To our customers,

Old Company Name in Catalogs and Other Documents

On April 1st, 2010, NEC Electronics Corporation merged with Renesas Technology Corporation, and Renesas Electronics Corporation took over all the business of both companies. Therefore, although the old company name remains in this document, it is a valid Renesas Electronics document. We appreciate your understanding.

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

April 1st, 2010
Renesas Electronics Corporation

Issued by: Renesas Electronics Corporation (http://www.renesas.com)

Send any inquiries to http://www.renesas.com/inquiry.

Notice

1. All information included in this document is current as of the date this document is issued. Such information, however, is subject to change without any prior notice. Before purchasing or using any Renesas Electronics products listed herein, please confirm the latest product information with a Renesas Electronics sales office. Also, please pay regular and careful attention to additional and different information to be disclosed by Renesas Electronics such as that disclosed through our website.
2. Renesas Electronics does not assume any liability for infringement of patents, copyrights, or other intellectual property rights of third parties by or arising from the use of Renesas Electronics products or technical information described in this document. No license, express, implied or otherwise, is granted hereby under any patents, copyrights or other intellectual property rights of Renesas Electronics or others.
3. You should not alter, modify, copy, or otherwise misappropriate any Renesas Electronics product, whether in whole or in part.
4. Descriptions of circuits, software and other related information in this document are provided only to illustrate the operation of semiconductor products and application examples. You are fully responsible for the incorporation of these circuits, software, and information in the design of your equipment. Renesas Electronics assumes no responsibility for any losses incurred by you or third parties arising from the use of these circuits, software, or information.
5. When exporting the products or technology described in this document, you should comply with the applicable export control laws and regulations and follow the procedures required by such laws and regulations. You should not use Renesas Electronics products or the technology described in this document for any purpose relating to military applications or use by the military, including but not limited to the development of weapons of mass destruction. Renesas Electronics products and technology may not be used for or incorporated into any products or systems whose manufacture, use, or sale is prohibited under any applicable domestic or foreign laws or regulations.
6. Renesas Electronics has used reasonable care in preparing the information included in this document, but Renesas Electronics does not warrant that such information is error free. Renesas Electronics assumes no liability whatsoever for any damages incurred by you resulting from errors in or omissions from the information included herein.
7. Renesas Electronics products are classified according to the following three quality grades: "Standard", "High Quality", and "Specific". The recommended applications for each Renesas Electronics product depends on the product's quality grade, as indicated below. You must check the quality grade of each Renesas Electronics product before using it in a particular application. You may not use any Renesas Electronics product for any application categorized as "Specific" without the prior written consent of Renesas Electronics. Further, you may not use any Renesas Electronics product for any application for which it is not intended without the prior written consent of Renesas Electronics. Renesas Electronics shall not be in any way liable for any damages or losses incurred by you or third parties arising from the use of any Renesas Electronics product for an application categorized as "Specific" or for which the product is not intended where you have failed to obtain the prior written consent of Renesas Electronics. The quality grade of each Renesas Electronics product is "Standard" unless otherwise expressly specified in a Renesas Electronics data sheets or data books, etc.

   "Standard": Computers; office equipment; communications equipment; test and measurement equipment; audio and visual equipment; home electronic appliances; machine tools; personal electronic equipment; and industrial robots.

   "High Quality": Transportation equipment (automobiles, trains, ships, etc.); traffic control systems; anti-disaster systems; anti-crime systems; safety equipment; and medical equipment not specifically designed for life support.

   "Specific": Aircraft; aerospace equipment; submersible repeaters; nuclear reactor control systems; medical equipment or systems for life support (e.g. artificial life support devices or systems), surgical implantations, or healthcare intervention (e.g. excision, etc.), and any other applications or purposes that pose a direct threat to human life.
8. You should use the Renesas Electronics products described in this document within the range specified by Renesas Electronics, especially with respect to the maximum rating, operating supply voltage range, movement power voltage range, heat radiation characteristics, installation and other product characteristics. Renesas Electronics shall have no liability for malfunctions or damages arising out of the use of Renesas Electronics products beyond such specified ranges.
9. Although Renesas Electronics endeavors to improve the quality and reliability of its products, semiconductor products have specific characteristics such as the occurrence of failure at a certain rate and malfunctions under certain use conditions. Further, Renesas Electronics products are not subject to radiation resistance design. Please be sure to implement safety measures to guard them against the possibility of physical injury, and injury or damage caused by fire in the event of the failure of a Renesas Electronics product, such as safety design for hardware and software including but not limited to redundancy, fire control and malfunction prevention, appropriate treatment for aging degradation or any other appropriate measures. Because the evaluation of microcomputer software alone is very difficult, please evaluate the safety of the final products or system manufactured by you.
10. Please contact a Renesas Electronics sales office for details as to environmental matters such as the environmental compatibility of each Renesas Electronics product. Please use Renesas Electronics products in compliance with all applicable laws and regulations that regulate the inclusion or use of controlled substances, including without limitation, the EU RoHS Directive. Renesas Electronics assumes no liability for damages or losses occurring as a result of your noncompliance with applicable laws and regulations.
11. This document may not be reproduced or duplicated, in any form, in whole or in part, without prior written consent of Renesas Electronics.
12. Please contact a Renesas Electronics sales office if you have any questions regarding the information contained in this document or Renesas Electronics products, or if you have any other inquiries.

