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April 1<sup>st</sup>, 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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Document No. U18787EJ2V0AN00 (2nd edition) Date Published September 2008 N

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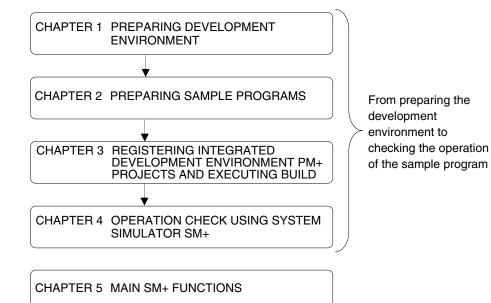
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#### PREFACE

- Target ReadersThis manual is intended for customers using sample programs for the first time as well<br/>as customers using the 78K0S/Kx1+ microcontroller development tools for the first time.<br/>To use the development tools, basic knowledge on how to operate Windows<sup>™</sup> is<br/>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.



CHAPTER 6 RELATED DOCUMENTS

APPENDIX REVISION HISTORY

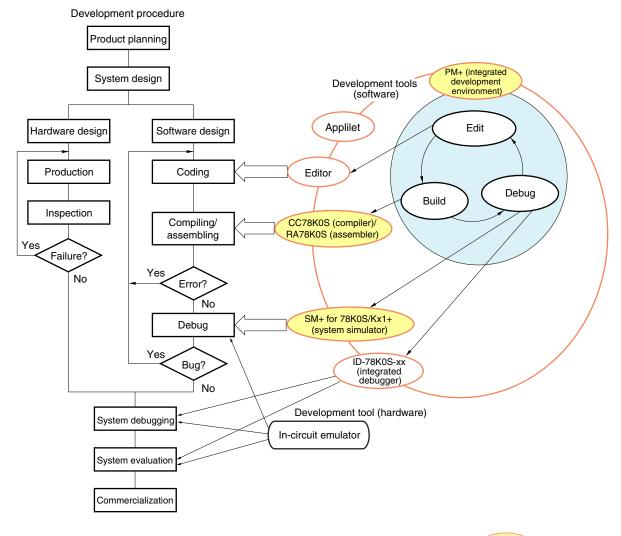
The descriptions in chapter 2 and the following chapters use the sample program (initial setting) for the 78K0S/KB1+ microcontroller as an example.

#### 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.

→ <u>http://www.necel.com/micro/en/designsupports/sampleprogram/78k0s/low\_pin\_count/index.html</u>

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

		Pro	gramming Exa	amples Search		
	78K05/Kx1+ Micro	controllers	All 78K0S/KB1+ 78K0S/KA1+ 78K0S/KY1+ 78K0S/KU1+	•		—— Select "78K0S/KB1+".
1	Programming Lang	juage		ssembler OC		
3	Function					
Select "In Setting".		ction	C Timer 8bit timer Interval T 8bit timer Interval T PWM 16bit time Interval T External I PWM PPG Outp Oneshot F	Timer H1 Timer or 00 Timer Event Counter ut	○ A/D Converter ○ Serial Interface UART6 ○ Software UART	
		Title al Setting , co	Lang	Date PI	Reset DF 🕜 source 🖓 Prj 🖉 SM+	
	Swit 78K0S/KB1+ Initi (LEC	D Lighting tch Control) al Setting D Lighting tch Control)	mment C	Rev. 1.00	6мв) (ЗКВ) (ЗКВ) (1К 6мв) (2КВ) (7КВ) (1К (7КВ) (1К (7КВ) (1К	
	Applica (*.pdf)	tion Note	)		de files to be used	Include microcontroller operation simulation files to be used with SM+ for 78K0S/Kx1+
	(	Only source files (*.zip)			PM+ as well as for 78K0S/Kx1+	(*.zip)

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< th=""><th>and decom</th><th>pressing a</th><th>sample program</th><th>(compressed</th><th>file)&gt;</th></downloading<>	and decom	pressing a	sample program	(compressed	file)>

File Download
Do you want to open or save this file?         Image: U18752E_78K05KB1P_ASM_SRC_0704_V1.zip         Type: Compressed (zipped) Folder, 2.17 KB         Click         From: www.necel.com         Image:
Save As
Save in: 🔁 download 💿 🕜 🌮 🖽 -
My Recent Documents       Select a desired location ("download" folder in this example).
My Documents Click
My Computer
My Network     File name:     U18752E_78K0SKB1P_ASM_SRC_0704_V1.zip      Save       Save as type:     Compressed (zipped) Folder     Cancel
Download complete         Saved:        OSKB1P_ASM_SRC_0704_V1.zip from www.necel.com         Download complete:         Downloaded:       2.17 KB in 7 sec         Download to:      U1018752E_78K05KB1P_ASM_SRC_0704_V1.zip         Transfer rate:       317 bytes/Sec         Close this dialog box when download completes         Open       Open Folder
Right-click and select [Extract

#### 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).  $\Rightarrow$  <Procedure  $3.1.1 \rightarrow 3.2 \rightarrow 4.1.1 \rightarrow 4.1.3 \rightarrow 4.2$ >

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

**32** 

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

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

File Name	Description	PDF (*.pdf) File	Compressed (*.zip) File Includ		Included
		POF	尙	<b>모</b> 제 성명 8 - <mark>32</mark>	<b>32</b>
UxxxxxxxxXANxx.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	Project file for system simulator SM+ for			Note 2	
xxx.prs	78K0S/Kx1+				
xxx.prm					
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 <u>PM+ Project Manager User's Manual</u>.

#### 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 **assembly** 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.

	New WorkSpace - Step 1/9 [Workspace Information]		
(b) Specify the folder location (click [Browse], select a folder, and click [OK]).	* Workspace File Name : initia Figure Blank Workspace * Eolder : C.VPtogram Files/NEC Electronics Tools/PM+/V6.30/b Browse Project Group Name :	2. Select sol	der:
(c) Enter the group name ("Initialization" in this example).	Initialization         * Microcontrollers Name :         78K0S         Image: State of the	6. Link Directh 7. Setup Sourd 8. Select Debu 9. Confirmation (#) V850 Microco Only (4-6)	CC78K05  DEV  DEV  PM+ V6,31  W_data Work hlp Kelation  Kelation
(d) Select "78K0S" for the microcontroller name (click [♥] and select it from the drop-down list).	This will set up the basic information about the monopole and the property of the test of of test	ct.	Help
	(e) Select the device name (click [▼] and select it from Click the [Next the drop-down list).	] button after se	tting items (a) to (e).

(a) Enter the file name ("initial" in this example).

- (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.<sup>Note</sup>
  - <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.

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

New WorkSpace - Step 2/9 [Select Tools]	
Tool Set :	Tool Version Detail Setting
[Changed](Selected01)78K0S Software Package V3.00(English 💌	>>> CC78K0S RA78K0S
Tool ⊻ersions :	✓Unused         Unused           □w2.01         ✓w2.00           □w2.00         ✓
Tool         Version           CC78K0S         Unused           RA78K0S         W2.00	<2> Set the RA78K0S version to W2.00 or later and click the [OK] button.
<1> Click the [Detail Setting] button.	
Select only Installed Tools	78KDS Software Package V3.00(English Version)
Detail Setting	
Please select the Tools from NEC Electronics to be used.	OK Cancel Help
< <u>B</u> ack Next>	Cancel Help

<3> Click the [Next] button.

- (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 <u>CHAPTER 2 PREPARING SAMPLE PROGRAMS</u>, and the [Open] button is clicked.)
  - <3> The source files selected in step <2> will be specified. Click the [Next] button.

New WorkSpace - Step 7/9 [Setup Source Files]	
Please setup Source Files. Source File Name : 22E 78K05KB1P_ASM_SRC_0704_V1\op.asm Bemove Remove All Up Down You can also add source files by specifying the list file or the folder. You can also add source files by specifying the list file or the folder. You can also add source files by specifying the list file or the folder. You can also add source files by specifying the list file or the folder. You can also add source files by specifying the list file or the folder. You can also add source files by specifying the list file or the folder. You can setup source files here, and you can setup source file Settings] later.	1. Select P       Look in: U18752E_79K0SKB1P_ASM_SRC_(        Imain.asm       Imain.asm         4. Startup F       5. Register       Imain.asm       Imain.asm       Imain.asm         5. Register       6. Link Dire       Imain.asm       Imain.asm       Imain.asm         >>7. Setup So       8. Select D       9. Confirma       Imain.asm       Imain.asm       Imain.asm         (#) V850 Micr Only (4-5)       File pame:       Imain.asm'' 'op.asm''       Imain.asm'' 'op.asm''       Imain.asm         File sof type:       Source Files(*.s.*.asm)       Cancel       Help         Add Files from Folder       Add Files from Folder
< <u>₿</u> ack <u>N</u> ext>	Cancel Help
	<3> Click the [Next] button.

