To our customers,

Old Company Name in Catalogs and Other Documents

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April 1st, 2010
Renesas Electronics Corporation

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RENESAS

Application Note

78K0S/Kx1+

Sample Program

Startup Guide

This document describes how to download and install the development environment required for using sample programs and how to use the sample programs.

Target devices

78K0S/KA1+ microcontroller
78K0S/KB1+ microcontroller
78K0S/KU1+ microcontroller
78K0S/KY1+ microcontroller

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Date Published September 2008 N

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PREFACE

Target Readers

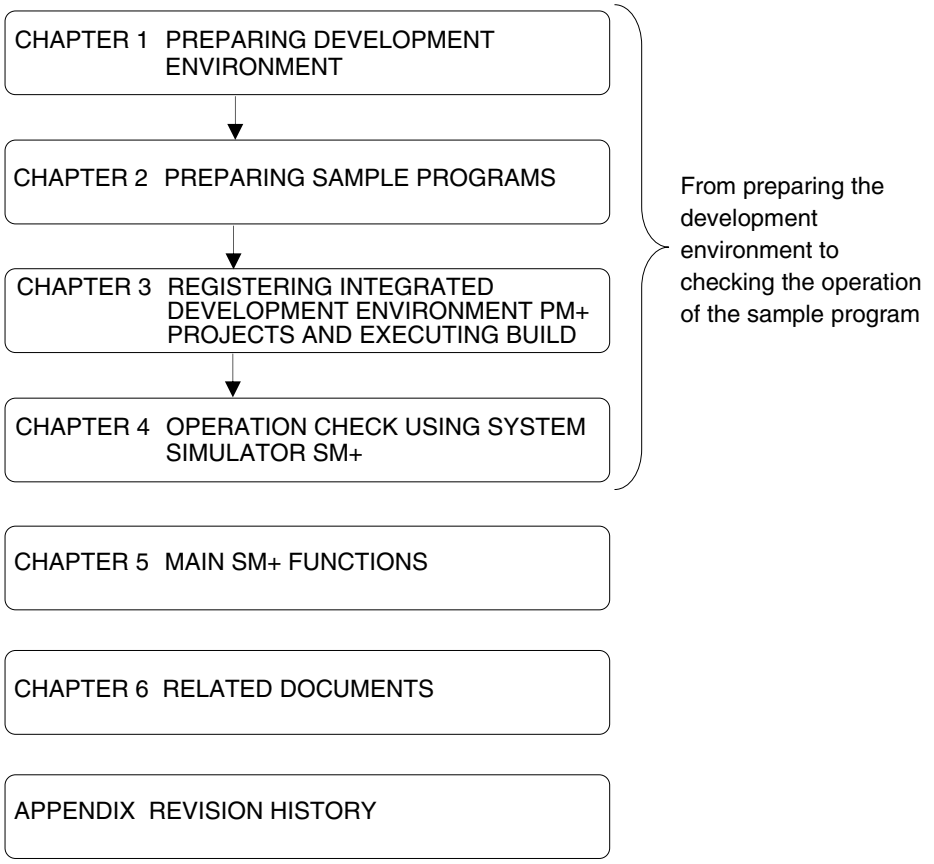
This manual is intended for customers using sample programs for the first time as well as customers using the 78K0S/Kx1+ microcontroller development tools for the first time. To use the development tools, basic knowledge on how to operate Windows™ is required.

Purpose

This manual is intended for customers to understand how to use sample programs and the basic operation of the 78K0S/Kx1+ microcontroller development tools. A deeper understanding of how to use sample programs and the basic operation of the development tools can be obtained when the tools are actually operated while reading this manual.

Organization

This manual consists of the following chapters.



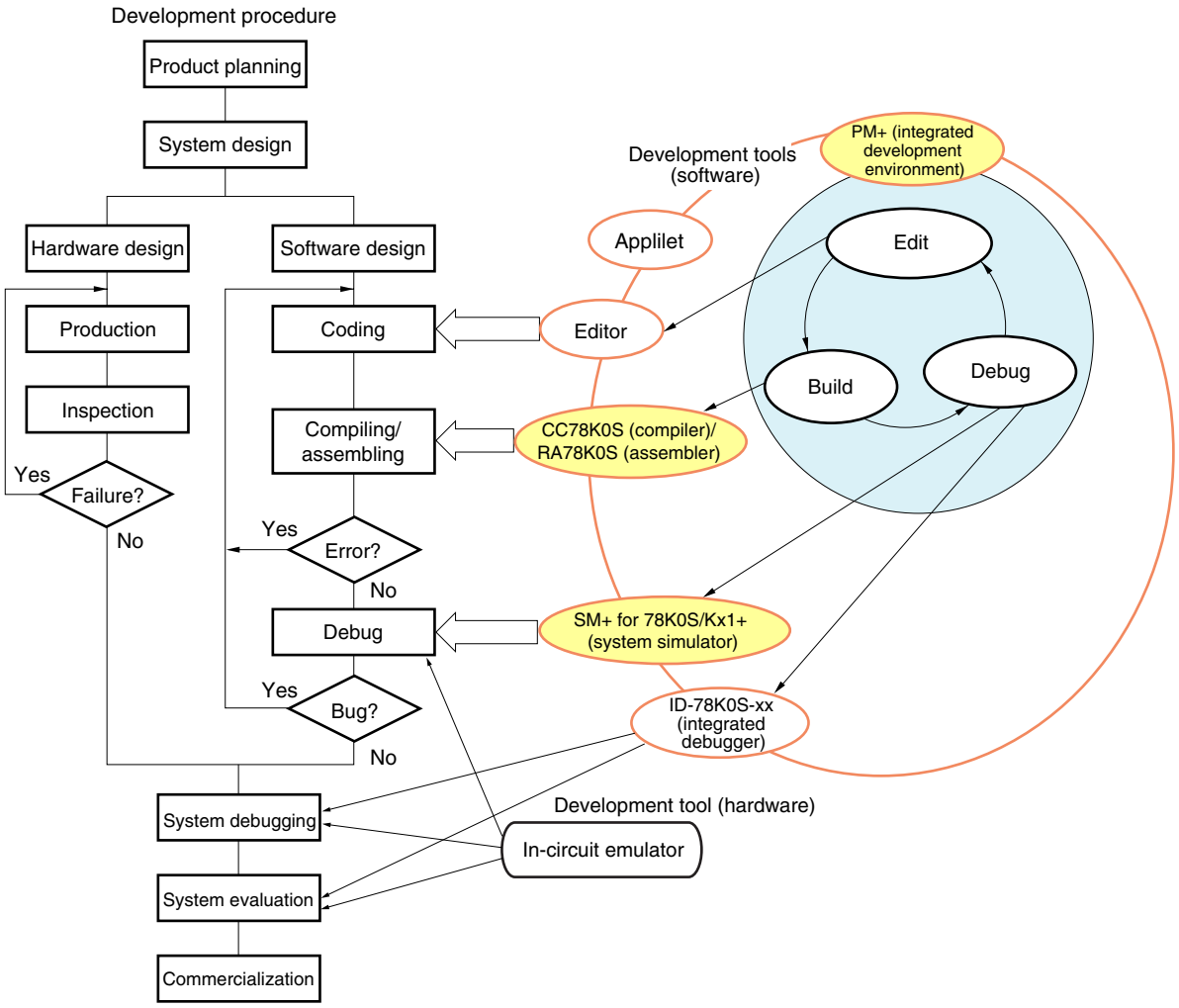
The descriptions in chapter 2 and the following chapters use the sample program (initial setting) for the 78K0S/KB1+ microcontroller as an example.

CHAPTER 1 PREPARING DEVELOPMENT ENVIRONMENT

This chapter describes the preparation of the development environment.

1.1 Relation Between the Development Procedure and the Development Tools

The following figure shows the development procedure and development tools.



To check the operation of a sample program, the development tools in the shaded ovals are used.

1.2 Configuration of Development Environment

To check the operation of a sample program, the following development tools must be installed.

(1) Device file

This file contains device-specific information. It is used in combination with each tool (CC78K0S, RA78K0S, SM+ for 78K0S/Kx1+).

(2) CC78K0S (C compiler)

This is a highly versatile and portable C compiler developed for coding embedded control programs for the 78K0S microcontroller in C language. PM+ is required to operate CC78K0S on Windows.

(3) RA78K0S (assembler)

RA78K0S generates an execution code that can be executed from the assembler source program using the 78K0S microcontroller. PM+ is required to operate RA78K0S on Windows.

(4) PM+ (integrated development environment)

This is an integrated development environment to be used on Windows. It enables efficient development by operating in combination with development tools, such as editors, compilers, and debuggers.

(5) SM+ for 78K0S/Kx1+ (system simulator)

SM+ for 78K0S/Kx1+ simulates the execution code created for the 78K0S/Kx1+ microcontroller, on the host PC.

To obtain the above tools, contact your sales representative.

CHAPTER 2 PREPARING SAMPLE PROGRAMS

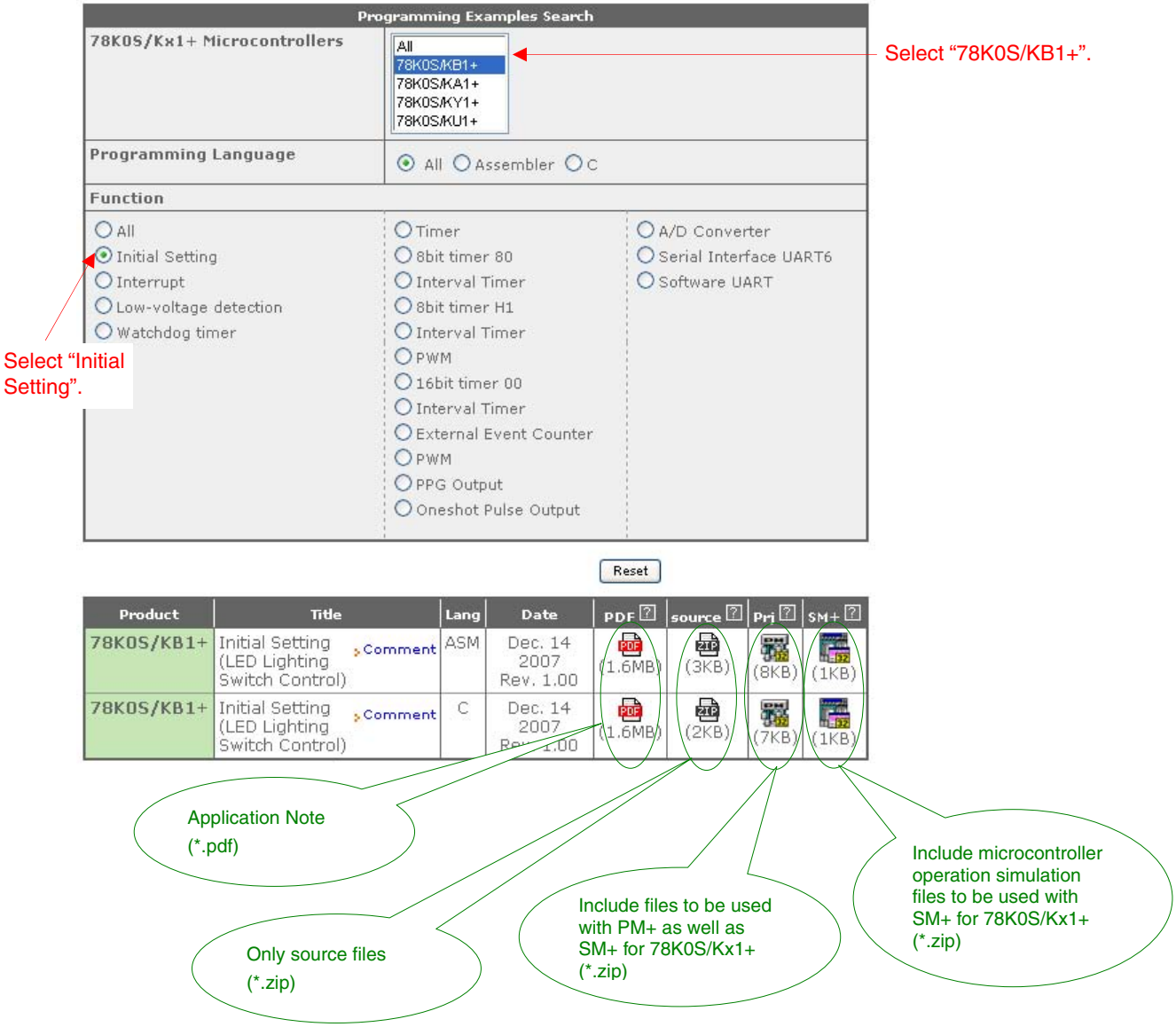
This chapter describes the preparation of the sample programs.

2.1 Downloading Sample Programs

The sample programs for the 78K0S/Kx1+ microcontroller can be obtained from the following Web site.

→ http://www.necel.com/micro/en/designsupports/sampleprogram/78k0s/low_pin_count/index.html

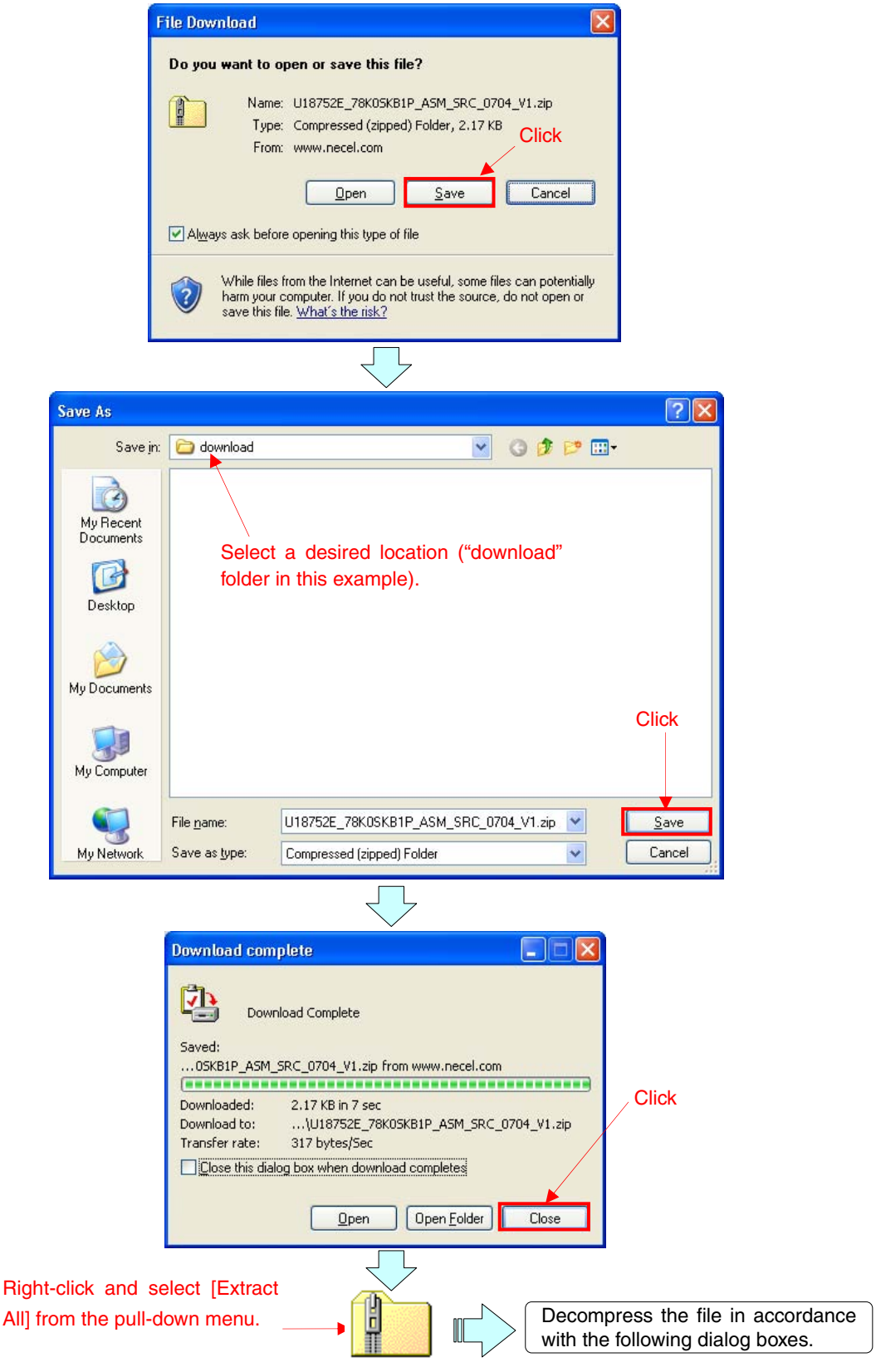
<78K0S/KB1+ microcontroller sample program (initial setting)>



Click to open a PDF file (Application Note).

Click , , to launch the download dialog box of a compressed file. Click the [Save] button to save the file to a desired location. Decompress the file after saving it.

<Downloading and decompressing a sample program (compressed file)>



2.2 File Configuration

The following files can be downloaded from among the files listed in the table of sample programs.


Application Note (PDF file)


Only the source file is included (ZIP file). ⇒ <Procedure 3.1.1 → 3.2 → 4.1.1 → 4.1.3 → 4.2>


The files to be used with integrated development environment PM+ and system simulator SM+ for 78K0S/Kx1+ are included (ZIP file). ⇒ <Procedure 3.1.2 → 3.2 → 4.1.2 → 4.2>


The microcontroller operation simulation file to be used with system simulator SM+ for 78K0S/Kx1+ is included (ZIP file). ⇒ <Procedure 4.1.3>

The configuration of the files to be downloaded is as follows.

File Name	Description	PDF (*.pdf) File	Compressed (*.zip) File Included		
					
UxxxxxxxxxxANxx.pdf	Application Note of sample program	●			
main.asm (Assembly language version) main.c (C language version)	Source file for hardware initialization processing and main processing of microcontroller		●Note 1	●Note 1	
op.asm	Assembler source file for setting the option byte (sets the system clock source)		●	●	
xxx.prw	Work space file for integrated development environment PM+			●	
xxx.prj	Project file for integrated development environment PM+			●	
xxx.pri xxx.prs xxx.prm	Project file for system simulator SM+ for 78K0S/Kx1+			●Note 2	
xxx.pnl	I/O panel file for system simulator SM+ for 78K0S/Kx1+ (used for checking peripheral hardware operations)			●Note 2	●
xxx0.wvo	Timing chart file for system simulator SM+ for 78K0S/Kx1+ (used for checking waveforms)			**Note 3**	●

Notes 1. “main.asm” is included with the assembly language version, and “main.c” with the C language version.

2. SM+ for 78K0S/Kx1+ is not supported with the 78K0S/KU1+ microcontroller (as of July, 2008). It is therefore not included with the 78K0S/KU1+ microcontroller.

3. This compressed file (source files + project file) does not include “xxx0.wvo”, but it need not be additionally downloaded, because the timing chart itself is saved into the project file.

CHAPTER 3 REGISTERING INTEGRATED DEVELOPMENT ENVIRONMENT PM+ PROJECTS AND EXECUTING BUILD

This chapter describes how to register integrated development environment PM+ projects and how to execute build, using the 78K0S/KB1+ microcontroller sample program (initial setting) as an example. A project must be registered before executing build in PM+.

Remark For the details of how to operate PM+, refer to the PM+ Project Manager User's Manual.

3.1 Project Registration

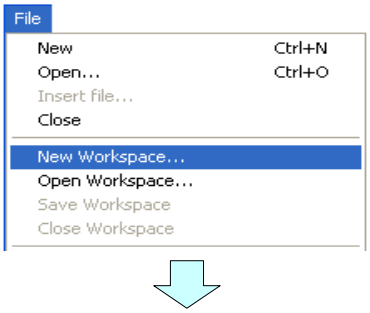
The project registration method varies, depending on the file to be downloaded.

3.1.1 Project registration (only source files)

This section describes how to register a project, using the assembly language source file that has been downloaded by clicking the ZIP icon of the 78K0S/KB1+ microcontroller sample program (initial setting).

(1) Start PM+.

(2) Select [New Workspace] from the [File] menu.



(3) The [New WorkSpace - Step 1/9 [Workspace Information]] dialog box will be displayed. Set the following items.

(a) Workspace File Name

Specify the name of the file to which the workspace information is to be saved. (In the example shown below, the file name is entered as "initial".)

(b) Folder

Specify the folder in which the workspace file and project file are to be saved. Click the [Browse] button to open the [Browse for Folder] dialog box and specify any folder. (In the example below, the arbitrarily created "work" folder under the default folder ("bin" folder in which PM+ is located) is specified.)

(c) Project Group Name

Specify the name of the project group to be displayed on the Project window. (In the example below, the group name is entered as "Initialization".)

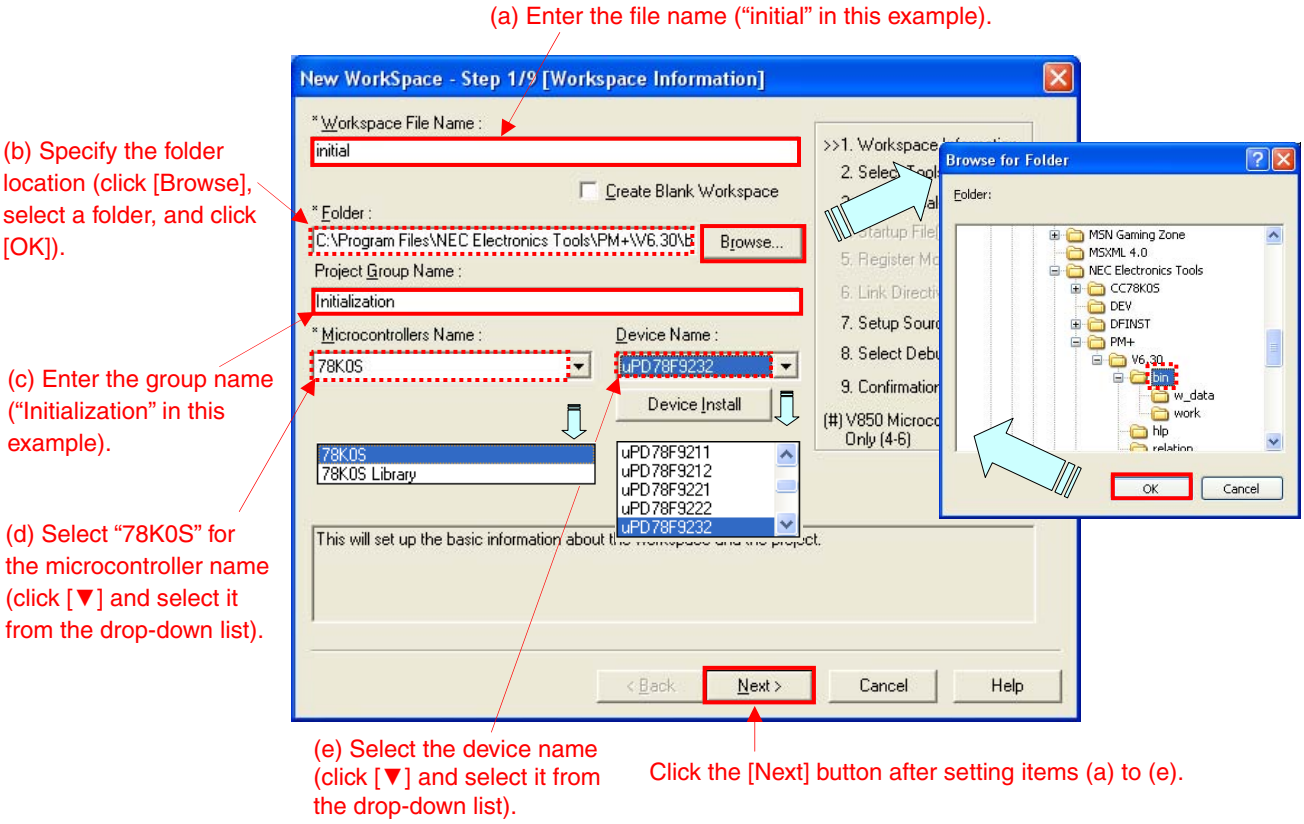
(d) Microcontrollers Name

To use the 78K0S/Kx1+ microcontroller sample program, select “78K0S” from the drop-down list displayed by clicking [▼].

