User's Manual

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M16C R8C UART Debugger User's Manual

Renesas Microcomputer Development Environment System

R8C Family / R8C/3x Series, R8C/Lx Series

Notes on Connecting R8C/3xC Group R8C/3xD Group R8C/LxC Group

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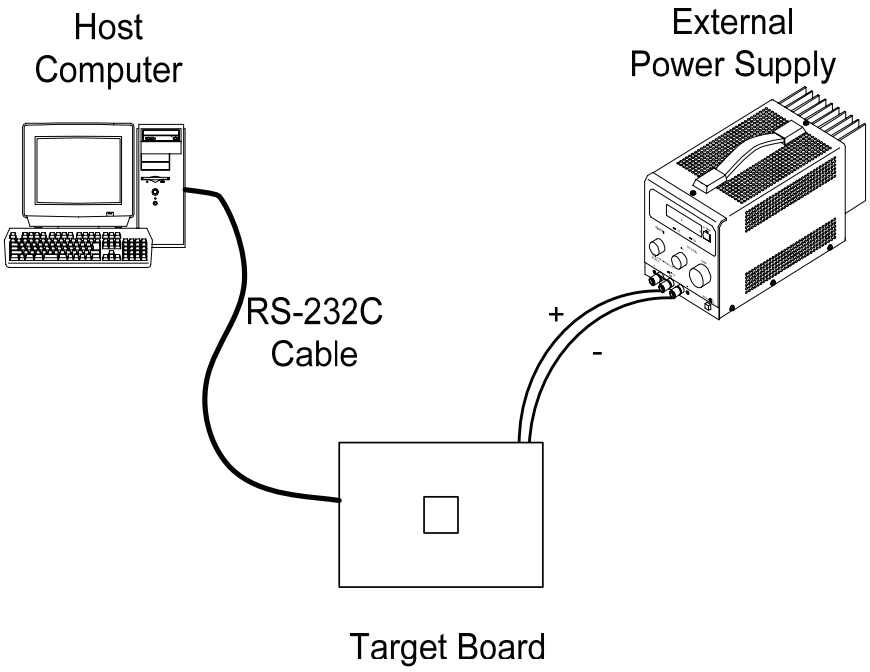


Figure 1 Connecting the Target Board to the User System

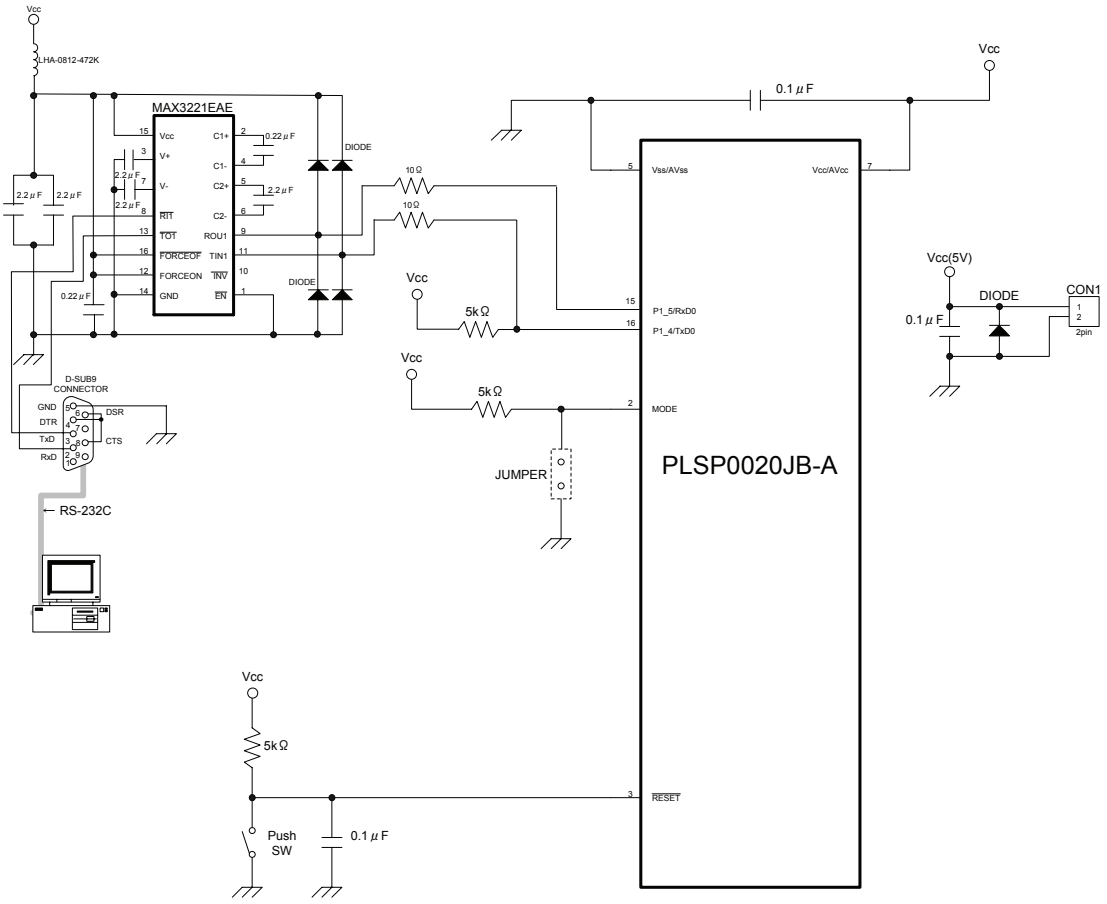


Figure 2 Circuit Using the RS-232C Cable with the R8C/32C, 32D Groups.

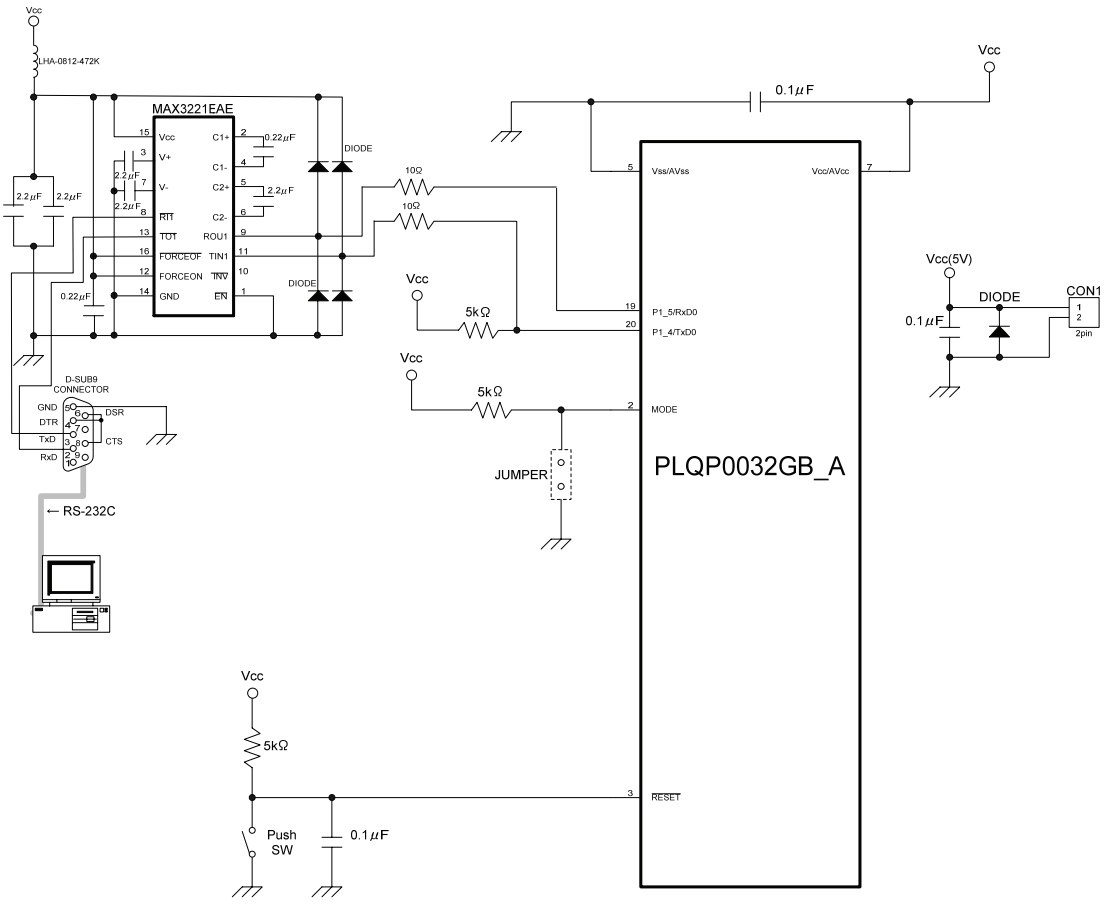


Figure 3 Circuit Using the RS-232C Cable with the R8C/33C, 33D Groups.

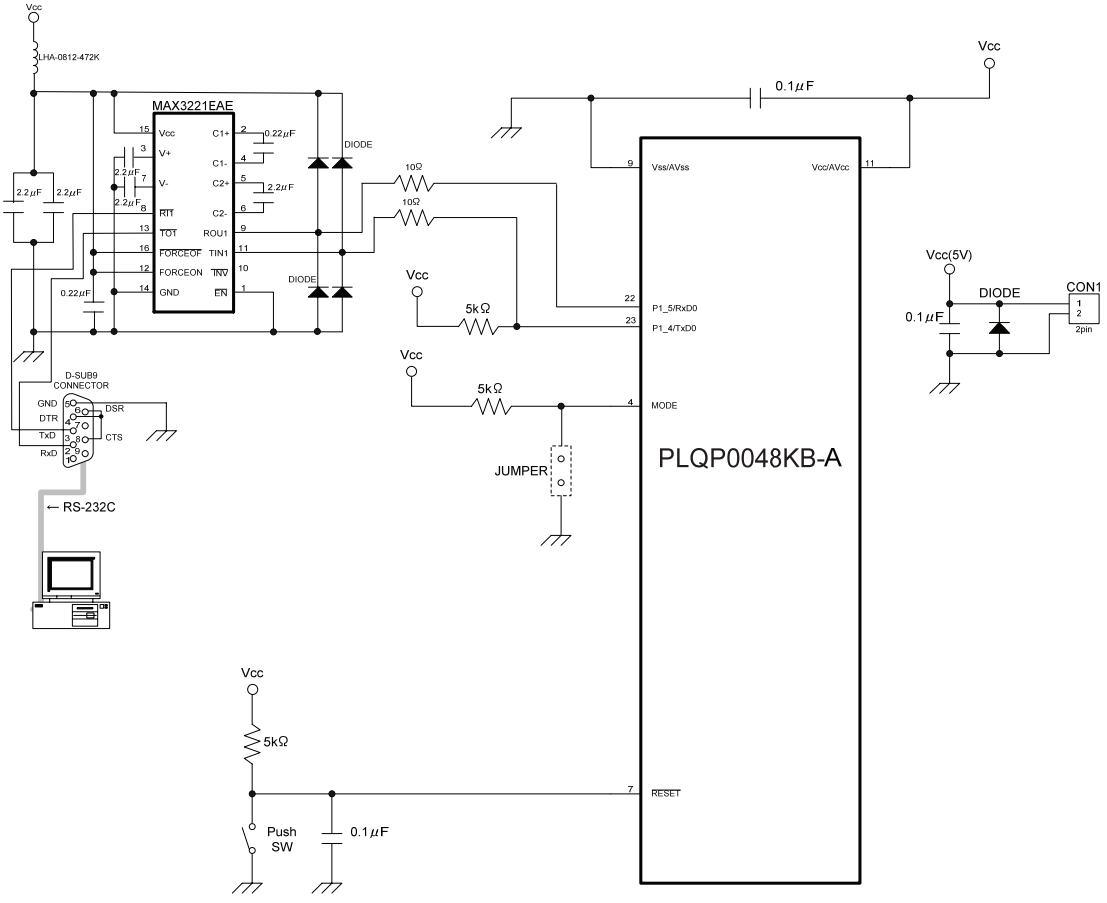


Figure 4 Circuit Using the RS-232C Cable with the R8C/34C Group.

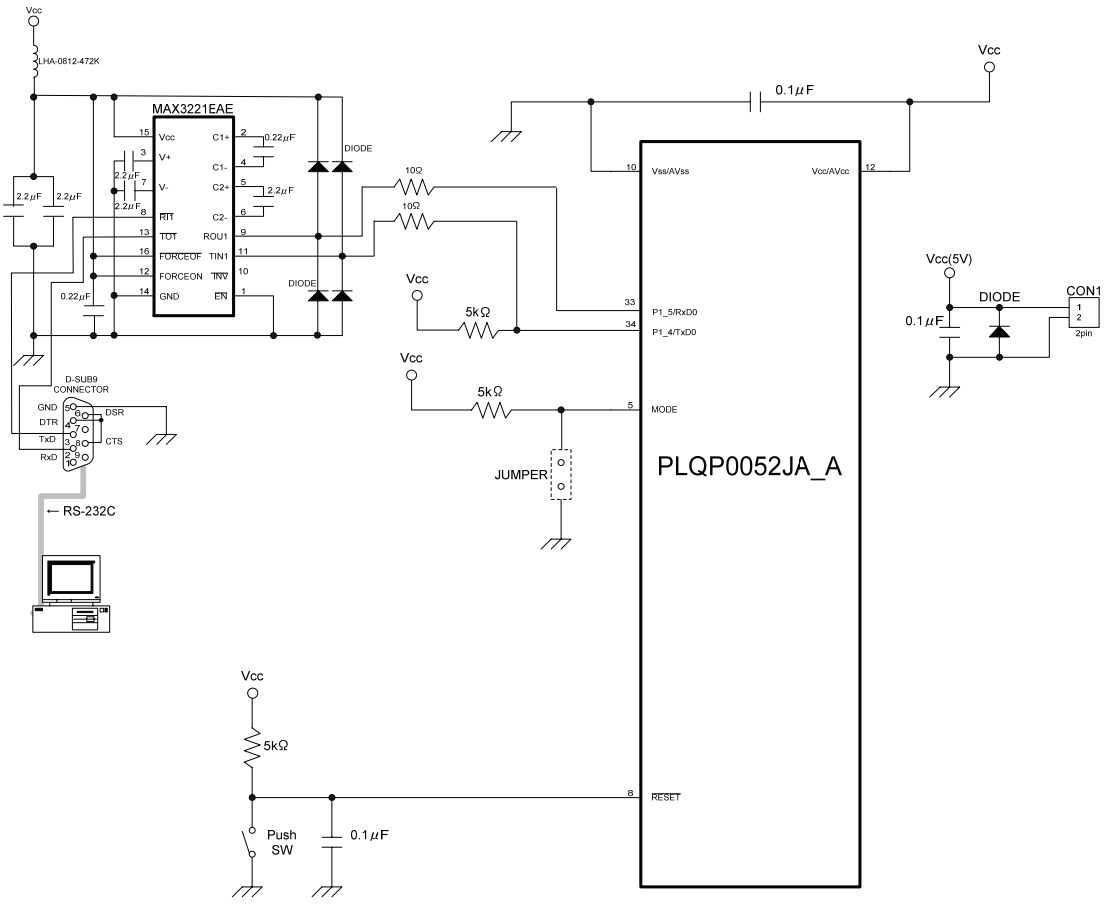


Figure 5 Circuit Using the RS-232C Cable with the R8C/35C, 35D Groups.

