RL78/L12

Low Power Mode 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 low power operating mode. The CPU and all peripherals are configured to run off the internal high speed oscillator. The CPU is placed in low power (snooze) mode by executing the STOP instruction which stops the internal high speed oscillator's oscillations. The CPU is woken up from snooze mode by an interrupt request from the interval timer; which in turn triggers an A/D conversion.

Target Device

RL78/L12

Development environment

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

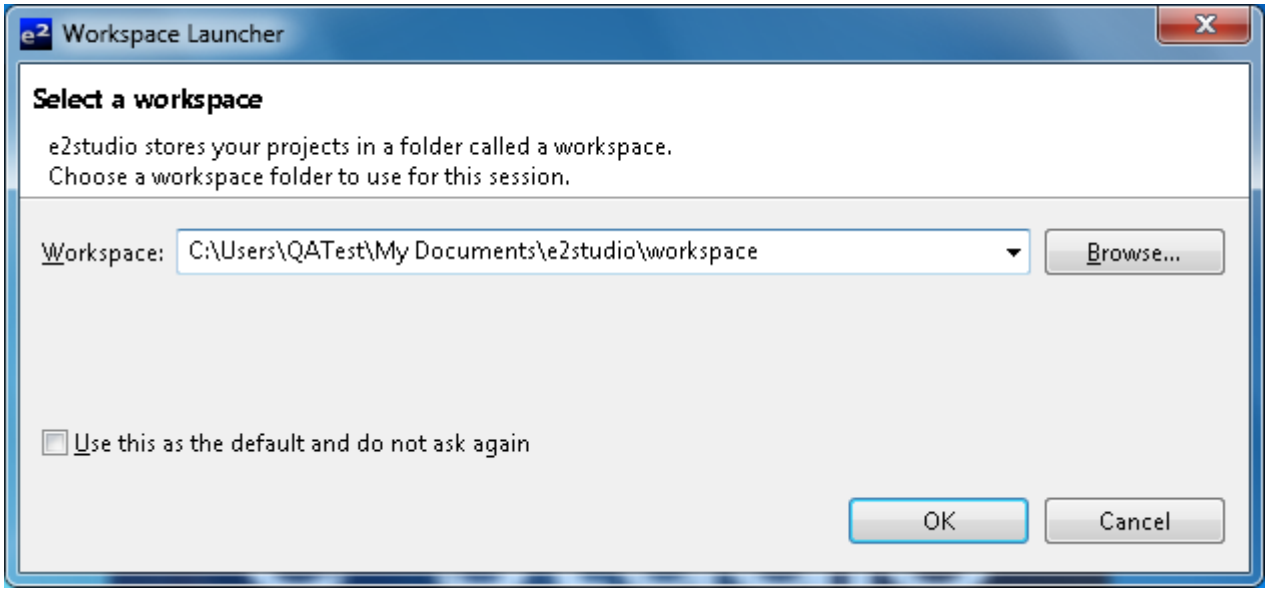
Contents

1. Installation

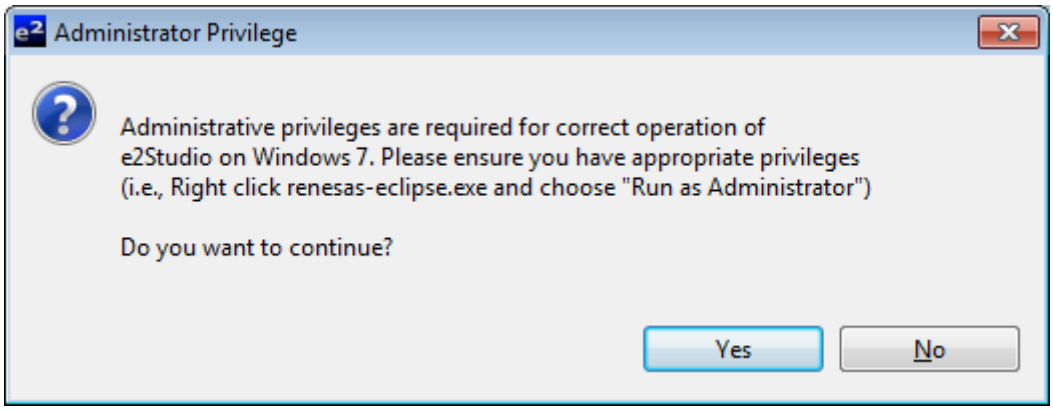
This section assumes e2studio IDE is already installed on the user's personal computer (PC). Create a new folder and name it as 'RSKRL78L12_Workspace'. Copy the zipped file 'an_r01an1564eg0100_rl78l12_power_save.zip', available in the Application Note package downloaded from the website to this folder. Extract the 'an_r01an1564eg0100_rl78l12_power_save.zip' file to the RSKRL78L12_Workspace folder.

