

e² studio IDE

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Debugging in C and Assembly

Introduction

For embedded programming, it is very common for software engineer to write application codes in C or C++ for code portability reason. The compiler toolchain therefore helps to translate these C source codes into the object codes that enable the debugger to operate. For this reason, in some cases, the debugger may not operate in the manner of the C source codes flow. Therefore, it is a necessity to master the debugging skills in both C and the object codes like Assembly language.

This application note focuses on the usage of disassembly view using Renesas Starter Kit for RX111 CPU board (referred as RX111 CPU Board) and E1 emulator under the e² studio IDE.

e² studio V.2.2.0.13

C/C++ Compiler for Renesas RX Family: V2.01.00




Target Device

RX Family

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1. Overview

The Disassembly view shows the loaded program as assembly instructions mixed with the C source code. Both the C Source view and the Disassembly view can be synchronized if “Link with Active Debug Context” (icon: ) and “Shows Source” (icon: ) are enabled. To step in the Disassembly view, enable “Instruction Stepping Mode” (icon: ) ; to step in the C Source view, disable Instruction Stepping Mode”:

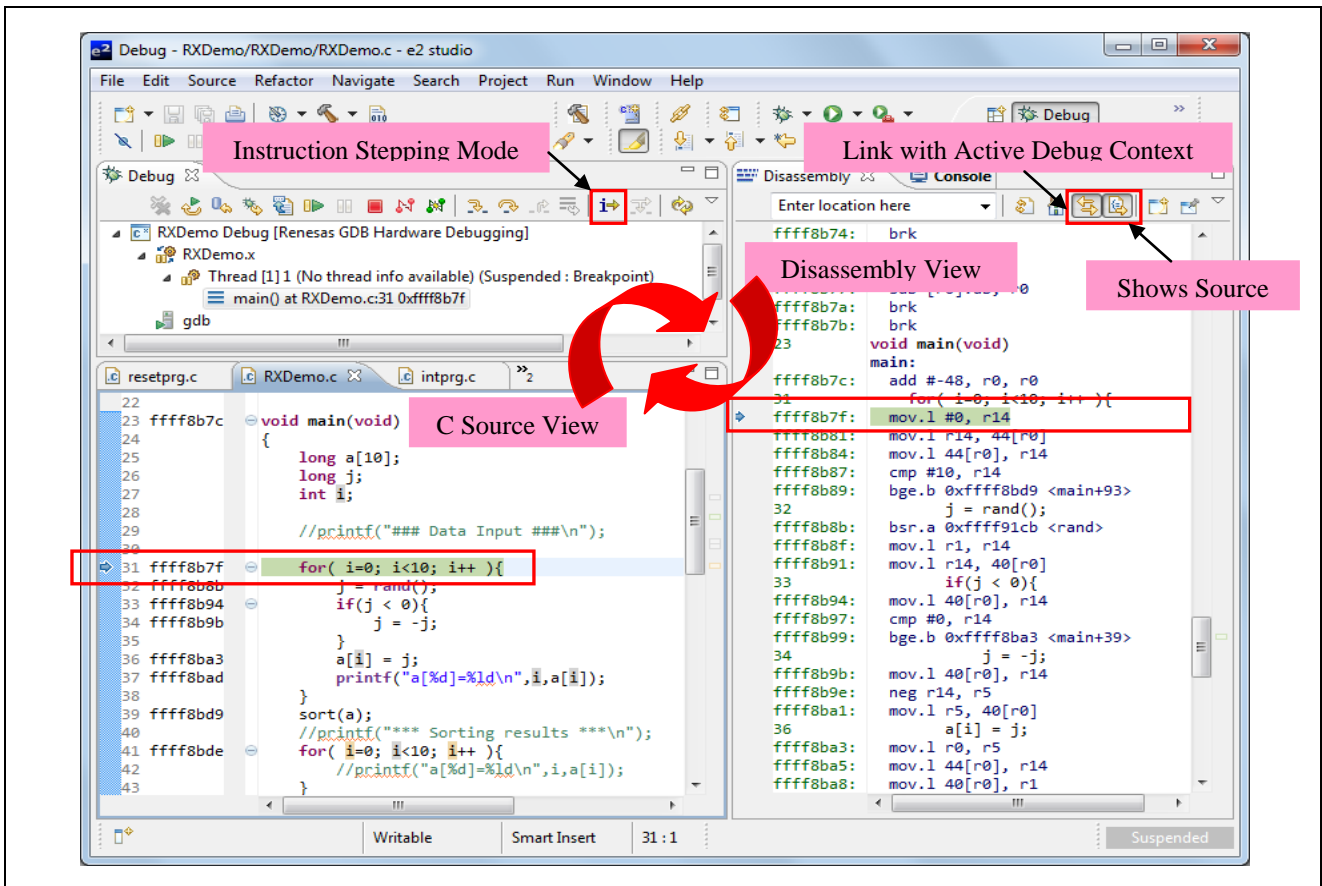


Figure 1 Disassembly View

During the debugging stage, it is often recommended to turn off the optimization settings (e.g. Optimization level = 0) for both the compiler and linker. The reason being with optimization turned on, whether for the size or speed, the compiler is very likely to generate fewer object codes corresponds to the assembly instructions. Hence, it becomes difficult to debug as the debugging operation may not follow the logical flow of the C source codes.