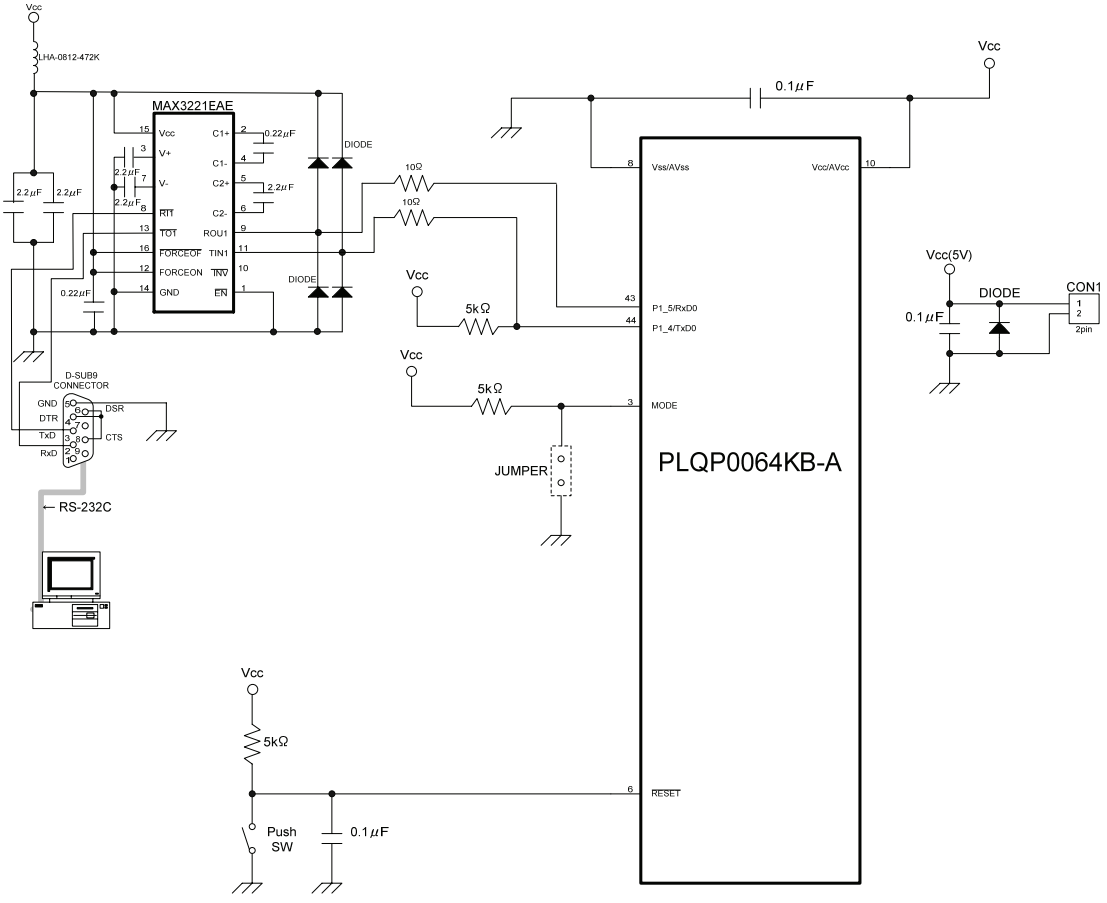


Figure 6 Circuit Using the RS-232C Cable with the R8C/36C Groups.

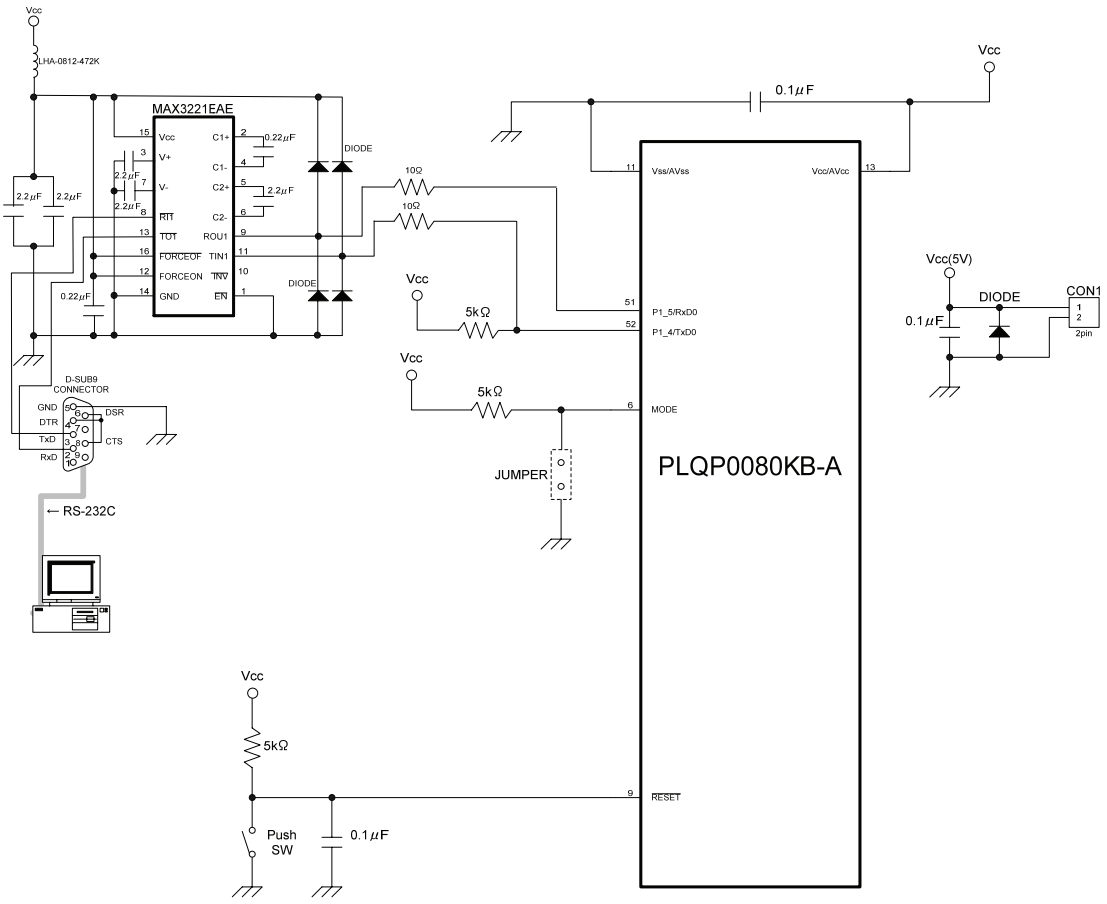


Figure 7 Circuit Using the RS-232C Cable with the R8C/38C Groups.

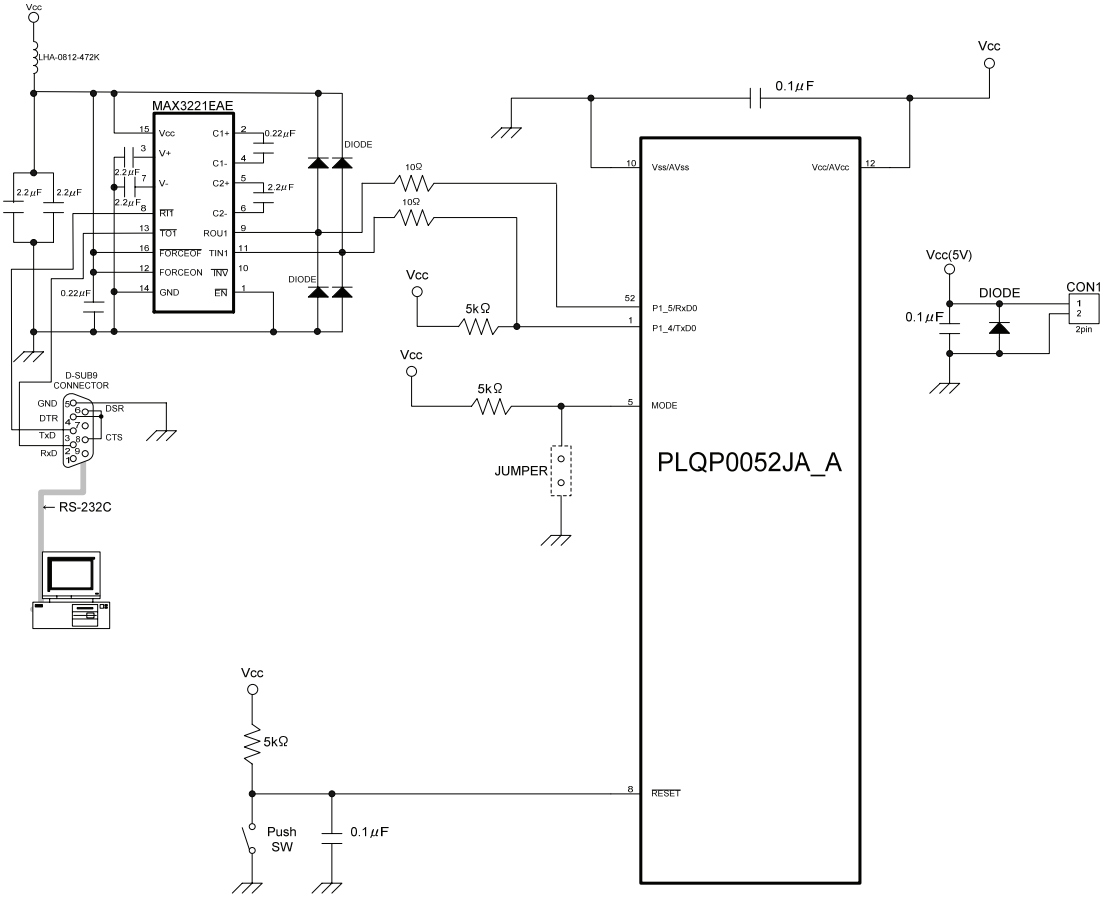


Figure 8 Circuit Using the RS-232C Cable with the R8C/L35C Groups.

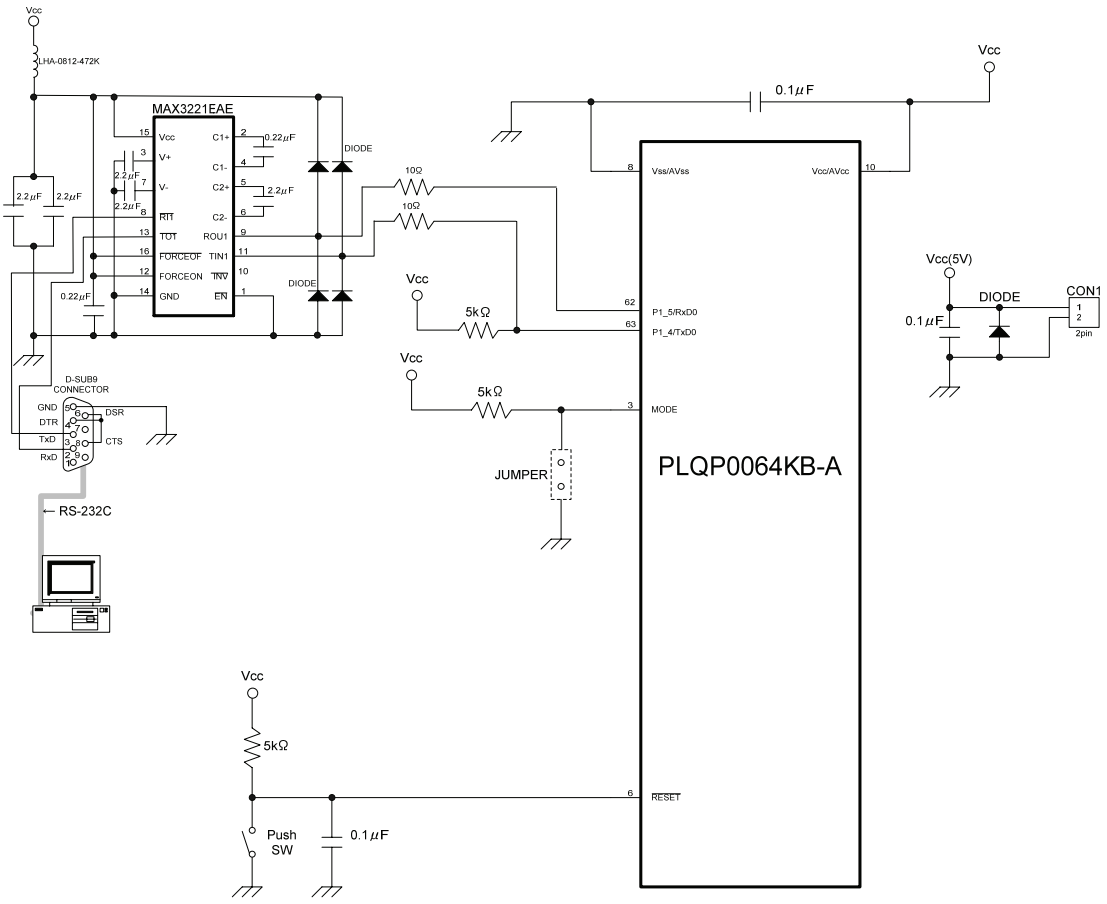


Figure 9 Circuit Using the RS-232C Cable with the R8C/L36C Groups.