(e) Device Name

Select the sample program of the product to be used. Select from the drop-down list displayed the name of the device to be used, by clicking [▼]. (In the example below, the 78K0S/KB1+ microcontroller product “uPD78F9232” is selected.)

After setting items (a) to (e), click the [Next] button.



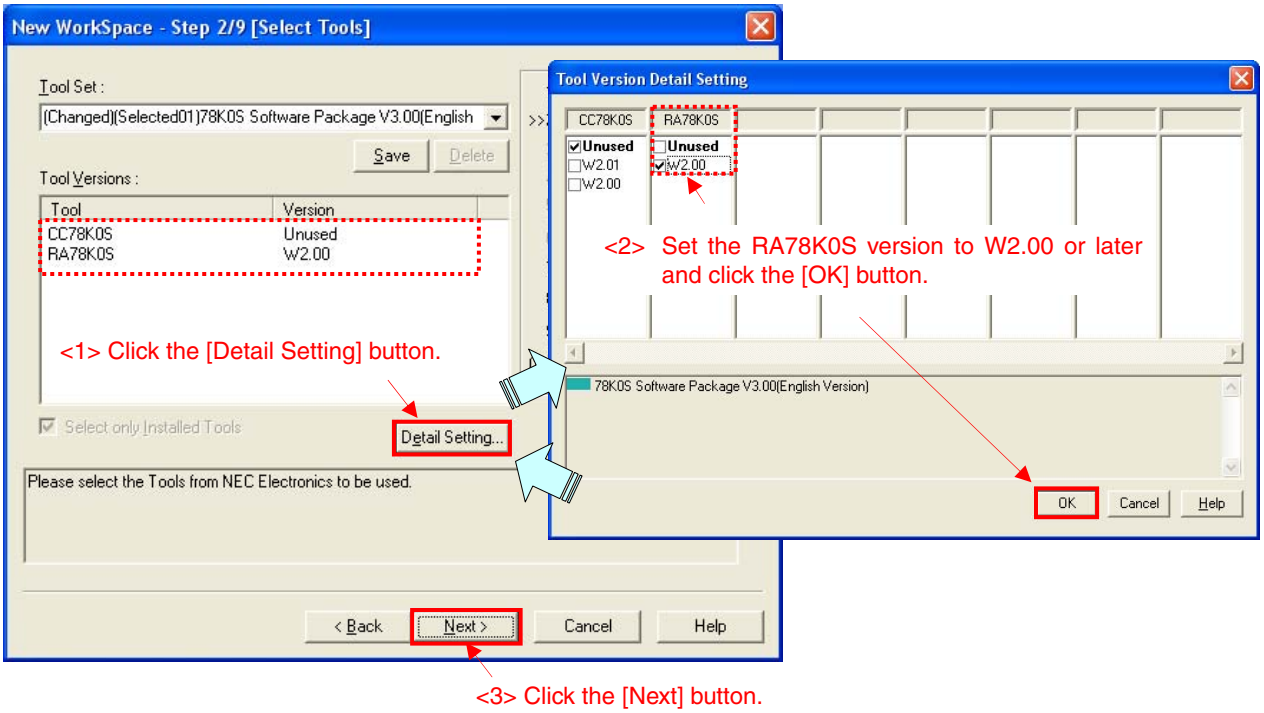
(4) The [New WorkSpace - Step 2/9 [Select Tools]] dialog box will be displayed. Set the tool versions in the order of the following procedure.

<1> Click the [Detail Setting] button.

<2> The [Tool Version Detail Setting] dialog box will be displayed. Set the RA78K0S version to W2.00 or later and click the [OK] button.[Note]

<3> The tools and their versions selected in step <2> will be set. Click the [Next] button.

Note To use the C language source file, set the CC78K0S version to W2.01 or later.

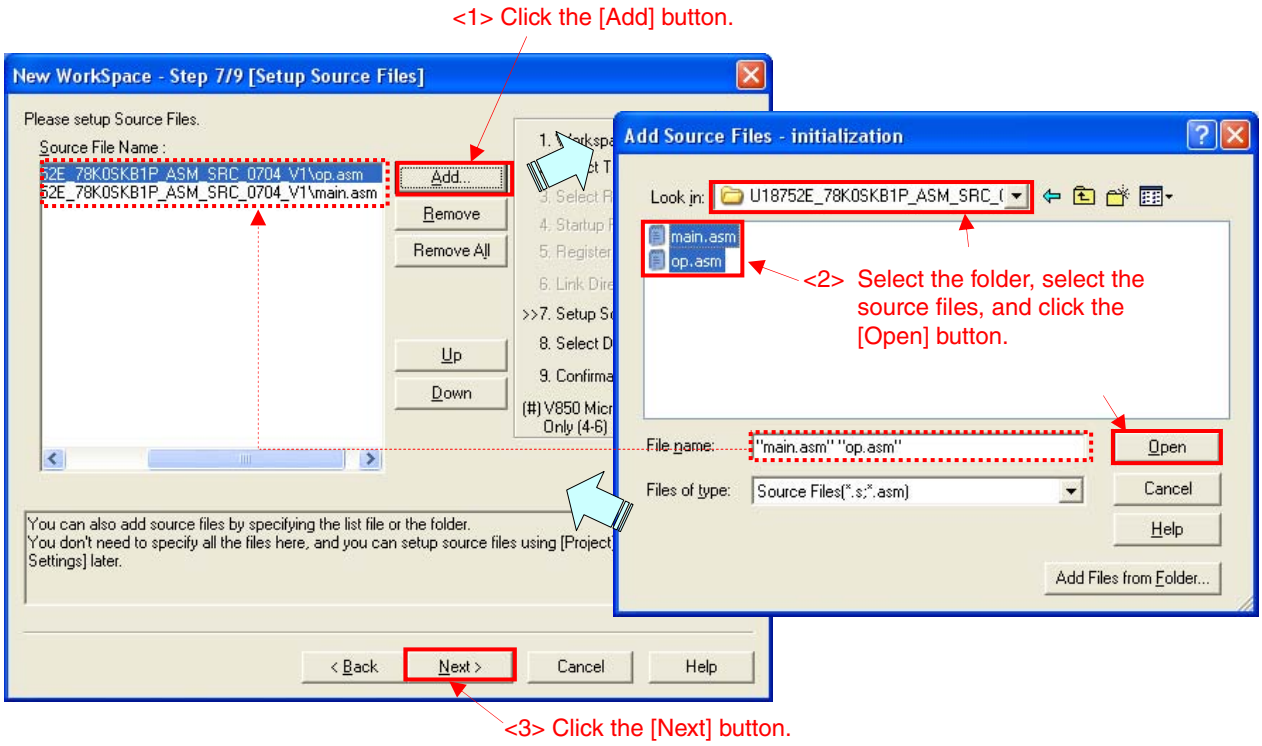


(5) The [New WorkSpace - Step 7/9 [Setup Source Files]] dialog box will be displayed. Set the source files in the order of the following procedure.

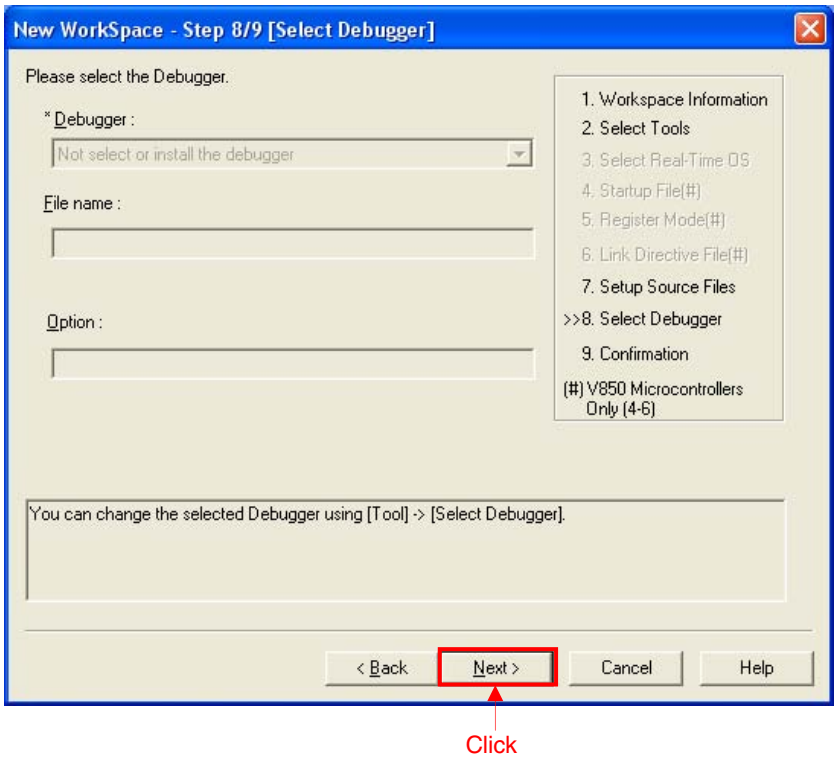
<1> Click the [Add] button.

<2> The [Add Source Files] dialog box will be displayed. Select the source files and click the [Open] button. (In the example below, “main.asm” and “op.asm” are selected from the location where the files have been decompressed in CHAPTER 2 PREPARING SAMPLE PROGRAMS, and the [Open] button is clicked.)

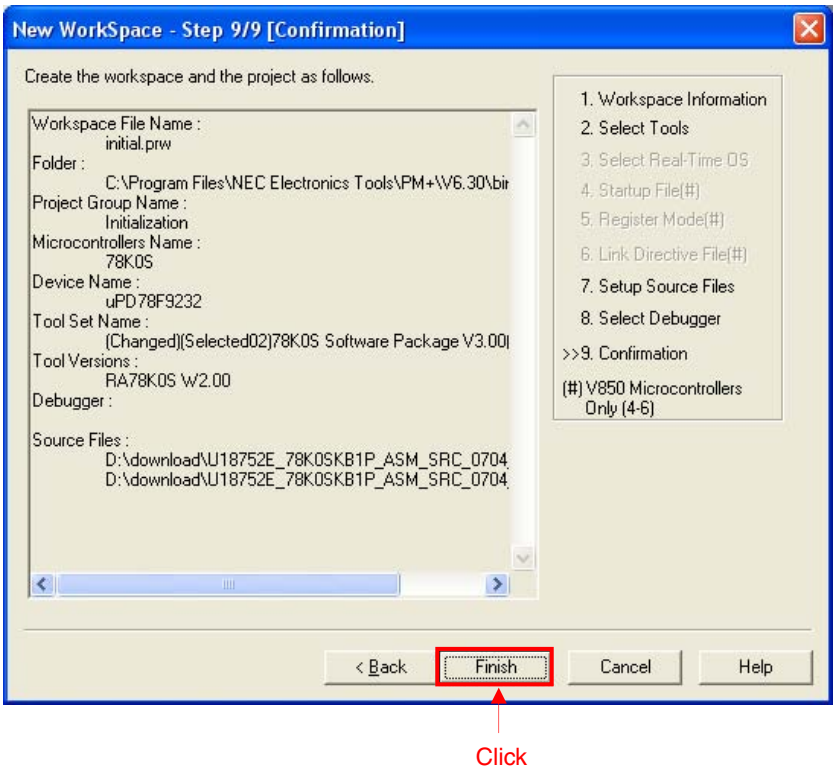
<3> The source files selected in step <2> will be specified. Click the [Next] button.



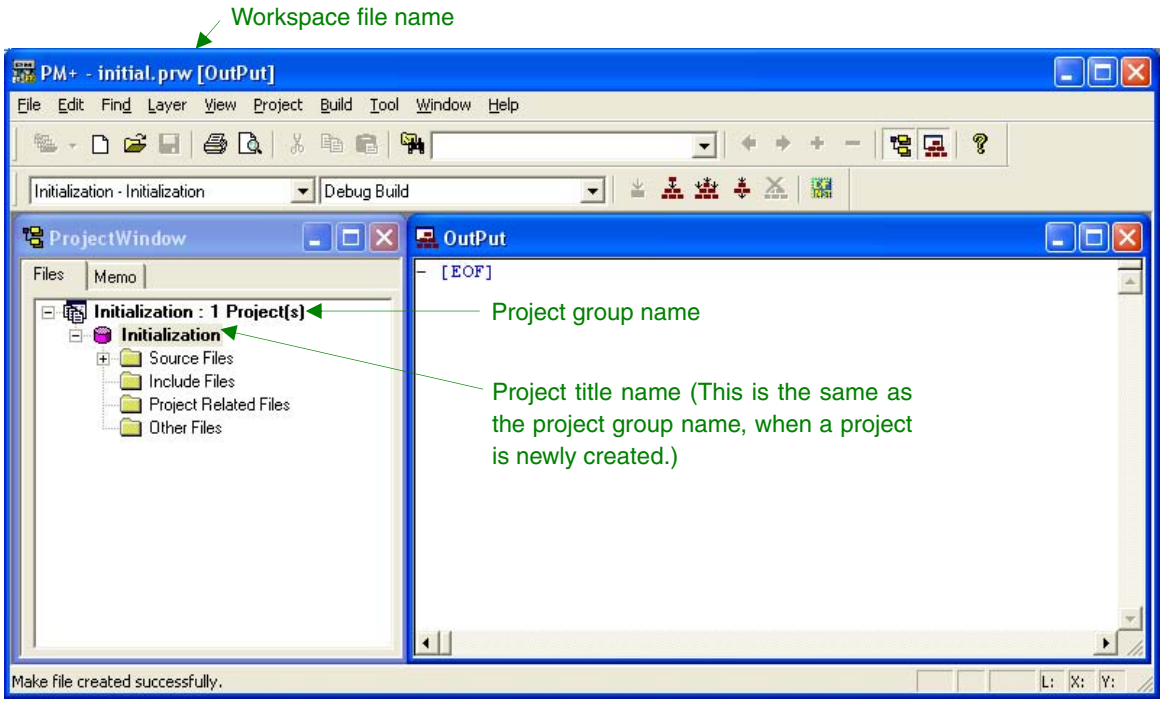
(6) The [New WorkSpace - Step 8/9 [Select Debugger]] dialog box will be displayed. Click the [Next] button.



(7) The [New WorkSpace - Step 9/9 [Confirmation]] dialog box will be displayed. Confirm the settings and click the [Finish] button.



(8) A workspace will be created and the project will be registered. Perform build operation after project registration. (Refer to 3.2 Executing Build.)



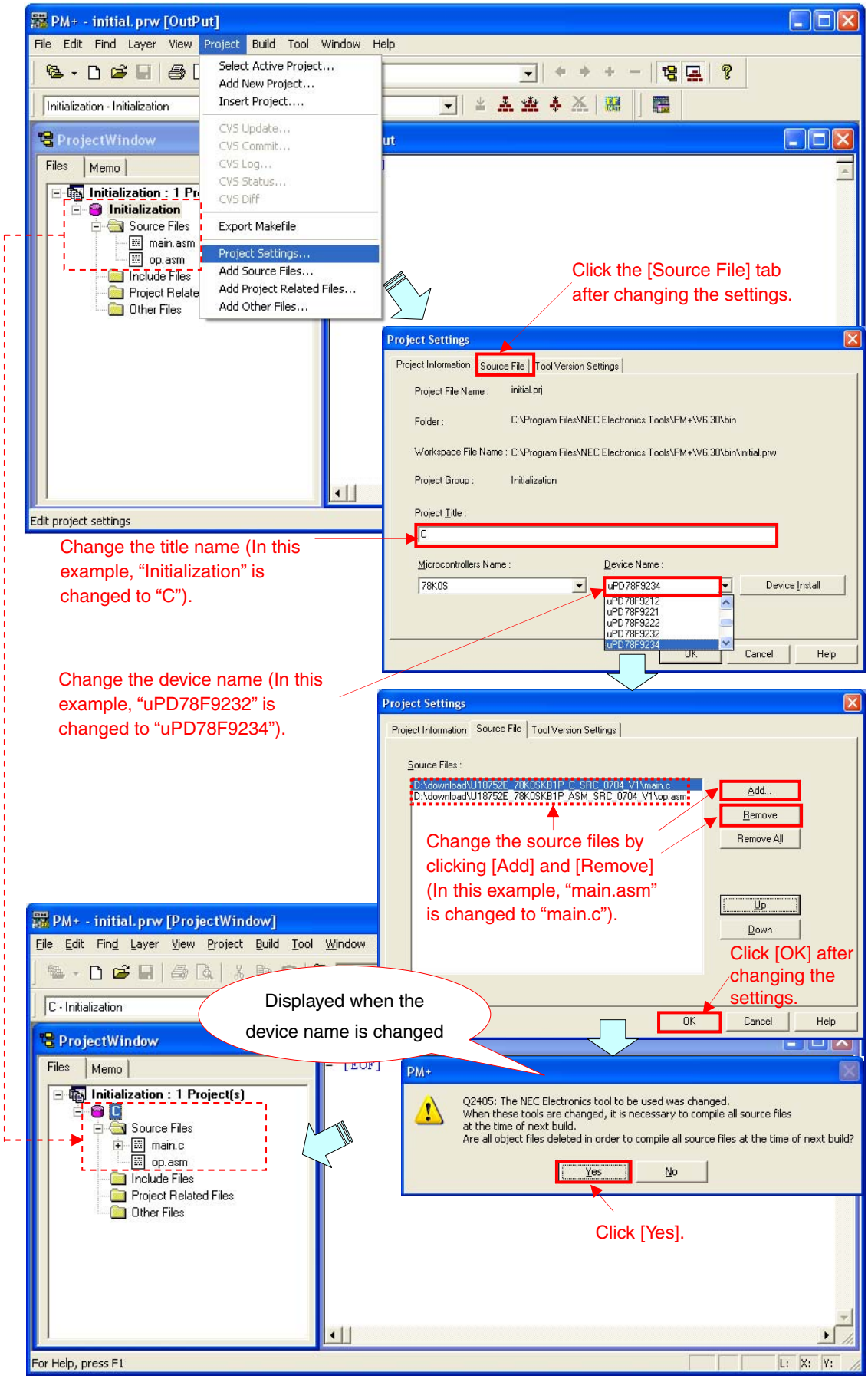
(9) To save the information of the currently opened workspace and project with the same file name, do so in the following manner.

- Select [Save Workspace] from the [File] menu (to save the workspace while it is kept opened).
- Select [Close Workspace] from the [File] menu (to close and save the workspace).
- Select [Exit PM+] from the [File] menu (to terminate PM+ after saving the workspace).

Remarks 1. After starting PM+ for the second time, PM+ is set to automatically start the previous project by default when PM+ is started.

2. After project registration, the following settings can be changed by selecting [Project Settings] from the [Project] menu.

- Changing the project title (In the example below, “Initialization” is changed to “C”.)
- Changing the device file (In the example below, “uPD78F9232” is changed to “uPD78F9234”.)
- Adding and deleting source files (In the example below, “main.asm” is changed to “main.c”.)
- Setting the tools and their versions

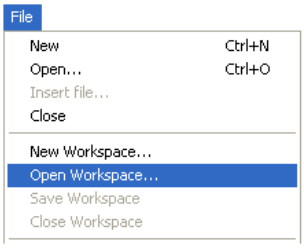

PM+ - initial.prw [OutPut]
File Edit Find Layer View Project Build Tool Window Help
Select Active Project...
Add New Project...
Insert Project....
CVS Update...
CVS Commit...
CVS Log...
CVS Status...
CVS Diff
Export Makefile
Project Settings...
Add Source Files...
Add Project Related Files...
Add Other Files...
ProjectWindow
Files Memo
Initialization : 1 Pr
Initialization
Source Files
main.asm
op.asm
Include Files
Project Relate
Other Files
Edit project settings
Click the [Source File] tab after changing the settings.
Project Settings
Project Information Source File Tool Version Settings
Project File Name : initial.prj
Folder : C:\Program Files\NEC Electronics Tools\PM+\V6.30\bin
Workspace File Name : C:\Program Files\NEC Electronics Tools\PM+\V6.30\bin\initial.prw
Project Group : Initialization
Project Title :
C
Microcontrollers Name :
78K0S
Device Name :
uPD78F9234
uPD78F9212
uPD78F9221
uPD78F9222
uPD78F9232
uPD78F9234
Device Install
OK Cancel Help
Change the title name (In this example, “Initialization” is changed to “C”).
Change the device name (In this example, “uPD78F9232” is changed to “uPD78F9234”).
Project Settings
Project Information Source File Tool Version Settings
Source Files :
D:\download\U18752E_78K0SKB1P_C_SRC_0704_V1\main.c
D:\download\U18752E_78K0SKB1P_ASM_SRC_0704_V1\op.asm
Add...
Remove
Remove All
Up
Down
Change the source files by clicking [Add] and [Remove] (In this example, “main.asm” is changed to “main.c”).
Click [OK] after changing the settings.
OK Cancel Help
PM+ - initial.prw [ProjectWindow]
File Edit Find Layer View Project Build Tool Window
C - Initialization
ProjectWindow
Files Memo
Initialization : 1 Project(s)
C
Source Files
main.c
op.asm
Include Files
Project Related Files
Other Files
Displayed when the device name is changed
PM+
Q2405: The NEC Electronics tool to be used was changed.
When these tools are changed, it is necessary to compile all source files at the time of next build.
Are all object files deleted in order to compile all source files at the time of next build?
Yes No
Click [Yes].
For Help, press F1

3.1.2 Project registration (source files and project file)

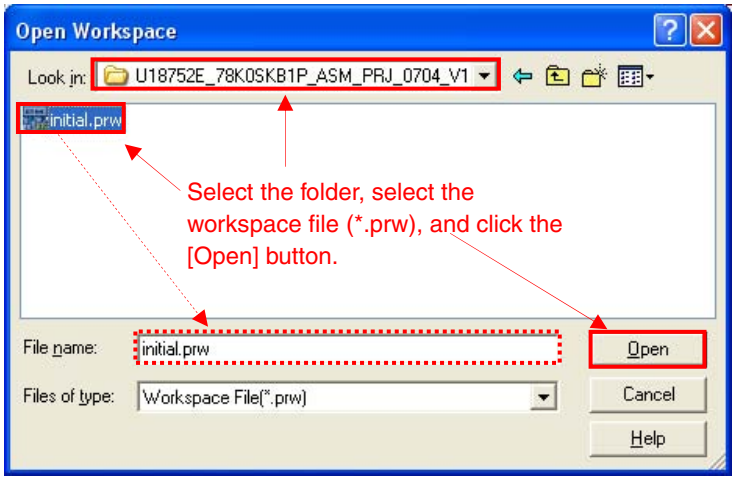
This section describes how to register a project, using the assembly language sample program (source program + project file) that has been downloaded by clicking the icon of the 78K0S/KB1+ microcontroller sample program (initial setting).

