User's Manual
TK-78K0R/KG3+NET

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Rev. 1.1

Printed in Japan

CAUTION

- Do not give any physical damage to this equipment such as dropping
- Do not superimpose voltage to this equipment.
- Do not use this equipment with the temperature below 0℃ or over 40℃.
- Make sure the USB cables are properly connected.
- Do not bend or stretch the USB cables.
- Keep this equipment away from water.

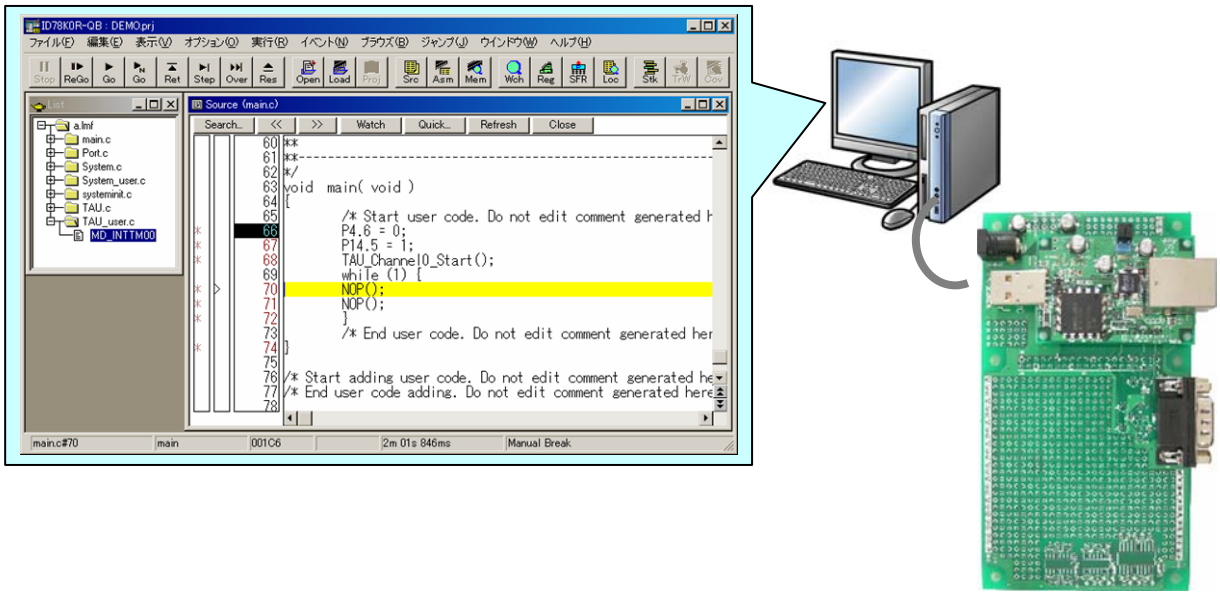
- Take extra care to electric shock.
- This equipment should be handled like a CMOS semiconductor device. The user must take all precautions to avoid build-up of static electricity while working with this equipment.
- All test and measurement tool including the workbench must be grounded.
- The user/operator must be grounded using the wrist strap.
- The connectors and/or device pins should not be touched with bare hands.

Contents

Introduction

TK-78K0R/KG3+NET is the evaluation kit for development with Ethernet systems using "78K0R/Kx3", NEC Electronics 16bit all flash microcontroller.
The user only needs to install the development tools and USB driver, and connect the host machine with the target board to start the code development, build, monitoring the output, and debugging code.
(This demonstration kit uses the on-chip debug feature from the microcontroller itself, without emulator connection)

Configuration for Debugging



Overview This manual consists of the following contents.

Read chapter 1 and 2 first for installing the development tools and using the sample programs.

Read chapter 3-6 for customizing the sample programs and the hardware.

Chapter 1: Preparations
Install the development tools

Chapter 2: Experiences
Experience the basic operations of integrated development environment (PM+) and integrated debugger (ID78K0R-QB) with using sample programs.

Chapter 3: Hardware Specifications
Explain the hardware of TK-78K0R/KG3+NET

Chapter 4: Sample Programs
Explain functions used in sample programs

Chapter 5: Troubleshooting
Describe how to solve troubles you may face, such as errors when starting the integrated debugger (ID78K0R-QB)

Chapter 6: Other Information
Introduce other information, such as how to create a new workspace (project) on integrated development environment (PM+), how to register additional source file, and some useful tips of the integrated debugger. The circuit diagrams of demonstration kit are included in this chapter.

Reader This manual is intended for development engineers who wish to become familiar with the development tools for the 78K0R.
It is assumed that the readers have been familiar with basics of microcontrollers, C and Assembler languages, and the Windows™ operating system.

Purpose This manual is intended to give users an understanding of the features, hardware configurations, development tools for the 78K0R.

CHAPTER 1　Preparation

This chapter describes following topics:

- Overview of development tools
- Installation of development tools
- Overview and preparation of sample programs

Users can experience the development flow such as coding, build, debugging, and test, by using the development tools bundled with TK-78K0R/KG3+NET.

1.1 Development Tools / Software

- Device file DF781188 V3.00

  A device file contains device specific information. So, users need a device file to use the development tools.

- Integrated Development Environment (IDE) PM+ V6.30

  The IDE works on Windows operation system.
  Users can develop a system efficiently by using the editor with idea processor function, compiler, and debugger.

- C Compiler CC78K0R　W1.10 (code size limited version)

  C compiler for the 78K0R microcontrollers. The object code size is limited to 64 Kbyte.
  This compiles C code for 78K0R and ANSI-C code program into assembler code.
  This produces object code and linker.

- Assembler RA78K0R　W1.10 （code size limited version）

  Assembler for the 78K0R microcontrollers. The object code size is limited to 64 Kbyte.
  This convert the assembler code for 78K0R into object program. The object program will be used for debugger.

- 78K0R Integrated Debugger ID78K0R-QB V3.30

  This is the tool for debugging the object program generated by C compiler and assembler. The debugger enables to do C source level debugging. With the debugger, you can debug the code easily and efficiently by refering and changing variables, using step-in debuging function, and so on.

- Starter Kit USB Driver

  USB driver for the USB connection with the TK-78K0R/KG3+NET and PC.

- Sample program

  WEB server sample program

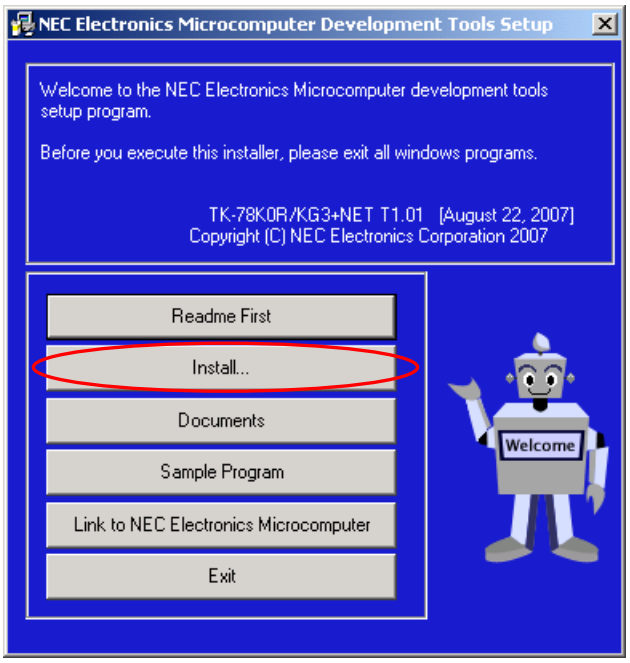
1.2 Installation of Development Tools

1.2.1 Installation Package

The attached CD-ROM includes the development tools and documentations. Users can use the installer to install those development tools and documentations.

1.2.2 Installation of Development Tools

① Please insert the CD-ROM in the drive. The installer will show up automatically. If it does not start automatically, please initiate it by double clicking the SETUP.EXE.



<1> Readme First

The contents of the CD-ROM, and some notes are available.

Please read it at first.

<2> Install…

Click "Install" to start installation of development tools.

For details, please refer to the next section.

<3> Documents

Manuals of development tools and the evaluation kit are available in PDF files.

When this button is clicked, the WWW browser will start. Adobe® Acrobat® Reader is available in the CD-ROM.

<4> Sample Program

Click this button to start the WWW browser for the sample program and the tutorial.

<5> Link to NEC Electronics Microcontrollers

Click this button to start the WWW browser display the link to the NEC Electronics Microcontroller web site (http://www.necel.com/micro/index_e.html)

The NEC Electronics Microcontroller web page provides with the latest product/tool information and FAQs.

<6> Exit

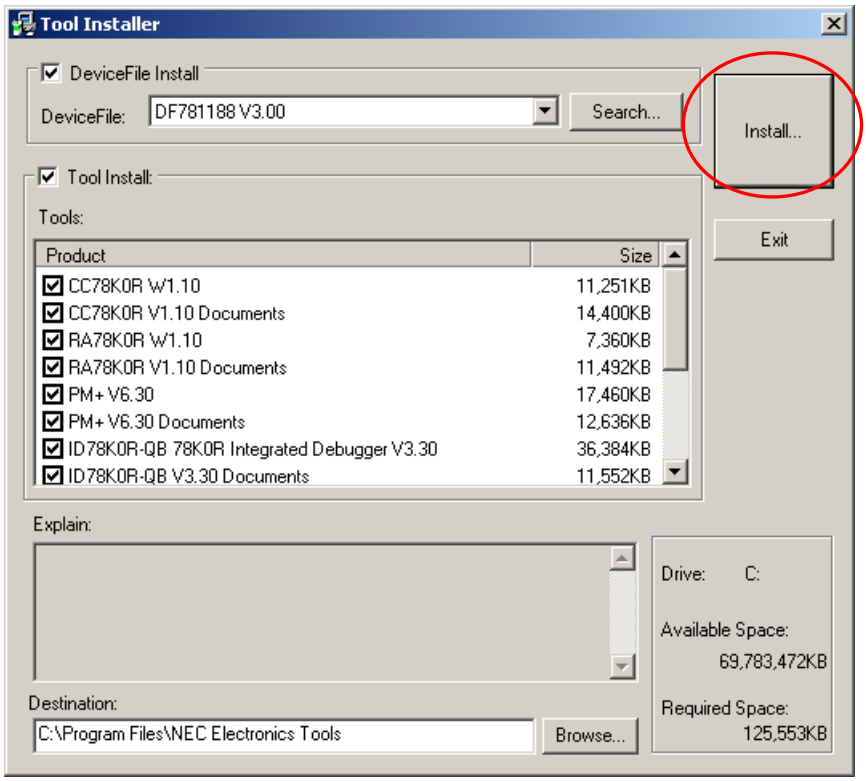
Terminate the setup.

② Click the "Install"

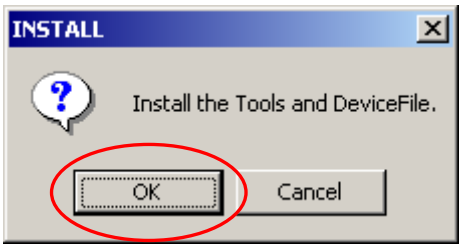
③ "Tool Installer" dialog box is opened.
Select products that you need to install.
(as default, all the products that you need to use the TK-78K0R/KG3+NET are selected.)
"Explain" area displays an explanation of the selected product.
To change the installation destination, click Browse··· .

When all the settings are completed, click Install··· .

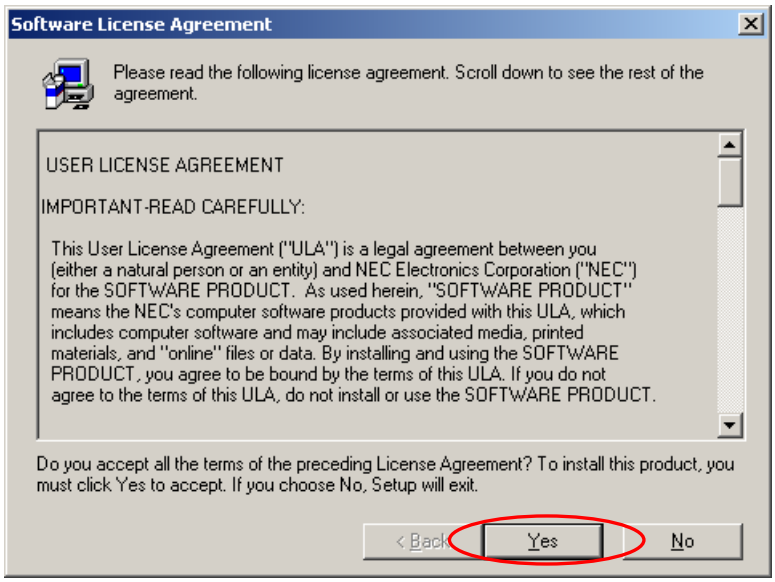
* In this document, it is assumed that users install the programs under "NEC Electronics Tools" directory (default installation directory). Users can find the tools by selecting "Start Menu" -> "Programs" -> "NEC Electronics Tools".



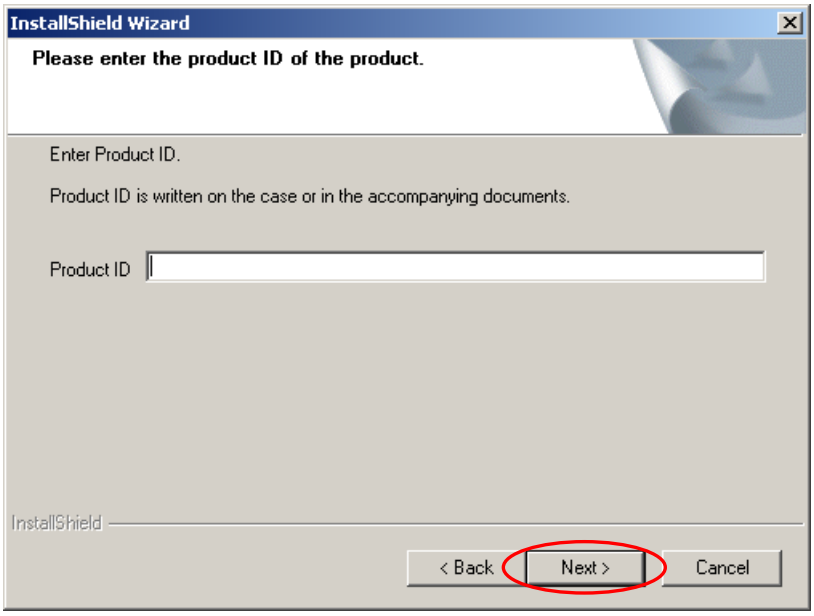
④ Click OK when "Install" comfirmation dialog box is opened.



⑤ Read "software license agreement" and click [Yes] for continuing the installation.
To stop the installation, click [No] .

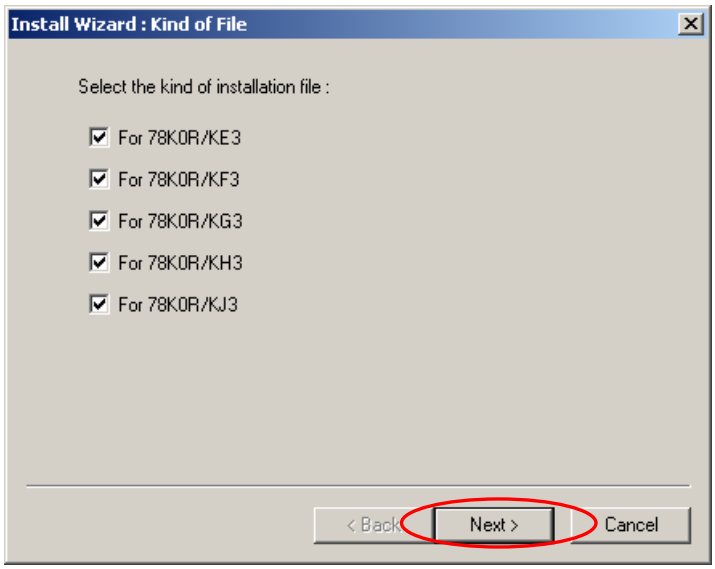


⑥ Enter the product ID, and click [Next] .
＊The product ID is available on the other sheet.

