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April 1st, 2010
Renesas Electronics Corporation

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User's Manual

M16C R8C FoUSB/UART Debugger

User's Manual

Renesas Microcomputer Development Environment System
R8C Family R8C/2x Series
Notes on Connecting R8C/2E, R8C/2F

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Rev.1.00 2008.12

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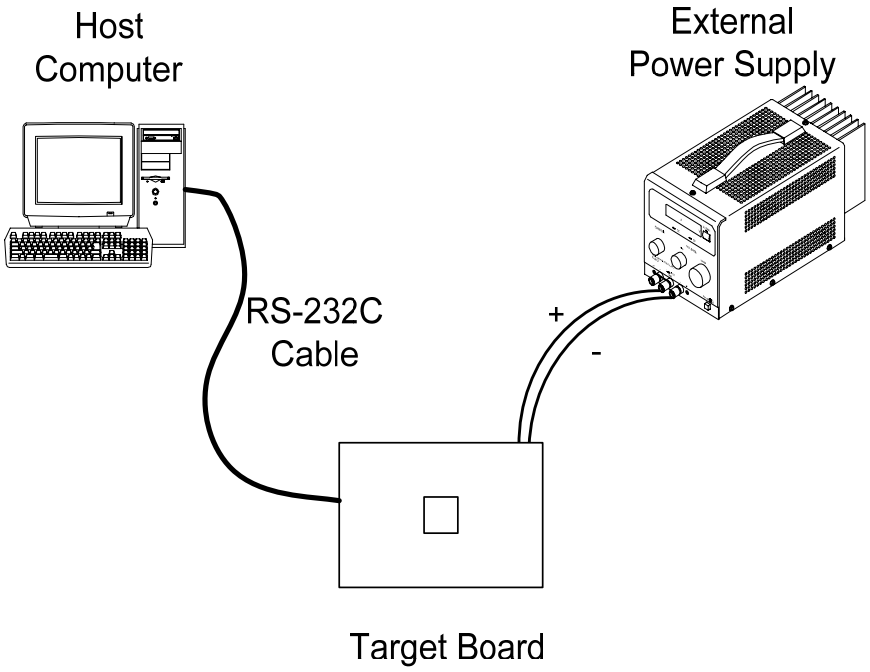


Figure 1 Connecting the Target Board to the User System

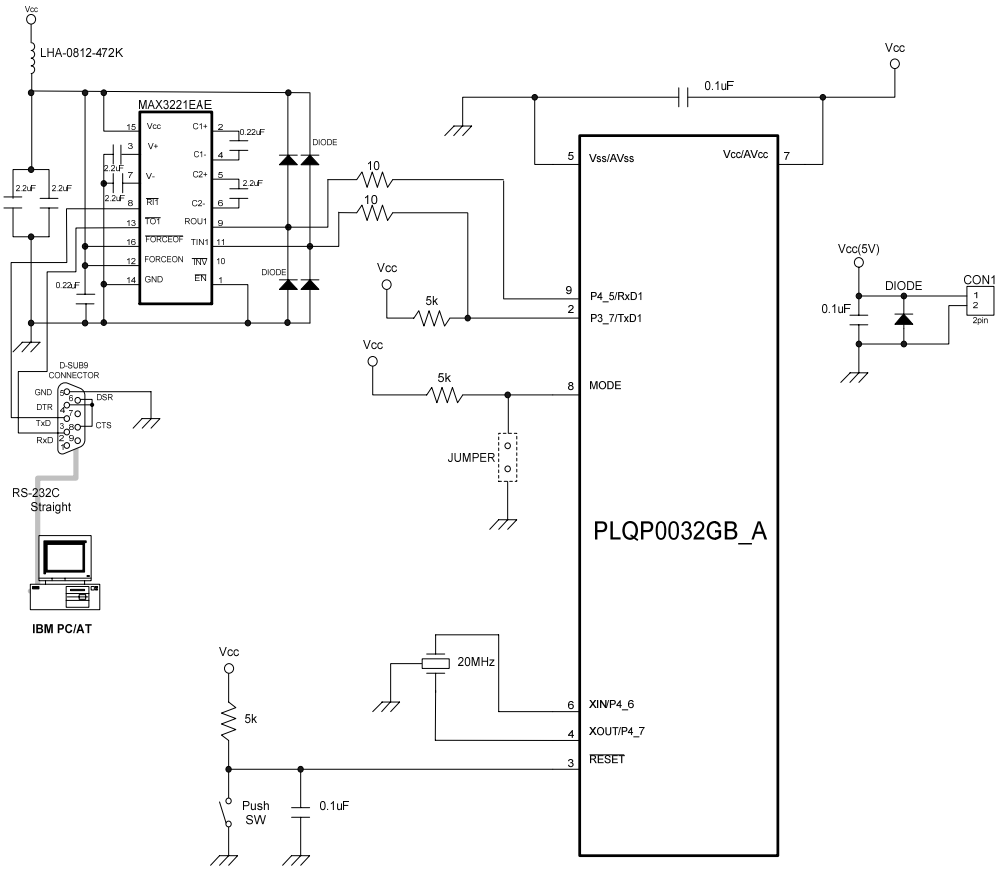


Figure 2 Circuit Using the RS-232C Cable (R8C/2E, 2F Groups)

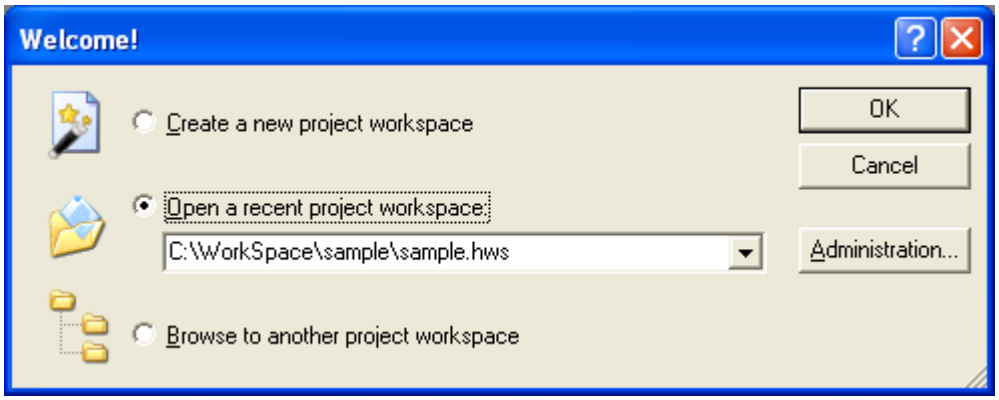
2. Preparing the M16C R8C FoUSB/UART Debugger

The M16C R8C FoUSB/UART debugger (hereinafter R8C UART debugger) is used for debugging by connecting an RS-232 cable between the host computer and the target board.

A monitor program comes bundled and is automatically installed with the R8C UART debugger software.

For the R8C Family, the monitor program is automatically programmed when starting the R8C UART debugger. The monitor program does not need to be preprogrammed with an M16C FlashStarter or other flash programmer.

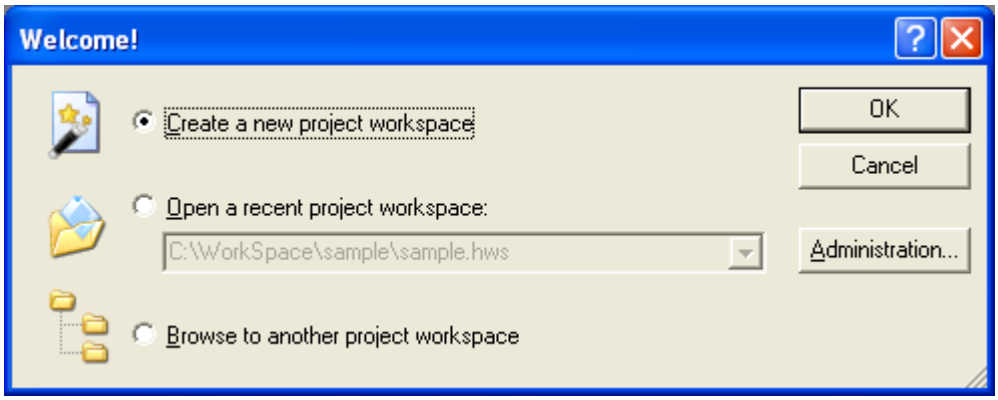
a) To start the High-performance Embedded Workshop (HEW), go to “Start”, “Programs”, “Renesas”, “High-performance Embedded Workshop”, and “High-performance Embedded Workshop”. You will see the following “Welcome!” dialog box.



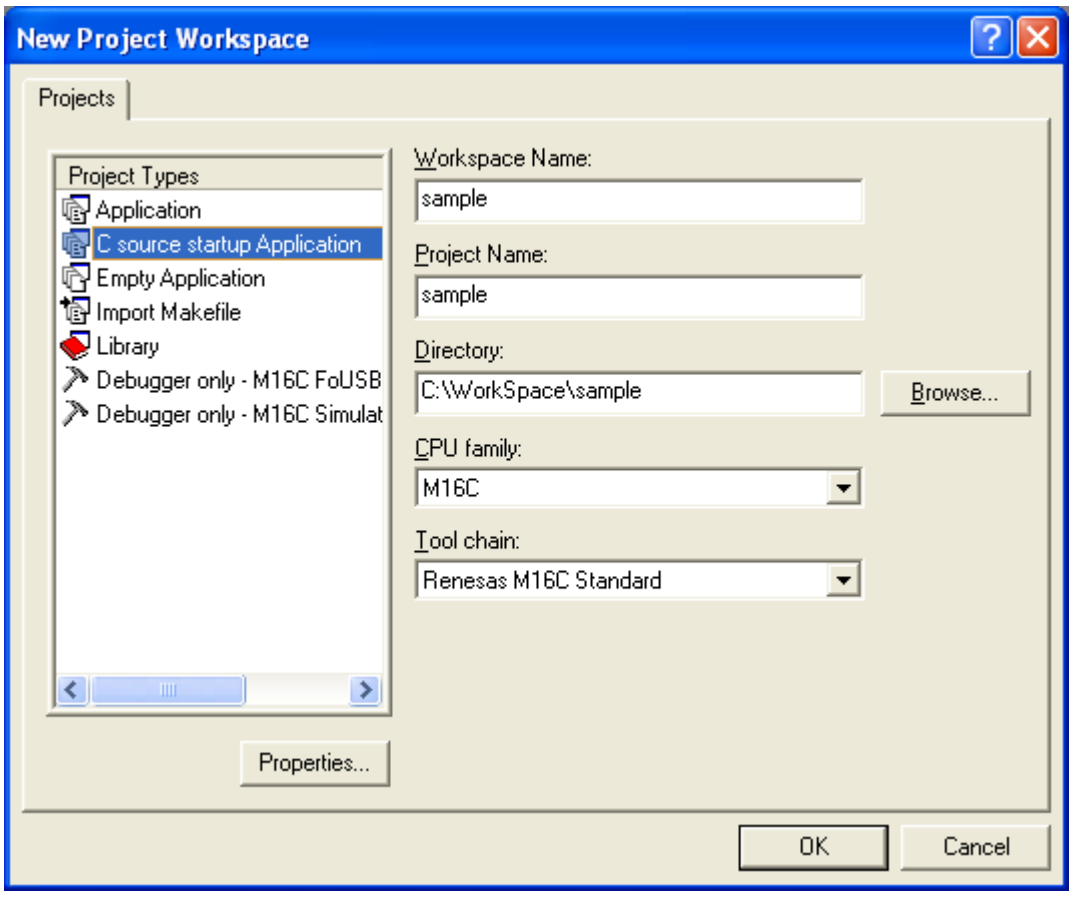
- [Create a new project work space]
  Select this when creating a new workspace.
- [Open a recent project workspace]
  Select this when using an existing workspace. Previous workspaces are displayed in the pull-down menu.
- [Browse to another project workspace]
  Select this when using an existing workspace, and there are no previous workspaces listed in the pull-down menu.