(1) Start PM+.

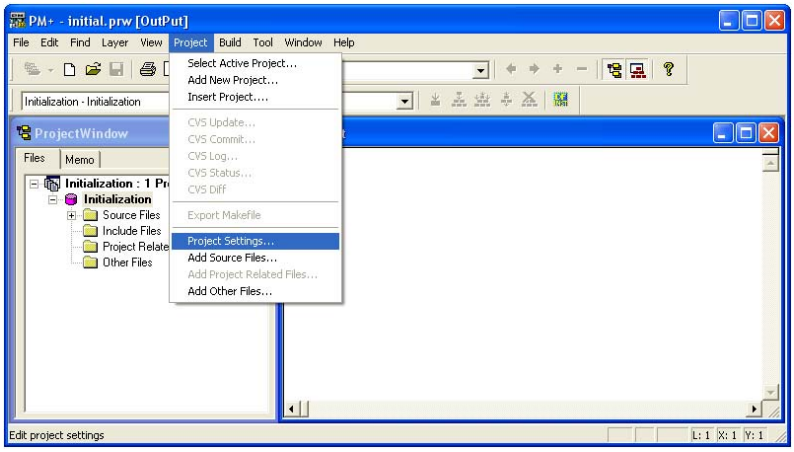
(2) Select [Open Workspace] from the [File] menu.



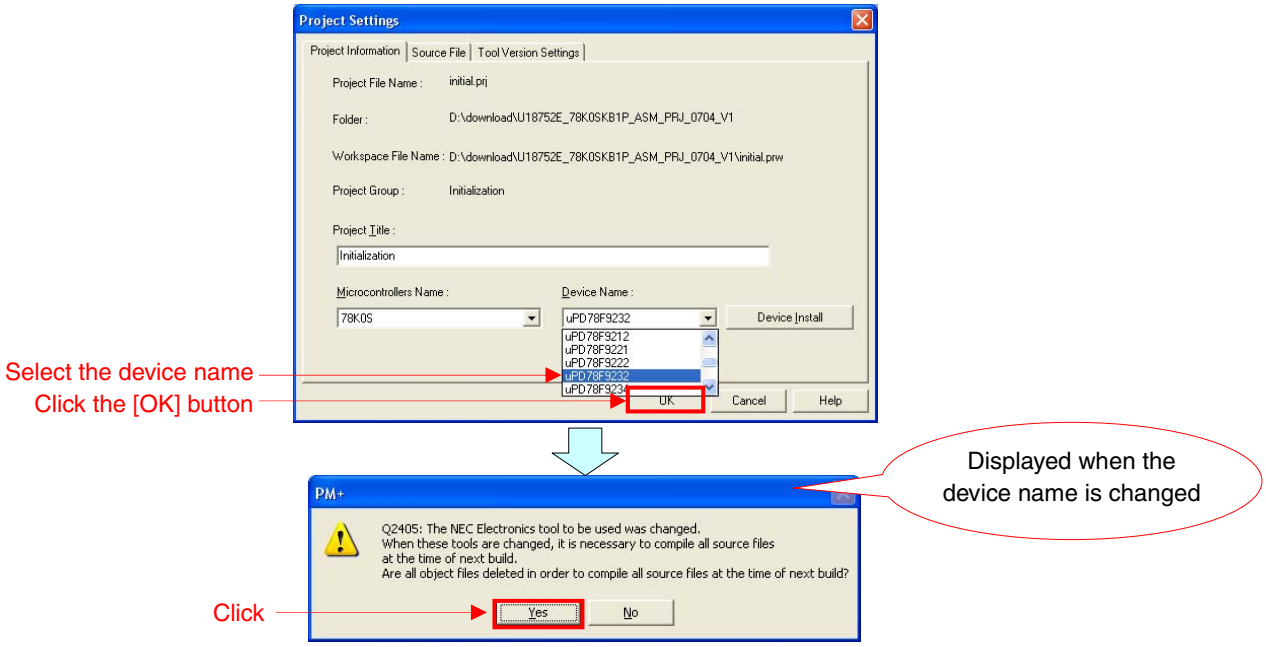
(3) The [Open Workspace] dialog box will be opened. Select a workspace file (*.prw) and click the [Open] button. (In the example below, “initial.prw” is selected from the location where the files have been decompressed in CHAPTER 2 PREPARING SAMPLE PROGRAMS, and the [Open] button is clicked.)



(4) The project will be registered. After project registration, check the device file set by default and change the setting as required. Select [Project Settings] from the [Project] menu.



(5) The [Project Settings] dialog box will be displayed. The device with the largest ROM or RAM size ("uPD78F9234" in the example below) is set as the Device Name by default. Select the device name to be used ("uPD78F9232" in the example below) and click the [OK] button.



(6) The device file will be changed. After changing the device file, perform build operation. (Refer to 3.2 Executing Build.)

(7) To save the information of the currently opened workspace and project with the same file name, do so in the following manner.

- Select [Save Workspace] from the [File] menu (to save the workspace while it is kept opened).
- Select [Close Workspace] from the [File] menu (to close and save the workspace).
- Select [Exit PM+] from the [File] menu (to terminate PM+ after saving the workspace).

Remarks 1. After starting PM+ for the second time, PM+ is set to automatically start the previous project by default when PM+ is started.

2. After project registration, the following settings can be changed by selecting [Project Settings] from the [Project] menu.

- Changing the project title
- Changing the device file
- Adding and deleting source files
- Setting the tools and their versions

For details, refer to Remark 2 in 3.1.1. (Refer to (4) to (6) in 3.1.2 when only changing the device files.)

[Column] Tab width in a source program

The source of a sample program is set to be easy to view when the tab width is set to eight characters. It is recommended to change the setting by the following procedure, because with PM+ the tab width is set to four characters by default.

<1> Select [PM+ Settings] from the PM+ [Tool] menu.

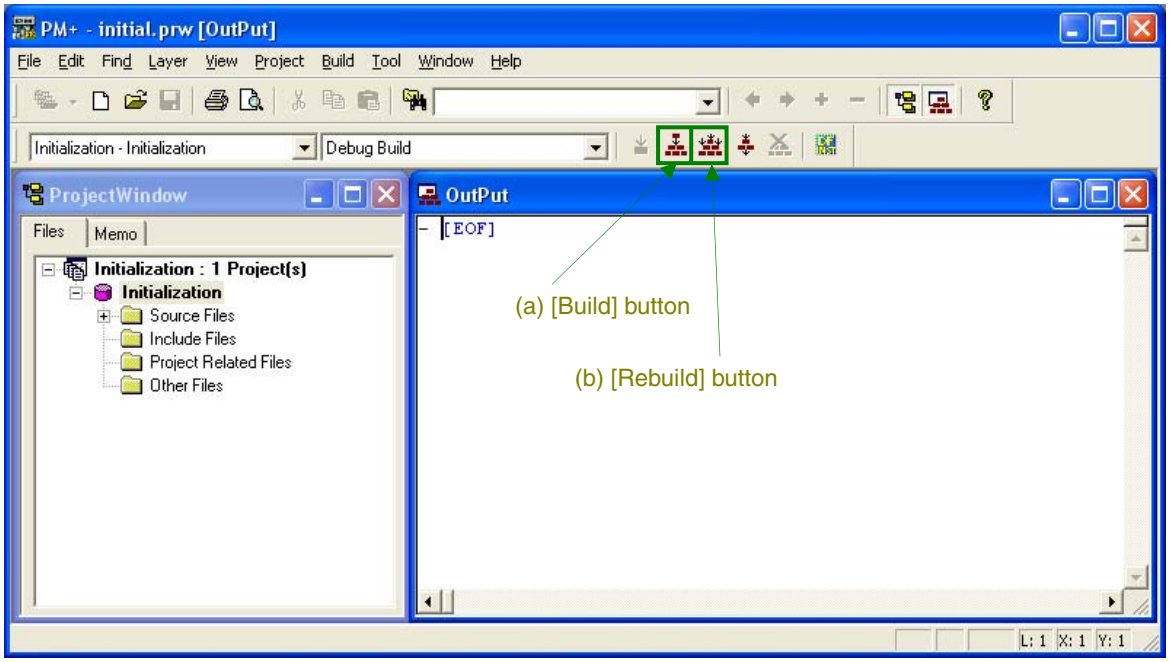
<2> The PM+ Settings dialog box will be displayed. Click the [View] tab.

<3> Set [Memorize number of Tab characters each Window] to "8" and click the [OK] button.

3.2 Executing Build

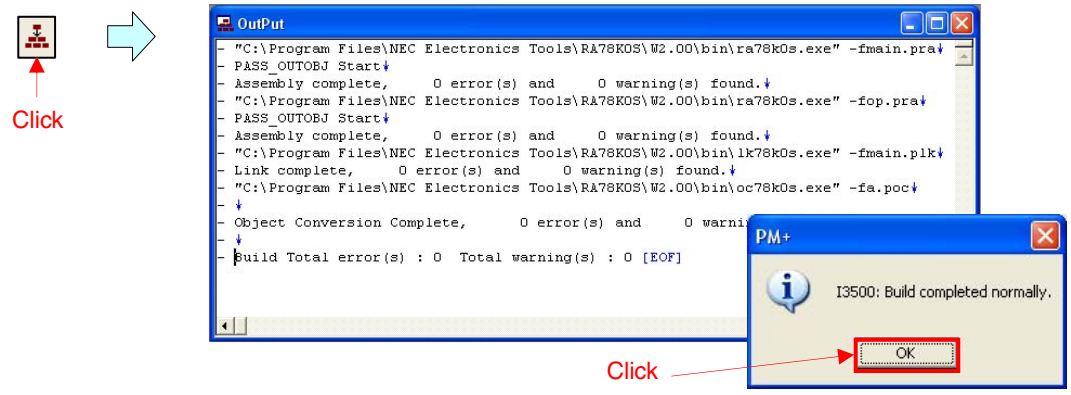
After performing the settings described in 3.1.1 or 3.1.2, execute build by clicking the buttons on the build bar.

When build is executed, a HEX file (*.hex) is created in the folder in which the workspace file (*.prw) is located. If a programming environment is available, the HEX file can be written to the microcontroller flash memory.



(a) [Build] button ( )

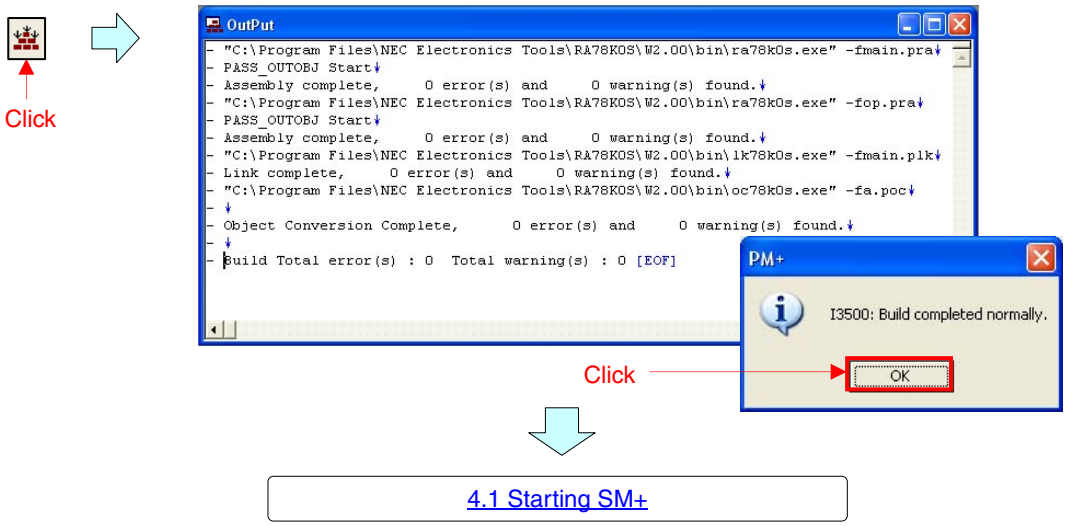
Click the [Build] button to execute build. When the source files are built normally, the message “I3500: Build completed normally.” will be displayed. Click the [OK] button.



4.1 Starting SM+

(b) [Rebuild] button ( )

Click the [Rebuild] button to execute rebuild. When the source files are rebuilt normally, the message “I3500: Build completed normally.” will be displayed. Click the [OK] button.



4.1 Starting SM+

[Column] Build errors

Change the compiler option setting according to the following procedure when the error message “A006 File not found ‘C:\NECTOOLS32\LIB78K0S\s0sl.rel’” or “*** ERROR F206 Segment ‘@@DATA’ can’t allocate to memory - ignored.” is displayed, when building with PM+.

<1> Select [Compiler Options] from the [Tool] menu.
<2> The [Compiler Options] dialog box will be displayed. Select the [Startup Routine] tab.
<3> Uncheck the [Using Fixed Area of Standard Library] check box. (Leave the other check boxes as they are.)

A RAM area of 118 bytes that has been secured as a fixed standard library area will be enabled for use when the [Using Fixed Area of Standard Library] check box is unchecked; however, the standard libraries (such as the getchar function and malloc function) will be disabled for use.
The [Using Fixed Area of Standard Library] check box is unchecked by default when the file that has been downloaded by clicking the icon is used in this sample program.

CHAPTER 4 OPERATION CHECK USING SYSTEM SIMULATOR SM+

This chapter describes how a sample program operates with system simulator SM+ for 78K0S/Kx1+, using the 78K0S/KB1+ microcontroller sample program (initial setting) as an example.

Caution SM+ for 78K0S/Kx1+ is not supported with the 78K0S/KU1+ microcontroller (as of July, 2008). The operation of the 78K0S/KU1+ microcontroller therefore cannot be checked with SM+ for 78K0S/Kx1+.

4.1 Starting SM+

When SM+ for 78K0S/Kx1+ W1.02 (hereinafter “SM+”) is used in an environment of PM+ Ver. 6.30, SM+ cannot be selected as the debugger. In this case, start SM+ using method (a) or (b) described below, while keeping PM+ running after building a project has been completed.

(a) When starting SM+ in PM+

<1> Select [Register Ex-tool] from the [Tool] menu and register “SM+ for 78K0S/Kx1+”.
<2> Select [Ex-tool Bar] from the [View] menu to display the SM+ icon on the PM+ toolbar.
<3> Start SM+ by clicking the SM+ icon.
(See the PM+ help for details of how to register external tools.)

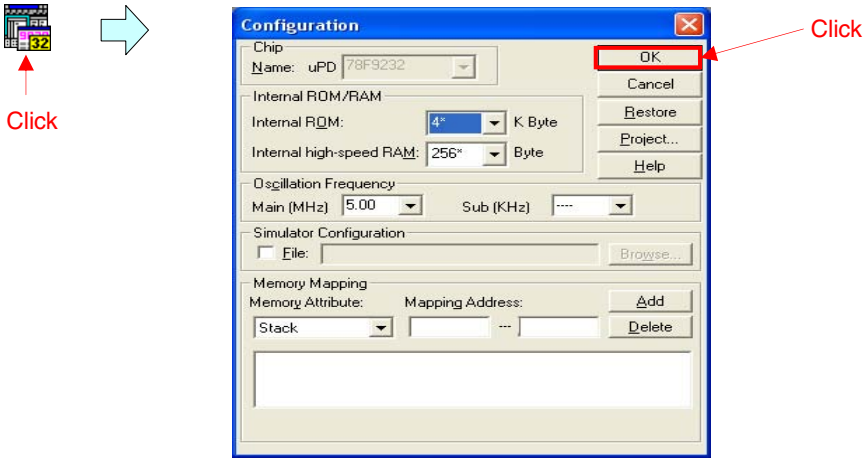
(b) When not starting SM+ in PM+

- Start SM+ from the Windows start menu.

When SM+ is started, the start screen differs depending on the downloaded file.

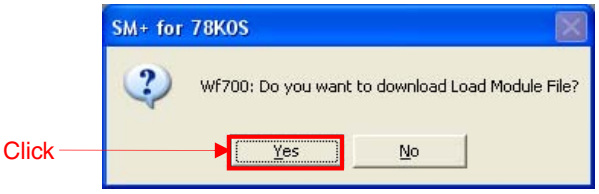
4.1.1 SM+ start screen (only source files)

(1) When SM+ is started, the [Configuration] dialog box will be opened. Click the [OK] button.

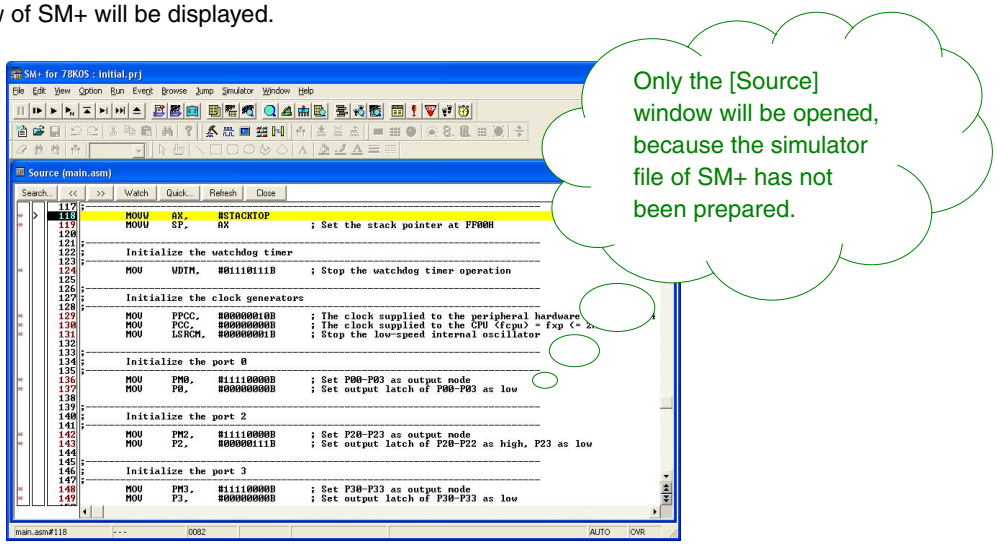


Remark Set the clock frequency and other settings in the [Configuration] dialog box, depending on the program. Such settings are not required in the sample program (initial setting) example shown above, because a high-speed internal oscillator is used.

(2) The message “Wf700: Do you want to download Load Module File?” will be displayed. Click the [Yes] button.



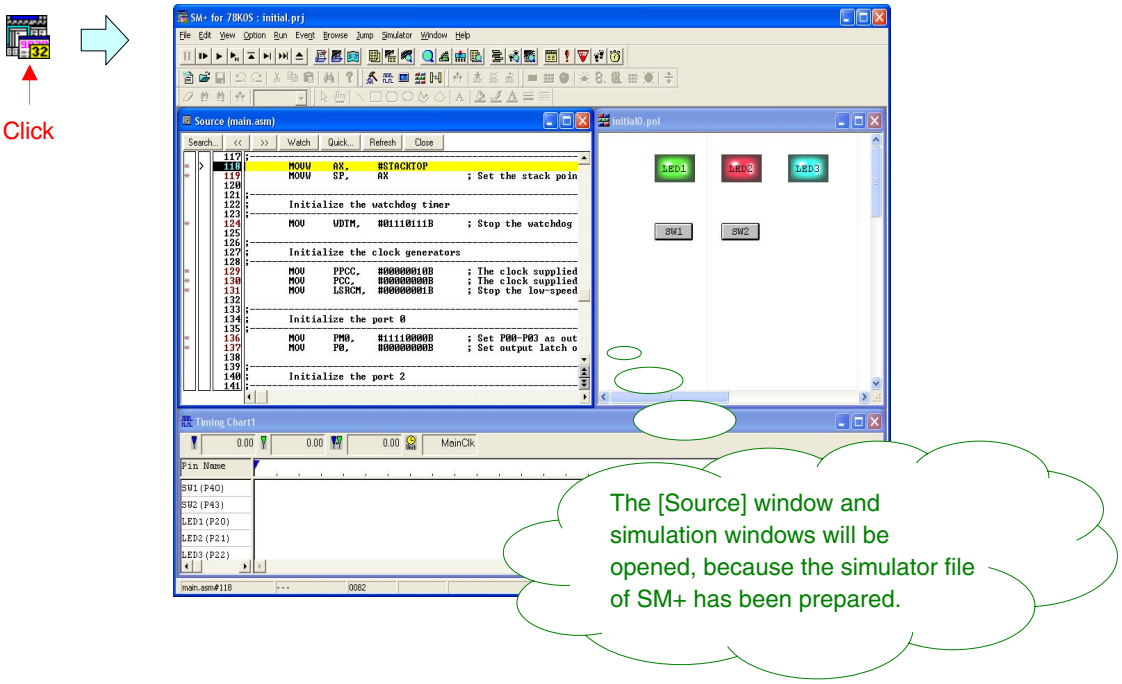
(3) The Main window of SM+ will be displayed.



4.1.3 Opening a simulation file (only source files)

4.1.2 SM+ start screen (source files and project file)

When SM+ is started, the Main window ([Source] window + simulation windows) will be displayed.



4.2 Simulation

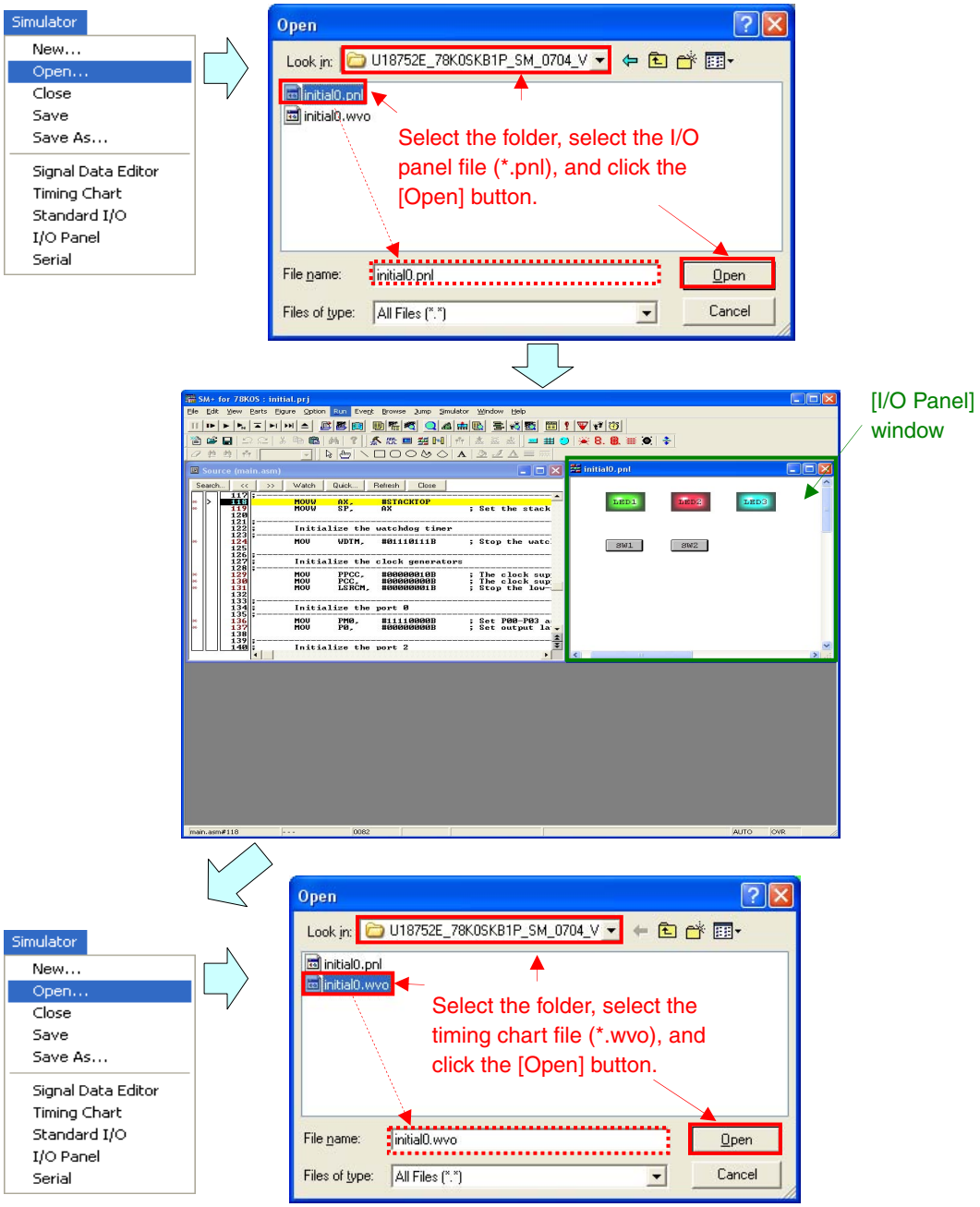
4.1.3 Opening a simulation file (only source files)

When only source files are downloaded (by clicking), only the [Source] window will be opened in the Main window of SM+.