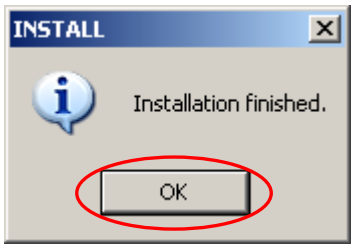


⑦ It starts copying the files.

⑧ Click Next when "Select Files" installation wizard dialog opened.



⑨ When the installation is completed, the following dialog opens.
Click OK .



⑩ "NEC Electronics Starter Kit Virtual UART" USB driver must be installed on PC before you connect to TK-78K0R/KG3+NET.

Install the USB driver by referring "1.3 Installation of USB Driver".

Notes on the installation authority

To install this tool in Windows 2000 or XP, the authority of an administrator is necessary. Therefore, please login as an administrator.

Notes on the install-directory

Please do not use 2-byte characters, such as umlaut in the directory name, where the product is to be installed.

Note on the version of Windows

If the language of the Windows is not English, a file transfer error during installation might be observed. In this case, please abort the installation in the language, and re-install it in an English version of Windows.

The identical problem may be observed, if a language other than English is specified as the system language in the "Regional Settings Properties" tab.

Limitation

Assembler RA78K0R and C compiler CC78K0R limit the object size to 64 Kbytes.

1.3 Installation of USB Driver

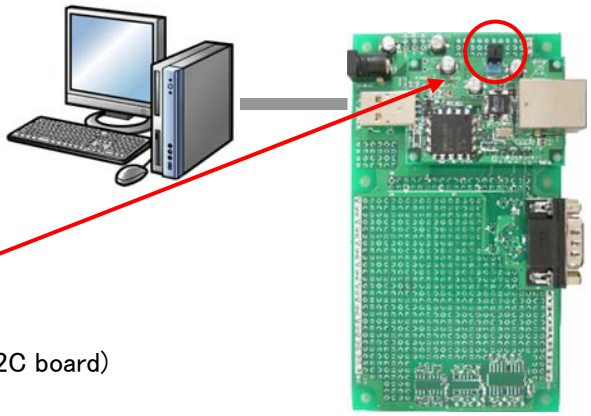
"NEC Electronics Starter Kit Virtual UART" USB driver must be installed on PC before you start using the TK-78K0R/KG3+NET.
Please, follow the instruction below to install the driver.

"Starter Kit USB Driver" must be installed on the PC. If not, please refer to "1.2 Installation of Development Tools" to install the driver first.

CAUTION:

Do not use a USB hub for connecting TK-78K0R/KG3+NET.

First, connect the TK-78K0R/KG3+NET to PC with USB extension cable.
Make sure that the setting of JP1 is the same as below.



Setting of JP1
Jumper Open
(Supplying power from EXT-232C board)

Depending on the version of Windows OS, the installation will be differed. Please check your Windows version, and follow the instructions

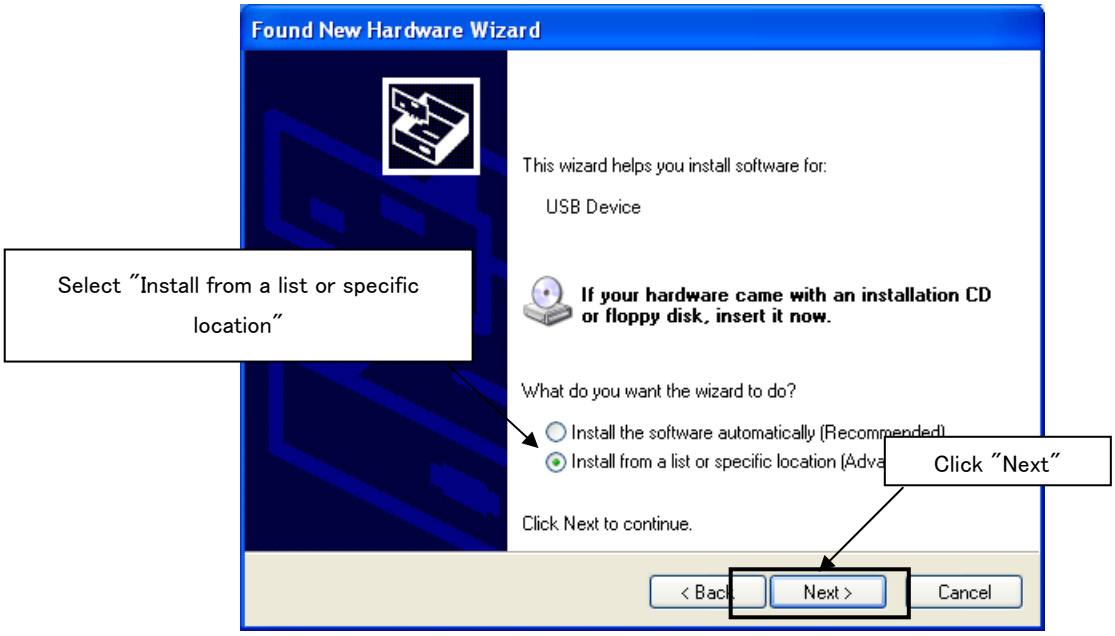
- Windows XP -> "1.3.1 Installation on Windows XP"
- Windows 2000 -> "1.3.2 Installation on Windows 2000"

After the installation, go to "1.3.3 Completion of USB Driver Installation"

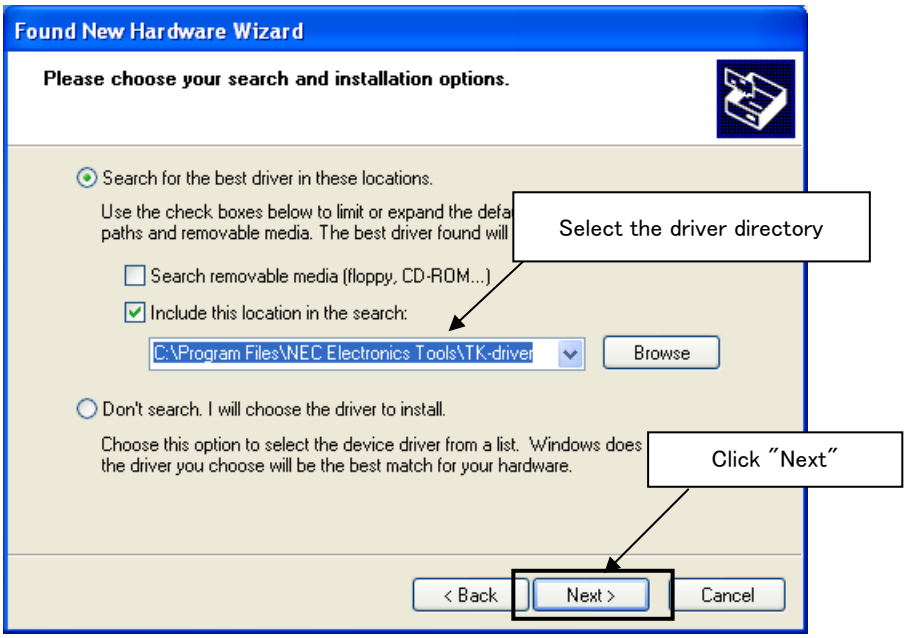
1.3.1 Installation on Windows XP

1. Once the TK-78K0R/KG3+NET is connected with USB, the "Found New Hardware Wizard" will be started.
   Select "No, not this time" and click Next > .

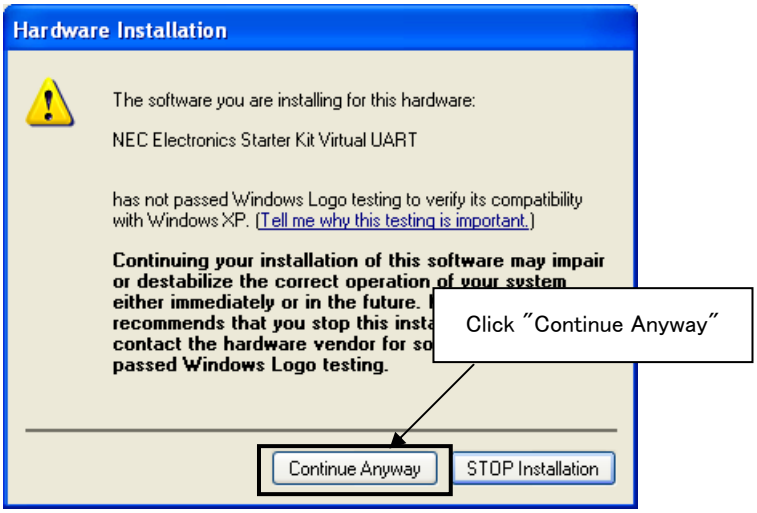
2. Select "Install from a list or specific location" and click Next > .



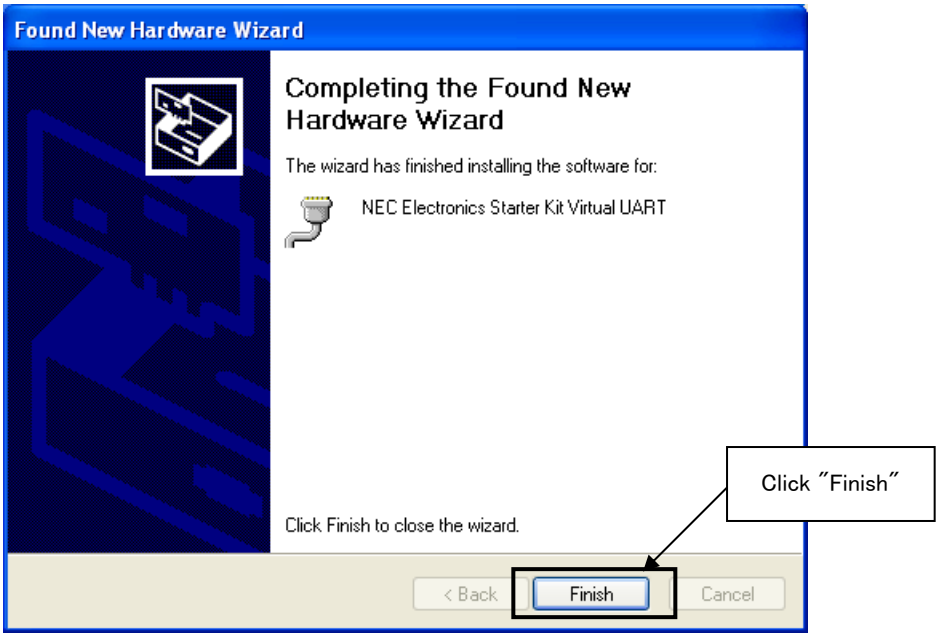
3. Select "Search for the best driver in these locations.", check "Include this location in the search:", and then click "Browse..." to select the driver directory path. The path should be "C:¥Program Files¥NEC Electronics Tools¥TK-driver" as default installation. If the installation directory is not default, then select "TK-driver" under the installation directory.
   Click [Next >] .



4. If the following dialog is opened, click [Continue Anyway] .



6. The installation of "NEC Electronics Starter Kit Virtual UART" driver is completed. Click Finish .

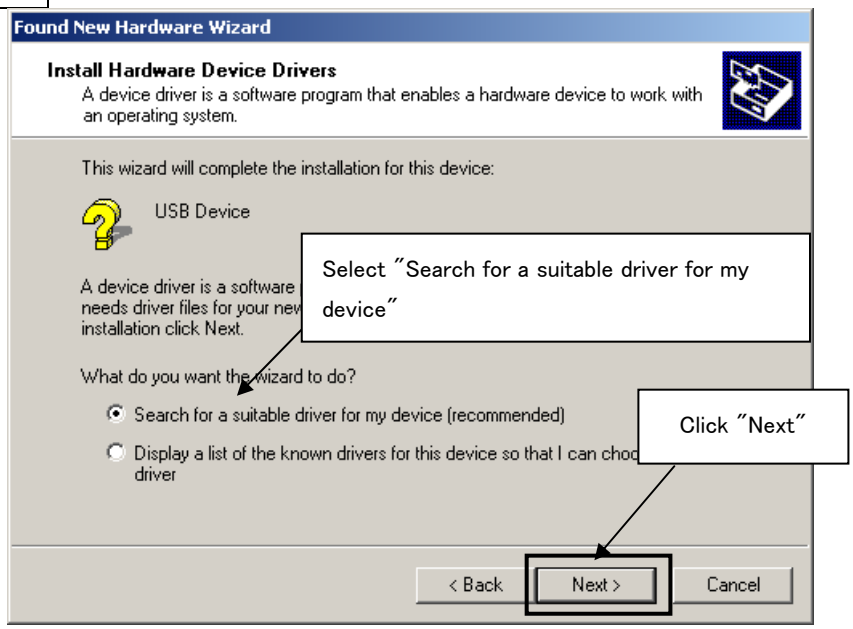


7. Go to "1.3.3 Completion of USB Driver Installation".

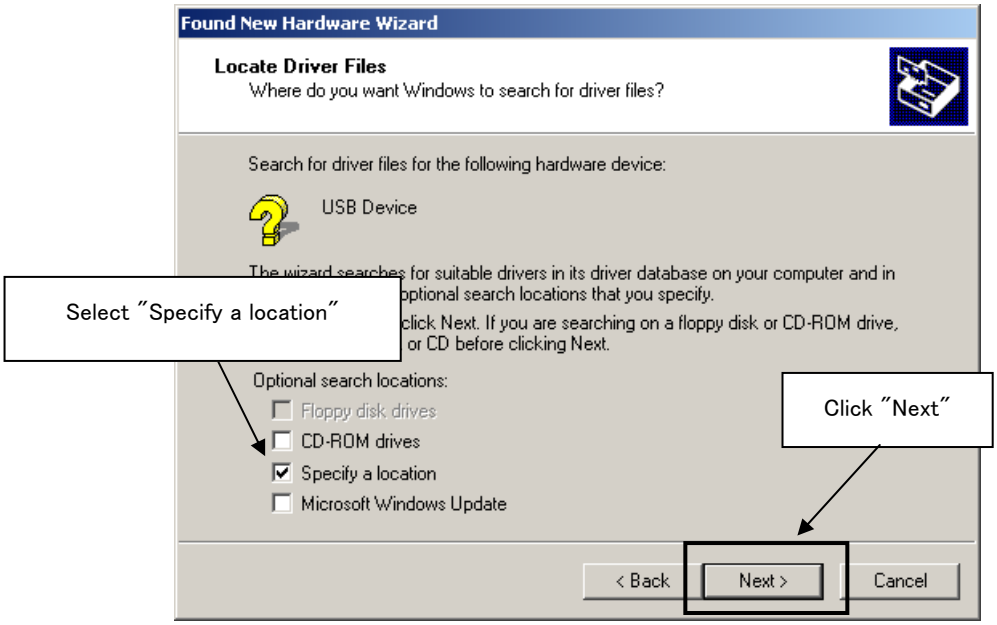
1.3.2 Installation on Windows 2000

1. Once the TK-78K0R/KG3+NET is connected with USB, the "Found New Hardware Wizard" will be started.
   Select "No, not this time" and click [Next >] .