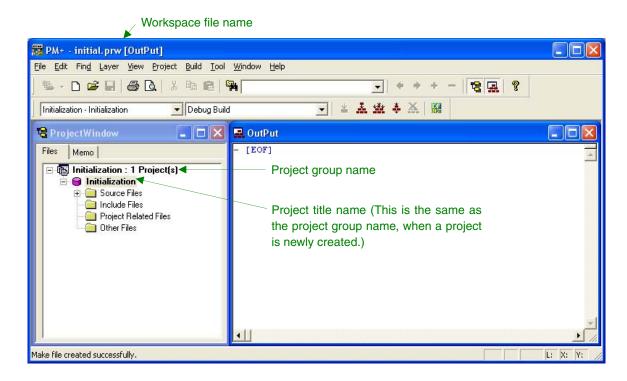
#### <1> Click the [Add] button.

- New WorkSpace Step 8/9 [Select Debugger] Please select the Debugger. 1. Workspace Information \* Debugger : 2. Select Tools Not select or install the debugger Ψ. 3. Select Real-Time OS <u>File name :</u> 5. Register Mode(#) 7. Setup Source Files >>8. Select Debugger Option : 9. Confirmation (#) V850 Microcontrollers Only (4-6) You can change the selected Debugger using [Tool] -> [Select Debugger]. < <u>B</u>ack <u>N</u>ext > Cancel Help Click
- (6) The [New WorkSpace Step 8/9 [Select Debugger]] dialog box will be displayed. Click the [Next] button.

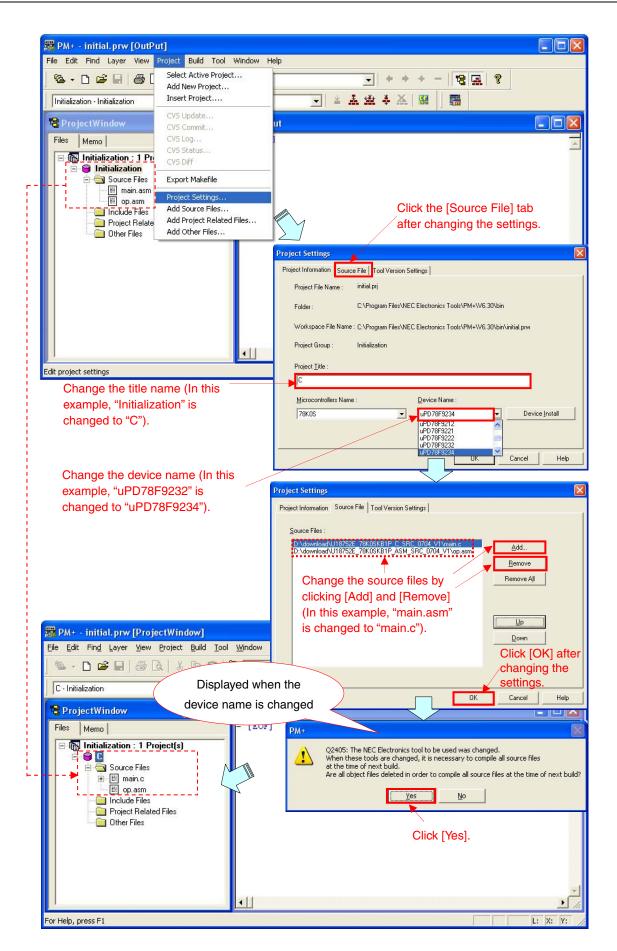
(7) The [New WorkSpace - Step 9/9 [Confirmation]] dialog box will be displayed. Confirm the settings and click the [Finish] button.

lew WorkSpace - Step 9/9 [Confirmation]	
Create the workspace and the project as follows.	1. Workspace Information
Workspace File Name : initial.prw Folder : C:\Program Files\NEC Electronics Tools\PM+\V6.30\bir Project Group Name : Initialization Microcontrollers Name : 78K0S Device Name : uPD78F9232 Tool Set Name : (Changed)(Selected02)78K0S Software Package V3.00) Tool Versions : RA78K0S W2.00 Debugger : Source Files : D:\download\U18752E_78K0SKB1P_ASM_SRC_0704, D:\download\U18752E_78K0SKB1P_ASM_SRC_0704,	2. Select Tools 3. Select Real-Time OS 4. Startup File(#) 5. Register Mode(#) 6. Link Directive File(#) 7. Setup Source Files 8. Select Debugger >>9. Confirmation (#) V850 Microcontrollers Only (4-6)
< Back Finish	Cancel Help
Click	

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



- (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



#### 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 **project** icon of the 78K0S/KB1+ microcontroller sample program (initial setting).

- (1) Start PM+.
- (2) Select [Open Workspace] from the [File] menu.
  - File

     New
     Ctrl+N

     Open...
     Ctrl+O

     Insert file...
     Ctrl+O

     Close
     New Workspace...

     Open Workspace...
     Save Workspace

     Close
     Close
- (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 <u>CHAPTER 2 PREPARING SAMPLE PROGRAMS</u>, and the [Open] button is clicked.)

Open Workspace	? 🛛
Look jn: 🗀 U18752E_78K0SKB1P_ASM_PRJ_0704_V1 🗸 🗢 🛍	<del>c*</del> 🔳 *
initial.prw	
Select the folder, select the	
workspace file (*.prw), and click the [Open] button.	
File name: initial.prw	<u>O</u> pen
Files of type: Workspace File(*.prw)	Cancel
	Help

(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.

s - D 🚅 🖬 🚳 [	Project Build Tool Window Help Select Active Project	+ + + - 12 ?	
	Add New Project Insert Project		
Initialization - Initialization		■ ▲ 丞 忠 キ 丞   圖	
ProjectWindow	CVS Update CVS Commit		
Files Memo	CVS Log		
Initialization : 1 Procession - 1 Procession	CVS Status CVS Diff		
🗄 🧰 Source Files	Export Makefile		
Include Files	Project Settings		
Dther Files	Add Source Files		
	Add Project Related Files Add Other Files		
5			

(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.

	Project Settings
	Project Information   Source File   Tool Version Settings
	Project File Name : initial.prj
	Folder: D:\download\U18752E_78K0SKB1P_ASM_PRJ_0704_V1
	Workspace File Name : D:\download\U18752E_78K0SKB1P_ASM_PRJ_0704_V1\initial.pnw
	Project Group : Initialization
	Project Inite : Initialization
	Microcontrollers Name : Device Name :
	78K0S V UPD78F9232 V Device Install
	uPD78F9212
Select the device name —	uPD 78F9222
Click the [OK] button —	UK Cancel Help
	Displayed when the
	PM+ device name is changed
	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?
Click —	
Click —	

- (6) The device file will be changed. After changing the device file, perform build operation. (Refer to <u>3.2 Executing</u> <u>Build</u>.)
- (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 <u>Remark 2 in 3.1.1</u>. (Refer to (4) to (6) in 3.1.2 when only changing the device files.)

[Column] Tab width in a source program

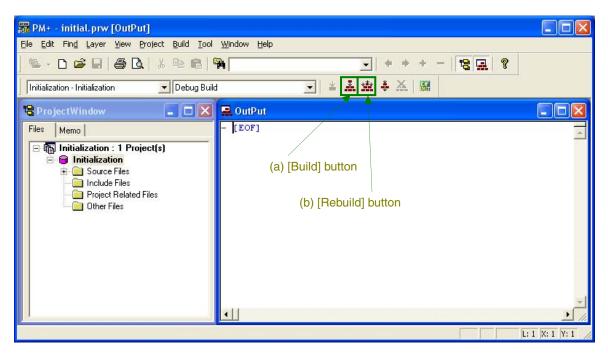
The source of a sample program is set to be easy to view when the tab width is set to eight characters. It is recommended to change the setting by the following procedure, because with PM+ the tab width is set to four characters by default.