(Note 1) "Renesas Electronics" as used in this document means Renesas Electronics Corporation and also includes its majority-owned subsidiaries.

(Note 2) "Renesas Electronics product(s)" means any product developed or manufactured by or for Renesas Electronics.

R8C Family

Creating Workspace with MR8C/4

Introduction

Creating workspace with MR8C/4 is a fundamental step towards writing an application that utilizes MR8C/4 RTOS. It is a critical step towards greater understanding and utilization of MR8C/4.

This document describes in detail the entire process of creating a workspace with MR8C/4. The step-by-step guide explanation strives to guide user from the installation of software required to downloading of program for debugging.

Target Device

Applicable MCU: R8C Family

Contents

1. Guide in using this Document

This document aims to equip users with the fundamental knowledge of creating a workspace supporting MR8C/4 thereby providing them with greater ease of using MR8C/4.

With ample pictorial displays, users will find it with ease to follow the step-by-step guide.

Table 1 Explanation of Document Topics

Topic	Objective	Pre-requisite
Preparing the Software	Describe the installation steps for MR8C/4 and corresponding compiler package	None
Opening a Workspace	Guide users in creating a workspace that supports MR8C/4	Knowledge in High-performance Embedded Workshop
Configuring Workspace for MR8C/4	Elaboration on the configurations required based on hardware setups	R8C Family Devices
Downloading Program with E8a Emulator	Guide users in downloading of program using E8a Emulator	Knowledge in High-performance Embedded Workshop and E8a Emulator
Reference Documents	Listing of documents that equip users with knowledge in the pre-requisite requirements	None

2. Preparing the Software

To create a workspace supporting MR8C/4, both Renesas MR8C/4 and C Compiler Package for M16C Series and R8C Family [M3T-NC30WA] of version 5.45 and above must be installed.

2.1 Installing M3T-NC30WA

To begin, double click on the installer for M3T-NC30WA and follow the steps describe below.

Note: Ensure the package is version 5.45 and above.