2. Creating the Project Workspace

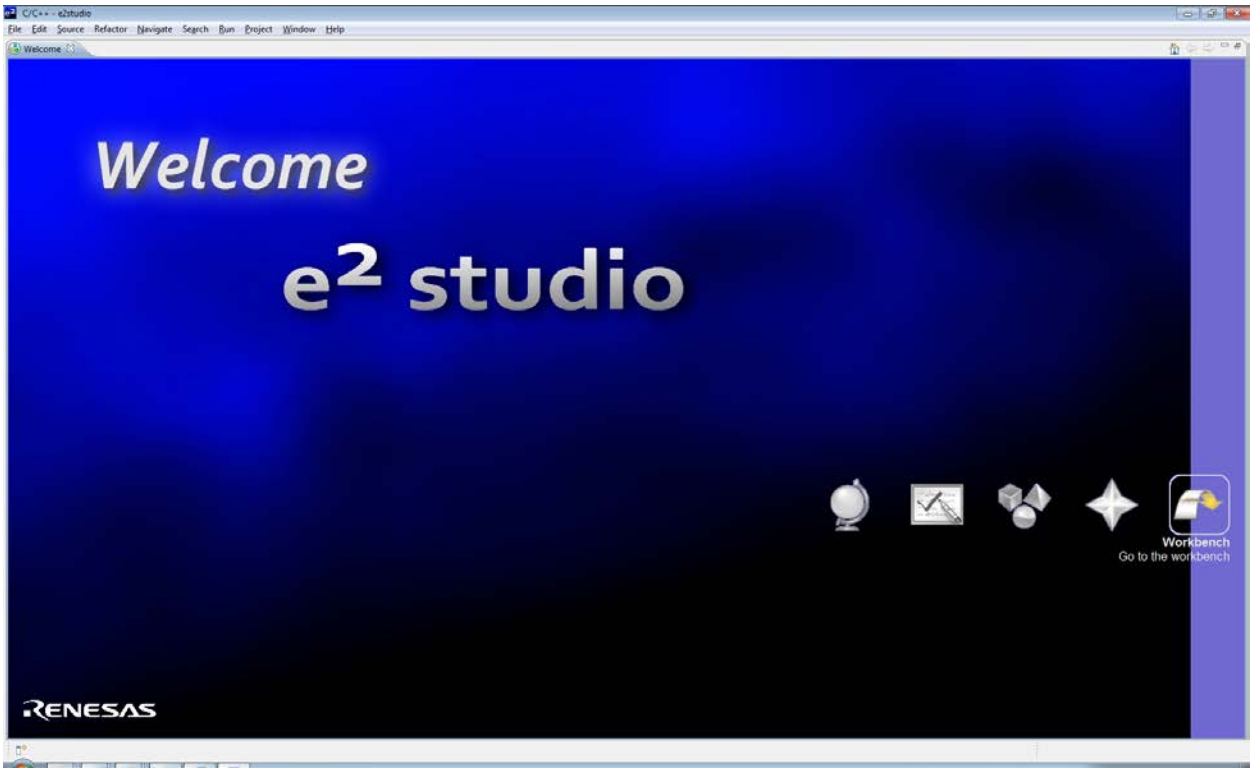
Open e2studio IDE by clicking the Windows Start button, select All Programs > Renesas Electronics e2studio > Renesas e2studio.



Select <OK>.