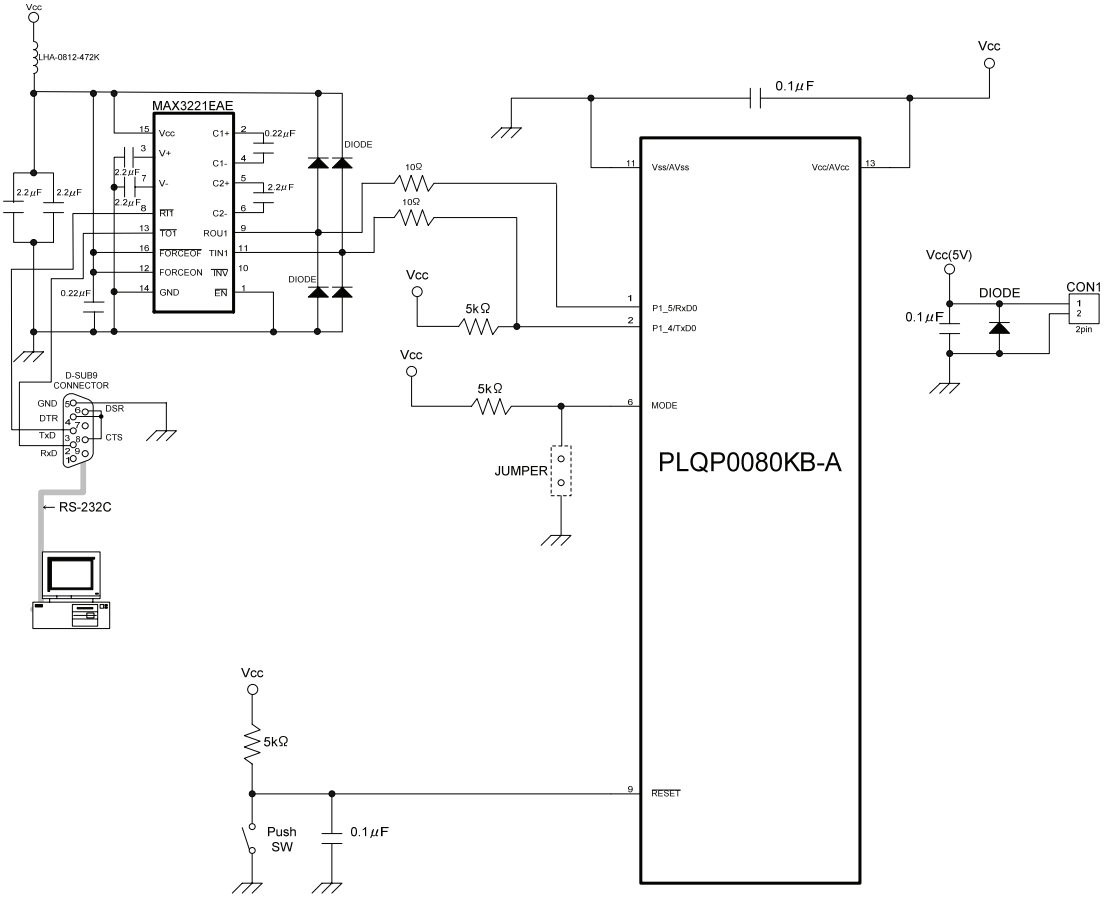


Figure 10 Circuit Using the RS-232C Cable with the R8C/L38C Groups.

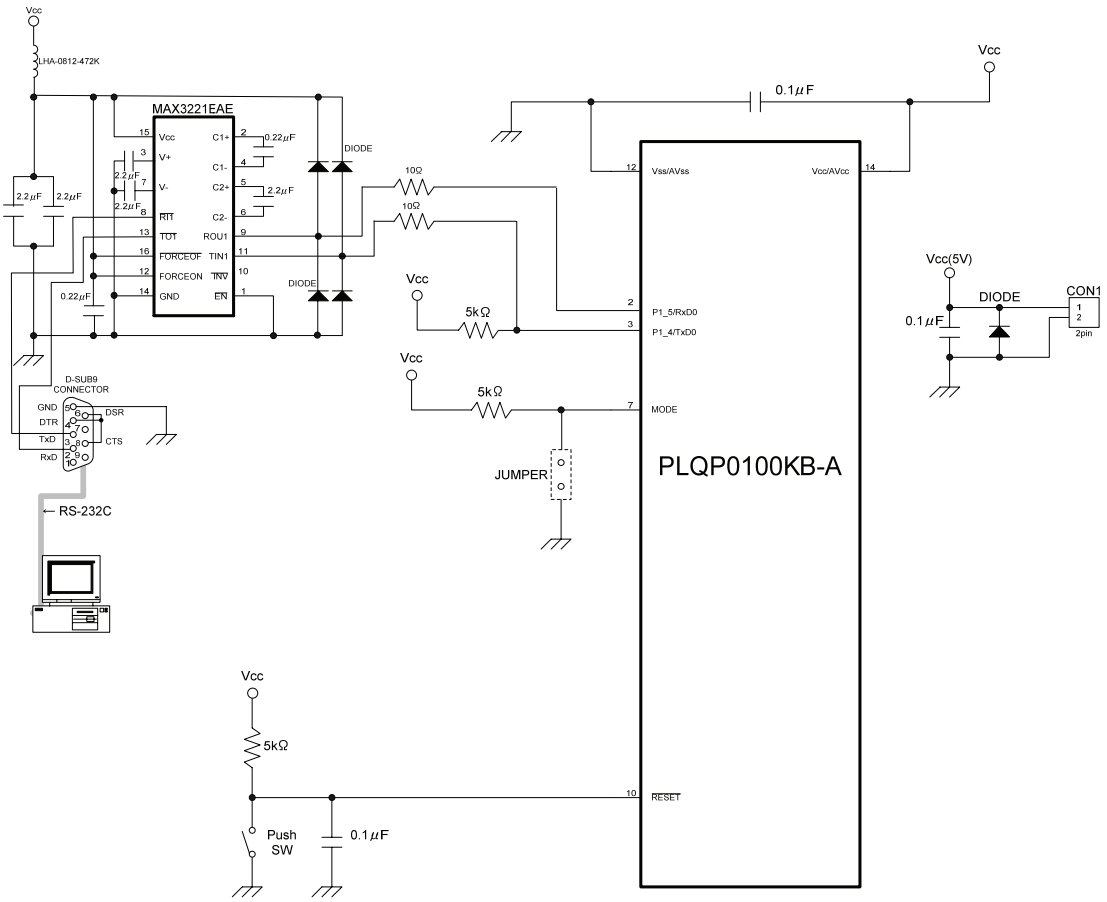


Figure 11 Circuit Using the RS-232C Cable with the R8C/L3AC Groups.

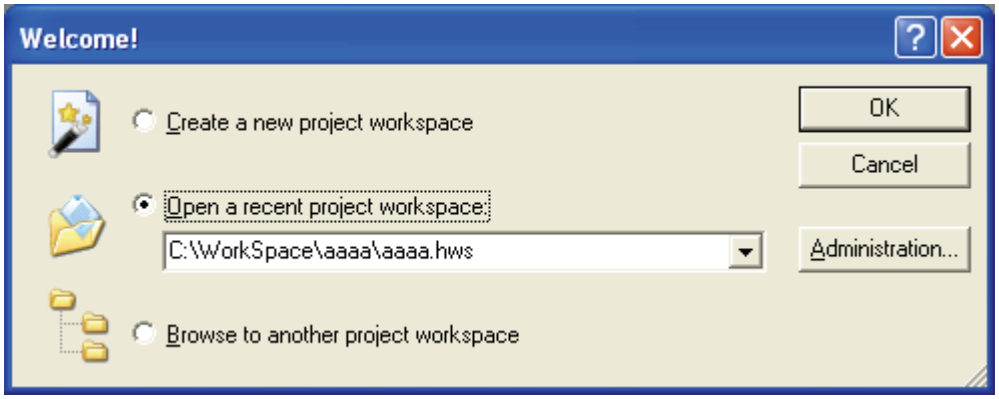
2. Preparing the M16C R8C FoUSB/UART Debugger

The M16C R8C FoUSB/UART debugger (hereinafter R8C UART debugger) is used for debugging by connecting an RS-232C 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.

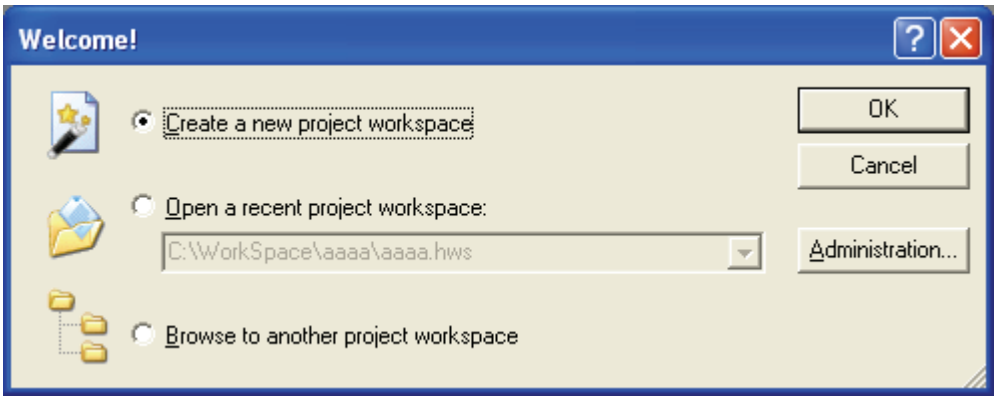
a) To start the High-performance Embedded Workshop, go to “Start”, “Programs”, “Renesas”, “High-performance Embedded Workshop”, and “High-performance Embedded Workshop”. You will see the following “Welcome!” dialog box.



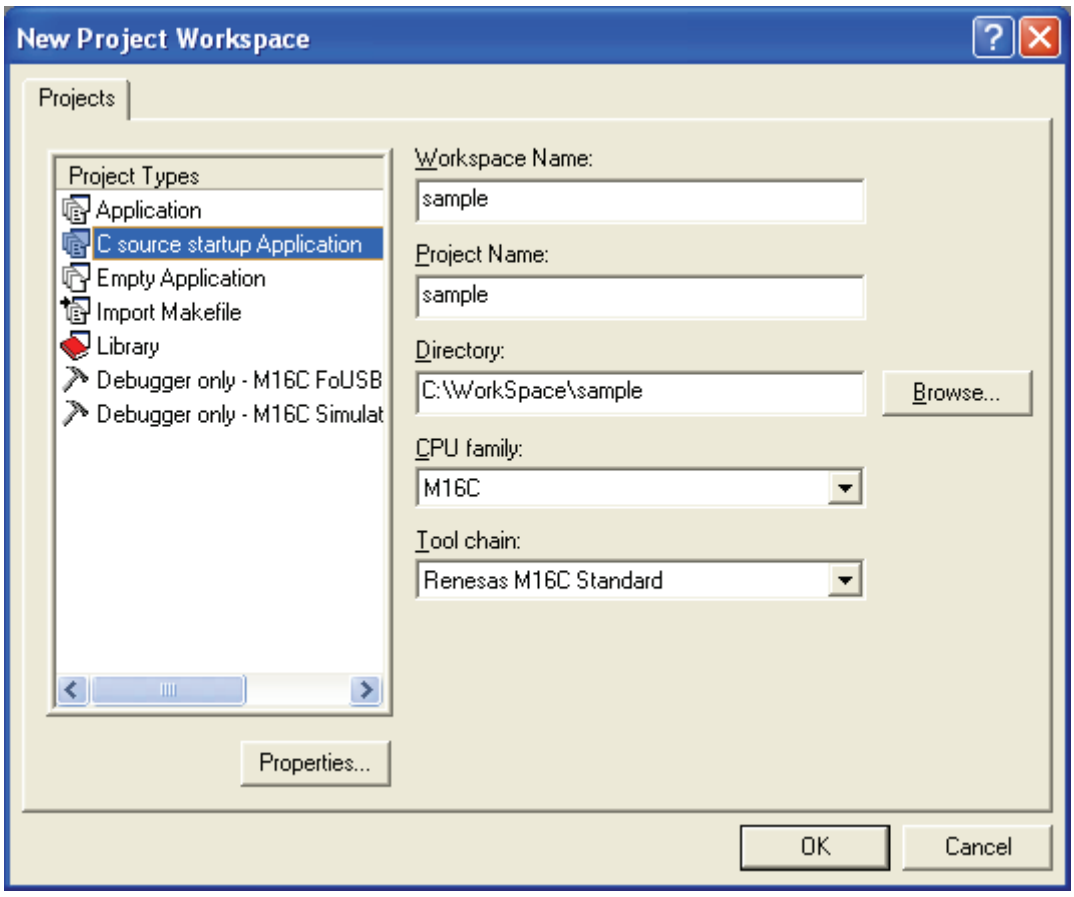
- “Create a new project work space”
  Select this when creating a new workspace.
- “Open a recent project workspace”
  Select this when using an existing workspace. Previous workspaces are displayed in the pull-down menu.
- “Browse to another project workspace”
  Select this when using an existing workspace,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

After selecting an existing workspace and pressing [OK], the screen shown in letter s) (Page 21) is displayed.

b) Select “Create a new project workspace” and 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.