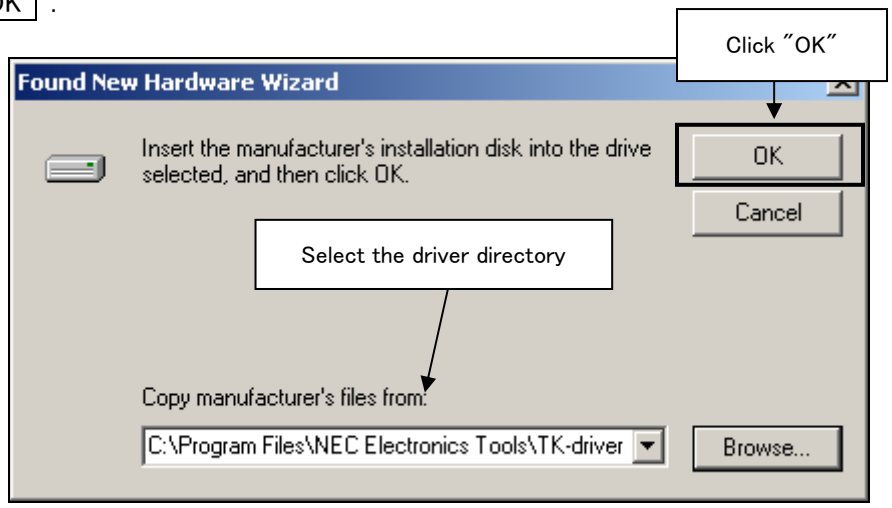
2. Select "Search for a suitable driver for my device".
   Click [Next >] .



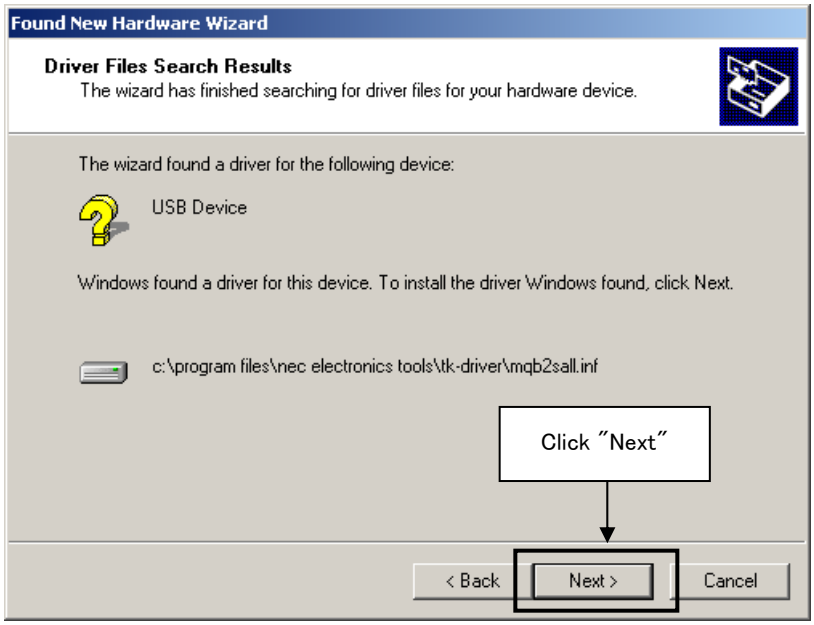
3. Select "Specify a location".
   Click [Next >] .



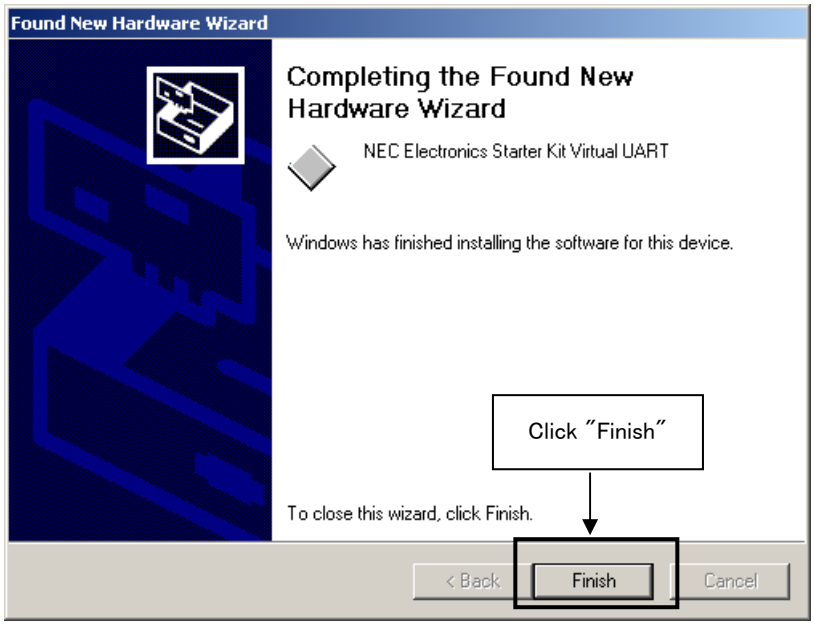
4. Select the driver directory path. The path should be "C:¥Program Files¥NEC Electronics Tools¥TK-driver" as default installation.
   If the installation directory is not default, then select "TK-driver" under the installation directory.
   Click [OK] .



5. Click [Next >] .



6. The installation of "NEC Electronics Starter Kit Virtual UART" driver is completed. Click [Finish] .



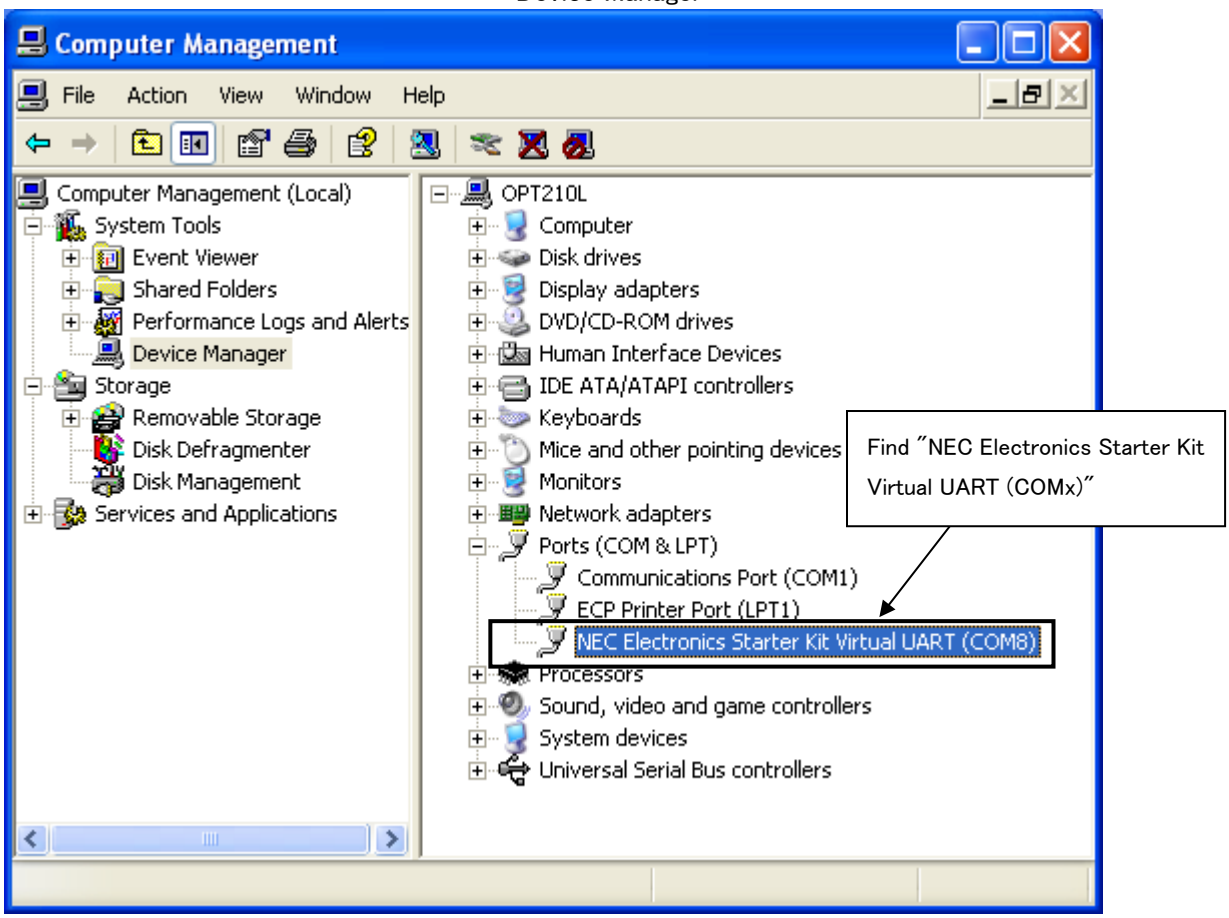
7. Go to "1.3.3 Completion of USB Driver Installation".

1.3.3 Completion of USB Driver Installation

Confirm the USB driver is installed on PC.

Start "Device Manager", and find "NEC Electronics Starter Kit Virtual UART" (without "?" mark) under the "Ports (COM & LPT)".

Device Manager



The screen above shows that the COM port number is "COM8". If ID78K0R-QB is not in use, you can use this port number for connecting TK-78K0R/KG3+NET.
When you change the USB port connection, the COM port number will be changed as well.

CAUTION

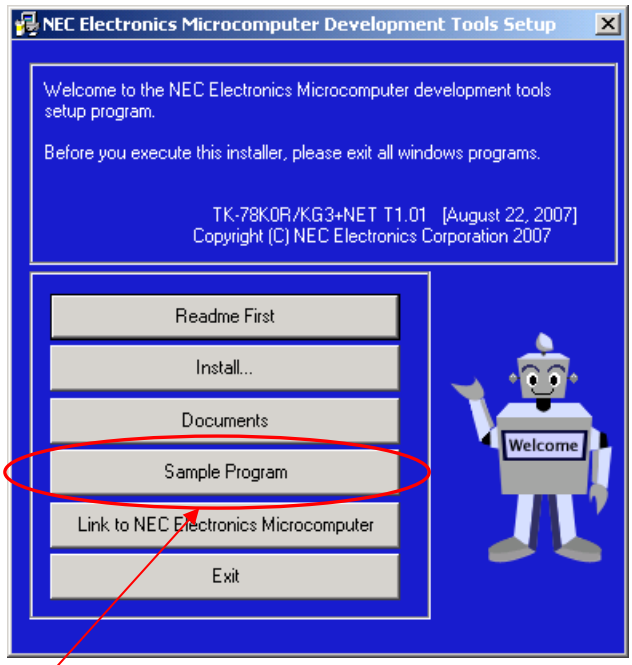
・Do not do "Hardware Modification Scan" when you communicate with the target device.

1.4 Sample Programs

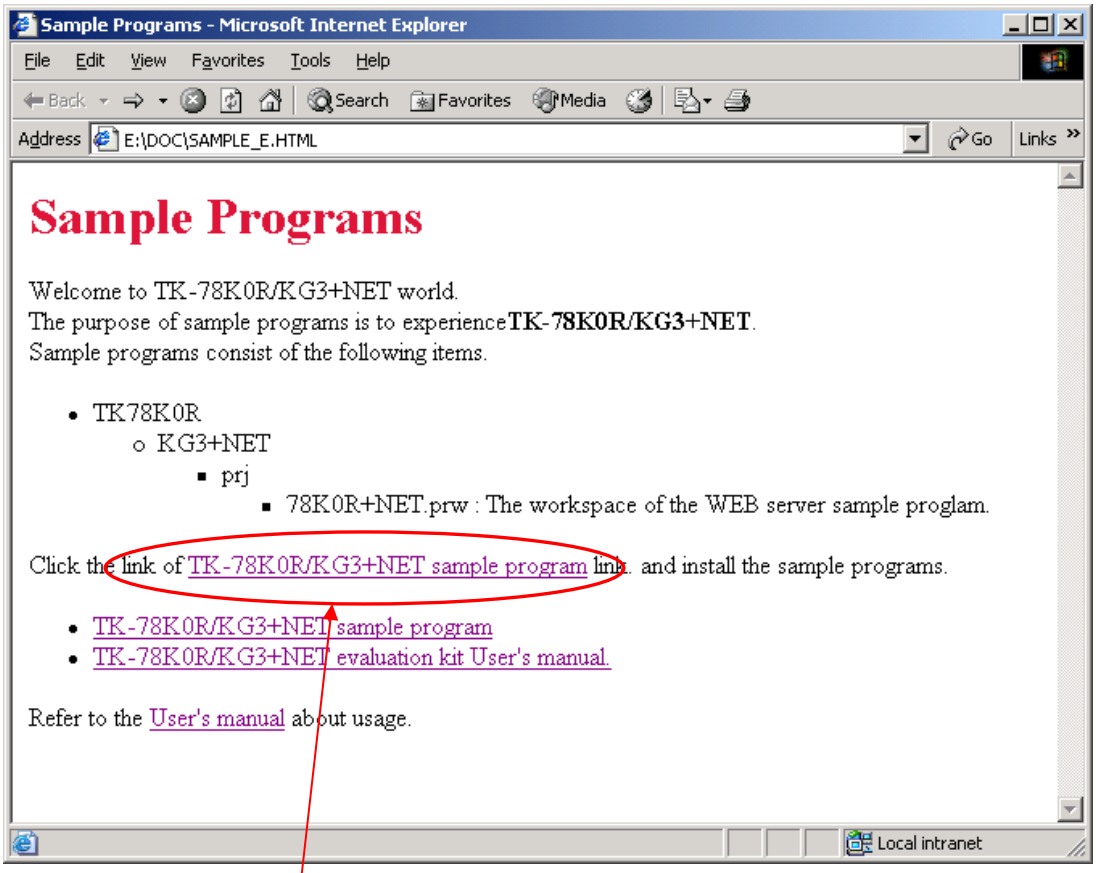
This section explains the overview and preparation of sample programs.
For details about the sample programs, see "4. Sample Programs".

1.4.1 Preparation of Sample Programs

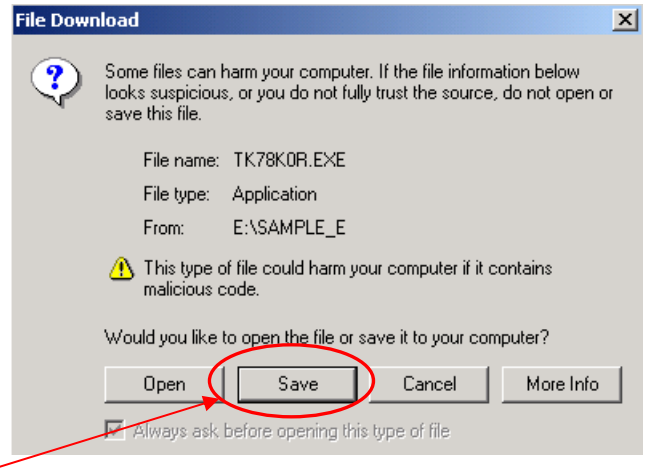
① Insert the CD-ROM disk in the CD-ROM drive of your PC. The [NEC Electronics Microprocessor Development Tools Setup] screen automatically appears.(if this screen does not appear automatically, start setup.exe from Explorer. etc.)



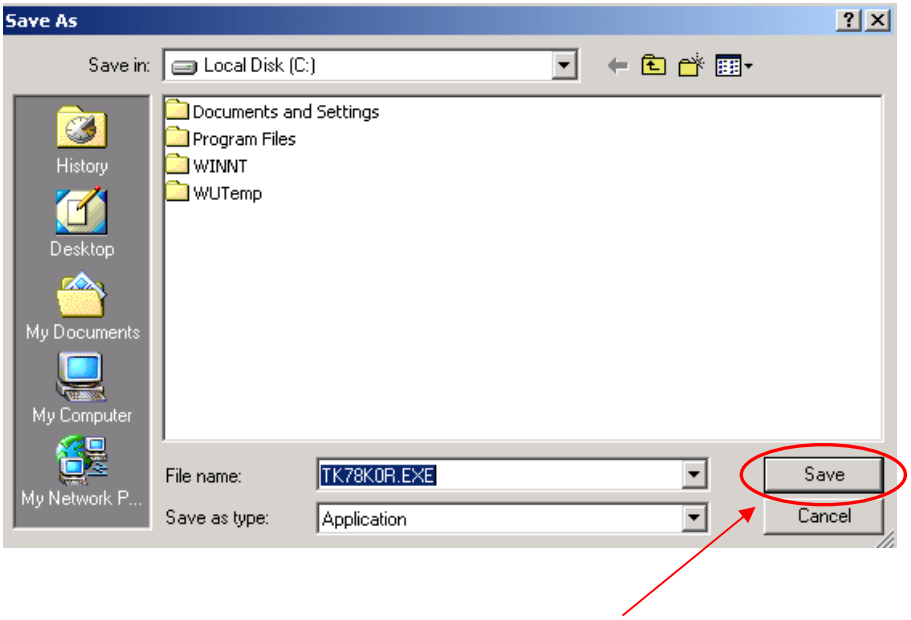
② Press the Sample Program button to start the WWW browser.