After selecting an existing workspace and pressing [OK], the screen under letter t) (Page 17) is displayed.

b) Select “Create a new project workspace”. Press [OK].



c) The Project Generator starts. When a toolchain is preinstalled, the following screen is displayed.

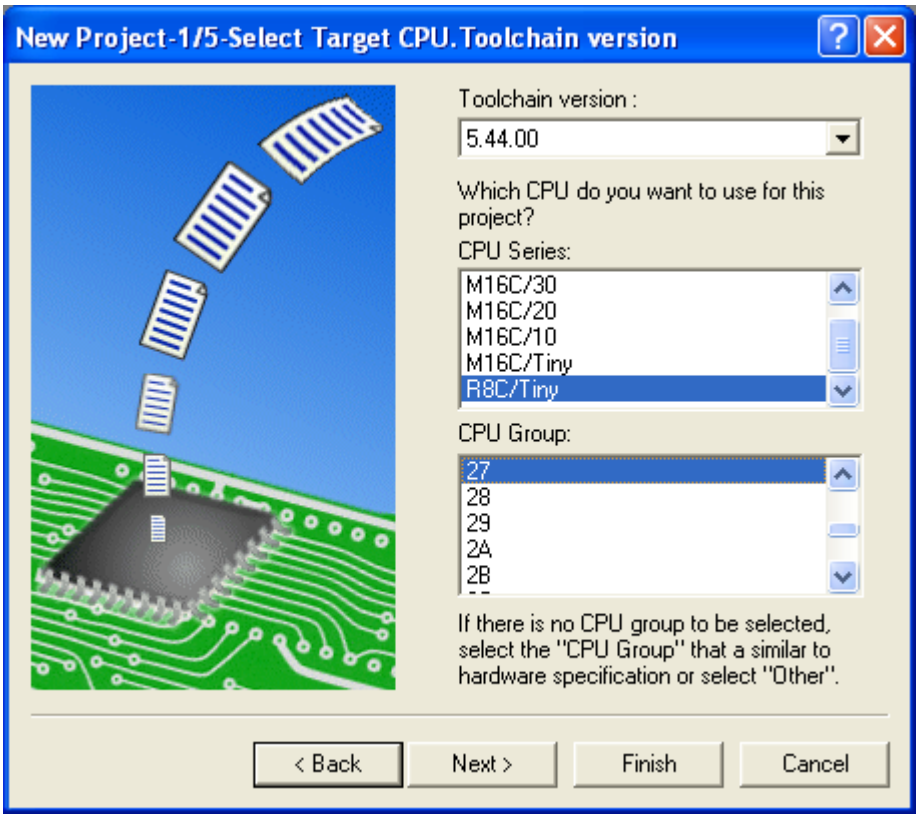


- [Workspace Name]
  Enter a name to create a new workspace. “sample” has been input as an example.

- [Project Name]
  Enter a project name. If the project name is to be the same as the workspace name, it is not necessary to input anything in the [Project Name] field.

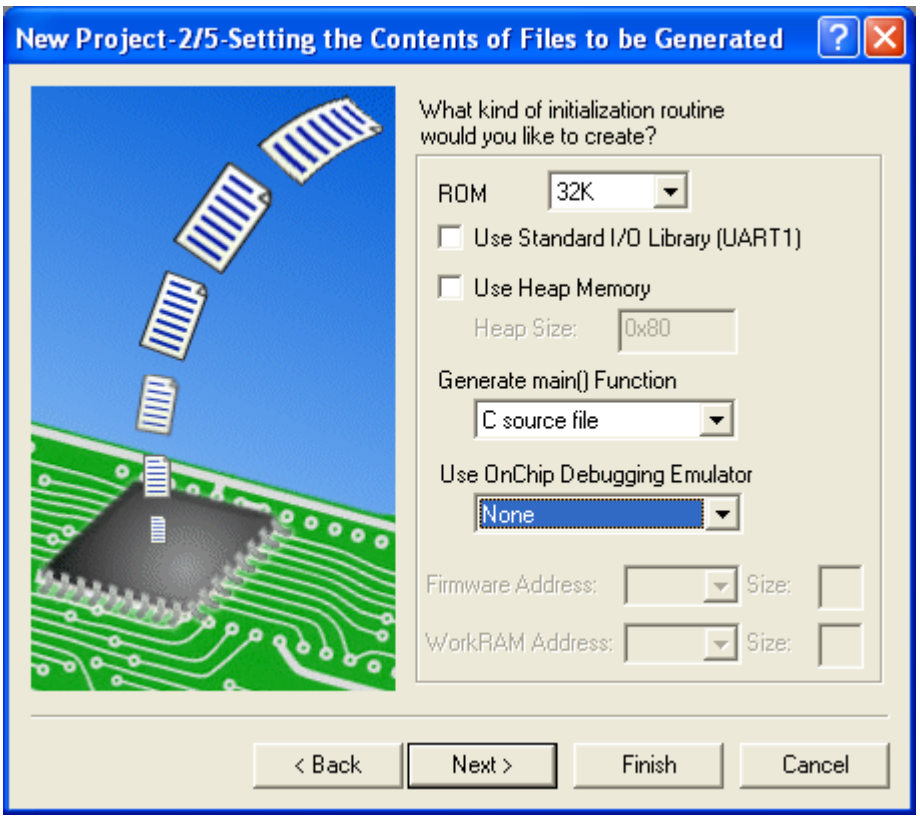
- [CPU family]
  Select the applicable CPU family. In this case, M16C has been selected for the R8C Family.
- [Toolchain]
  When using a toolchain, select the applicable toolchain name. When not using a toolchain, select “None”.
- [Project Types] Window
  Select a project type. The project type which supports the C start-up has been selected as an example.

d) Set the toolchain version.



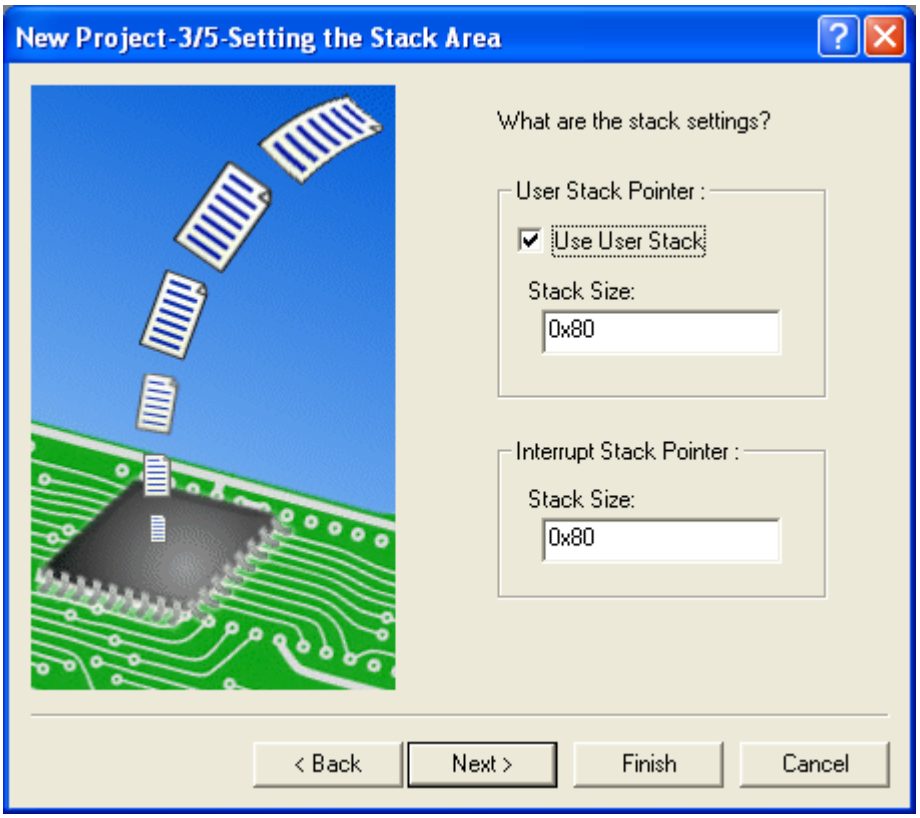
Select the “Toolchain Version”, “CPU Series”, “CPU Group” and then press [Next]. In this example, R8C/27 Group is selected.

e) Select the MCU ROM size and other related settings.