2. Debugging in Disassembly View (with optimization turned on)

Using RX111 CPU Board as an example, targets for RX111 MCU device (part number: R51115AxFM), the sections below explain the debugging in the Disassembly view with compiler setting “Optimization for Size” at optimization level = 2.

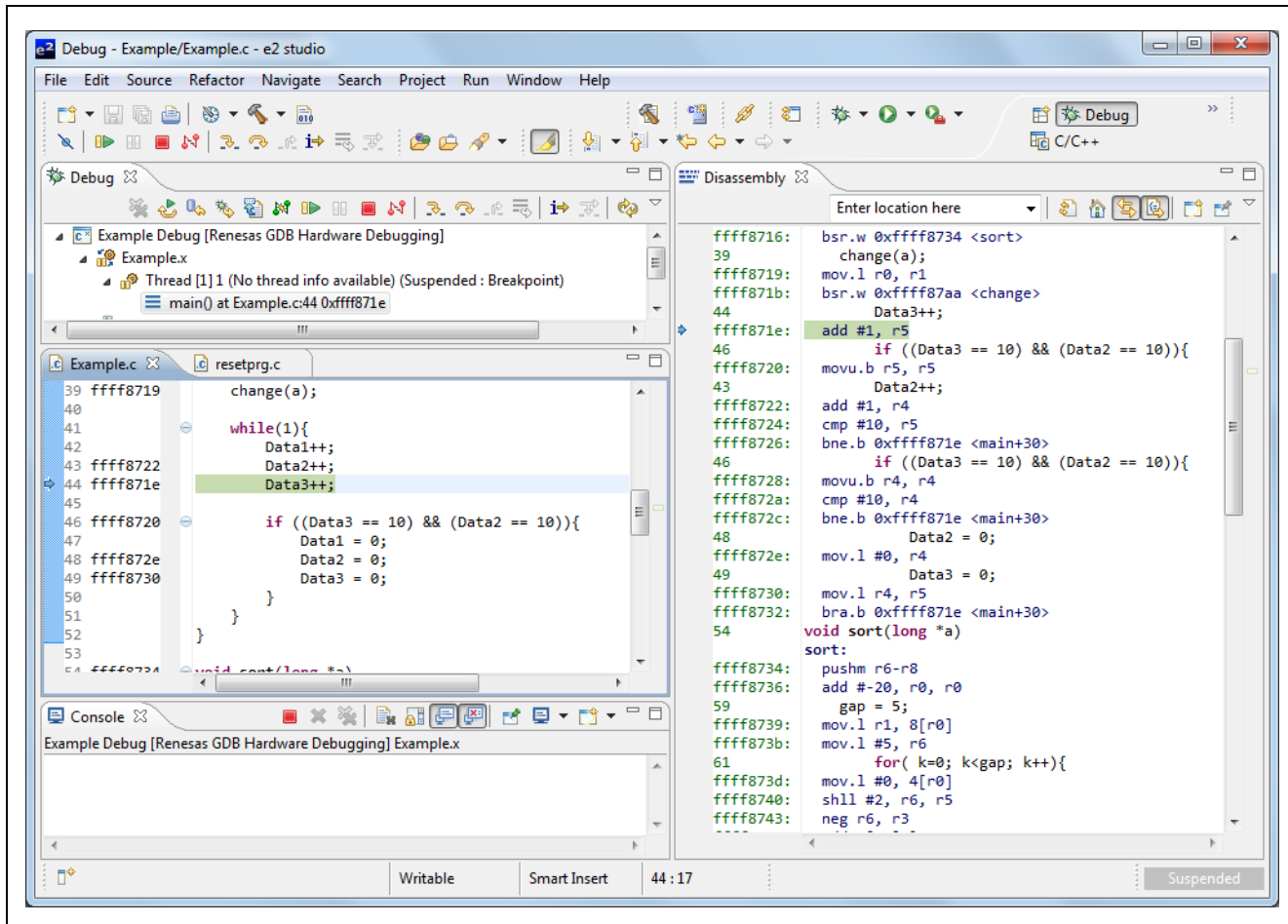


Figure 2 Debugging in Disassembly View (with Optimization turned on)

In C Source view, because of the optimization, it is observed that

- Address of the variable Data1 is omitted
- “Data3++” (address: 0xffff871e) and “if ((Data3 == 10) && (Data2 == 10))” (address: 0xffff8722) are executed ahead of “Data2++” (0xffff8720)

With reference to the debugging in the Disassembly view, it is confirmed that the variable “Data1” is omitted due to not in use and execution sequence for “Data2” and “Data3” follows the assembly instructions as shown in the Disassembly view.