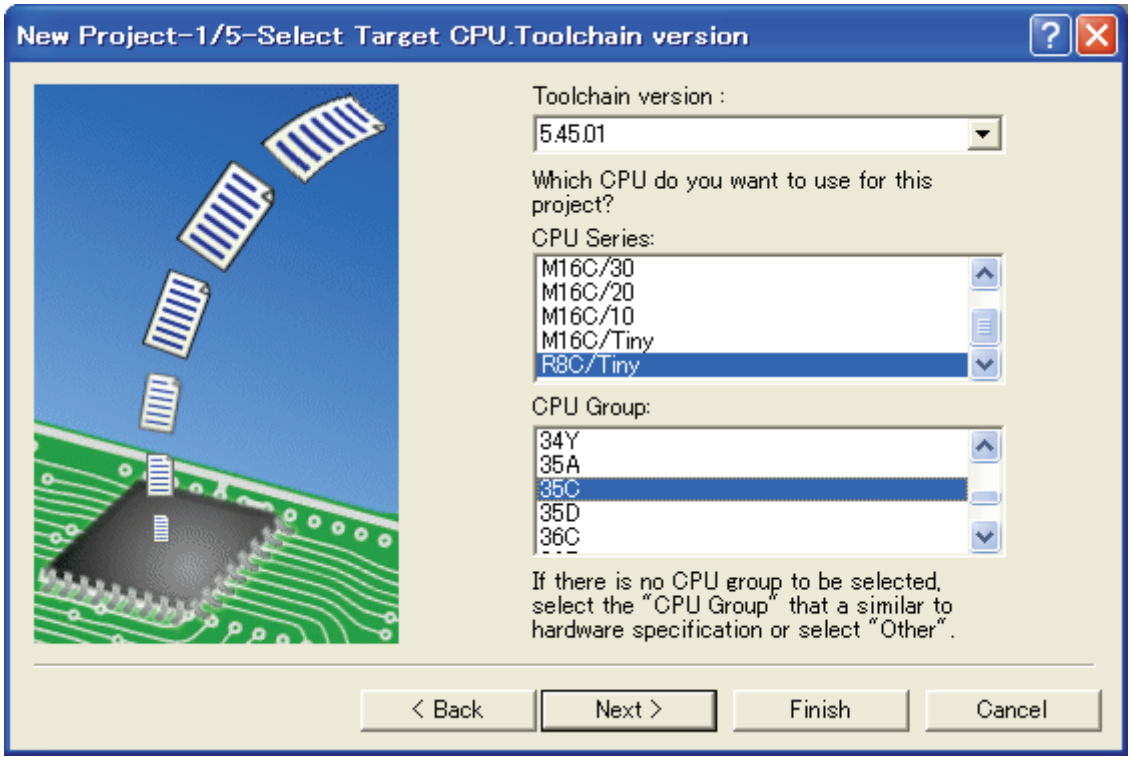
- ” Toolchain”

  When using a toolchain, select the applicable toolchain name. When not using a toolchain, select “None”.

- ” Project Types” Window

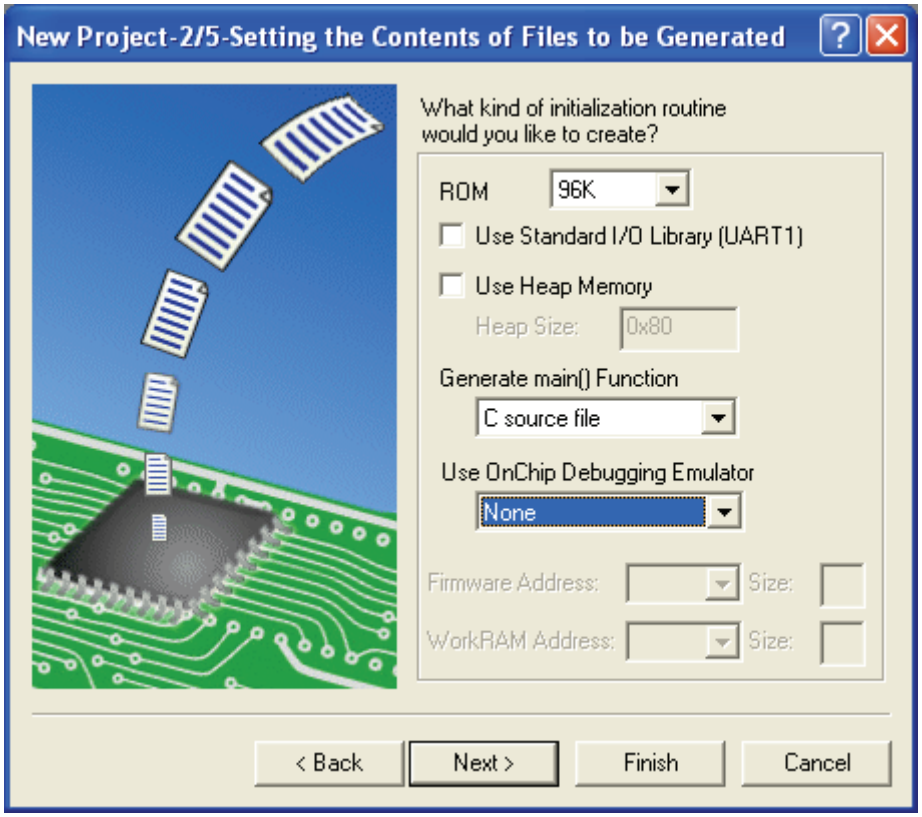
  Select a project type. The project type which supports the C start-up has been selected as an example.

d) Set the toolchain version.



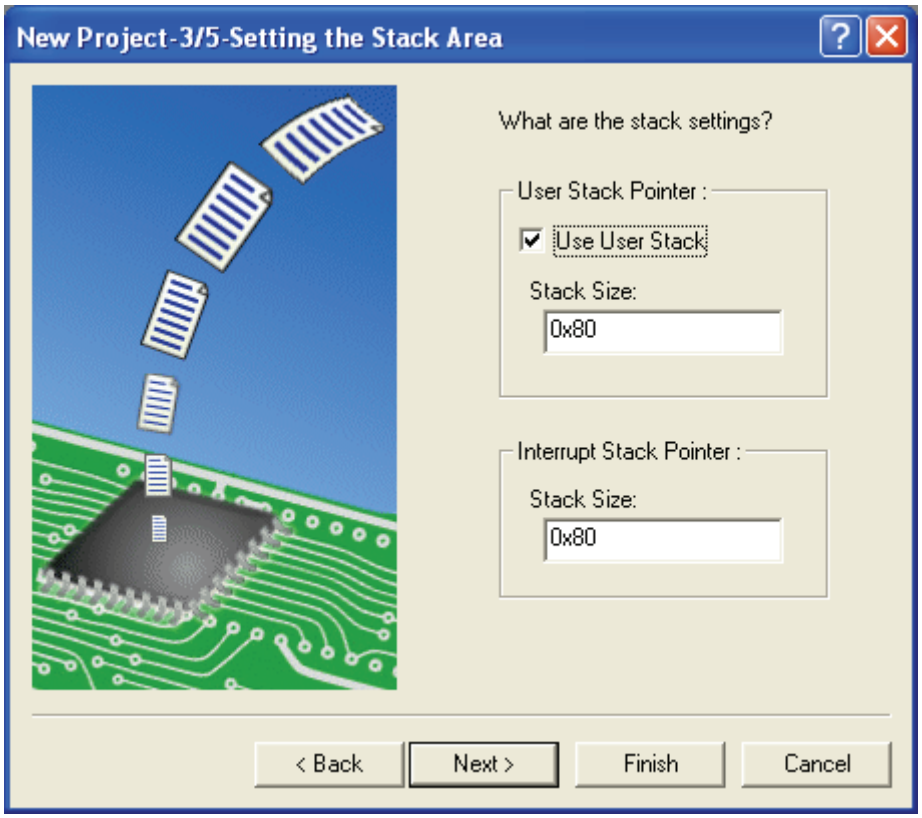
Select “Toolchain Version”, “CPU Series”, “CPU Group” and then press [Next]. In this example, the R8C/35C Group is selected.

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



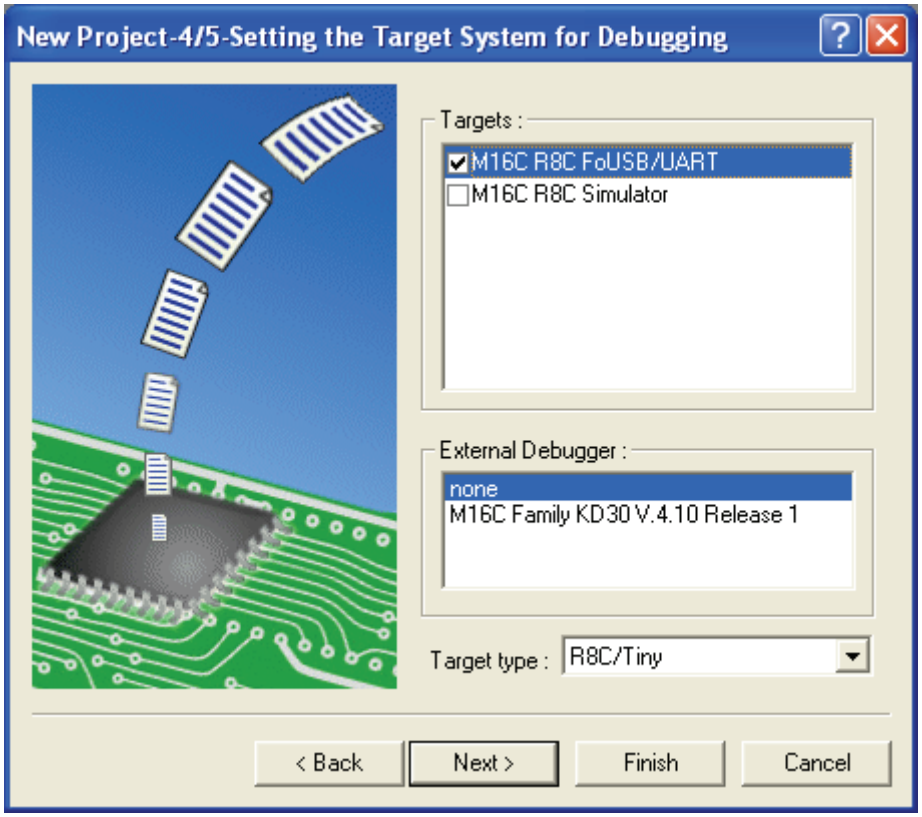
Select the MCU ROM size and heap size. Select “None” for the on-chip debugging emulator. And press [Next].

f) Set the stack.



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

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

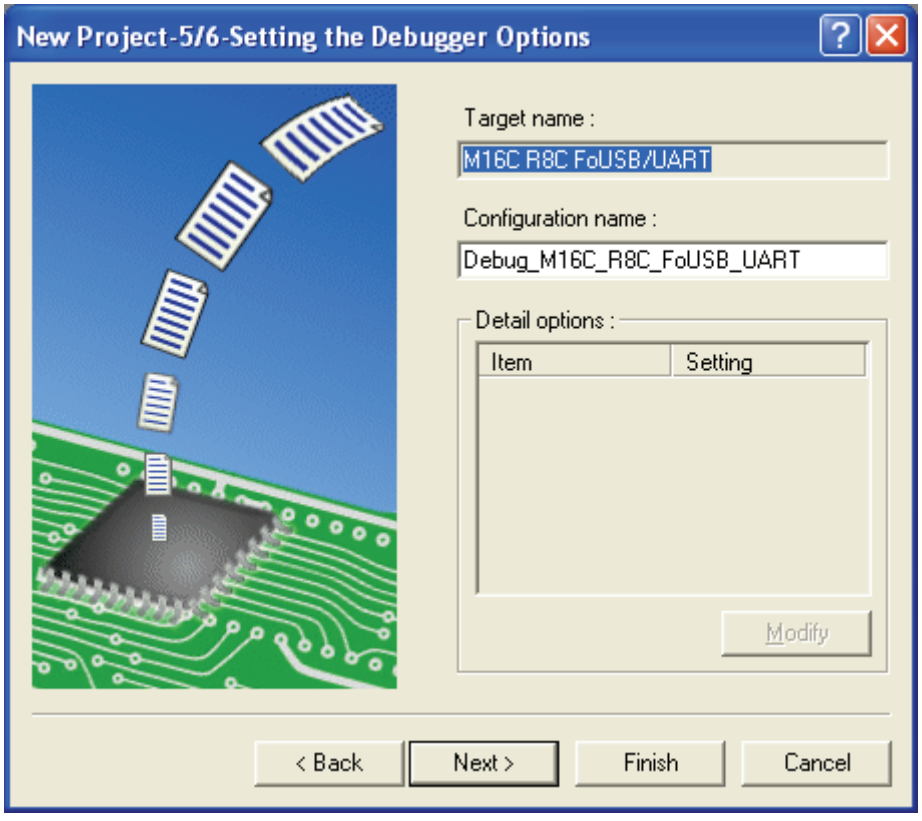


Select “M16C R8C FoUSB/UART” and press [Next].