<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 <u>3.1.1</u> or <u>3.1.2</u>, 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.



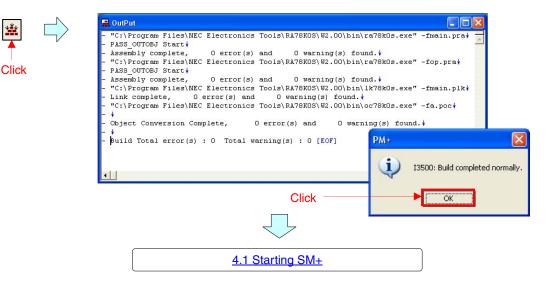
#### (a) [Build] button ( 🚣 )

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.

<u></u>		DutPut		
		C:\Program Files\NEC Electronics Tools\R&78KOS\W2.00\bin\ra78kOs.exe" -fm &SS OUTOBJ Start↓	ain.pra🕴 🔁	
⊤ Click	- A - "	ssembly complete, 0 error(s) and 0 warning(s) found.↓ C:\Program Files\NEC Electronics Tools\RA78KOS\W2.00\bin\ra78kOs.exe" -fo ASS OUTO&S Start↓	p.pra‡	
Olick	- A - "	ssembly complete, 0 error(s) and 0 warning(s) found.↓ C:\Program Files\NEC Electronics Tools\RA78KOS\W2.00\bin\Lk78KOs.exe" -fm ink complete, 0 error(s) and 0 warning(s) found.↓	ain.plk∳	
		C:\Program Files\NEC Electronics Tools\R&78KOS\W2.00\bin\oc78kOs.exe" -fa	.poc‡	
	- *	bject Conversion Complete, O error(s) and O warni uild Total error(s) : O Total warning(s) : O [EOF]		
	-	13500	: Build complete	d normally.
	•			
		Click	OK	
		4.1 Starting SM+		

#### (b) [Rebuild] button (1)

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.



#### [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.)

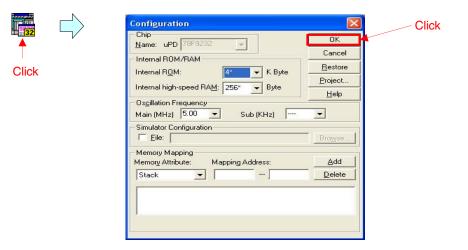
#### (b) When not starting SM+ in PM+

• 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)

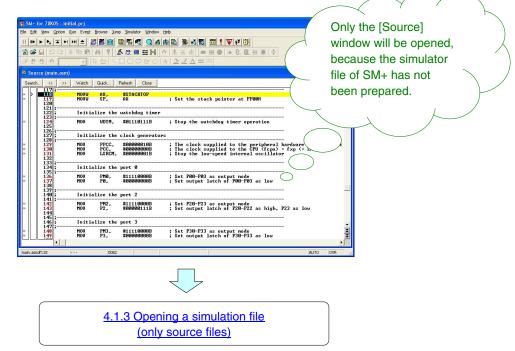
(1) When SM+ is started, the [Configuration] dialog box will be opened. Click the [OK] button.



- **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.

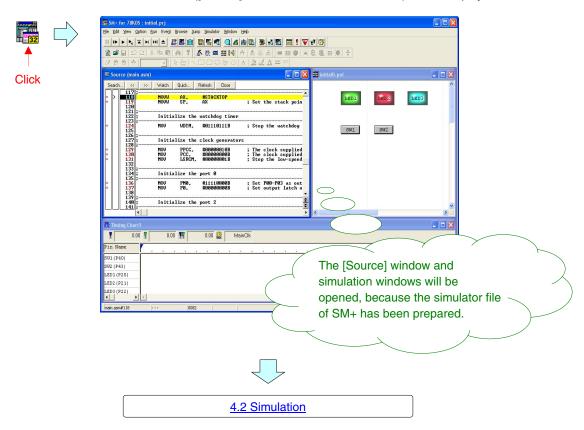
	SM+ for 78KOS	
	WF700: Do you want to download Load Module	File?
Click ——		

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



#### 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.



#### 4.1.3 Opening a simulation file (only source files)

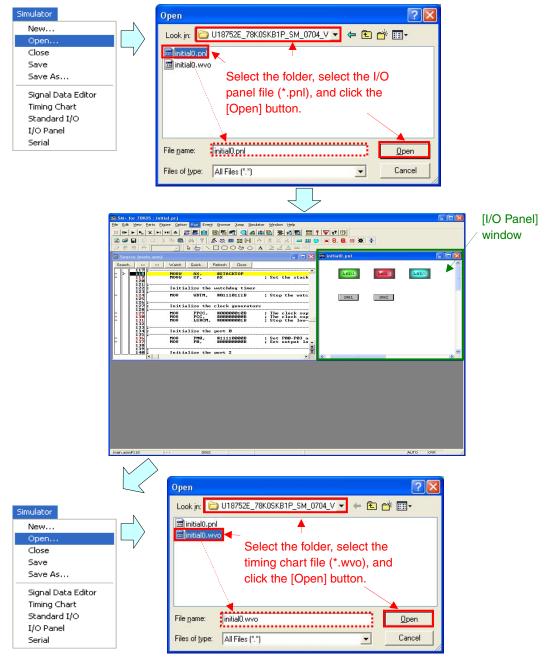
When only source files are downloaded (by clicking zip), only the [Source] window will be opened in the Main window of SM+.



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.)

		SM+ for 78K0S : initial.prj [//O Panel]					[I/O Panel]	
-	<b>⊜</b> ∎⊇2.			• ₩₩ ₩\$\$ 35• ¥\$ 153 ₩₩ 1  +1+   & & & & = ±± @		*		/ window
0	2 2 m x 1	- 12 m		$ A  \ge \angle A \equiv \overline{m}$	1)-, Gr 66, m (9)			V
				<b>- - X</b>	🚾 initial0.pnl			
S	earch << >>	Watch Quick	Refresh Close					
	> 118	MOUN AX, MOUN SP,	#STACKTOP AX	; Set the stack	LED1	LED2	LED3	
	122		e watchdog time:	e				
		MOU WDTH,	#01110111B	; Stop the watc	30/1	81/2		
	125 126 127 128		e clock generat					
	129 130 131 132	MOU PPCC, MOU PCC, MOU LSRCM	#88888818B #8888888888 #8888888888888888	; The clock sup ; The clock sup ; Stop the low-				
	133 : 134 : 135 ;	Initialize th						
2	136	MOU PM8, MOU PØ,	#11110800B #00080800B	; Set P00-P03 a ; Set output la -				
	138 139 140	Initialize th	port 2	÷			~	
1990	initial0.wvo							
7	0.00	0.00	0.00 🤮 M	leinClk				
Pir	Name							
	(P40) (P43)						A.	
	01(P20)							
	2 (P21) 03 (P22)							[Timing Chart]
521								
								window
100	I STATE						-	
mai	n.asm#118		2	1			AUTO OVR	
				$\checkmark$				
ſ								
			<u>4.2</u>	<b>Simulation</b>				
Ų							)	

**Remark** When source files and a project file have been downloaded (by clicking **PP**), 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

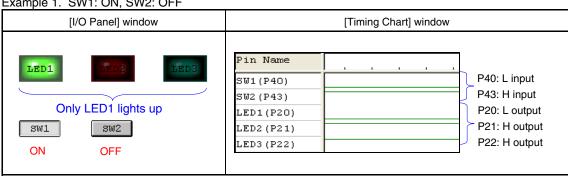
This section confirms how the 78K0S/KB1+ microcontroller sample program (initial setting) operates, by using the SM+ simulation functions.