③ Click the "TK-78K0R/KG3+NET Sample Programs" link , the following download confimation window appears.



④ Click the Save butten.



⑤ After specifying the download destination folder, click the Save button.

⑥ The self-extraction sample program set (TK78K0R.exe) is copied to the specified folder.
The folder that the "TK78K0R" folder is made when this file is executed, and the sample program is stored under the folder in addition is made.

1.4.2 Overview of Sample Programs

The sample programs consist of following directories.

```
¥TK78K0R
  └ ¥KG3+NET                  ・・・ User program directory
      ├ ¥inc                  ・・・ include files
      │  └ ¥uip-1.0           ・・・ uIP include files
      ├ ¥lib                  ・・・ Object files of evaluation kit software (unable to modify)
      ├ ¥prj                  ・・・ Project files
      └ ¥src                  ・・・ User program source files
          ├ main.c            ・・・ Main routine file
          ├ timer.c           ・・・ Timer file
          ├ uart.c            ・・・ UART file
          └ ¥webserver        ・・・ Web application program source files
              ├ httpd-cgi.c   ・・・ CGI file that is used in Web contents
              ├ httpd-fsdata.c ・・・ Web content data file that is produced by makefsdata.exe
              ├ httpd-fs.c    ・・・ File that is used for displaying Web contents
              ├ makefsdata.exe ・・・ Executable file for creating Web content data file
              └ ¥fs           ・・・ HTML files created by user
                  ├ 404.html  ・・・ HTML file for "File not found"
                  ├ index.html ・・・ HTML file for top (home) page.
                  ├ ¥cgi      ・・・ CGI files crated by user
                  │  ├ iostat ・・・ CGI file for displaying I/O port
                  │  ├ nwstat ・・・ CGI file for displaying network address
                  │  ├ uart2web・・・ CGI file for displaying UART to Web
                  │  └ web2uart ・・・ CGI file for displaying Web to UART
                  └ ¥css      ・・・ CSS files created by user
                      └ header.css
```

CHAPTER 2　Experiences

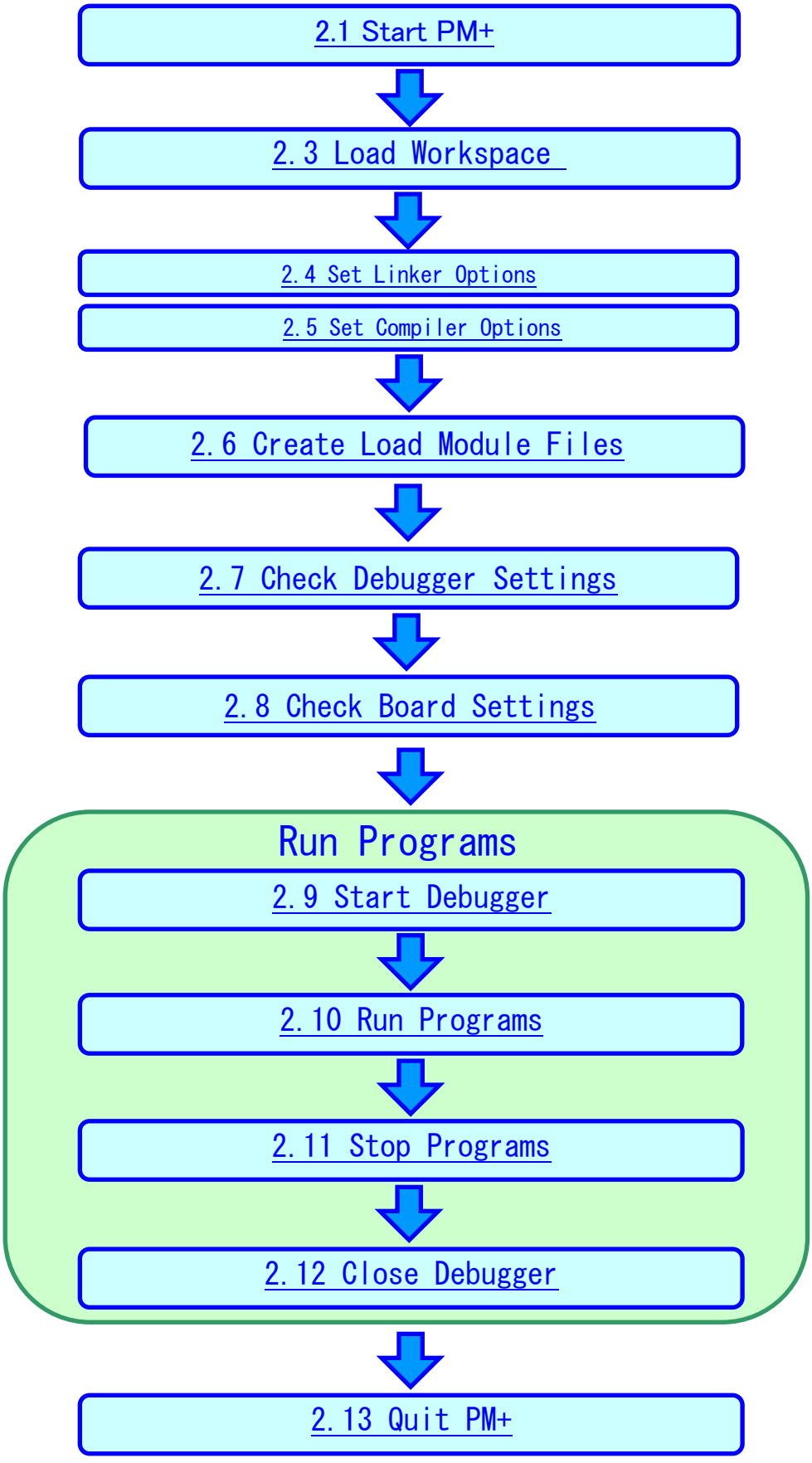
In this chapter, you will experience how to use the development tools with using the sample programs.
The development tools are :

- Integrated Development Environment (IDE), PM+
- Integrated Debugger, ID78K0R-QB

You will use the programs that you prepared in "1.4 Sample Programs", as the sample programs for TK-78K0R/KG3+NET.

You will be able to understand how to use the development tools and the concept of project files which you need for producing application programs.

The overall steps are as follows:



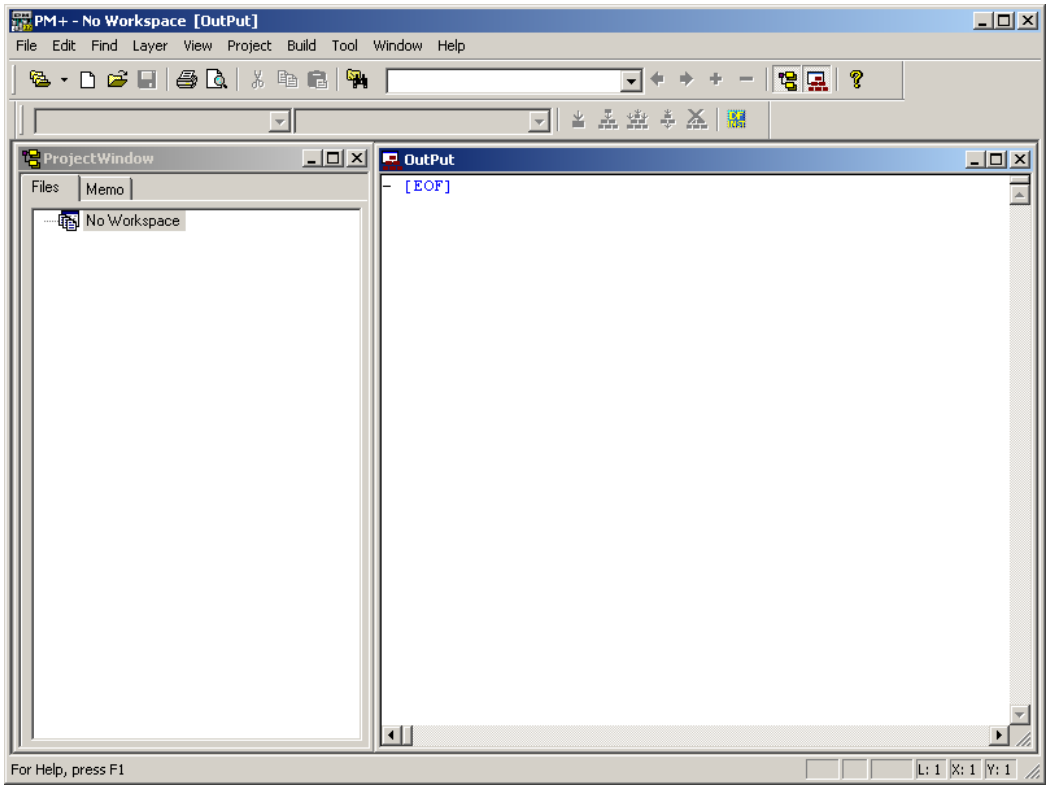
2.1 Start PM+

Let's start using the development tools.

First, start the PM+

Select "Windows Start Menu" -> "Program" -> "NEC Electronics Tools" -> "PM+ V6.30".

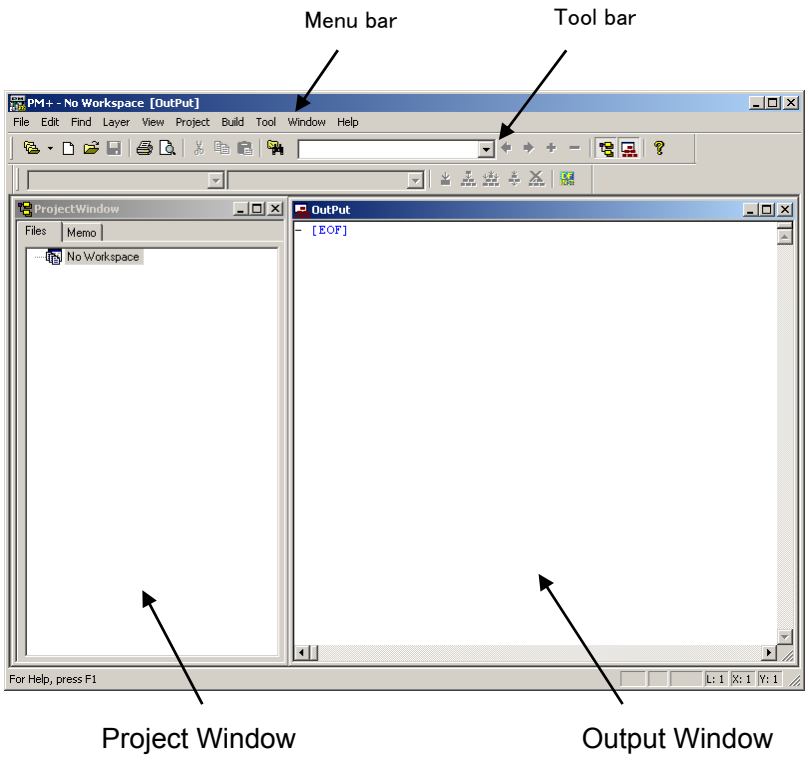
PM+ starts up



2.2 What is PM+

In PM+, application programs and environment setting are handled as a single project, and series of actions such as program creation using the editor, source management, build, and debugging are managed.

Also, one of more project files is managed together as a workspace.



Project window	A window in which project names, source files, and include file are displayed using a tree structure.
Output window	A window in which the build execution status is displayed.

For details regarding menu bars and tool bars, refer to "Help" menu in PM+.
"Help" on menu bar , then "PM+ Help"

What is a project?

A project is the unit that is managed by PM+. A project refers to an application system and environment development based on PM+.

PM+ saves project information in a "project file".

What is a project file?

A project file contains project information that includes the source files, device name, tool options for compiling, editor, and debugger information.

The file name format is "xxxxx.prj".

Project files are created in the directory you specifies when you create a new workspace.

What is a project group?

A project group is a group comprised of a number of projects in an application system.

The target device of each project must be the same within a project group.

What is a workspace?

A workspace is the unit used to manage all the projects and project group required for one application system.

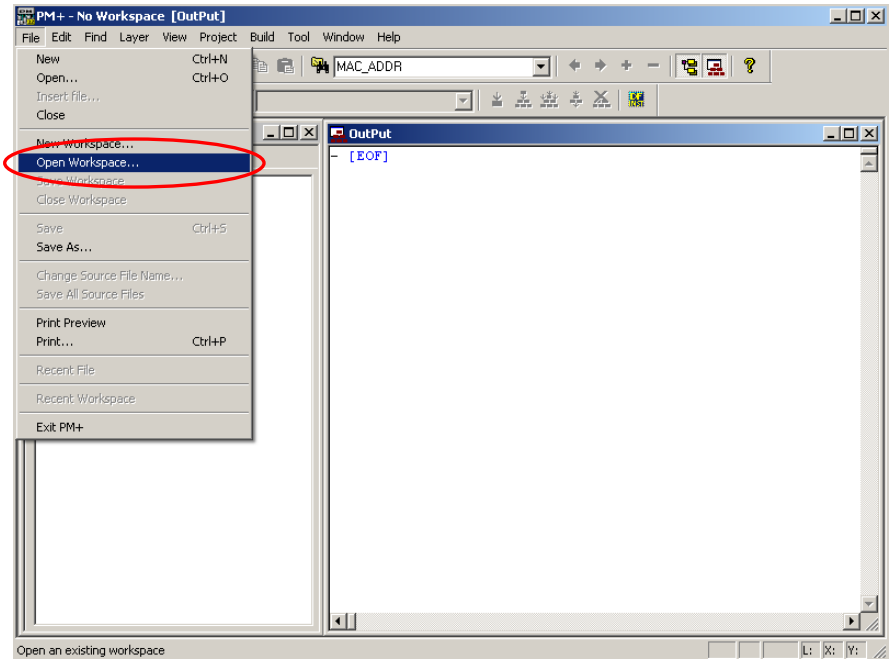
A workspace file contains one or more project files.

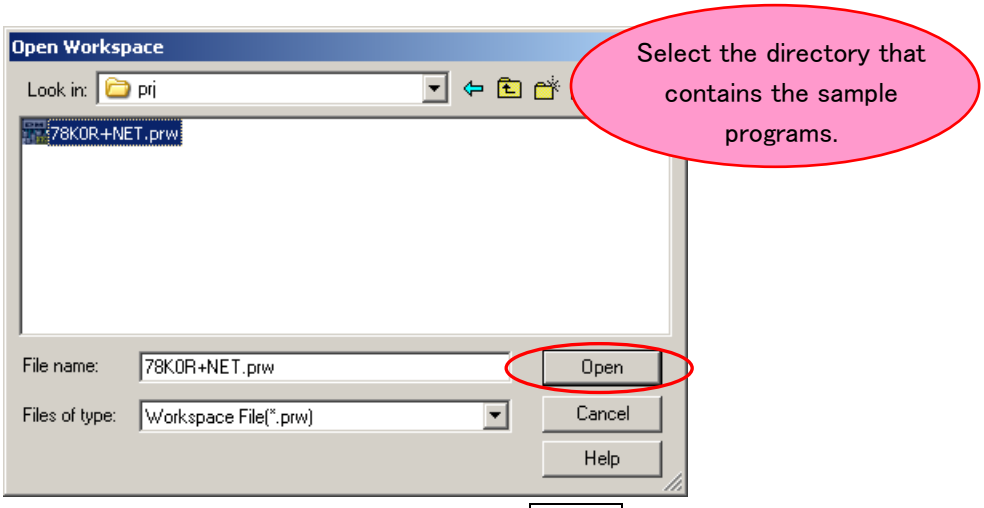
The file name format is "xxxxx.prw".

