User's Manual

AP4, Applilet3

Common Operations

User's Manual

Target Devices

RX Family

RL78 Family

RZ Family

RH850 Family

All information contained in these materials, including products and product specifications, represents information on the product at the time of publication and is subject to change by Renesas Electronics Corp. without notice. Please review the latest information published by Renesas Electronics Corp. through various means, including the Renesas Electronics Corp. website (http://www.renesas.com).

Renesas Electronics
www.renesas.com

Rev.1.01 Oct 2016

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 in 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-crime systems; and safety equipment etc.

   Renesas Electronics products are neither intended nor authorized 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.
6. 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.
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 for 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” 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.

(2012.4)

How to Use This Manual

1. Purpose and Target Readers

This manual is designed to provide the user with an understanding of the hardware functions and electrical characteristics of the MCU. It is intended for users designing application systems incorporating the MCU. A basic knowledge of electric circuits, logical circuits, and MCUs is necessary in order to use this manual.

The manual comprises an overview of the product; descriptions of the CPU, system control functions, peripheral functions, and electrical characteristics; and usage notes.

Particular attention should be paid to the precautionary notes when using the manual. These notes occur within the body of the text, at the end of each section, and in the Usage Notes section.

The revision history summarizes the locations of revisions and additions. It does not list all revisions. Refer to the text of the manual for details.

Please use the following documents in conjunction with this manual.

The related documents listed below may include preliminary versions. However, preliminary versions are not marked as such.

Document Type	**Description**	**Document Title**	**Document No.**
User's manual for Software	Description of CPU instruction set	RX Group User's Manual: Software	R01US0032EJ
		RL78 Group User's Manual: Software	R01US0015EJ
Renesas Technical Update	Product specifications, updates on documents, etc.	Available from Renesas Electronics Web site.	

2. Terminology

The meanings of the terms used in this manual are described in the table below.

Term	Meaning
Renesas environment	An environment in which program development is conducted by using language tools and an integrated development environment platform made by Renesas Electronics Corporation.
GNU environment	An environment in which program development is conducted using Gcc.
IAR environment	An environment in which program development is conducted by using language tools and an integrated development environment platform made by IAR Systems.

CONTENTS

Chapter 1 Outline

1.1 Overview

The AP4 and Applilet3 (hereinafter, referred to as AP4) is a software tool for automatically generating control programs (device driver programs) for peripheral modules in accordance with user settings. The AP4 consistent with the device to be employed should be used.

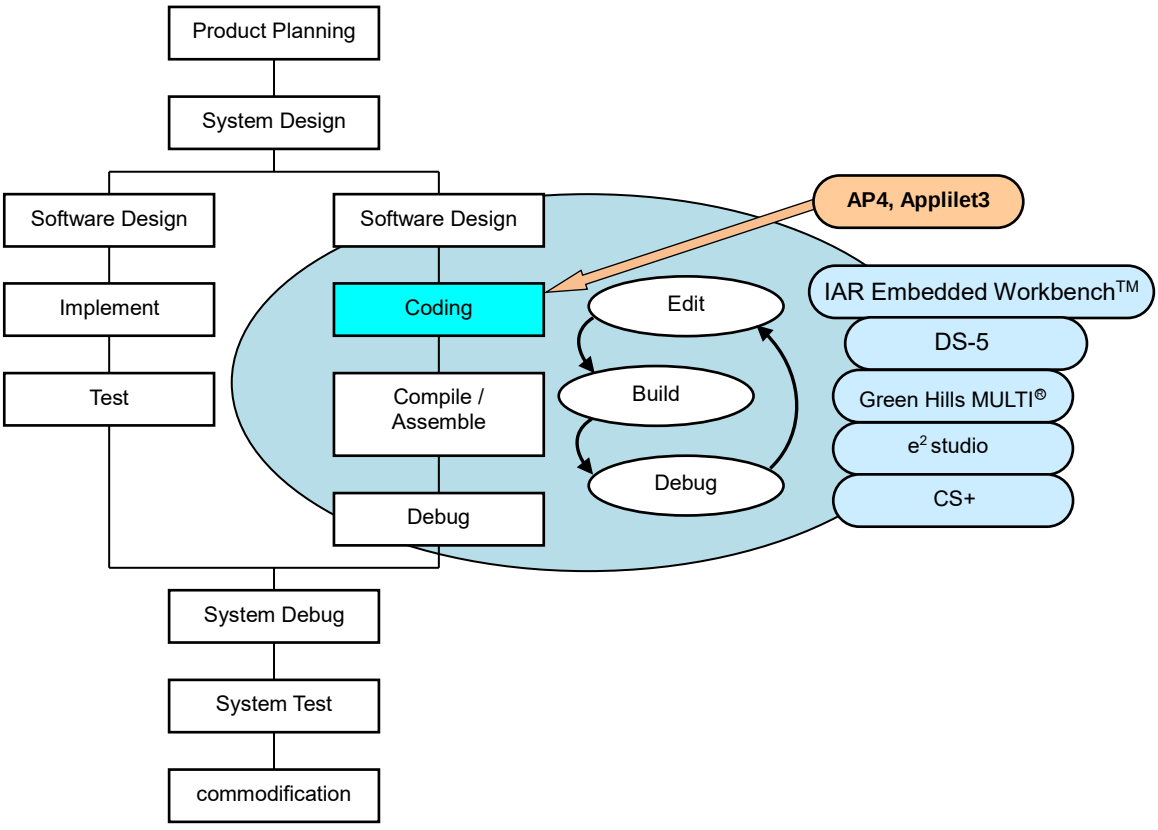
This manual provides common operation specifications, such as the AP4 main window, menus, and dialog operating methods, which are not dependent on the specific device to be employed.

This manual provides explanations by using RX111 as examples.

1.2 Names and Functions of Hardware

The flowchart of developmental tasks using the AP4 is shown in the figure below.

Figure 1-1 Developmental Flowchart



Remark: IAR Embedded Workbench: An integrated development environment provided by IAR Systems

DS-5: An integrated development environment provided by ARM© Limited

Green Hills MULTI: An integrated development environment provided by Green Hills Software

1.3 Functions

○ Outputting device drivers

According to the parameters that are set through the GUI, the AP4 automatically generates, in a file, the source code that initializes peripheral functions. File names can be changed as desired.

○ Providing API functions

In addition to peripheral function initialization code, the AP4 provides API functions, such as starting and stopping a peripheral function or modifying the conditions.
API function names can be changed as desired.

○ Selecting a build tool

The type of a build tool (compiler) can be selected from gcc and IAR.

- AP4 for RL78
  CA78K0R, CCRL, EWRL78, GCCRL78 for e2 studio
- Applilet for RL78
  CA78K0R compiler, CCRL compiler, GCC compiler, IAR compiler
- AP4 for RX
  CCRX, EWRX, GNURX for e2 studio
- AP4 for RZ
  ARMCC (DS-5), GCC (e2 studio), IAR EWARM
- AP4 for RH850
  CC-RH, EWRH, GHSRH

The AP4 outputs the workspace/project file for the integrated development environment platform that matches the selected build tool.

- IAR environment: Project Connection file for IAR Embedded Workbench (.ipcf)

○ Merging

● Merging source codes

Programs written between the merge comments can be retained without deletion during the re-output (overwriting) of the code.

● Merging workspace/project files

The AP4 stores output files as target files to be built in a workspace/project file in the integrated development environment platform. During code regeneration, the AP4 changes the storage of target build files as the number of files that are output by the AP4 increases or decreases*. In such a case, any previously stored user files are retained without being deleted.

* The AP4 stores files on an add-on basis, but it does not delete files that are no longer needed.

○ Outputting report

Reports on peripheral function settings, API function names associated with the various functions, and file names can be output in a file. As the format of an output file, either HTML or CSV can be selected.

Chapter 2 Installation

2.1 Features of Installer

The AP4 Installer has the features described below.

○ Accommodating multiple versions

Multiple versions of the AP4 can be installed on a single PC.

2.2 Installation Procedure

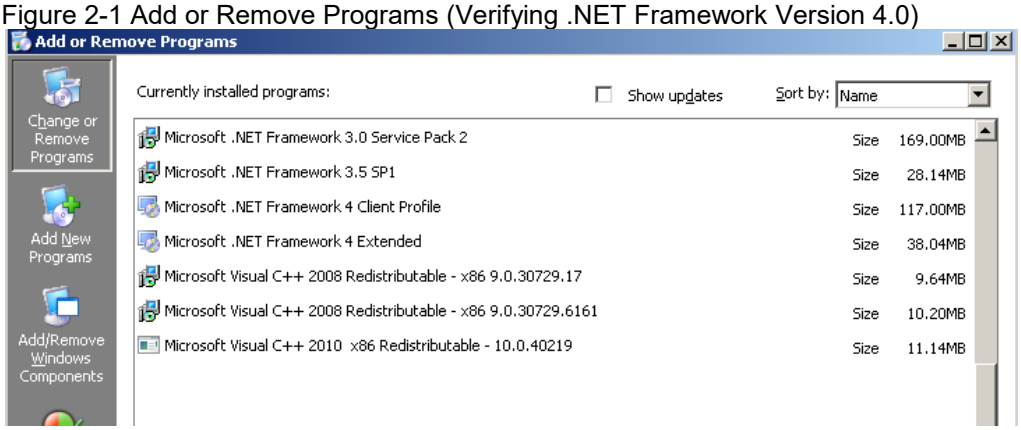
This section describes the procedure for installing the AP4, taking the installation of [AP4 for RX] in Windows 7 as an example. The contents of display may vary depending upon the particular operating system and software being used.

Cautions 1. You need to perform installation by logging in as a user with Administrator privileges.

2. For the execution of the AP4, you need to install ".NET Framework Version 4" as well as the "Microsoft Visual C++ 2010 SP1" run-time library. If these files have not already been installed on the host machine being used, install the files by downloading them from Microsoft Corporation's website.

Whether these files have been previously installed can be checked by viewing [Add or Remove Programs] in Windows.

Figure 2-1 Add or Remove Programs (Verifying .NET Framework Version 4.0)



(1) Using the AP4 installer, execute the [Setup.exe] file.

Remarks 1. The AP4 installer can be acquired from the website for Renesas Electronics.

http://www.renesas.com/applilet_download

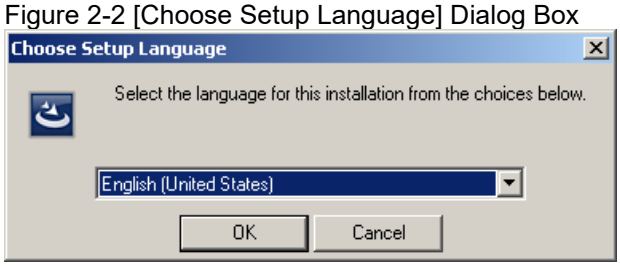
(The address of the website is subject to change without notice.)

2. The downloaded installer may be compressed. If it is compressed, decompress it and execute the [Setup.exe] file.

(2) The [Choose Setup Language] dialog box appears.

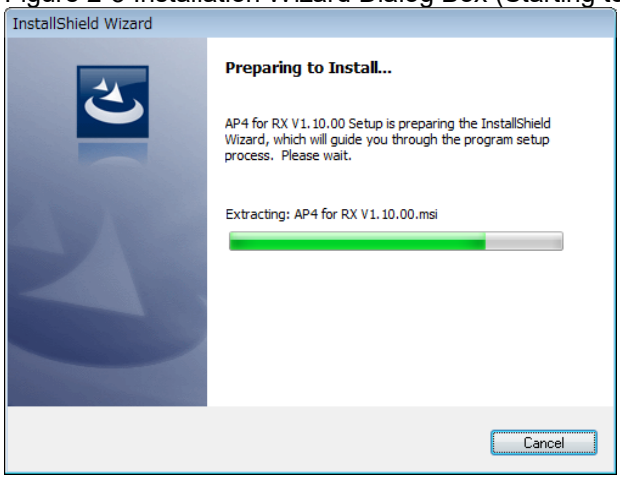
Select the desired language, and click the [OK] button.

Figure 2-2 [Choose Setup Language] Dialog Box



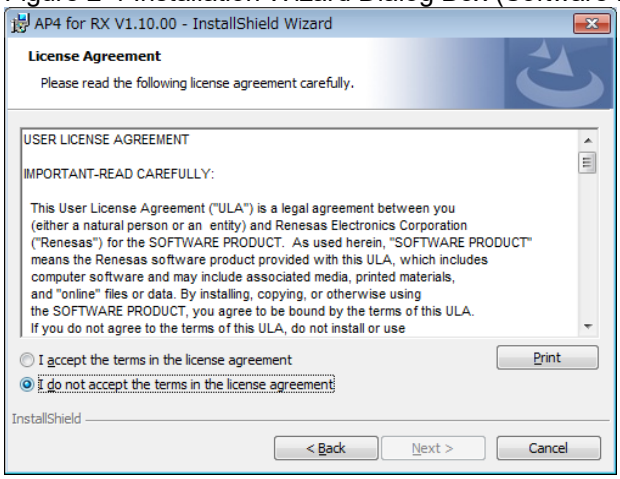
(3) Specify installation settings according to the wizard dialog that appears.
In each dialog box, clicking either the [Next] or [Yes] button brings up the next screen.

Figure 2-3 Installation Wizard Dialog Box (Starting to Set AP4 up)



(4) Read and accept the software license agreement to proceed with the [Next] button. Please note that user has to accept the license agreement, otherwise installation cannot be continued. Specify installation settings according to the wizard dialog that appears.

Figure 2-4 Installation Wizard Dialog Box (Software License Agreement)

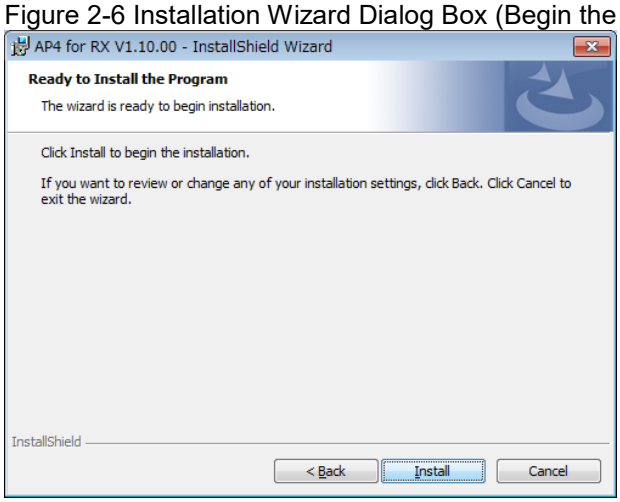


(5) Select the install location and click the [Next] button to continue. If you wish to change the install location, click [Browse…] button to modify it.

Figure 2-5 Installation Wizard Dialog Box (Select the install location)

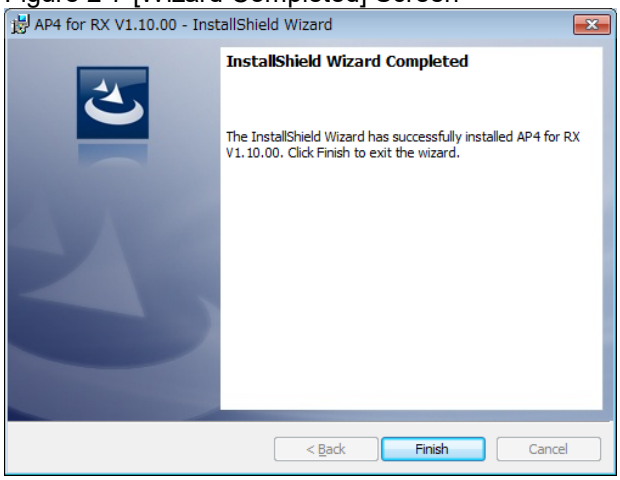
Caution: In the installation destination folder name, none of these 11 characters, [(/ * : < > ? | ” ¥ ; ,] can be used. Also, a space (a single-byte blank character) cannot be used at the beginning or end of a folder name.
The installation process may fail if an illegal character is specified in the folder name.

Figure 2-6 Installation Wizard Dialog Box (Begin the installation)



(6) To end the installation process, click the [Finish] button on the [Wizard Completed] screen.

Figure 2-7 [Wizard Completed] Screen



2.3 Uninstallation Procedure

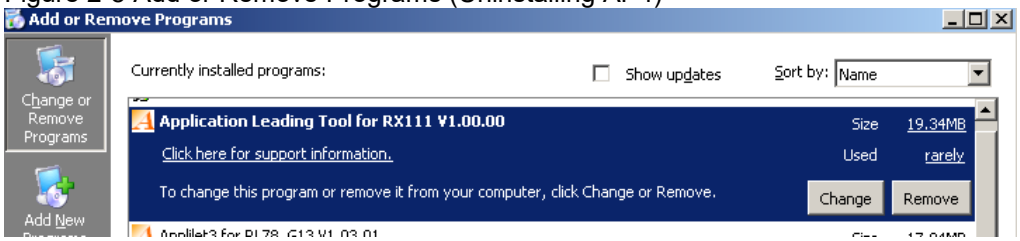
This section describes the procedure for uninstalling the AP4, taking the uninstallation of AP4 for RX in Windows 7 as an example. The contents of display may vary depending upon the particular operating system and software being used.

Cautions 1. You need to perform uninstallation by logging in as a user with Administrator privileges.

2. Uninstalling the AP4 will not uninstall the ".NET Framework Version 4" and "Microsoft Visual C++ 2010 SP1" run-time library and associated files.

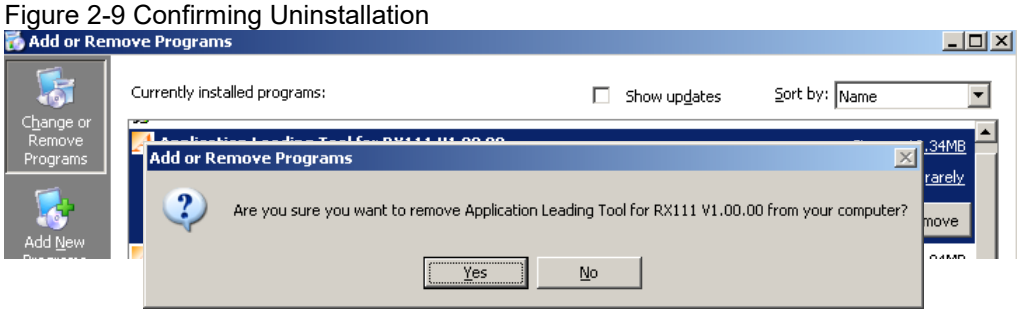
（1）In [Add or Remove Programs] of Windows 7, click the [Uninstall] button for the AP4 to be uninstalled.

