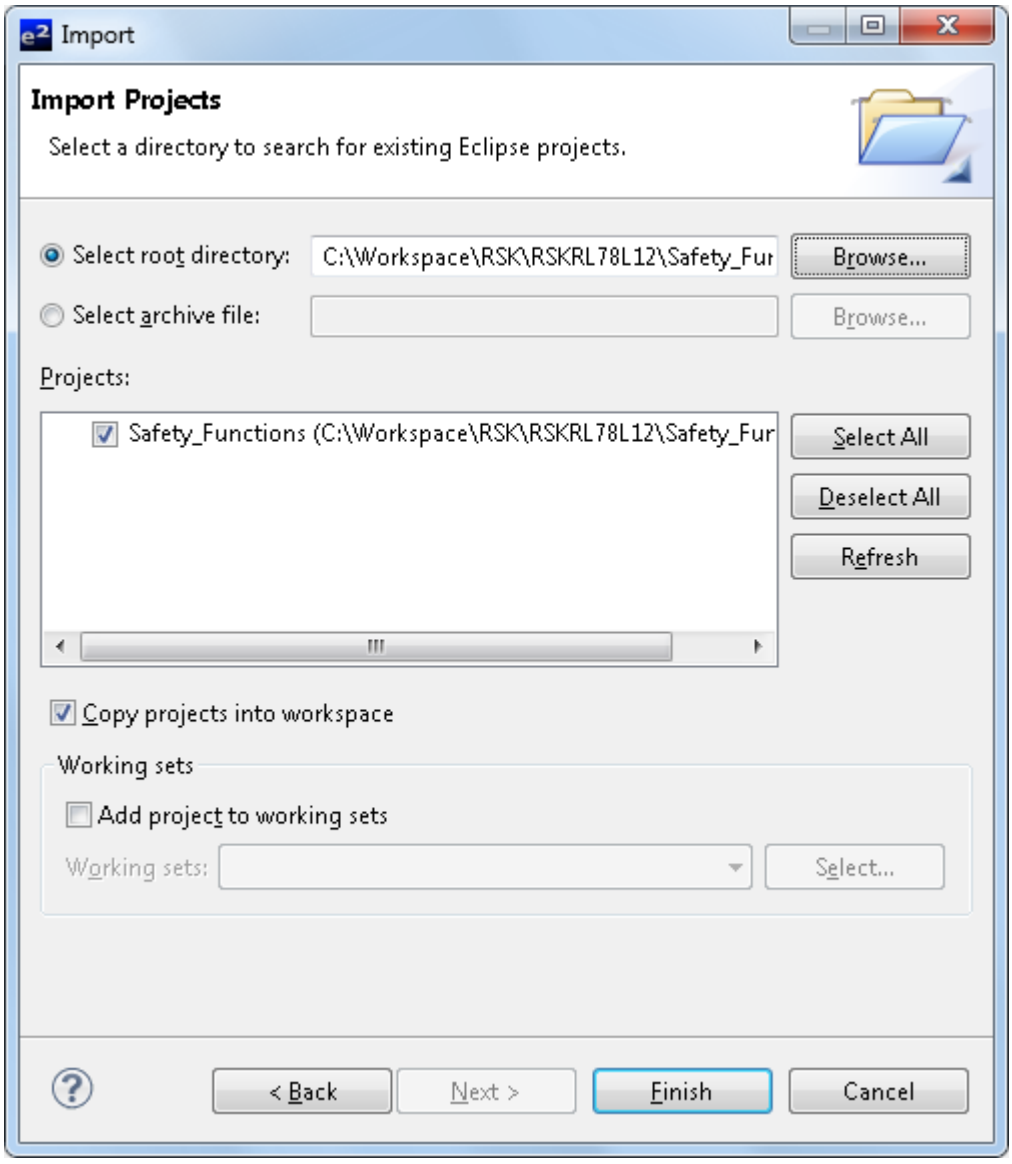
2. The Import dialog will now appear. Expand the “General” folder icon, and select “Existing Projects into Workspace”, then click ‘Next’.




3. The Import Dialog will now appear ,specify the project to import .Click the “Browse” button and locate the directory: C:\Workspace\RSK\RSKRL78L12