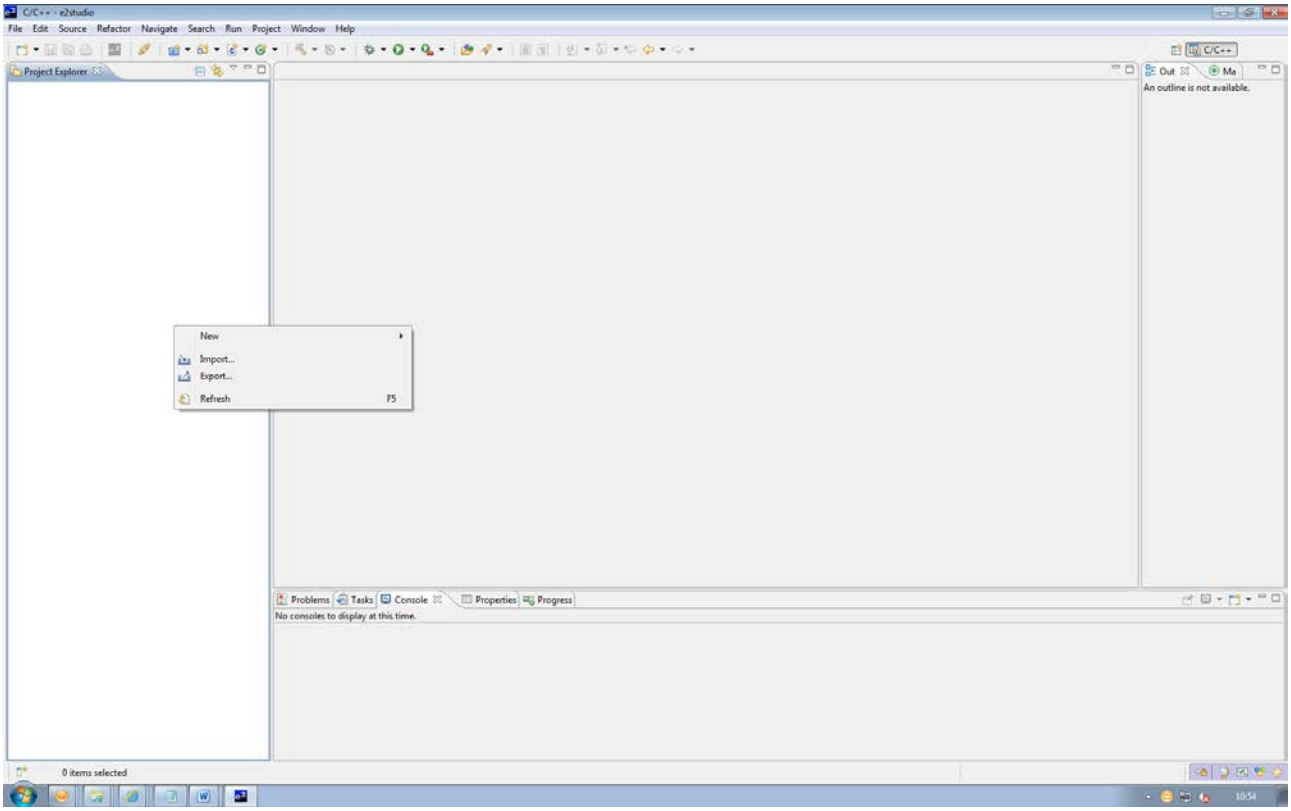


Select <Yes> to Administrator Privilege dialog.