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

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

	SM+ f	or 78K0S	: initial.prj							
				Browse Jur	mp <u>S</u> imulator <u>W</u> indov	v <u>H</u> elp				
						1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	<b>V</b>			
Click				In succession of the successio	<u>≦</u> ≣ <u></u> ≦ <u></u> ∰ <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u>		€ 8. 8. 3	5 AL		
		的 命 [		k @   ∕			× 0. 0. 4			
	-	ce (main.					🔀 🗮 initia	alO.pnl		
	Search.	. <<	>> Watch	Quick	Refresh Close		_	_	· · · · · ·	
	* >	118 119	MOUW MOUW	AX, SP,	#STACKTOP AX	; Set the stack poi	<u> </u>	LEDI	a strange	LED3
		120		51,		, set the stack por				3
		121 ;- 122 ; 123 ;-	Initia	lize the	watchdog time	r				
	*	124 125	MOU	WDTM,	#01110111B	; Stop the watchdog		SW1	SW2	
		126;-	Initia	lize the	clock generat	ors	-			
	*	128;-	MOU	PPCC, PCC,	#0000010B	; The clock supplie ; The clock supplie	a l			
	*	130 131	MOU MOU	PCC, LSRCM,	#00000000B #00000001B	; The clock supplie ; Stop the low-spee	1			
		132 133;-					-			
		134; 135;-		lize the			-			
	*	136 137	MOU MOU	PMØ, PØ,	#11110000B #00000000B	; Set POO-PO3 as ou ; Set output latch				
		138 139;- 140;	Toded	lize the	ment 9					
		141;-		112e the	port 2		- 王			×
		1					• <			2 .::
	nn Timi	ng Chart1								
		0.00	0.0	D 👭 🗌	0.00 🔮 🛛 M	MainClk				
	Pin Na	me								<u>.</u>
	SW1 (P4	0)								<u> </u>
	SW2 (P4	3)								
This turns	LED1(P									
red during	LED2 (P									
program	LED3 (P	22)	•							ĿĹ
execution.	main, asm	#118	100	0082		RUN			AUTO	
			1							

(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

#### Example 2. SW1: OFF, SW2: ON

[I/O Panel] window	[Timing Chart] window
LED1     LED2       Only LED2 lights up       SW1       SW2       OFF	Pin Name       P40: H input         SW1 (P40)       P43: L input         SW2 (P43)       P43: L input         LED1 (P20)       P20: H output         LED2 (P21)       P21: L output         LED3 (P22)       P22: H output

#### Example 3. SW1: ON, SW2: ON

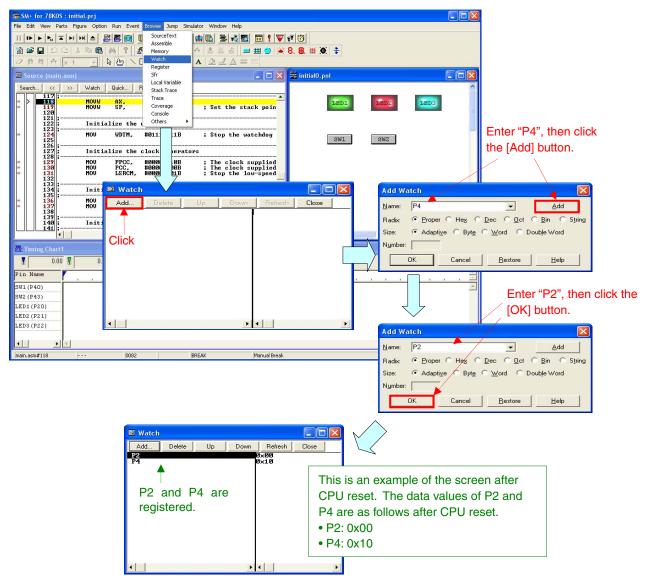
[I/O Panel] window	[Timing Chart] window
DED1     DED3       Only LED3 lights up       SW1       ON	Pin Name         P40: L input           SW1 (P40)         P43: L input           SW2 (P43)         P43: L input           LED1 (P20)         P20: H output           LED2 (P21)         P21: H output           LED3 (P22)         P22: L output

#### Example 4. SW1: OFF, SW2: OFF

[I/O Panel] window	[Timing Chart] window
All LEDs turn off SW1 SW2 OFF OFF	Pin Name         P40: H input           SW1 (P40)         P43: H input           SW2 (P43)         P43: H input           LED1 (P20)         P20: H output           LED2 (P21)         P21: H output           LED3 (P22)         P22: H output

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 <u>5.6 [Watch] Window</u>).
  - <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

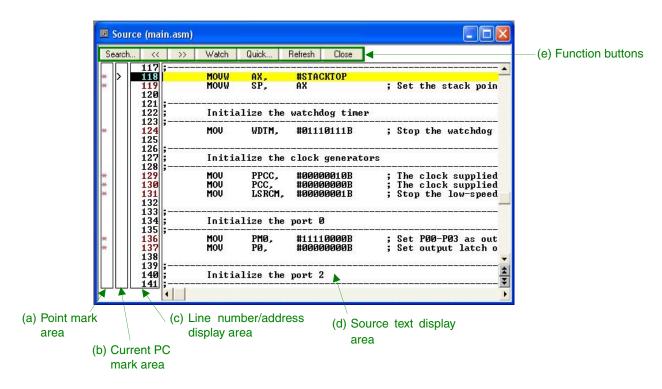
#### **CHAPTER 5 MAIN SM+ FUNCTIONS**

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

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

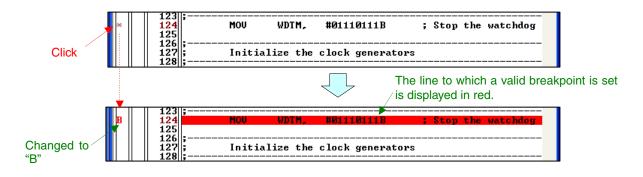
#### 5.1 [Source] Window

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



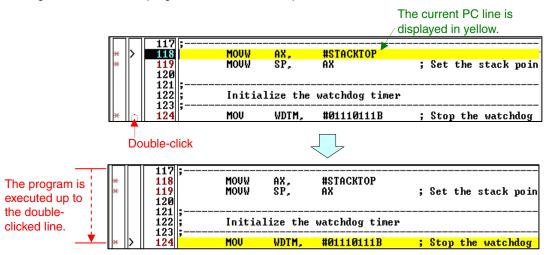
#### (a) Point mark area

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 doubleclicking 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.

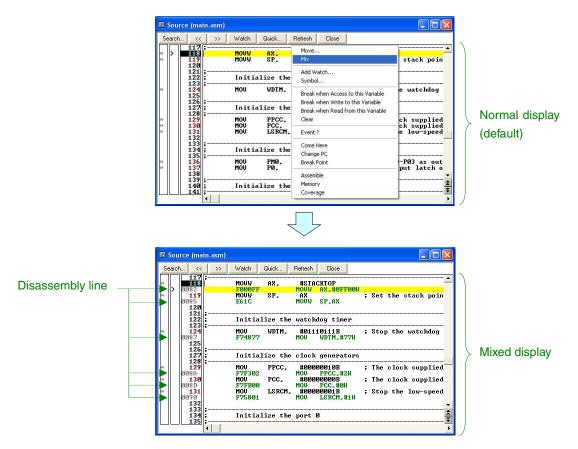
Click the following buttons on the toolbar to execute the source program displayed on the [Source] window.	
--	--

11	Stops execution during user program execution. Same function as selecting [Stop] from the [Run] menu.
(Stop)	Same function as selecting [Stop] from the [Fun] menu.
•	Resets the CPU and executes the user program. Same function as selecting [Restart] from the [Run] menu.
(Restart)	
(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.

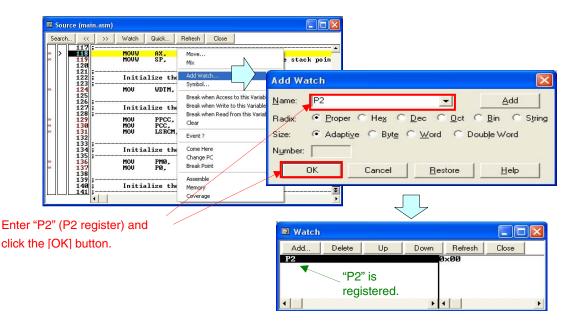
#### <1> Mix

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

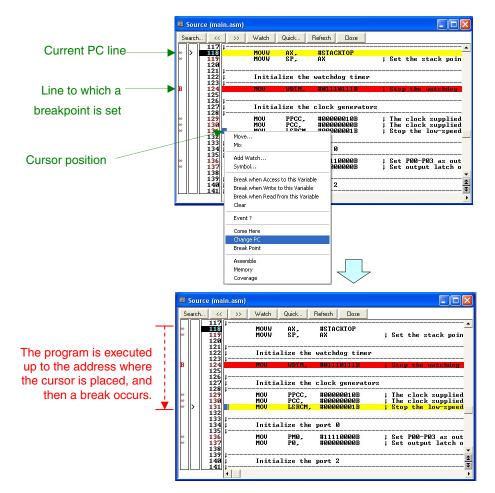
Select [Add Watch] from the context menu (displayed by right-clicking anywhere on the [Source] window) to open the [Add Watch] dialog box. Specify the data and click the [OK] button in this dialog box to register the specified data in the [Watch] window.