Figure 2-8 Add or Remove Programs (Uninstalling AP4)



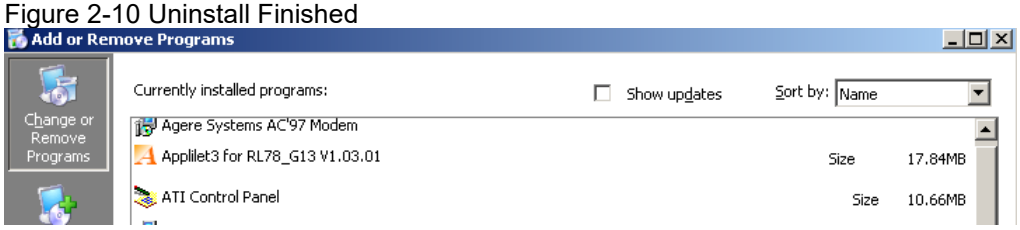
（2）In the wizard dialog box that appears, select [Yes].

Figure 2-9 Confirming Uninstallation



（3）The uninstallation process finishes.

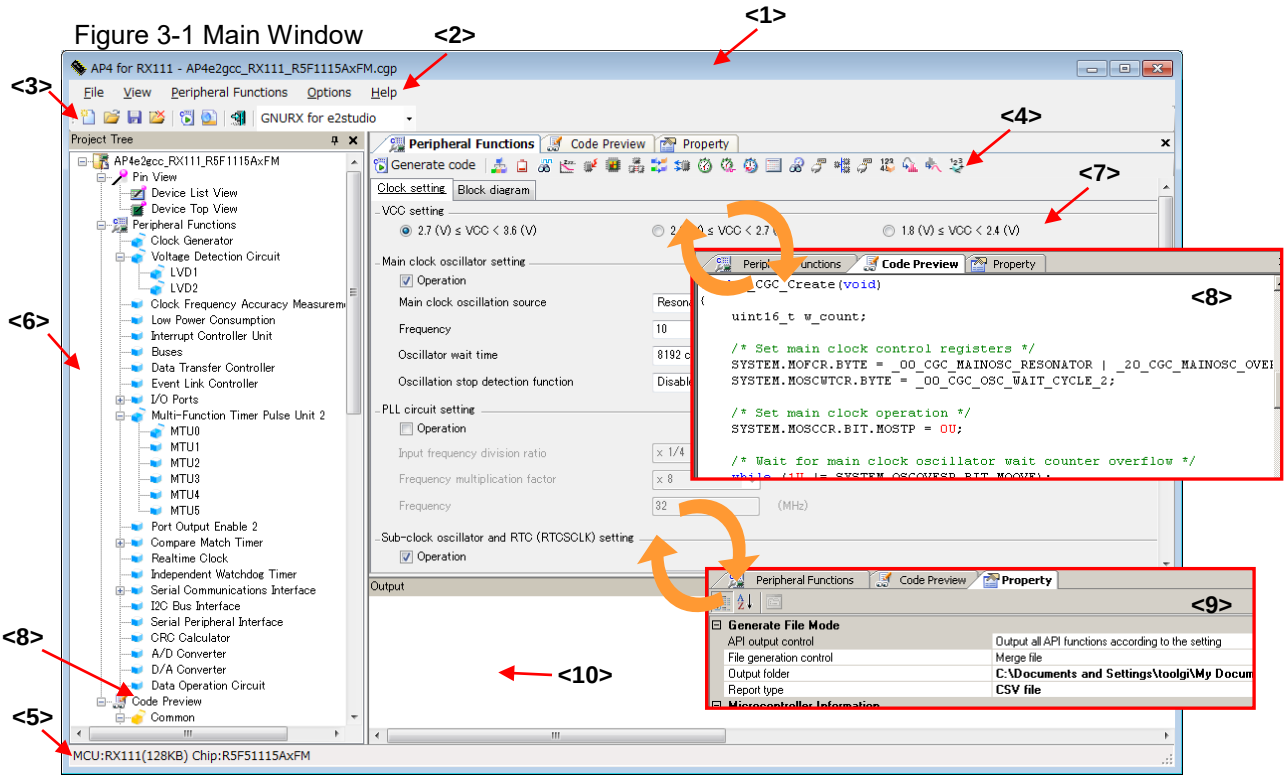
Figure 2-10 Uninstall Finished



Chapter 3 Operating Procedure

3.1 Names of Parts

Figure 3-1 Main Window

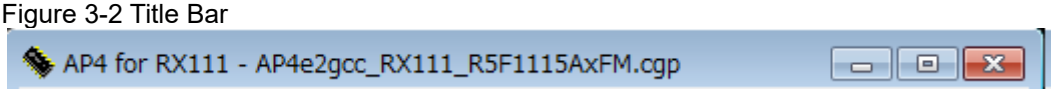


<1> Title : Displays the product name and the AP4 project file name.
<2> Menu : Allows the user to select and execute a command.
<3> Main Toolbar : Allows the user to select and execute a command by clicking a button.
<4> Module Toolbar : Generates code. Also, switches between peripheral functions that are displayed or set up on the Module Panel.
<5> Status : Displays information on the current project.
<6> Project Tree : Indicates the settings for a peripheral function. Also, switches between peripheral functions that are displayed or set up on the Module Panel.
<7> Module : Allows the user to set up a peripheral function. The Module and Preview panels can be switched by pressing the tab key.
<8> Preview : Allows the user to set the file and API function to be output when code is generated. The Preview and Module panels can be switched by pressing the tab key.
<9> Property : Allows the user to view or make output, macro, or file settings.
<10> Output : Displays information, including the execution status of code generation or report output, or the allowable range for a selected input field.

3.1.1 Title Bar

The title bar displays the product name and the AP4 project file name. A project file name tagged with a "*" indicates that the file does not contain the latest settings.

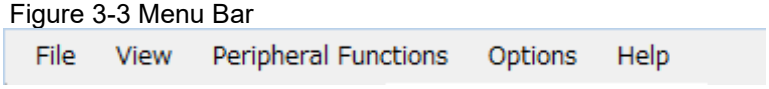
Figure 3-2 Title Bar



3.1.2 Menu Bar

The menu bar is used to select and execute a command. For the functions of the various menus, see "Chapter 4 Menu Reference".

Figure 3-3 Menu Bar



3.1.3 Main Toolbar

Clicking a button on the main toolbar allows the user to execute frequently used functions. For button functions, see "4.5.1 Main Toolbar".

Figure 3-4 Toolbar

3.1.4 Module Toolbar

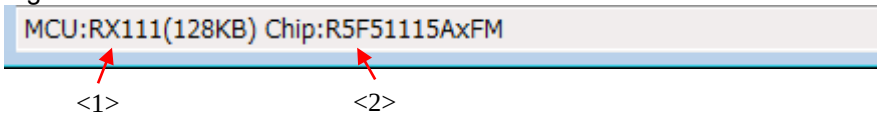
Code generation can be executed by clicking the [Generate code] button on the module toolbar. Also, clicking a peripheral function button switches between peripheral functions that are displayed or set up on the Module panel. For button functions, see "4.5.2 Module Toolbar".

Figure 3-5 Module Toolbar

3.1.5 Status Bar

The status bar displays device information (the product series name and device name).

Figure 3-6 Status Bar

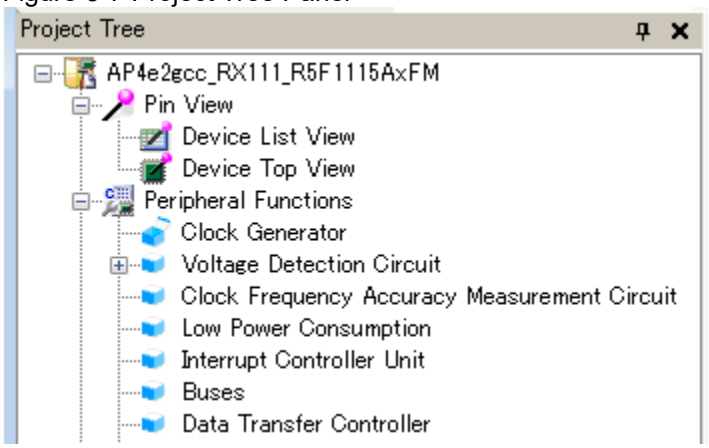


Remark: <1> Device product group name, <2> Applicable device name

3.1.6 Project Tree Panel

This panel shows the settings status of each peripheral function in the form of an icon. Double-clicking a peripheral function name switches between modules that are displayed or set up on the Module panel. For a description of what is displayed, see “5.1 Project Tree Panel”.

Figure 3-7 Project Tree Panel

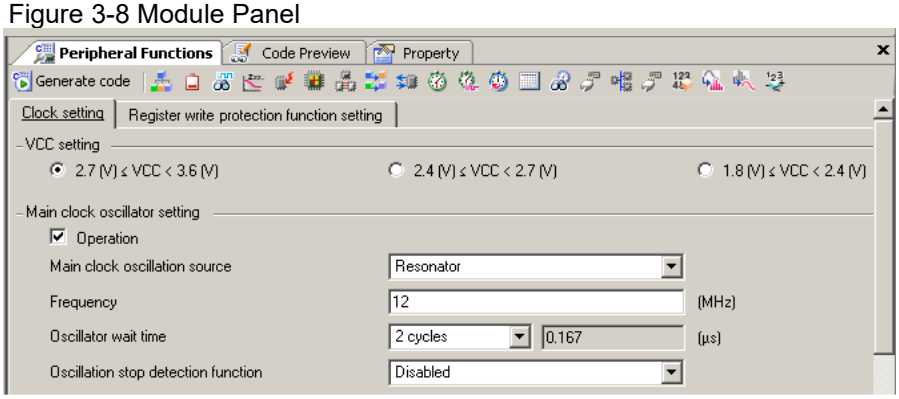


Remark: **If the width of the Project Tree panel is too small to display all character strings, place the mouse cursor on the character string or icon of interest. This will display all character strings for an item on the tooltip.**

3.1.7 Module Panel

This panel is used to set up a peripheral function. For the operating procedure, see “3.6 Setting up a Peripheral Function”.

Figure 3-8 Module Panel

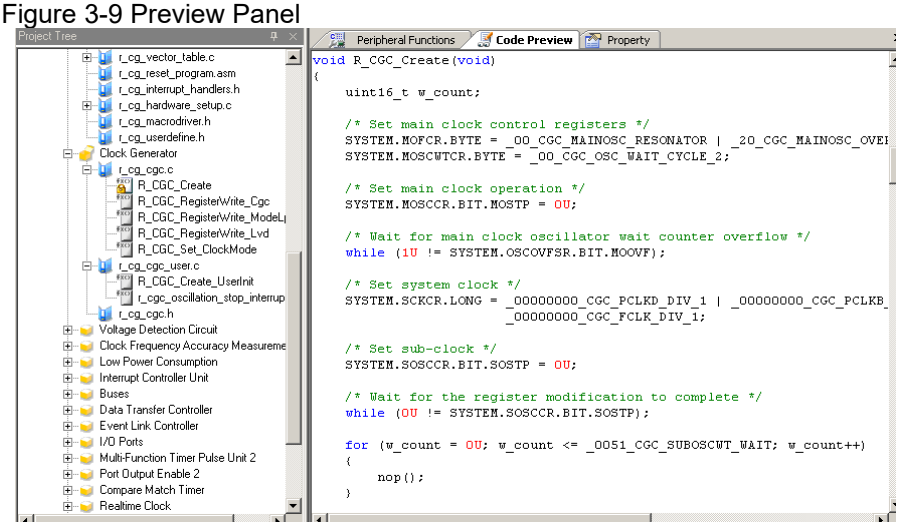


Remark: **The positions of the Module panel and Preview panel can be switched by dragging and dropping the tab.**

3.1.8 Preview Panel

This panel is used to set the file and the API function that are output during the code generation process. For the operating procedure, see “3.7 Checking Source Code”.

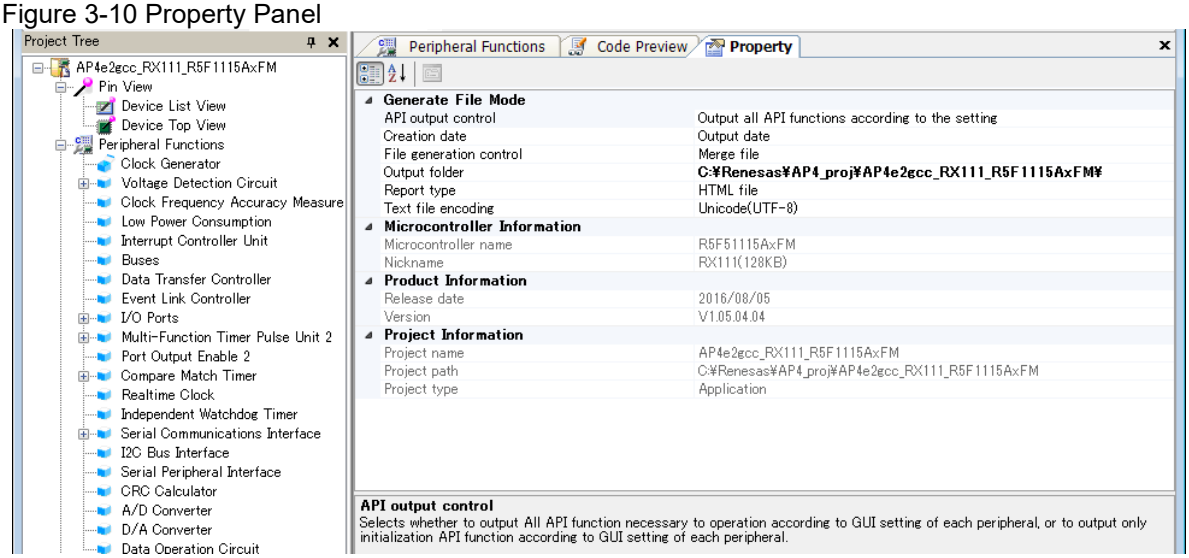
Figure 3-9 Preview Panel



3.1.9 Property Panel

This panel is used to view or make output, macro, and file settings. For a description of what is displayed, see “5.4 Property Panel”.

Figure 3-10 Property Panel



3.1.10 Output Panel

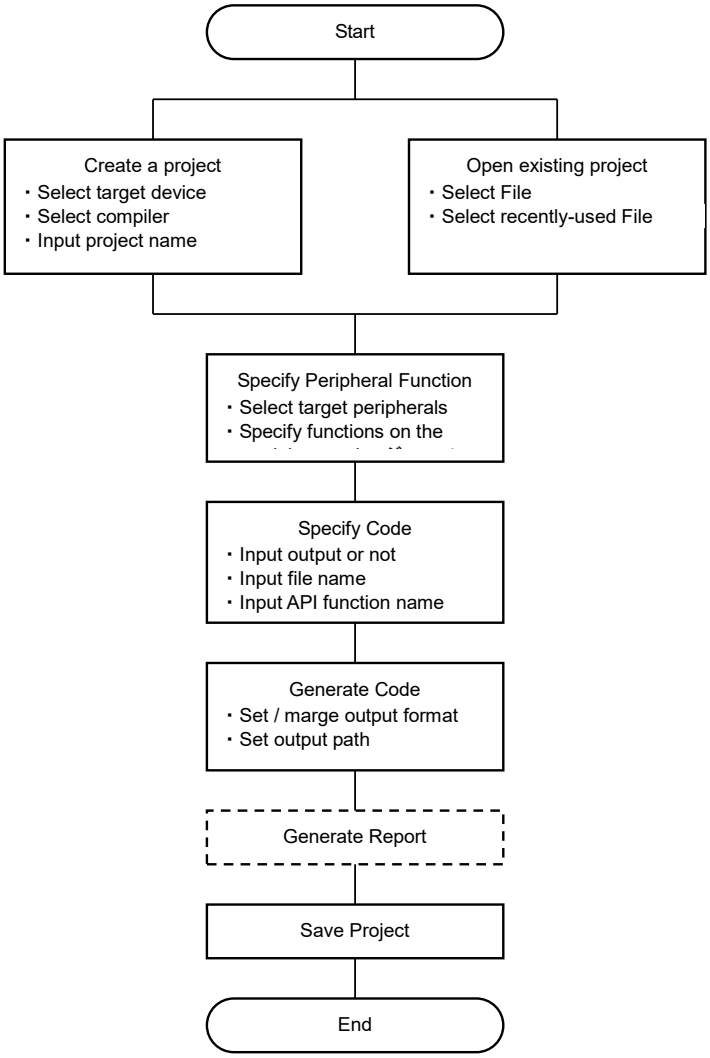
This panel displays the execution status of code generation or report output, and information such as the allowable range for a selected input field. For a description of what is displayed, see “5.5 Output Panel”.

Figure 3-11 Output Panel

3.2 Operating Procedure

In the AP4, source code is created by performing the following procedure:

Figure 3-12 Operating Procedure

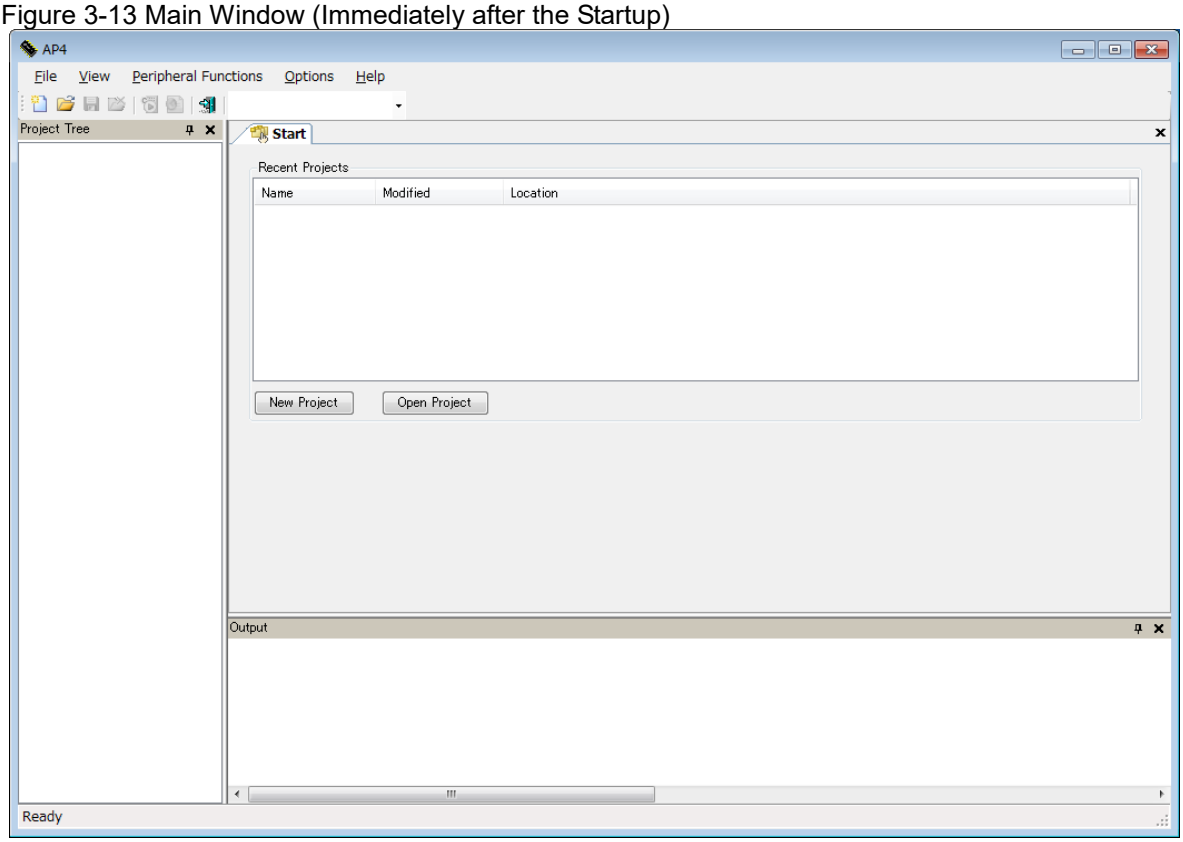


3.3 Starting up

This section explains how to start up the AP4.