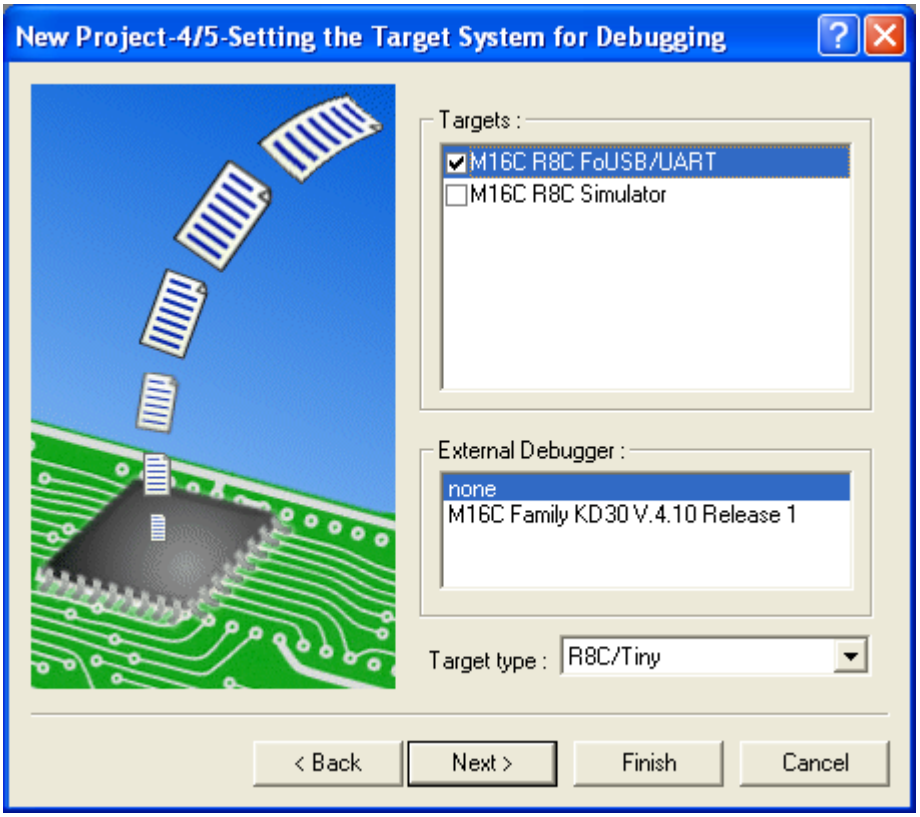
Select the MCU ROM size and heap size. Select “None” for the on-chip debugging emulator. And press [Next].

f) Set the stack.



Set the “Stack Size” and press [Next].

g) When the toolchain setting is complete, the following screen is displayed.

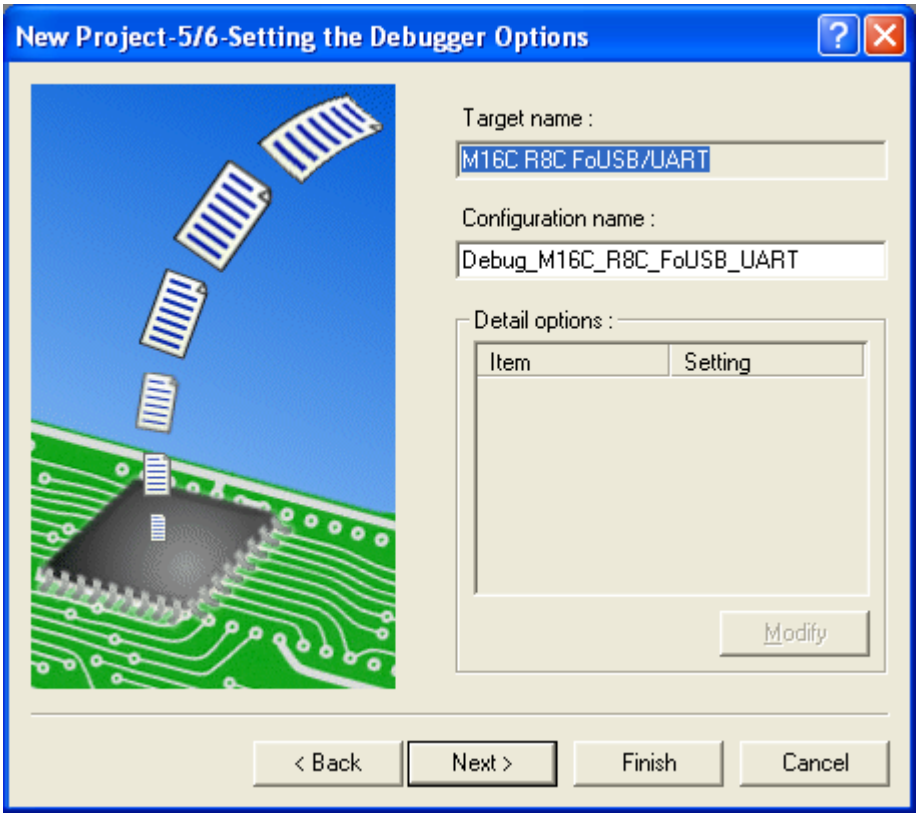


Select “M16C R8C FoUSB/UART” and press [Next].

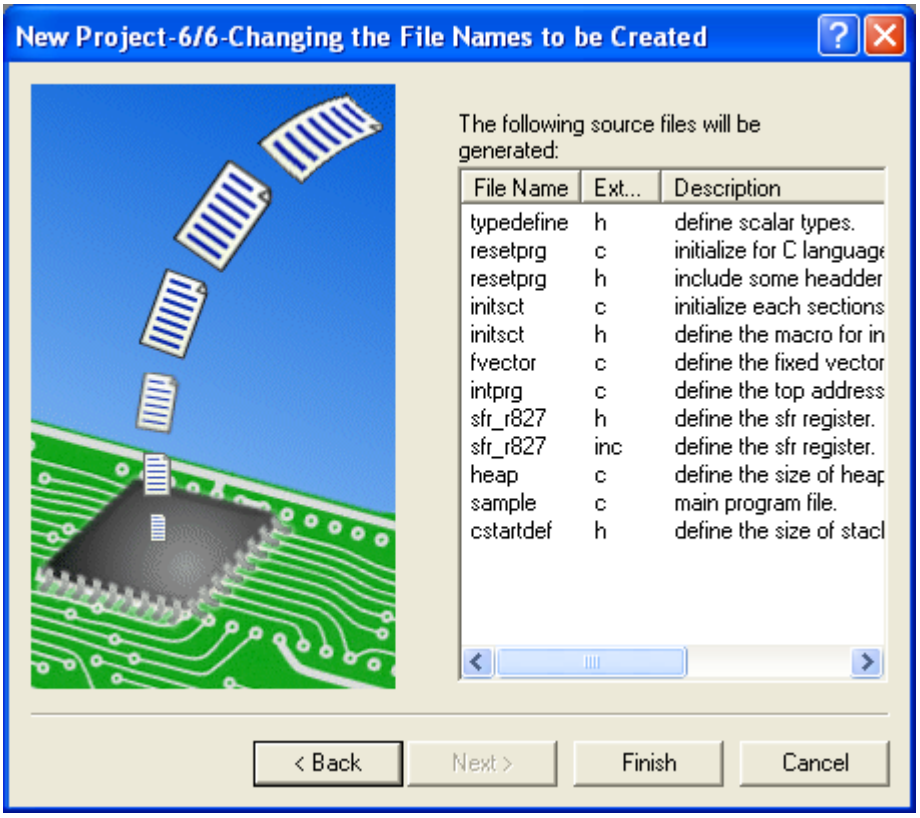
If necessary, select other targets.

h) Set the configuration file name.

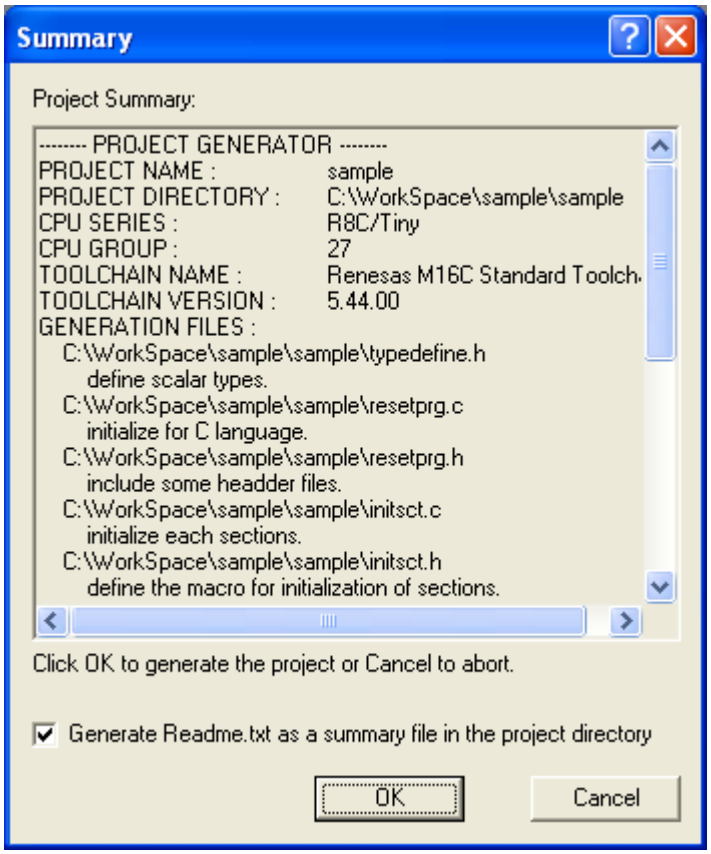
Configurations are the build option settings (e.g., output of debug information or optimization) having their own names. The term "configuration" can also be referred to as "build configuration".