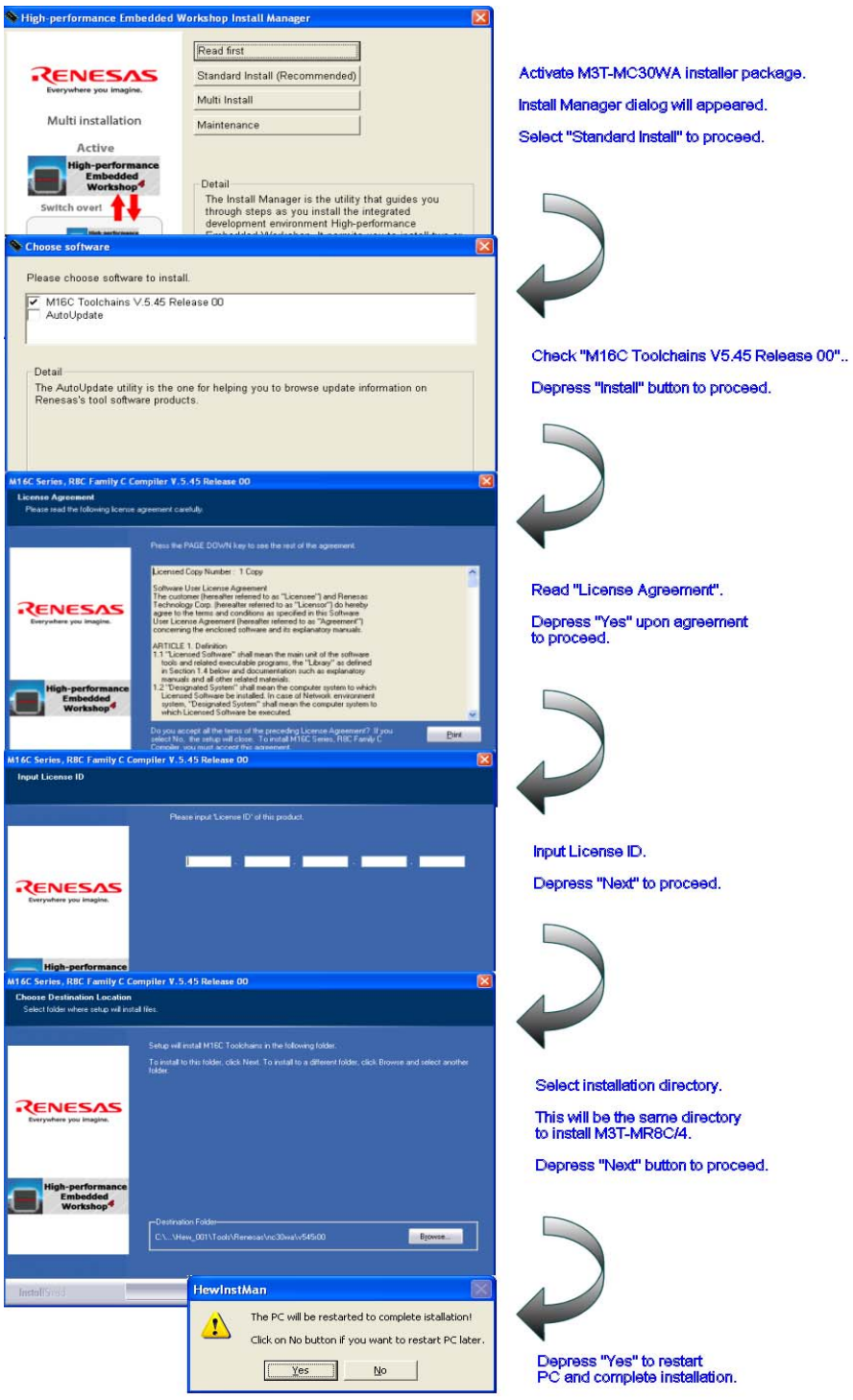


Figure 1 Procedure in M3T-NC30WA Installation

2.2 Installing MR8C/4

To begin, double click on the installer for MR8C/4 and follow the steps describe below.

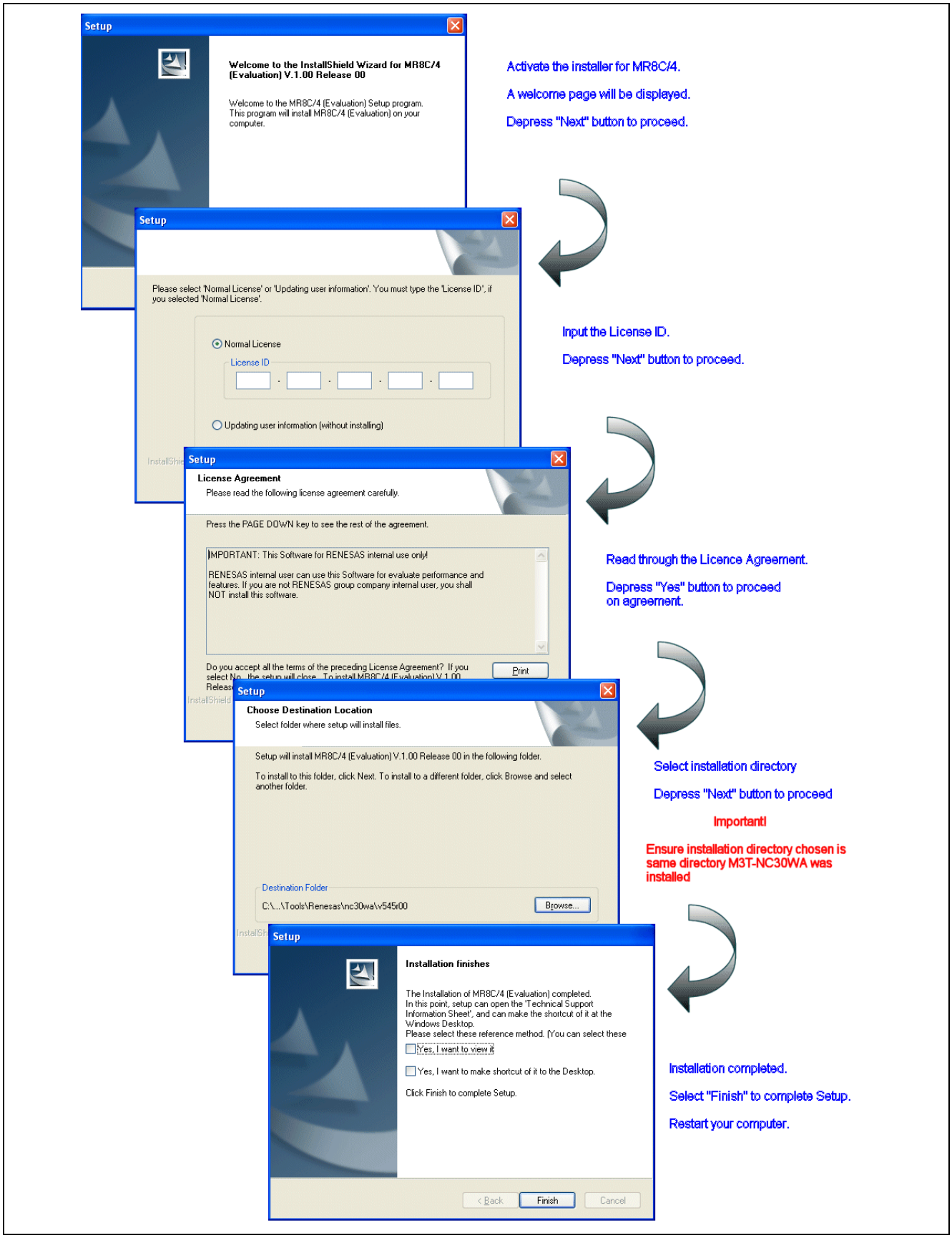


Figure 2 Procedures in MR8C/4 Installation

3. Opening a Workspace

Start High-performance Embedded Workshop and follow the creation procedure describe below.