2.3 Load Workspace (project)

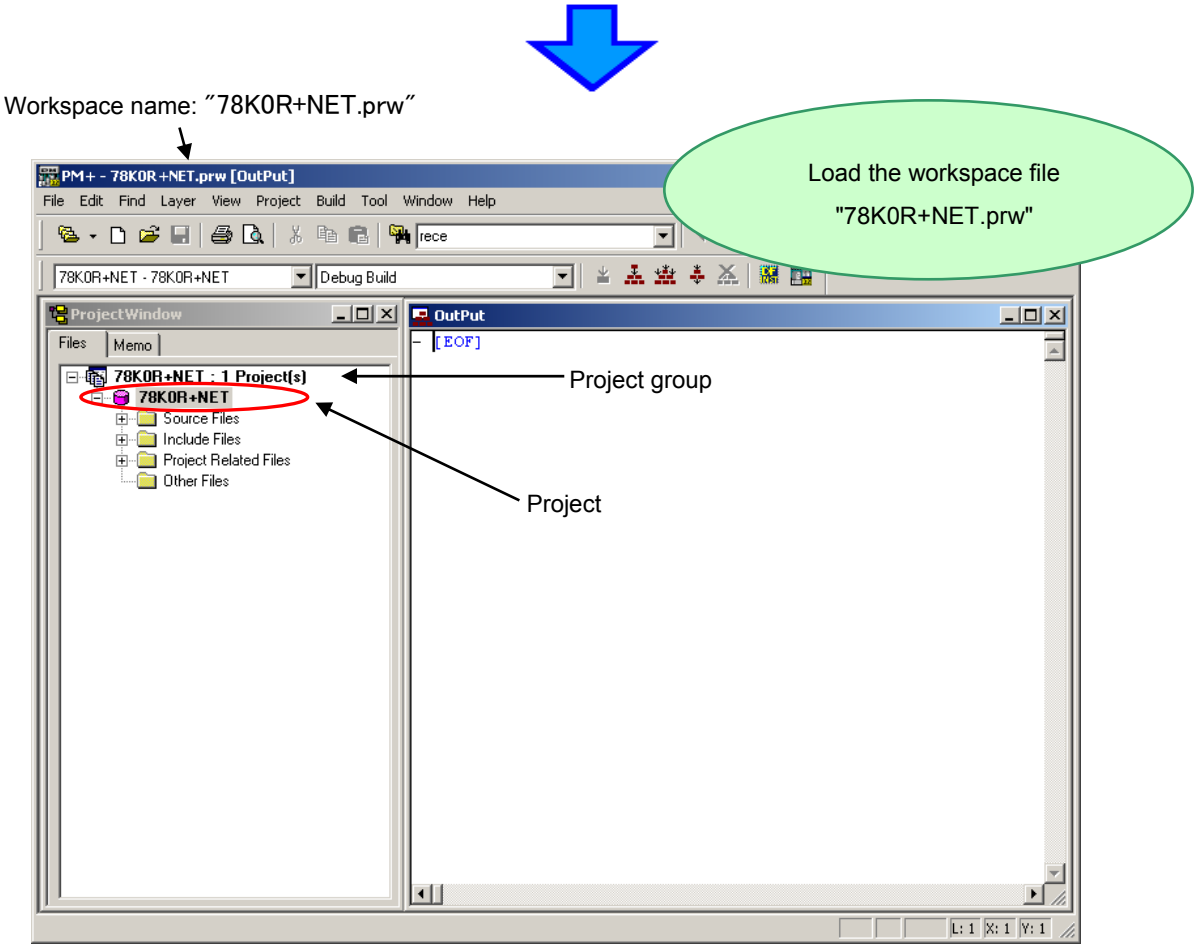
In this section, you will use the workspace that you created in "1.4 Sample Programs"
For creating a new workspace, refer to "Chapter 6 Other Information".
The workspace has information about the build environment for the sample programs.

Select "File" on menu bar and "Open Workspace…".
Then, select "78K0R+NET.prw" under the directory "TK78K0R¥KG3+NET¥prj¥".





Select "78K0R+NET.prw", then click Open .



The workspace file "78K0R+NET.prw" contains one project called "78K0R+NET". You will use this project "78K0R+NET".

CAUTION:

Please ignore when you get a prompt saying "files could not be found". This may occurred when the installation directory is not a default.

2.4 Set Linker Options

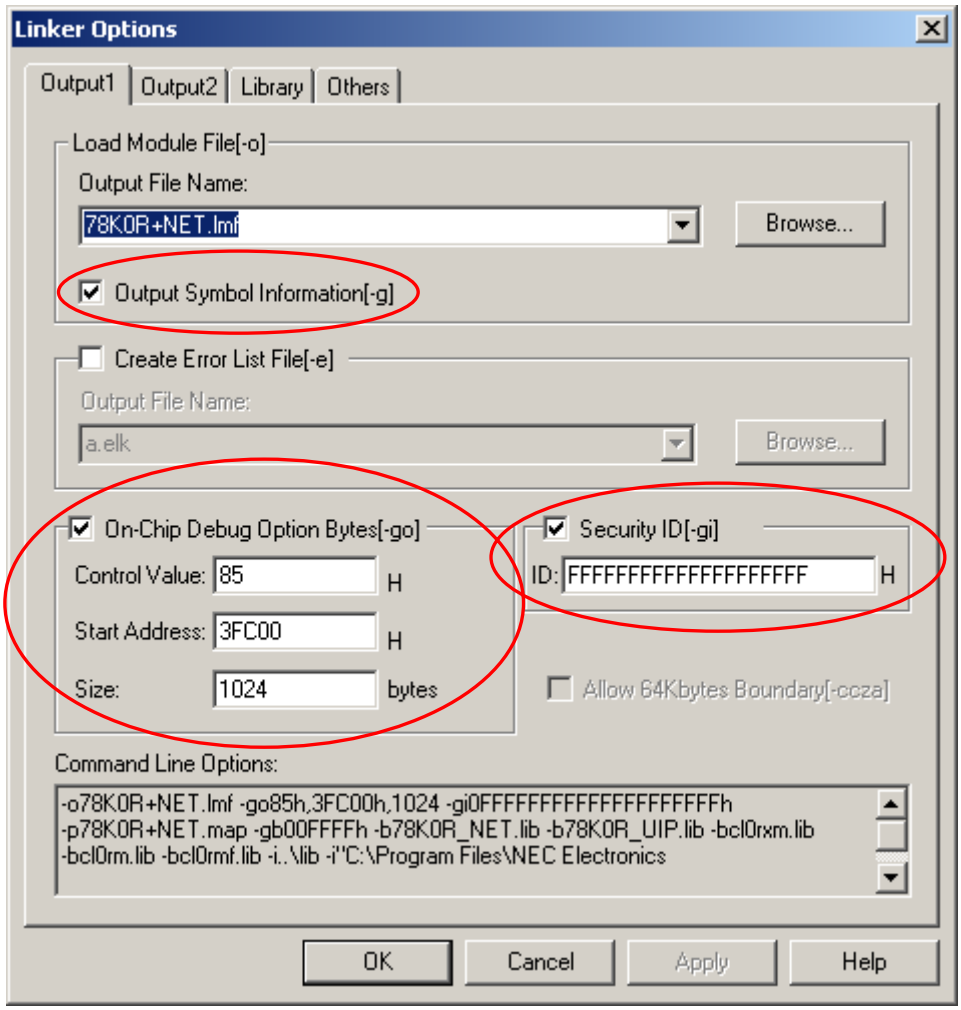
The linker options have been set by the project file. However, some option settings will be covered in this section because the linker option settings are important for debugging. Following three settings are covered specifically.

- Outputs from debugging
- On-chip debug (Disable/Enable, security ID)
- Watchdog timer

Select "Tools" on menu bar, then "Linker options....".

2.4.1 "Output1" Tab

Select "Output1" tab on "Linker Options" window, and see following settings.



- Load Module File settings

  Check "Output Symbol Information".

  This enables to do source level debugging (setting break points, monitoring variables in watch window, etc).

  Also, you can specify the load module file name.

- On-Chip Debug Option Byte

  Check "On-Chip Debug Option Byte". Enter "85" in "Control value". This setting enables the on-chip debugging function of the microcontroller.

  * For details of "Control value", refer to the user's manual of 78K0R/KG3 (U17847E).

  See "Start address" is set to "3FC00", and "Size" is set to "1024".

  These settings reserve the memory address area for the monitor program (the flash memory area that the debugger uses for on-chip debugging).

  In this case, the "Control value" is allocated to the address of C3H in flash memory, and FFH is set to the next address. Because of this, the following areas could not be set the segments.

  <Address area that reserved by on-chip debugging>

  - 2H, 3H
  - CEH-D7H
  - From the address set in "Start address" to the byte set in "Size"

- Security ID

  Check "Security ID", and enter the security ID which is a unique ID code (10 bytes) to authenticate when the debugger is launched.

  The security ID is stored in the flash memory (C4H-CDH), and checked if it is the same as the code entered in Linker options dialog when the debugger is launched.

  The debugger will not be launched when the security ID is unmatched. By using this function, you can secure the programs from leaks.

  If you do not need to set the security, it is recommended to set the security ID "FFFFFFFFFFFFFFFFFFFF" as this is the initial code.

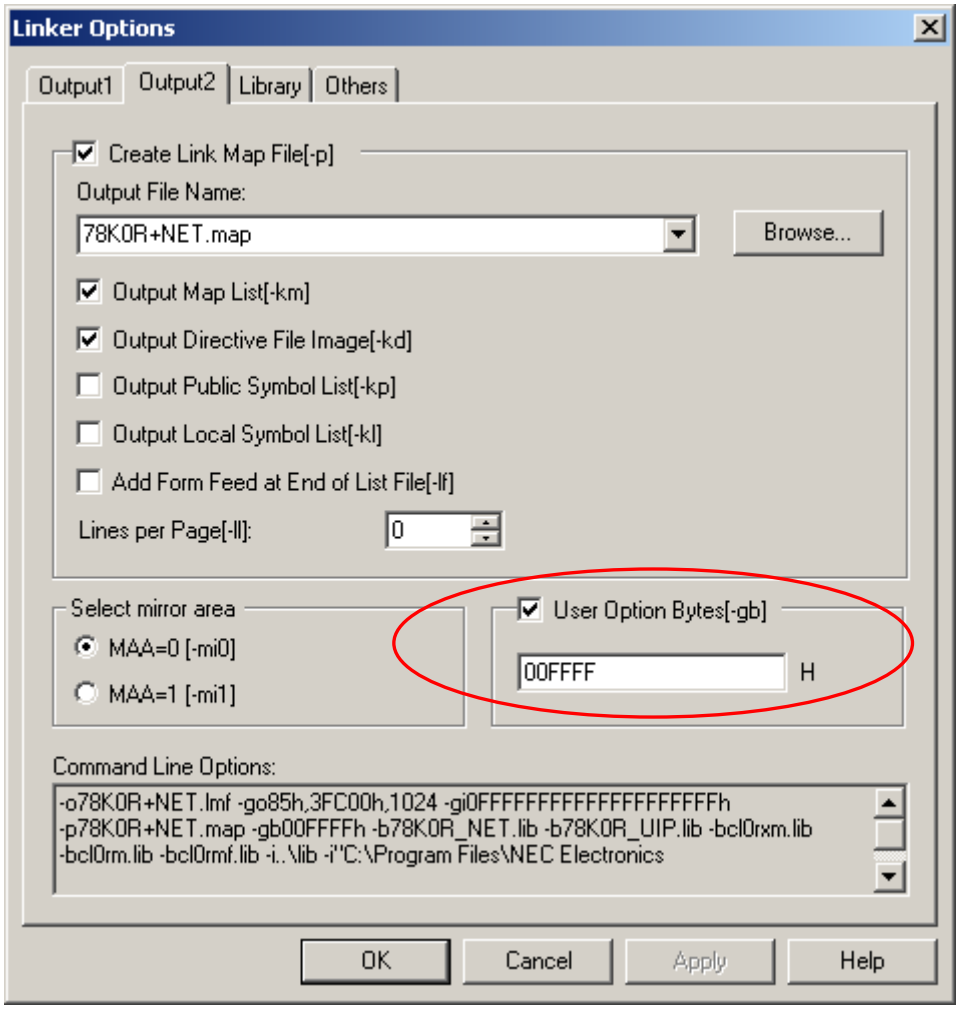
If you forget about the security ID (stored in the address of C4H-CDH) or if you set wrong on-chip debug option byte, you will not be able to use the debugger (ID78K0R-QB).

To solve this, you can use the "78K0R Starter Kit Setting" for changing the setting to initialize the flash memory at the time debugger launched.

For details, refer to "6.3.8 Erase microcontroller built-in flash memory".

2.4.2 "Output2" Tab

Select "Output2" tab on "Linker Options" window, and see following settings.



- User Option Byte

  Check "User Option Byte", and then enter "00FFFF". Here, you can do the setting of watchdog timer, low-voltage detector, and system reserved memory area. The 3 bytes you entered are stored at C0H-C2H on flash memory:

  - C0H: setting for watchdog timer
  - C1H: setting for low-voltage detector
  - C2H: setting for system reserved memory area (must be set as FFH)

  This time, you disabled the watchdog timer and the default start function of low-voltage detector. For details, refer to the user's manual, 78K0R/KG3 (U17847E).

2.5 Set Compiler Options

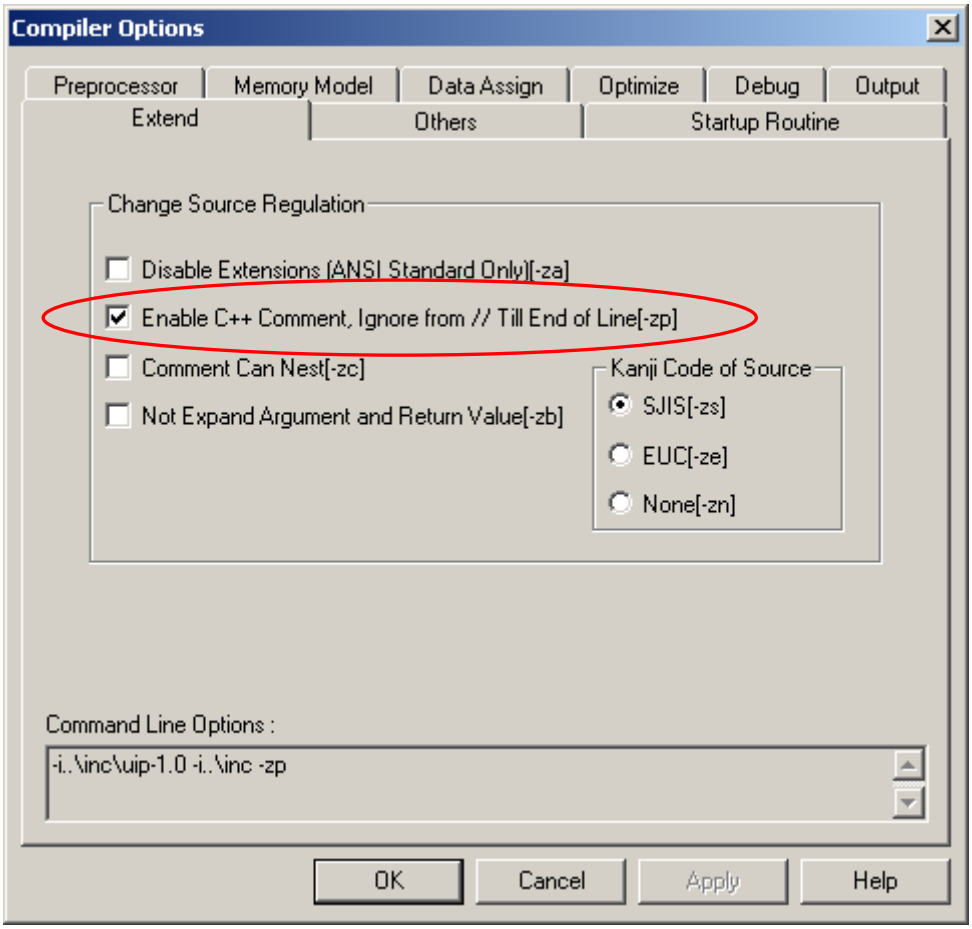
The compiler options have been set by project file. However, because some compiler options are useful, following two settings are covered specifically in this section.