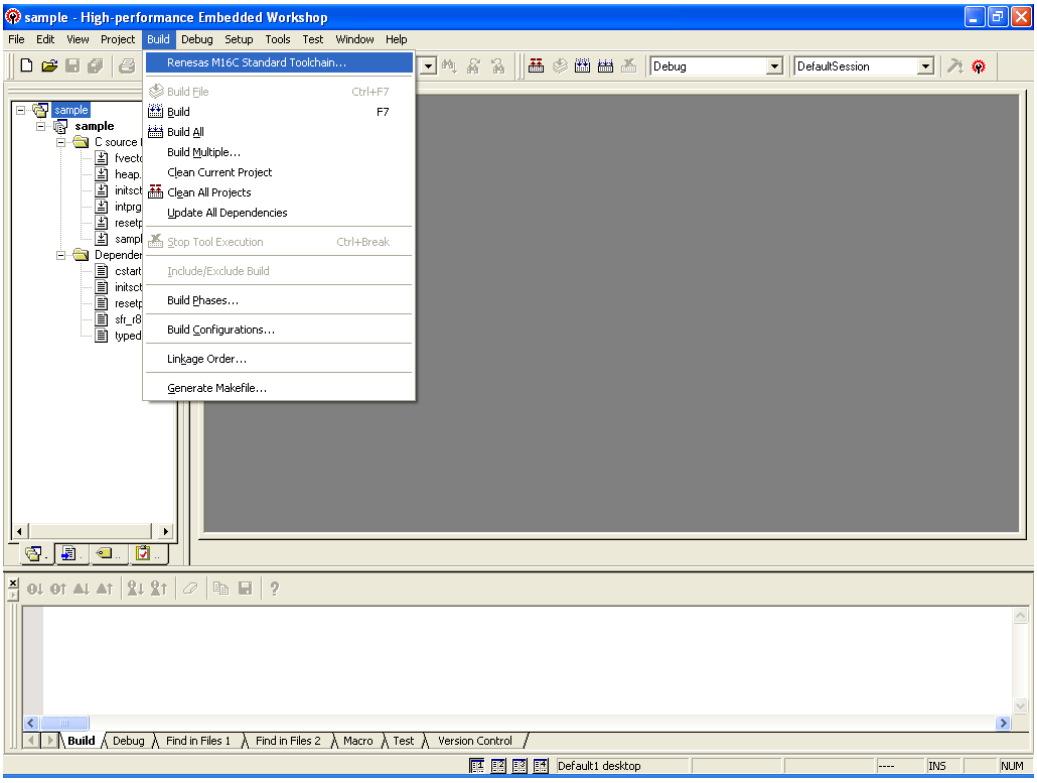
i) Verify the file names to be generated.



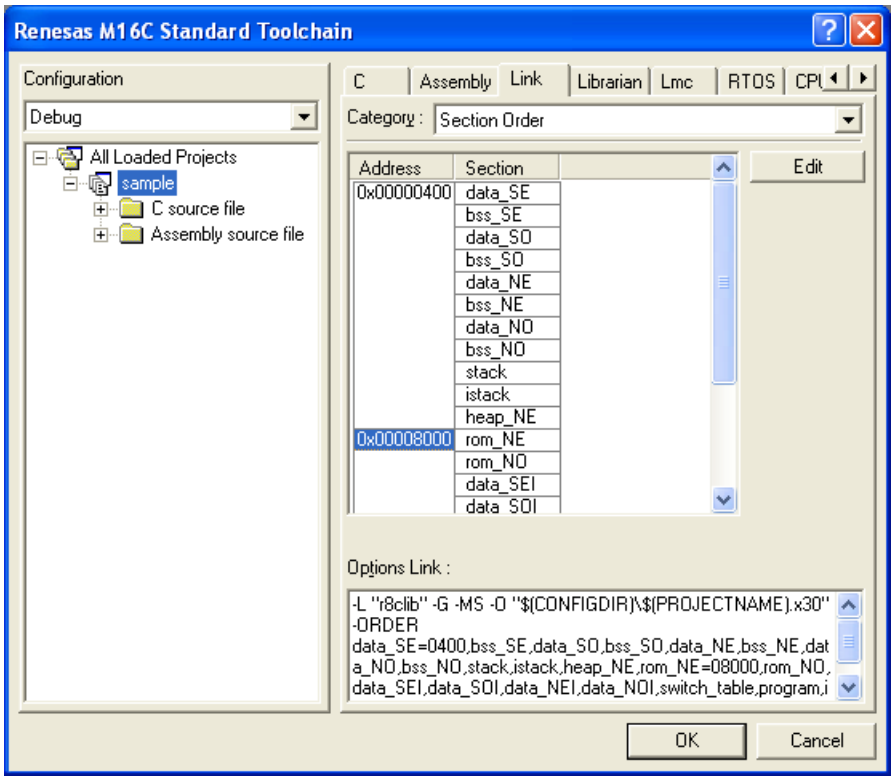
j) The figure below displays the files generated by the High-performance Embedded Workshop based on the above settings. Pressing [OK] launches High-performance Embedded Workshop.



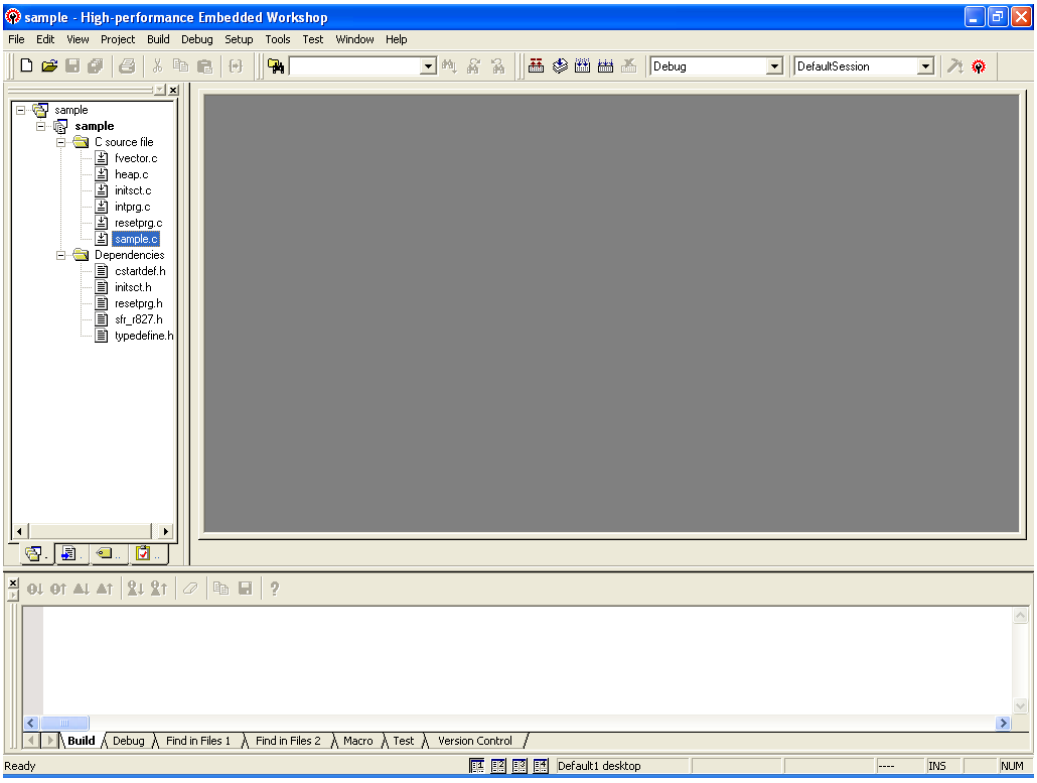
k) Check the section address. Under the “Build” menu, select “Renesas M16C Standard Toolchain”.



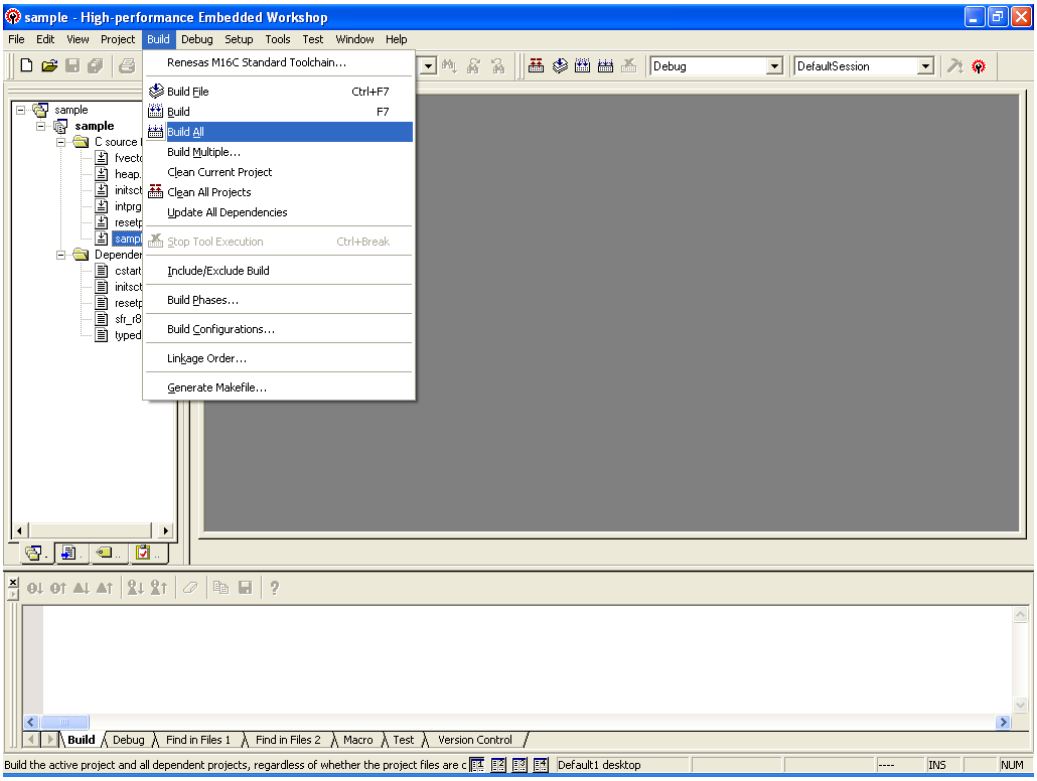
l) “Renesas M16C Standard Toolchain” is displayed. Click on the “Link” tab and select “Section Order” from the “Category” pull-down menu. Make sure the section start address does not overlap with the monitor program occupied area shown in Table 1. If there is any overlap, edit the address value.