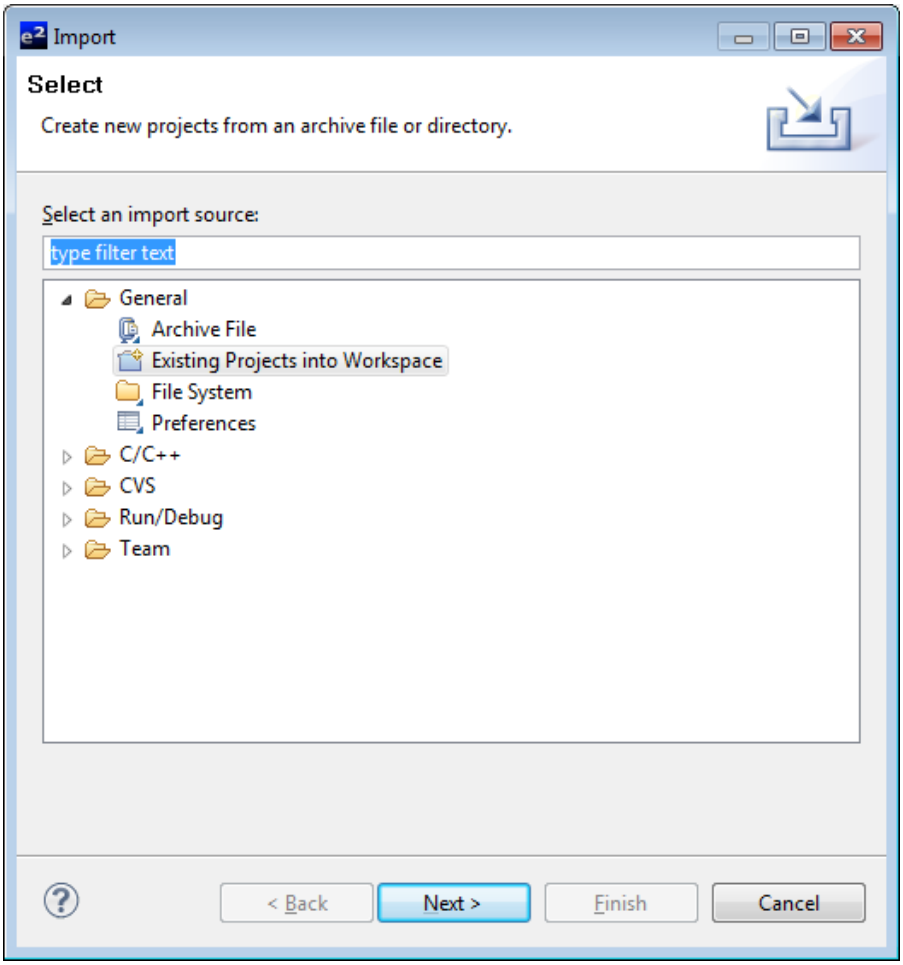


On the welcome screen select ‘Go to the Workbench’ icon as shown above.

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’.