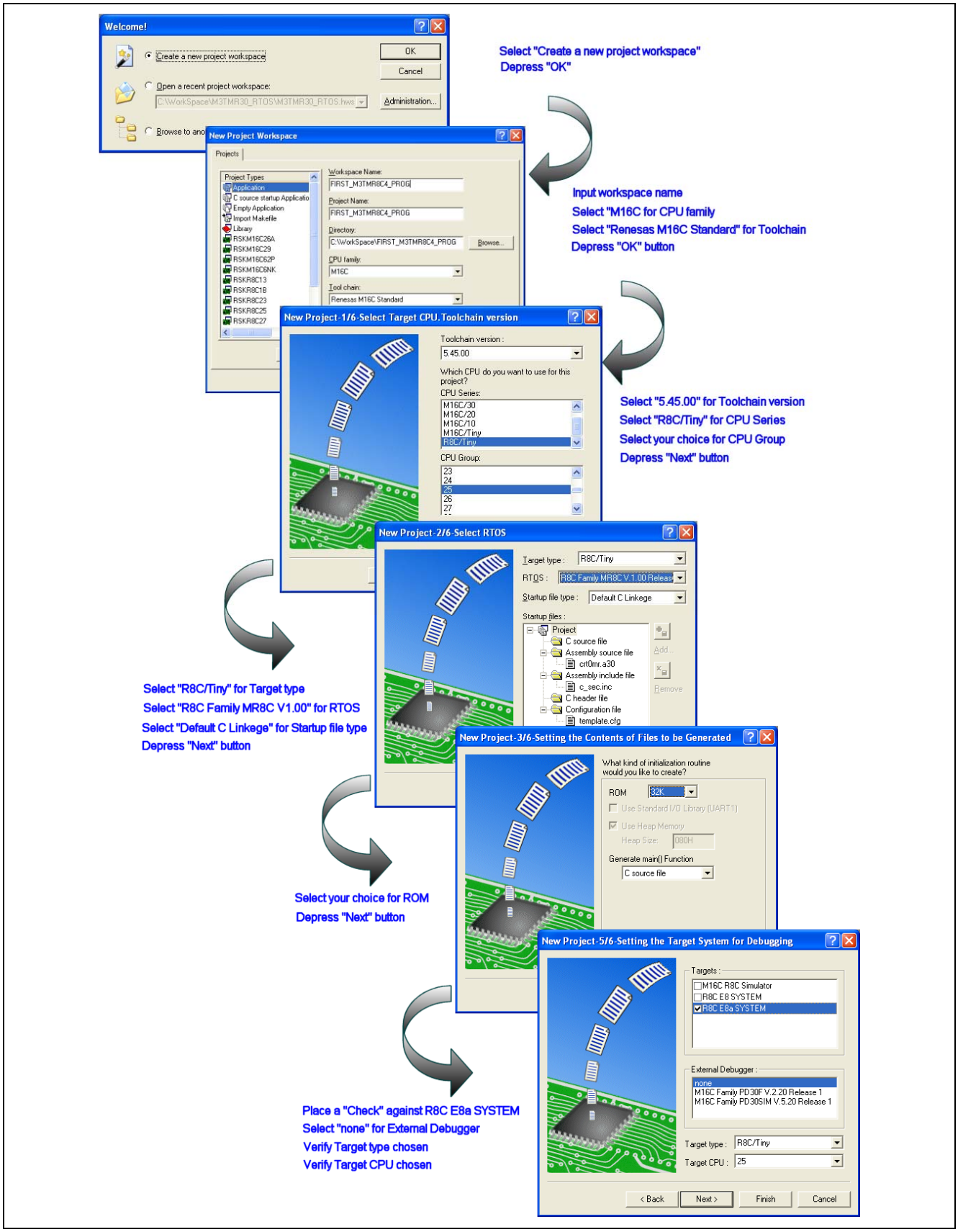


Figure 3 Procedures in Creating Workspace with MR8C/4

Upon the creating of workspace, user will see the following file structure.

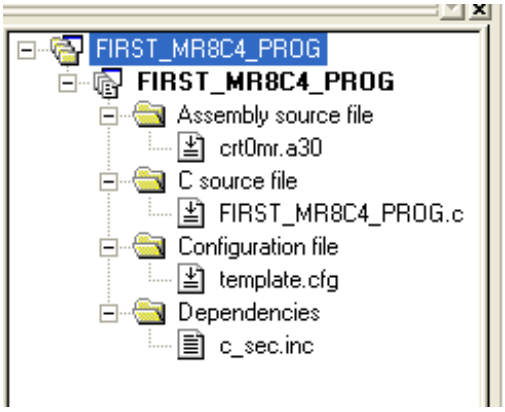


Figure 4 Workspace File Structure

Table 2: Description of Workspace Files

File	Description
crt0mr.a30	The MR8C/4 startup program for C language. Its purpose encompasses initializing RAM data used by MR8C, defining initial startup task, initializing parameters inherent in the application and act as a system clock interrupt handler.
FIRST_MR8C4_PROG.c	The source file for the application.
template.cfg	The configuration file for the definition of MR8C/4 RTOS resources.
c_sec.inc	Included from crt0mr.a30, this file map each section, sets starting addresses of sections, defines size of stack and heap sections, sets interrupt vector table and the fixed vector table.

4. Configuring Workspace for MR8C/4

Before starting off in writing an application and compiling it, user is required to make the following modifications for the proper assembling, compiling and linking of the workspace. It is important to note that not all mentioned modifications are necessary. It depends on the target system and the oscillator mode to be used.