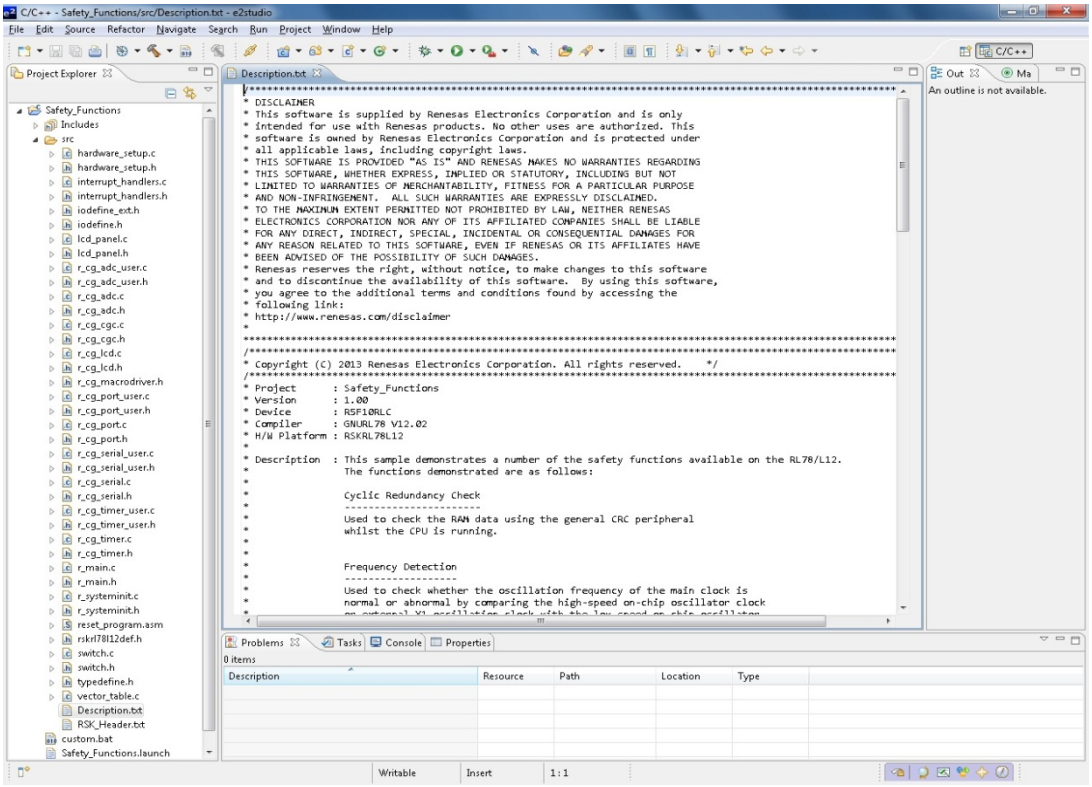
   Navigate to the unzipped Safety_ Functions folder located folder located in RSKRL78L12 Workspace folder. Select the Safety_ Functions folder located folder

   And also ensure that the ‘Copy projects into workspace’ option is ticked, and then click <Finish>


Import
Import Projects
Select a directory to search for existing Eclipse projects.
Select root directory:
C:\Workspace\RSK\RSKRL78L12\Safety_Fur
Browse...
Select archive file:
Browse...
Projects:
Safety_Functions (C:\Workspace\RSK\RSKRL78L12\Safety_Fur
Select All
Deselect All
Refresh
Copy projects into workspace
Working sets
Add project to working sets
Working sets:
Select...
< Back
Next >
Finish
Cancel

## 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_main.c’. This source file includes the C function main(). All source files and dependent files whose filenames are prefixed with ‘r_’ were generated using Applilet3 (Application Leading Tool). For more information, refer to Description.txt.

## 5. Code Execution

The sample code demonstrates a number of the safety functions available on the RL78/L12.

Modifications:

The following required changes assume there has been no prior modification to the board. Please refer to the RSKRL78L12 User Manual and Schematics if in doubt.

Please refer to the schematics document and component placement diagram in the User Manual to help locate components.

Connect a jumper to pins 1 and 2 of J12 and J13 headers.

Connect a jumper to pins 2 and 3 of J10 and J11 headers.

Instructions:

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

2. The LCD will initialise. After approximately 5 seconds, the heart symbol will toggle on and off before it is turned off again.

3. A MENU will be displayed.
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:

A/D Self-Test and Illegal Memory Access
Press SW1 (enabling) or SW3 (disabling) invalid memory access. IMEM will be displayed on the LCD panel.

If enabled, a write to the reserved memory location (0xEF000) will be attempted which will result in a device reset. The application will restart from step 2 (the user can stop the debugger and view the RESF register in the SFR list. The SFR list can be called from the menu bar View > SFR. Search the RESF register, which will have its bit1 set high. This indicates an illegal memory access caused the reset.).

If disabled, a byte written to the reserved memory location (0xEF000) will be attempted which will not result in a device reset. No modification occurs on the memory location and 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 two conversions, one on the internal 0V (AVrefm) and the other on the AVrefp voltage. The two results are stored in the g_adc_test_result array. The 0V and AVrefp are store in array locations 0 and 1, consecutively. The expected conversion results are 0x00 and 0xFF.

Returns back to MENU.

Cyclic Redundancy Check and RAM Guard
Press SW2 (enabling) or SW3 (disabling) RAM guard. RAM will be displayed on the LCD panel.

If enabled, protection is enabled to prevent write access to the first 128 bytes of RAM, where the A/D conversion results are stored.

If disabled, protection is removed from these bytes.

CRC will be displayed on the LCD panel.

Press a switch to get an ADC reading. If RAM guard is enabled, the reading will be 0, otherwise a valid reading is obtained. Adjust the potentiometer and press a switch again to get a different reading. Repeat this for four readings. Press a switch for the fifth time and the CRC value will be shown.

Press a switch to return back to MENU.

Frequency Detection and SFR Guard
Press SW1 (enabling) or SW3 (disabling) SFR guard. SFR will be displayed on the LCD panel.

If enabled, write access to the interrupt control register will prevent the UART transmit interrupt from being enabled; preventing the main clock's frequency (20 MHz) measurement based on the UART's transmit data. The measured frequency will show as 0 MHZ.

If disabled, the UART interrupt will allow data transmission; enabling the frequency to be measured. The measured frequency will be shown on the LCD panel and will be approximate to 20 MHz This will be in the format: xx.xx MHZ will also be displayed.

Press a switch to return back to MENU.

Note: The first initialisation of the LCD will briefly show a number of segments turning on then off. This is expected due to a SEG19 pin being used as a port pin for frequency detection.

For more information on the safety functions please refer to the RL78/L12 hardware manual.

## 6. Website, Inquiries and Support

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http://www.renesas.com/
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## Revision Record

| Rev. | Date | Description | |
|---|---|---|---|
| | | Page | Summary |
| 1.00 | November 01, 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 type 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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