<3> Come Here

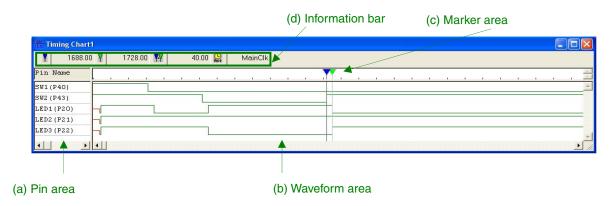
Select [Come Here] from the context menu (displayed by right-clicking anywhere on the [Source] window) to execute the program, from the address indicated by the current PC register up to the address where the cursor has been placed, after which a break occurs.

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



#### 5.2 [Timing Chart] Window

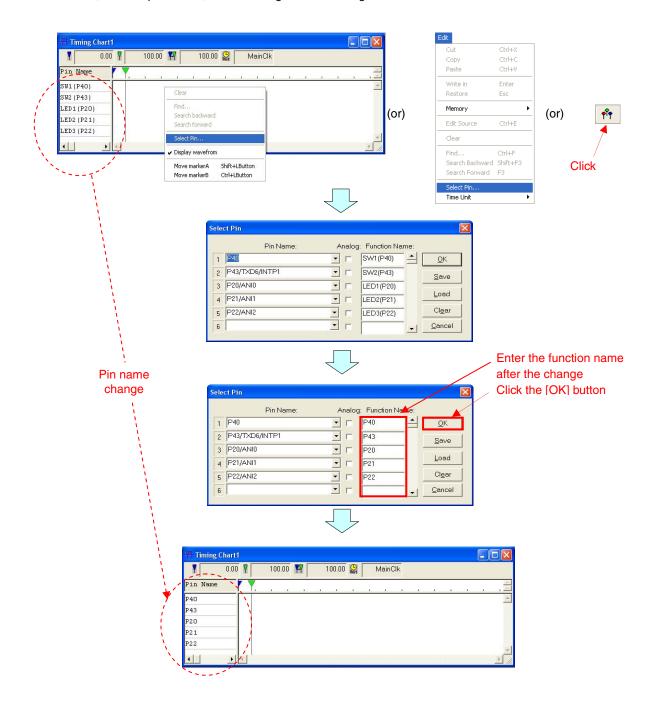
This window displays in the form of a timing chart input signals and output signals for pins.



#### (a) Pin area

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

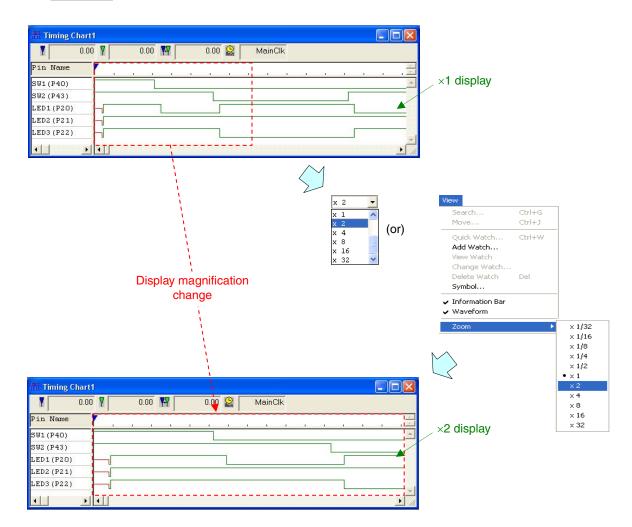
Select [Select Pin] from the context menu (displayed by right-clicking anywhere on the (b) Waveform area), select [Select Pin] from the [Edit] menu, or click the vertice button on the toolbar to open the [Select Pin] dialog box. Items, such as pin names, can be changed in this dialog box.



#### (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  $x \perp \mathbf{v}$  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.

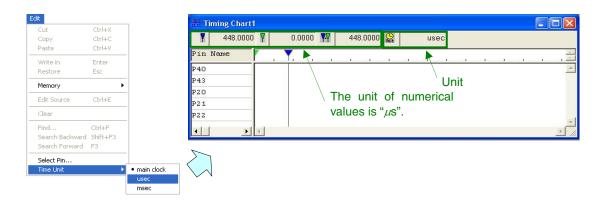
Y 0.00 Y	0.00 🕎 0.00 🤮 MainClk	
Pin Name		
P40	Clear	
P43		
P20	Find Search backward	
221	Search forward	
22	Select Pin	
• •	✓ Display wavefrom	<u>.</u>
	Move markerA Shift+LButton Move markerB Ctrl+LButton	
101	$\overline{\mathbf{Q}}$	
Timing Chart1		
Timing Chart1	0.00 MainClk	
¥ 224.00 ¥	0.00 MainClk	
Y 224.00 Y	0.00 M 224.00 MainClk	
Y         224.00         Y           Pin Name         Pin Name         Pin Name	· · · · · · · · · ·	
224.00         Image: Constraint of the second	0.00 MainClk 	
224.00 Y 21n Name 240 243 220	Place marker A.	
	· · · · · · · · · ·	

#### (d) Information bar

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

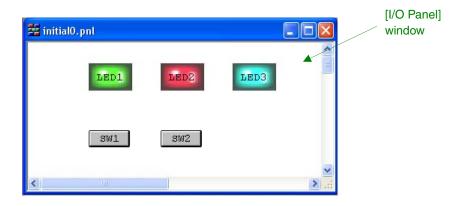
100.00	Displays the time from the simulation start to the marker A location.
<b>7</b> 300.00	Displays the time from the simulation start to the marker B location.
200.00	Displays the time between markers A and B as an absolute value.
MainClk	Displays the unit of the time information.

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

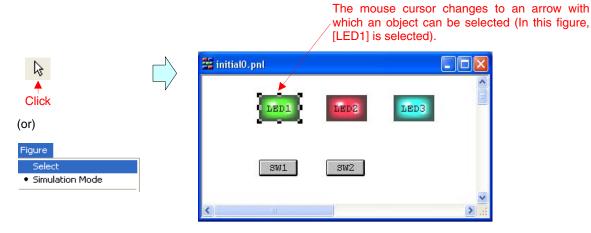


# 5.3 [I/O Panel] Window

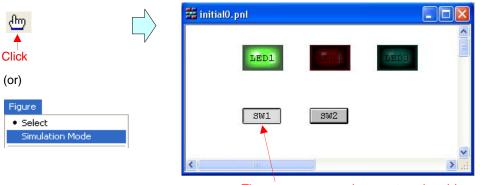
This window is used to create a pseudo target system. This window is used to display and manipulate connected parts.



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



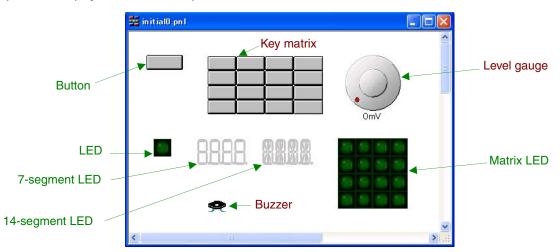
Click dim on the toolbar or select [Simulation Mode] from the [Figure] menu to select an object in the [I/O Panel] window or to simulate the input to a connected part.



The mouse cursor changes to a hand image with which the input to a connected part can be simulated (In this figure, the [SW1] switch is input). 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.

	Switch
(Button creation)	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.
Ħ	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.
(Key matrix	A key matrix can be connected to any pin, and data can be input using multiple keys.
creation)	Same function as selecting [Key Matrix] from [Parts] on the menu bar.
-	Used for inputting analog data, such as power supply voltage. Any data within a given range can be set.
(Level gauge	Any value within a specified range can be assigned to a pin connected to an A/D converter.
creation)	Same function as selecting [Level Gauge] from [Parts] on the menu bar.
	LED (Light Emitting Diode)
(LED creation)	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.
8.	A product that consists of 7 LEDs configured to represent a numeric figure.
(7-segment LED creation)	When the output from the pin to which the digit signal is assigned is active, the corresponding 7-segment LED switches on or off.
creation	Same function as selecting [7-segment LED] from [Parts] on the menu bar.
8	A product that consists of 14 LEDs configured to represent an alphabetic character.
(14-segment LED creation)	When the output from the pin to which the digit signal is assigned is active, the corresponding 14-segment LED switches on or off.
creation	Same function as selecting [14-segment LED] from [Parts] on the menu bar.
Ш.	A product that consists of multiple LEDs arranged in a matrix array.
(Matrix LED creation)	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.
0	Buzzer
(Buzzer creation)	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 **m** button on the toolbar to open the [Assemble] window.