In Windows, select the [Start] button >> [Program] >> [Renesas Electronics Application Leading Tool] >>[RX] >> [Vx.xx.xx]. After these items are selected, the AP4 main window starts up.

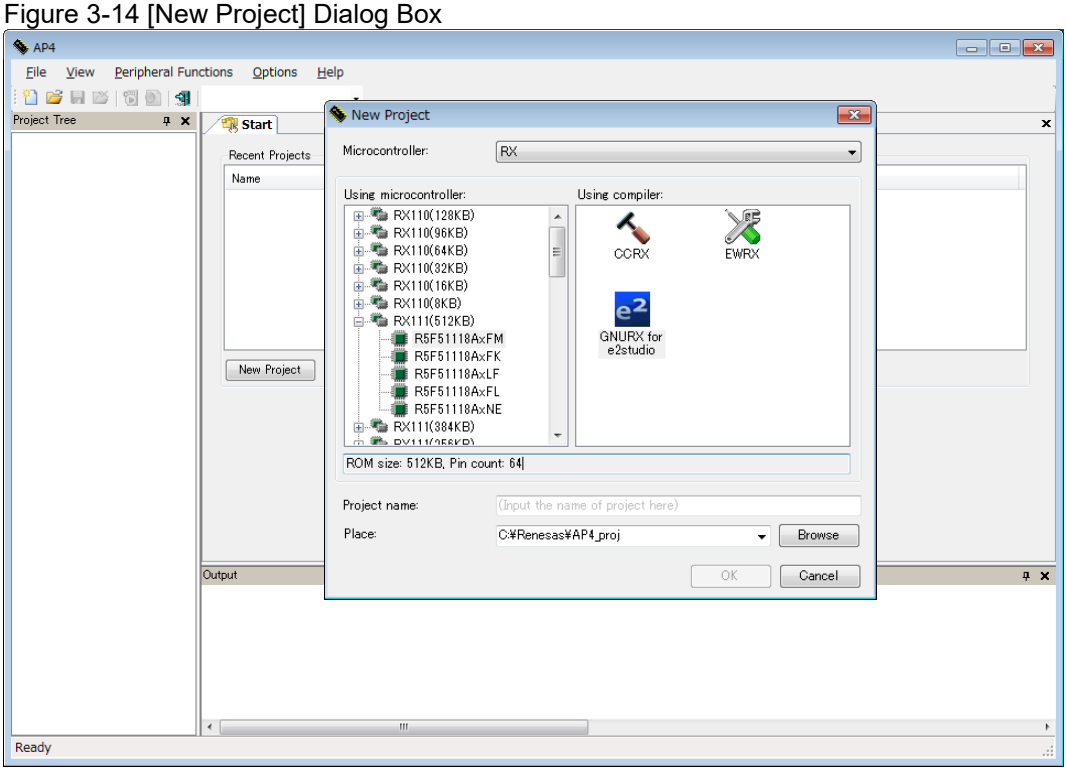
Figure 3-13 Main Window (Immediately after the Startup)



3.4 Creating a New Project File

1. On the main window, press the [New Project] button to display the [New Project] dialog box.

Figure 3-14 [New Project] Dialog Box



2. Set up items and then click the [OK] button to create a new project.

Table 3-1 Project Creation Settings

Item	Summary
Microcontroller	Specify a target device. Peripheral functions that can be set up vary with the specified device.
Using compiler *1	From CCRX (made by Renesas), EWRX (made by IAR), and GNURX (made by KPIT), select the compiler to be used for the build process. The build tool can be changed even after a project is created.
Project name	Specify a project folder/file name. If IAR Embedded Workbench is specified as the build tool, the project folder/file name is also used as the Project Connection file name (.ipcf).
Place	Specify where the project is to be saved.

*1: The item which can be chosen changes with a micro controller.

Caution: In a folder/file name, a single-byte alphanumeric character and "_" (underbar) can be used.

Also, a space (a single-byte blank character) cannot be used at the beginning or end of a folder/file name.

The creation process may fail if an illegal character is specified in the folder/file name.

Remark: If a project with the same name already exists in a specified location, an overwrite confirmation message appears. Clicking the [OK] button overwrites the existing project file.

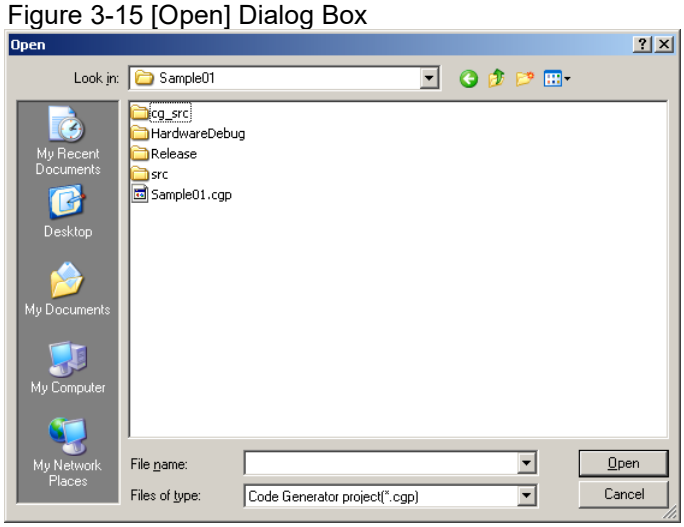
3.5 Opening an Existing Project

If a previously created project exists, it can be opened by either specifying the file name or by selecting it from a list of recent projects.

（1）Opening a file by selecting it

In the Main window, press the [File] button. The [Open] dialog box appears.

Figure 3-15 [Open] Dialog Box

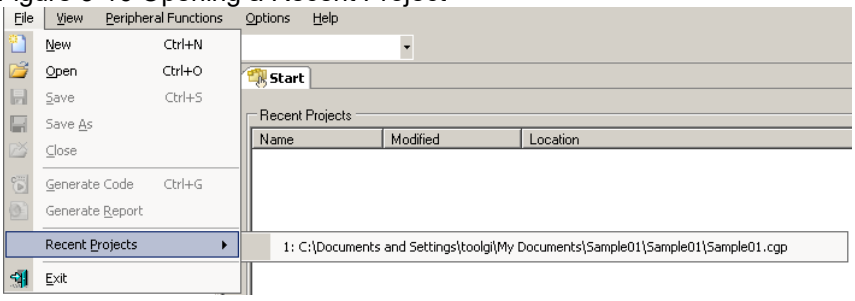


Selecting the file and clicking the [Open] button opens the selected file.

（2）Opening a recently used file

From the [Recent Projects] displayed in the Main window, select the file to be opened.

Figure 3-16 Opening a Recent Project



3.6 Setting up a Peripheral Function

Peripheral functions to be displayed on the Module panel can be selected by one of the methods listed below. For a description of what is displayed on the Module panel, see “5.2 Module Panel”.

- From the [Peripheral Functions] menu in the Main window, select a peripheral function.
- On the Tree View panel, double-click the peripheral function name.
- Click the module toolbar button.

Remark: Even when the Module panel is not being displayed, the Module panel can be opened by selecting a peripheral function from either the [Peripheral Functions] menu or the Tree View panel.

Figure 3-17 Setting up a Peripheral Function

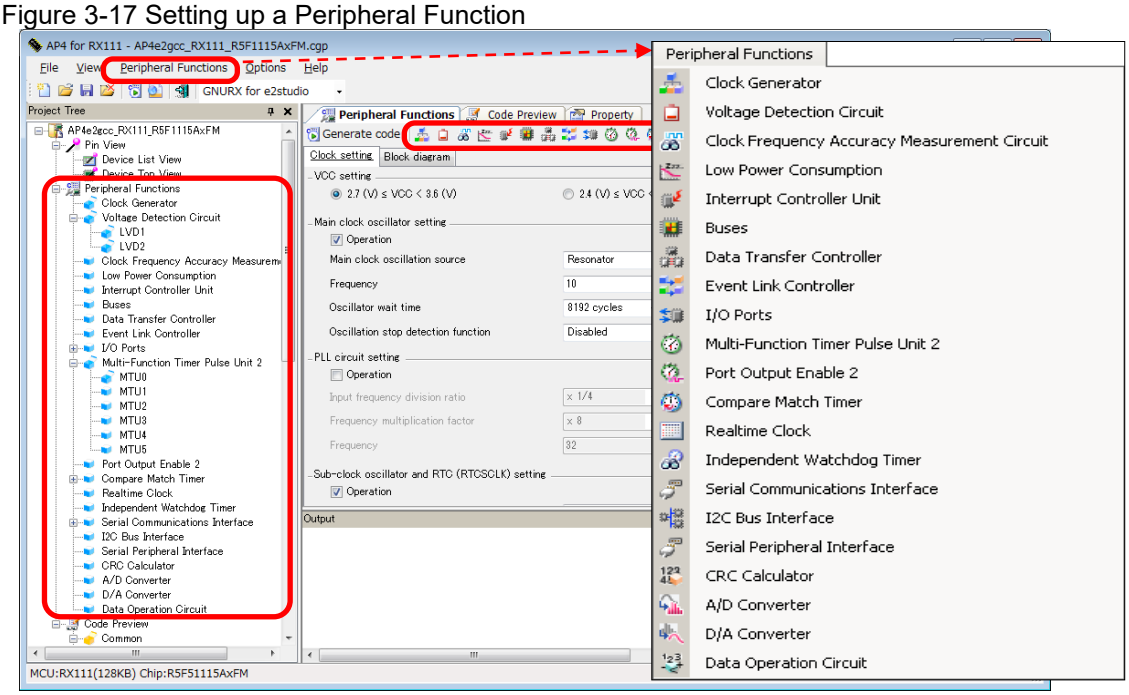
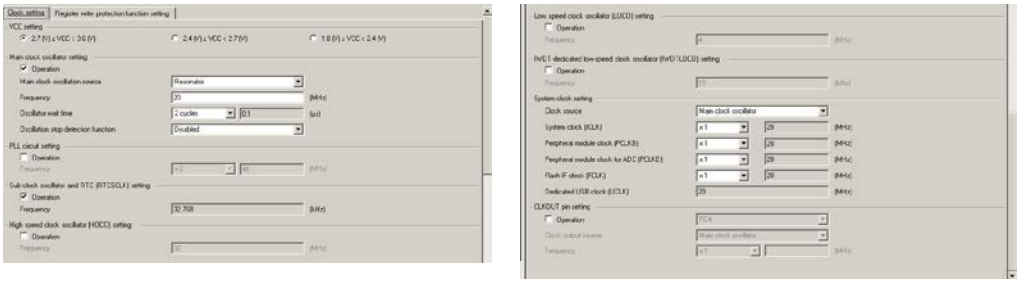


Figure 3-18 Example of Settings in the Module Panel (Clock Setting)



Caution: The [Clock setting] can affect other peripheral function settings. If the [Clock setting] is modified, the settings for other peripheral functions need to be rechecked.

3.6.1 Input Conventions

Input of information into the Module panel is subject to the following conventions:

(1) Character set

Table 3-2 lists character sets that the Module panel can accept for input.

Table 3-2 List of Character Sets

Character set	Summary
ASCII	Single-byte alphabetic, numeric, and symbol characters
Shift-JIS	Double-byte alphabetic, numeric, symbol, hiragana, katakana, and kanji characters, and single-byte katakana characters
EUC-JP	Double-byte alphabetic, numeric, symbol, hiragana, katakana, and kanji characters, and single-byte katakana characters
UTF-8	Double-byte alphabetic, numeric, symbol, hiragana, katakana, or kanji (including Chinese) characters, and single-byte katakana characters

(2) Numeric values

Table 3-3 shows radix base numbers that the Module panel can accept for input.

Table 3-3 List of Radix Base Numbers

Radix number representation	Summary
Decimal	A number beginning with a numeral 1 to 9, followed by numerals 0 to 9, including 0.
Hexadecimal	A number beginning with 0x, followed by 0 to 9 or alphabetic characters a to f, (not case-sensitive).

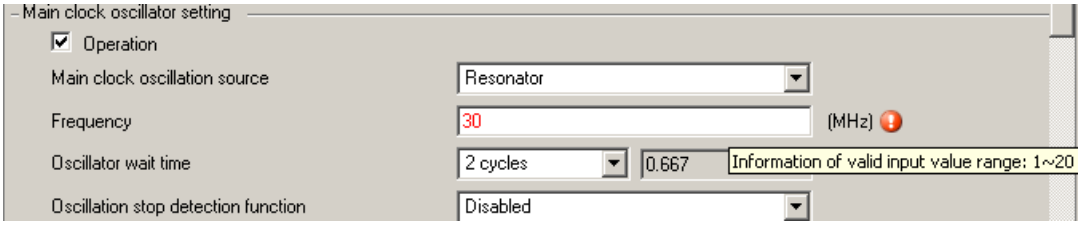
3.6.2 Icon Display on Invalid Input Fields

If an illegal character string is entered or if a value is not entered in a required field, the Module panel displays a icon indicating that the input data is incorrect. In addition, the Module panel represents the affected character string in red to provide a warning that input is invalid.

Remarks 1. If an invalid input field is present, control cannot move to another peripheral function setup view.

2. If the mouse cursor is moved to the icon, information on the character string to be input (a helpful hint on how to resolve the input error) is displayed as a popup.

Figure 3-19 Icon Display on Invalid Input Fields

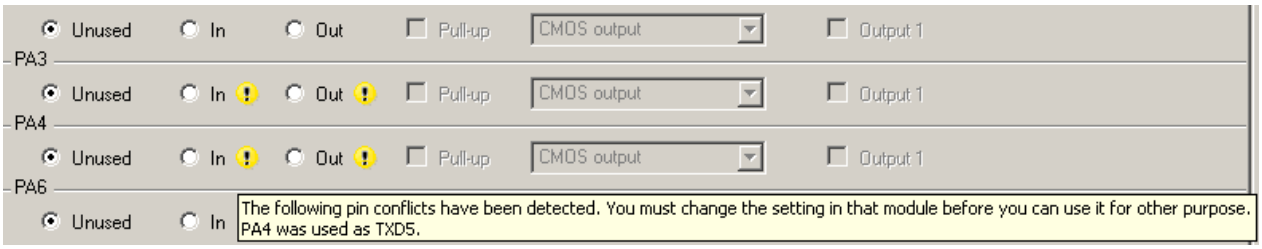


3.6.3 Icon Display on Pin Contention

As peripheral functions are set on items in which pin contention can occur, the Module panel displays a icon in the affected spot to provide a warning on pin contention, indicating that a contention has occurred.

Remarks 1. The function for which a pin contention warning icon is displayed cannot be enabled. When using the affected function, the contending peripheral function should be disabled.
If the mouse cursor is moved to the icon, information on pin contention (a helpful hint on how to avoid contention) appears as a popup.

Figure 3-20 Icon Display on Pin Contention



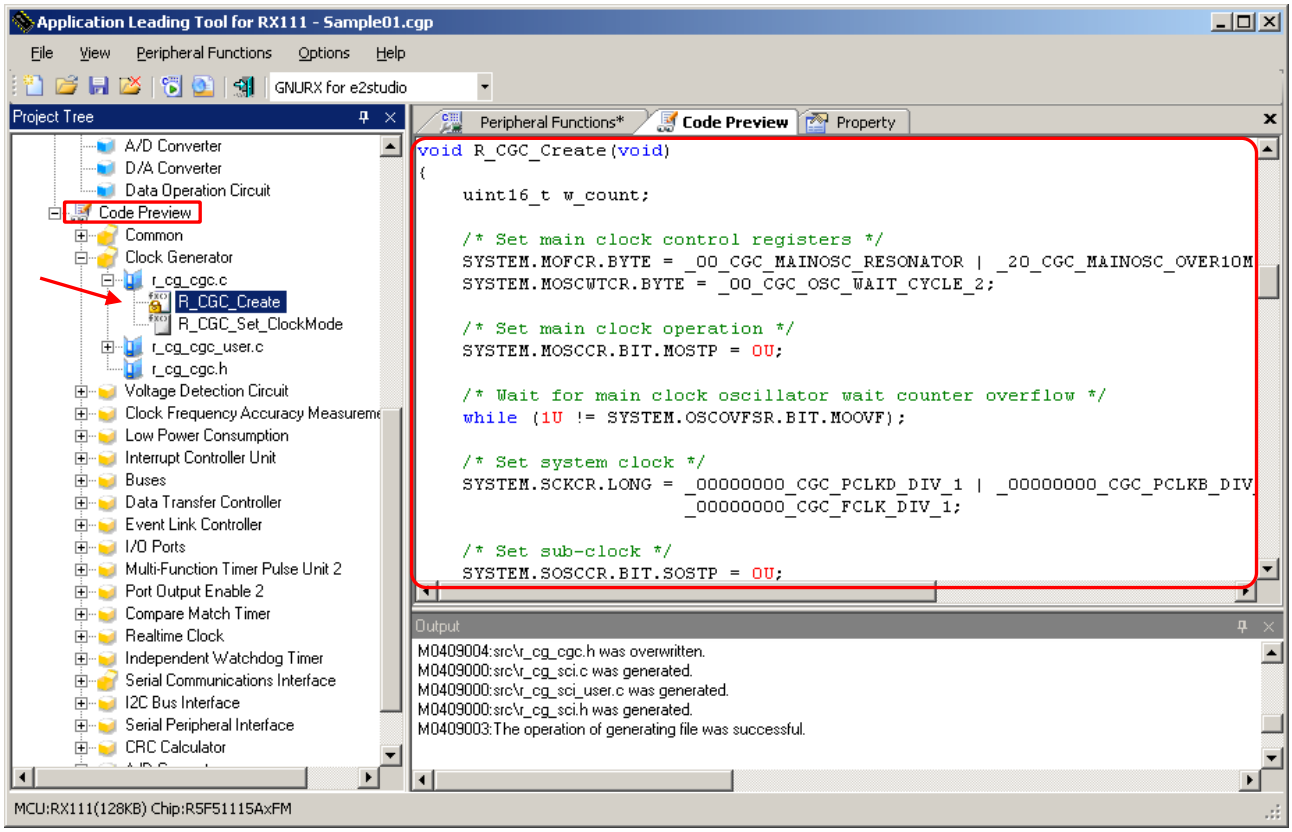
3.7 Checking Source Code

The AP4 generates source code (a device driver program) that matches peripheral function settings (see “3.6 Setting up a Peripheral Function”). The source code can be checked on the Preview panel. If the Preview panel is not open, clicking the [Preview] tab switches the Module panel to the Preview Panel.