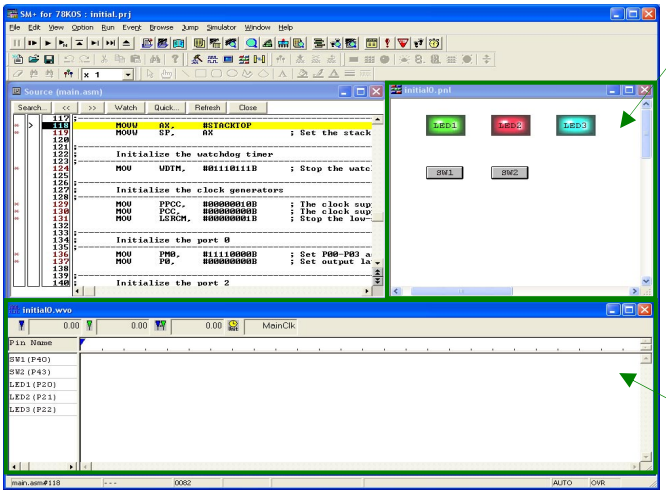
The simulation windows are added in the Main window of SM+ by using a simulation file (downloaded by clicking). They are added through the following procedure.

(1) Select [Open] from the [Simulator] menu to open the dialog box for selecting a simulation file. Change [Files of type] to “All Files (*.*)”, select a simulation file, and click the [Open] button. (In the example shown below, “initial0.pnl” and “initial0.wvo” are selected from the location where the files have been decompressed in CHAPTER 2 PREPARING SAMPLE PROGRAMS, and the [Open] button is clicked.)

Caution Multiple files cannot be selected in the file selection dialog box. When multiple simulation files have been prepared, open the simulation windows by selecting one file at a time.



(2) The simulation windows will be added in the Main window of SM+. (In the example shown below, the [I/O Panel] window and [Timing Chart] window are added.)



4.2 Simulation

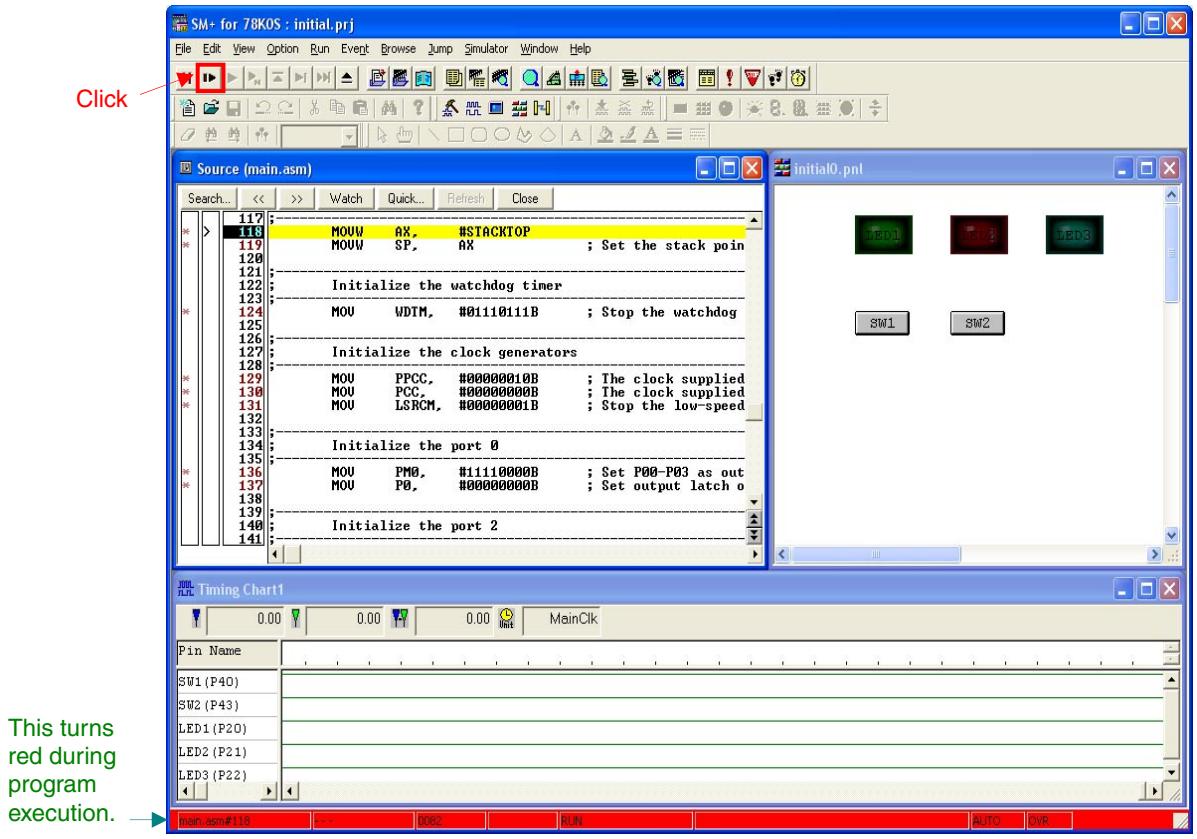
Remark When source files and a project file have been downloaded (by clicking ), the simulation windows will be automatically opened in the Main window of SM+ which is started after build execution, because an SM+ simulator file has been prepared in advance.

4.2 Simulation

This section confirms how the 78K0S/KB1+ microcontroller sample program (initial setting) operates, by using the SM+ simulation functions.

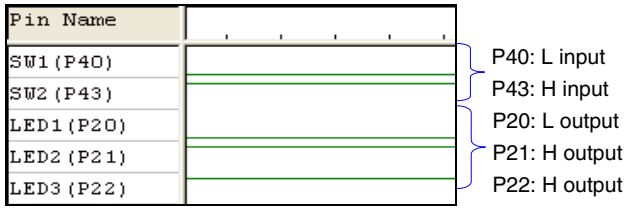
Remark For the details of how to operate SM+, refer to the SM+ System Simulator Operation User's Manual.

(1) Click  ([Restart] button). The program will be executed after the CPU is reset and the following screen will be displayed.

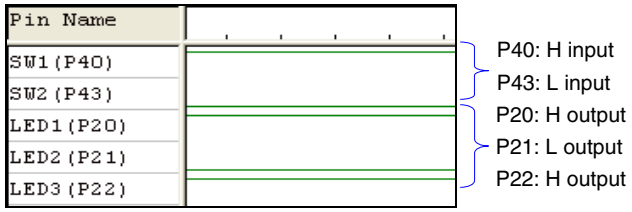


(2) Click the [SW1] and [SW2] buttons in the [I/O Panel] window, during program execution. Check the lighting of [LED1] to [LED3] in the [I/O Panel] window, as well as the waveforms in the [Timing Chart] window change, depending on the combination of the [SW1] and [SW2] buttons.

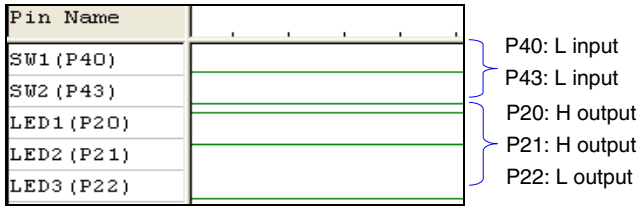
Example 1. SW1: ON, SW2: OFF

[I/O Panel] window	[Timing Chart] window
	

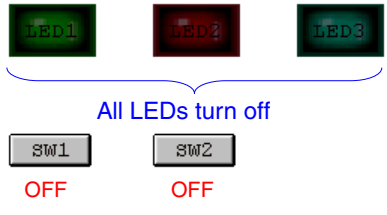
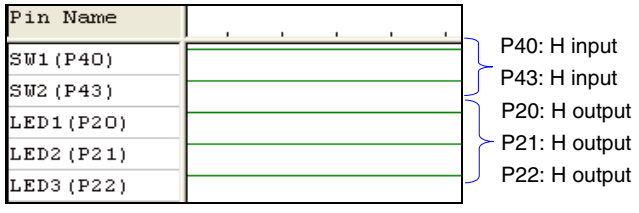
Example 2. SW1: OFF, SW2: ON

[I/O Panel] window	[Timing Chart] window
	

Example 3. SW1: ON, SW2: ON

[I/O Panel] window	[Timing Chart] window
	

Example 4. SW1: OFF, SW2: OFF

[I/O Panel] window	[Timing Chart] window
	

Remark H: High level, L: Low level

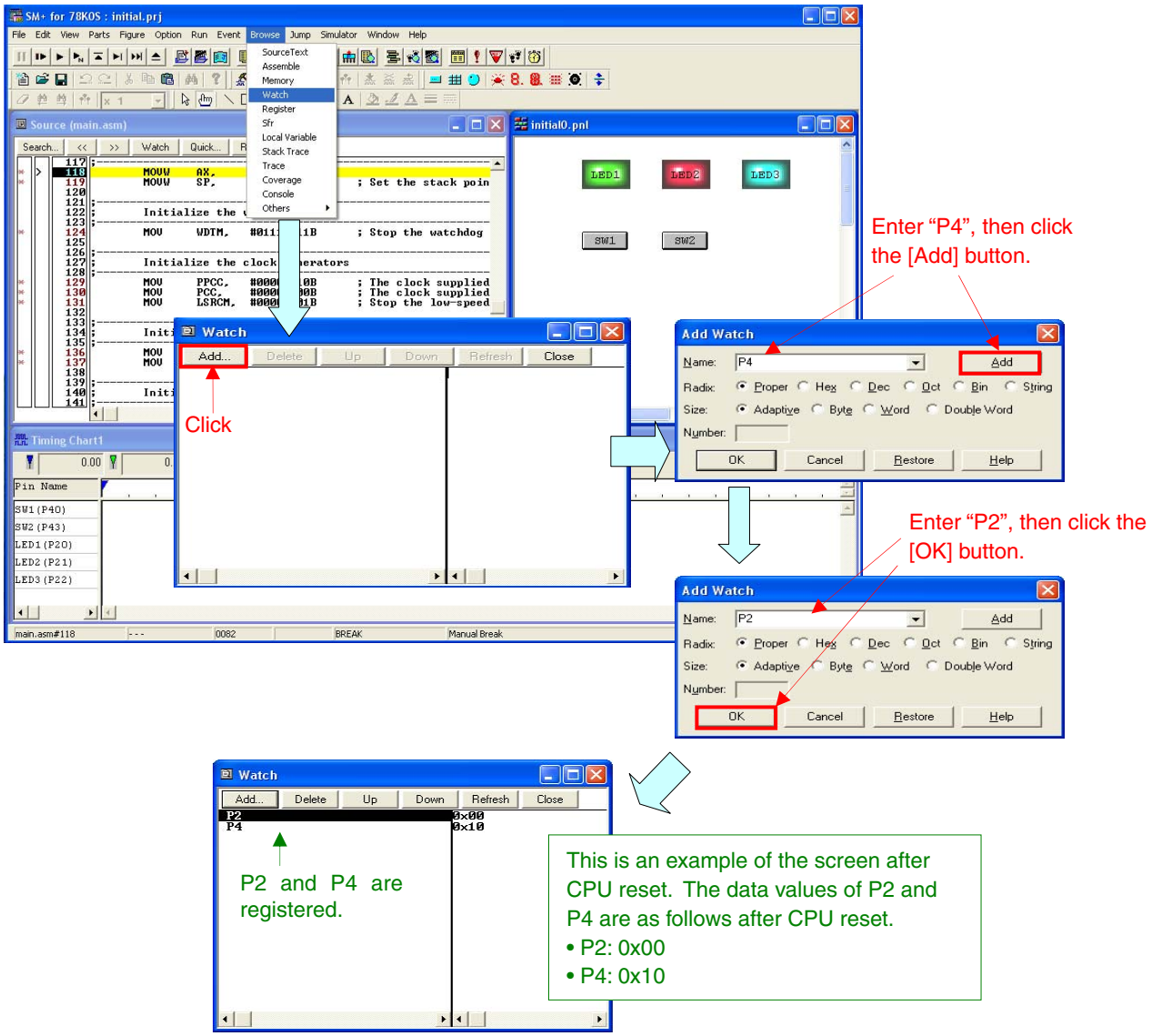
[Supplement] The changes in the data values of ports 2 and 4 can be checked by using the SM+ watch function (refer to 5.6 [Watch] Window).

<1> Select [Watch] from the [Browse] menu to open the [Watch] window.

<2> Click [Add] to open the [Add Watch] window. (At this time, the [Watch] window is kept opened.)

<3> Enter “P4” in the [Name] field and click the [Add] button to register “P4” in the [Watch] window. (At this time, the [Add Watch] window is kept opened.)

<4> Next, enter “P2” in the [Name] field and click the [OK] button to register “P2” in the [Watch] window and close the [Add Watch] window.



<5> Execute the program and click the [SW1] and [SW2] buttons in the [I/O Panel] window. Check that the data values of P2 and P4 in the [Watch] window change, depending on the combination of the [SW1] and [SW2] buttons.

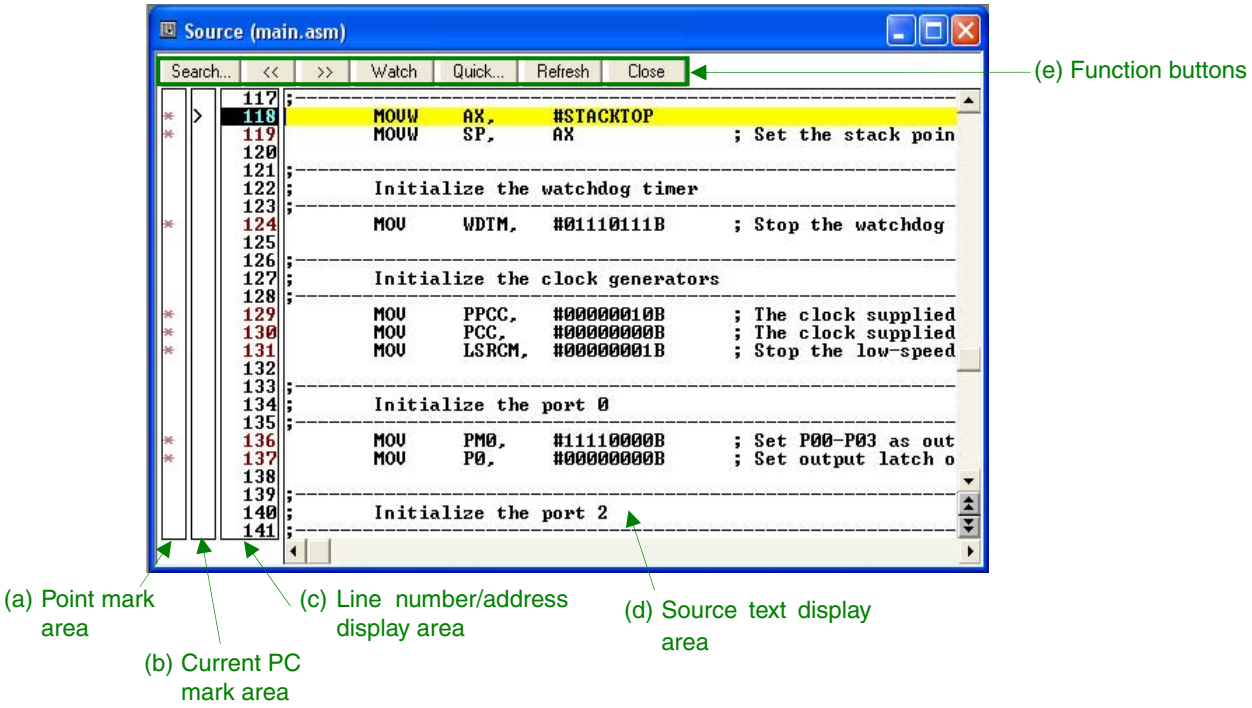
Combination of SW1 and SW2	Data Value in [Watch] Window
SW1: ON, SW2: OFF	P2: 0x06, P4: 0x08
SW1: OFF, SW2: ON	P2: 0x05, P4: 0x01
SW1: ON, SW2: ON	P2: 0x03, P4: 0x00
SW1: OFF, SW2: OFF	P2: 0x07, P4: 0x09

This chapter describes the main functions of the SM+ windows.

Remark For the details of how to operate SM+, refer to the SM+ System Simulator Operation User's Manual.

5.1 [Source] Window

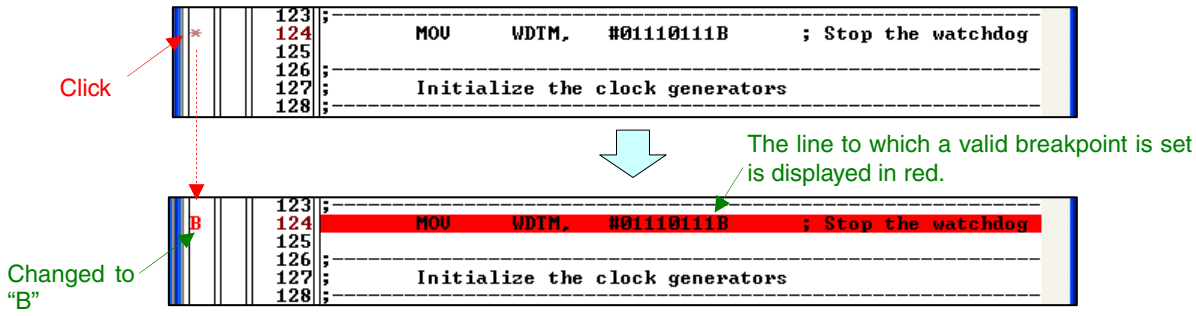
This window is used to display source files or text files.



(a) Point mark area

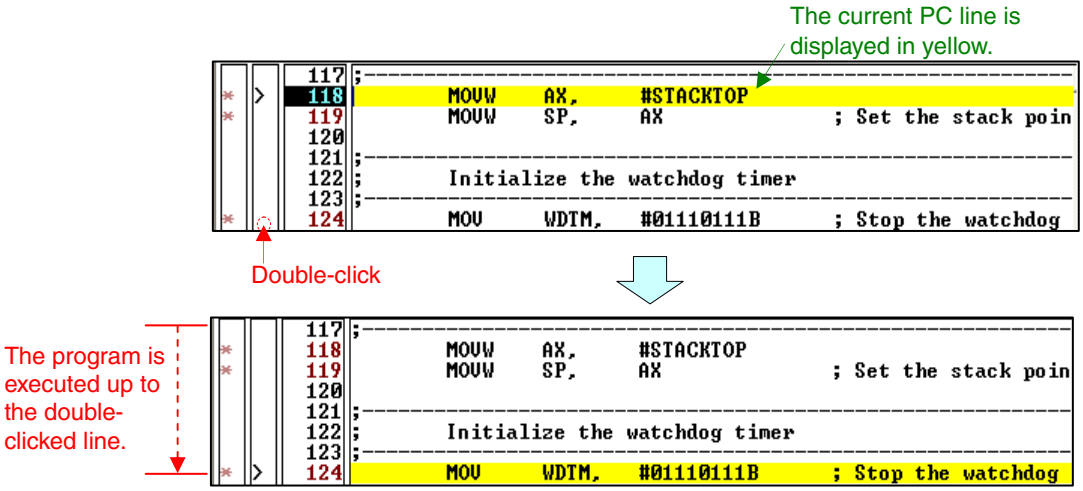
This area is used for the event setting status and program code display, as well as breakpoint setting.

A breakpoint can be set by clicking the asterisk ("*") of the location to which it is to be set.



(b) Current PC mark area

The “>” mark, which indicates the current PC value (PC register value), is displayed in this area. By double-clicking this area, the user program can be executed up to the double-clicked line.



(c) Line number/address display area

This area displays the line number of a source file or text file.

(d) Source text display area

This area displays source texts and text files.

Yellow indicates the current PC line, and red indicates lines where a valid breakpoint is set.

(e) Function buttons

Search…	Searches a character string (opens the [Source Search] dialog box).
<<	Searches forward (upward on screen) for the specified character string.
>>	Searches backward (downward on screen) for the specified character string.
Stop (during a search)	Stops searching.
Watch	Adds contents, such as a selected variable, to the [Watch] window.
Quick…	Temporarily displays the contents, such as a selected variable, in the [Quick Watch] dialog box.
Refresh	Updates the contents of the window with the latest data.
Close	Closes the [Source] window.