- Enable C++ comments
- Use multiplier and divider

Select "Tools" on menu bar, then "Compiler options".

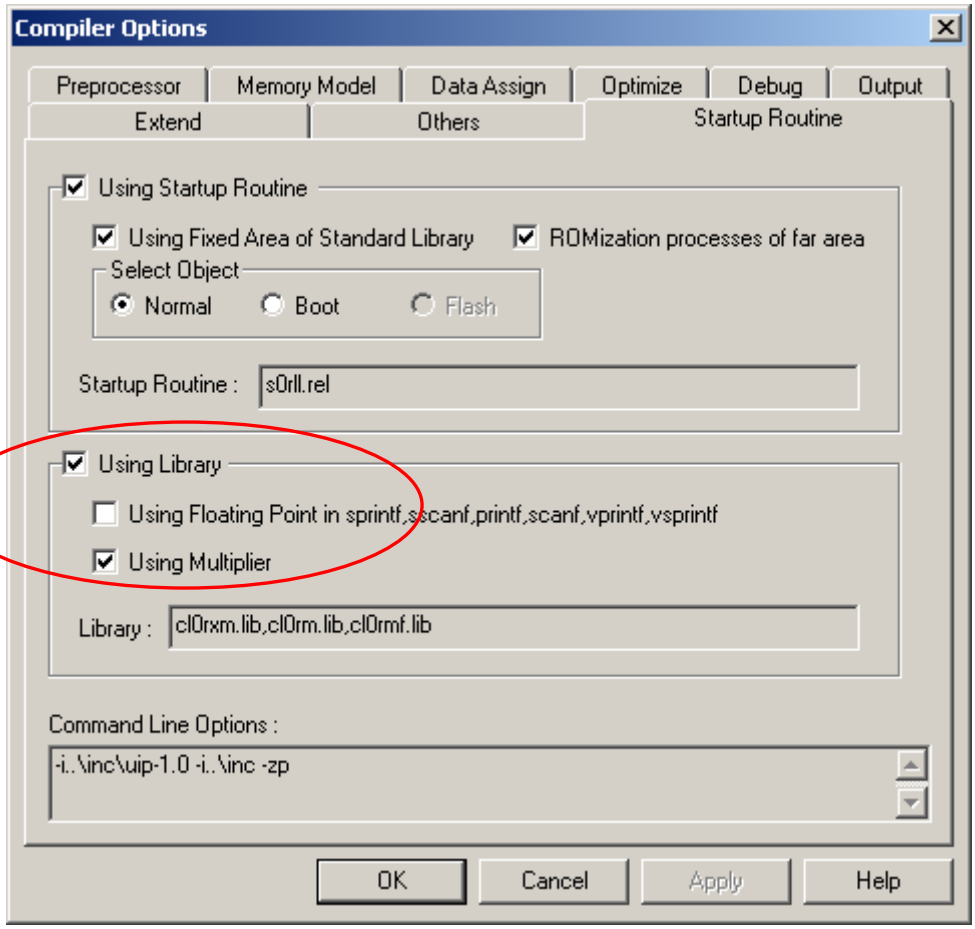
2.5.1 "Extend" Tab

Select "Extend" tab, and check "Enable C++ Comment".
This setting allow you to use the C++ comment using "//".
It is useful feature when developing code.



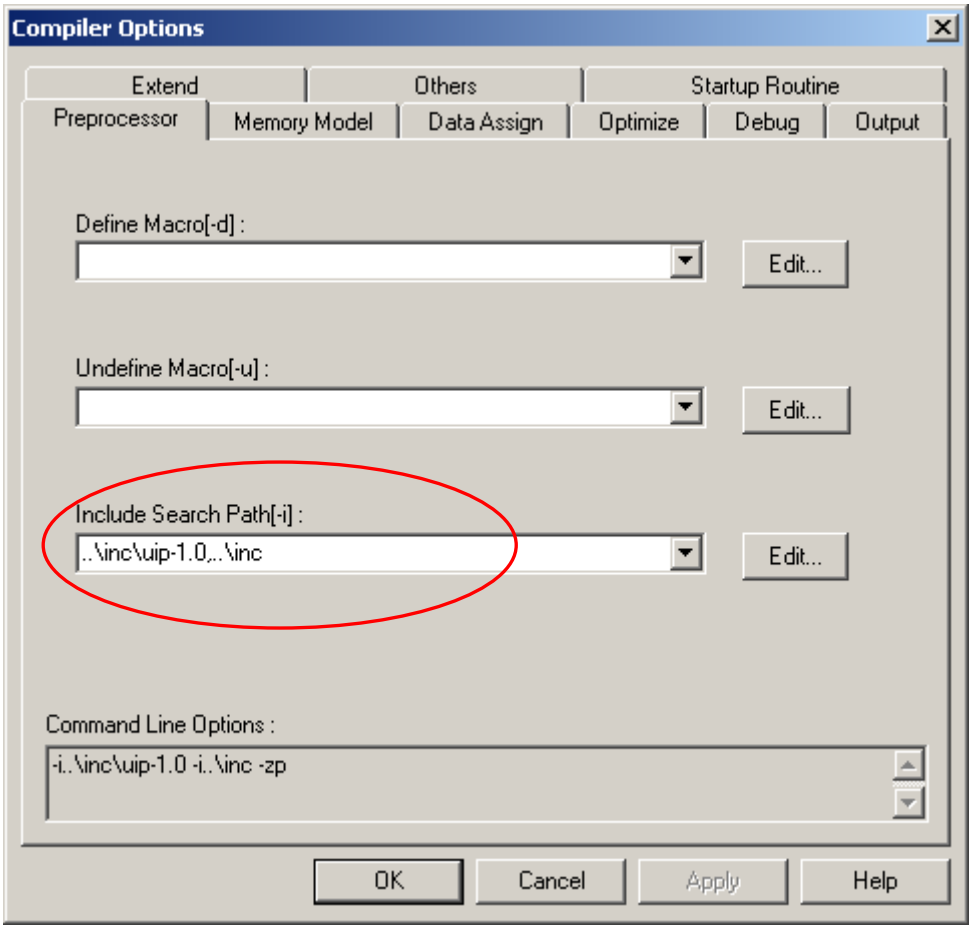
2.5.2 "Startup Routine" Tab

Select "Startup Routine" tab, and check "Using Library" and "Using Multiplier". The 78K0R/KG3 has feature of multiplier to increase those calculation speed.



2.5.3 "Preprocessor" Tab

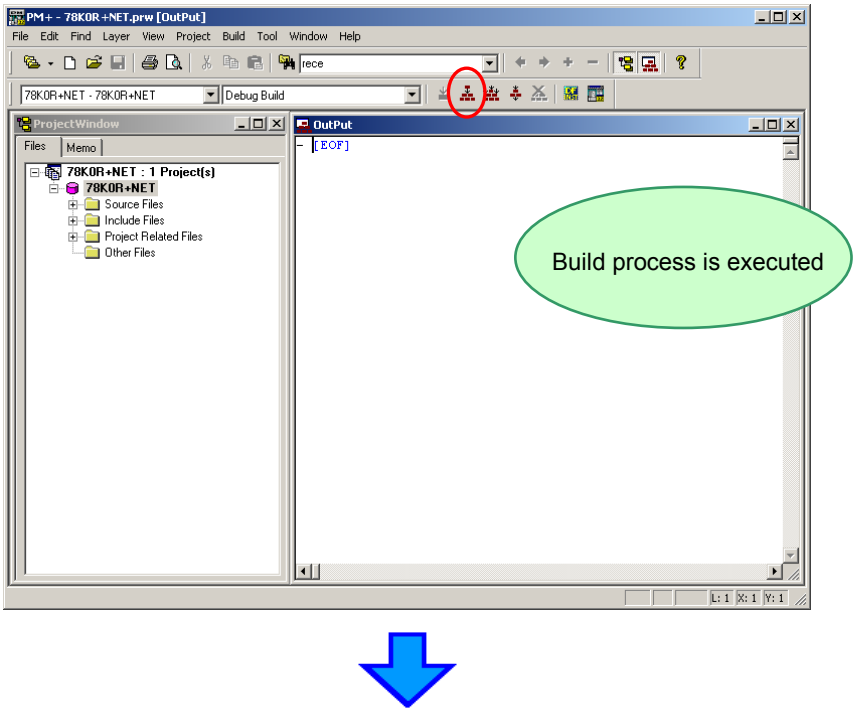
Select "Preprocessor" tab, and enter "..¥inc¥uip-1.0,..¥inc" in the "Include Search Path".

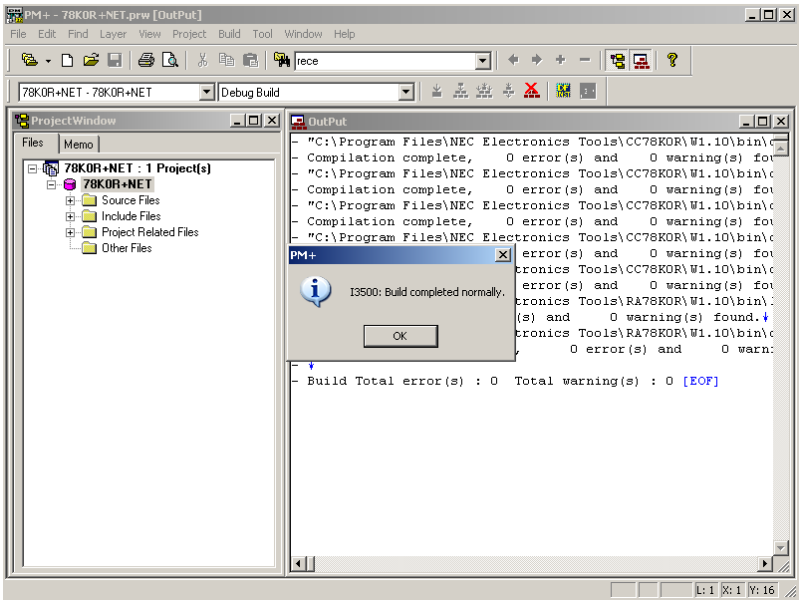


2.6 Create Load Module Files

After developing the source code, you have to create load module files by compiling, assembling, and linking. This process is called build.

Click the build button  , or select "Build" on menu bar, then "Build".





Build has been completed successfully.

What is build?

Build is a function that creates an executable file from source files in a project.

PM+ automatically performs compiling, assembling, linking, and other processing actions.

To reduce the time for the build, PM+ detects and compiles/assembles only the files that have been updated from the previous build process.

What is rebuild?

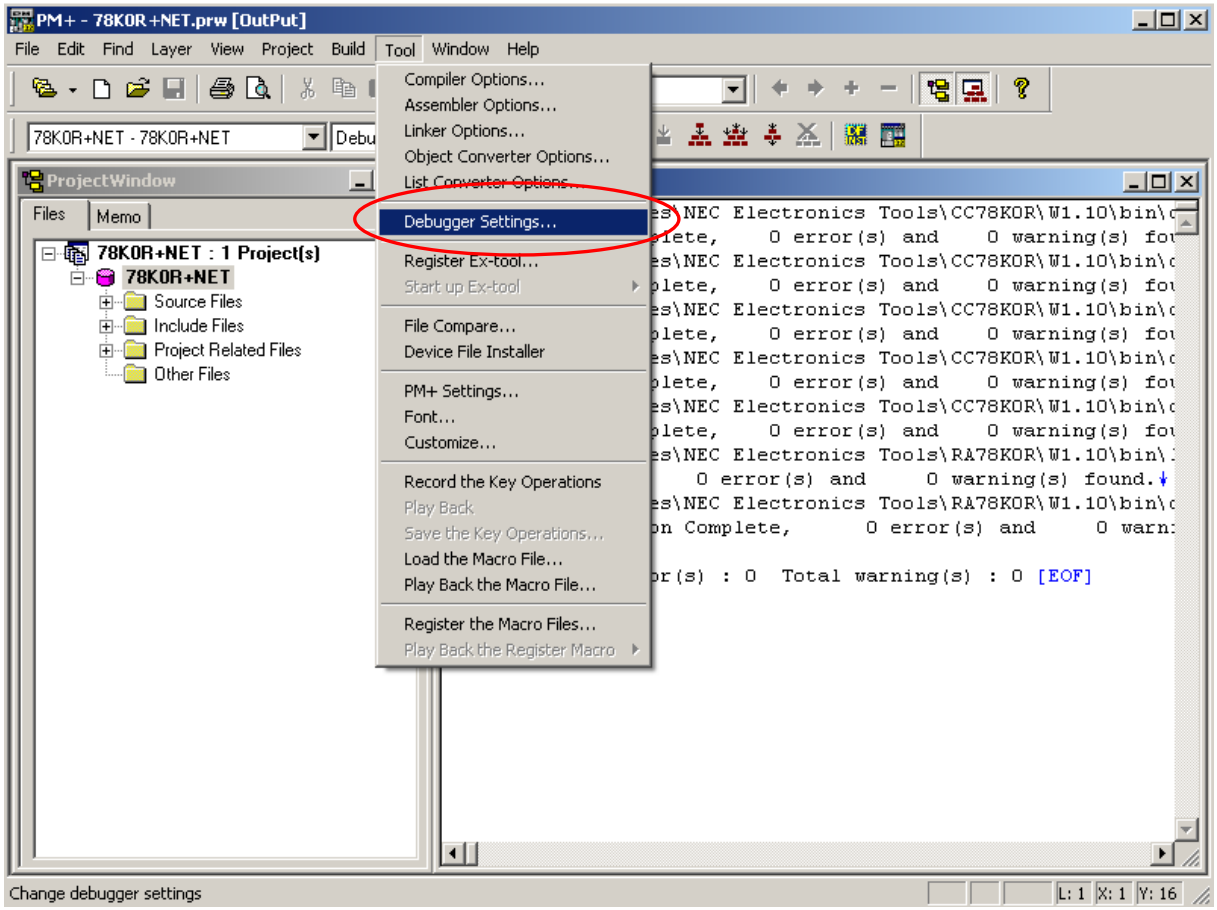
Build compiles and assembles only the source files that have been updated from the previous time, whereas rebuild compiles and assembles all the source files.

When setting, such as compiler options, have been changed, you must rebuild instead of build.

