Contents

Chapter 1. Changes .................................................................................................................................. 2
  1.1 Problems fixed (Changes from V2.04.00 to V2.04.01) ................................................................. 2
  1.2 Standard and Professional editions ............................................................................................. 2
  1.3 Checking of source code against MISRA-C:2004 rules [Professional] ............................................ 2
  1.4 Checking of source code against MISRA-C:2012 rules [Professional] ............................................ 2
  1.5 Detection of stack smashing [Professional] ................................................................................... 2
  1.6 Extensions to CRC calculation ....................................................................................................... 3
  1.7 Enhanced support for UTF-8 ......................................................................................................... 4
  1.8 Other improvements ..................................................................................................................... 4

Chapter 2. Points for Caution .................................................................................................................... 5
  2.1 Note on a case of the W0523041 message [C/C++ Compiler] ...................................................... 5
  2.2 Note on using MVTC or POPC instructions [Assembler] ............................................................ 5
  2.3 Note on the delete option for linkage [Optimizing linkage editor] .............................................. 5

Chapter 3. Restrictions .............................................................................................................................. 6
  3.1 Restriction on usage of math.h functions (frexp, ldex, scalbn and remquo) in C++ language (including EC++) .............................................................................................................................. 6
  3.2 Restriction of PIC/PID function (pic and pid options) .................................................................. 8
  3.3 Eliminated options (for the C/C++ compiler) .............................................................................. 8
  3.4 Notes on C/C++ source-level debugging (for the C/C++ compiler) ............................................. 8
  3.5 Note on using sections that include the address 0xffffffff (in assembler) ................................. 9
  3.6 Note on using -form and -output at the same time (in the linkage editor) .............................. 9
  3.7 Note on using function names that begin with _builtin (for the C/C++ compiler) .................. 9
  3.8 Note on using #pragma interrupt with functions for which save_acc is enabled and that have dummy arguments (for the C/C++ compiler) ................................................................. 9

Chapter 4. Standard Libraries Included ................................................................................................... 10
  4.1 Library files ............................................................................................................................... 10
  4.2 Using the library files ................................................................................................................ 11
Chapter 1. Changes

This section describes changes on CC-RX from V2.03.00 to V2.04.01.

1.1 Problems fixed (Changes from V2.04.00 to V2.04.01)

The following problems, of which we informed you in RENESAS TOOL NEWS Document No. 151106/tn1, have been fixed:

"-stack_protector" and "-stack_protector_all" options (RXC#037)
http://tool-support.renesas.com/eng/toolnews/151106/tn1.htm

1.2 Standard and Professional editions

The CC-RX compiler has the following two editions.

- Standard edition
- Professional edition

The features of the latter can only be used if the compiler is registered under the professional license. They are indicated as [Professional] from here on.

1.3 Checking of source code against MISRA-C:2004 rules [Professional]

The following options can only be used if the compiler is registered under the professional license.

- -misra2004
- -ignore_files_misra
- -check_language_extension

1.4 Checking of source code against MISRA-C:2012 rules [Professional]

The -misra2012 option, which selects the checking of source code against the MISRA-C:2012 rules, has been added. An --ignore_files_misra option for the selection of files that are not to be checked, and a --check_language_extension option which enables the source-code checking, which are partially suppressed by language extensions, are specifiable at the same time as each other and -misra2012. Note that the -misra2012 and -misra2004 options cannot be specified at the same time.

Specifying these options to statically check source code makes improving the quality of user programs in early stages possible.

1.5 Detection of stack smashing [Professional]

A feature for the detection of stack smashing has been added. This feature can be realized by the -stack_protector/-stack_protector_all compiler options, or the extended language specification #pragma stack_protector/#pragma no_stack_protector.
This feature generates the codes which detect stack smashing at the entry and end of functions. Specifically, instructions to execute the following three processes are produced.

1. 4-byte immediately before (upper direction) the local variable area of the stack frame are allocated at the entrance to the function, and the values specified with the option are stored there.

2. A check is run on whether the value which was stored in step 1 has not been changed at the end of the function.

3. The __stack_chk_fail function is called when the value has been changed, which would lead to smashing the stack.

The __stack_chk_fail function is defined by user and describes the processing to be executed when stack smashing is detected. For example, the __stack_chk_fail function will be executed when the following code, which smashes the stack area, is executed.

```c
void f1() {
    volatile char str[10];
    int i;
    for (i = 0; i <= 10; i++){
        str[i] = i;  // The stack is smashed when i=10
    }
    ...
}
```

Figure 1.1: Example of code that will lead to the __stack_chk_fail function being called

### 1.6 Extensions to CRC calculation

The -CRC option of the optimizing linkage editor has been extended as follows.

- The range for calculation can be specified by a section name.
- Various methods of calculation have been added. The methods added in this version are listed in Table 1.1.