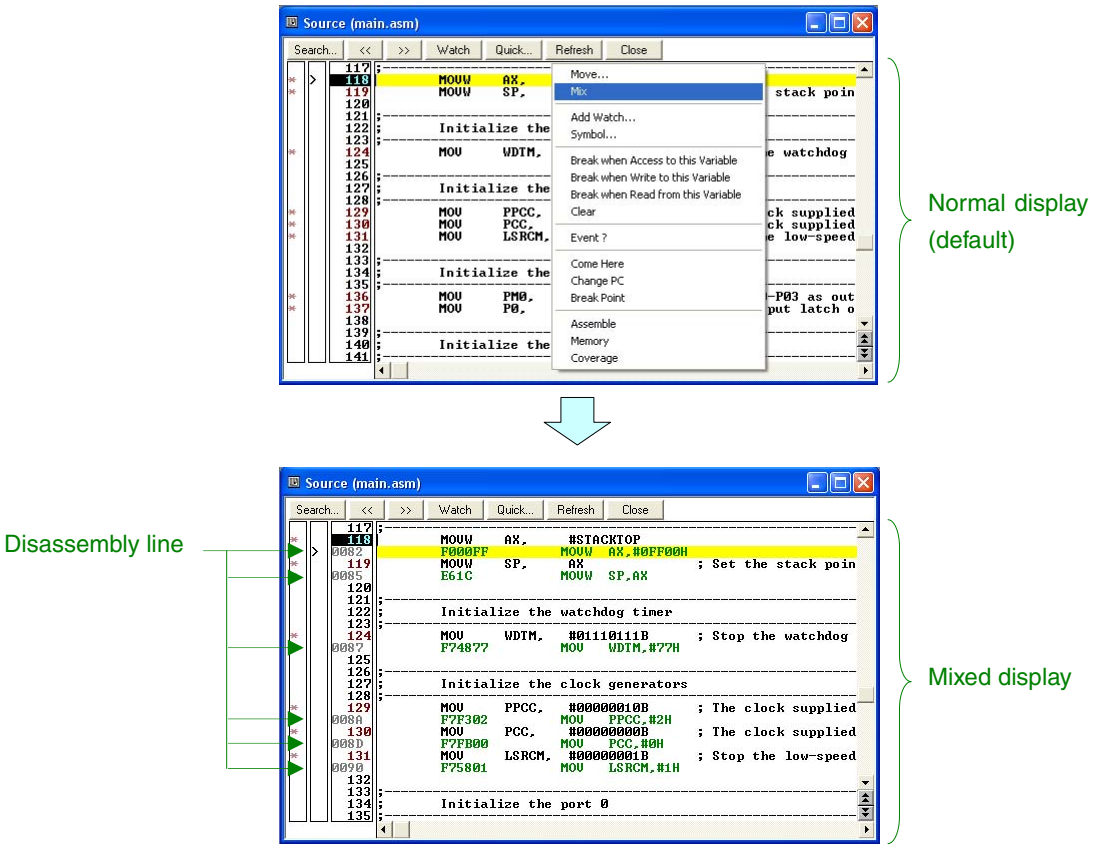
Click the following buttons on the toolbar to execute the source program displayed on the [Source] window.

 (Stop)	Stops execution during user program execution. Same function as selecting [Stop] from the [Run] menu.
 (Restart)	Resets the CPU and executes the user program. Same function as selecting [Restart] from the [Run] menu.
 (Go)	Executes the user program from the current PC without resetting the CPU. Same function as selecting [Go] from the [Run] menu.
 (Ignore break point and Go)	Ignores the set breakpoints and executes the user program. Same function as selecting [Ignore break points and Go] from the [Run] menu.
 (Return)	The user program is executed until execution returns. Same function as selecting [Return Out] from the [Run] menu. **Caution This command is used for functions described in C language.**
 (Step in)	Step execution (executes instructions in the program one by one.) If a function or subroutine is called, its instructions are executed one by one. Same function as selecting [Step In] from the [Run] menu.
 (Next Over)	Next step execution (executes the program, assuming a function/call statement as one step.) If a function or subroutine is called, its instructions are not executed on a step-by-step basis. Same function as selecting [Next Over] from the [Run] menu.
 (CPU Reset)	Resets the CPU. Same function as selecting [CPU Reset] from the [Run] menu.

The menu (context menu) will be displayed if the right mouse button is clicked anywhere on the [Source] window. The three main functions that can be selected from the context menu are described next.

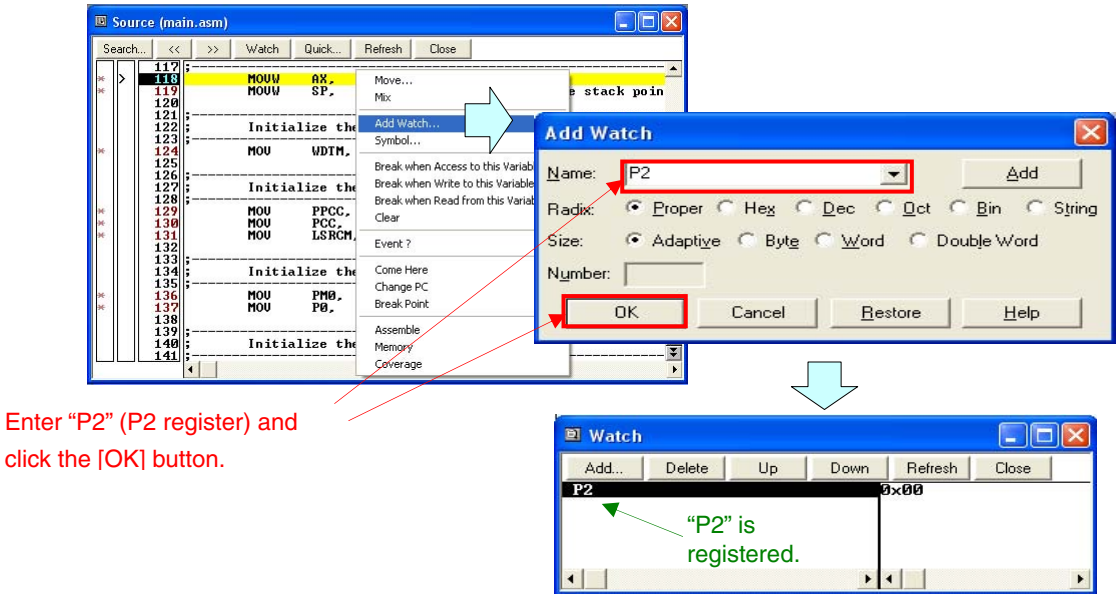
<1> Mix

Select [Mix] from the context menu (displayed by right-clicking anywhere on the [Source] window) for a combined display of the source file and the disassembly of the program on the [Source] window.



<2> Add Watch

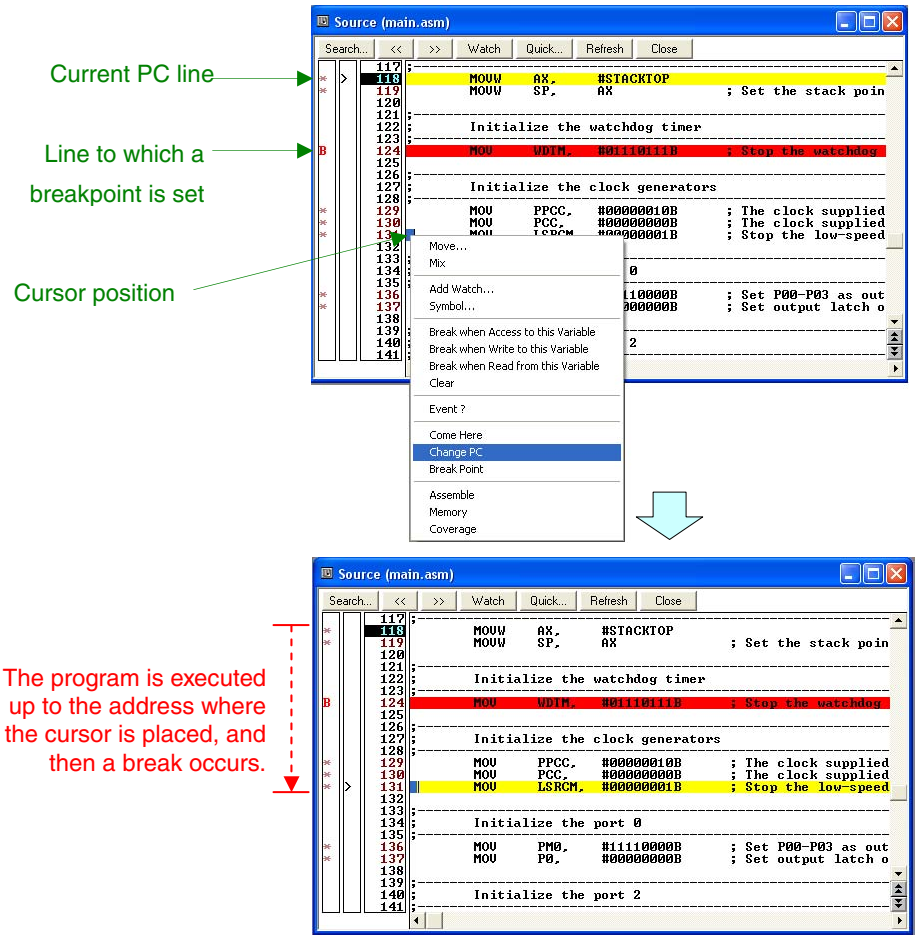
Select [Add Watch] from the context menu (displayed by right-clicking anywhere on the [Source] window) to open the [Add Watch] dialog box. Specify the data and click the [OK] button in this dialog box to register the specified data in the [Watch] window.



<3> Come Here

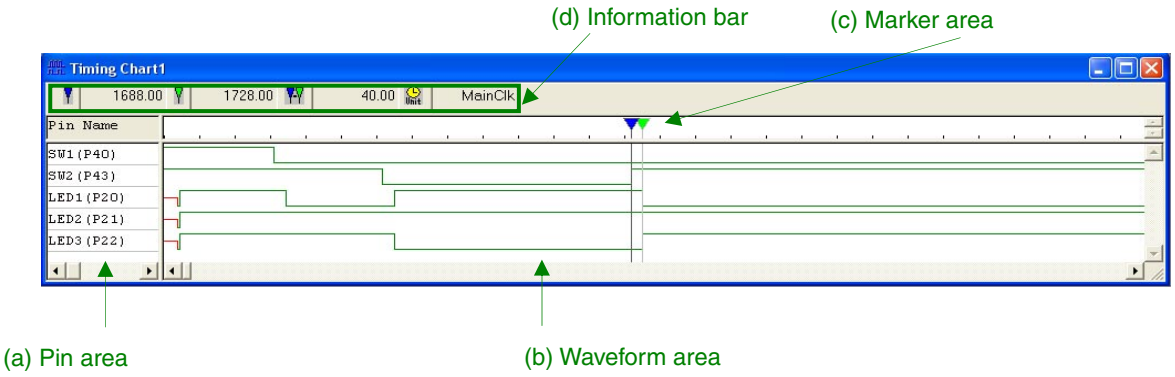
Select [Come Here] from the context menu (displayed by right-clicking anywhere on the [Source] window) to execute the program, from the address indicated by the current PC register up to the address where the cursor has been placed, after which a break occurs.

While the program is being executed, the break event currently set does not occur.



5.2 [Timing Chart] Window

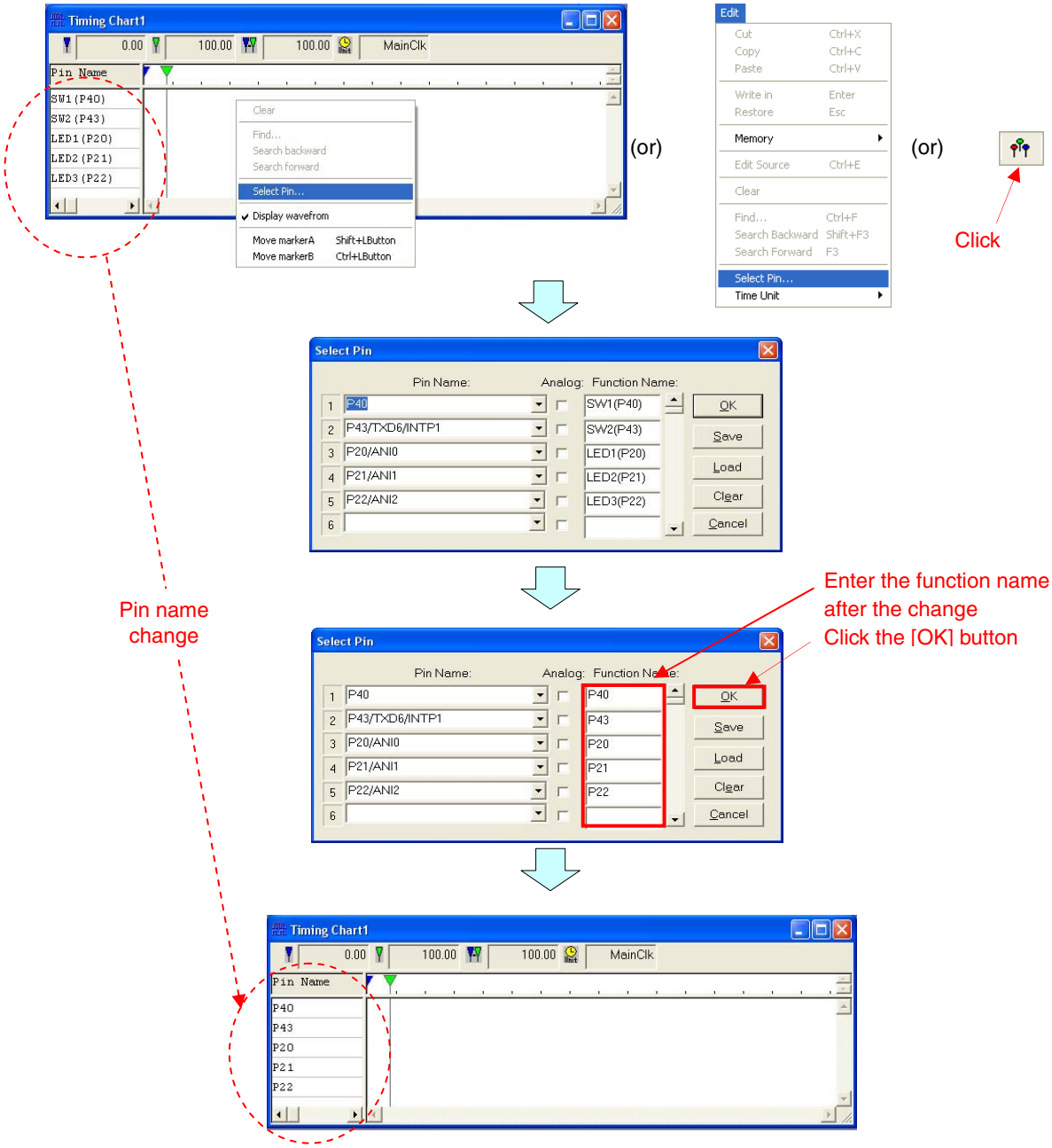
This window displays in the form of a timing chart input signals and output signals for pins.



(a) Pin area

This area displays the names of pins to be displayed in the [Timing Chart] window.

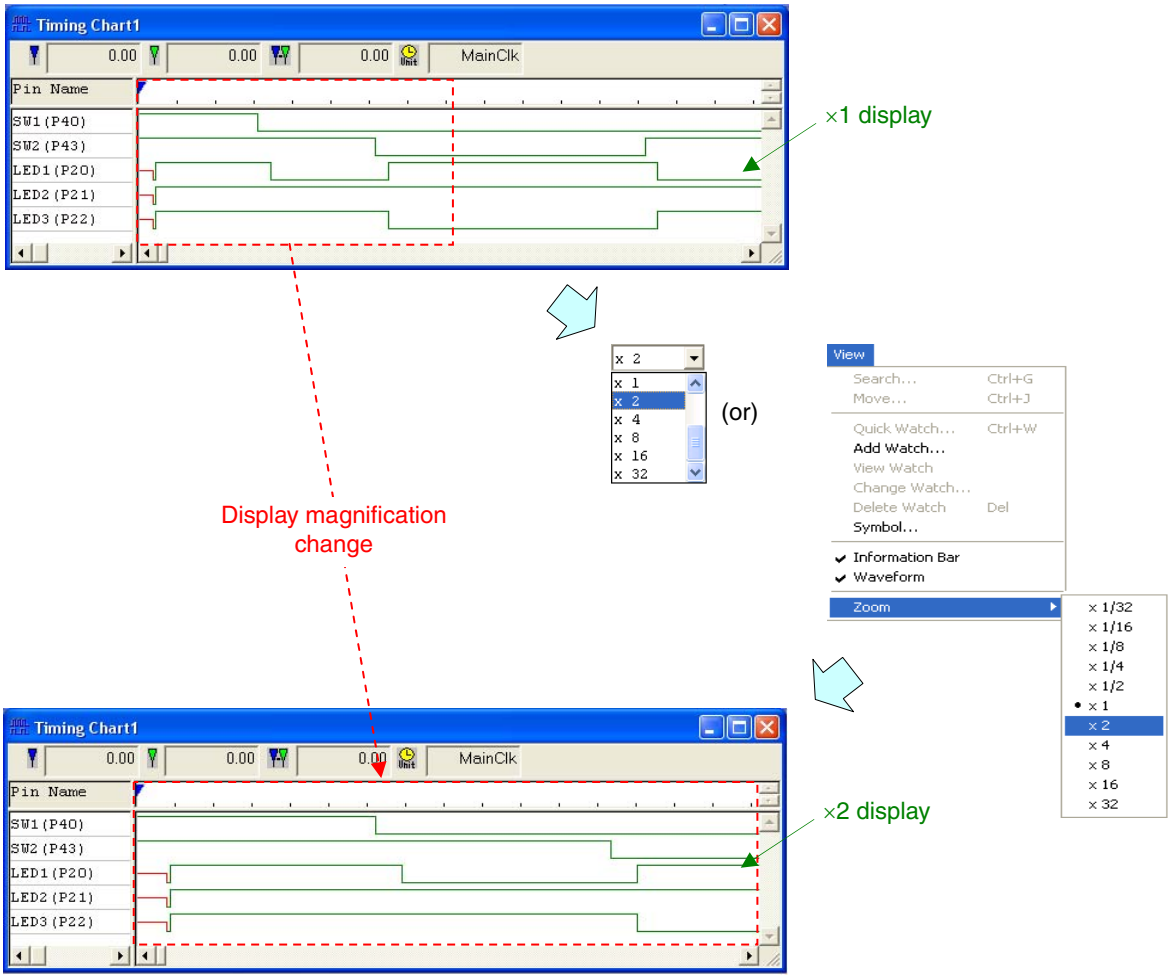
Select [Select Pin] from the context menu (displayed by right-clicking anywhere on the (b) Waveform area), select [Select Pin] from the [Edit] menu, or click the button on the toolbar to open the [Select Pin] dialog box. Items, such as pin names, can be changed in this dialog box.



(b) Waveform area

This area displays as a timing chart the data of the pins specified in the (a) Pin area.

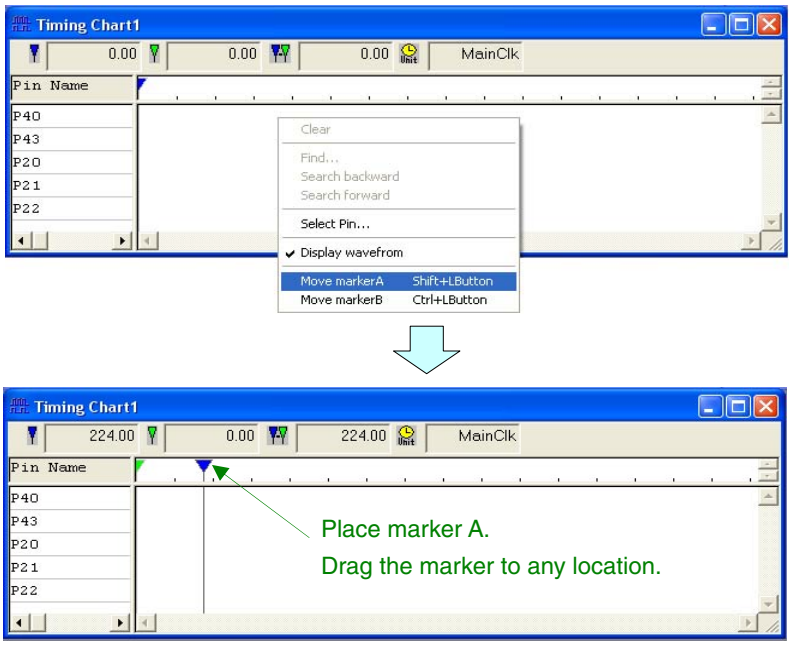
The magnification of the timing chart display can be selected by selecting [Zoom] from the [View] menu or using x 1 on the toolbar.



(c) Marker area

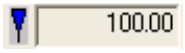
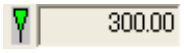
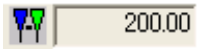
This area displays the headers of markers A and B.

The markers can be set by selecting [Move markerA] and [Move markerB] from the context menu (displayed by right-clicking anywhere on the (b) Waveform area). The placed markers can be dragged to the desired locations.

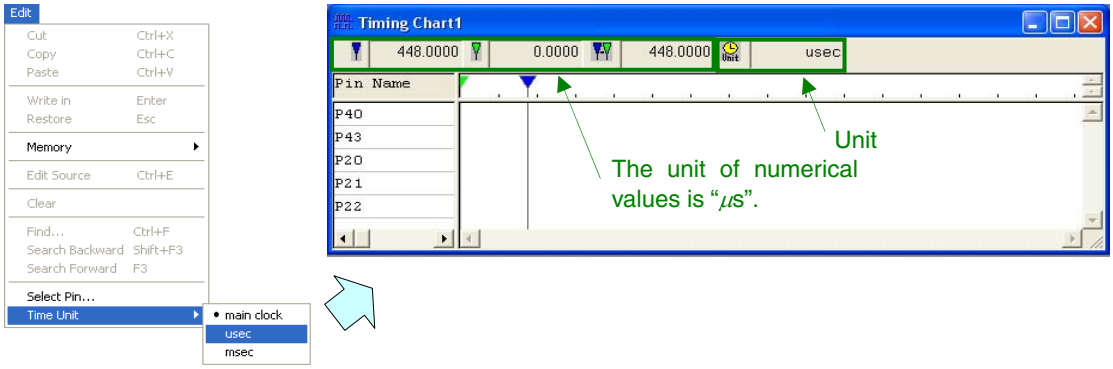


(d) Information bar

This area can be displayed or hidden via the [View] menu or the [Information bar].

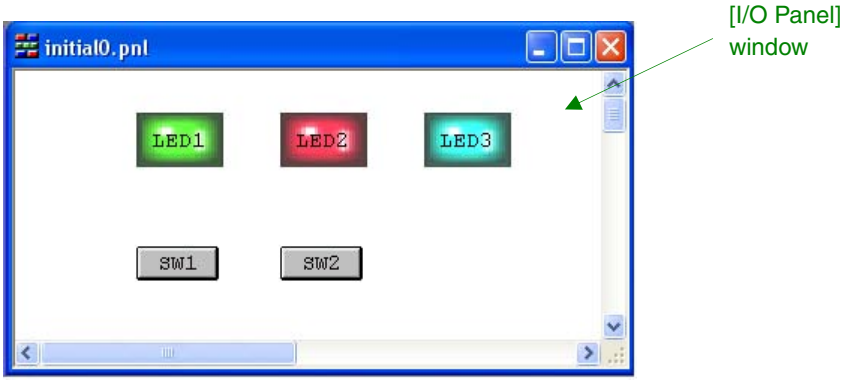
	Displays the time from the simulation start to the marker A location.
	Displays the time from the simulation start to the marker B location.
	Displays the time between markers A and B as an absolute value.
	Displays the unit of the time information.

The unit of the time information displayed on the Information bar can be changed by selecting [Time Unit] from the [Edit] menu.