3. Debugging in Disassembly View (with optimization turned off)

Using RX111 CPU Board as an example, targets for RX111 MCU device (part number: R51115AxFM), the sections below explain the debugging in the Disassembly view with no optimization, e.g. optimization level = 0.

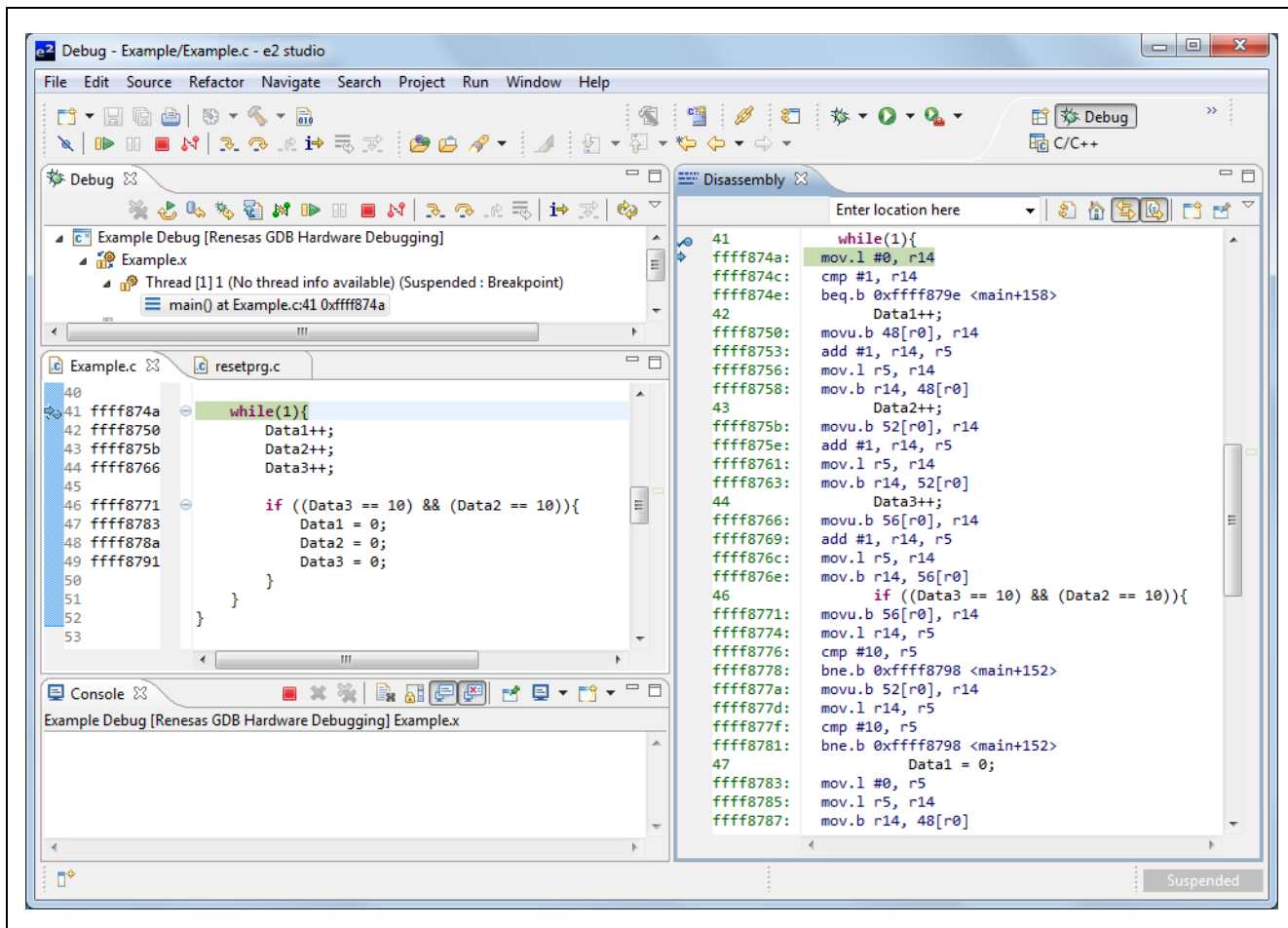


Figure 3 Debugging in Disassembly View (with Optimization turned off)

In C Source view, as the optimization is turned off, it is observed that

- Address for “Data1”, “Data2” and “Data3” are generated
- “Data1”, “Data2” and “Data3” are executed in the sequence order of the C source code

With reference to the debugging in the Disassembly view, it is confirmed that operation sequence for variables “Data1”, “Data2” and “Data3” are the same as in the C Source view.

4. Summary

- Renesas debugger operates in accordance to the object codes (assembly instructions) generated by the compiler toolchain, not necessary the same order as C source code description because of optimization.
- It is easier to understand and debug application codes without optimization. Hence, it may be convenient to turn off optimization settings during debugging stage.

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Revision History

Rev.	Date	Description	
		Page	Summary
1.00	Mar 15. 2014	-	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 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 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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