On the tree on the Preview panel, double-clicking either the source code file name or the API function name switches the display of the source code.

On the Preview panel tree, you can specify whether to turn on or off an output, rename API functions, or rename files.

Figure 3-21 Verifying Source Code



Remarks **1.** Source code cannot be edited on the Preview panel.

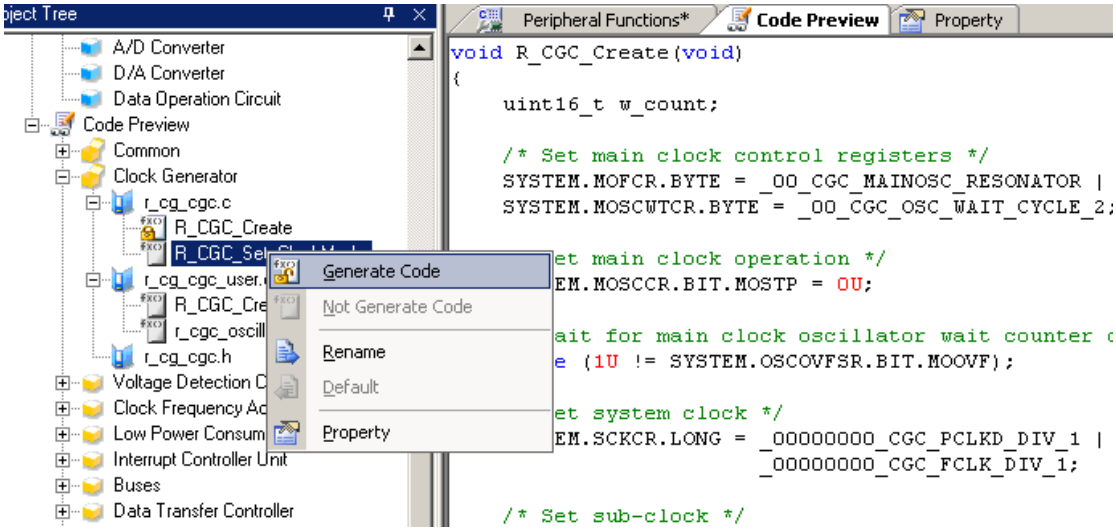
2. In some API functions (such as API functions for a serial array unit), register value SFRs and other values are calculated during the code generation process before the function is finalized. For this reason, the source code displayed on the Preview panel may not agree with the source code that is actually output.

3.7.1 Setting Output on/off

According to the peripheral function settings, the AP4 automatically enables the output of a required API function. For non-mandatory API functions, the user can enable/disable the output of the API function.

On the Preview panel tree, right-clicking the API function name brings up a context menu. By selecting [Generate Code] / [Not Generate Code], the user can specify whether to turn on or off an output of the API function.

Figure 3-22 Output on/off Settings



Remark: Whether output is on or off can be checked by the type of each icon on the Preview panel.

Table 3-4 Source Code Output on/off

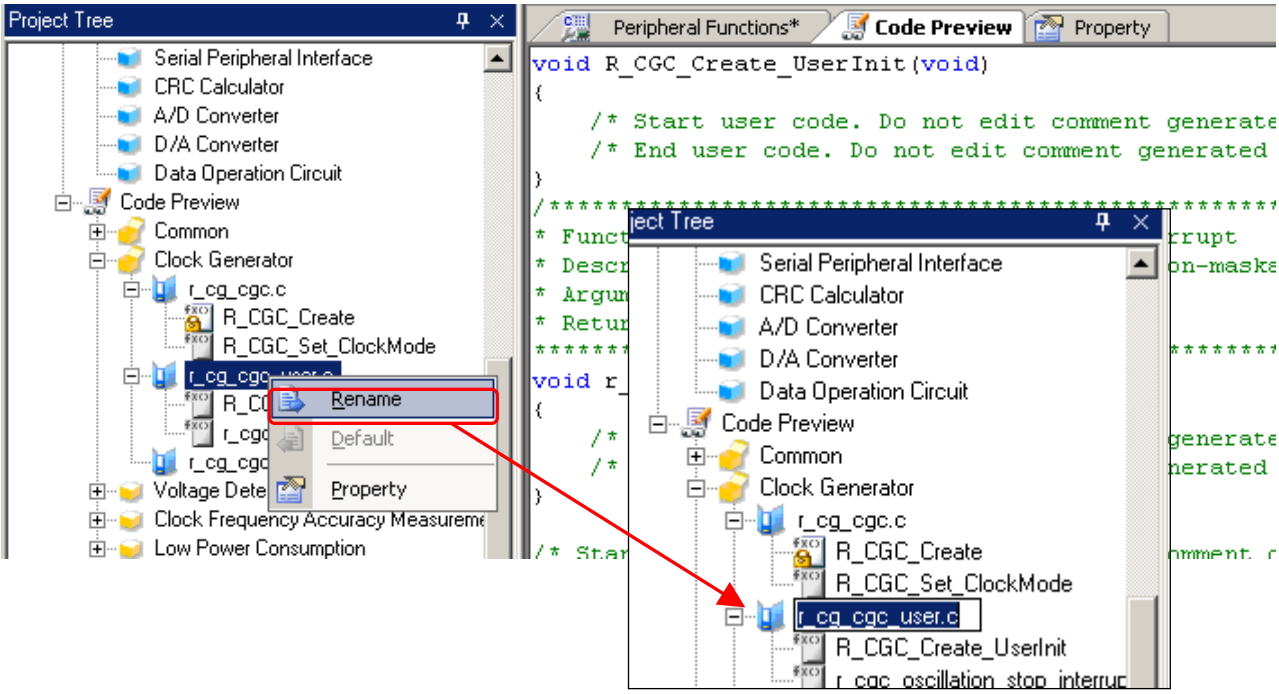
Icon type	Summary
	The source code for this API function will be output. The API function for which this icon is displayed is treated as a function requiring source code output (not changeable to a ).
	The source code for this API function will be output.
	The source code for this API function will not be output.

3.7.2 Renaming a File

In the AP4, the code to be output can be assigned any file name.

On the Preview panel tree, right-clicking the file name brings up the context menu. By selecting [Rename], you can edit the file name.

Figure 3-23 Renaming a File

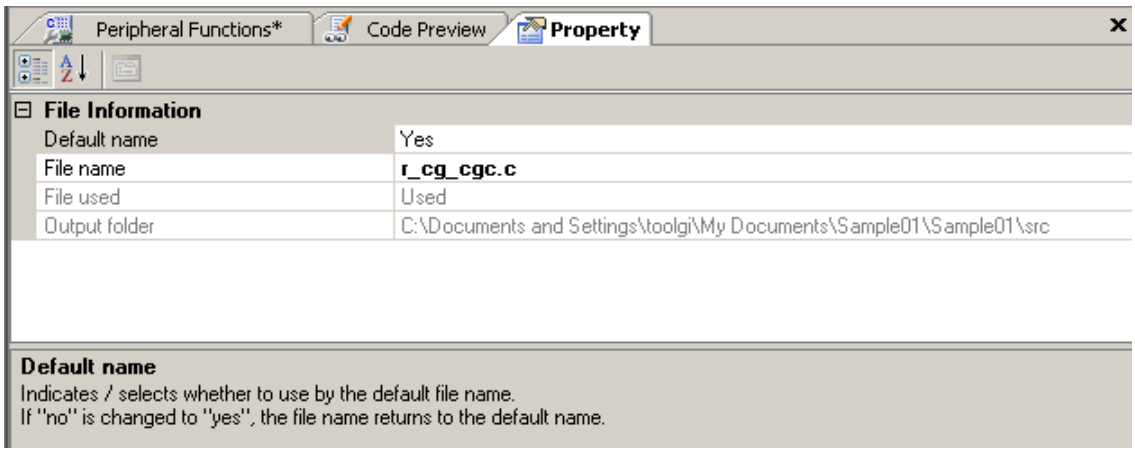


Remarks **1.** To reset the file name to the default file name provided by the AP4, select [Default] from the context menu.

2. In file names, single-byte alphanumeric characters and [_] (underscore) can be used.

3. Information on the file selected on the Preview panel is displayed in [File name] on the Property panel. File names can also be edited in [File Information].

Figure 3-24 [File Information] Tab (Renaming a File)

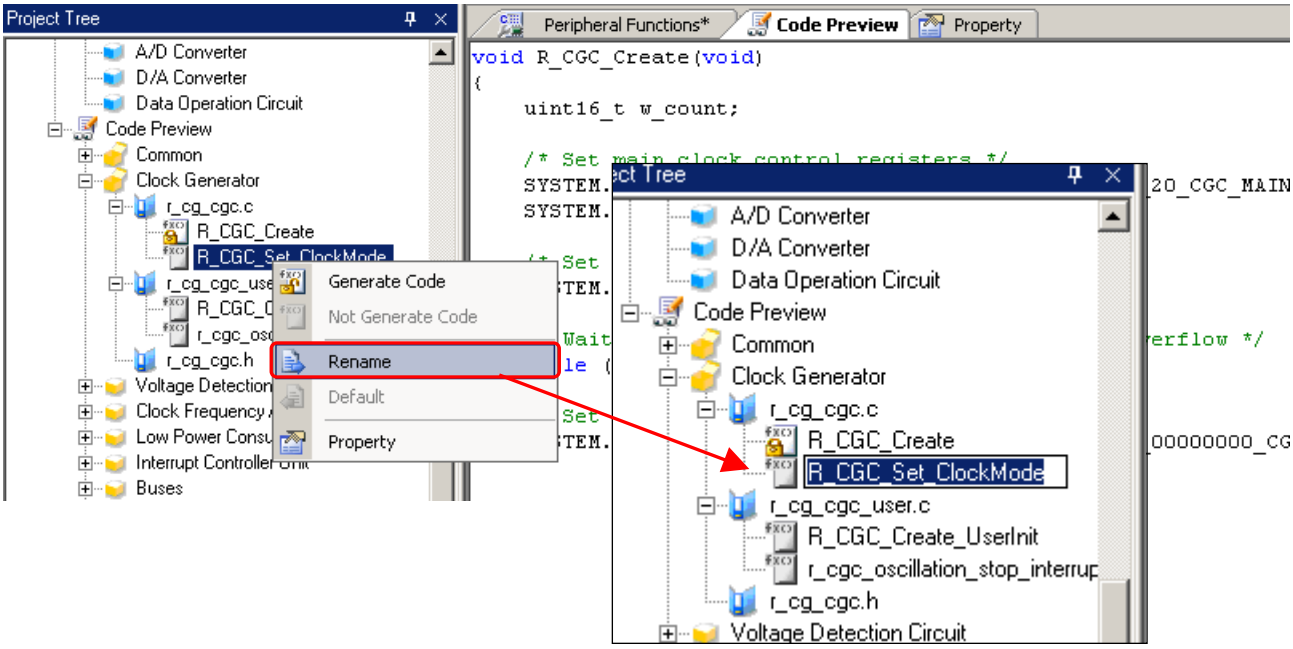


3.7.3 Renaming an API Function

In the AP4, the code to be output can be assigned any API function name.

On the Preview panel tree, right-clicking the API function name brings up the context menu. By selecting [Rename], you can edit the file name.

Figure 3-25 Renaming an API Function



Remarks **1.** The name of the *main* function cannot be changed.

2. In file names, single-byte alphanumeric characters and [_] (underscore) can be used.

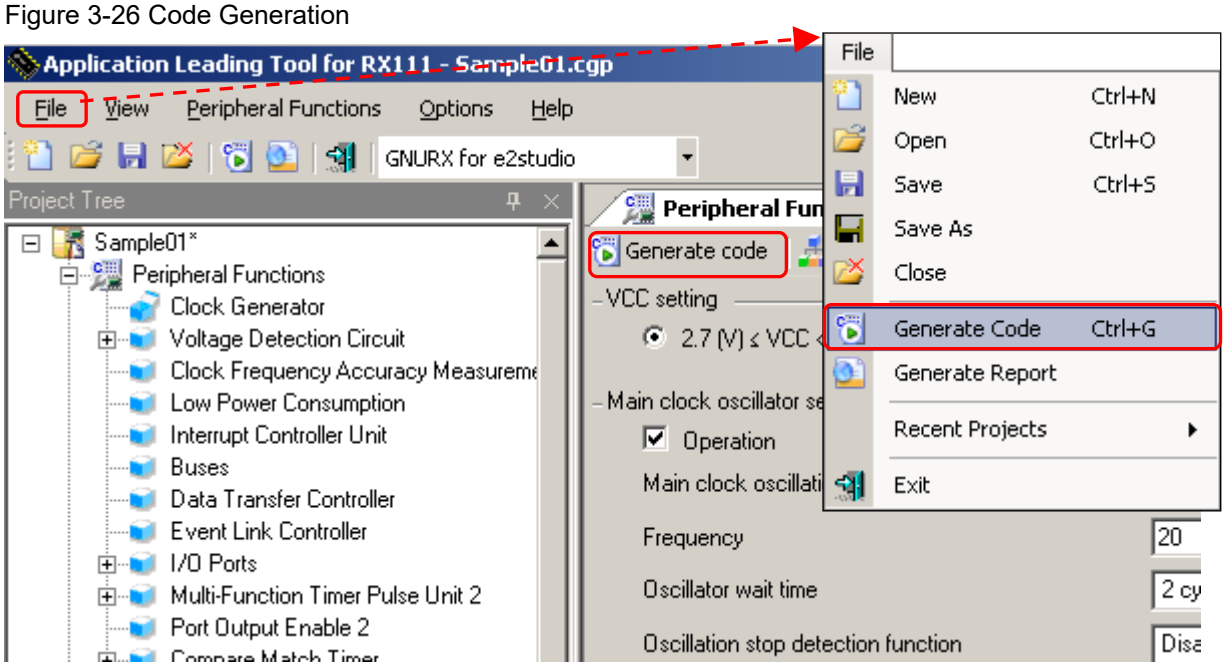
3. Whether output is on or off can be checked by the type of each icon on the Preview panel.

3.8 Output of Source Code

Source code (a device driver program) can be output by any of the following methods:

- From the [File] menu, select [Generate Code].
- On the toolbar, click the [ ] button.
- On the module toolbar, click the [Generate code] button

Figure 3-26 Code Generation

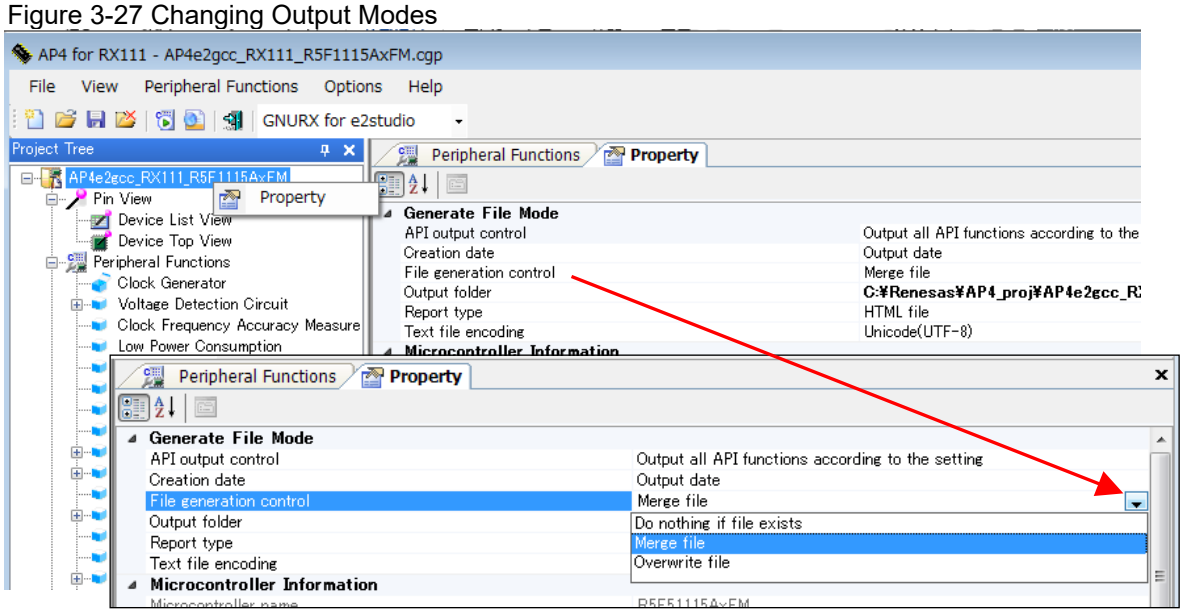


3.8.1 Modifying the Output Modes

In the AP4, you can select an output mode (overwriting, merging, or previous-file-priority) from [Generate File Mode] on the Property panel.

To change output modes, in the [File generation control] field, click the button to select a desired mode from the list.

Figure 3-27 Changing Output Modes



An output mode can be selected from the three modes listed in Table 3-5.

Table 3-5 Source Code Output Mode

Output mode	Summary
Overwrite file	If an identically named file already exists, overwrites that file.
Merge file	If an identically named file already exists, merges that file with the current file. Only the content of a merge comment is subject to the merging action. /* Start user code. Do not edit comment generated here */ [merge section] /* End user code. Do not edit comment generated here */
Do nothing if file exists	If an identically named file already exists, does not output the current file.

Remarks 1. The merge comment can vary depending on where it occurs.