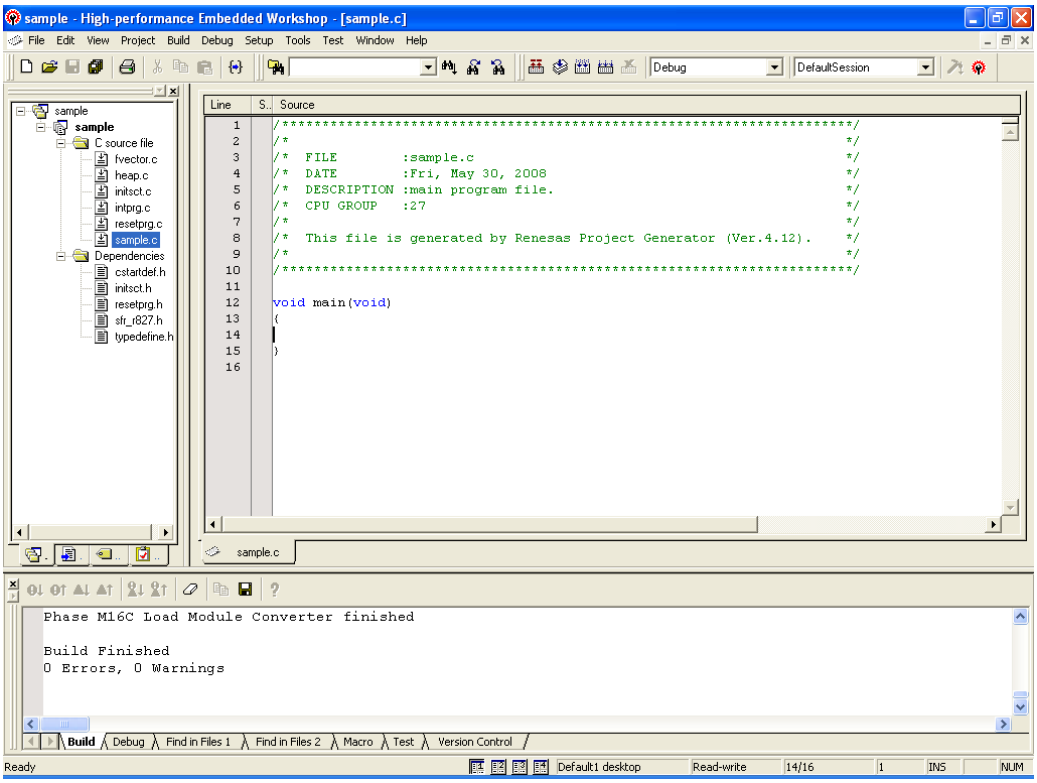
m) Double-click the source program to launch the program editor.



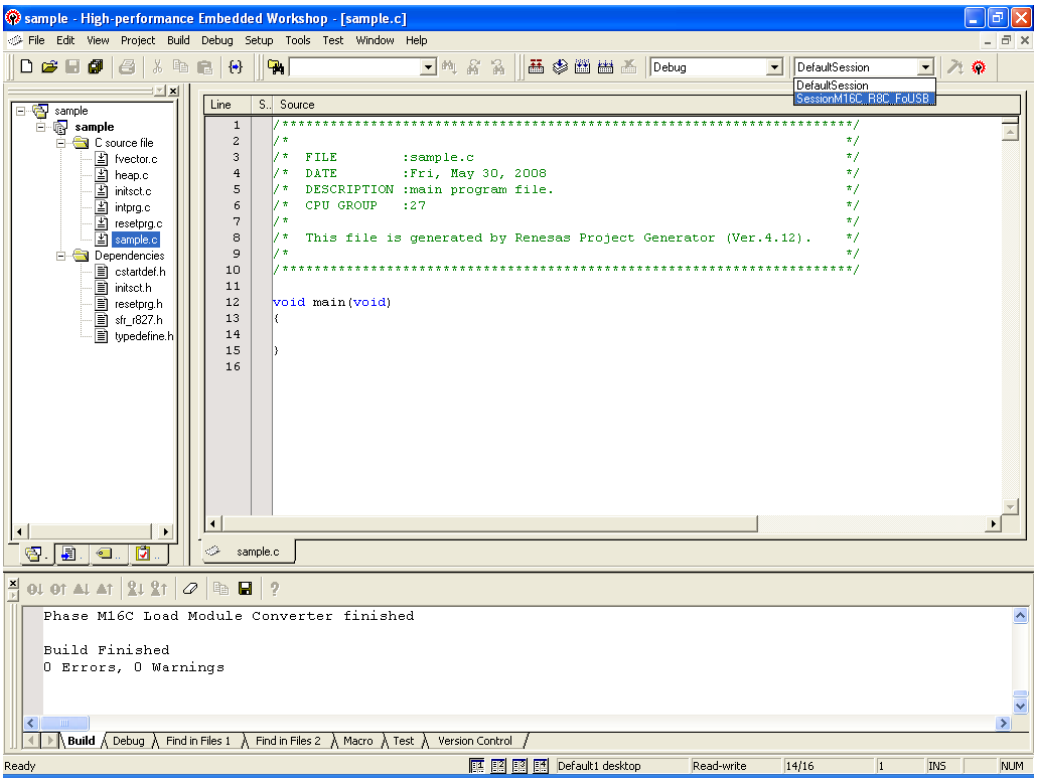
n) When the program is complete, under the “Build” menu, select “Build” or “Build All” to build the program.



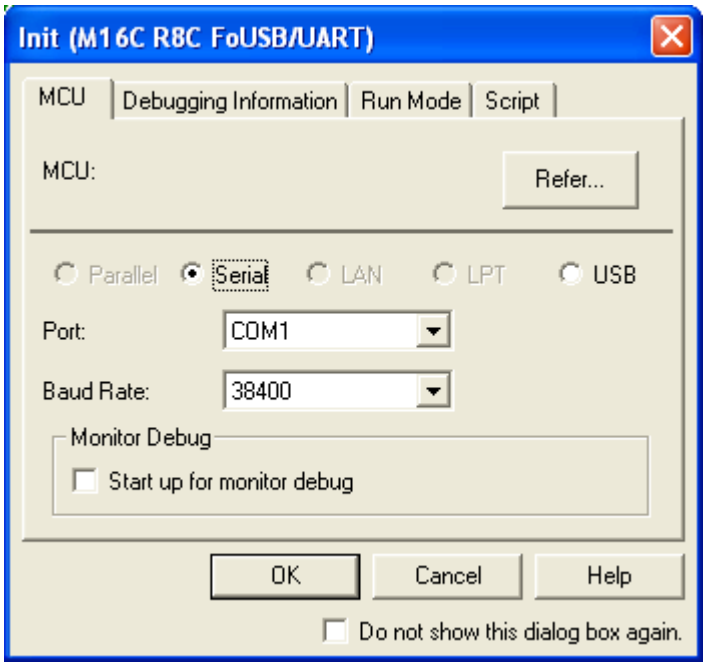
o) The result of the build is displayed.



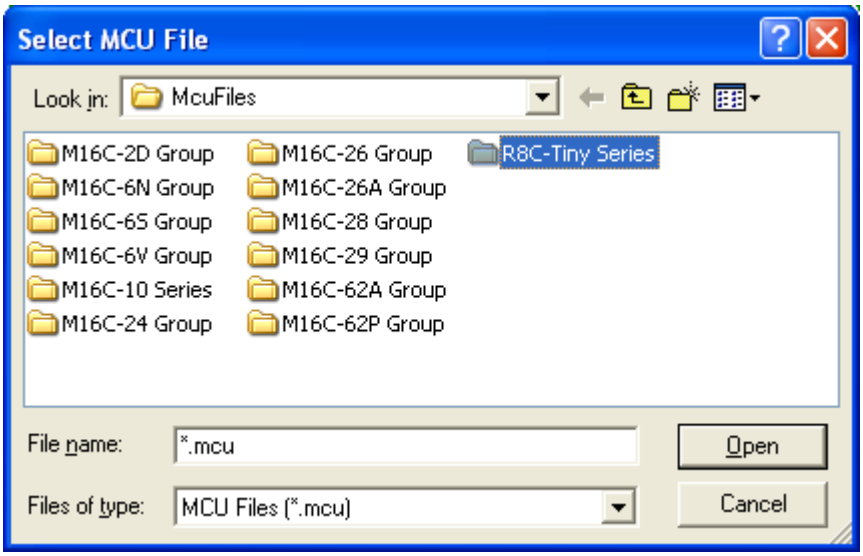
p) Connect with the target. A host computer can be connected with the target easily by switching to the session file in which the setting to use the R8C UART debugger is pre-registered.



q) The Init screen is displayed. Select the “Serial” radio button and press [Refer(ence)].



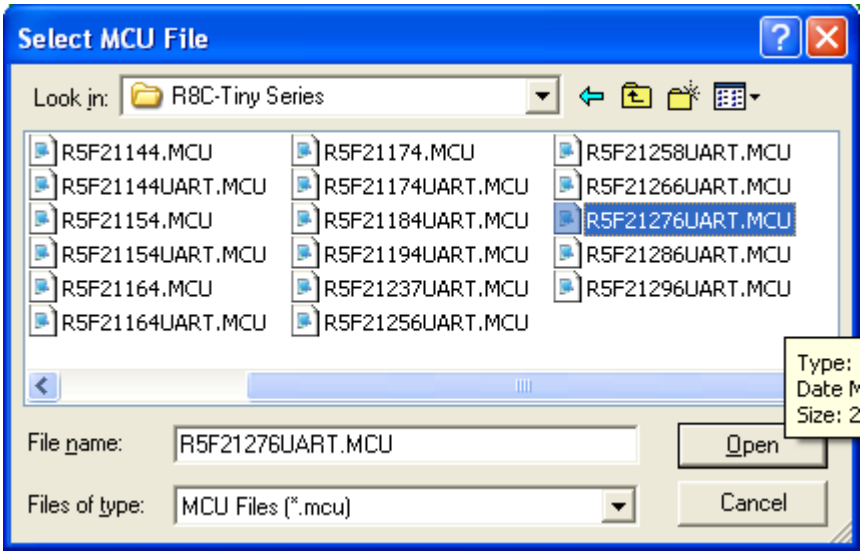
r) Select “R8C-Tiny Series”.



s) Select one of the following MCU files depending on the group.