	🕅 As	sser	nble								
	Sear	rch	. <<	>>	Watch	Quick	Refresh	Close	•		— (e) Function buttons
	*		0076			00		ROR	A,1		
	÷		0077 0078			00		ROR	A,1	100	
	4		0078			00		ROR	A,1 A,1		
			007A			00		ROR	A,1		
	*		007B			00		ROR	A,1		
	w		007C			00		ROR	A,1		
	*		007D			00		ROR	A,1		
	w.		007E			ōc		ROR	A,1		
	*		007F			00		ROR	A,1		
	w.		0080	- <b>14</b> - 14 -		90		DECW	HL		
	*	>	0082	RESET	START	FC	OOFF	MOVW	AX, #OFFOOH		
	1		0085	1.0			51C	MOVW	SP,AX		
	*		0087				4877	MOV	WDTM, #77H		
	*		008A				F302	MOV	PPCC,#2H		
	*		008D				FBOO	MOV	PCC,#OH		
	W		0090				5801	MOV	LSRCM, #1H		
			0093				20F0	MOV	PMO, #OFOH		
	W		0096				0000	MOV	STACKTOP, #OH		
			0099				22F0	MOV	PM2, #OFOH		
	1		009C				0207	MOV	P2,#7H		
	÷		009F				23F0 0300	MOV MOV	PM3,#0F0H P3,#0H		
	4		00A2				2409	MOV	PM4,#9H		
	*		OOAB				3409	MOV	PU4,#9H	-	
	*		OOAB				0400	MOV	P4,#0H	*	
	*		OOAE				2CF0	MOV	PM12,#OFOH	Ŧ	
		T		4						•	
	/-	7									
	/										
(a) Point mark	area	a∖		) (c) A	ddress	specific	ation are	a \			
				(3)					Disasamble dia		
								(u)	Disassemble dis	play alea	
		(	(b) Cu	Irrent F	C mark	carea					

#### (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 doubleclicking 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.

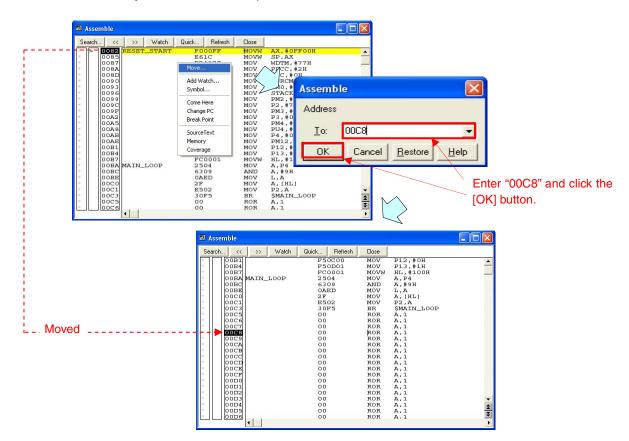
#### (e) Function buttons

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.

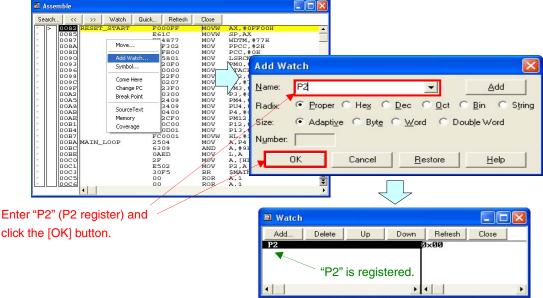
<1> Move

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

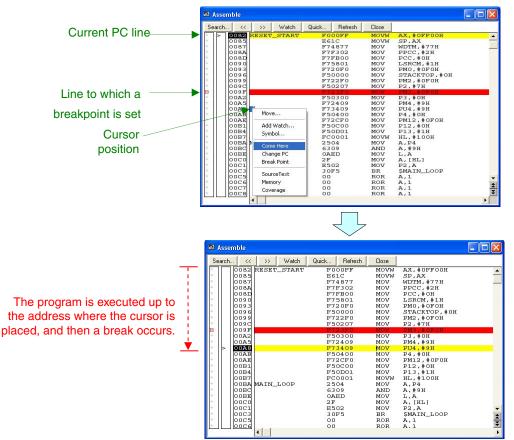
Select [Add Watch] from the context menu (displayed by right-clicking anywhere on the [Assemble] window) to open the [Add Watch] dialog box. Specify the data and click the [OK] button in this dialog box to register the specified data in the [Watch] window.



#### <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 <u>mathematical select</u> button on the toolbar to open the [Memory] window.

📧 Memor	у																
Search	<<		>>	Refre	sh	Mod	íty	Clos	se	•							- (c) Function buttons
Addr+0	+1	+2	+3	+4	+5	+6	+7	+8	+9	+A	+B	+C	+D	+E	+F		
000082	00	82	00	82	00	82	00	82	00	82	00	82	00	82	00	*	
001082	00	82	00	82	00	82	00	82	00	82	00	82	00	82	00		
002082	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00		
003000	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00		
005000	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00		
006000	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00		
007000	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00		
00809C	FF	FO	00	FF	E6	1C	F7	48	77	F7	F3	02	F7	FB	00		
0090F7	58	01	F7	20	FO	F5	00	00	F7	22	FO	F5	02	07	F7		
00A023	FO	F5	03	00	F7	24	09	F7	34	09	F5	04	00	F7	2C		
OOBOFO	F5	0C	00	F5	OD	01	FC	00	01	25	04	63	09	AO	ED		
00C02F	E5	02	30	F5	00	00	00	00	00	00	00	00	00	00	00		
000000	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00		
OOEOOO	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00		
00F000 010003	00	00	00	00	00	00	00	00	00 07	00	00	00	00	00	00		
011000	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00		
012000	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00		
013000	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00		
014000	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00		
015000	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00		
016000	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	-	
017000	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00		
018000	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	*	
019000	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	×.	
1								1									
a) Addre	ss c	lisp	lay a	area				(b) N	Nen	nory	/ dis	play	are	а			

# (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.

0000000	00	00	00	~~~	00	00	00	00	00	00	00	00	00	00	00
00E000	00	00	0.0	00	00	00	00	00	00	00	00	00	00	00	00
00F000	00	00	00		00	00	00	00	00	00	00	00	00	00	00
					Ent	er "F	F".	~	$\bigcirc$						
000000	00	00	00	00	00	00	00	0.0	00	00	00	00	00	00	00
00E000	00	00	00		00	00	00	00	00	00	00	00	00	00	00
00F000	00	00	00	00	00	00	00	00	00	00	00	0.0	00	00	00
Press the Enter key.															
00D000	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
00E000	00	00	00	FF	00	00	00	00	00	00	00	00	00	00	00
00F000	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00