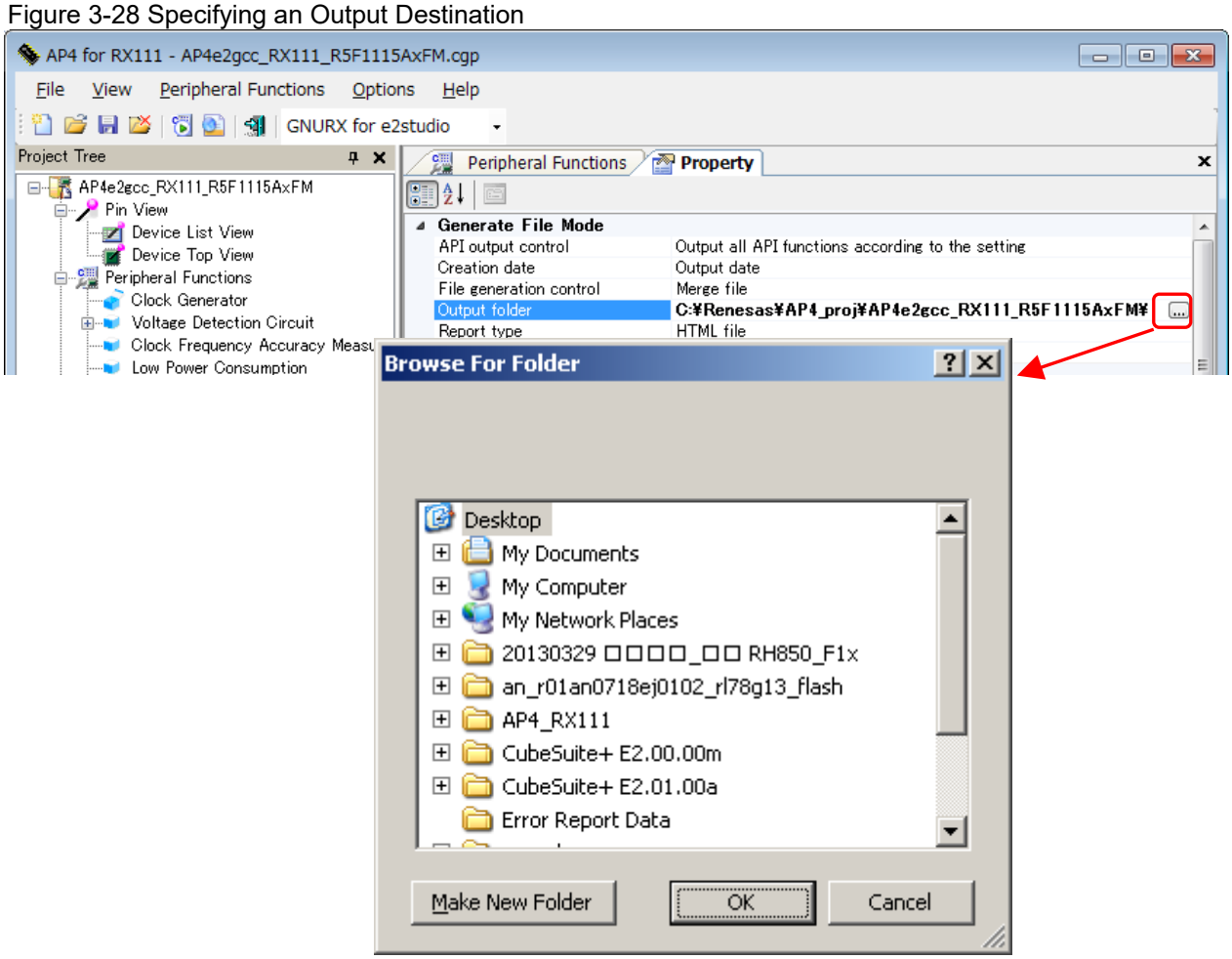
2. A merge comment should not be edited or moved. If it is edited or moved, the merging cannot be performed correctly.

3.8.2 Changing Output Destinations

In the AP4, where source code is to be output can be specified in [Output folder] on the Property panel.

To change destination folders, an output destination folder can be selected on the [Browse For Folder] screen, which is displayed when the ... button in the destination folder field is clicked.

Figure 3-28 Specifying an Output Destination



Remark: In the installation destination folder name, none of these 11 characters, [(/ * : < > ? | " ¥ ; ,] can be used.

Also, a space (a single-byte blank character) cannot be used at the beginning or end of a folder name.

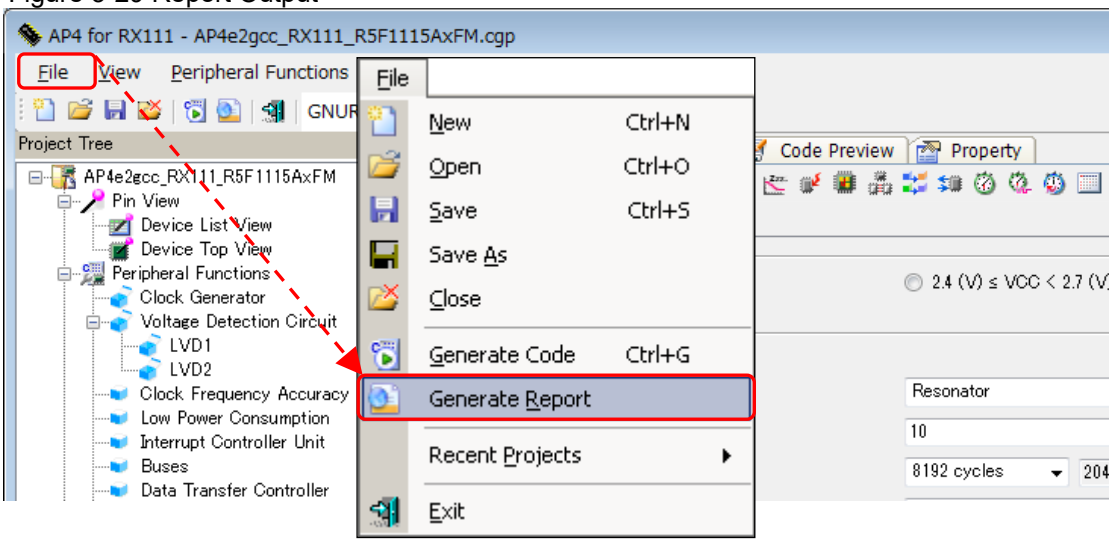
The output changing process may fail if an illegal character is specified in the folder name.

3.9 Generating a Report File

A report file can be output by either of the following methods:

- From the [File] menu, select [Generate Report].
- On the toolbar, click the [ ] button.

Figure 3-29 Report Output



Remarks **1.** The names of report files are “macro” and “function”.

macro : Peripheral function settings information

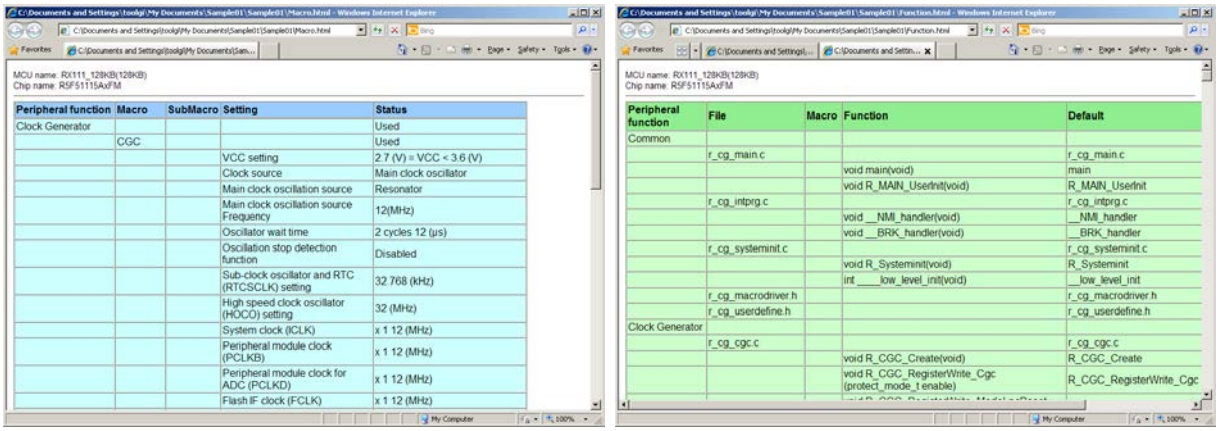
function : Source code information

2. The format (HTML or CSV) for the report file and its output destination can be selected on the [output] tab on the Property panel.

3. If the destination folder for the report file already contains a report file, the existing file will be overwritten, irrespective of file generation mode settings.

Figure 3-30 Example of Report File Output

(a) macro.html **(b) function.html**



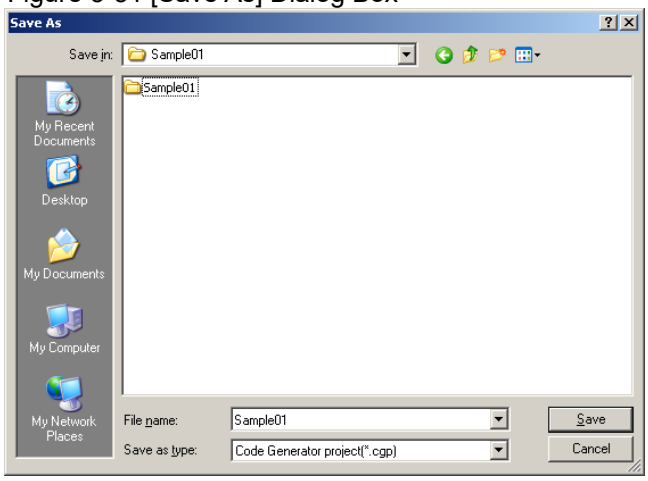
3.10 Saving a Project

To save information that has been set, any of the following methods can be used:

（1）Save as

Select the [File] menu >> [Save As…], the [Save As] dialog box appears.

Figure 3-31 [Save As] Dialog Box



To save the information that has been set, specify a destination and a file name, and click the [Save] button.

（2）Save

Select the [File] menu >> [Save]. Or on the toolbar, click the [ ] button. The file (project) being edited is saved on an overwrite basis.

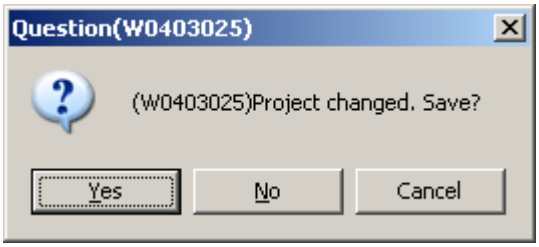
（3）Close and save

When an attempt is made to exit from the AP4 without saving the modified settings, a save confirmation dialog box appears.

Clicking the [Yes] button saves the file (project) being edited on an overwrite basis.

Clicking the [No] button skips the save process.

Figure 3-32 Question Dialog Box



Remark: The name of the file to be saved (not including the extension) is identical to the AP4 project name.

3.11 Closing

The AP4 can be closed by any of the following methods:

- On the Main window, select the [File] menu >> [Exit].
- On the toolbar, click the [ ] button.
- On the Main window, click the [ ] button.
- On the menu that appears when an icon on the title bar is clicked, select [Close].

3.12 Coding

After code is generated, the source code that has been output is read using the integrated development environment platform.

The program is completed by adding user source files as necessary or adding code in the merge comment in the file that is output by the AP4.

When outputting a source code using the AP4 again after editing the source code on the integrated development environment platform, observe the following points:

Cautions 1. If the output mode is [Overwrite file], any editing that was performed on the integrated development environment platform with respect to the AP4 output file will be disabled.

2. If the output mode is [Merge file], any editing that was performed on the integrated development environment platform outside a merge comment will be disabled.

3. If the output mode is [Do nothing if file exists], any changes to AP4 settings other than a new output file will be disabled.

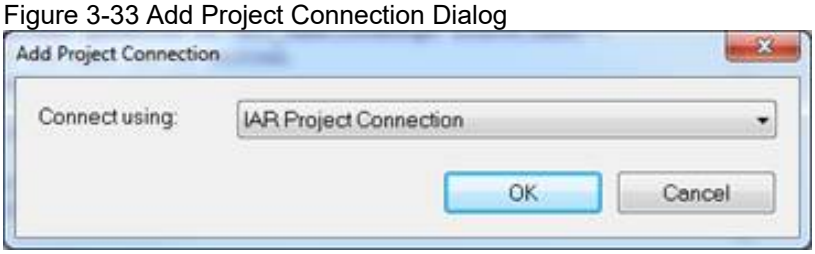
4. The AP4 does not delete files that are no longer needed due to changes in settings.

3.12.1 How to create a project connection between IAR Embedded Workbench and AP4

AP4 generates a so called **Project Connection** file (.ipcf) that contains references to the generated source files. Every time you add/remove or change a module in AP4, the project connection updates your IAR Embedded Workbench project with the files that the module needs. Proceed as follows to create a project connection:

1) In the IAR Embedded Workbench IDE, choose **[Project] >> [Add Project Connection]** to display the Add Project Connection dialog box. From the drop-down menu, choose IAR Project Connection.

Figure 3-33 Add Project Connection Dialog



2) In the standard **Open File** dialog box that is displayed, browse to the location where the AP4 project file (.cgp) is stored and select the generated Project Connection file (.ipcf).

3) The generated module files will now be placed in the group category **Renesas_AP** in the **Workspace** window.

Chapter 4 Menu Reference

4.1 [File] Menu

Figure 4-1 [File] Menu

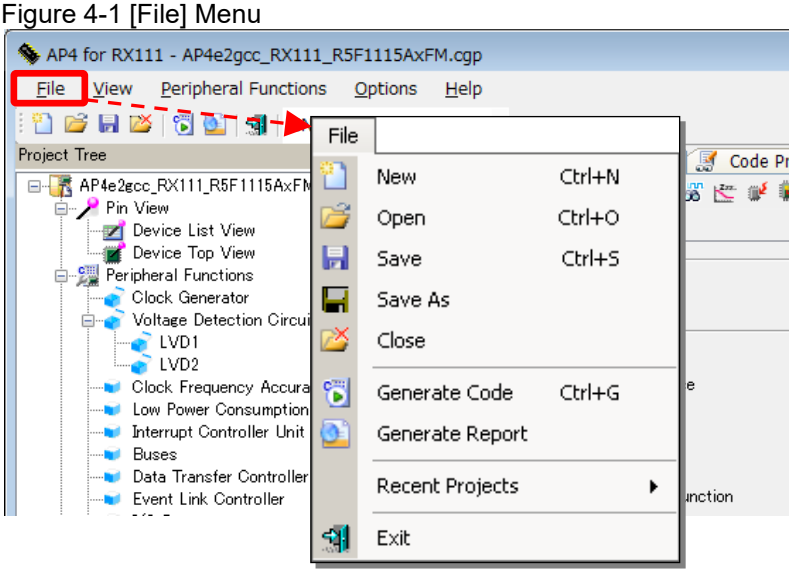


Table 4-1 [File] Menu

Item	Description
[New]	Creates a new project.
[Open]	Opens an existing project.
[Save]	Overwrites the currently open project with the current settings.
[Save As…]	Saves the current settings under a different project name.
[Close]	Closes the currently open project.
[Generate Code…]	Outputs the source code.
[Generate Report…]	Outputs settings information to a file.
[Recent Projects]	Displays recently opened projects. Selecting a project from a submenu loads the project.
[Exit]	Exits from AP4.

4.2 [Peripheral Functions] Menu

The [Peripheral Functions] menu displays peripheral functions that the target device has (only those peripheral functions that are supported by AP4). When a peripheral function is selected, the associated settings screen is displayed on the Module panel.

Figure 4-2 [Peripheral Functions] Menu

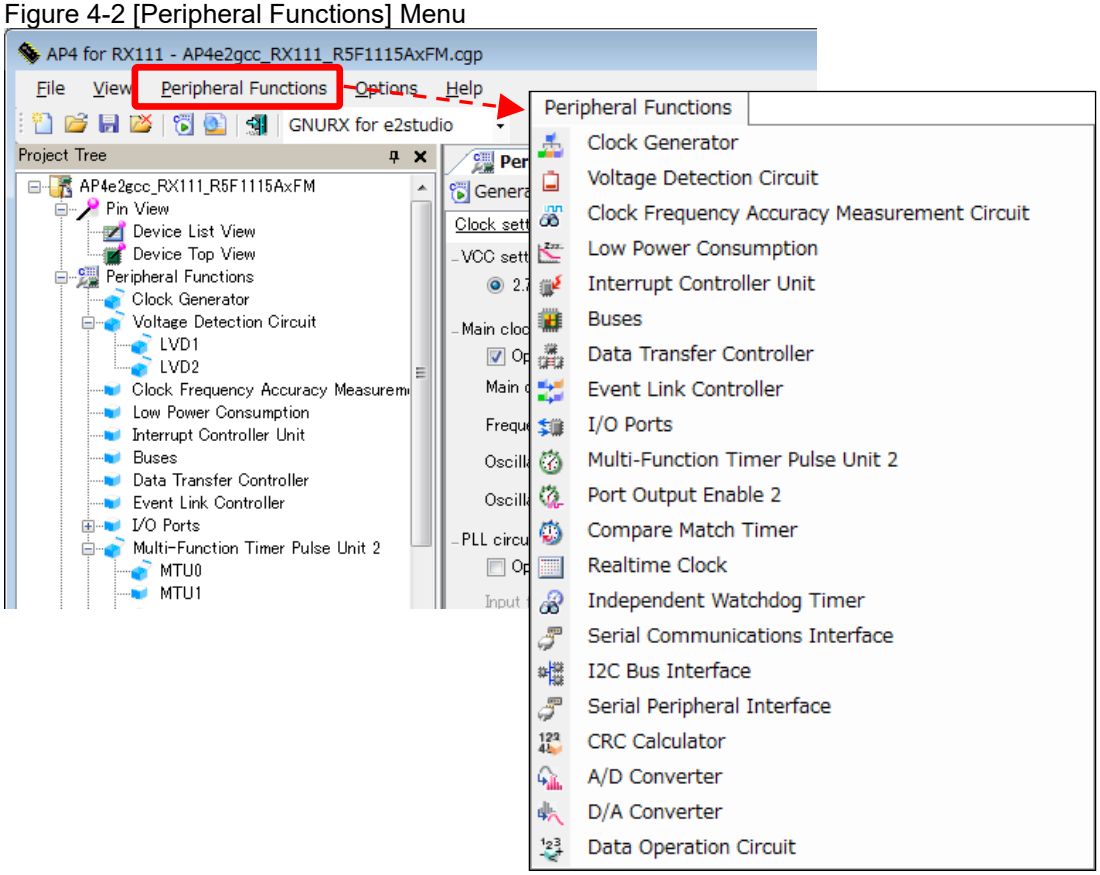


Table 4-2 [Peripheral Functions] Menu

Item	Description
Peripheral function name	Displays the associated settings screen on the Module panel. The names of peripheral functions that are displayed may vary from one product to another.