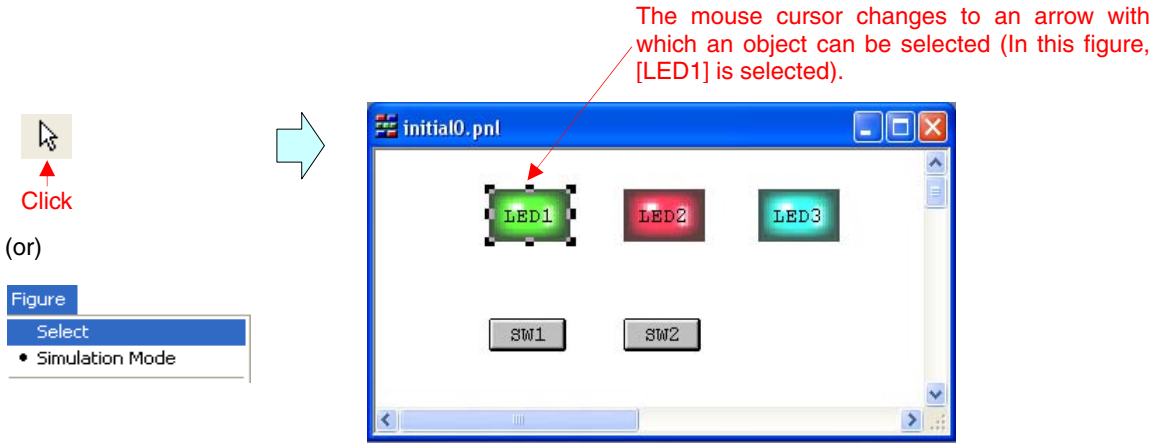


5.3 [I/O Panel] Window

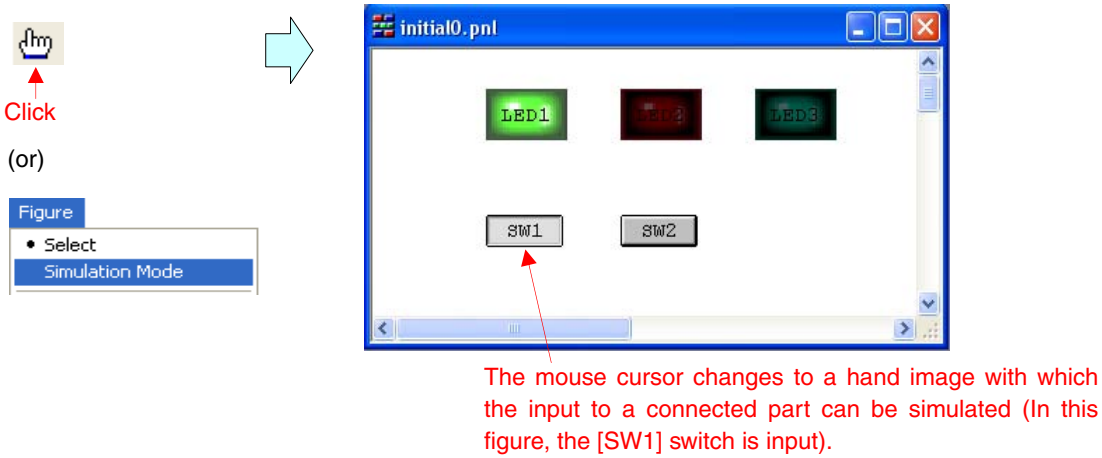
This window is used to create a pseudo target system. This window is used to display and manipulate connected parts.



Click on the toolbar or select [Select] from the [Figure] menu to select an object in the [I/O Panel] window.



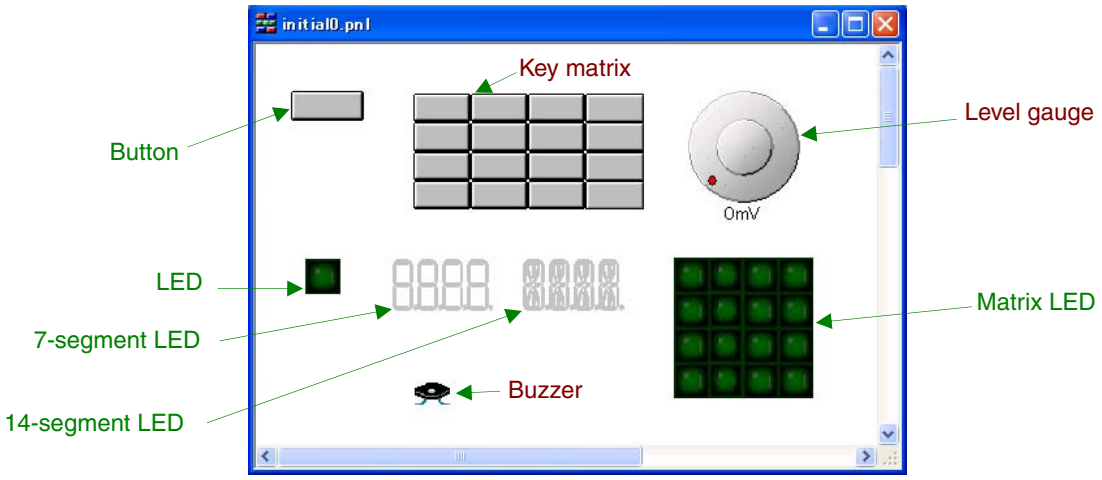
Click on the toolbar or select [Simulation Mode] from the [Figure] menu to select an object in the [I/O Panel] window or to simulate the input to a connected part.



The connected parts can be added to the [I/O Panel] window by clicking the following buttons on the toolbar. By double-clicking the connected parts in the [I/O Panel] window, the dialog box opens and the information of the connected parts can be set.

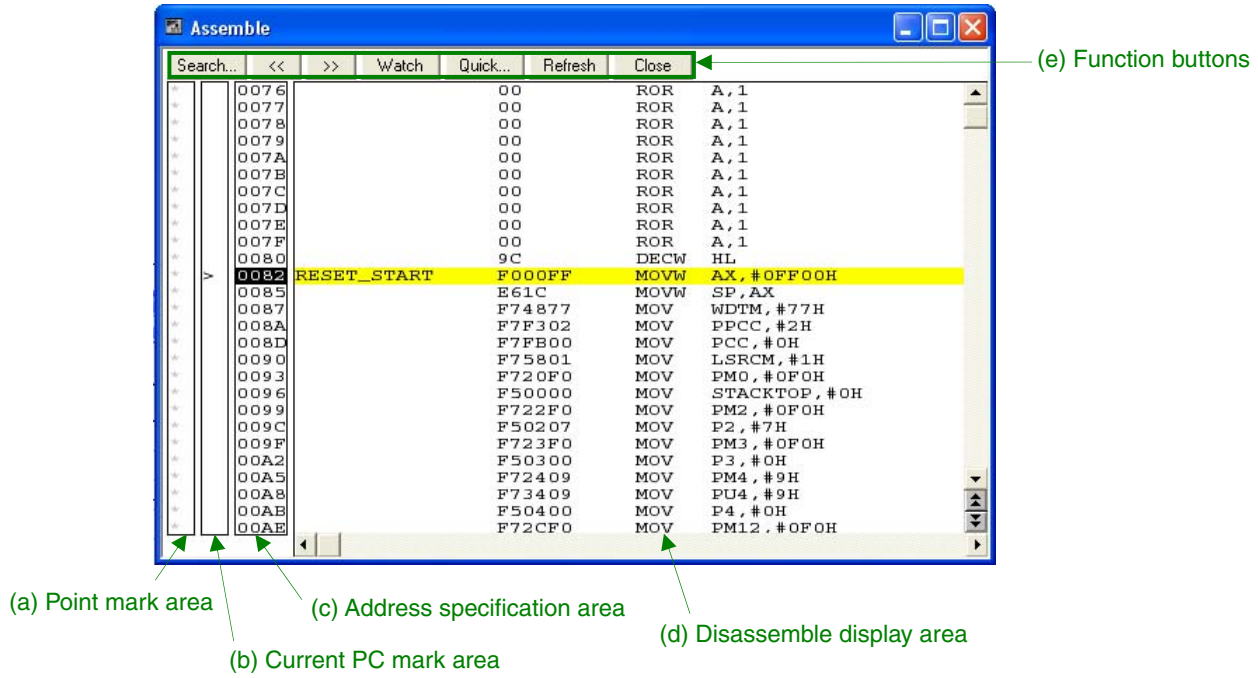
(Button creation)	Switch A button can be connected to any pin. An input value can be given to the connected pin by clicking the displayed button. Same function as selecting [Button] from [Parts] on the menu bar.
(Key matrix creation)	A key matrix consists of multiple pins connected in a matrix array, wherein each contact represents a key, and clicking a key results in a specific state. A key matrix can be connected to any pin, and data can be input using multiple keys. Same function as selecting [Key Matrix] from [Parts] on the menu bar.
(Level gauge creation)	Used for inputting analog data, such as power supply voltage. Any data within a given range can be set. Any value within a specified range can be assigned to a pin connected to an A/D converter. Same function as selecting [Level Gauge] from [Parts] on the menu bar.
(LED creation)	LED (Light Emitting Diode) An LED can be connected to any pin, and the output from the pin can be indicated by switching the LED on or off. Same function as selecting [LED] from [Parts] on the menu bar.
(7-segment LED creation)	A product that consists of 7 LEDs configured to represent a numeric figure. When the output from the pin to which the digit signal is assigned is active, the corresponding 7-segment LED switches on or off. Same function as selecting [7-segment LED] from [Parts] on the menu bar.
(14-segment LED creation)	A product that consists of 14 LEDs configured to represent an alphabetic character. When the output from the pin to which the digit signal is assigned is active, the corresponding 14-segment LED switches on or off. Same function as selecting [14-segment LED] from [Parts] on the menu bar.
(Matrix LED creation)	A product that consists of multiple LEDs arranged in a matrix array. When the output from the pin to which the digit signal is assigned is active, the corresponding matrix LED switches on or off. Same function as selecting [Matrix LED] from [Parts] on the menu bar.
(Buzzer creation)	Buzzer A buzzer connected to a pin indicates with a bitmap or buzzer sound the output information from the connected pin. Same function as selecting [Buzzer] from [Parts] on the menu bar.

An example of the display of the connected parts is shown below.



5.4 [Assemble] Window

This window is used to display the disassembly of a program. Select [Assemble] from the [Browse] menu or click the  button on the toolbar to open the [Assemble] window.



(a) Point mark area

This area is used for the event setting status display and breakpoint setting. A breakpoint can be set by clicking the asterisk ("*") of the location to which it is to be set.

(b) Current PC mark area

The ">" mark, which indicates the current PC value (PC register value), is displayed in this area. By double-clicking this area, the user program can be executed up to the double-clicked line.

(c) Address specification area

This area displays the disassembly start address.

(d) Disassemble display area

This area displays the labels and code data of addresses, and disassembled mnemonics.

Yellow indicates the current PC line, and red indicates lines where a valid breakpoint is set.

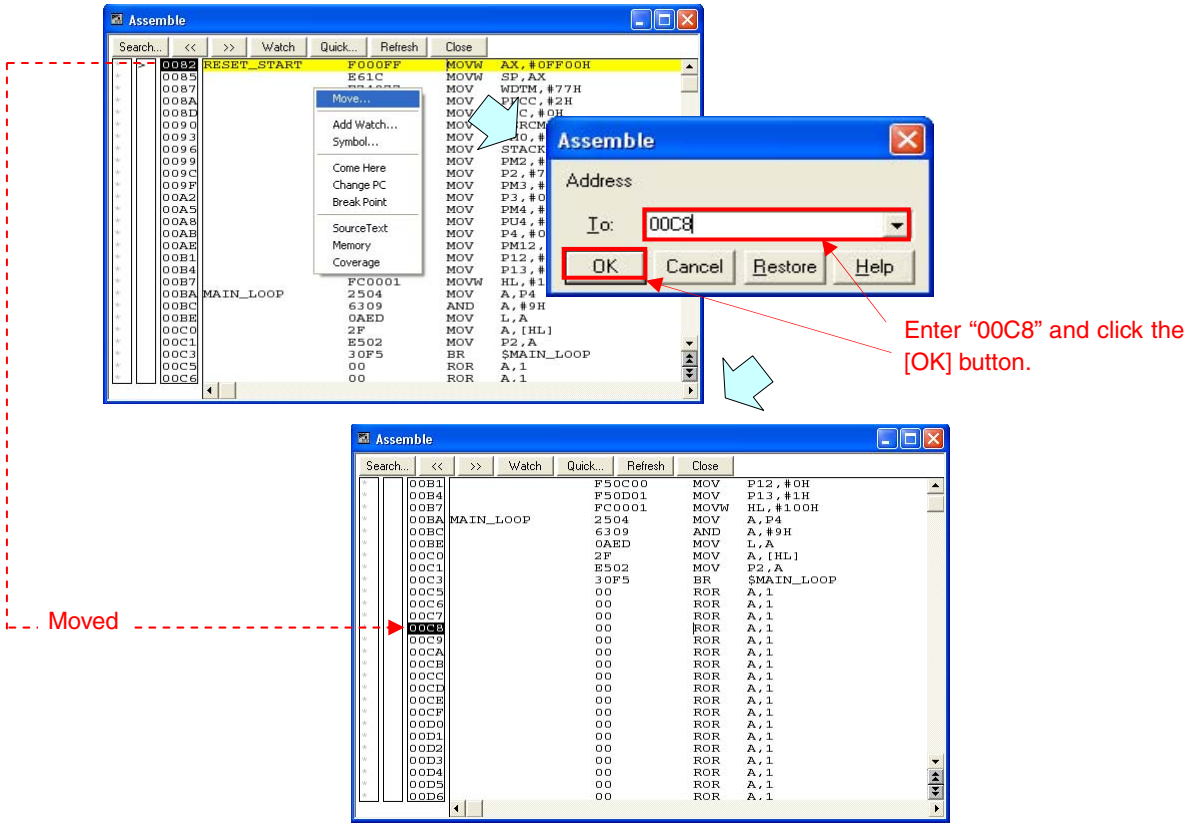
(e) Function buttons

Search…	Searches a character string (opens the [Assemble Search] dialog box).
<<	Searches forward (upward on screen) for the specified character string.
>>	Searches backward (downward on screen) for the specified character string.
Stop (during a search)	Stops searching.
Watch	Adds contents, such as a selected variable, to the [Watch] window.
Quick…	Temporarily displays the contents, such as a selected variable, in the [Quick Watch] dialog box.
Refresh	Updates the contents of the window with the latest data.
Close	Closes the [Assemble] window.

The menu (context menu) will be displayed if the right mouse button is clicked anywhere on the [Assemble] window. The three main functions that can be selected from the context menu are described next.

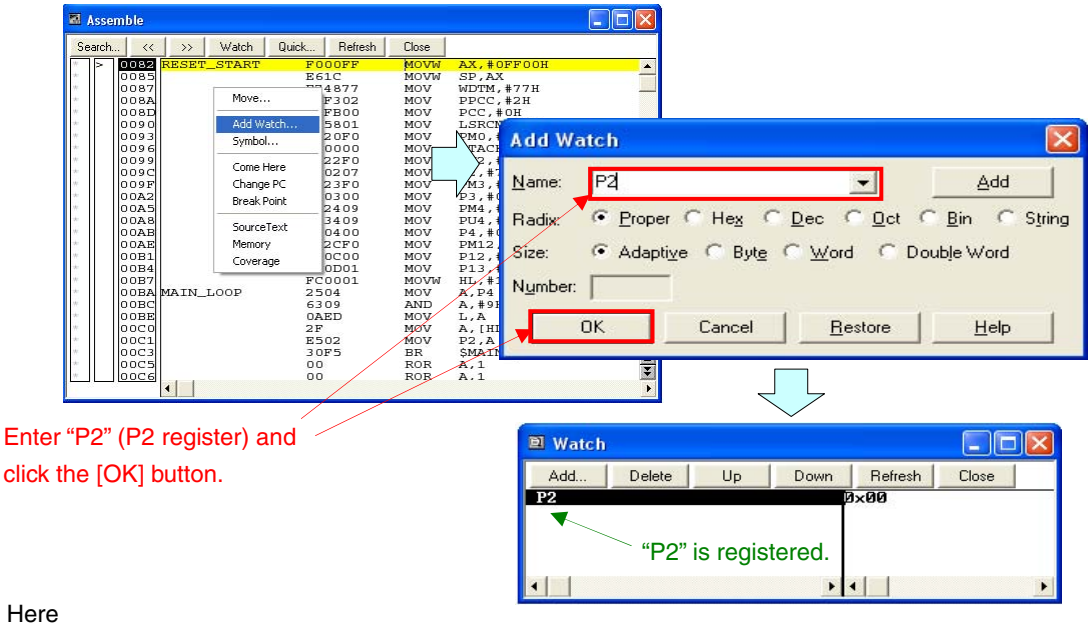
<1> Move

Select [Move] from the context menu (displayed by right-clicking anywhere on the [Assemble] window) to open the [Address Move] dialog box. Specify an address value and click the [OK] button in this dialog box to move the disassembly start address to the specified address value.



<2> Add Watch

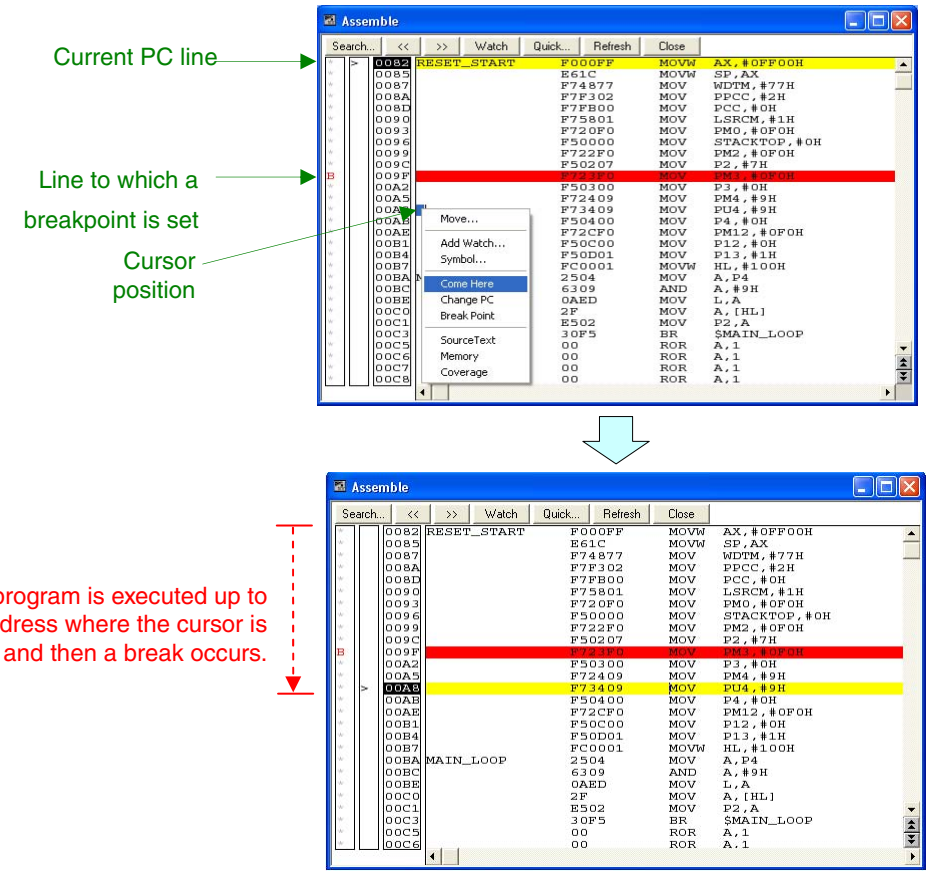
Select [Add Watch] from the context menu (displayed by right-clicking anywhere on the [Assemble] window) to open the [Add Watch] dialog box. Specify the data and click the [OK] button in this dialog box to register the specified data in the [Watch] window.



<3> Come Here

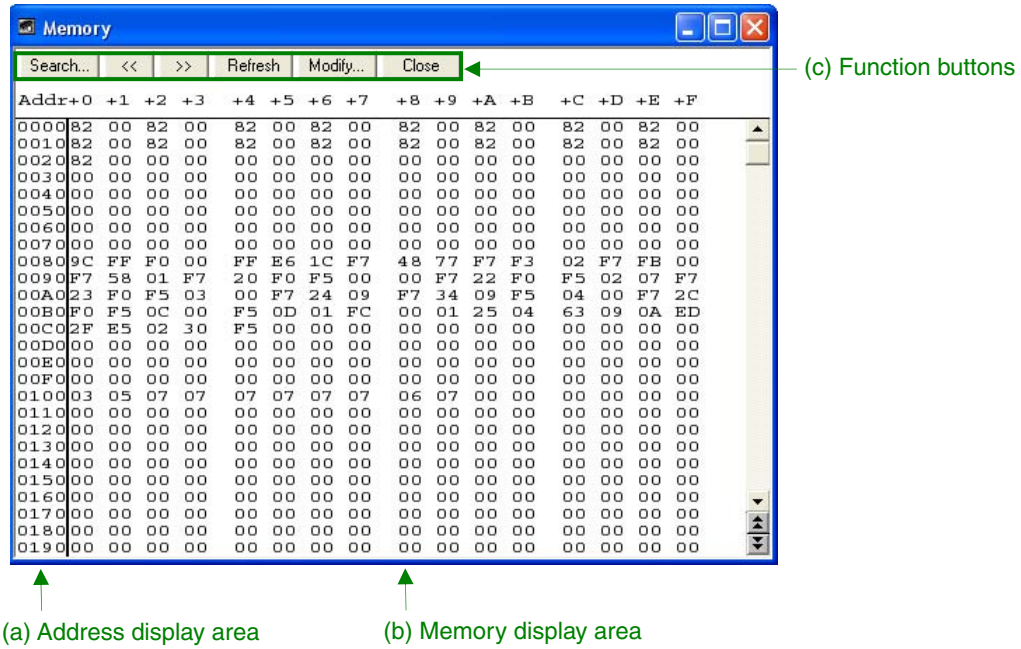
Select [Come Here] from the context menu (displayed by right-clicking anywhere on the [Assemble] window) to execute the program, from the address indicated by the current PC register up to the address where the cursor has been placed, after which a break occurs.

While the program is being executed, the break event currently set does not occur.



5.5 [Memory] Window

This window is used to display memory contents. Select [Memory] from the [Browse] menu or click the button on the toolbar to open the [Memory] window.



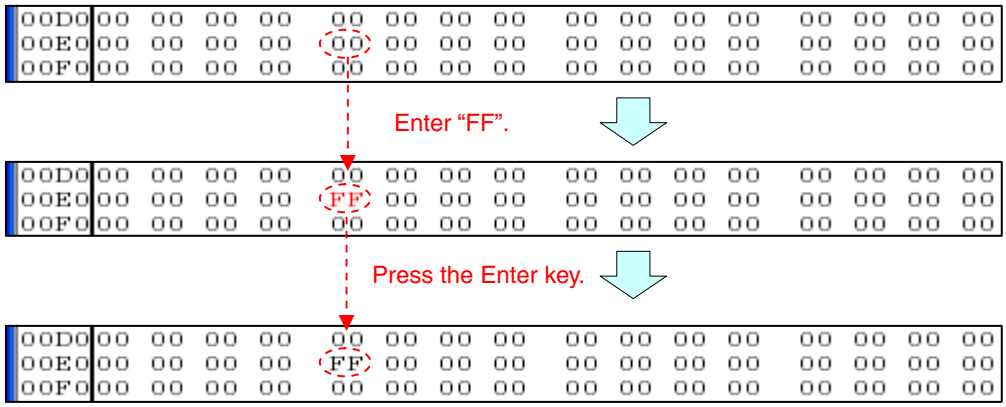
(a) Address display area

This area displays memory addresses.