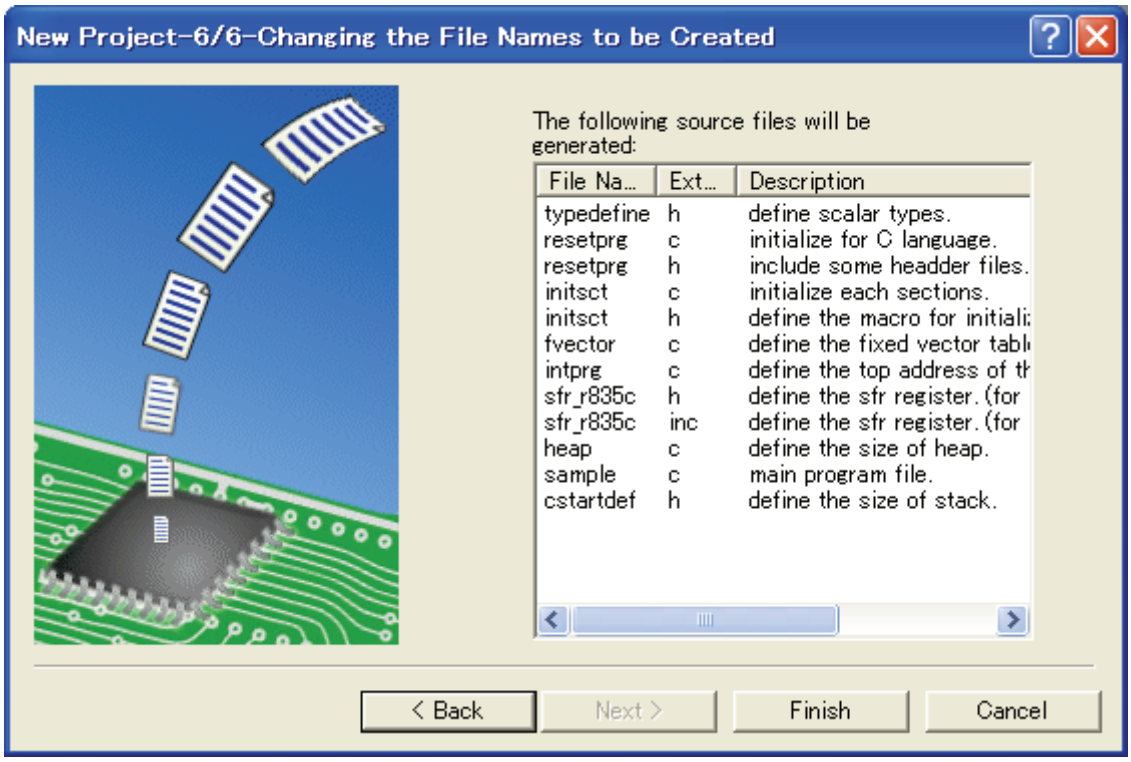
If necessary, select other targets.

h) Set the configuration file name.

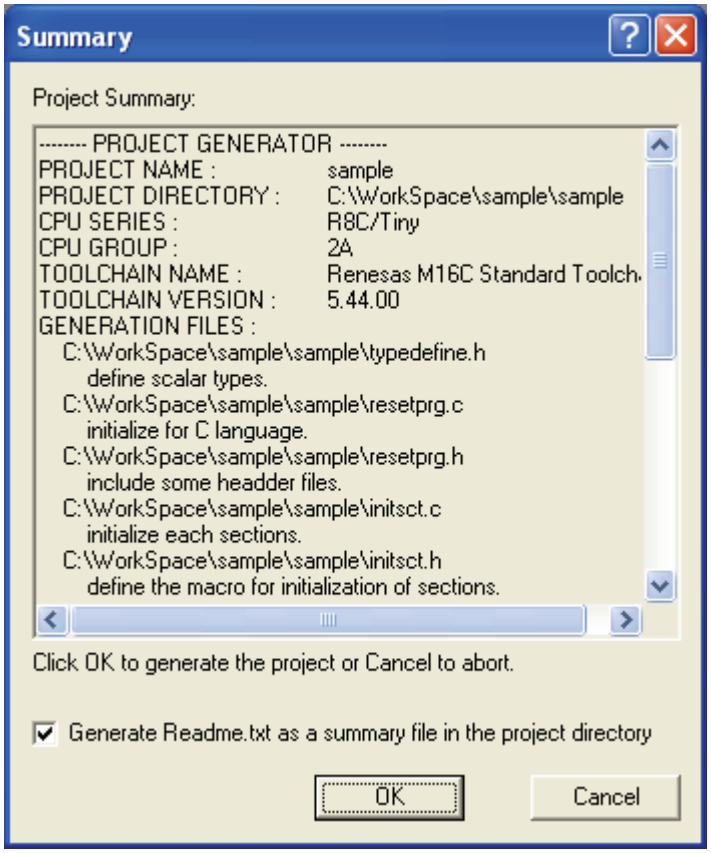
Configurations are the build option settings (e.g. output of debug information or optimization) having their own names. The term "configuration" can also be referred to as "build configuration".



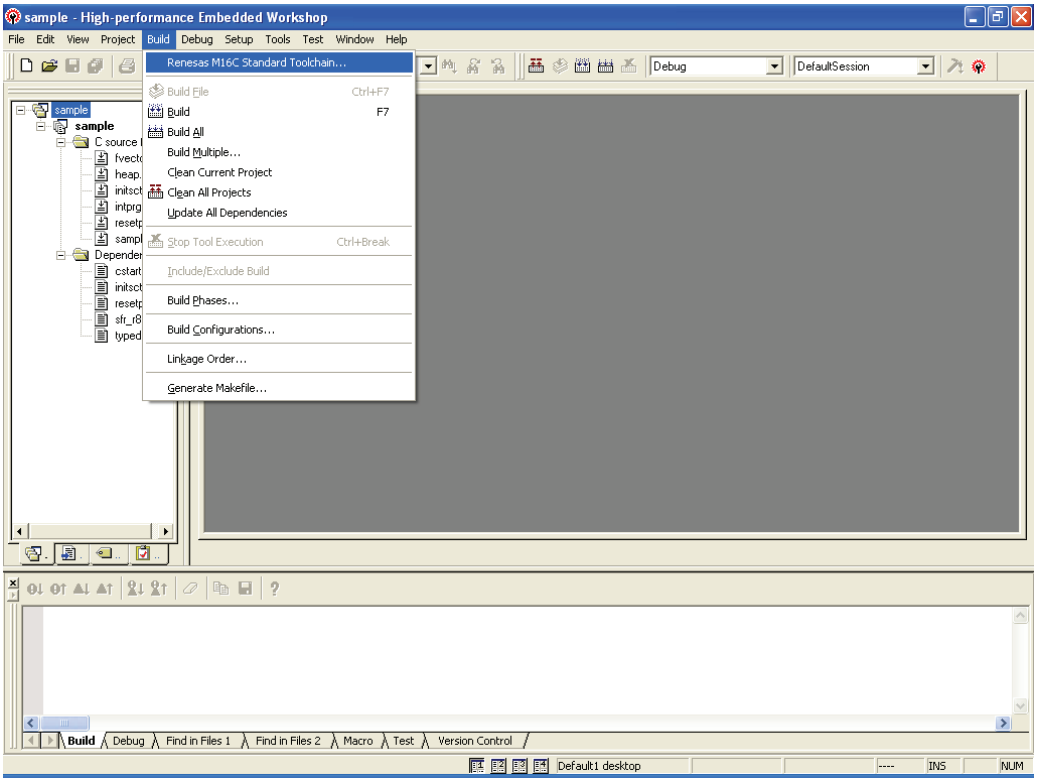
i) Verify the file names to be generated.



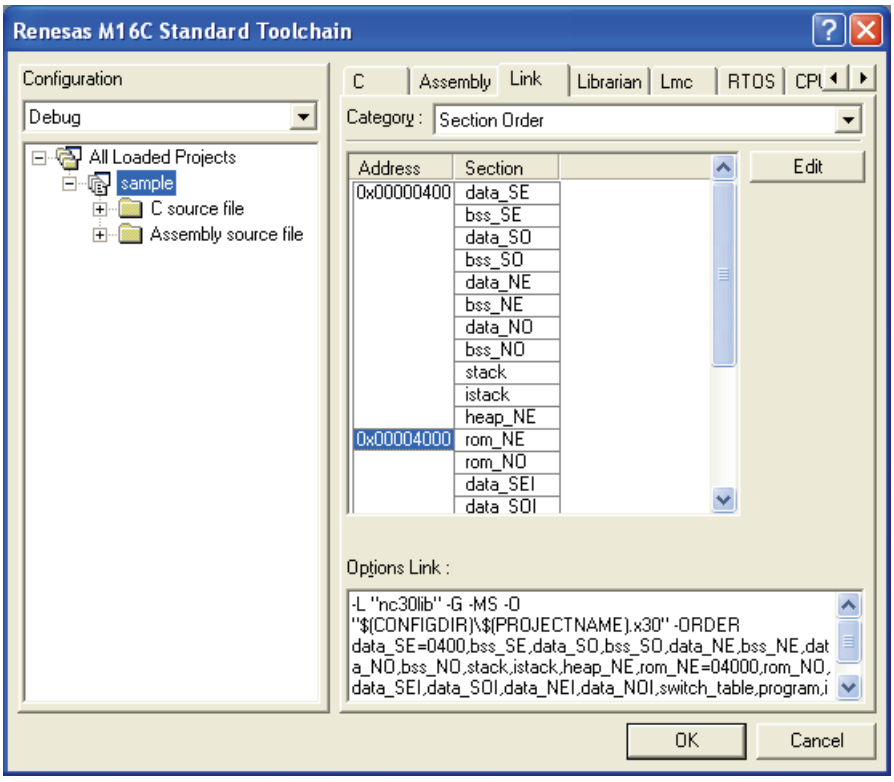
j) The figure below displays the files generated by the High-performance Embedded Workshop based on the above settings. Pressing [OK] launches High-performance Embedded Workshop.



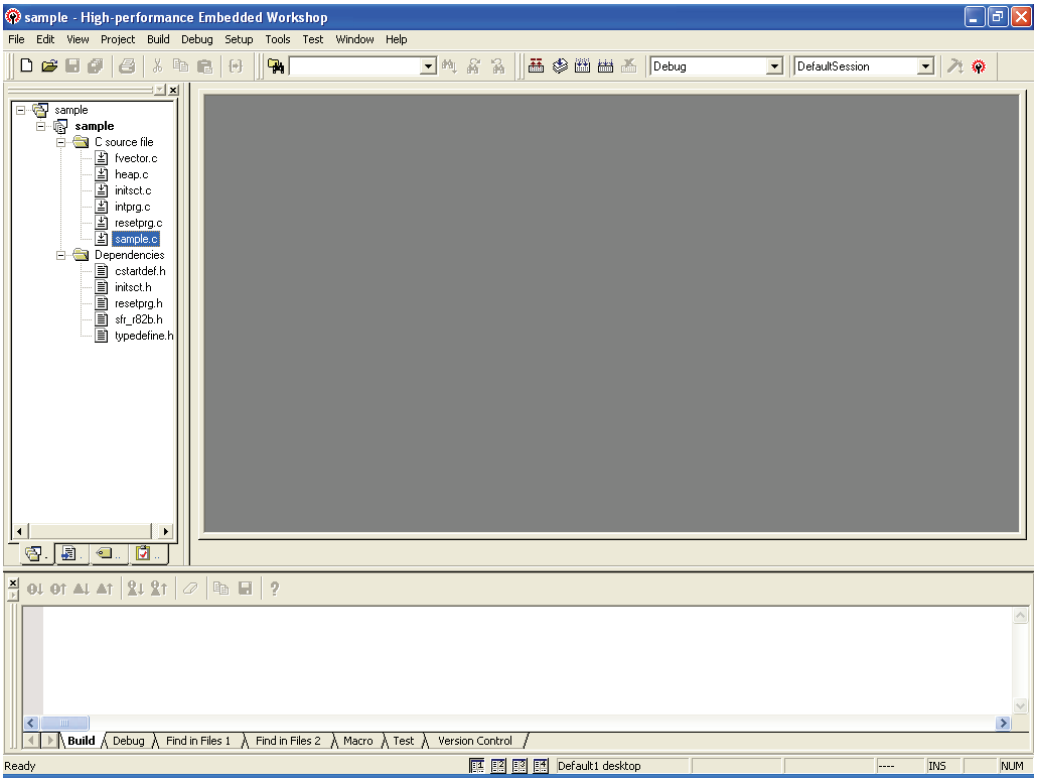
k) Check the section address. Under the “Build” menu, select “Renesas M16C Standard Toolchain”.



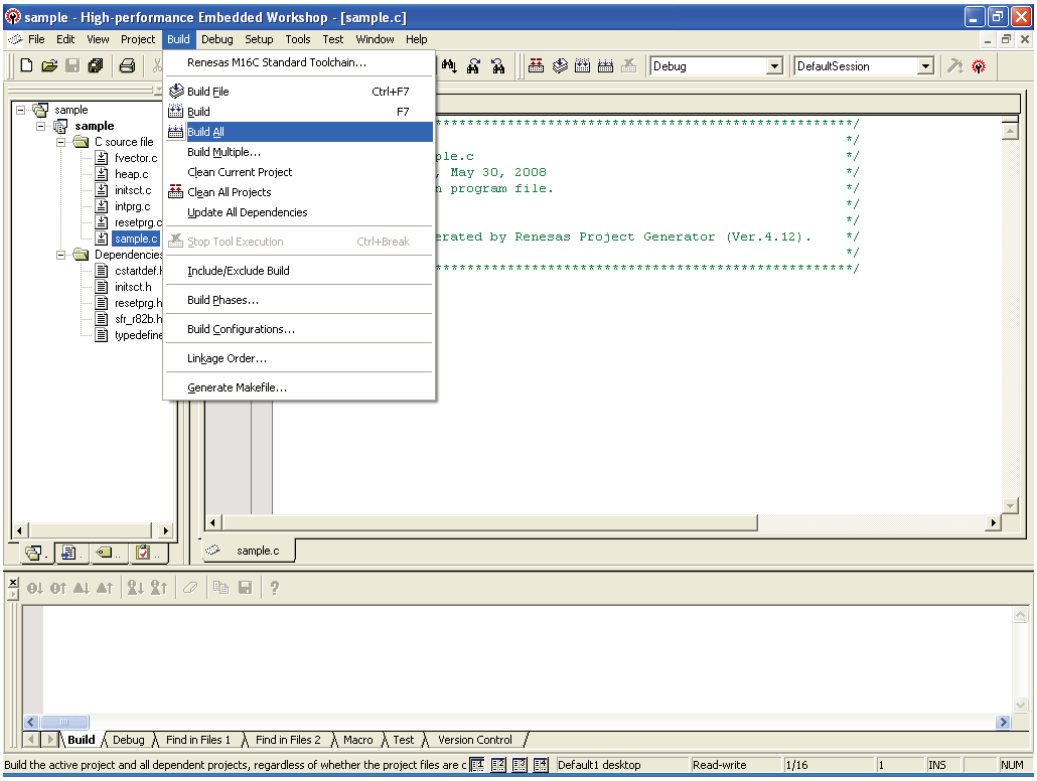
l) “Renesas M16C Standard Toolchain” is displayed. Click on the “Link” tab and select “Section Order” from the “Category” pull-down menu. Make sure the section start address does not overlap with the monitor program occupied area shown in Table 1. If there is any overlap, edit the address value.