4.3 [Options] Menu

Figure 4-3 [Options] Menu

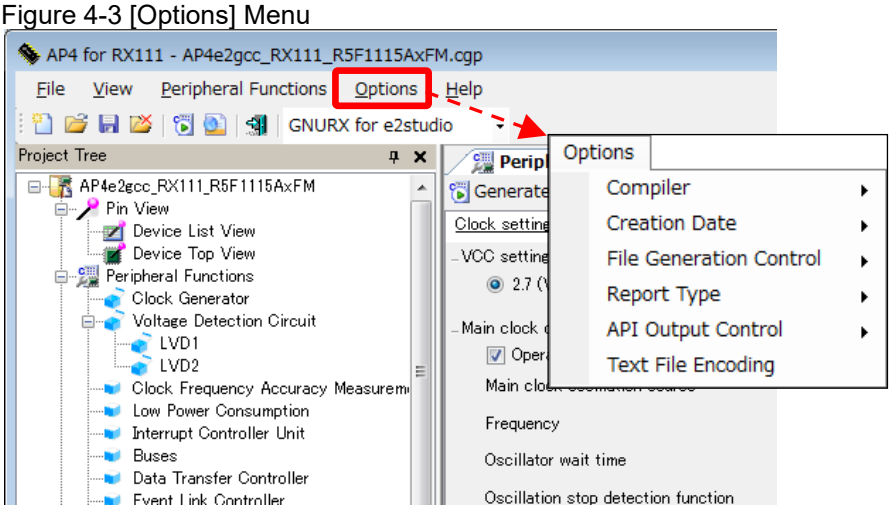


Table 4-3 [Options] Menu

Item	Description
Compiler	Selects the format of the output code. The compiler names that are displayed may vary from one product to another.
Creation Date	Selects whether to output creation date.
File Generation Control	File generation control can be selected from: overwrite file, merge files, and do nothing if a file already exists.
Report Type	Select either HTML or CSV.
API Output Control	API function output control can be selected from “output all API functions according to the setting”, and “output only initialization API function.” The default is “output all according to the settings”. Selecting the “output only initialization API function” option skips the generation of the file R_xxx_user.c that codes interrupt handlers, in which case all interrupt handlers must be coded by the customer himself/herself.
Text File Encoding	Selects the format of encoding.

4.4 [Help] Menu

Figure 4-4 [Help] Menu

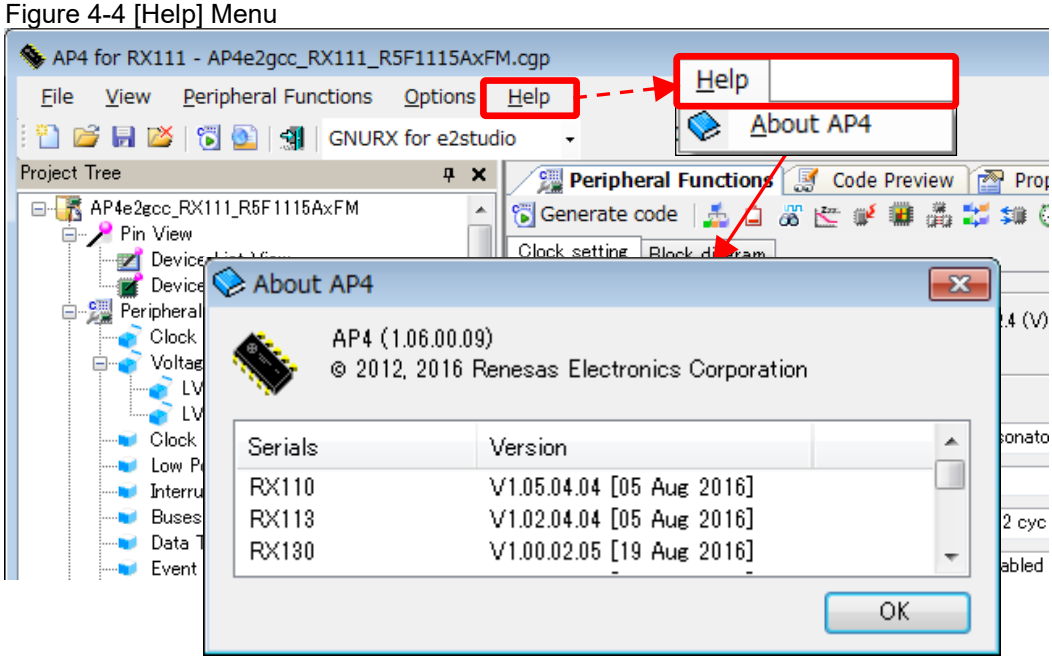


Table 4-4 [Help] Menu

Item	Description
About AP4	Displays version information and other items.

4.5 Toolbars

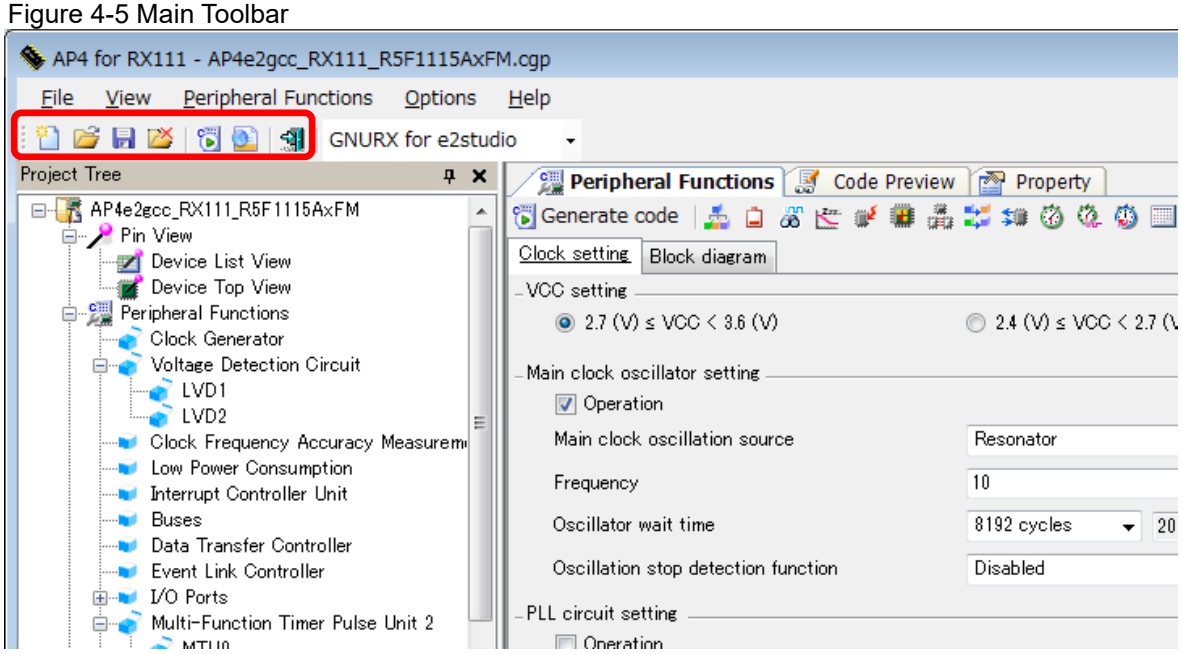
AP4 provides two toolbars: The main toolbar, which is always displayed below the Manu bar, and a module toolbar, which is displayed above the Module panel.

4.5.1 Main Toolbar

The main toolbar is always displayed below the menu bar.

By clicking buttons on the main toolbar, you can execute functions such as project file operation, code generation, and report output.

Figure 4-5 Main Toolbar



The main toolbar contains the following buttons:

Table 4-5 Functions of Main Toolbar

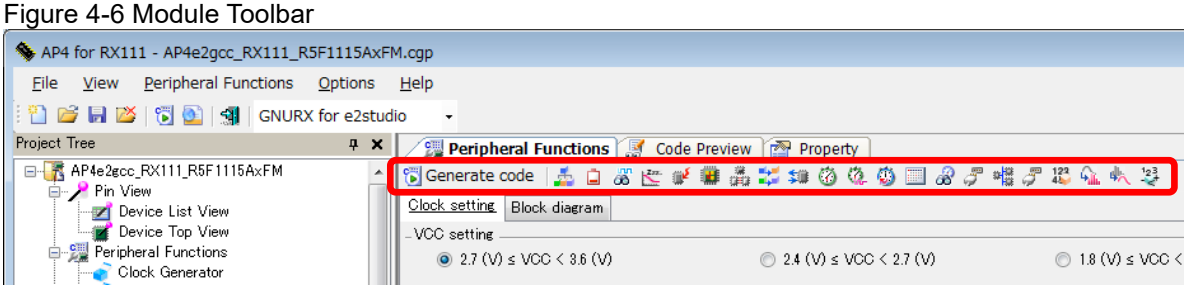
Button	Name	Description
	New project	Creates a new project.
	Open a project	Reads an existing project.
	Save a project	Overwrites the currently open project with the current settings, and saves the results.
	Close	Closes the currently open project.
	Generate Code	Outputs the source code.
	Generate Report	Outputs a report file.
	Exit	Exits from AP4.

4.5.2 Module Toolbar

The module toolbar is displayed above the Module panel.

Clicking the [Generate code] button causes the execution of the code generation process. By clicking peripheral function buttons, you can switch the peripheral functions to be displayed or set up on the Module panel.

Figure 4-6 Module Toolbar



The module toolbar contains the following buttons:

Table 4-6 Functions of Module Toolbar

Button	Name	Description
Generate code	Generate code	Outputs source code.
	Clock Generator	On the Module panel, displays peripheral function setting screens that are associated with buttons. **Remark: The buttons listed in the table are intended solely as examples. The buttons that are actually displayed may vary from one product to another.**
	Voltage Detection Circuit	
	Clock Frequency Accuracy Measurement Circuit	
	Low Power Consumption	
	Interrupt Controller	
	Buses	
	Data Transfer Controller	
	Event Link Controller	
	I/O Ports	
	Multi-Function Timer Pulse Unit 2	
	Port Output Enable 2	
	Compare Match Timer	
	Realtime Clock	
	Independent Watchdog Timer	
	I2C Bus Interface	
	Serial Communications Interface	
	12-Bit A/D Converter	
	D/A Converter	
	Data Operation Circuit	

Chapter 5 Window Reference

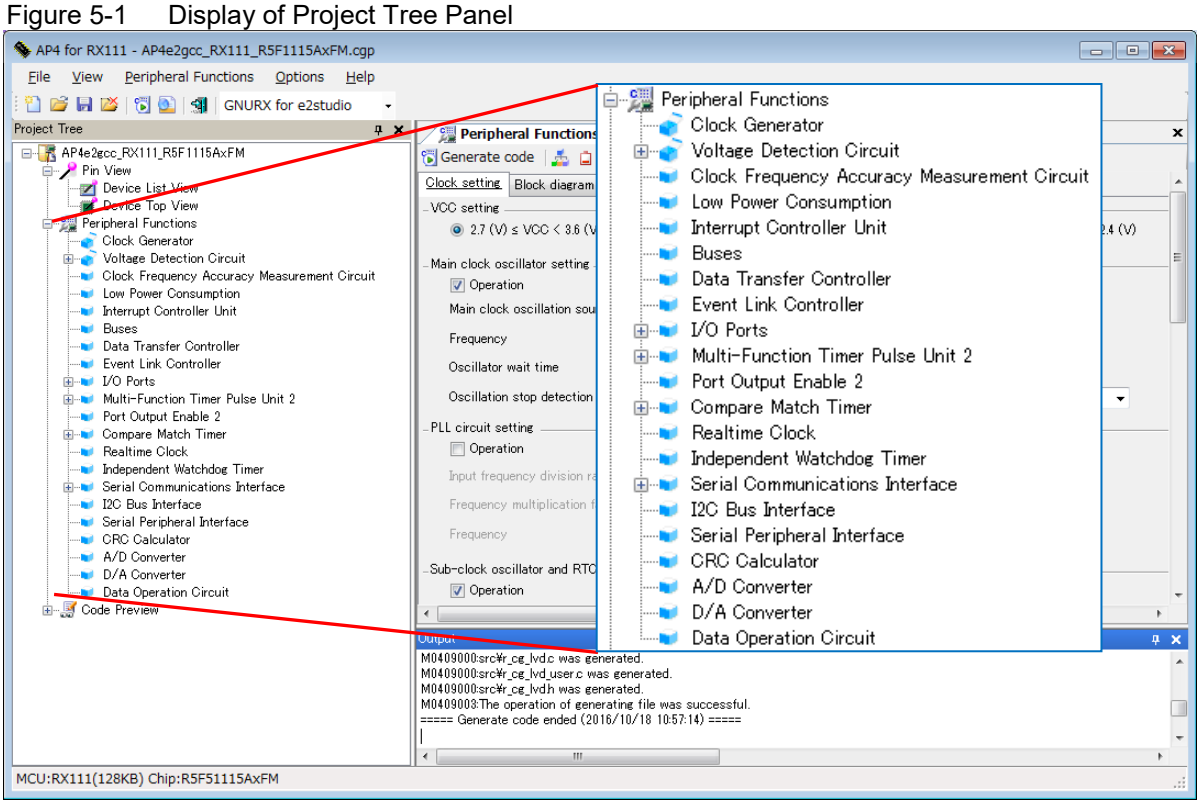
The AP4 provides different windows for different microcontroller products that it supports.

This manual describes the displays and operating procedures that are common to the microcontroller products that the AP4 supports. Product-by-product descriptions of windows are omitted.

5.1 Project Tree Panel

The Project Tree panel displays, in tree format, the peripheral functions (those which are supported by the AP4) that target devices possess. By double-clicking the name of a peripheral function, you can switch between modules that are displayed or set up on the Module panel.

Figure 5-1 Display of Project Tree Panel



The shape of the icon for each peripheral function changes according to the status of the settings.

Table 5-1 Project Tree Panel Icons

Icon	Summary
	The corresponding peripheral function is already set.
	The corresponding peripheral function is not set/used.

Right-clicking the name of a peripheral function brings up a context menu. Executing [Return to Reset Value] from the Project Tree panel resets the settings to their default values.

Figure 5-2 Return to Reset Value

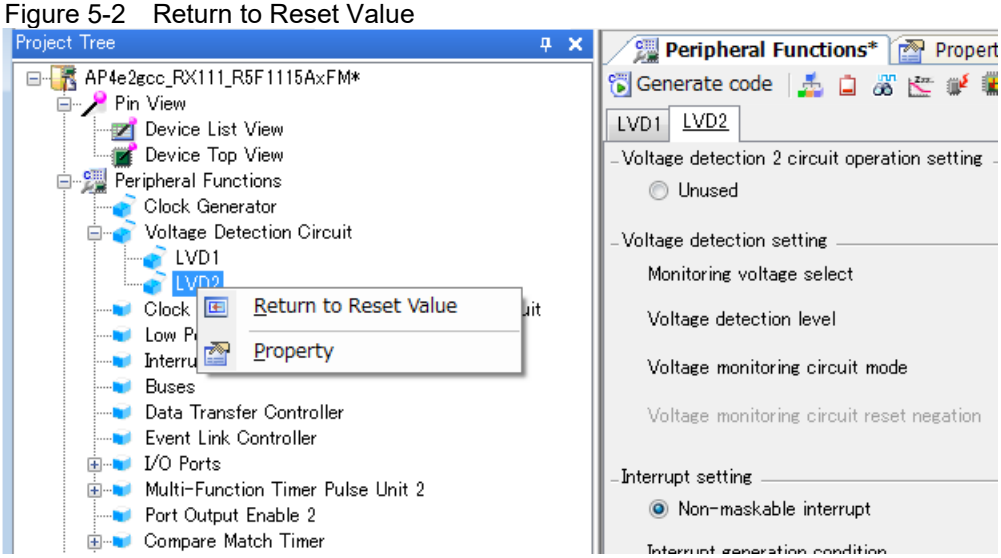


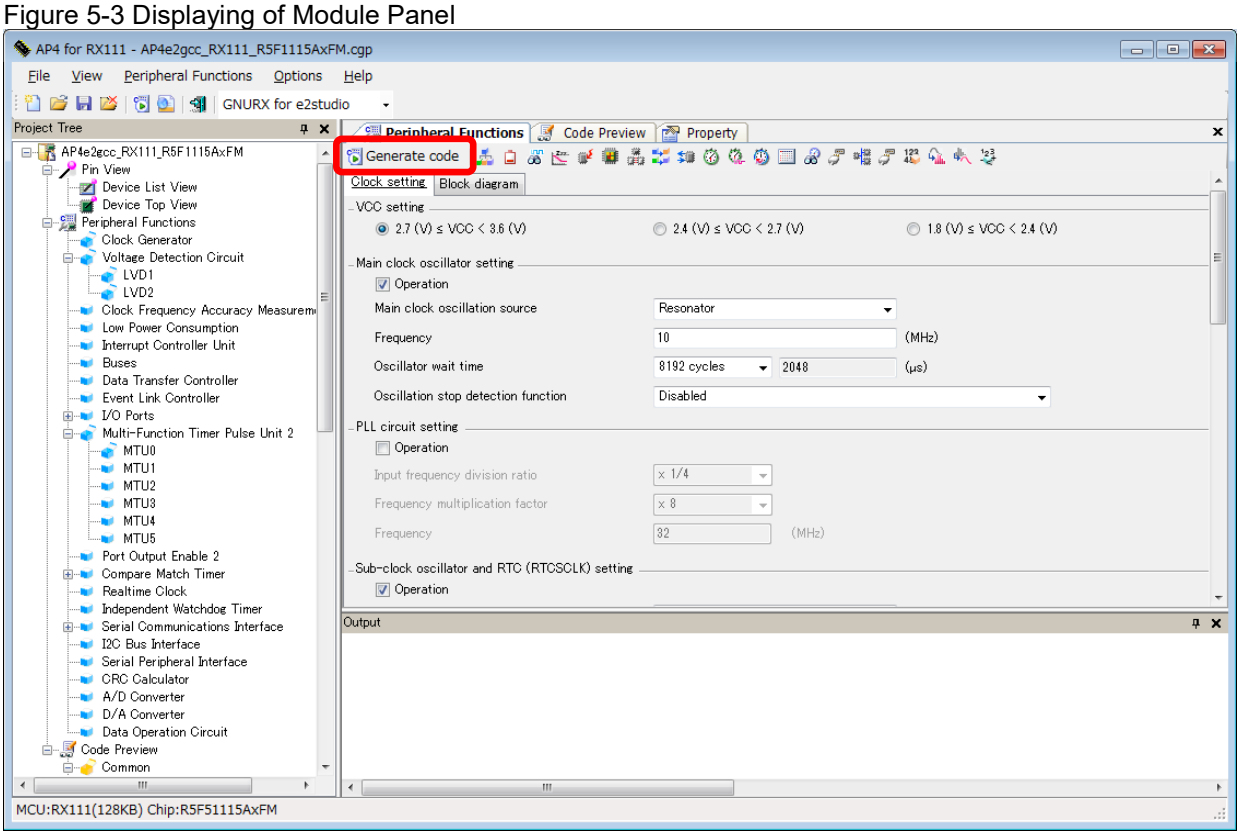
Table 5-2 Project Tree Panel Context Menu

Item	Description
[Return to Reset Value]	Resets the settings for a selected peripheral function to their AP4 default. The range of initial settings may vary by function.

5.2 Module Panel

The Module panel allows you to set peripheral functions. For a description on how to operate the Module panel, see “3.6 Setting up a Peripheral Function”.