#### (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.

🜌 Mem	югу	1															
Search.		<<		>>	Refre	sh	Mod	ify	Clos	se							
Addr+	0	+1	+2	+3	+4	+5	+6	+7	+8	+9	+A	+B	+C	+D	+E	+F	
00008	2	00	82	00	82	00	82	00	82	00	82	00	82	00	82	00	
00108	2	00	82	00	82	00	82	00	82	00	82	00	82	00	82	00	-
00208	2	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	
00300	0	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	
00400		00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	
00500	0	00	00	00	00	00	<b></b>				00	00	00	00	00	00	
00600		00	00	00	00	00	8	Move.		- 1	00	00	00	00	00	00	
00700		00	00	00	00	00	-			_	00	00	00	00	00	00	
00809		FF	FΟ	00	FF	E6	10.3	Bin		- 1	F7	F3	02	F7	FB	00	
0090F		58	01	F7	20	FO	4	Oct		- 1	22	FO	F5	02	07	F7	
00A02		FΟ	F5	03	00	F7	1			- 1	09	F5	04	00	F7	2C	
OOBOF		F5	0C	00	F5	OD		Dec		- 1	25	04	63	09	OA	ED	
00C02		E5	02	30	F5	00		Hex		- 1	00	00	00	00	00	00	
00000		00	00	00	00	00	-				00	00	00	00	00	00	
00E00		00	00	00	00	00	1 2	Nibble		- 1	00	00	00	00	00	00	
OOFOO		00	00	00	00	00				- 1	00	00	00	00	00	00	
01000		05	07	07	07	07		Byte		- 1	00	00	00	00	00	00	
01100		00	00	00	00	00	1.1	Word		- 1	00	00	00	00	00	00	
01200	0	00	00	00	00	00	1.3	D	e Word	- I	00	00	00	00	00	00	
01300		00	00	00	00	00	1.1	Double	s word	۲. I	00	00	00	00	00	00	
01400		00	00	00	00	00					00	00	00	00	00	00	
01500		00	00	00	00	00		Ascii			00	00	00	00	00	00	
01600		00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	-
01700		00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	1
01800		00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	<u></u>
01900	0	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	¥

						A	٩S	CII	dis	pla	ay i	area
🖻 Me	mor	у										
Sear	sh	<<		>>	Refre	sh	Mod	ify	Clos	e		
Addı	+0	+1	+2	+3	+4	+5	+6	+7	+8	+9	+A	+B 012 456789ABCDEF
0000		00	82	00	82	00	82	00	82	00	82	00
0010		00	82	00	82	00	82 00	00	82	00	82	00
0020		00	00	00	00	00	00	00	00	00	00	00
0040		00	00	00	00	00	00	00	00	00	00	00
0050		00	00	00	00	00	00	00	00	00	00	00
0060		00	00	00	00	00	00	00	00	00	00	00
0070		00 FF	00 F0	00	00	00 E6	00 1C	00 F7	00 48	00	00 F7	00
0080		58	01	F7	20	FO	FS	00	48	F7	22	F0.X
DOAC		FO	FS	03	00	F7	24	09	F7	34	09	F5#S4
OOBC	FO	F5	0C	00	F5	OD	01	FC	00	01	25	04 %.c
0000		E5	02	30	F5	00	00	00	00	00	00	00/0
OODC		00	00	00	00	00	00	00	00	00	00	00
OOEC		00	00	00	00	00	00	00	00	00	00	00
0100		00	07	07	07	07	07	07	00	07	00	00
0110		00	00	00	00	00	00	00	00	00	00	00
0120	00	00	00	00	00	00	00	00	00	00	00	00
0130		00	00	00	00	00	00	00	00	00	00	00
0140		00	00	00	00	00	00	00	00	00	00	00
0150		00	00	00	00	00	00	00	00	00	00	00
0160		00	00	00	00	00	00	00	00	00	00	00
0180		00	00	00	00	00	00	00	00	00	00	00
	•											•

<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)

by default).		Displayed in	
	/	hexadecimal numbers	<b>—</b>
Memory			Displayed in
Search << >> Re	efresh Modify Close		binary numbers
Addr+0 +1 +2 +3 +		Memory	
001082 00 82 00 8 002082 00 00 00 0	0 00 00 00 00 00 00 00 00 00	Search << >> Refresh Modify Close	
004000 00 00 00 0	0 00 00 00 00 00 00 00 00 00	00 00 Addr+0 +1 +2 3	+4 +5
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	0         0	00         00         00110000010         00000000         000000000000000000000000000000000000	000011 00000000 11110111 000000 11110101 00001101 110000 11110101 00000000
		0160000000 00000000 0000000 0000000 000	000000 0000000 0000000 <b>1</b>

<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).

1	Displayed in byte units
🖬 Memory	X
Search << >> Refresh Modify Close Addr+0 +1 +2 +3 +4 +5 +6 +7 +8 +9 +A +B +C +D + +F	Displayed in word units
000082         00         82 <td< td=""><td>Memory</td></td<>	Memory
000000000000000000000000000000000000	Addr+0         +2         +4         +6         +8         +A         +C         +E           00000652         0622
	□ 0130 0000 0000 0000 0000 0000 0000 000

# 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 Q button on the toolbar to open the [Watch] window.

🗎 Watch		
Add Delete Up Down	Refresh Close (C)	-unction buttons
(a) Symbol name display area	(b) Data value display/setting area	

# (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.

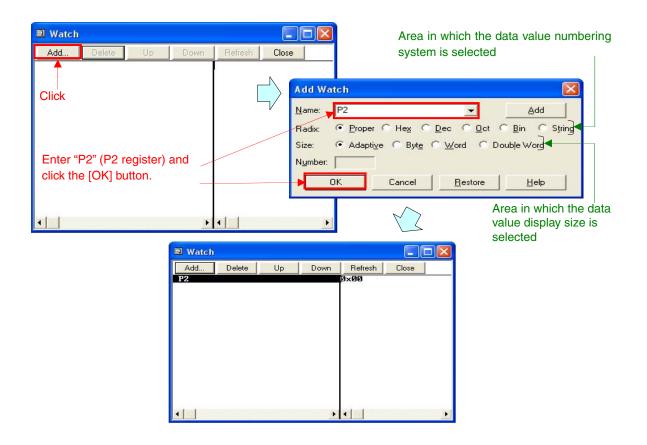
#### (b) Data value display/setting area

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.

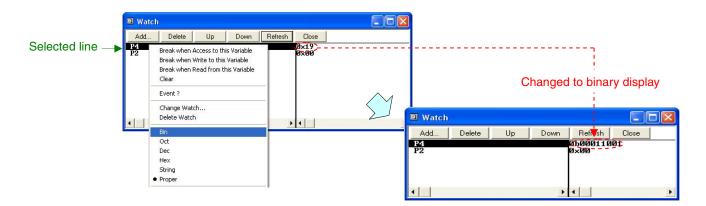


The menu (context menu) will be displayed if the right mouse button is clicked anywhere on the [Watch] window. The main function that can be selected from the context menu is described next.

· Selecting the numbering system display

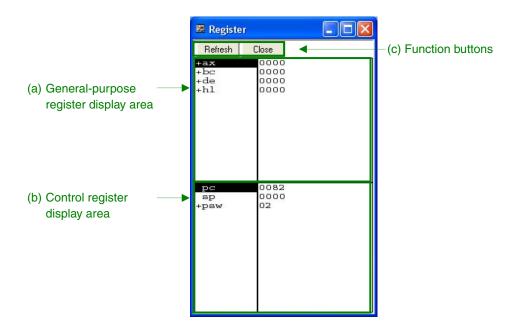
The data value numbering system can be selected from the context menu (displayed by right-clicking anywhere on the [Watch] window).

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 *k* button on the toolbar to open the [Register] window.

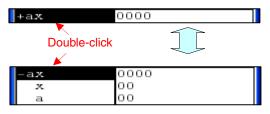


Application Note U18787EJ2V0AN

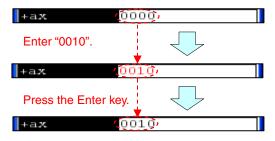
#### (a) General-purpose register display area

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.



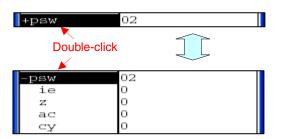
Register values are changed through direct entry. Changes are displayed in red and the contents of the changes are written to the target memory by pressing the Enter key. The previous values can be discarded by pressing the ESC key.



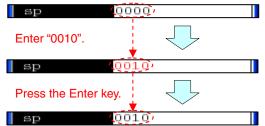
# (b) Control register display area

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.



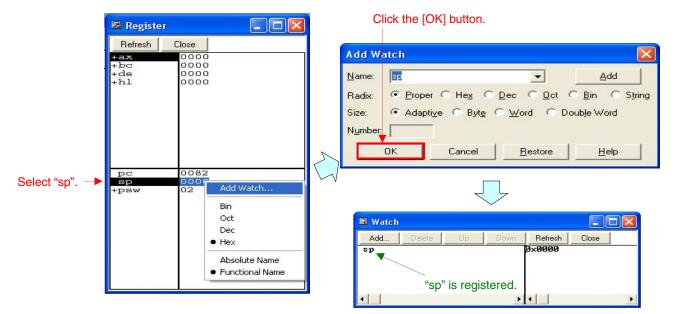
# (c) Function buttons

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.