<table>
<thead>
<tr>
<th>Method</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>16-CCITT-MBS</td>
<td>The result of calculation is obtained by applying CRC-16-CCITT to the input MSB first.</td>
</tr>
<tr>
<td>16-CCITT-MSB-LITTLE-4</td>
<td>The input is a 4-byte unit with little endian. The result of calculation is obtained by applying CRC-16-CCITT to the input MSB first.</td>
</tr>
<tr>
<td>16-CCITT-MSB-LITTLE-2</td>
<td>The input is a 2-byte unit with little endian. The result of calculation is obtained by applying CRC-16-CCITT to the input MSB first.</td>
</tr>
<tr>
<td>16-CCITT-LSB</td>
<td>The result of calculation is obtained by applying CRC-16-CCITT to the input LSB first.</td>
</tr>
</tbody>
</table>

Table 1.1 Methods of CRC calculation added in CC-RX V2.04.00
**SENT-MSB**
The input is 1 byte, with the higher- and lower-order 4 bit units in little endian. The result of calculation on the input MSB first is obtained with SENT compliance.

**32-ETHERNET**
The result of calculation is obtained by applying CRC-32-ETHERNET to the input. The initial value of the result is 0xFFFFFFFF, and is XOR inverted and the bit order is reversed.

### 1.7 Enhanced support for UTF-8

The following options have been extended or added.

- Extended the -utf8 option and -outcode=utf8 option.
  Those options are now always selectable, not only when -lang=c99 option is also selected.
- Added a new assembler option –utf8.
  String literals and comments in assembly source are handled as encoded in UTF-8.

### 1.8 Other improvements

Other improvements are described below.

(a) Improved debugging information
   Unnecessary debugging information was deleted to reduce the sizes of object files (*.obj) and load module files (*.abs).

(b) Fixed incorrect display when stepping
   When stepping over an if statement, and it has a condition expression including any of the operators below, the debugger displayed an incorrect result. The problem has been fixed.
   ```
   &&  ||  !  ?:  
   ```

(c) Internal errors
   Some of internal errors has been fixed.

(d) Optimization
   The performance and the size of generated code have been improved.

(e) Compiling time
   Compiling some programs with optimization took excessive time. This problem has been relieved by shortening the times.
Chapter 2. Points for Caution

This section describes points for caution regarding CC-RX.

2.1 Note on a case of the W0523041 message [C/C++ Compiler]
When the int_to_short option is specified and a file including a C standard header is compiled as C++ or EC++, the compiler may show the W0523041 message. In this case, simply ignore the message because there are no problems.

[NOTE]
In compilation of C++ or EC++, the int_to_short option will be invalid.
Data that are shared between C and C++ (EC++) program must be declared as the long or short type rather than as the int type.

2.2 Note on using MVTC or POPC instructions [Assembler]
In the assembly language, the program counter (PC) cannot be specified for MVTC or POPC instructions.

2.3 Note on the delete option for linkage [Optimizing linkage editor]
When a function symbol is removed by the delete option, its following function in the source program is not allowed to have a breakpoint at its function name on the editor in your debugging. If you would like to set a breakpoint via the Label window at the function entrance, set the breakpoint via the Label window or at the program code of the function.
Chapter 3. Restrictions

This chapter describes restrictions on CC-RX.

3.1 Restriction on usage of math.h functions (frexp, ldexp, scalbn and remquo) in C++ language (including EC++)

An object is generated which will be an infinit-loop at execution when the actual argument of some function (frexp, ldexp, scalbn or remquo) of math.h is int-type, at compiling C++ or EC++ program.

Conditions:
This problem occurs when both (1) and (2) are satisfied.
(1) This program is in C++ or the lang=cpp option is effective.
(2) math.h is included and any of the following functions is called.
   (a) frexp(double, long*) with 'int **' type second argument (except when the first argument is float-type and the dbl_size=8 option is effective).
   (b) ldexp(double, long) with 'int **' type second argument (except when the first argument is float-type and the dbl_size=8 option is effective).
   (c) scalbn(double, long) with 'int **' type second argument (except when the first argument is float-type and the dbl_size=8 option is effective).
   (d) remquo(double, double, long*) with 'int **' type third argument (except when the both the first and second arguments are float-type and the dbl_size=8 option is effective).

Examples:
file.cpp:
// Example of compiling C++ source that generates an infinity-loop
#include <math.h>
double d1,d2;
int i;
void func(void)
{
    d2 = frexp(d1, &i);
}

Command Line:
ccrx -cpu=rx600 -output=src file.cpp
file.src: Example of the generated assembly program

_func:
    ; ...(Omitted)
    ; Calling substitute function of frexp
    BSR __$frexp__tm__2_f__FZ1ZPi_Q2_21_Real_type__tm__4_Z1Z5_Type
    ; ...(Omitted)

__$frexp__tm__2_f__FZ1ZPi_Q2_21_Real_type__tm__4_Z1Z5_Type:
L11:
    BRA L11 ; Calls itself ==> infinity-loop

Countermeasures:

Select one of the following ways to avoid the problem.