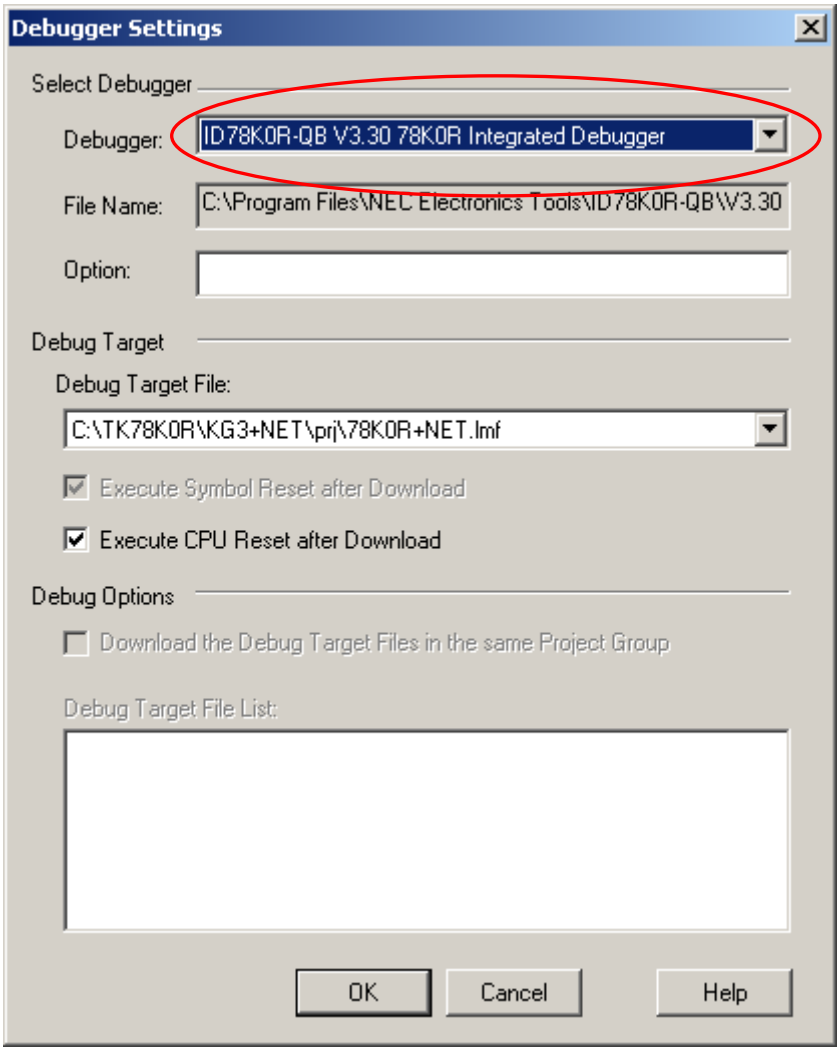
2.7 Check Debugger Settings

After the build, you should configure the debugger settings.
The debugger settings have been set by the project file as well. However, because those settings are important for debugging, some settings are covered in this section.

Select "Tools" on menu bar, then "Debugger Setting...".



Check if "ID78K0R-QB V3.30 78K0R Integrated Debugger" is selected on "Debugger".

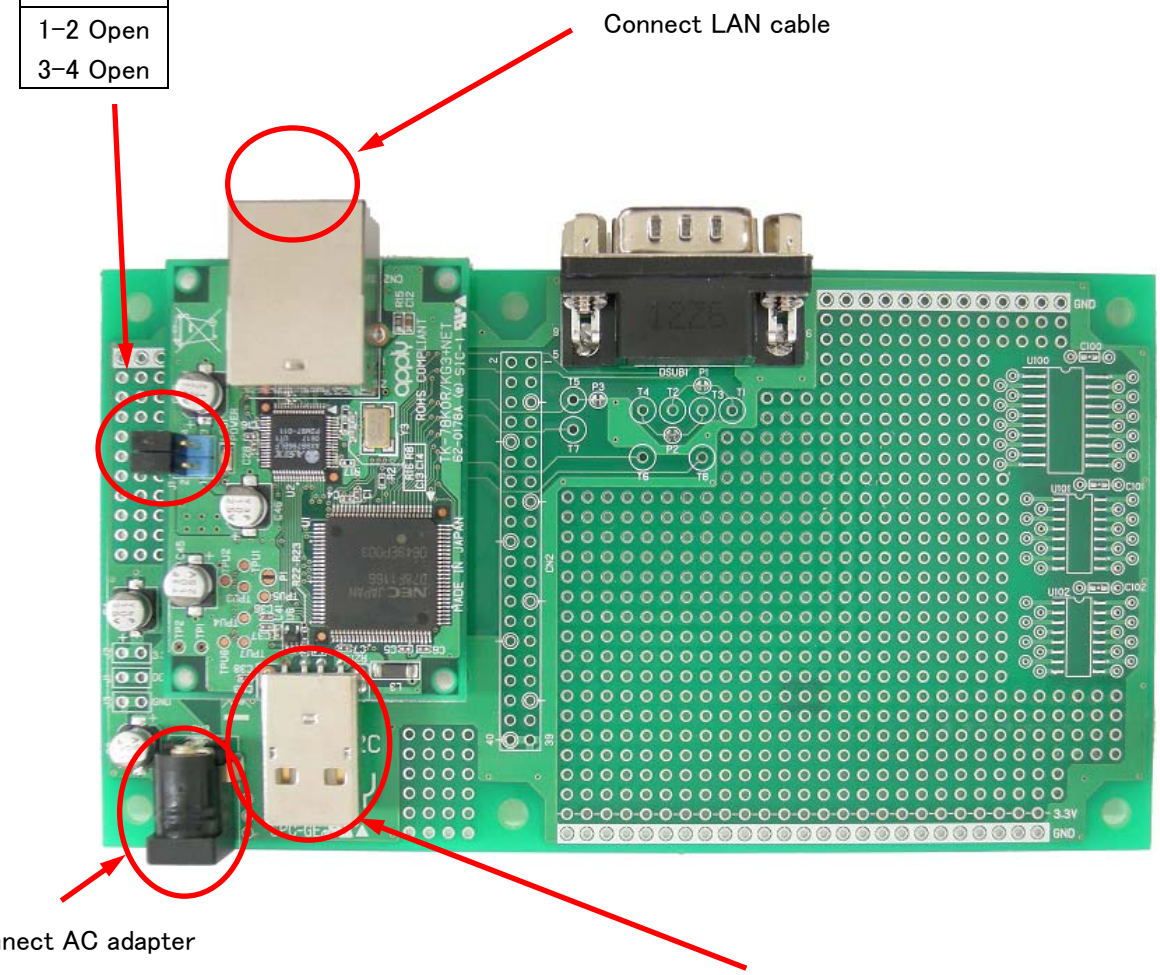


If you cannot select "ID78K0R-QB V3.30 78K0R Integrated Debugger", select "Project" on menu bar, "Project settings" -> "Tool version settings" -> "Detailsetting" -> then select "ID78K0R-QB".

2.8 Check Board Settings

Before connecting the PC and the TK-78K0R/KG3+NET with USB, you should check the setting of JP1 on the TK-78K0R/KG3+NET.
Set CN1 on TK-78K0R/KG3+NET and CN1 on EXT-232C board as shown below.

J1 Setting
1-2 Open
3-4 Open



After the switch settings are completed, connect the PC to CN3 on TK-78K0R/KG3+NET with USB extension cable.
Connect CN2 and PC with LAN cross cable.
Supply power by connecting bundled AC adapter to CN3 on RS-232C board.
LED1 is lighted when CPU gets power supplied.

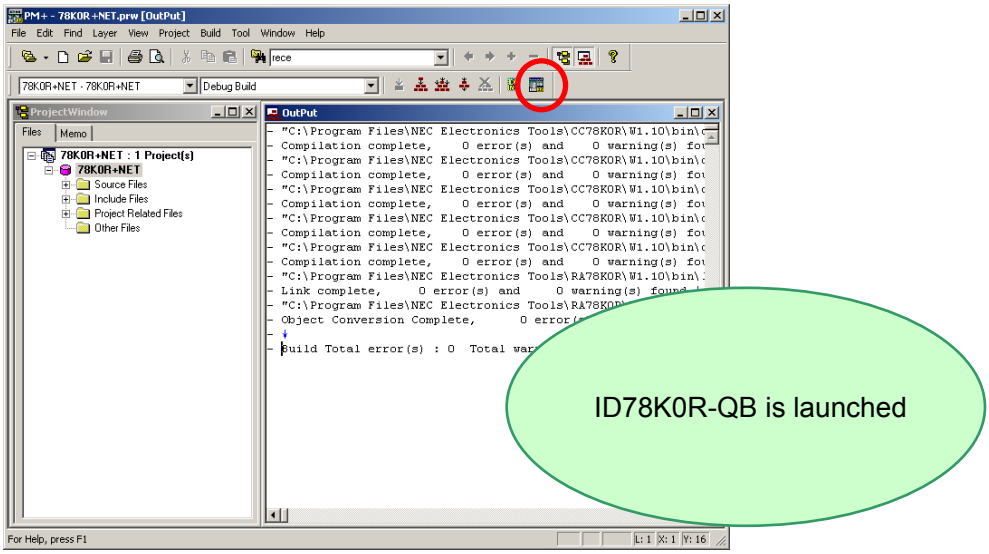
If the "Found New Hardware Wizard" is started, install USB driver with referring "1.3 Installation of USB Driver".

2.9 Start Debugger (ID78K0R-QB)

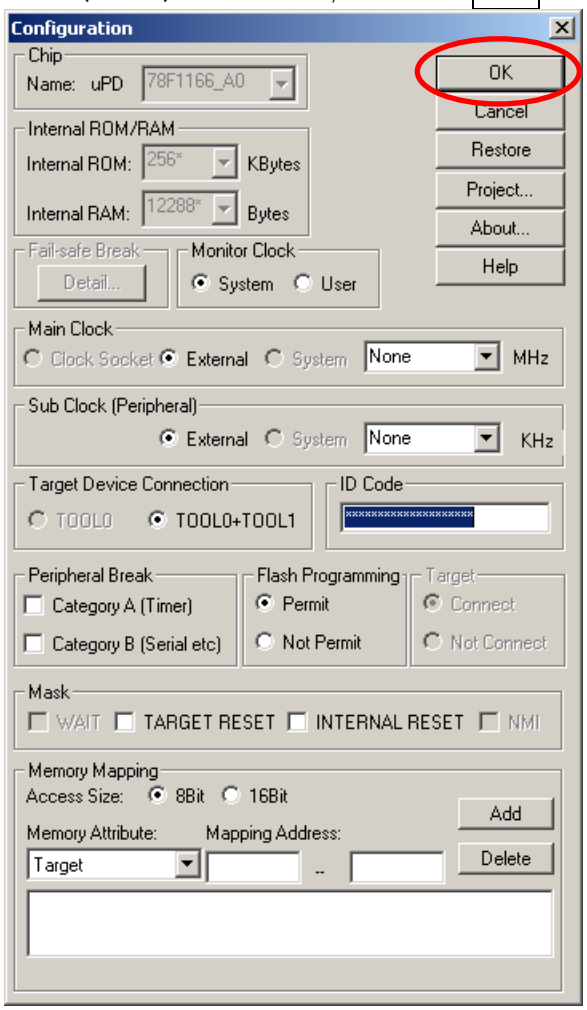
Click the debug button  , or select "Build" on menu bar, then "Debug".

If you do not see the debug button, go to "2.7 Check Debugger Settings" for changing the settings.

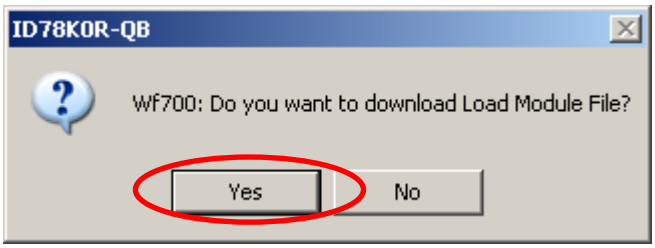
The steps to start the debugger will be explained below.

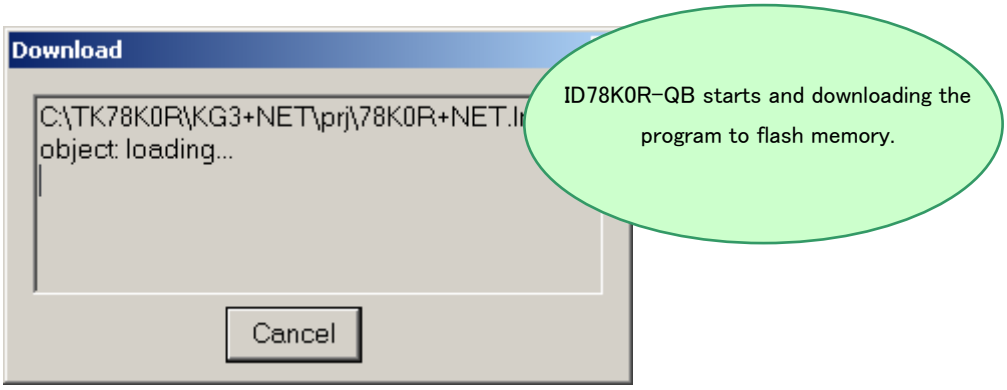


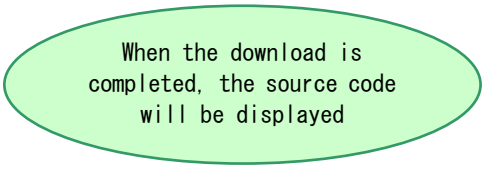
"Configuration" dialog is opened.
Enter "FFFFFFFFFFFFFFFFFFFF" (F x 20) in "ID Code", then click [OK] .

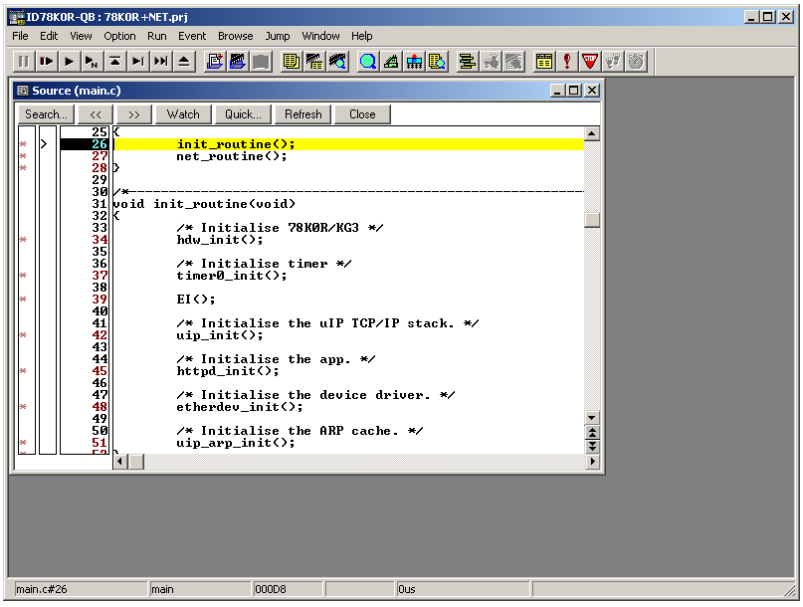


Click [Yes] when the confirmation dialog for downloading load module file is opened.