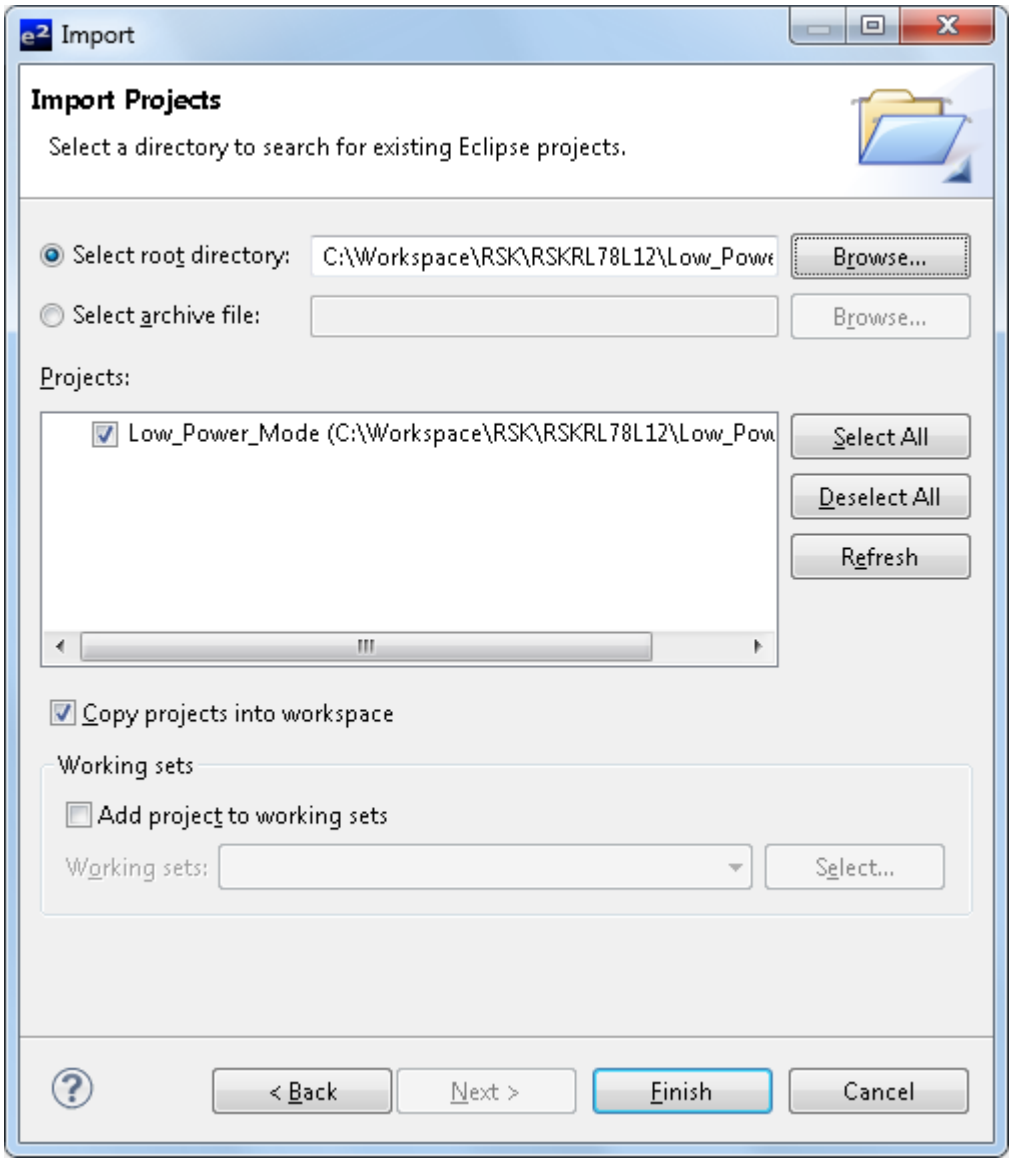


3. The Import Dialog will now appear ,specify the project to import .Click the “Browse” button and locate the directory: C:\Workspace\RSK\RSKRL78L12

   Navigate to the unzipped Low_Power_Mode folder located in RSKRL78L12 Workspace folder.

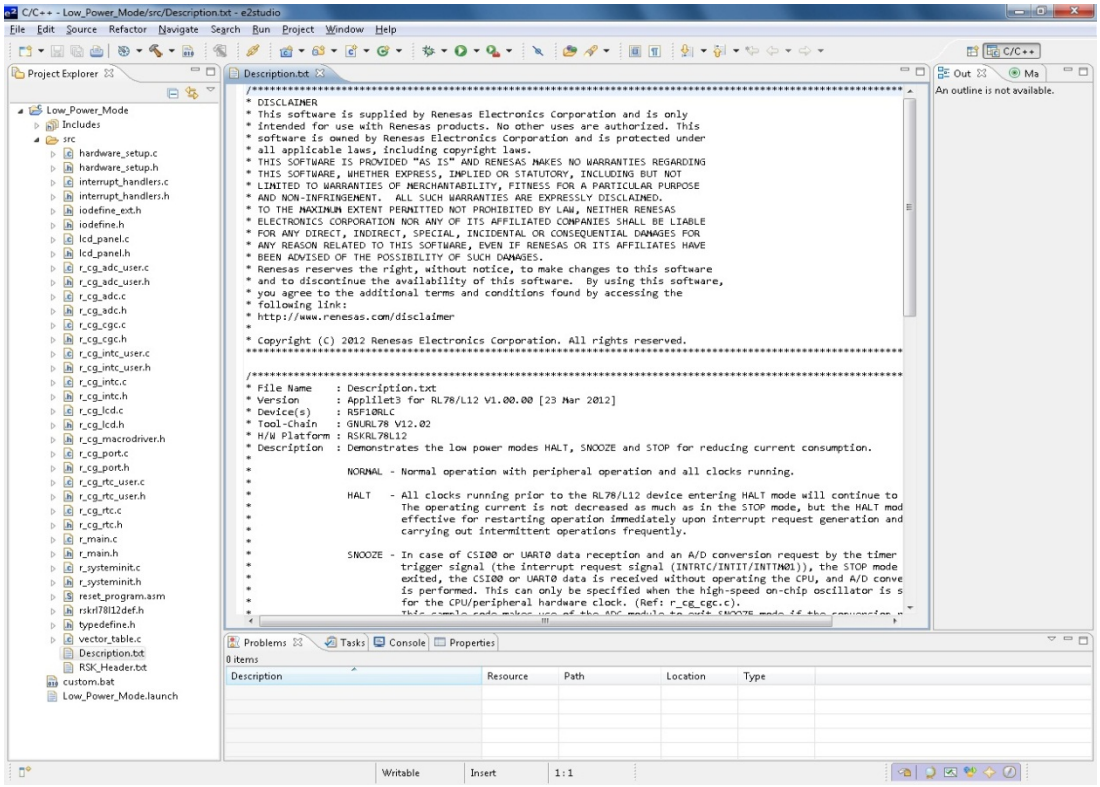
   Select the Low_Power_Mode folder.