1. Compile the program with the lang=c or lang=c99 option.
2. Change int or int * into long or long *.
3. Append the following declarations to each function that is being used.
   /* For the frexp function */
   static inline double frexp(double x, int *y)
   { long v = *y; double d = frexp(x,&v); *y = v; return (d); }
   /* For the ldexp function */
   static inline double ldexp(double x, int y)
   { long v = y; double d = ldexp(x,v); return (d); }
   /* For the scalbn function */
   static inline double scalbn(double x, int y)
   { long v = y; double d = scalbn(x,v); return (d); }
   /* For the remquo function */
   static inline double remquo(double x, double y, int *z)
   { long v = *z; double d = remquo(x,y,&v); *z = v; return (d); }

Example of (2):

Change in file.cpp:
#include <math.h>
double d1,d2;
int i;
void func(void)
{
    long x = i; /* Accept as long type temporary */
    d2 = frexp(d1, &x); /* Call with long type argument */
    i = x; /* Set the result for variable 'i' */
}
Example of (3):
Change in file.cpp:
```c
#include <math.h>
/* Append declaration */
static inline double frexp(double x, int *y)
{ long v = *y; double d = frexp(x,&v); *y = v; return (d); }
double d1,d2;
int i;
void func(void)
{
    d2 = frexp(d1, &i);
}
```

3.2 Restriction of PIC/PID function (pic and pid options)
When a standard library is created by the library generator (lbgrx) with the pic or pid option specified, the
following warning may appear once or more.
W0591301:"-pic" option ignored (When the pic option has been specified)
W0591301:"-pid" option ignored (When the pid option has been specified)
Despite the warning, the created standard library has no problems.

3.3 Eliminated options (for the C/C++ compiler)
(a) -file_inline, -file_inline_path
Specifying these options has no effect and the compiler will output a warning. Instead of -file_inline or -file_inline_path, write #include in the source code.
(b) -enable_register
This option is simply ignored and does not affect the generated code.

3.4 Notes on C/C++ source-level debugging (for the C/C++ compiler)
(1) Even when -debug is specified, you may not be able to set a breakpoint or stop stepped execution on lines that
contain a dynamic initialization expression for a global variable (in C++),
are the first lines of functions that begin with a loop statement (e.g. do or while) and do not have an
auto variable or of functions for which #pragma inline_asm has been specified, or
contain the control section and body of a loop statement (e.g. for, while, or do) written as a single line.
(2) The values of members of union type and of dummy variables that are to be passed via registers may be displayed incorrectly (e.g. in the [Watch] window).
3.5 Note on using sections that include the address 0xffffffff (in assembler)
If two or more .section directives in the assembly source code contain .org directives, the sections have
the same name, and the sections overlap at 0xffffffff, the assembler outputs an internal error message
(C0554098).
Example)

```assembly
.section SS,ROMDATA
.org 0xffffffff
.byte 1
.byte 2 ; 0xffffffff
.section SS,ROMDATA
.org 0xffffffffh
.byte 3; ; 0xffffffff
.end
```

3.6 Note on using -form and -output at the same time (in the linkage editor)
When -form=rel and -output=<filename> are specified for the linkage editor (rlink) at the same time, the
filename extension given as <filename> is ignored and replaced with .rel.
Example)

```bash
rlink -form=relocate -output=DefaultBuild\lib_test.lib
```
The filename specified for output, test.lib, is changed to test.rel.

3.7 Note on using function names that begin with _builtin (for the C/C++ compiler)
Declaration of a function with a name that begins with _builtin and for which the definition is in machine.h
in the include directory may lead to an internal error. In general, do not use any names that begin with an
underscore (_) in your source code, since such names are reserved.

3.8 Note on using #pragma interrupt with functions for which save_acc is
enabled and that have dummy arguments (for the C/C++ compiler)
When #pragma interrupt is specified for a function and the save_acc flag is enabled (including where this
is done by using the -save_acc compiler option), the compiler may not output code that reflects the correct
values of dummy arguments which are passed via R4. Note: In general, we do not recommend defining
arguments for functions with the #pragma interrupt specification.
Chapter 4. Standard Libraries Included

This chapter describes restrictions on standard libraries included in RX Family C/C++ Compiler.

This compiler package includes four library files (*.lib) for the RX600. You can use any of the library files if they correspond to the options that you wish to specify. Using these files shortens the time required for building.

4.1 Library files
Table 4.1 shows the standard library files and compiler options.

Note:
The compiler options you specify should be the same as the microcontroller options defined for each of the library files listed in table 4.1. Otherwise these library files are not usable, so specify your compiler options in the library generator to generate your own library file.