- Defining Oscillator Mode
- Defining Target System
- Modifying toolchain setting
- Adding kernel header files
- Writing the first task

4.1 Defining Oscillator Mode

The ***crt0mr.a30*** program file does not define the selection of Oscillator. Therefore, a user is required to make the necessary modification to match the target system.

An example of changing the selection to using an external oscillator is illustrated in Figure 5.

```
 after reset,this program will start
-------------------------------------------------------------------------
   ldc #(__Sys_Sp&0FFFFH),ISP  ; set initial ISP

   mov.b   #2H,0AH
   mov.b   #00,PMOD        ; Set Processor Mode Regsiter
   mov.b   #0H,0AH
   ldc #00H,FLG
   ldc #(__Sys_Sp&0FFFFH),fb
   ldc #__SB__,sb

   .glb    _ConfigureOperatingFrequency
   JSR.W   _ConfigureOperatingFrequency
```

Figure 5 Modification of Oscillator Mode selections in crt0mr.a30

The function “ConfigureOperatingFrequency” can be declared and defined in one of the source files. In this example, an external oscillator mode is selected.

```
/***********************************************************************************
Name:           ConfigureOperatingFrequency
Description:    Sets up operating speed
Parameters:     none
Returns:        none
***********************************************************************************/
void ConfigureOperatingFrequency(void)
{
    prcr = 1;   /* Protect off */
    cm13 = 1;   /* Xin Xout */
    cm15 = 1;   /* XCIN-XCOUT drive capacity select bit : HIGH  */
    cm05 = 0;   /* Xin on */
    cm16 = 0;   /* Main_Task clock = No division mode */
    cm17 = 0;   /* Main_Task clock = No division mode */
    cm06 = 0;   /* CM16 and CM17 enable */
    /* Waitting for stable of oscillation */
    asm("nop");
    asm("nop");
    asm("nop");
    asm("nop");
    ocd2 = 0;   /* Main_Task clock change */
    prcr = 0;   /* Protect on */
}
```

Figure 6 Selection of External Oscillator Mode

4.2 Defining Target System

The memory map for different target device varies. For example, R5F21256 and R5F21258 devices from R8C/25 Group have internal ROM that starts from 0x8000H and 0x4000H respectively. To be able to download and run the application successfully, memory section defined in ***c_sec.inc*** must match the target device.

The default setting of ROM data area in ***c_sec.inc*** is defined 0x4000H.

```
;-----------------------------------------
; Far ROM data area
;-----------------------------------------
    .section    rom_FE,ROMDATA
    .org        04000H
rom_FE_top:
```

Figure 7 Default setting of ROM Area

If the target device is one that has an internal ROM memory starting from 0x8000H, modifications will be as followed.

```
;-----------------------------------------
; Far ROM data area
;-----------------------------------------
    .section    rom_FE,ROMDATA
    .org        08000H
rom_FE_top:
```

Figure 8 Modified setting of ROM Area to 08000H

4.3 Modifying Toolchain Setting

It is necessary to define the RTOS specification and its version in the toolchain. The following steps provide the guide.