Figure 5-3 Displaying of Module Panel

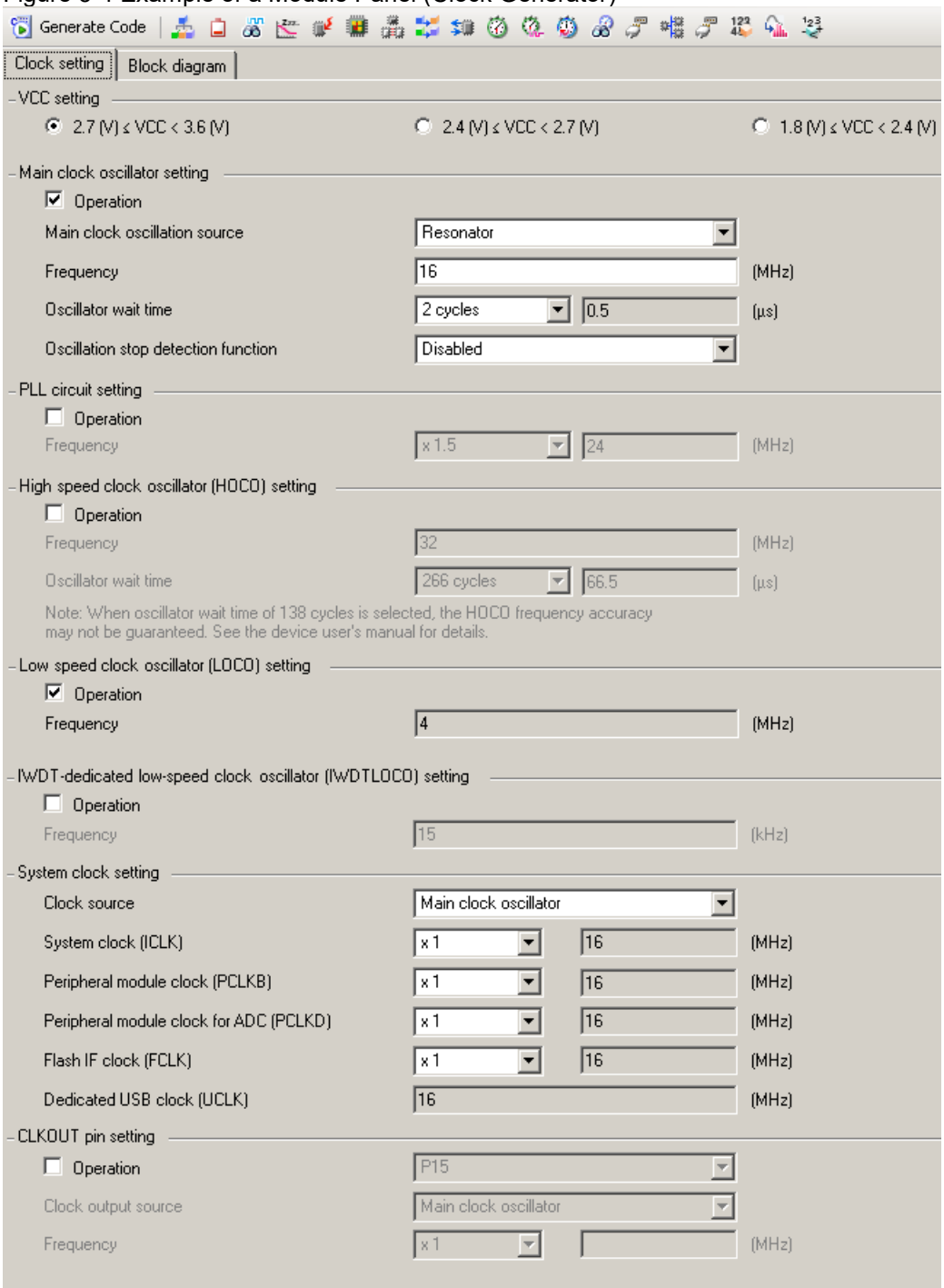


Remark: The display positions of the Module panel and Preview panels can be changed by dragging and dropping the tab.

5.2.1 Example of a Module Panel for Clock Generation Circuits

The figure below shows an example of a Module panel for clock generation circuits. By changing functions to be set through the tabs, you can set an operation, by function. Executing [Return to Reset Value] from the Project Tree panel resets all tab settings to their default values.

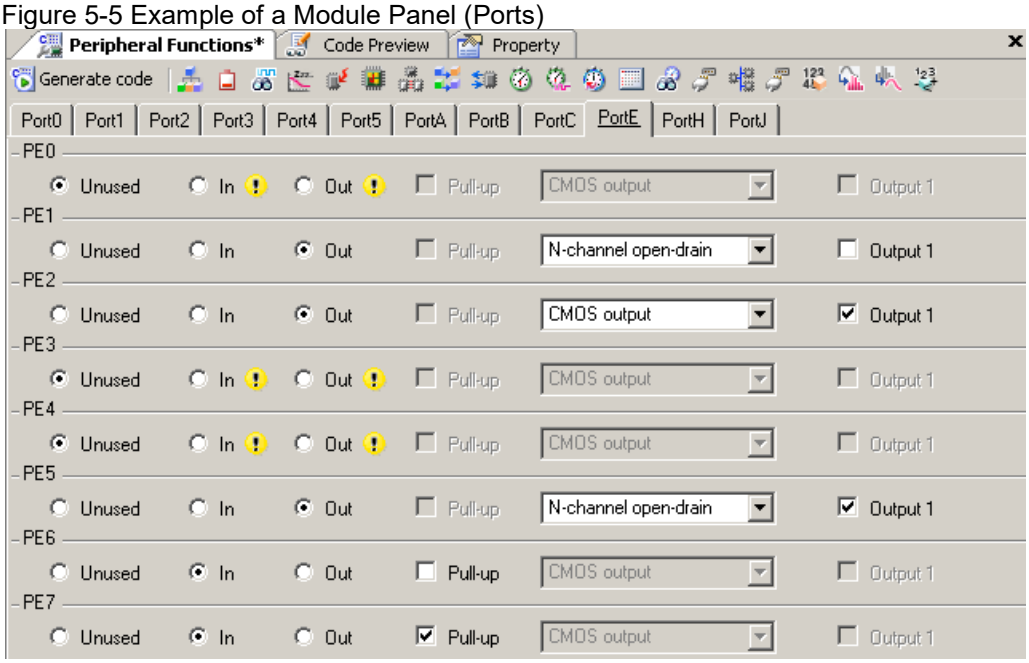
Figure 5-4 Example of a Module Panel (Clock Generator)



5.2.2 Example of a Module Panel for Ports

The figure below shows an example of a Module panel for ports. By changing ports to be set through the tabs, you can set peripheral function operations by port. Executing [Return to Reset Value] from the Project Tree panel resets all tab (port) settings to their default values.

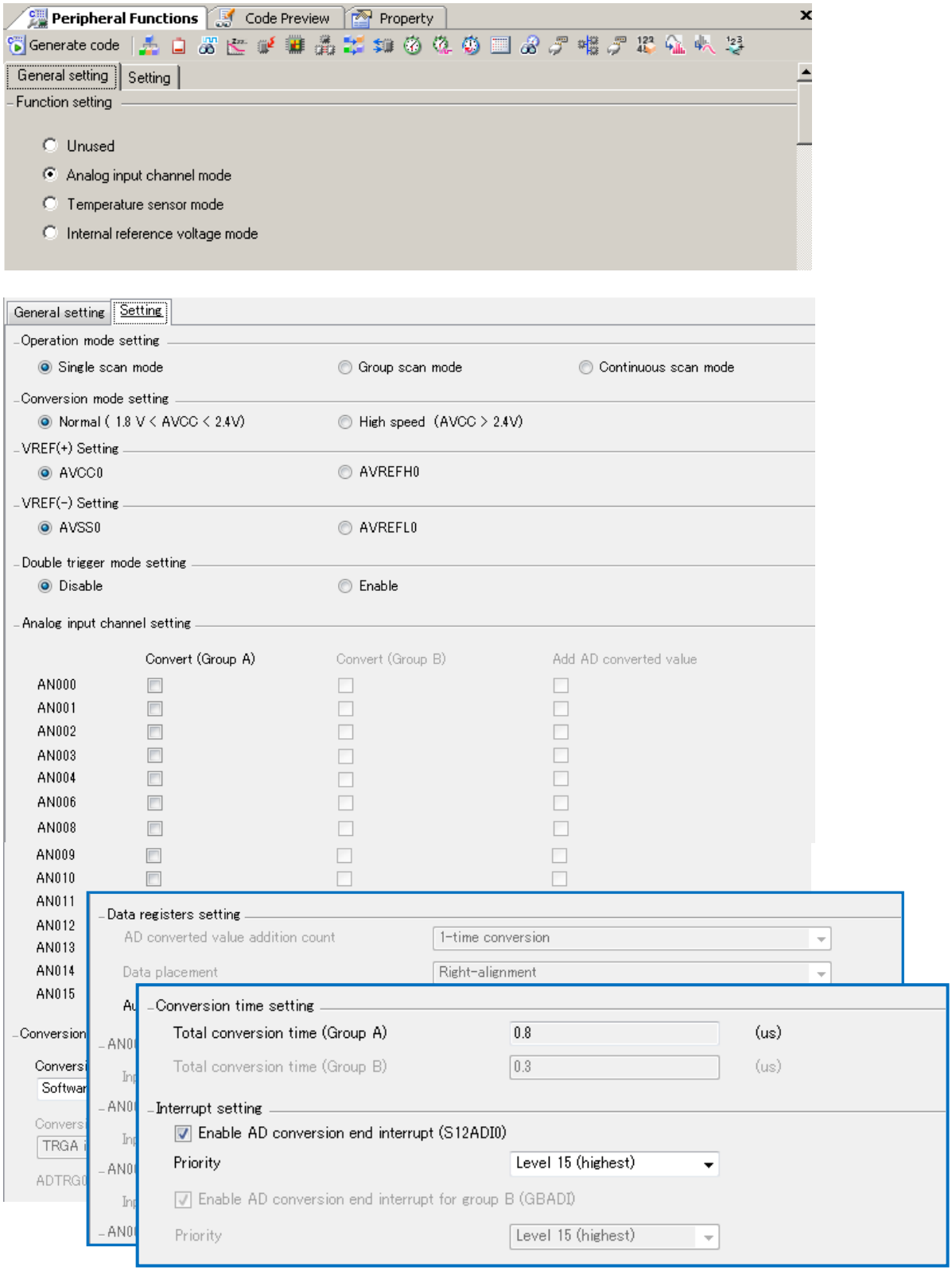
Figure 5-5 Example of a Module Panel (Ports)



5.2.3 Example of a Module Panel for a Peripheral Function (1 Channel)

The figure below shows an example of a Module panel for a peripheral function with only one channel installed. The operation of the peripheral function can be set by setting the various items that are displayed on the panel. Executing [Return to Reset Value] from the Project Tree panel resets the settings to their default values.

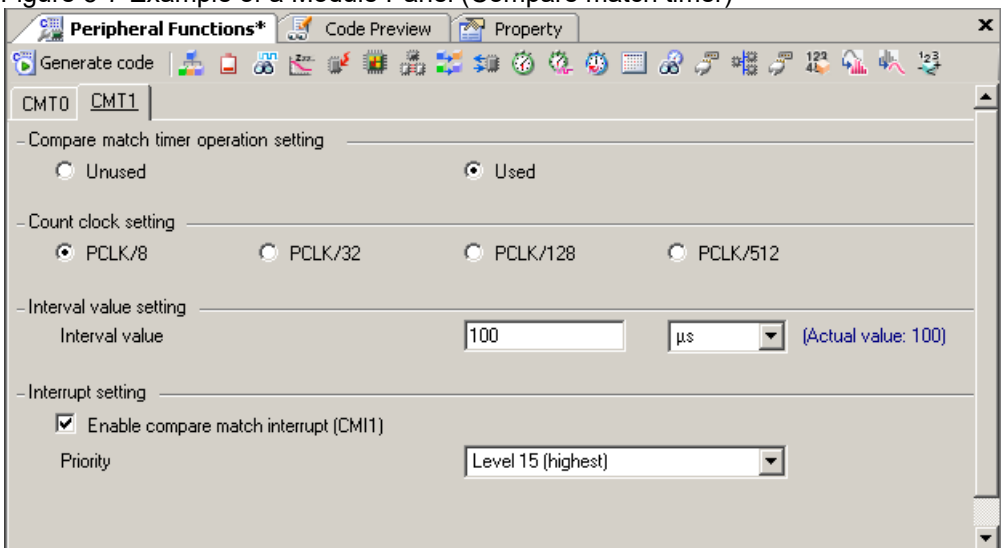
Figure 5-6 Example of a Module Panel (A/D Converter)



5.2.4 Example of a Module Panel for a Peripheral Function (Multiple Channels)

The figure below shows an example of a Module panel for a peripheral function containing multiple channels. By changing channels to be set through the tabs, you can set peripheral function operations, by channel. Executing [Return to Reset Value] from the Project Tree panel resets the settings for the currently selected channel to their default values.

Figure 5-7 Example of a Module Panel (Compare match timer)

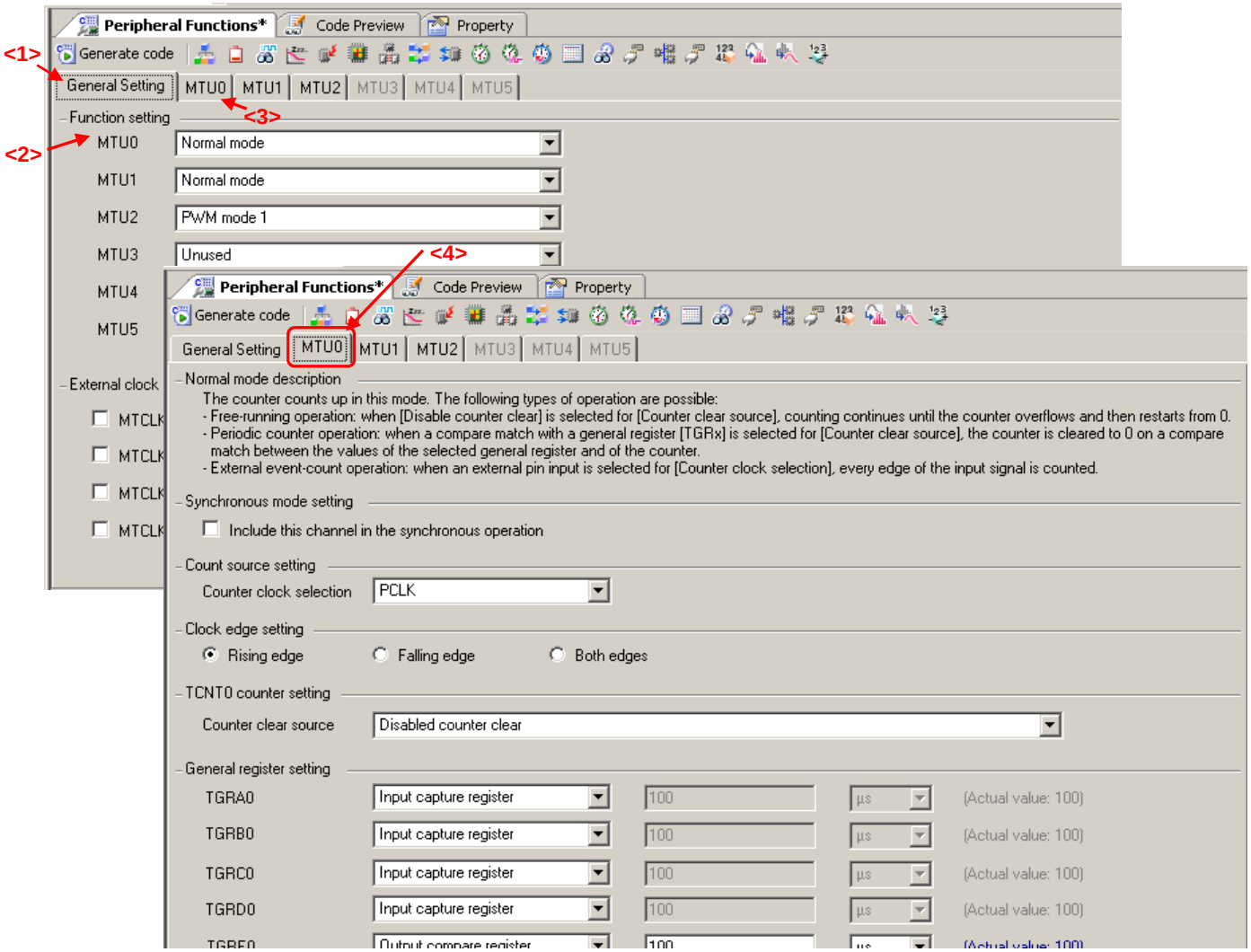


Caution: Executing the [Return to Reset Value] when a target peripheral function is not displayed on the Module panel resets the settings for the starting channel (the leftmost tab) to their default values.

5.2.5 Example of a Module Panel for a Peripheral Function (1 Unit)

The figure below shows an example of a Module panel in which settings change by channel, according to a selected function. For each channel, select the function to be used, and for each selected channel, set details. Executing [Return to Reset Value] from the Project Tree panel resets all tab (channel) settings to their default values.

Figure 5-8 Example of a Module panel (Multi-Function Timer Pulse Unit2)



Remark: In the example shown in Figure 5-7, settings are specified in the following order:

<1> Select the [general Setting] tab.

<2> Select MTU0 function (the [MTU0] tab is enabled).