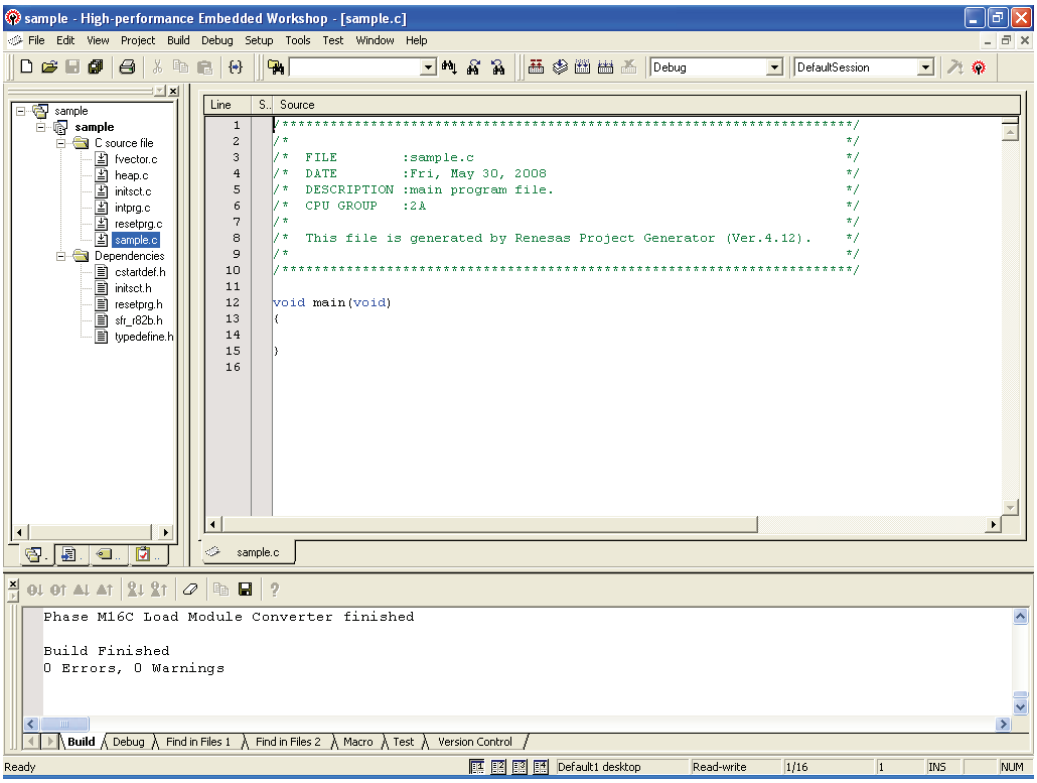
m) Double-click the source program to launch the program editor.



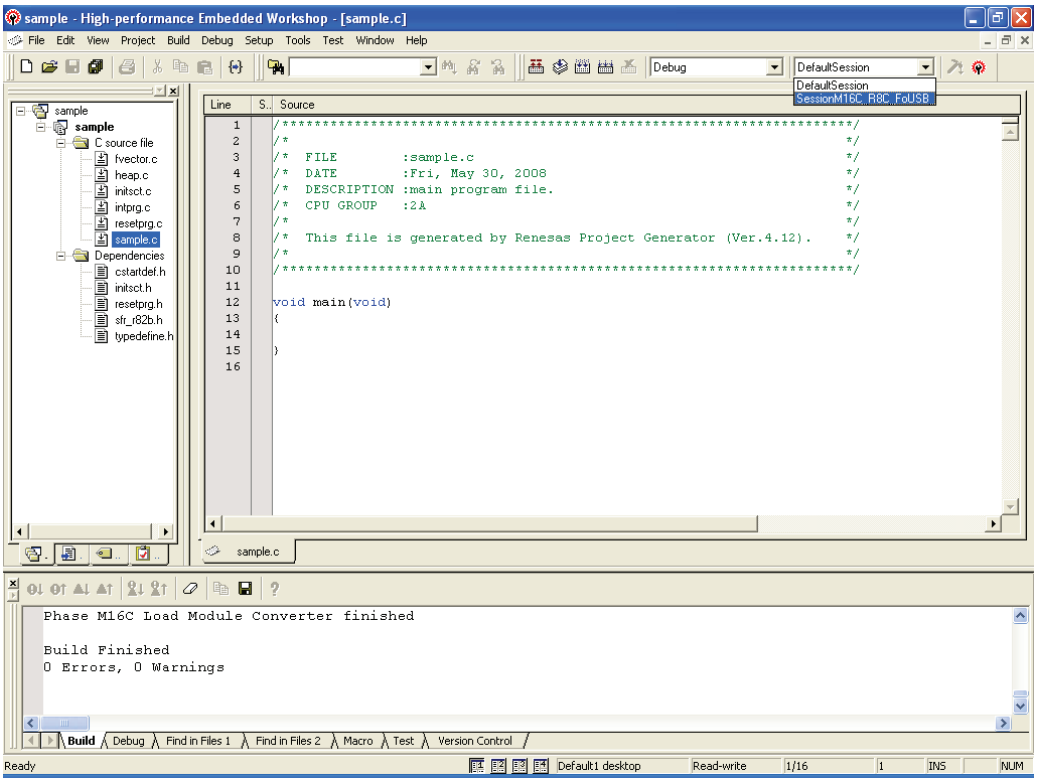
n) When the program is complete, under the “Build” menu, select “Build” or “Build All” to build the program.



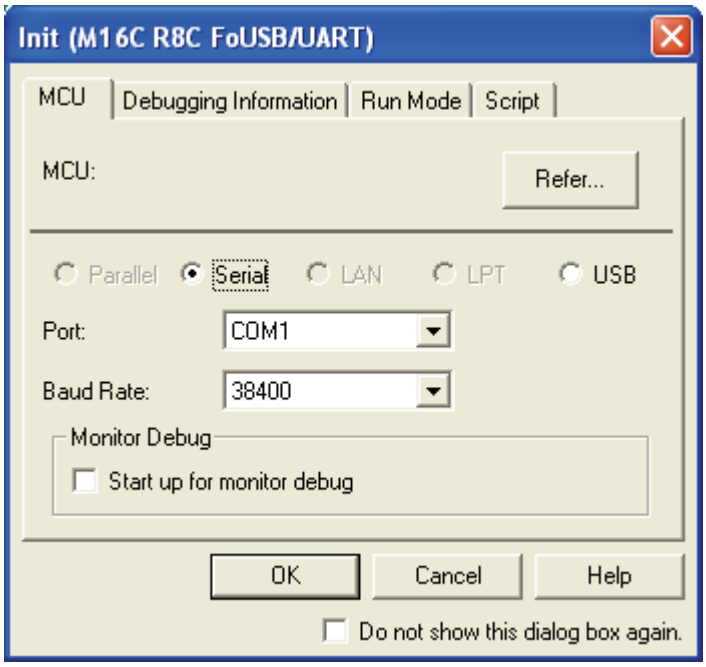
o) The result of the build is displayed.



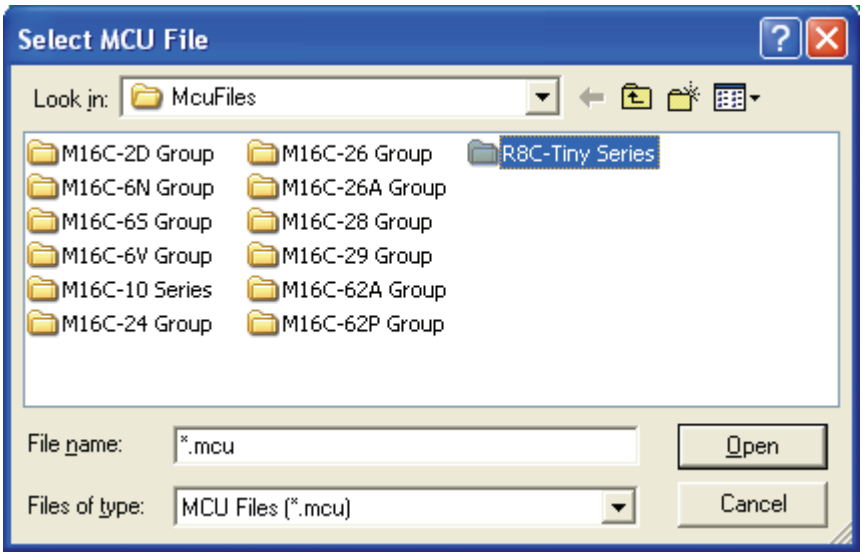
p) Connect with the target. A host computer can easily be connected with the target by switching to the session file in which the setting to use the R8C UART debugger is pre-registered.



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 and memory size.

Memory Size	Group			
	R8C/32D	R8C/3GD	R8C/33D	R8C/35D
4KB	R5F21324DUART.MCU	R5F213G6DUART.MCU	R5F21336DUART.MCU	
8KB				
16KB				R5F21356CUART.MCU
24KB				
32KB				

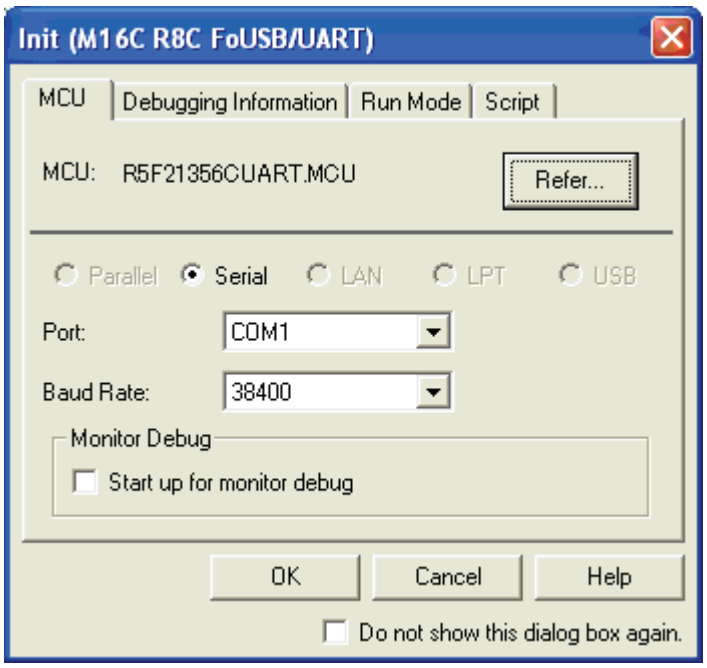
Memory size	Group				
	R8C/32A,32C	R8C/33A,33C	R8C/34C	R8C/3GA,3GC	R8C/3JA,3JC
4KB	R5F21324CUART.MCU	R5F21336CUART.MCU			
8KB			R5F21346CUART.MCU	R5F213G6CUART.MCU	R5F213J6CUART.MCU
16KB					
24KB					
32KB					

Memory size	Group			
	R8C/35A,35C	R8C/36A,36C	R8C/38A,38C	R8C/33T
4KB	R5F21356CUART.MCU			
8KB				
16KB		R5F2136CCUART.MCU		R5F21336TUART.MCU
24KB				
32KB			R5F2138CCUART.MCU	
48KB	R5F2135CCUART.MCU			
64KB				
96KB				
128KB				

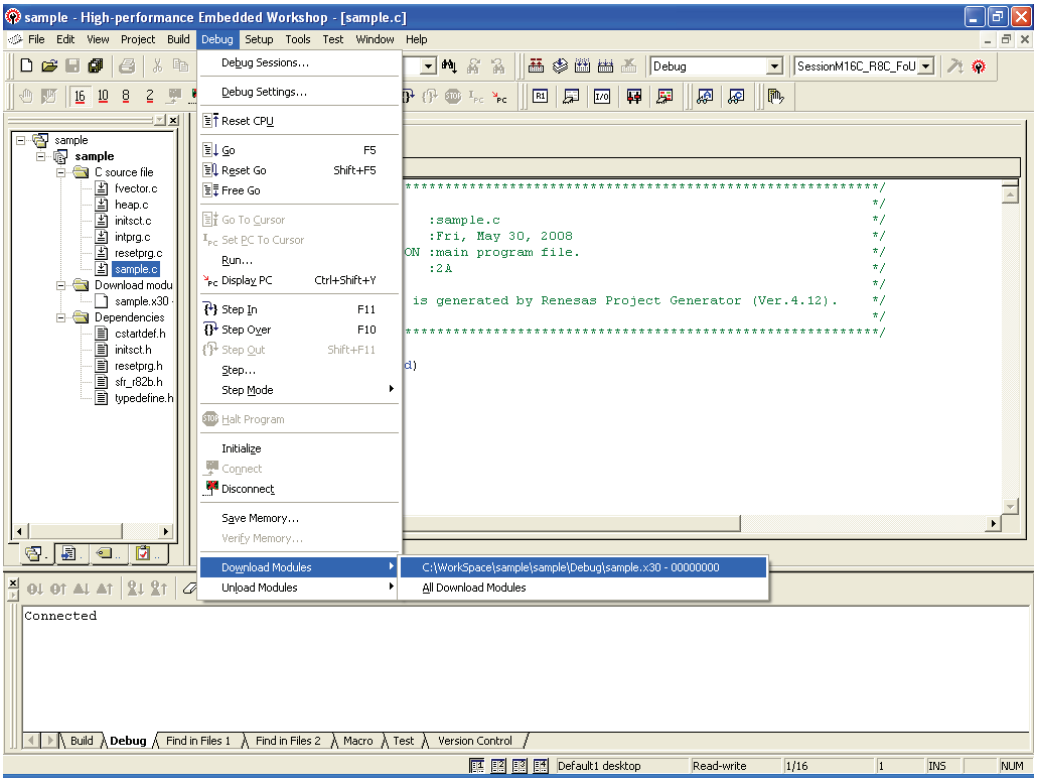
Memory size	Group			
	R8C/L35A,L35B,L35C	R8C/L36A,L38B,L36C	R8C/L38A,L38B,L38C	R8C/L3AA,L3AB,L3AC
48KB	R5F2L35CCUART.MCU	R5F2L36CCUART.MCU	R5F2L38CCUART.MCU	R5F2L3ACCUART.MCU
64KB				
96KB				
128KB				