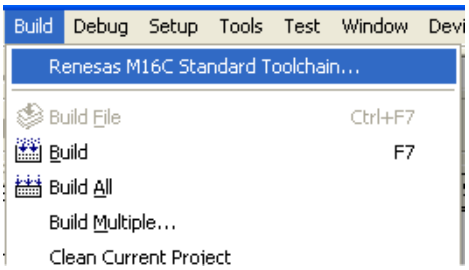


Figure 9 Opening Toolchain

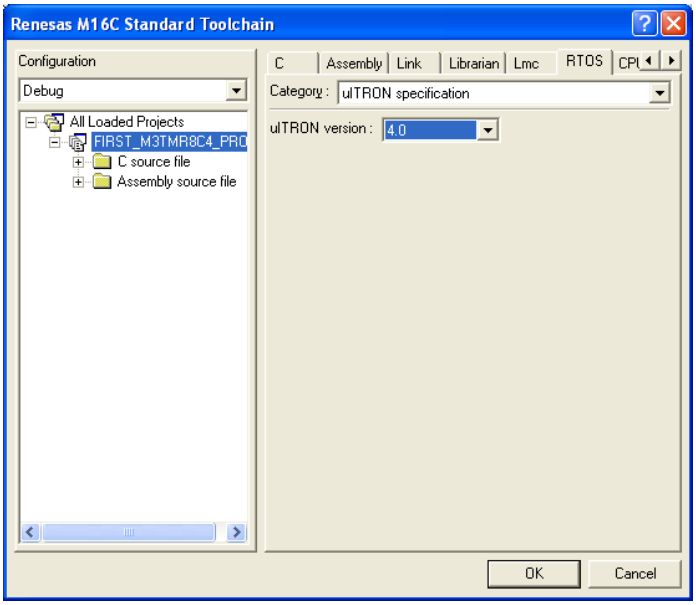


Figure 10 Defining RTOS Specification

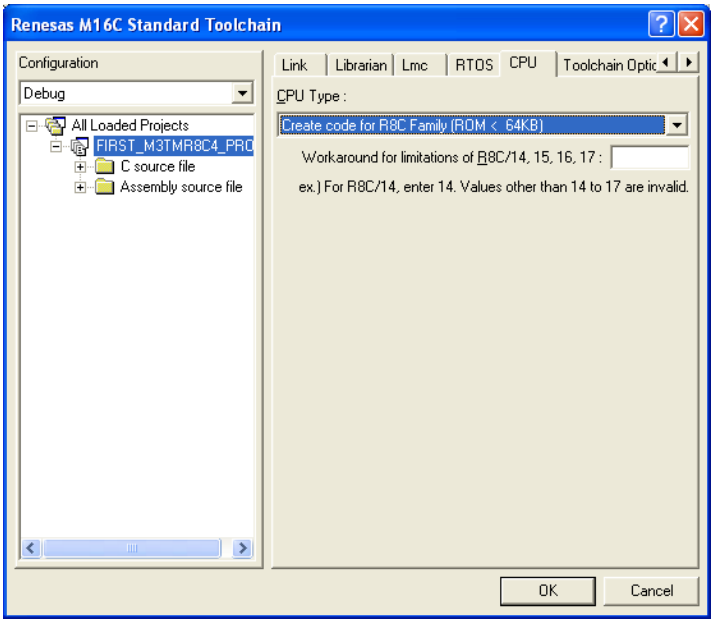


Figure 11 Verifying the CPU Type

4.4 Adding Kernel Header Files

Three kernel header files, namely, “itron.h”, “kernel.h” and “kernel_id.h” need to be included. Table 3 provides a discussion on the functionalities of each file.

Table 3: Explanation on Kernel Header Files

File	Description
itron.h	Contain definitions of data types, constants and macros, and other definitions specified in ITRON General Definitions section
kernel.h	Contain all service call declarations, data types, constants, and macro definitions specified in the kernel specification
kernel_id.h	Automatic assignment header file generated by kernel configurator

```
/************************************************
Includes <System Includes> , "Project Includes"
************************************************/
#include <itron.h>
#include <kernel.h>
#include "kernel_id.h"
```

Figure 12 Inclusions of Kernel Header Files

4.5 Writing the First Task

With all the configurations being done, the next step is to proceed in doing the coding. To start off in writing the first task, user will need to enlist a task resource in template.cfg and define the task context in the source file. Figure 13 provides the details on the enlistment of a task resource in template.cfg.