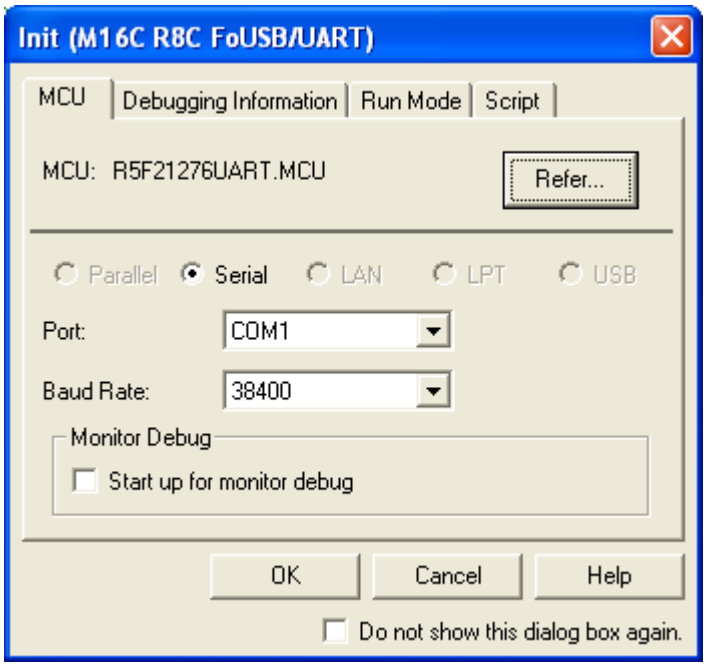
R8C/2E Group: R5F212E4UART.MCU

R8C/2F Group: R5F212F4UART.MCU

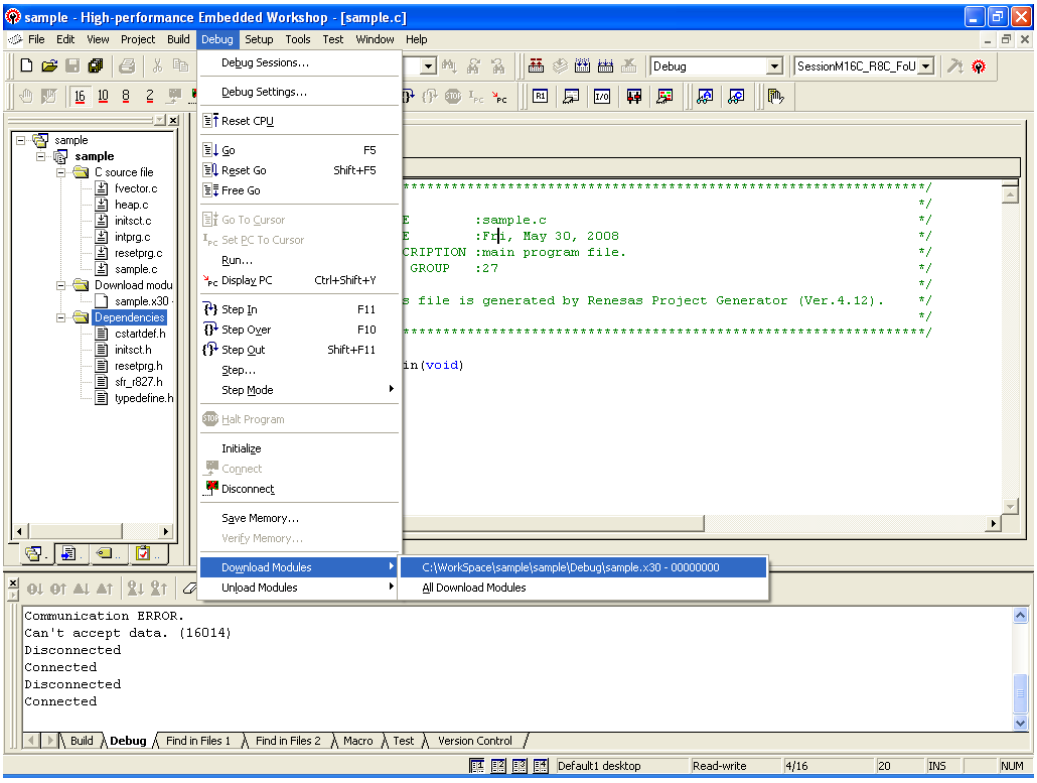


In this example, R8C/27 Group is selected.

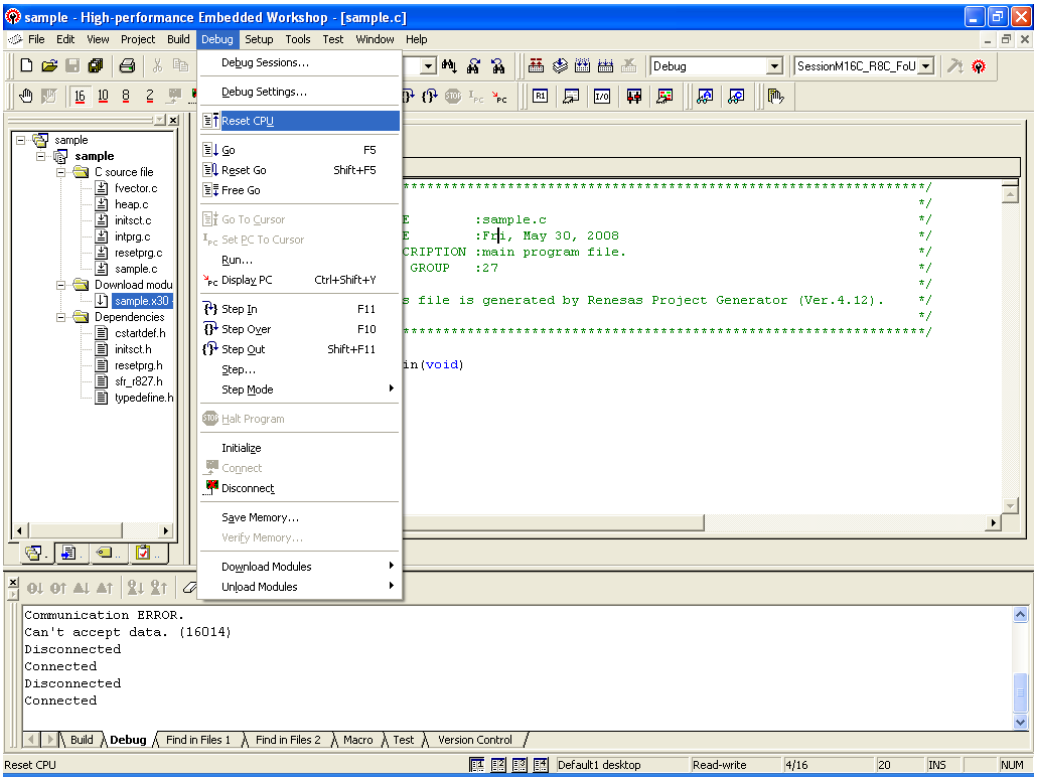
t) Select the appropriate ”Port” and ”Baud Rate” from the pull-down menus. Press [OK] and a monitor program is downloaded.



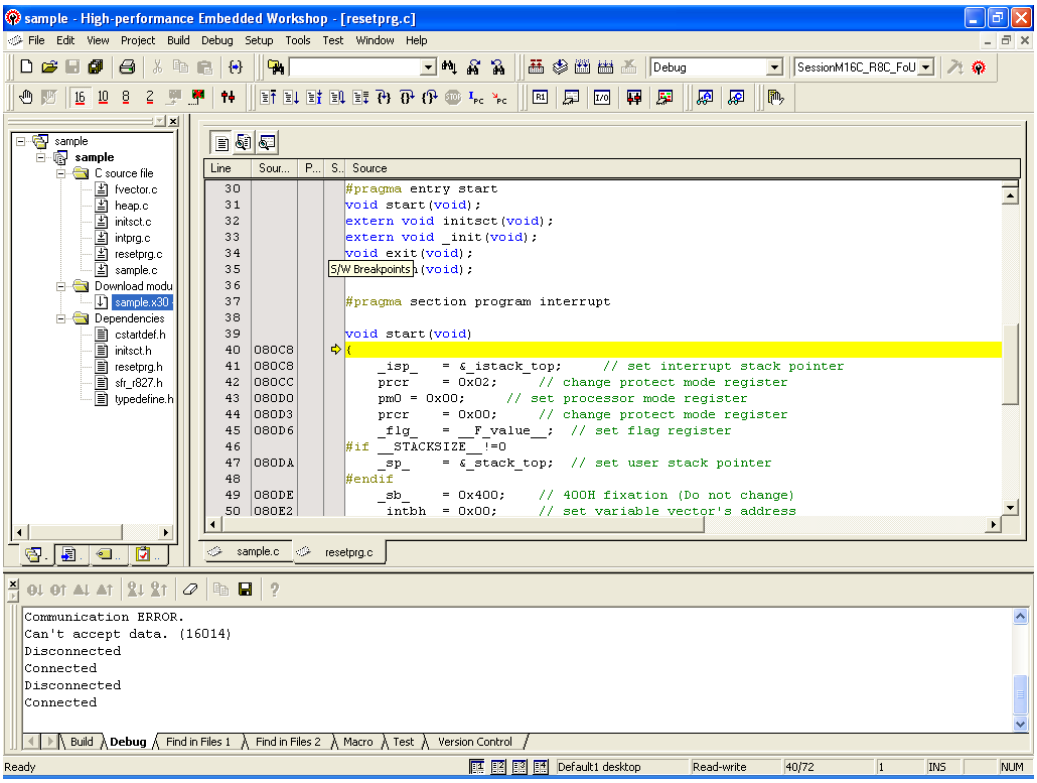
u) To download a user program, select “Download File (X30 file)” in the “Download Modules” submenu under the “Debug” menu.



v) To reset the user program, select “Reset CPU” under the “Debug” menu.



w) The cursor moves to the top of the user program and debugging starts.



3. Memory Map When Using the R8C UART Debugger

Figure 3 shows a memory map (16 KB).