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

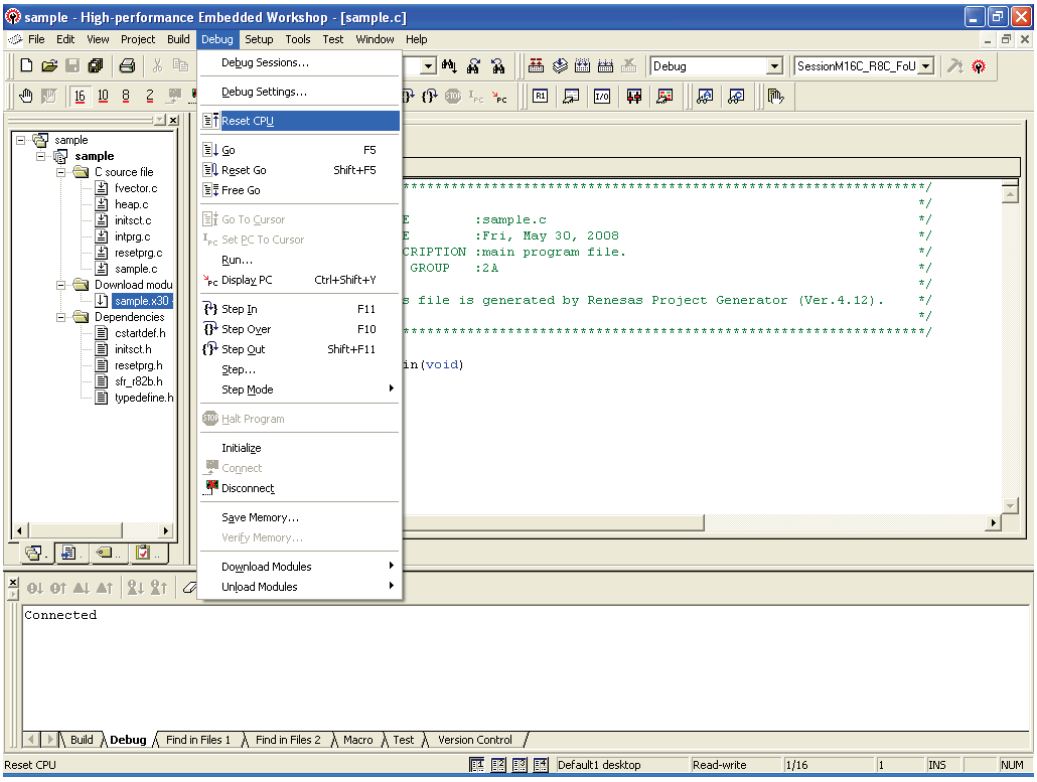
Note: When connecting the R8C UART debugger,all data in the flash memory is erased.



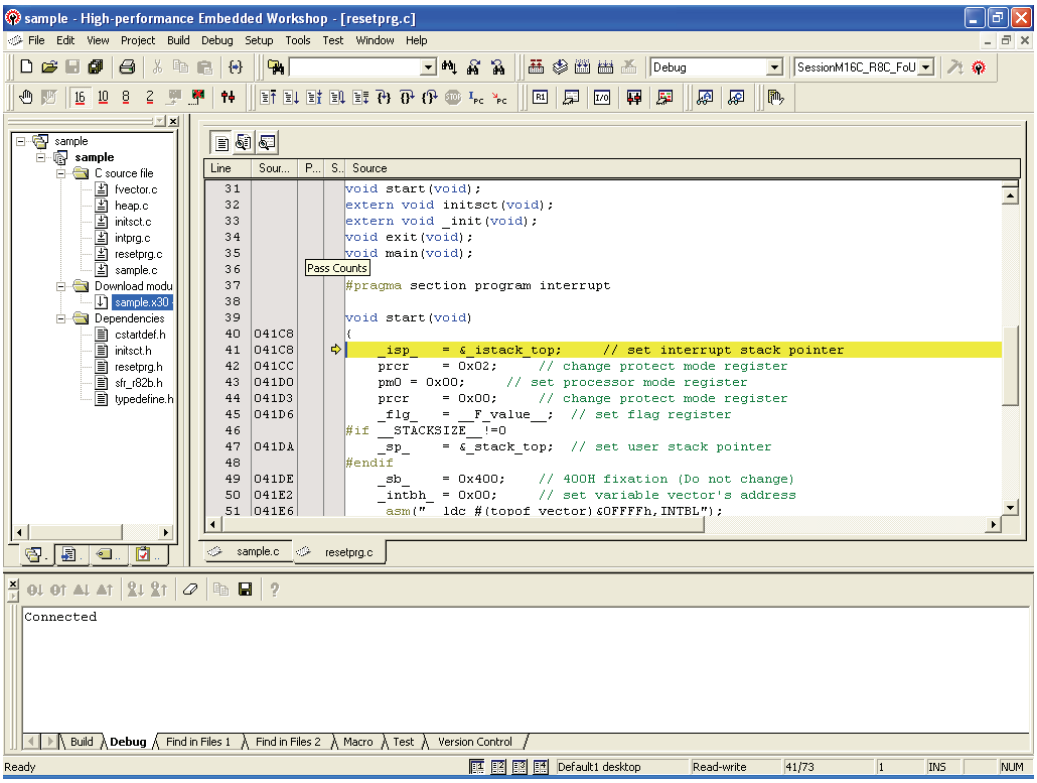
u) To download a user program, select “Download File (X30 file)” in the “Download Modules” submenu under the “Debug” menu.



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 12 shows a memory map (32 KB).

Figure 13 shows a memory map (128 KB).

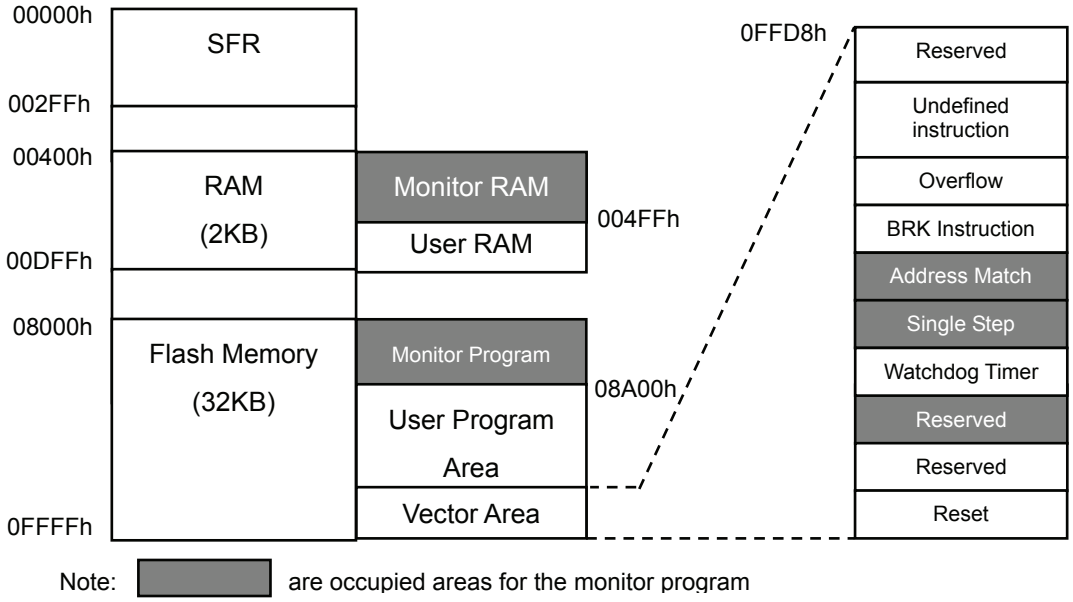


Figure 12 Memory Map (32 KB)

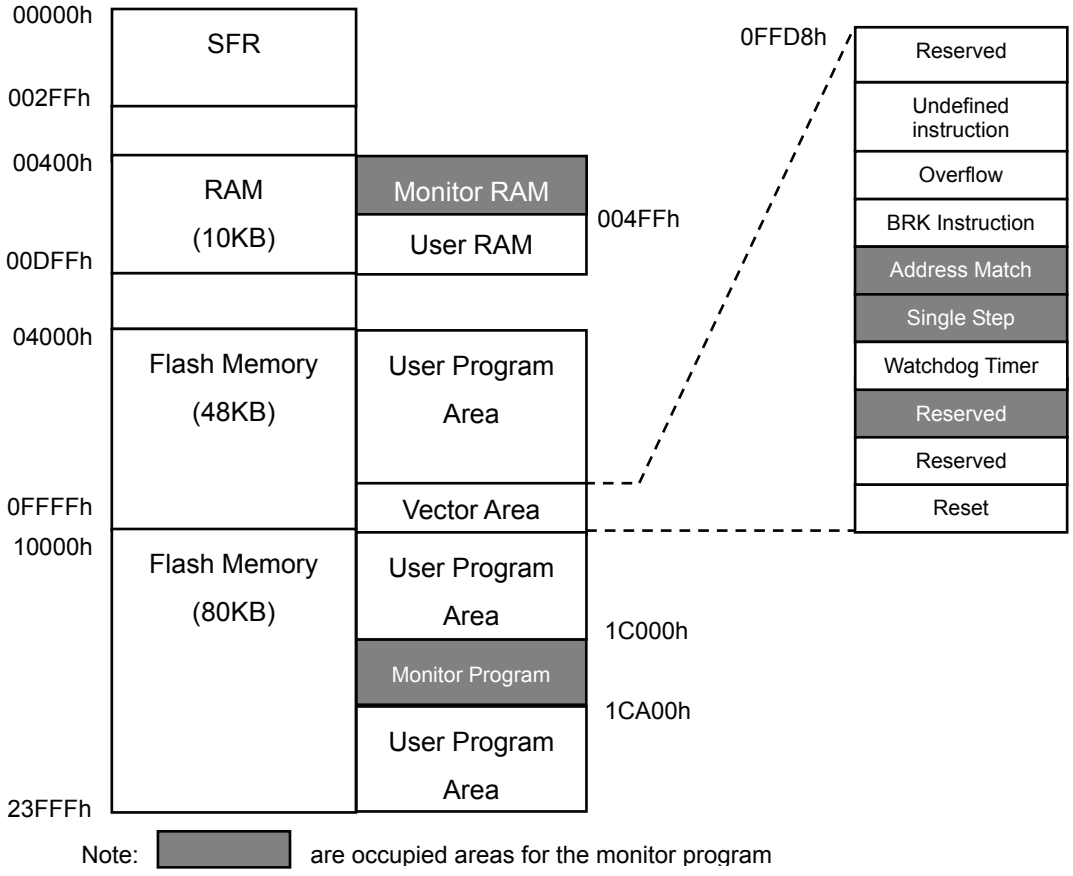


Figure 13 Memory Map (128 KB)

4. Monitor Program Occupied Area

Table 1 Monitor Program Occupied Area

ROM / RAM	Occupied Area for Monitor Program
4KB / 512Bytes	RAM:400h to 4FFh Vector:FFE8h to FFEBh,FFECh to FFEFh, FFF4h to FFF7h
8KB / 1KB	RAM:400h to 4FFh Vector:FFE8h to FFEBh,FFECh to FFEFh, FFF4h to FFF7h
16KB / 1.5KB	RAM:400h to 4FFh Vector:FFE8h to FFEBh,FFECh to FFEFh, FFF4h to FFF7h
24KB / 2KB	RAM:400h to 4FFh Vector:FFE8h to FFEBh,FFECh to FFEFh, FFF4h to FFF7h
32KB / 2.5KB	RAM:400h to 4FFh Flash memory:8000h to 89FFh Vector:FFE8h to FFEBh,FFECh to FFEFh, FFF4h to FFF7h
48KB / 4KB 48KB / 6KB	RAM:400h to 4FFh Vector:FFE8h to FFEBh,FFECh to FFEFh, FFF4h to FFF7h
64KB / 6KB 64KB / 8KB	RAM:400h to 4FFh Vector:FFE8h to FFEBh,FFECh to FFEFh, FFF4h to FFF7h
96KB / 8KB 96KB / 10KB	RAM:400h to 4FFh Vector:FFE8h to FFEBh,FFECh to FFEFh, FFF4h to FFF7h
128KB / 10KB 128KB / 10KB	RAM:400h～4FFh Flash memory:1C000h～1C9FFh Vector:FFE8h～FFEBh,FFECh～FFEFh, FFF4h～FFF7h

5. Notes on Using the R8C UART Debugger

5.1. Restarting the R8C UART Debugger After it is Done Debugging

When restarting the R8C UART debugger, turn off the power to the target and turn on the power again.