(b) Memory display area

This area is used to display and change memory contents.

Memory contents are changed through direct entry. Changes are displayed in red and the contents of the changes are written to the target memory by pressing the Enter key. The previous values can be discarded by pressing the ESC key. Up to 256 bytes can be changed at one time.



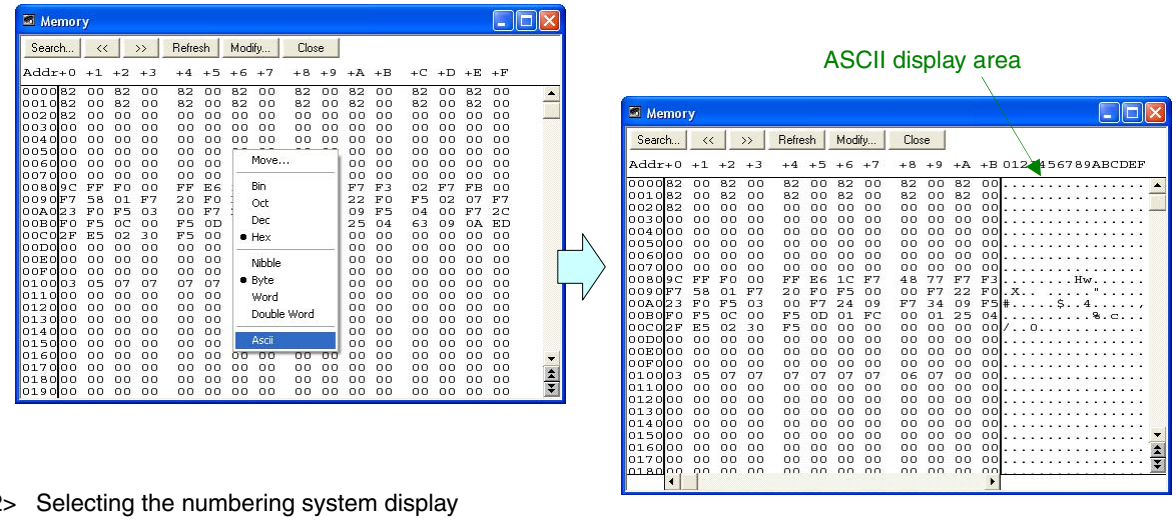
(c) Function buttons

Search…	Searches a character string or memory contents (opens the [Assemble Search] dialog box).
<<	Searches forward (upward on screen) for the specified character string or memory contents.
>>	Searches backward (downward on screen) for the specified character string or memory contents.
Stop (during a search)	Stops searching.
Refresh	Updates the contents of the window with the latest data.
Modify…	Rewrites the memory contents during program execution via the [DMM] dialog box.
Close	Closes the [Memory] window.

The menu (context menu) will be displayed if the right mouse button is clicked anywhere on the [Memory] window. The three main functions that can be selected from the context menu are described next.

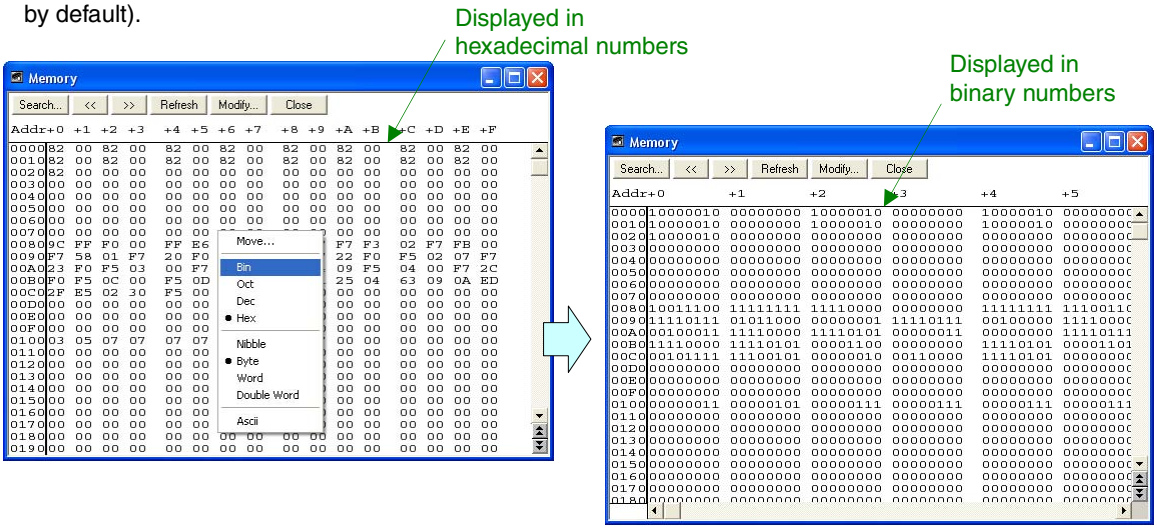
<1> ASCII display

Select [Ascii] from the context menu (displayed by right-clicking anywhere on the [Memory] window) to display the ASCII display area. ASCII characters of the memory contents can be displayed and changed in this area.



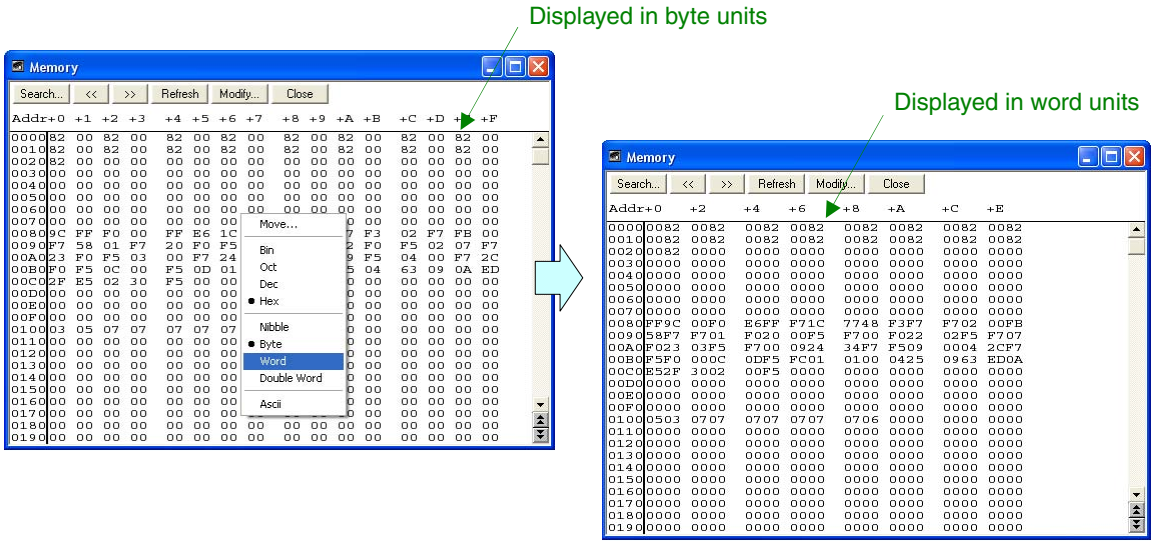
<2> Selecting the numbering system display

Select [Bin], [Oct], [Dec], or [Hex] from the context menu (displayed by right-clicking anywhere on the [Memory] window) to change the numbering system display of the memory display area (hexadecimal display by default).



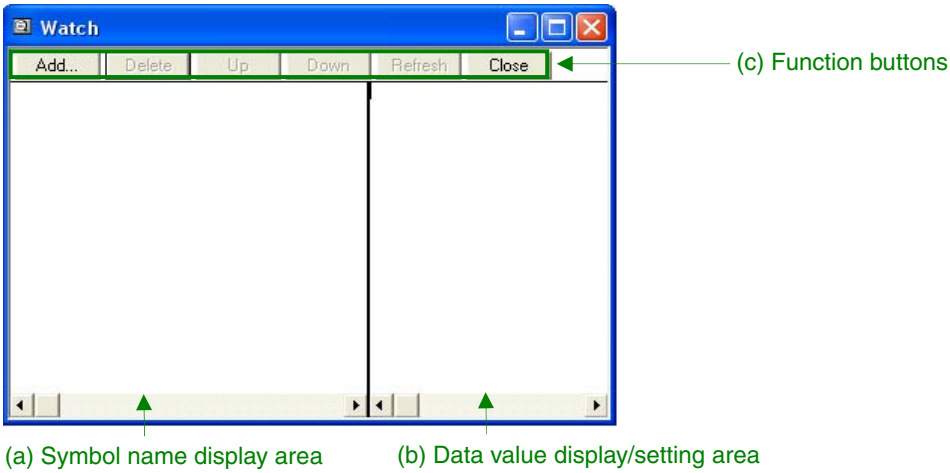
<3> Selecting the display unit

Select [Nibble] (4-bit units), [Byte] (8-bit units), [Word] (16-bit units), or [Double Word] (32-bit units) from the context menu (displayed by right-clicking anywhere on the [Memory] window) to change the display unit of the memory display area (byte display by default).



5.6 [Watch] Window

This window is used to display the shifts in data values registered. Select [Watch] from the [Browse] menu or click the button on the toolbar to open the [Watch] window.



(a) Symbol name display area

This area is used to display variable names, symbol names and types, and tag names of structures or unions registered in the [Add Watch] dialog box.

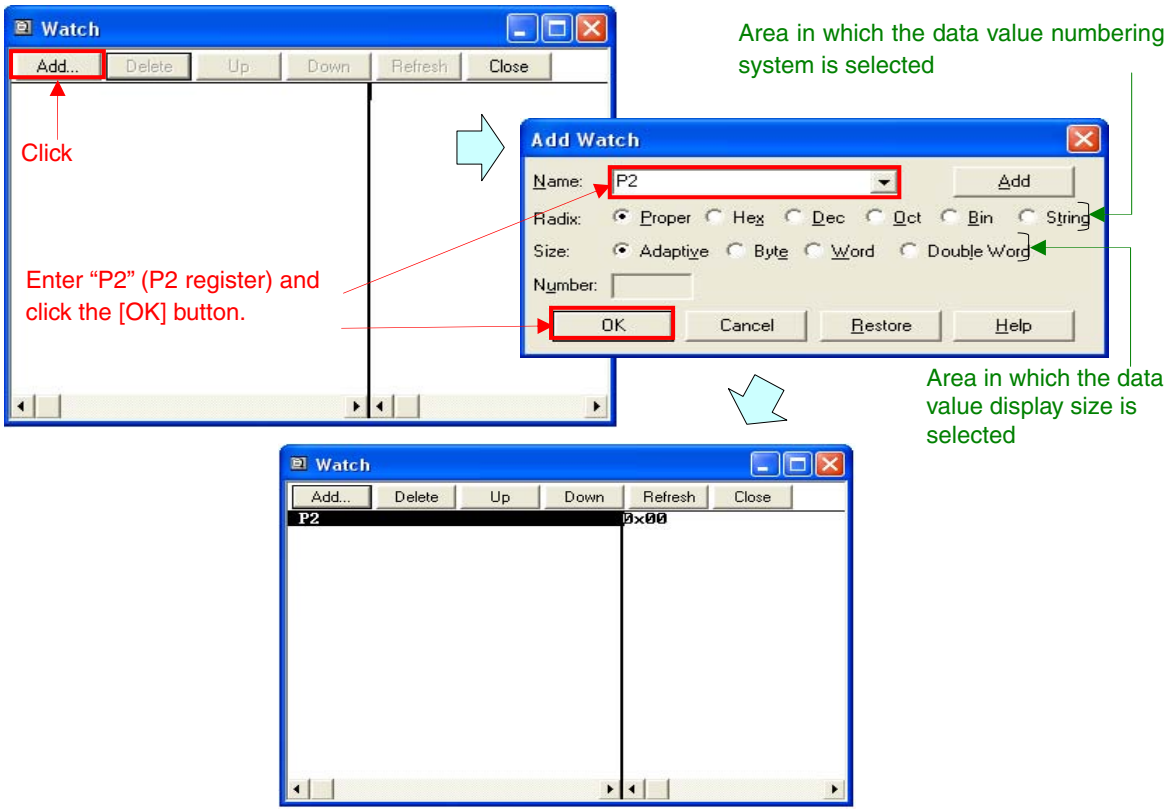
(b) Data value display/setting area

This area is used to display and change data values. The values are updated when execution is stopped.

(c) Function buttons

Add…	Rewrites the watch data via the [Add Watch] dialog box.
Delete	Deletes the selected watch data from the window.
Up	Moves the selected line one line up.
Down	Moves the selected line one line down.
Refresh	Updates the contents of the window with the latest data.
Close	Closes the [Watch] window.

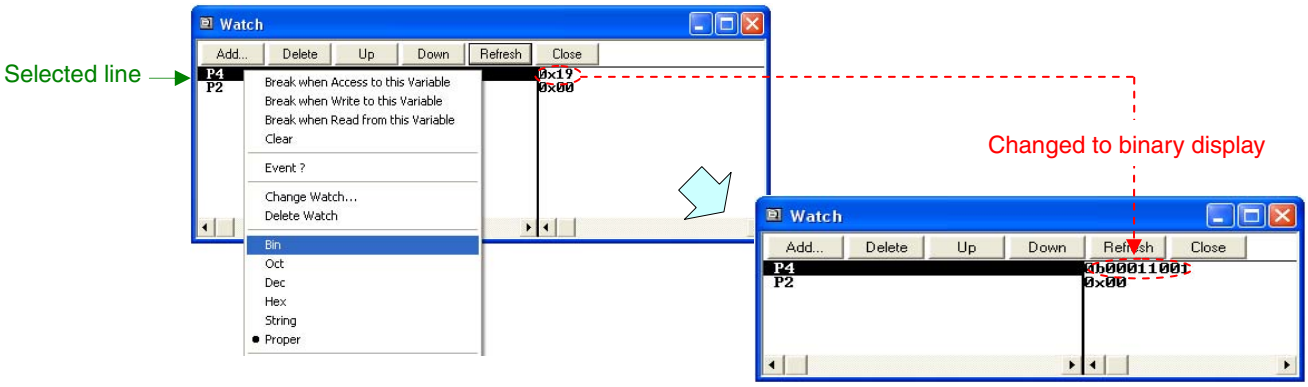
An example in which the [Add…] function button is used to register data to the [Watch] window is shown below.



The menu (context menu) will be displayed if the right mouse button is clicked anywhere on the [Watch] window. The main function that can be selected from the context menu is described next.

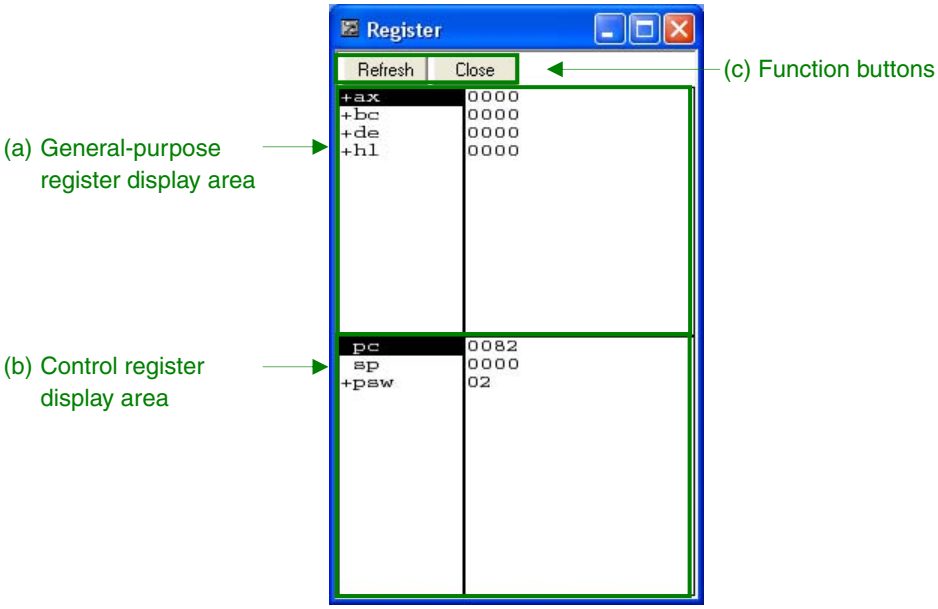
- Selecting the numbering system display
  The data value numbering system can be selected from the context menu (displayed by right-clicking anywhere on the [Watch] window).

Bin	Displays the selected line in binary numbers.
Oct	Displays the selected line in octal numbers.
Dec	Displays the selected line in decimal numbers.
Hex	Displays the selected line in hexadecimal numbers.
String	Displays the selected line as a character string.
Proper (default)	Displays the selected line in accordance with the setting of the [Debugger Option] dialog box (selected from [Debugger Option] in the [Option] menu) (default: hexadecimal).



5.7 [Register] Window

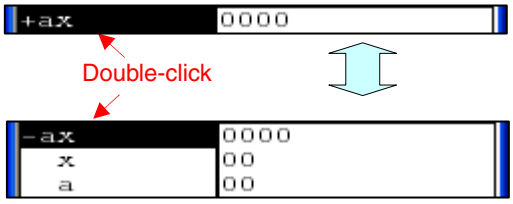
This window is used to display registers. Select [Register] from the [Browse] menu or click the button on the toolbar to open the [Register] window.



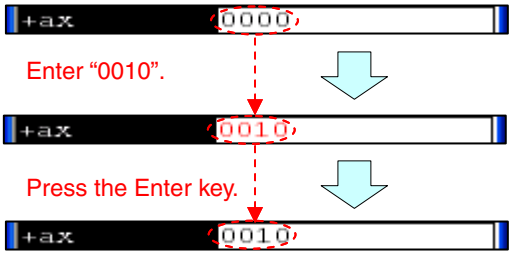
(a) General-purpose register display area

This area is used to display general-purpose registers.

The plus sign (“+”) indicates a 16-bit register whose display can be expanded. Double-click “+” to display the two register names and register values (“+” changes to “–”). Double click the minus sign (“–”) to cancel the expanded display.



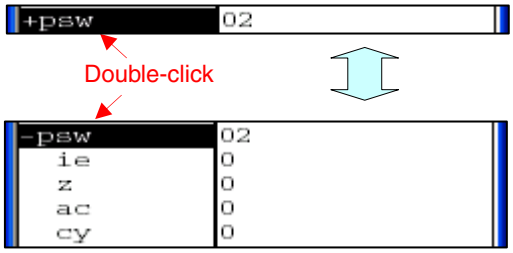
Register values are changed through direct entry. Changes are displayed in red and the contents of the changes are written to the target memory by pressing the Enter key. The previous values can be discarded by pressing the ESC key.



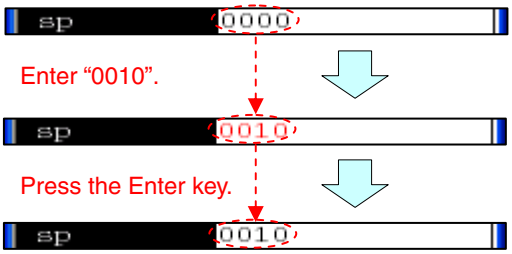
(b) Control register display area

This area is used to display control registers.

The plus sign (“+”) indicates a register whose display can be expanded. Double-click “+” to display the flag names and flag values (“+” changes to “–”). Double click the minus sign (“–”) to cancel the expanded display.



Register values are changed through direct entry. Changes are displayed in red and the contents of the changes are written to the target memory by pressing the Enter key. The previous values can be discarded by pressing the ESC key.



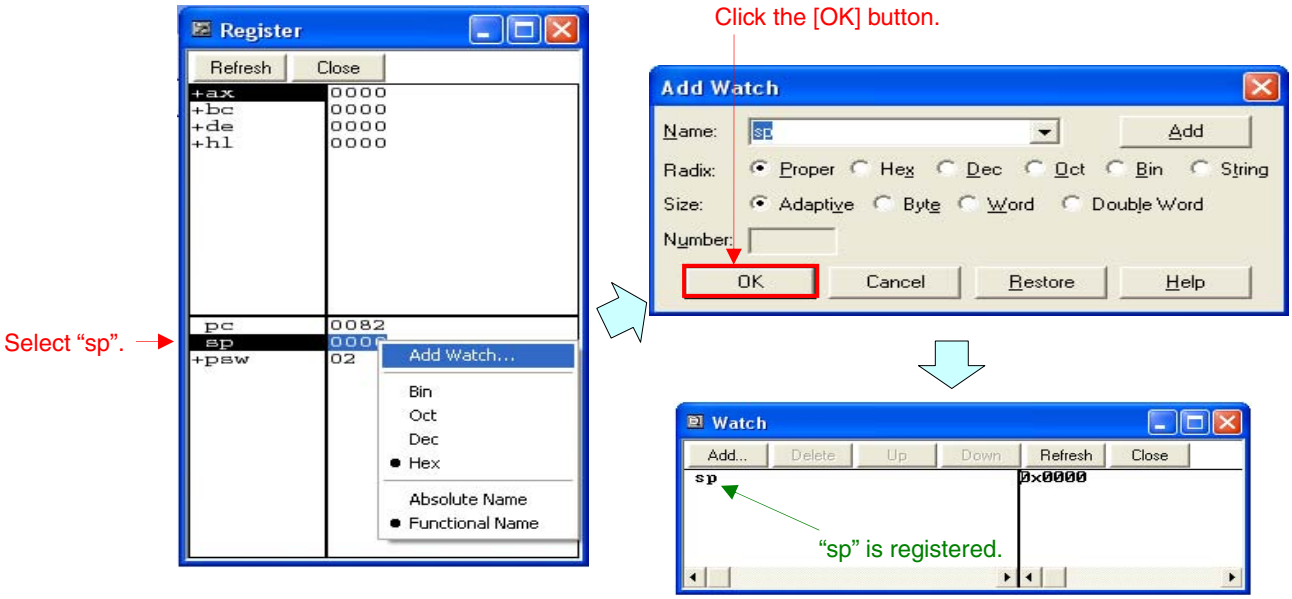
(c) Function buttons

Refresh	Updates the contents of the window with the latest data.
Close	Closes the [Register] window.

The menu (context menu) will be displayed if the right mouse button is clicked anywhere on the [Register] window. The two main functions that can be selected from the context menu are described next.