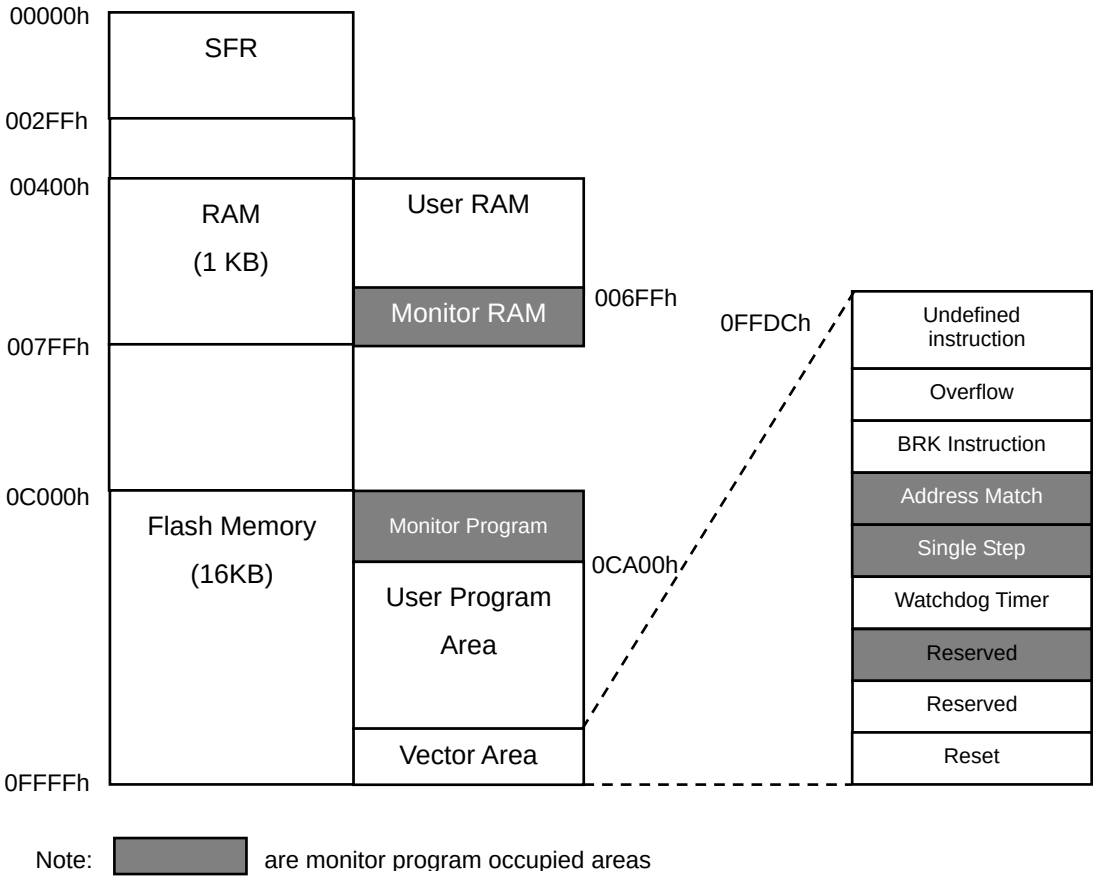


Figure 3 Memory Map (32 KB)

4. Monitor Program Occupied Area

Table 1 Monitor Program Occupied Area

ROM / RAM	Occupied Area for Monitor Program
8 KB / 512 B	Vector FFE8h to FFEBh, FFECh to FFEFh, FFF4h to FFF7h
16 KB / 1 KB	RAM 6FFh to 7FFh Flash memory C000h to C9FFh Vector FFE8h to FFEBh, FFECh to FFEFh, FFF4h to FFF7h

5. Notes on Using the R8C UART Debugger

5.1. Changing communication speed and restarting the R8C UART debugger after the R8C UART debugger is done

The target MCU holds the baud rate value after the R8C UART debugger is done. Therefore, when changing communication speed and restarting the R8C UART debugger, a communication error occurs. (The R8C UART debugger can be started when using the previous communication speed). When changing communication speed, turn off the target power and turn on the power again.

5.2. User program ID code

Set the ID code of the user program to **all FFh** when using the R8C UART debugger.

Table 2 ID Code Storing Address

Address	ID No.	Vector Table
0FFDFh – 0FFDCh	ID1	Undefined instruction
0FFE3h – 0FFE0h	ID2	Overflow
0FFE7h – 0FFE4h		BRK instruction
0FFEBh – 0FFE8h	ID3	Address match
0FFEFh – 0FFECh	ID4	Single step
0FFF3h – 0FFF0h	ID5	Watchdog timer, oscillation stop detection, voltage monitor 2
0FFF7h – 0FFF4h	ID6	Reserved
0FFFBh – 0FFF8h	ID7	Reserved
0FFFFh – 0FFFCh	(See Note)	Reset

Note: Refer to the hardware manual for the value set to address 0FFFFh.

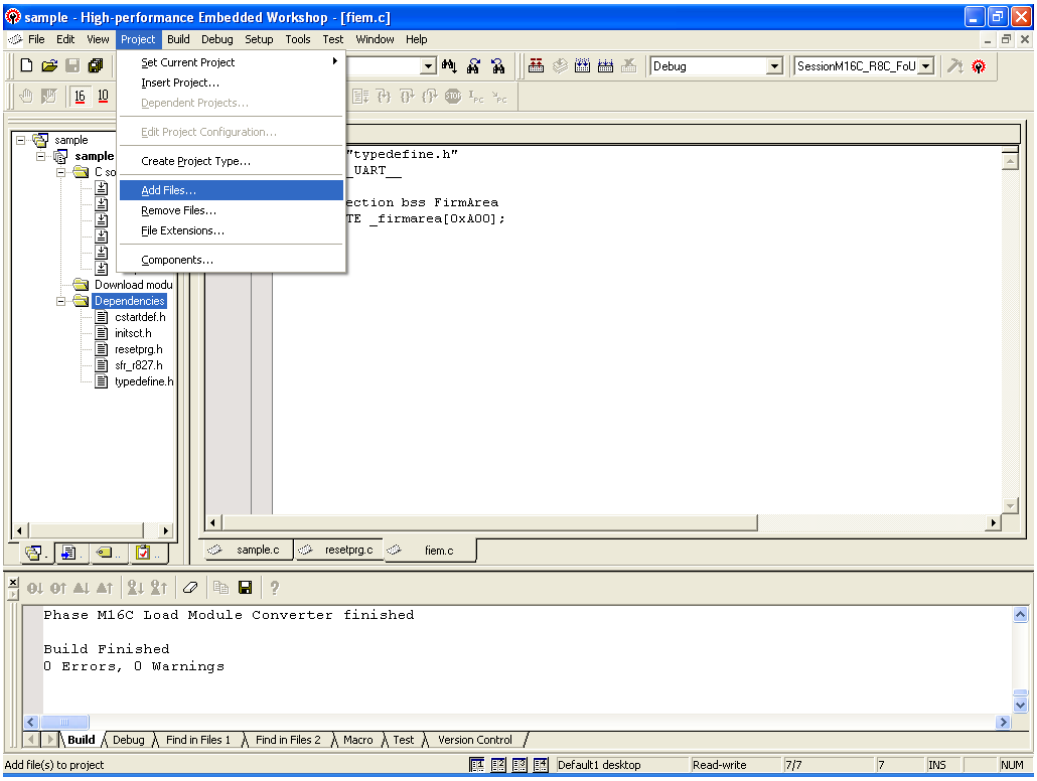
5.3. User program download area

As shown in Figure 3, a monitor program uses a part of RAM or flash memory when using the R8C UART debugger. The R8C UART debugger does not download a user program only in the area which overlaps with a monitor program. Note that the R8C UART debugger does not output an error at this time. When outputting an error, set the following.

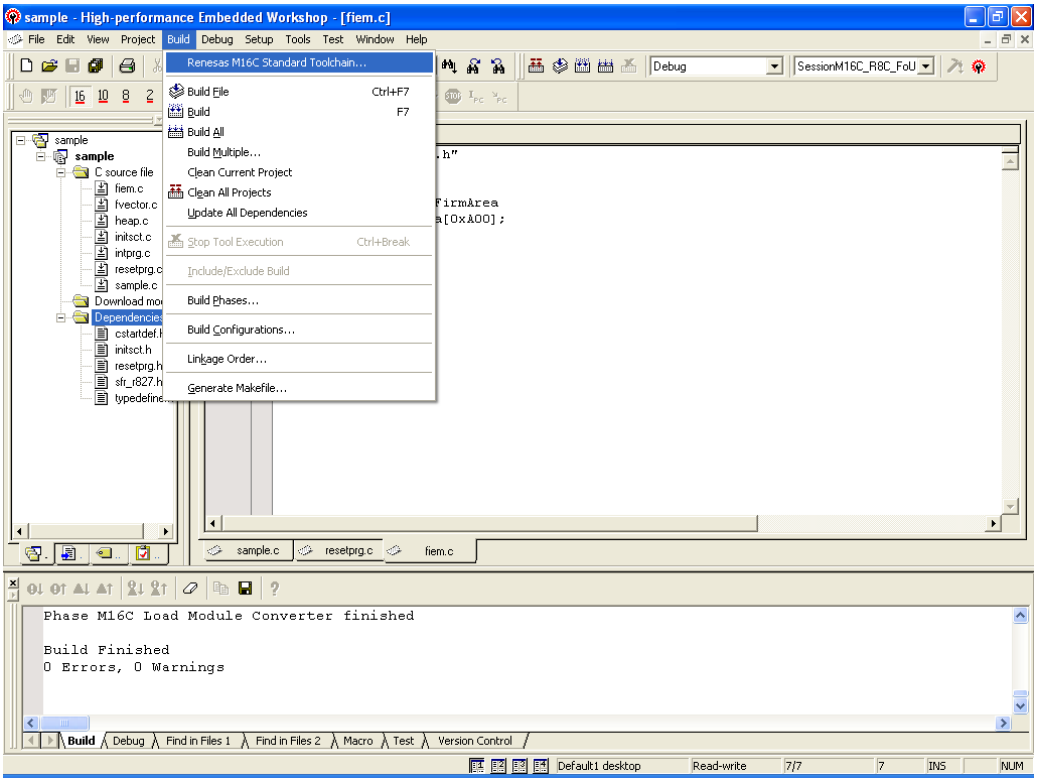
a) Make “firm.c” and enter the following:

```
#include "typedefine.h"
#ifdef __UART__

#pragma section bss FirmArea
_far _UBYTE _firmarea[0xA00];

#endif
```