<table>
<thead>
<tr>
<th>Library File</th>
<th>Purposes</th>
<th>Optimize Options</th>
<th>Microcontroller Options</th>
<th>Others</th>
</tr>
</thead>
<tbody>
<tr>
<td>rx600lq.lib</td>
<td>For the RX600 Optimization type: Speed Little endian</td>
<td>-speed -goptimize</td>
<td>-cpu -endian=little -rtti -exception -noexception</td>
<td>-round=nearest -denormalize=off -dbl_size=4 -unsigned_char -unsigned_bitfield -bit_order=right -unpack -fint_register=0 -branch=24</td>
</tr>
<tr>
<td>rx600ls.lib</td>
<td>For the RX600 Optimization type: Size Little endian</td>
<td>-size -goptimize</td>
<td>-cpu=rx600 -rtti=on -exception</td>
<td>-round=nearest -denormalize=off -dbl_size=4 -unsigned_char -unsigned_bitfield -bit_order=right -unpack -fint_register=0 -branch=24</td>
</tr>
<tr>
<td>rx600bq.lib</td>
<td>For the RX600 Optimization type: Speed Big endian</td>
<td>-speed -goptimize</td>
<td>-cpu=rx600 -rtti=on -exception</td>
<td>-round=nearest -denormalize=off -dbl_size=4 -unsigned_char -unsigned_bitfield -bit_order=right -unpack -fint_register=0 -branch=24</td>
</tr>
<tr>
<td>rx600bs.lib</td>
<td>For the RX600 Optimization type: Size Big endian</td>
<td>-size -goptimize</td>
<td>-cpu=rx600 -rtti=on -exception</td>
<td>-round=nearest -denormalize=off -dbl_size=4 -unsigned_char -unsigned_bitfield -bit_order=right -unpack -fint_register=0 -branch=24</td>
</tr>
</tbody>
</table>

Table 4.1 Library Files

*Notes:
*1 For details on microcontroller options, please see the “Microcontroller Options” columns of the “(1) Compile Options” of “section B.1.3 Options”, in the Integrated Development Environment User’s Manual:RX Build.
*2 These option selections are same from the each default of them.
4.2 Using the library files

The library files included in the compiler package must be linked in either of the ways given in sections 4.2.1 and 4.2.2.

4.2.1 Using the library files

When the e² studio has been installed in C:\Renesas\e2_studio, the library files are stored in the following location:

C:\Program Files\Renesas\RX\V2_4_0\lib

(“V2.04.00” indicates the version and revision number of the compiler package.)

4.2.2 Directory specifying a library file in the optimizing linkage editor

Copy the library file(s) included in the package (stored in the location given in section 4.2.1) into a desired directory. Then specify one of the copied library files for the Library option and start the linkage processing.

All trademarks and registered trademarks are the property of their respective owners.
Notice

1. 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.

2. 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 or omissions from the information included herein.

3. 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.

4. You should not alter, modify, copy, or otherwise misappropriate any Renesas Electronics product, whether in whole or in part. Renesas Electronics assumes no responsibility for any losses incurred by you or third parties arising from such alteration, modification, copy or otherwise misappropriation of Renesas Electronics product.

5. Renesas Electronics products are classified according to the following two quality grades: “Standard” and “High Quality.” The recommended applications for each Renesas Electronics product depends on the product's quality grade, as indicated below.

   - **“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 etc.
   - **“High Quality”**: Transportation equipment (automobiles, trains, ships, etc.); traffic control systems; anti-disaster systems; anti-criminal systems; and safety equipment etc.

6. Renesas Electronics products are either intended for use in products or systems that may pose a direct threat to human life or bodily injury (artificial life support devices or systems, surgical implantations etc.), or may cause serious property damages (nuclear reactor control systems, military equipment etc.). 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 for which it is not intended. 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 which the product is not intended by Renesas Electronics.

7. 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 systems manufactured by you.

8. 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.

9. Renesas Electronics products and technology may not be used or incorporated into any products or systems whose manufacture, use, or sale is prohibited under any applicable domestic or foreign laws or regulations. You should not use Renesas Electronics products or 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. When exporting the Renesas Electronics 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.

10. It is the responsibility of the buyer or distributor of Renesas Electronics products, who distributes, disposes of, or otherwise places the product with a third party, to notify such third party in advance of the contents and conditions set forth in this document. Renesas Electronics assumes no responsibility for any losses incurred by you or third parties as a result of unauthorized use of Renesas Electronics products.

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 product(s)” means any product developed or manufactured by or for Renesas Electronics.

(Note 2) “Renesas Electronics product(s)” may mean any product developed or manufactured by or for Renesas Electronics.

SALES OFFICES

Renesas Electronics Corporation

http://www.renesas.com