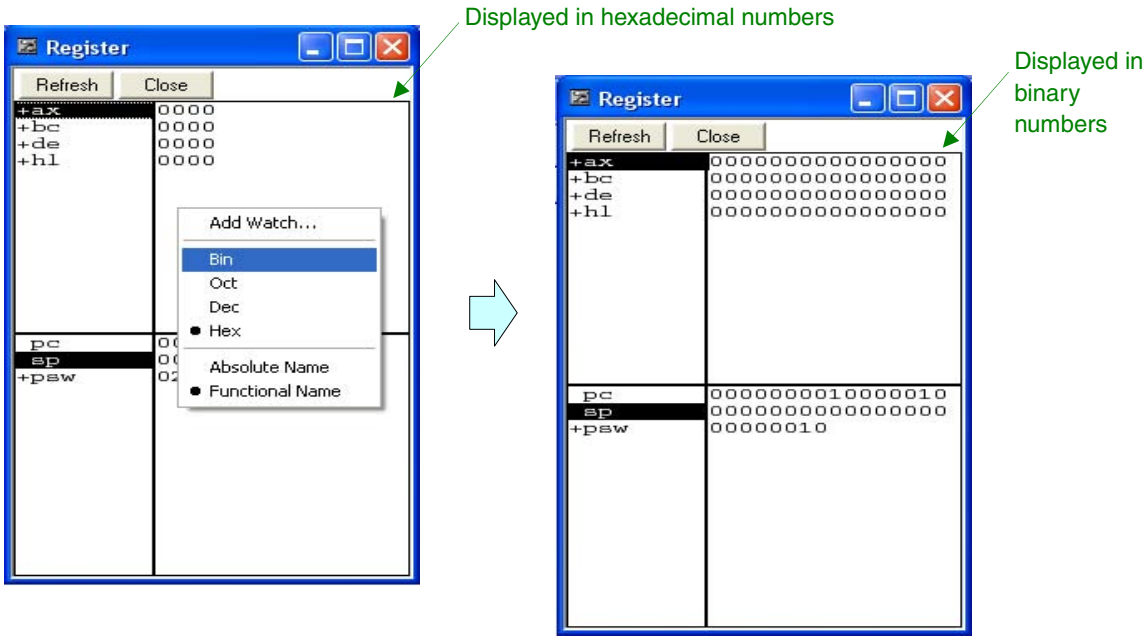
<1> Add Watch

Select on the window the name of the register to be added, and select [Add Watch] from the context menu (displayed by right-clicking anywhere on the [Register] window) to open the [Add Watch] dialog box. Check that the selected register name is added to the [Name:] column and click the [OK] button to register the specified data in the [Watch] window.



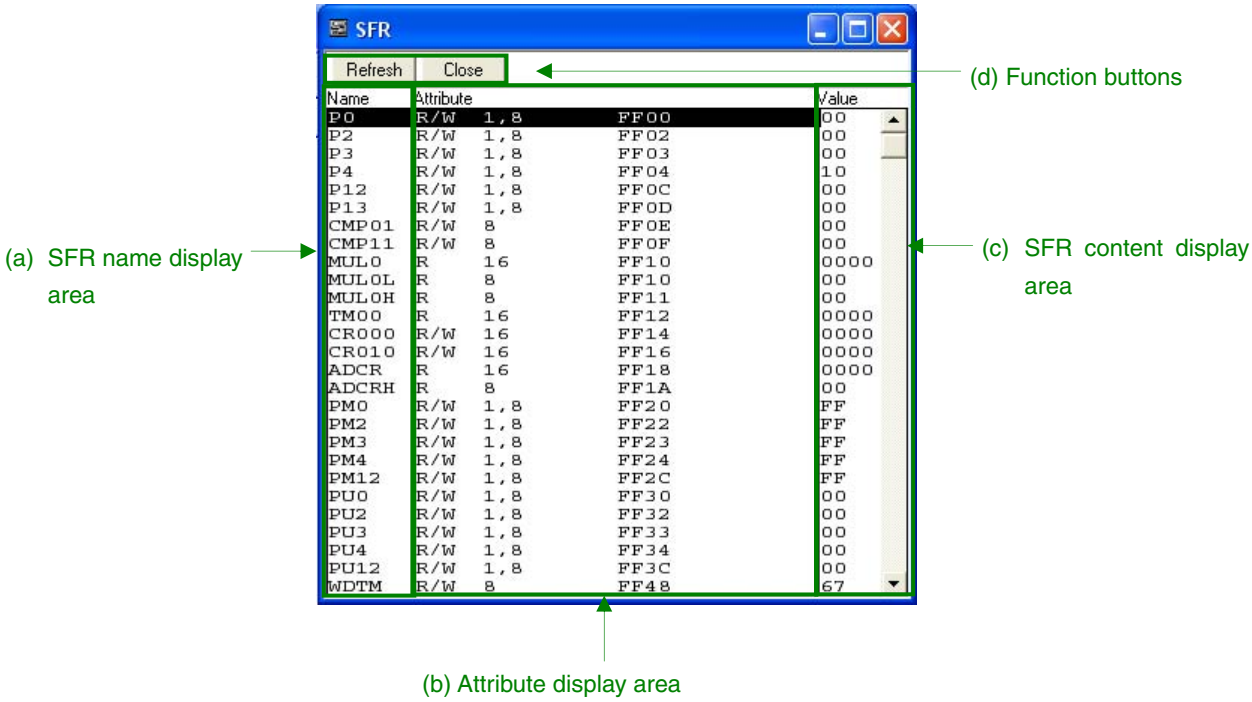
<2> Selecting the numbering system display

Select [Bin], [Oct], [Dec], or [Hex] from the context menu (displayed by right-clicking anywhere on the [Register] window) to change the numbering system display of the [Register] window (hexadecimal display by default).



5.8 [SFR] Window

This window is used to display registers. Select [SFR] from the [Browse] menu or click the button on the toolbar to open the [SFR] window.



Name	Attribute			Value
P0	R/W	1,8	FF00	00
P2	R/W	1,8	FF02	00
P3	R/W	1,8	FF03	00
P4	R/W	1,8	FF04	10
P12	R/W	1,8	FF0C	00
P13	R/W	1,8	FF0D	00
CMP01	R/W	8	FF0E	00
CMP11	R/W	8	FF0F	00
MUL0	R	16	FF10	0000
MUL0L	R	8	FF10	00
MUL0H	R	8	FF11	00
TM00	R	16	FF12	0000
CR000	R/W	16	FF14	0000
CR010	R/W	16	FF16	0000
ADCR	R	16	FF18	0000
ADCRH	R	8	FF1A	00
PM0	R/W	1,8	FF20	FF
PM2	R/W	1,8	FF22	FF
PM3	R/W	1,8	FF23	FF
PM4	R/W	1,8	FF24	FF
PM12	R/W	1,8	FF2C	FF
PU0	R/W	1,8	FF30	00
PU2	R/W	1,8	FF32	00
PU3	R/W	1,8	FF33	00
PU4	R/W	1,8	FF34	00
PU12	R/W	1,8	FF3C	00
WDTM	R/W	8	FF48	67

(a) SFR name display area

This area is used to display SFR names and I/O port names. If the value of an I/O port address is not defined, the I/O port name is displayed in a light color.

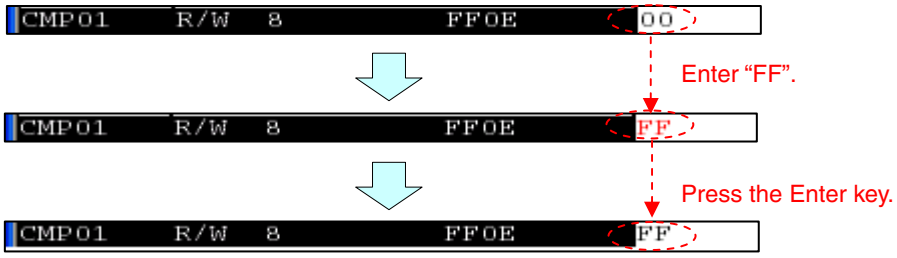
(b) Attribute display area

This area is used to display the attributes of SFRs and I/O ports. Read/write attributes, access types, and absolute addresses are displayed from the left side to the right.

(c) SFR content display area

This area is used to display the contents of SFRs and I/O ports.

Values are changed through direct entry. Changes are displayed in red and the contents of the changes are written to the target memory by pressing the Enter key. The previous values can be discarded by pressing the ESC key.



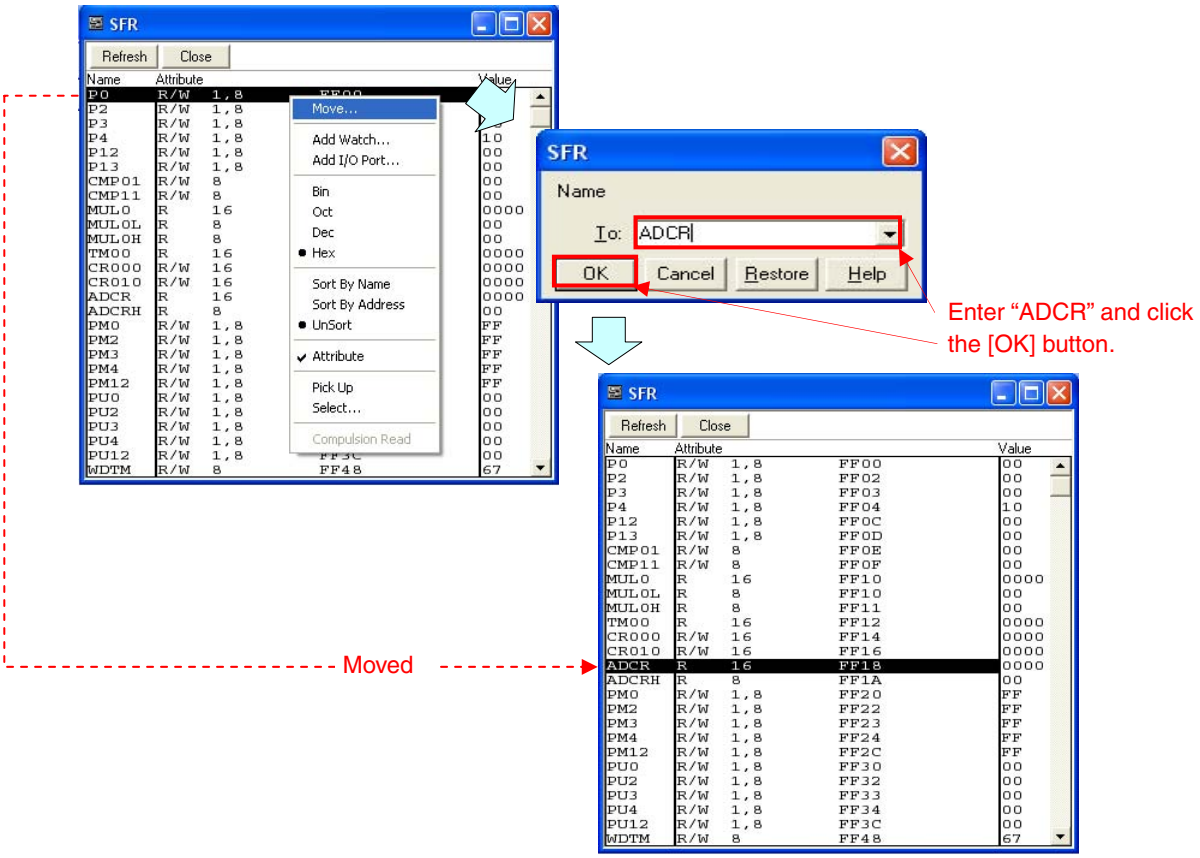
(d) Function buttons

Refresh	Updates the contents of the window with the latest data.
Close	Closes the [SFR] window.

The menu (context menu) will be displayed if the right mouse button is clicked anywhere on the [SFR] window. The four main functions that can be selected from the context menu are described next.

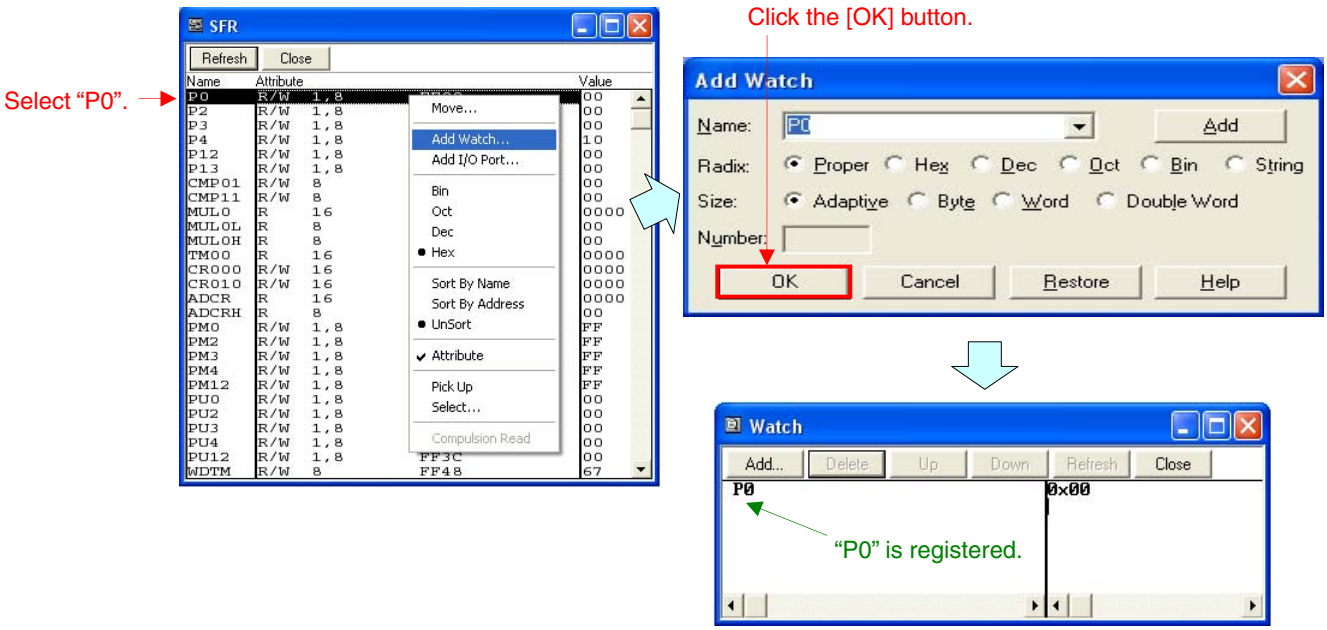
<1> Move

Select [Move] from the context menu (displayed by right-clicking anywhere on the [SFR] window) to open the [Address Move] dialog box. Specify an address value or SFR name and click the [OK] button in this dialog box to move the display start address to the specified address value.



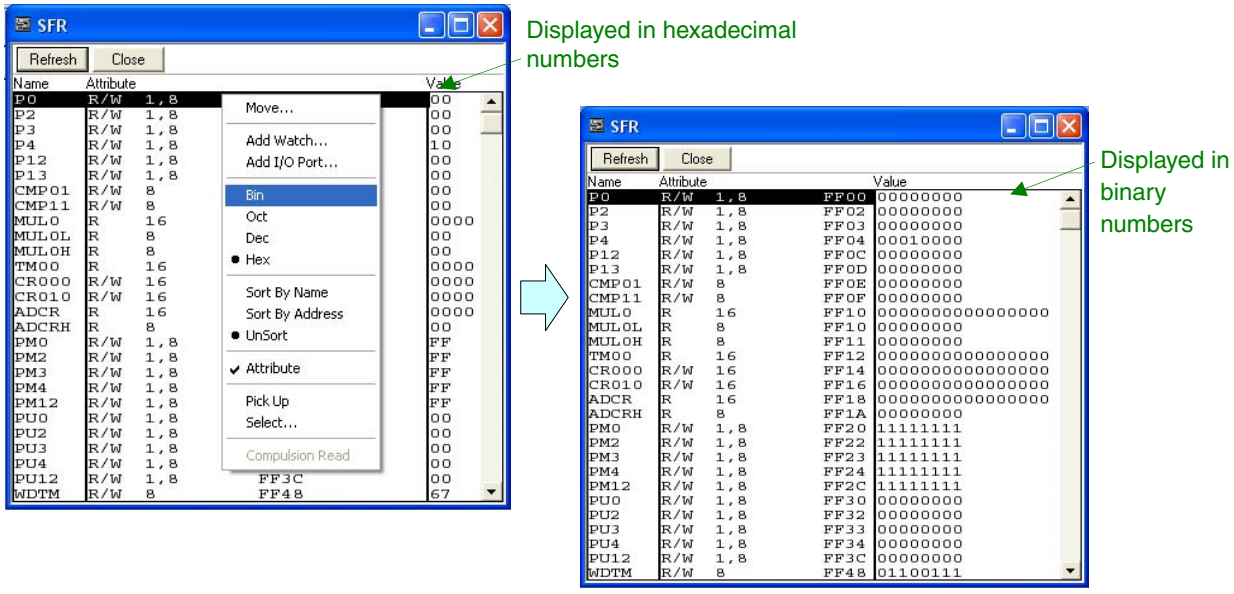
<2> Add Watch

Select on the window the name of the register to be added, and select [Add Watch] from the context menu (displayed by right-clicking anywhere on the [SFR] window) to open the [Add Watch] dialog box. Check that the selected register name is added to the [Name:] column and click the [OK] button to register the specified data in the [Watch] window.



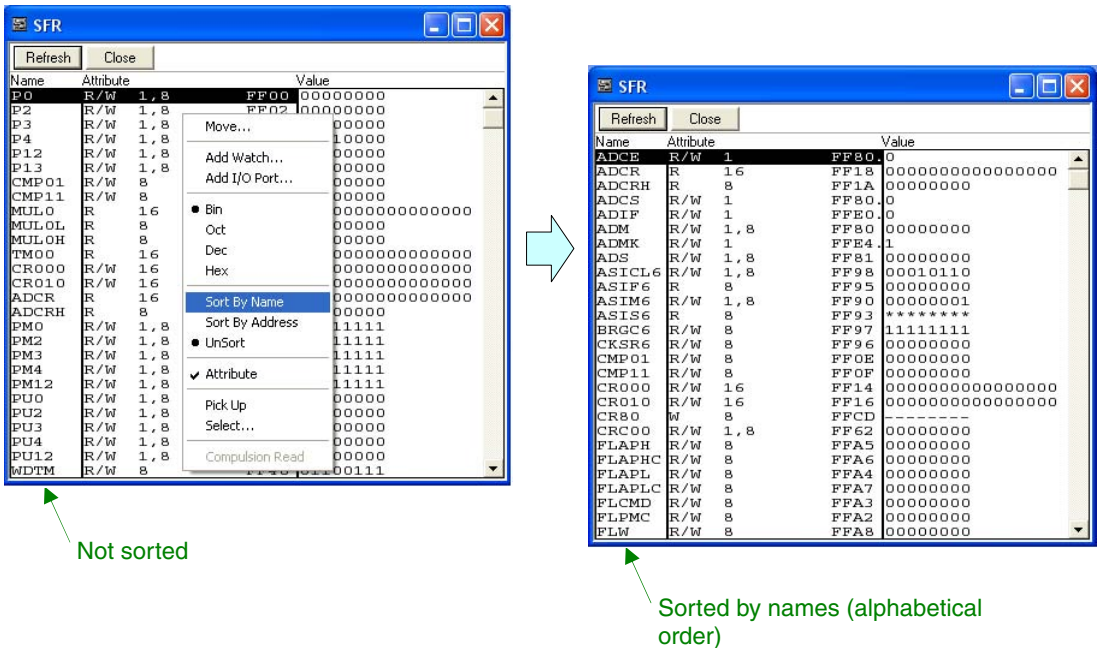
<3> Selecting the numbering system display

Select [Bin], [Oct], [Dec], or [Hex] from the context menu (displayed by right-clicking anywhere on the [SFR] window) to change the numbering system display of the [SFR] window (hexadecimal display by default).



<4> Selecting the sort method

Select [Sort By Name], [Sort By Address], or [UnSort] from the context menu (displayed by right-clicking anywhere on the [SFR] window) to change the way the SFR names and I/O port names are sorted on the [SFR] window ([UnSort] by default).



CHAPTER 6 RELATED DOCUMENTS

Document Name		Japanese/English
78K0S/KU1+ User's Manual		PDF
78K0S/KY1+ User's Manual		PDF
78K0S/KA1+ User's Manual		PDF
78K0S/KB1+ User's Manual		PDF
78K/0S Series Instructions User's Manual		PDF
RA78K0S Assembler Package User's Manual	Language	PDF
	Operation	PDF
CC78K0S C Compiler User's Manual	Language	PDF
	Operation	PDF
PM+ Project Manager User's Manual		PDF
SM+ System Simulator Operation User's Manual		PDF
Flash Programming Manual (Basic) (MINICUBE2) Information	78K0S/KU1+	PDF
	78K0S/KY1+	PDF
	78K0S/KA1+	PDF
	78K0S/KB1+	PDF
78K0S/Kx1+ Sample Program (Initial Settings) LED Lighting Switch Control Application Note		PDF

APPENDIX REVISION HISTORY

Edition	Date Published	Page	Revision
2nd edition	September 2008	–	–

For further information,
please contact:

NEC Electronics Corporation
1753, Shimonumabe, Nakahara-ku,
Kawasaki, Kanagawa 211-8668,
Japan
Tel: 044-435-5111
http://www.necel.com/

[America]

NEC Electronics America, Inc.
2880 Scott Blvd.
Santa Clara, CA 95050-2554, U.S.A.
Tel: 408-588-6000
800-366-9782
http://www.am.necel.com/

[Europe]

NEC Electronics (Europe) GmbH
Arcadiastrasse 10
40472 Düsseldorf, Germany
Tel: 0211-65030
http://www.eu.necel.com/

Hanover Office
Podbielskistrasse 166 B
30177 Hannover
Tel: 0 511 33 40 2-0

Munich Office
Werner-Eckert-Strasse 9
81829 München
Tel: 0 89 92 10 03-0

Stuttgart Office
Industriestrasse 3
70565 Stuttgart
Tel: 0 711 99 01 0-0

United Kingdom Branch
Cygnus House, Sunrise Parkway
Linford Wood, Milton Keynes
MK14 6NP, U.K.
Tel: 01908-691-133

Succursale Française
9, rue Paul Dautier, B.P. 52
78142 Velizy-Villacoublay Cédex
France
Tel: 01-3067-5800

Sucursal en España
Juan Esplandiu, 15
28007 Madrid, Spain
Tel: 091-504-2787

Tyskland Filial
Täby Centrum
Entrance S (7th floor)
18322 Täby, Sweden
Tel: 08 638 72 00

Filiale Italiana
Via Fabio Filzi, 25/A
20124 Milano, Italy
Tel: 02-667541

Branch The Netherlands
Steijgerweg 6
5616 HS Eindhoven
The Netherlands
Tel: 040 265 40 10

[Asia & Oceania]

NEC Electronics (China) Co., Ltd
7th Floor, Quantum Plaza, No. 27 ZhiChunLu Haidian
District, Beijing 100083, P.R.China
Tel: 010-8235-1155
http://www.cn.necel.com/

Shanghai Branch
Room 2509-2510, Bank of China Tower,
200 Yincheng Road Central,
Pudong New Area, Shanghai, P.R.China P.C:200120
Tel:021-5888-5400
http://www.cn.necel.com/

Shenzhen Branch
Unit 01, 39/F, Excellence Times Square Building,
No. 4068 Yi Tian Road, Futian District, Shenzhen,
P.R.China P.C:518048
Tel:0755-8282-9800
http://www.cn.necel.com/

NEC Electronics Hong Kong Ltd.
Unit 1601-1613, 16/F., Tower 2, Grand Century Place,
193 Prince Edward Road West, Mongkok, Kowloon, Hong Kong
Tel: 2886-9318
http://www.hk.necel.com/

NEC Electronics Taiwan Ltd.
7F, No. 363 Fu Shing North Road
Taipei, Taiwan, R. O. C.
Tel: 02-8175-9600
http://www.tw.necel.com/

NEC Electronics Singapore Pte. Ltd.
238A Thomson Road,
#12-08 Novena Square,
Singapore 307684
Tel: 6253-8311
http://www.sg.necel.com/

NEC Electronics Korea Ltd.
11F., Samik Lavied'or Bldg., 720-2,
Yeoksam-Dong, Kangnam-Ku,
Seoul, 135-080, Korea
Tel: 02-558-3737
http://www.kr.necel.com/

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