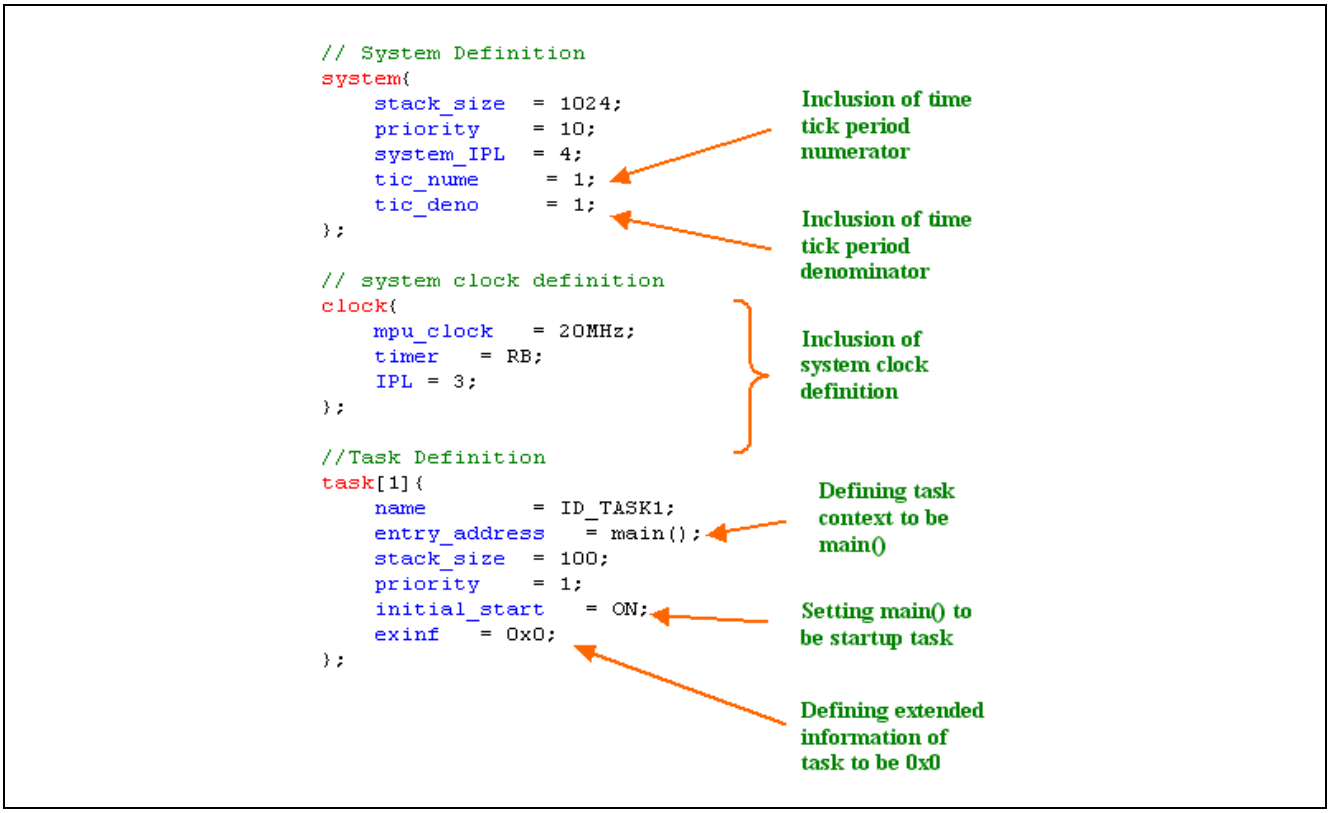


Figure 13 Enlistment of RTOS Resource in Template.cfg

Inclusion of system clock definition if service calls from Time Management Module are to be used in this example, Timer RB is selected to be the system clock. User will have a selection of “RA”, “RB” and “OTHER” to choose from. If “OTHER” is selected, user will need to make additional modification in crt0mr.a30 (Figure 14) and assigned a system clock interrupt handler.

```
.IF USE_TIMER          To be replaced with '0'
;+-------------------------------------------------+
;|     System timer interrupt setting              |
;+-------------------------------------------------+
    mov.b   #stmr_mod_val,stmr_mod_reg  ;set timer mode
    mov.b   #stmr_int_IPL,stmr_int_reg  ;set timer IPL
    mov.b   #stmr_cnt_lower,stmr_ctr_reg    ;set interval
    mov.b   #stmr cnt upper,stmr pre reg    ;set interval
```

Figure 14 Disabling of System Timer Interrupt in crt0mr.a30

```
clock{
    mpu_clock   = 20MHz;
    timer   = OTHER;
    IPL = 3;
};
// Chosen TimerRE as System Clock
interrupt_vector[10]{
    os_int  = YES;
    entry_address   = _SYS_STMR_INH();

};
```

Figure 15 Definition of System Timer Interrupt

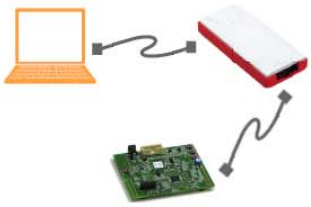
Upon the definition of RTOS resource in template.cfg, next step is to declare the task function in the source file. The example above defined entry address of task [1] to be main (). As such, it is mandatory to declare the task function to be “void main (VP_INT stacd)”. User may proceed in the performing a “BUILD ALL” for the workspace.

```
/*****************************************
Name:           main
Description:    Main Fnction
Parameters:     stacd
Returns:        none
*****************************************
void main(VP_INT stacd)
{
    /* Input your codes here */
}
```

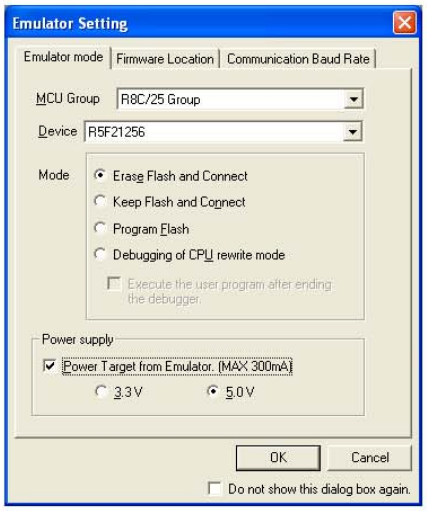
Figure 16 Declaration of Task “main ()” in *FIRST_MR8C4_PROG.c*

5. Downloading Program with E8a Emulator

The final step is to download the program after successfully created the workspace.



Connect target device to PC via E8a emulator

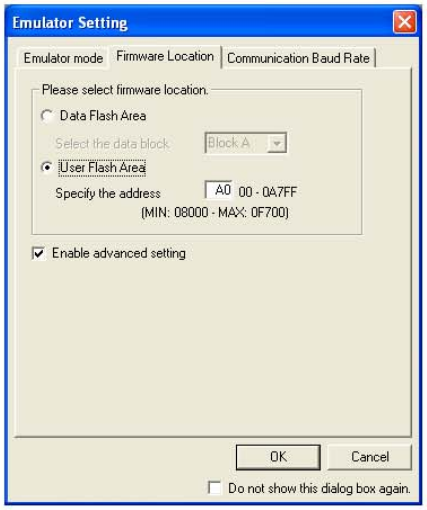


Go to HEW ->Debug ->Connect

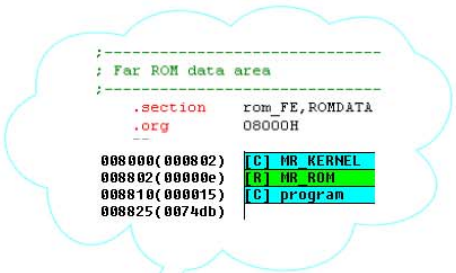
Select MCU Group

Select Flash Mode

Select Power Supply

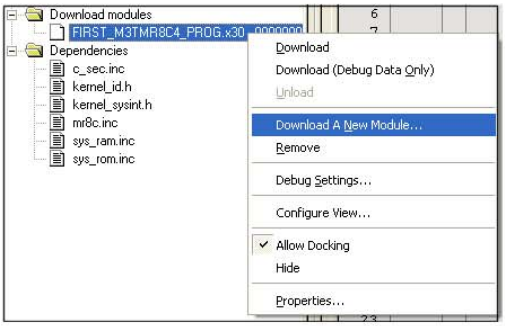


Go to "Firmware Location"