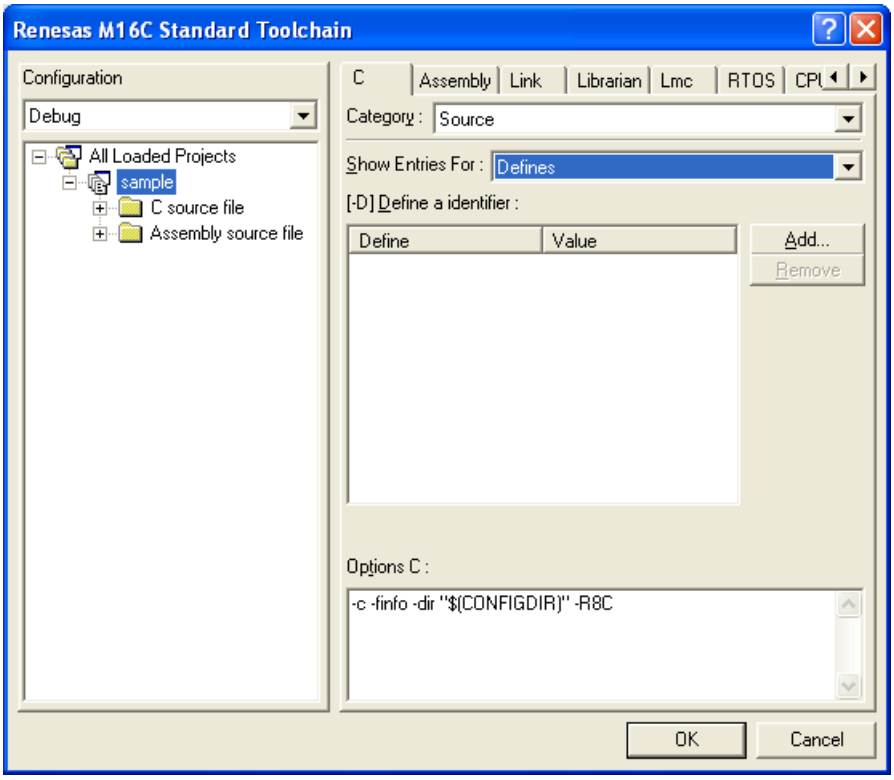
b) Add the file created above to the project. Under the “Project” menu select “Add Files…”. When the file selection screen is displayed, select “firm.c”.



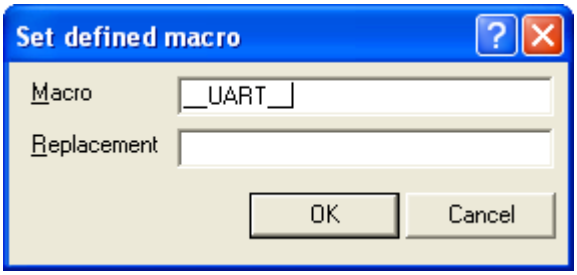
c) To add the compile option, select “Renesas M16C Standard Toolchain…” under the “Build” menu.



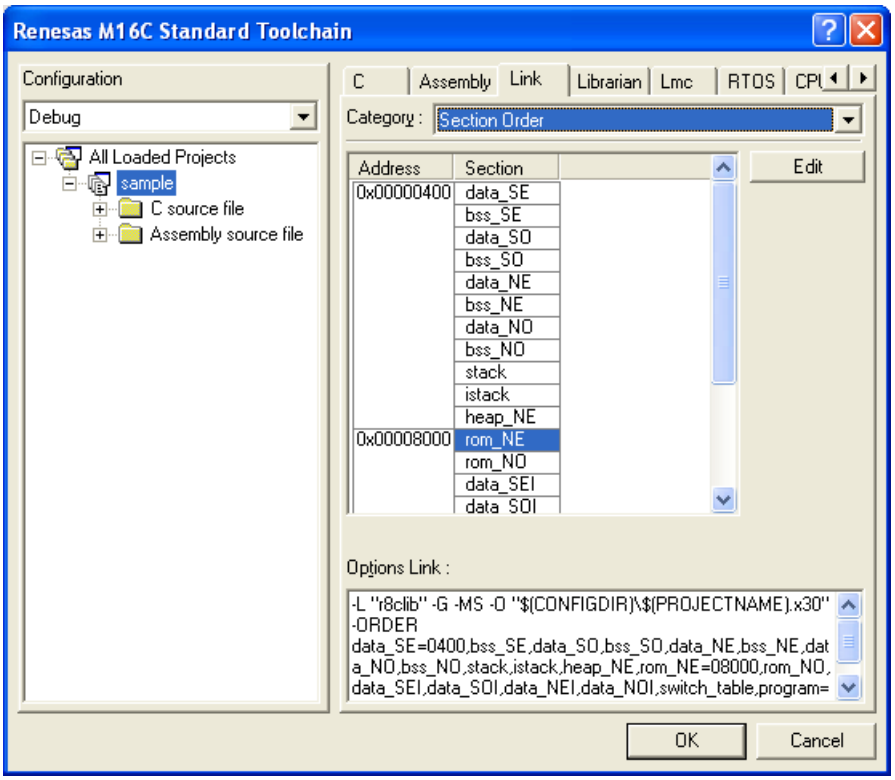
d) “Renesas M16C Standard Toolchain” is displayed. Select “Defines” from the “Show Entries For” pull-down menu, and then press [Add…].



e) “Set defined macro” is displayed. Enter “_UART_” in the “Macro” field and press [OK[.



f) To set the link option, in the “Renesas M16C Standard Toolchain” window, click on the “Link” tab and select “Section Order” from the “Category” pull-down menu. Add “FirmArea_NE” to the start address of the monitor program occupied area shown in Table 1.



When the user program overlaps with the monitor program occupied area due to the above settings, an error is output.

5.4. Frequency characteristics

The monitor program operates in the range of the main clock (Xin) frequency shown below. The monitor program may not run with frequencies not listed below, so use an oscillator that has this frequency range.

1 MHz (minimum) to 20 MHz (maximum)

Table 3 lists each frequency and communication available speed. However, note that operation may not be possible when dividing the main clock and using it with less than 1 MHz even in the range of the above frequency. Do not select low-speed on-chip oscillator or Xcin clock as a main clock.

Table 3 Communication Available Speed of Each Frequency

Frequency	Communication Speed (bps)					
	1200	2400	4800	9600	19200	38400
20 MHz	X	X	O	O	O	O
16 MHz	X	X	O	O	O	O
14 MHz	X	X	O	O	O	O
12 MHz	X	X	O	O	O	O
10 MHz	X	O	O	O	O	O
8 MHz	X	O	O	O	O	O
6 MHz	X	O	O	O	O	O
4 MHz	O	O	O	O	O	X
2 MHz	O	O	O	O	X	X
1 MHz	O	O	O	X	X	X

O: Communication available

X: Communication not available

Note: Communication may not be possible depending on temperature and voltage. If communication is not possible, lower the communication speed.

5.5. Limitations of SFR operations

Table 4 lists the limitations of register operations. Changing registers that are disabled will cause the monitor program to malfunction.

Table 4 Limitations on SFR Operation

Register	Default Value	Limitation	Change
Processor Mode Register 0	Reset to 00h	Single-chip mode only	Partially enabled
Processor Mode Register 1	Reset to 00h	————————	Enabled
System Clock Control Register 0	Reset to 08h	Set the CM05 bit to 0.	Partially enabled
System Clock Control Register 1	Reset to 28h	Set bits CM13 and CM15 to 1. Set the CM14 bit to 0.	Partially enabled
High-Speed On-Chip Oscillator Control Register 0	Reset to 03h	Set the FRA00 bit to 1.	Partially enabled
High-Speed On-Chip Oscillator Control Register 1	————————	Do not change this register.	Disabled
High-Speed On-Chip Oscillator Control Register 2	Reset to 03h	————————	Enabled
Oscillation Stop Detection Register	Reset to 00000x00b	Set this register to 00h.	Partially enabled
Protect Register	————————	————————	Enabled
Flag Register	————————	Writing to the D flag is ignored. Do not set the D flag to 1.	Partially enabled
ISP (Interrupt Stack Pointer)	Reset to 057Fh	Set an area not used by the monitor program.	Partially enabled

5.6. Limitations on stop mode and wait mode

When using stop mode or wait mode, start the R8C UART debugger in free-run mode, and close the RAM window, C watch window, and ASM window in advance. Also, do not operate the R8C UART debugger until the program stops at the break point by setting the break point after exiting stop mode or wait mode.

5.7. Watchdog timer

The watchdog timer is refreshed while the monitor program is running. When using the watchdog timer while running the user program, note that by referring to or changing memory content, the monitor program intervenes and the watchdog timer is refreshed.

5.8. Real-time operation of user program

- Sampling run mode (also known as sampling mode)

In sampling mode, execution status of the user program will be regularly monitored when executing Go and Come. Therefore, it is possible to detect when the user program is stopped by a break or other command. Select this mode when performing a normal debug.

- Free run mode

In free run mode, execution status of the user program will not be monitored when executing Go and Come. Although real-time operation of the user program is secure, it is not possible to detect if the user program is stopped by a break or other command. Therefore, even when the user program stops, the R8C UART debugger does not stop executing Go and Come. Press STOP to stop the R8C UART debugger.

Note: In free run mode, use the R8C UART debugger while the RAM window, C watch window, and ASM window are closed.

5.9. Executing anomalistic steps

- Software interrupt instruction

  The step execution cannot be performed continuously to the instruction internal process of the instructions (undefined instruction, overflow, BRK instruction, and INT instruction) which generate the software interrupts.

Example: INT instruction

```
        NOP
        NOP
        INT     #3          <-- INT instruction is skipped over when performing step execution
        NOP
        JMP     MAIN
INT_3:
        NOP     <-- Address at which program execution should stop
        NOP
        NOP
        REIT
```

- INT instruction

  To debug the program using the INT instruction, set the software break for the INT instruction process and use the Go command.

Example:

```
        NOP
        INT     #3          <-- Executed by the Go command
        NOP
        JMP     MAIN
INT_3:
        NOP     Break
        NOP
        REIT
```

5.10. Limitations on peripheral functions

UART1 is used for communication between the monitor program and the host computer. Do not use UART1 in the user program. Do not connect the pins below to other pins as they are used for communication with the host computer.

- R8C/2E,2F Groups
  P3_7/TRAO/TRFO11 (2 pin), P4_5/INT0 (9 pin)

5.11. Limitations on the flag register

When operating the flag register in a user program, execute the **FSET instruction and FCLR instruction** not to change the debug flag (D flag).

5.12. Operation on peripheral I/O during a break

Although an interrupt cannot be accepted during a break, peripheral I/O continues operating. For example, when stopping a user program by a break during operating a timer, the timer continues counting, but the timer interrupt cannot be accepted.

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