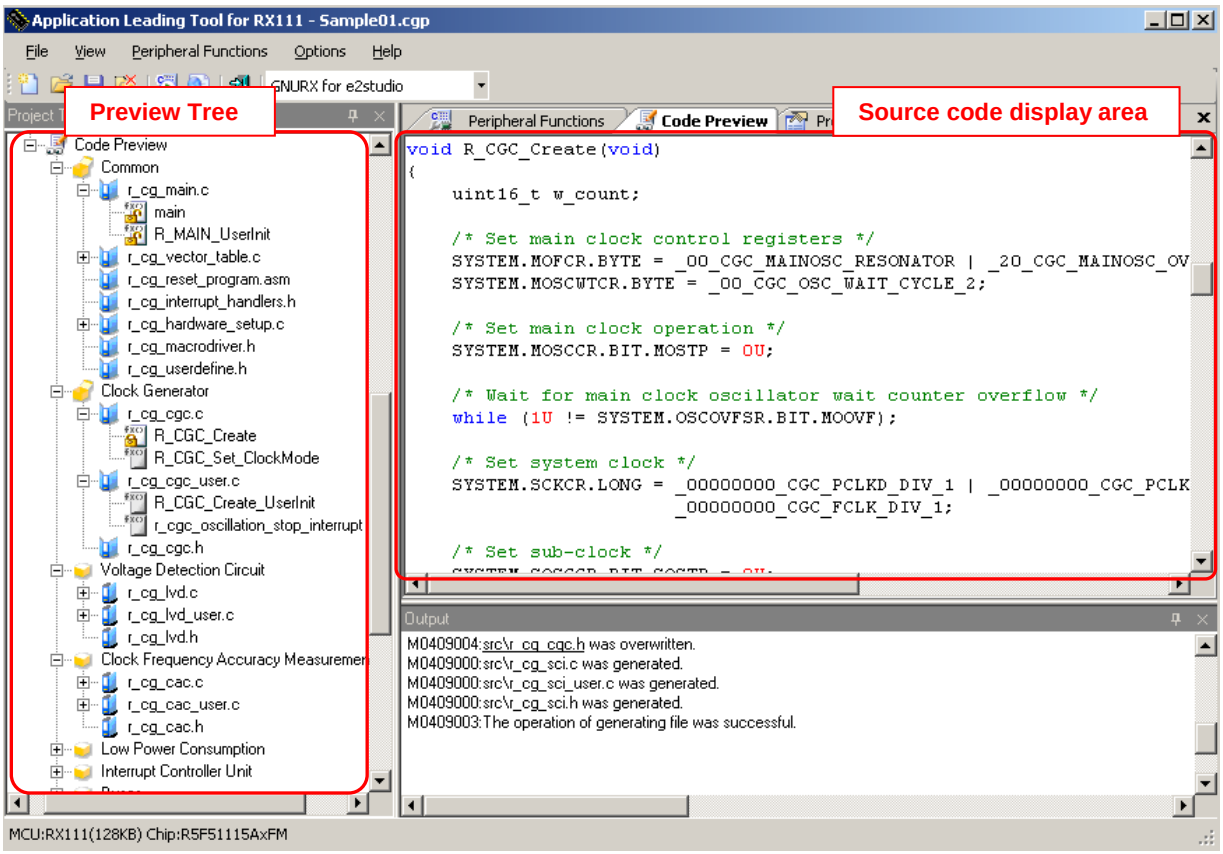
<3> Select the [MTU0] tab.

<4> Set details on MTU0.

5.3 Preview Panel

The Preview panel is used to the file and the API function to be output during code generation. For a description of operating procedure, see “3.7 Checking Source Code”.

Figure 5-9 Display of Preview Panel



（1） Preview Tree

Double-clicking the source file or API function name on the Preview tree changes the display of the source code display area.

On the Preview tree, the shapes of the icons change according to the status of the settings.

Table 5-3 Preview Tree Icons

Icon	Summary
	Peripheral function (used)
	Peripheral function (unused)
	File
	The API function to be output during code generation (required)
	The API function to be output during code generation (user-specifiable)
	The API function not to be output during code generation (user-specifiable)

Right-clicking the API function/file name brings up the context menu.

Table 5-4 Preview Tree Context Menu

Item	Object of action	Description
[Generate Code]	API function (,)	Sets the API function as an object of output for code generation. The icon changes from to .
[Not Generate Code]		Excludes the API function from the object of output for code generation. The icon changes from to .
[Rename]	API function (, ,) File ( )	Renames the API function name/file name that is output during code generation. The name changes to the Edit mode.
[Default]		Resets to an Applilet3 initial value the API function name/file name that is output during code generation.

(2) Source code display area

Verifies the source code (a device driver program). Double-clicking the source file name or the API function name on the Preview Tree switches the source code that is displayed.

The source code in this area is displayed in character colors listed in Table 5-5.

Table 5-5 Source Code Character Colors

Color of display	Summary
Green	Comment statement
Blue	C compiler reserved word
Red	Numeric value
Black	Code
Gray	File name

Remarks **1.** Source code cannot be edited in this area.

2. In some API functions (such as API functions for a serial array unit), register value SFRs and other values are calculated during the code generation process before the function is finalized. For this reason, the source code displayed in this area may not agree with the source code that is actually output.

Figure 5-10 Example of an AP Function Display

```
void INTP_Init( void )
{
        EGP0 = INTP_EGP_RESET_VALUE;
        EGN0 = INTP_EGN_RESET_VALUE;
        EGP1 = INTP_EGP_RESET_VALUE;
        EGN1 = INTP_EGN_RESET_VALUE;
        INTP_User_Init();
}
```

If this API function (INTP_Init()) is output, the function is called here.
During code generation, whether this line is to be or not to be actually output depends on the settings for the API function (INTP_User_Init()) that is called.

5.4 Property Panel

The Property panel displays information such as the generate file mode and the API function to be output during code generation. For a description of operating procedure, see “3.7 Checking Source Code”.

Figure 5-11 Display of Property Panel

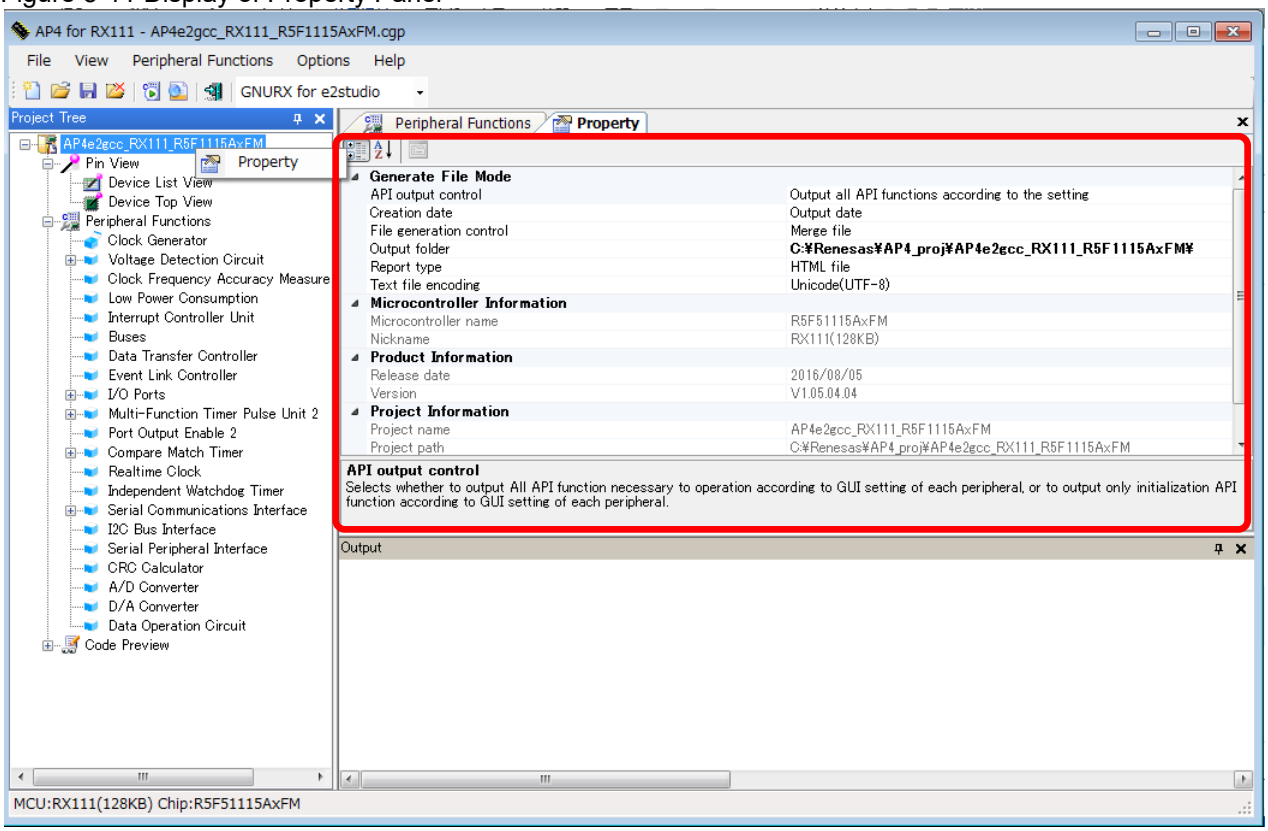


Table 5-6 Property Panel Icons

Icon	Summary
	Listed in Itemized
	Listed in an alphabetical order

Table 5-7 Property Panel Menu

Item	the node selected in the Project Tree panel.	Description
Generate File Mode		
API output control	 Project name	API function output control can be selected from “output all API functions according to the setting”, and “output only initialization API function.” The default is “output all according to the settings”. Selecting the “output only initialization API function” option skips the generation of the file R_xxx_user.c that codes interrupt handlers, in which case all interrupt handlers must be coded by the customer himself/herself.
Text file encoding		Selects the format of encoding.

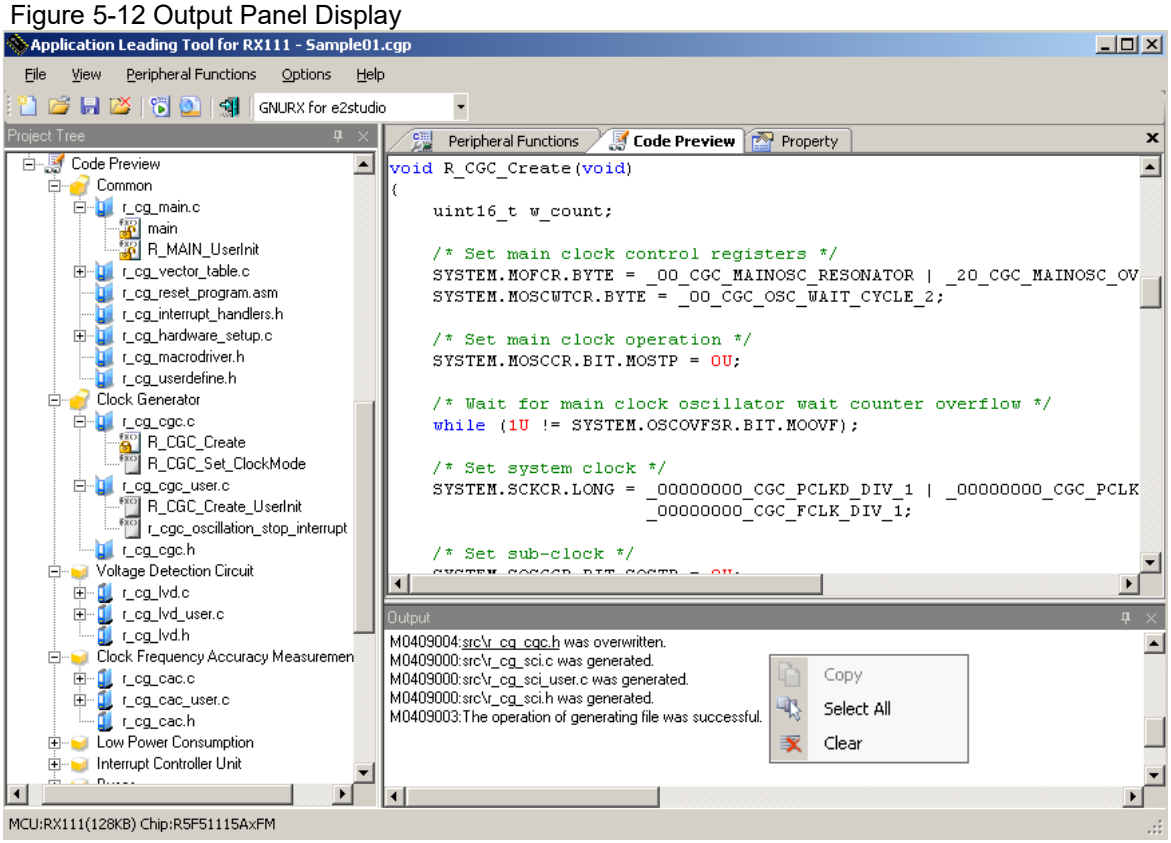
Item	the node selected in the Project Tree panel.	Description
File generation control		File generation control can be selected from: overwrite file, merge files, and do nothing if a file already exists. The default is “Merge file”
Report type		Select either HTML or CSV. The default is “HTML file”.
Output folder		Specify the destination folder of output files.
Creation date		Selects whether to output creation date. The default is “Output date”.
Project Information		
Project path	Project name	Displays Project path.
Project name		Displays Project name.
Project type		Displays Project type.
Microcontroller Information		
Microcontroller name	Project name	Displays Microcontroller name.
Nickname		Displays Nickname.
Product Information		
Version	Project name	Displays Version.
Release date		Displays Release date.
Device top view color setting		
Device	Device Top View	Select color setting of Device. The default is 128, 128, 128
Device group text		Select color setting of Device group text. The default is 192, 192, 192
Used pins		Select color setting of Used pins. The default is 144, 238, 144
Alternate function pins		Select color setting of Alternate function pins. The default is 255, 0, 255
Macro highlight		Select color setting of Macro highlight. The default is 255, 255, 0
Device part number text		Select color setting of Device part number text. The default is 192, 192, 192
Unused pins		Select color setting of Unused pins. The default is 176, 196, 222
Conflict pins		Select color setting of Conflict pins. The default is 255, 0, 0
Warning pins		Select color setting of Warning pins. The default is 255, 215, 0
Peripheral function Information		
Peripheral function used	Peripheral function	Displays whether using the peripheral function.
Peripheral function error		Displays whether there is error in the peripheral function.
Peripheral function name		Displays the peripheral function name.
File Information		

Item	the node selected in the Project Tree panel.	Description
Default name	Fie	Select whether to return the file name to the default name. The default is “Yes”. To restore the default file name defined by the Code Generator, select [Default] from the context menu.
File used		Display whether or not output to a file is to proceed when the [generate code] button is clicked. Note that whether or not this option is used depends on the settings in the Peripheral Functions panel corresponding to the selected node.
File name		Inputs the name of the file The name of the file can be changed by selecting [Rename] from the context menu after selecting the source code node in the Project Tree panel.
Output folder		Displays the output destination folder. Note that the output destination folder can be changed by using the above [Output folder].
Function Information		
Default name	API	Selects whether or not to restore the default name of the API function. Note that the default name of the API function can be restored by selecting [Default] from the context menu after selecting the source code node in the Project Tree panel.
Function generated		Selects whether or not to output the API function when the [Generate Code] button in the Peripheral Functions panel is clicked.
Function name		Inputs the name of the API function. Note that the name of the API function can be changed by selecting [Rename] from the context menu after selecting the API function node in the Project Tree panel.

5.5 Output Panel

The Output panel displays information such as the execution status of code generation or report output, and the allowable setting range for a selected input field.

Figure 5-12 Output Panel Display



Messages that are displayed on the Output panel are color-coded, depending on the type of message involved.

Table 5-8 Message Character Colors

Color	Type	Summary
Black	Normal message	Indicates information such as the execution status of code generation or report output.
Blue	Warning message	Displays a warning if the value in the input field is invalid.
Red	Error message	Indicates that the execution of processing is disabled due to a fatal error or other reasons.

Right-clicking the Output panel displays a context menu.

Table 5-9 Output Panel Context Menu

Item	Description
Clear	Selecting [Clear] from the context menu deletes all messages that are displayed on the Output panel.
Copy	Dragging a message (character string) on the Output panel selects (producing an inverted color display) the character string. Selecting [Copy] from the context menu copies the selected (inverted color display) character string (stores it in the clipboard).
Select All	Selects (in inverted color display) all the messages (character strings) on the Output panel.

Revision History

		Description	
Rev.	**Date**	**Page**	**Summary**
Rev.1.00	Mar. 31, 2015	-	First Edition issued
Rev.1.01	Oct. 31, 2016	All	Tool name changed (applilet -> AP4)
		All	Figure, updated
		32	3.12.1 How to create a project connection between IAR Embedded Workbench and AP4, added
		50	5.4 Property Panel, added

AP4, Applilet3 Common Operations User's Manual

Publication Date: Rev.1.00 Mar. 31, 2015
Rev.1.01 Oct. 31, 2016

Published by: Renesas Electronics Corporation

SALES OFFICES Renesas Electronics Corporation http://www.renesas.com

Refer to "http://www.renesas.com/" for the latest and detailed information.

Renesas Electronics America Inc.
2801 Scott Boulevard Santa Clara, CA 95050-2549, U.S.A.
Tel: +1-408-588-6000, Fax: +1-408-588-6130

Renesas Electronics Canada Limited
9251 Yonge Street, Suite 8309 Richmond Hill, Ontario Canada L4C 9T3
Tel: +1-905-237-2004

Renesas Electronics Europe Limited
Dukes Meadow, Millboard Road, Bourne End, Buckinghamshire, SL8 5FH, U.K
Tel: +44-1628-585-100, Fax: +44-1628-585-900

Renesas Electronics Europe GmbH
Arcadiastrasse 10, 40472 Düsseldorf, Germany
Tel: +49-211-6503-0, Fax: +49-211-6503-1327

Renesas Electronics (China) Co., Ltd.
Room 1709, Quantum Plaza, No.27 ZhiChunLu Haidian District, Beijing 100191, P.R.China
Tel: +86-10-8235-1155, Fax: +86-10-8235-7679

Renesas Electronics (Shanghai) Co., Ltd.
Unit 301, Tower A, Central Towers, 555 Langao Road, Putuo District, Shanghai, P. R. China 200333
Tel: +86-21-2226-0888, Fax: +86-21-2226-0999

Renesas Electronics Hong Kong Limited
Unit 1601-1611, 16/F., Tower 2, Grand Century Place, 193 Prince Edward Road West, Mongkok, Kowloon, Hong Kong
Tel: +852-2265-6688, Fax: +852 2886-9022

Renesas Electronics Taiwan Co., Ltd.
13F, No. 363, Fu Shing North Road, Taipei 10543, Taiwan
Tel: +886-2-8175-9600, Fax: +886 2-8175-9670

Renesas Electronics Singapore Pte. Ltd.
80 Bendemeer Road, Unit #06-02 Hyflux Innovation Centre, Singapore 339949
Tel: +65-6213-0200, Fax: +65-6213-0300

Renesas Electronics Malaysia Sdn.Bhd.
Unit 1207, Block B, Menara Amcorp, Amcorp Trade Centre, No. 18, Jln Persiaran Barat, 46050 Petaling Jaya, Selangor Darul Ehsan, Malaysia
Tel: +60-3-7955-9390, Fax: +60-3-7955-9510

Renesas Electronics India Pvt. Ltd.
No.777C, 100 Feet Road, HALII Stage, Indiranagar, Bangalore, India
Tel: +91-80-67208700, Fax: +91-80-67208777

Renesas Electronics Korea Co., Ltd.
12F., 234 Teheran-ro, Gangnam-Gu, Seoul, 135-080, Korea
Tel: +82-2-558-3737, Fax: +82-2-558-5141

© 2016 Renesas Electronics Corporation. All rights reserved.

Colophon 4.0

AP4, Applilet3 Common Operations

User's Manual

Renesas Electronics Corporation

R20UT3420EJ0101