   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\Low_Powe
Browse...
Select archive file:
Browse...
Projects:
Low_Power_Mode (C:\Workspace\RSK\RSKRL78L12\Low_Pow
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

Demonstrates the low power modes HALT, SNOOZE and STOP for reducing current consumption.

NORMAL - Normal operation with peripheral operation and all clocks running.

HALT - All clocks running prior to the RL78/L12 device entering HALT mode will continue to run. The operating current is not decreased as much as in the STOP mode, but the HALT mode is effective for restarting operation immediately upon interrupt request generation and carrying out intermittent operations frequently.

SNOOZE - In case of CSI00 or UART0 data reception and an A/D conversion request by the timer trigger signal (the interrupt request signal (INTRTC/INTIT/INTTM01)), the STOP mode is exited, the CSI00 or UART0 data is received without operating the CPU, and A/D conversion is performed. This can only be specified when the high-speed on-chip oscillator is selected for the CPU/peripheral hardware clock. (Ref: r_cg_cgc.c). This sample code makes use of the ADC module to exit SNOOZE mode if the conversion result is outside the lower (0xC8) and upper (0xFF) bound values.

STOP - The high-speed system clock oscillator and high-speed on-chip oscillator stop, stopping the whole system, thereby considerably reduce the CPU operating current.

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.

Remove R26

Connect an ammeter across J7

(Ensure the ammeter used is capable of measuring currents as low as 2 uA)

To enable Switch 2 and 3 to function, please link the following:

J12 pins 2 & 3.

J13 pins 2 & 3.

To enable SEG29 and SEG30 to function, please link the following:

J10 pins 2 & 3.

J11 pins 2 & 3.

External Device/Component

Connect an ammeter across J7; configure the ammeter for current measurement. Connect an external 5V regulated power supply to the PWR connector.

Instructions:

1. Compile the sample code and download to the RSK. Click the 'Debug Icon' button to start program execution. Click again if the programme stops at main().

2. A real time clock will be displayed in the format:

HH:MM

The: will flash every second. The clock is updated when the device is in normal operating mode.

3. Turn the potentiometer (RV1) fully counter-clockwise. This sets the potentiometer resistance to the lowest value.

4. The sample code will cycle through the 4 different operating modes starting with Normal, HALT, SNOOZE and STOP. Observe the current whilst in each mode. The battery indicator will change level state depending on the mode.

Normal Mode - press SW1 to exit

HALT Mode - Press SW1 to exit

SNOOZE Mode - slowly turn the potentiometer fully clockwise

STOP Mode - press SW1 to exit

5. Go to step 3 to repeat the test.

6. Website, Inquiries and Support

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http://www.renesas.com/
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http://www.renesas.com/inquiry
Support
http://www.renesas.com/rskrl78l12

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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