Define User Flash Area

(E.g. R5F21256 ROM area starts from 8000H as defined in "c_sec.inc" mentioned in section 4.2. Memory map shows 8000H to 8824H is used, so we choose A000H for precaution purpose)



Go to workspace and right click on file ".x30"

Download module file

Figure 17 Procedures in Downloading Program with E8a Emulator

6. Reference Documents

User's Manual

- MR8C/4 V1.00 User's Manual
- E8a Emulator User's Manual
- High-performance Embedded Workshop V4.05 User's Manual
- R8C Family Hardware Manual

The latest version can be downloaded from the Renesas Technology website

Website and Support

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

Inquiries
http://www.renesas.com/inquiry
csc@renesas.com

Revision Record

		Description	
Rev.	**Date**	**Page**	**Summary**
1.00	Jan.01.10	—	First edition issued

Notes regarding these materials

1. This document is provided for reference purposes only so that Renesas customers may select the appropriate Renesas products for their use. Renesas neither makes warranties or representations with respect to the accuracy or completeness of the information contained in this document nor grants any license to any intellectual property rights or any other rights of Renesas or any third party with respect to the information in this document.
2. Renesas shall have no liability for damages or infringement of any intellectual property or other rights arising out of the use of any information in this document, including, but not limited to, product data, diagrams, charts, programs, algorithms, and application circuit examples.
3. You should not use the products or the technology described in this document for the purpose of military applications such as the development of weapons of mass destruction or for the purpose of any other military use. When exporting the products or technology described herein, you should follow the applicable export control laws and regulations, and procedures required by such laws and regulations.
4. All information included in this document such as product data, diagrams, charts, programs, algorithms, and application circuit examples, is current as of the date this document is issued. Such information, however, is subject to change without any prior notice. Before purchasing or using any Renesas products listed in this document, please confirm the latest product information with a Renesas sales office. Also, please pay regular and careful attention to additional and different information to be disclosed by Renesas such as that disclosed through our website. (http://www.renesas.com)
5. Renesas has used reasonable care in compiling the information included in this document, but Renesas assumes no liability whatsoever for any damages incurred as a result of errors or omissions in the information included in this document.
6. When using or otherwise relying on the information in this document, you should evaluate the information in light of the total system before deciding about the applicability of such information to the intended application. Renesas makes no representations, warranties or guaranties regarding the suitability of its products for any particular application and specifically disclaims any liability arising out of the application and use of the information in this document or Renesas products.
7. With the exception of products specified by Renesas as suitable for automobile applications, Renesas products are not designed, manufactured or tested for applications or otherwise in systems the failure or malfunction of which may cause a direct threat to human life or create a risk of human injury or which require especially high quality and reliability such as safety systems, or equipment or systems for transportation and traffic, healthcare, combustion control, aerospace and aeronautics, nuclear power, or undersea communication transmission. If you are considering the use of our products for such purposes, please contact a Renesas sales office beforehand. Renesas shall have no liability for damages arising out of the uses set forth above.
8. Notwithstanding the preceding paragraph, you should not use Renesas products for the purposes listed below:
   (1) artificial life support devices or systems
   (2) surgical implantations
   (3) healthcare intervention (e.g., excision, administration of medication, etc.)
   (4) any other purposes that pose a direct threat to human life

   Renesas shall have no liability for damages arising out of the uses set forth in the above and purchasers who elect to use Renesas products in any of the foregoing applications shall indemnify and hold harmless Renesas Technology Corp., its affiliated companies and their officers, directors, and employees against any and all damages arising out of such applications.
9. You should use the products described herein within the range specified by Renesas, especially with respect to the maximum rating, operating supply voltage range, movement power voltage range, heat radiation characteristics, installation and other product characteristics. Renesas shall have no liability for malfunctions or damages arising out of the use of Renesas products beyond such specified ranges.
10. Although Renesas endeavors to improve the quality and reliability of its products, IC products have specific characteristics such as the occurrence of failure at a certain rate and malfunctions under certain use conditions. Please be sure to implement safety measures to guard against the possibility of physical injury, and injury or damage caused by fire in the event of the failure of a Renesas product, such as safety design for hardware and software including but not limited to redundancy, fire control and malfunction prevention, appropriate treatment for aging degradation or any other applicable measures. Among others, since the evaluation of microcomputer software alone is very difficult, please evaluate the safety of the final products or system manufactured by you.
11. In case Renesas products listed in this document are detached from the products to which the Renesas products are attached or affixed, the risk of accident such as swallowing by infants and small children is very high. You should implement safety measures so that Renesas products may not be easily detached from your products. Renesas shall have no liability for damages arising out of such detachment.
12. This document may not be reproduced or duplicated, in any form, in whole or in part, without prior written approval from Renesas.
13. Please contact a Renesas sales office if you have any questions regarding the information contained in this document, Renesas semiconductor products, or if you have any other inquiries.