5.2. User Program ID Code

When using the R8C UART debugger, **all flash memory areas are erased.**

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 to 0FFDCh	ID1	Undefined instruction
0FFE3h to 0FFE0h	ID2	Overflow
0FFE7h to 0FFE4h		BRK instruction
0FFEBh to 0FFE8h	ID3	Address match
0FFEFh to 0FFECh	ID4	Single step
0FFF3h to 0FFF0h	ID5	Watchdog timer, oscillation stop detection, voltage monitor 2
0FFF7h to 0FFF4h	ID6	Reserved
0FFFBh to 0FFF8h	ID7	Reserved
0FFFFh to 0FFFCh	(See Note)	Reset

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

5.3. User Program Download Area

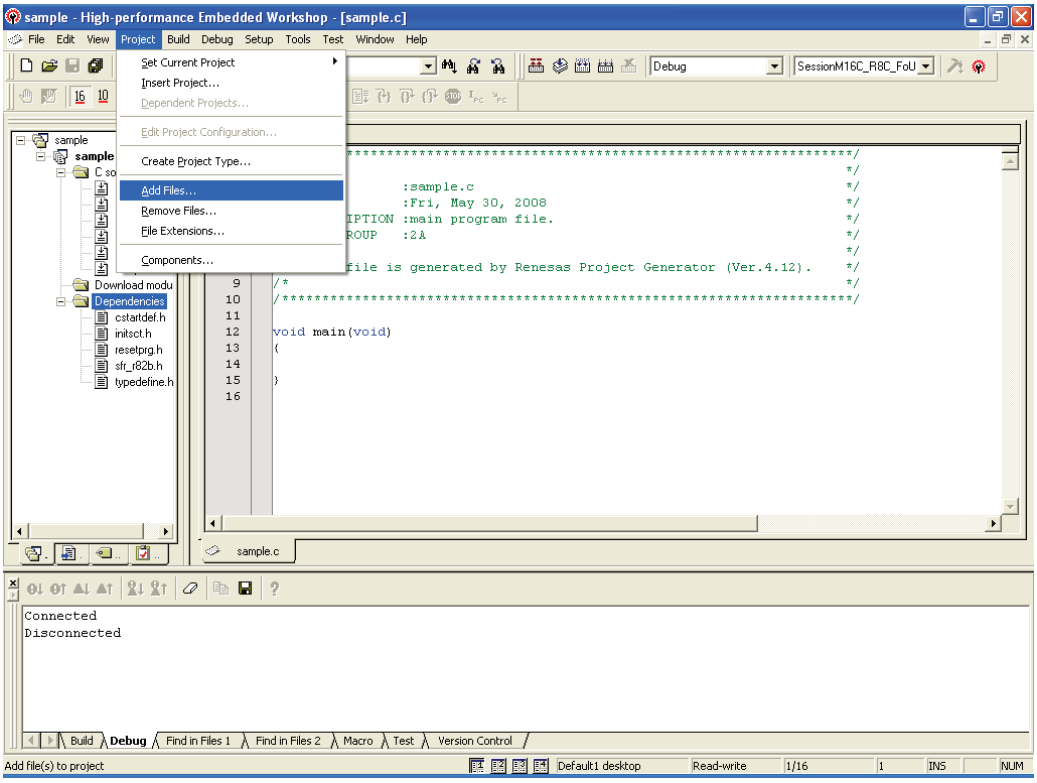
Please note that when the area in the user program overlaps with the area in the monitor program, the R8C UART debugger does not perform error output.

When error output is performed, please set the following:

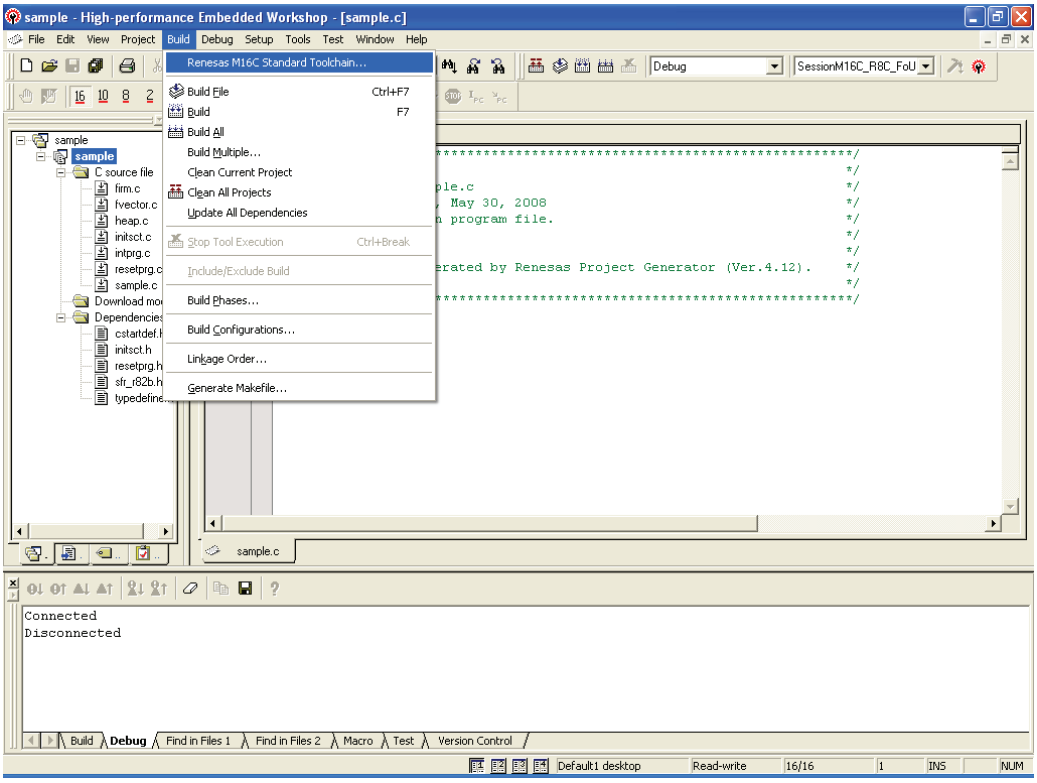
a) Make “firm.c” and enter the following:

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

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

#endif
```

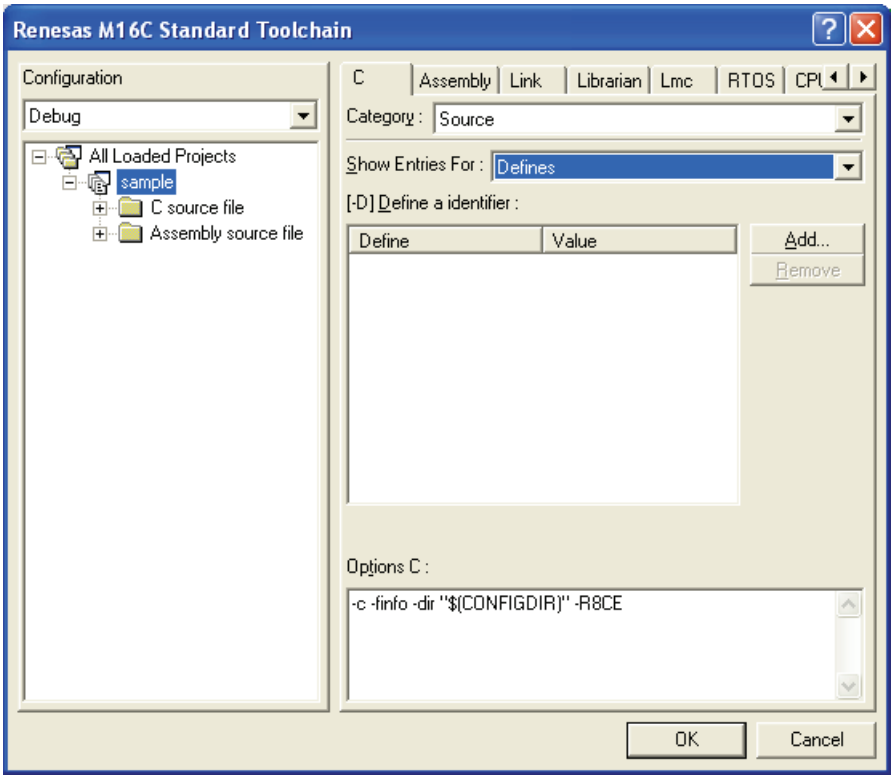
b) Add the file created above to the project. Under the “Project” menu, select “Add Files…”. When the file selection screen is displayed, select “firm.c”.



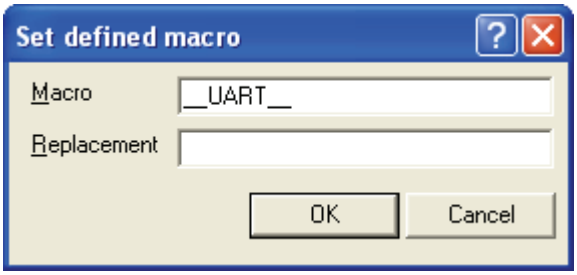
c) To add the compile option, select “Renesas M16C Standard Toolchain…” under the “Build” menu.



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

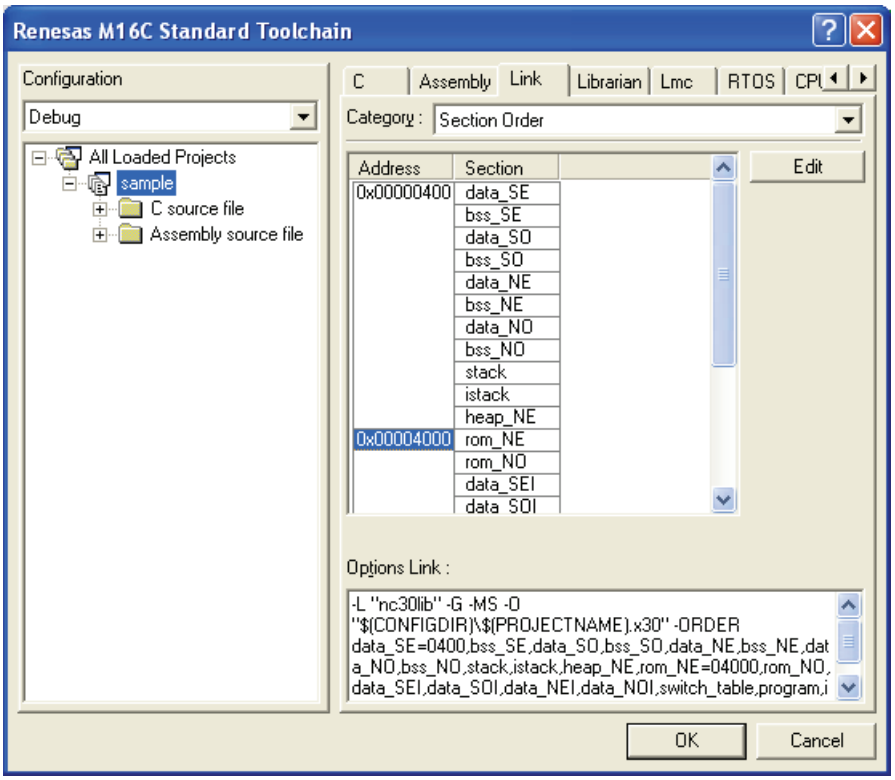


e) “Set defined macro” is displayed. Enter “_UART_” in the “Macro” field and press [OK]



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 the following to the start address of the monitor program occupied area shown in Table 1.

- Memory size: 48KB
  FirmArea_NE
- Memory size: 64KB, 96KB, 128KB
  FirmArea_FE



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

5.4. Frequency Characteristics

The monitor program only operates at 38600bps.

The monitor program operates in developer tool-dedicated high-speed on-chip oscillator. 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 use the low-speed on-chip oscillator or XCIN clock as the system clock.

Note: Communication may not be possible depending on temperature and voltage.

5.5. Limitations of SFR Operations

Table 3 lists the limitations of register operations. Changing registers that are disabled will cause the monitor program to malfunction.

Table 3 Limitations on SFR Operations

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	N/A	Enabled
System Clock Control Register 0	Reset to 28h	Set bit CM07 to 0.	Partially enabled
System Clock Control Register 1	Reset to 20h	Set bits CM10 to 0.	Partially enabled
High-Speed On-Chip Oscillator Control Register 0	Reset to 03h	Set to 0000X011b (X is an undefined value).	Partially enabled
High-Speed On-Chip Oscillator Control Register 1	N/A	Do not change this register.	Disabled
High-Speed On-Chip Oscillator Control Register 2	Reset to 03h	N/A	Enabled
Oscillation Stop Detection Register	Reset to 04h	N/A	Partially enabled
Protect Register	N/A	N/A	Enabled
Flag Register	N/A	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
UART 0 Transmit/Receive Mode Register	N/A	Do not change this register.	Disabled
UART 0 Bit Rate Register	N/A		
UART 0 Transmit/Receive Control Register 0	N/A		
UART 0 Transmit/Receive Control Register 1	N/A		
UART 0 Function Selection Register	N/A		
Port Mode Register	N/A		
UART 0 Transmit Buffer Register	N/A	Do not write data to this register.	Disabled
UART 0 Receive Buffer Register	N/A	Do not read this register.	Disabled

5.6. Limitations on Stop Mode or 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 normal debugging.

- 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

  Instructions that generate software interrupts (undefined instruction, BRK instruction, and INT instruction) cannot be continuously step executed in the instruction internal processing.

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:  <---------- Break
        NOP
        NOP
        REIT
```

5.10. Limitations on Peripheral Functions

UART0 is used for communication between the monitor program and the host computer. Do not use UART0 in the user program. Do not connect the pins below to other pins as they are used for communication with the host computer.

- R8C/32C, 32D Groups
  TxD0 (16 pin), RxD0 (15 pin)
- R8C/33C, 33D Groups
  TxD0 (20 pin), RxD0 (19 pin)
- R8C/34C Group
  TxD0 (23 pin), RxD0 (22 pin)
- R8C/35C, 35D Groups
  TxD0 (34 pin), RxD0 (33 pin)
- R8C/36C Group
  TxD0 (44 pin), RxD0 (43 pin)
- R8C/38C Group
  TxD0 (52 pin), RxD0 (51 pin)
- R8C/L35C Group
  TxD0 (1 pin), RxD0 (52 pin)
- R8C/L36C Group
  TxD0 (63 pin), RxD0 (62 pin)
- R8C/L38C Group
  TxD0 (2 pin), RxD0 (1 pin)
- R8C/L3AC Group
  TxD0 (3 pin), RxD0 (2 pin)

5.11. Limitations on Flag Register

When using the user program to rewrite the flag register, execute the **FSET and FCLR instructions** to prevent the debug flag (D flag) from being rewritten.

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 timer operation, the timer continues counting, but the timer interrupt cannot be accepted.

M16C/R8C UART Debbuer
User's Manual
R8C Family / R8C/3x Series, R8C/Lx Series
Notes on Connecting R8C/3xC Group R8C/3xD Group R8C/LxC Group

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Colophon 1.0

M16C R8C UART Debugger
User's Manual

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