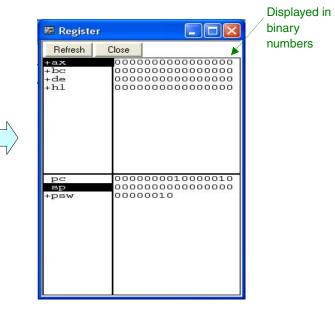


<2> Selecting the numbering system display

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).



# Displayed in hexadecimal numbers



# 5.8 [SFR] Window

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

SFR			
Refres	h Close 🚽	(d) Function buttons	
Name	Attribute	Value (d) Function Butterie	
PO	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 FFOC	00	
P13	R/W 1,8 FFOD	00	
CMP01 CMP11		00 00 (c) SER content disc	
(a) SFR name display	R/W 8 FF0F R 16 FF10	c) SFR content disp	blay
(a) Of IT fiame display Mold MULOL			
area MULOH		area	
TMOO	R 16 FF12	0000	
CR000		0000	
CR010		0000	
ADCR	R 16 FF18	0000	
ADCRH		00	
PMO	R/W 1,8 FF20	FF	
PM2	R/W 1,8 FF22	FF	
РМЗ	R/W 1,8 FF23	FF	
PM4	R/W 1,8 FF24	FF	
PM12	R/W 1,8 FF2C	FF	
PUO	R/W 1,8 FF30	00	
PU2	R/W 1,8 FF32 R/W 1,8 FF33	00	
PU3 PU4	R/W 1,8 FF33 R/W 1,8 FF34		
P04 PU12	R/W 1,8 FF3C	00	
WDTM	R/W B FF48	67 -	
VALUELLA			
	T		

(b) Attribute display area

# (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.

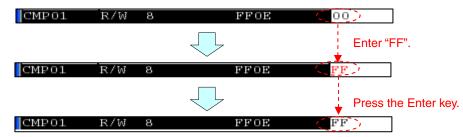
#### (b) Attribute display area

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.



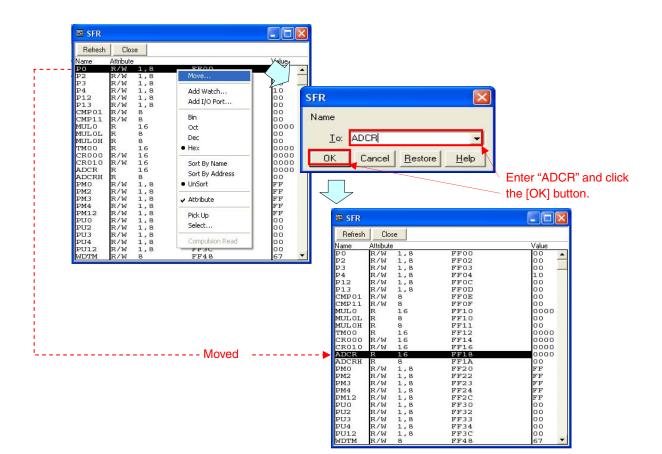
#### (d) Function buttons

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.

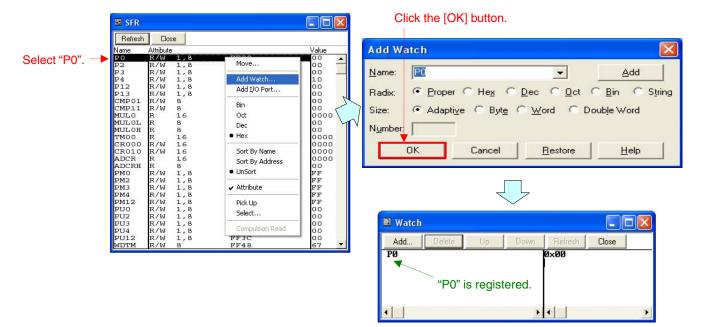
<1> Move

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.



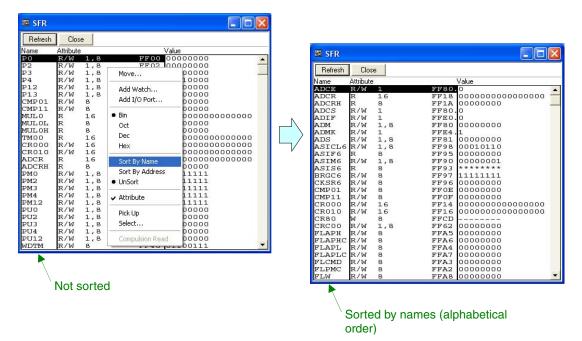
#### <3> Selecting the numbering system display

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).

SFR SFR			Displayed in hexad	decimal	
Refresh Close			numbers		
Name Attribute		Valle			
PO R/W 1,8 P2 R/W 1,8 P3 R/W 1,8	Move		SFR		
P4 R/W 1,8 P12 R/W 1,8	Add Watch Add I/O Port	10 00 00	Refresh Close		Displayed in
P13 R/W 1,8 CMP01 R/W 8 CMP11 R/W 8	Bin	00		Value L,8 FF00 0000000 L,8 FF02 0000000	binary
MULO R 16 MULOL R 8 MULOH R 8 TMOO R 16	Oct Dec • Hex		P3 R/W 2 P4 R/W 2 P12 R/W 2	L,8 FF03 0000000 L,8 FF04 00010000 L,8 FF0C 00000000	numbers
CR000 R/W 16 CR010 R/W 16 ADCR R 16 ADCRH R 8 PM0 R/W 1,8 PM2 R/W 1,8	Sort By Name Sort By Address • UnSort	0000 0000 0000 FF FF	CMP01 R/W CMP11 R/W CMP11 R/W MULO R CMP11 R/W MULOL R MULOL R MULOH R S TM00 R CMP11 R S S S S S S S S S S S S S S S S S S	FF0E         0000000           FF0F         0000000           FF10         0000000           FF10         0000000           FF10         00000000           FF10         00000000           FF11         00000000           FF12         00000000	0000000
PM3         R/W         1,8           PM4         R/W         1,8           PM12         R/W         1,8           PU0         R/W         1,8           PU2         R/W         1,8           PU3         R/W         1,8           PU4         R/W         1,8           PU12         R/W         1,8           PU14         R/W         1,8           PU12         R/W         1,8           WDTM         R/W         1,8	✓ Attribute Pick Up Select Compulsion Read FF3C FF48	FF FF 00 00 00 00 67	CR010 R/W 2 ADCR R ADCRH R PM0 R/W PM2 R/W PM3 R/W PM4 R/W PM4 R/W	16         FF14         0000000           16         FF16         00000000           16         FF18         00000000           3         FF1A         00000000           1,8         FF20         1111111           1,8         FF22         1111111           1,8         FF22         1111111           1,8         FF24         1111111           1,8         FF24         1111111           1,8         FF24         1111111	0000000
WEIG HAVW O	1140		PU2 R/W PU3 R/W PU4 R/W PU12 R/W	I.8         FF30         00000000           1,8         FF32         0000000           1,8         FF33         0000000           1,8         FF34         0000000           1,8         FF34         0000000           1,8         FF34         0000000           3         FF48         01100111	×

<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	<u>PDF</u>	
78K0S/KY1+ User's Manual		<u>PDF</u>
78K0S/KA1+ User's Manual		<u>PDF</u>
78K0S/KB1+ User's Manual	<u>PDF</u>	
78K/0S Series Instructions User's Manual	<u>PDF</u>	
RA78K0S Assembler Package User's Manual	Language	<u>PDF</u>
	Operation	<u>PDF</u>
CC78K0S C Compiler User's Manual	Language	<u>PDF</u>
	Operation	<u>PDF</u>
PM+ Project Manager User's Manual	<u>PDF</u>	
SM+ System Simulator Operation User's Manual	<u>PDF</u>	
Flash Programming Manual (Basic) (MINICUBE2)	78K0S/KU1+	<u>PDF</u>
Information	78K0S/KY1+	<u>PDF</u>
	78K0S/KA1+	<u>PDF</u>
	78K0S/KB1+	<u>PDF</u>
78K0S/Kx1+ Sample Program (Initial Settings) LED Lighting St	<u>PDF</u>	

# APPENDIX REVISION HISTORY

Edit	ion	Date Published	Page	Revision
2nd edit	ion	September 2008	-	_

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