NOTE:

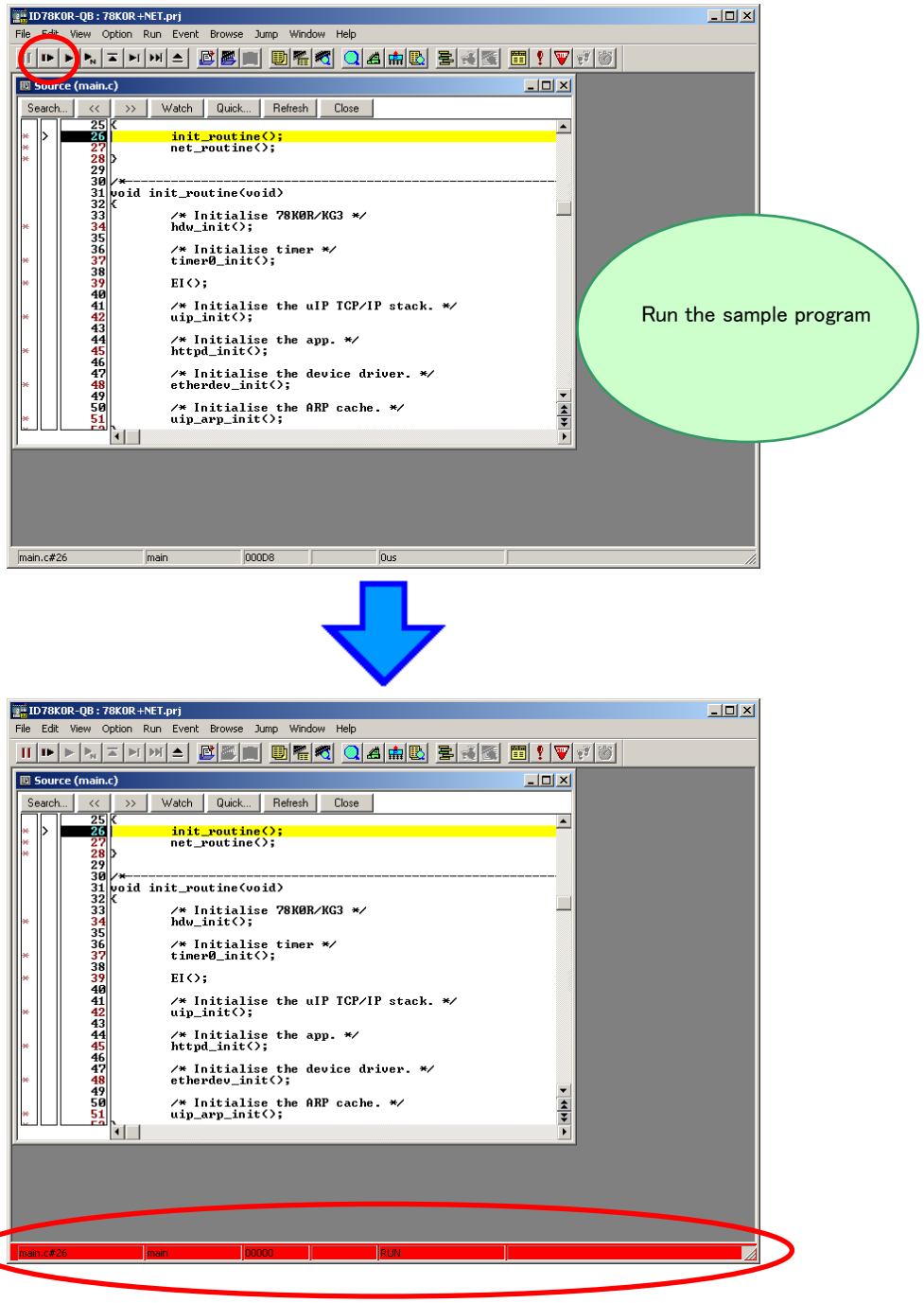
Completion of the download does not mean running the programs. Therefore, even though you press SW1 on the board, it does not make anything happened. To run the demonstration, see "2.10 Run Programs".

2.10 Run Programs

Now, you are ready to run the program.

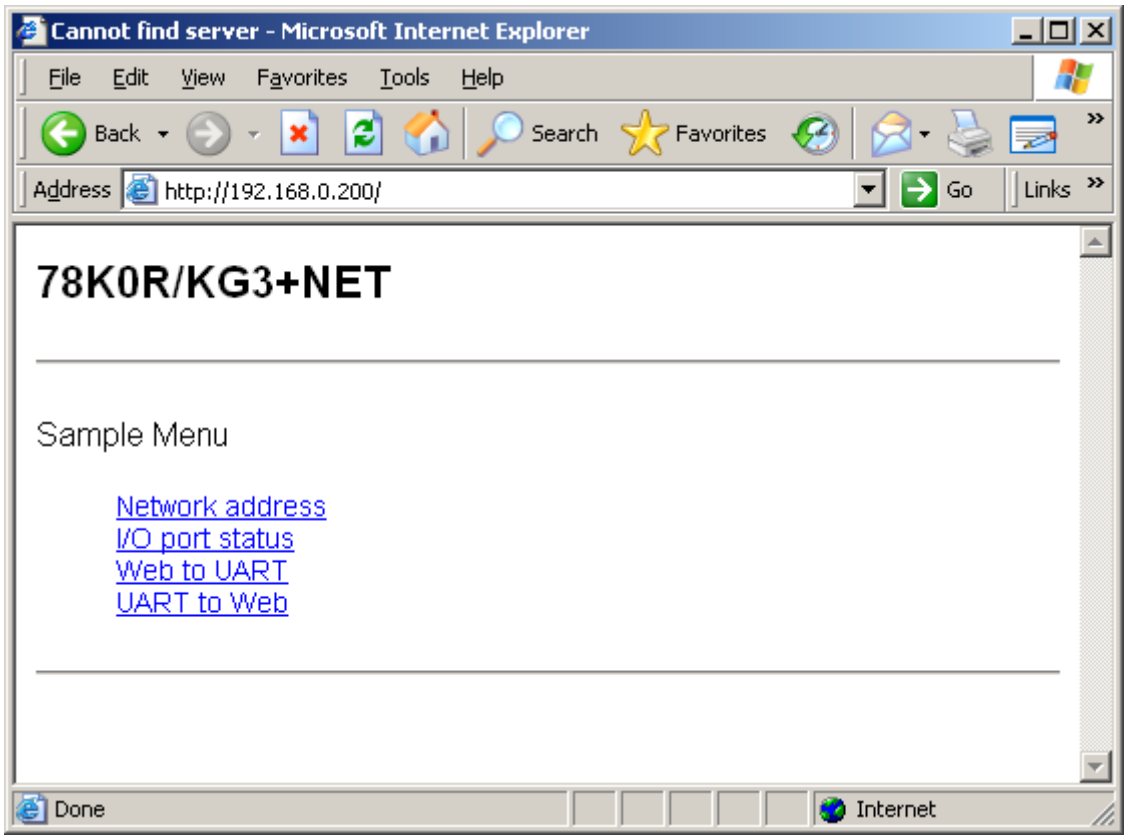
Click the restart button  , or select "Run" on menu bar, then "Restart".

The sample program runs.



When programs are running, the status bar will be red.

Start Web browser on PC and access "http://192.168.0.200/".
Confirm the following page is displayed.



You could confirm the sample program is working.

● When the page is not displayed, check the network address setting of PC.

Setting example of network address

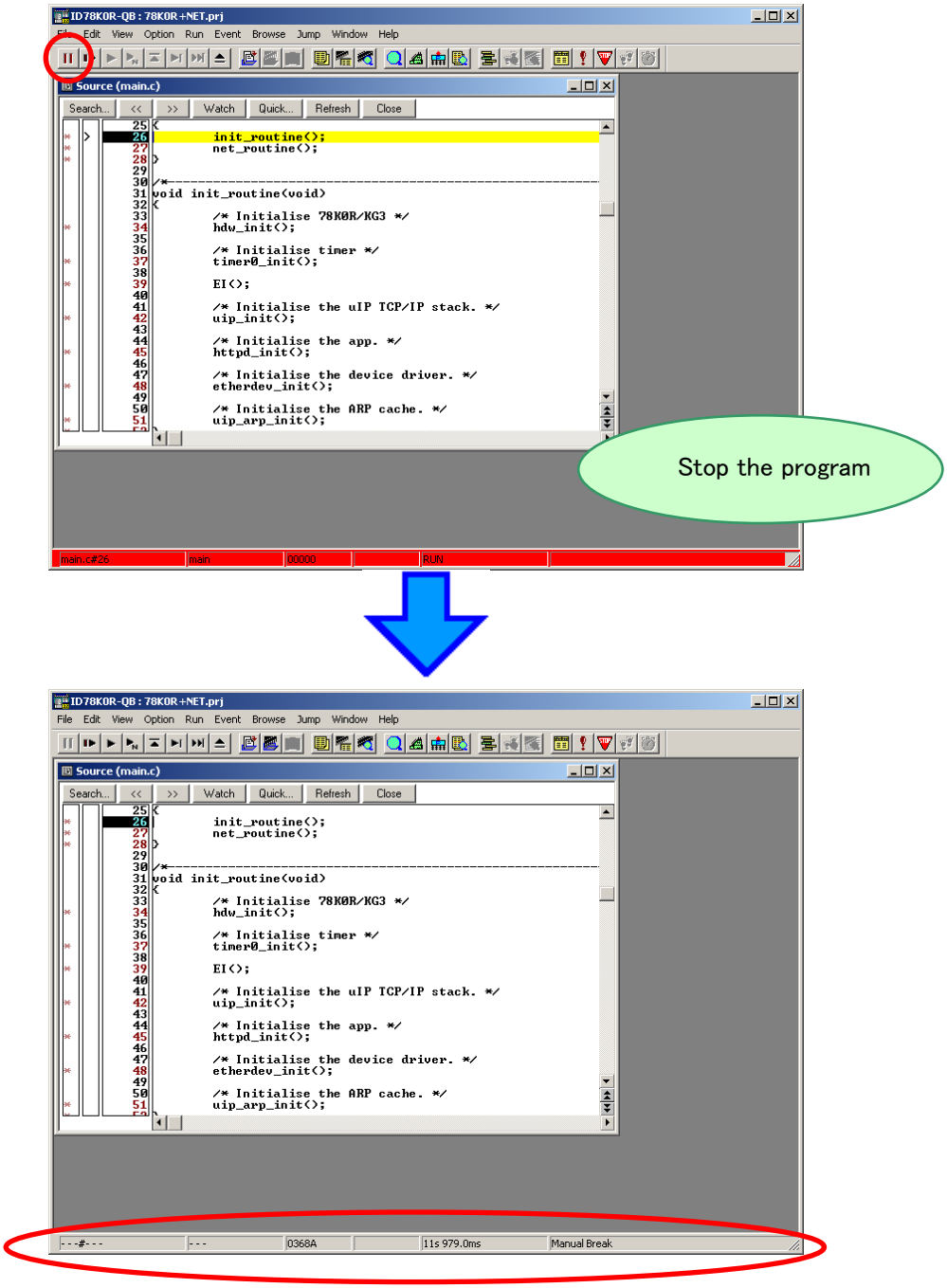
IP address	192.168.0.XXX (XXX=0～255)
Subnet mask	255.255.255.0

●For more information about the functions that are used in those sample program, see "Chapter 4 Sample Programs".

2.11 Stop Programs

Now, you are going to stop the program.

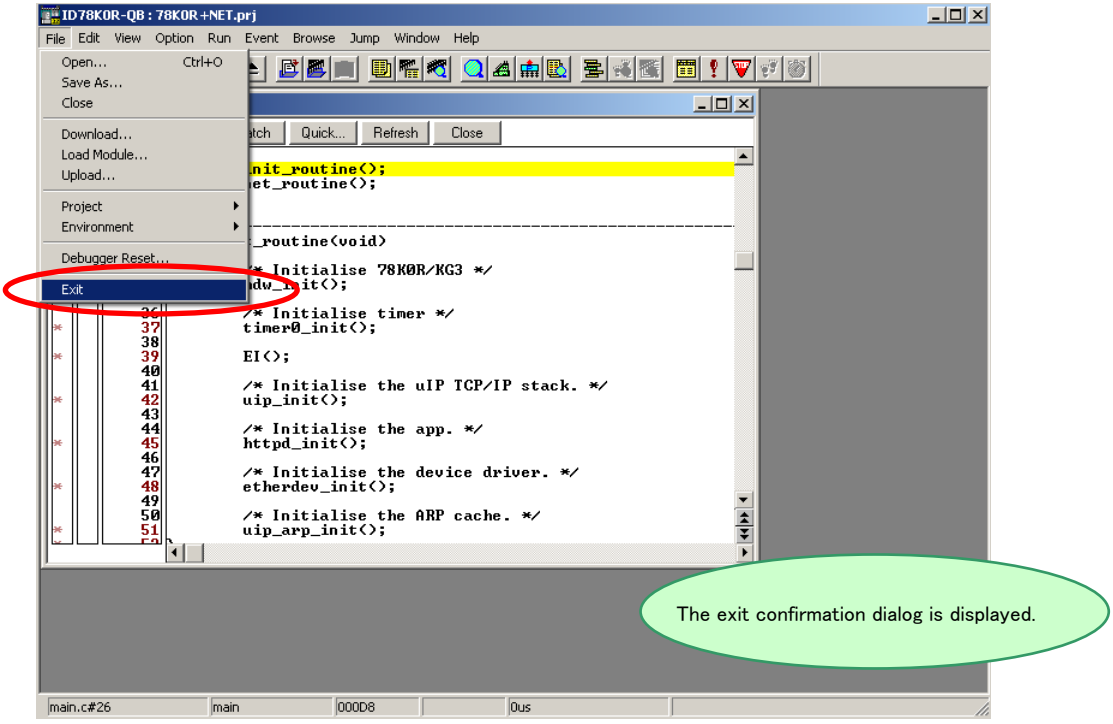
Click the stop button , or select "Run" on menu bar, then "Stop".

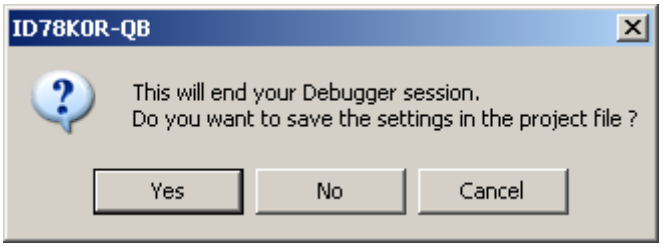


When the program stops, the status bar changes back to the original color.

2.12 Close Debugger (ID78K0R-QB)

Select "File" on menu bar, then "Exit".

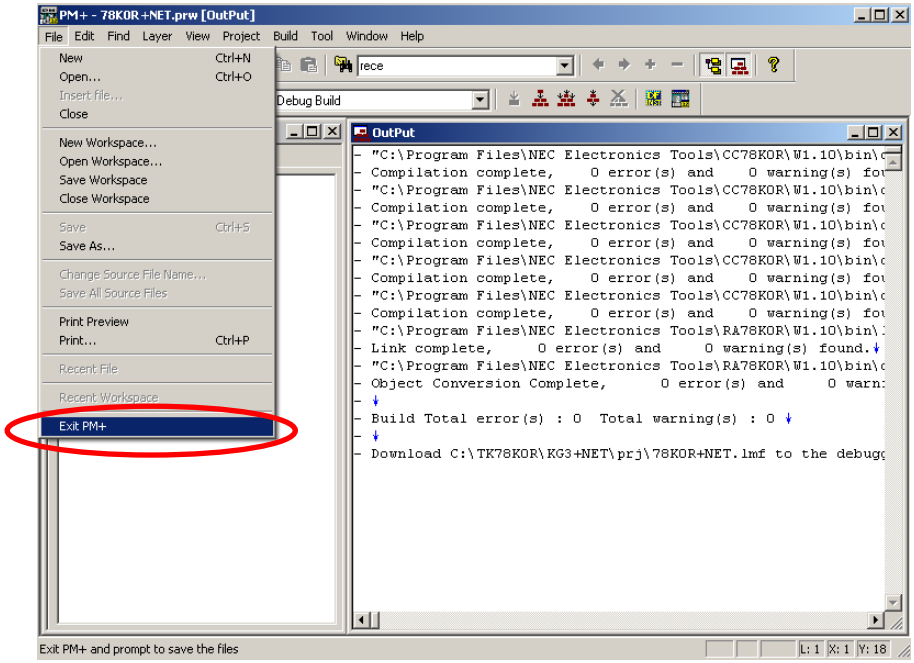




If you click Yes , it saves the settings in the project file, and then closes the ID78K0R-QB. It is recommended to save the settings as it saves the window you used, window size, layout, etc.
If you click No , it does not save the settings and closes the ID78K0R-QB.

2.13 Quit PM+

Select "File" on menu bar, then "Exit PM+".



PM+ is closed.

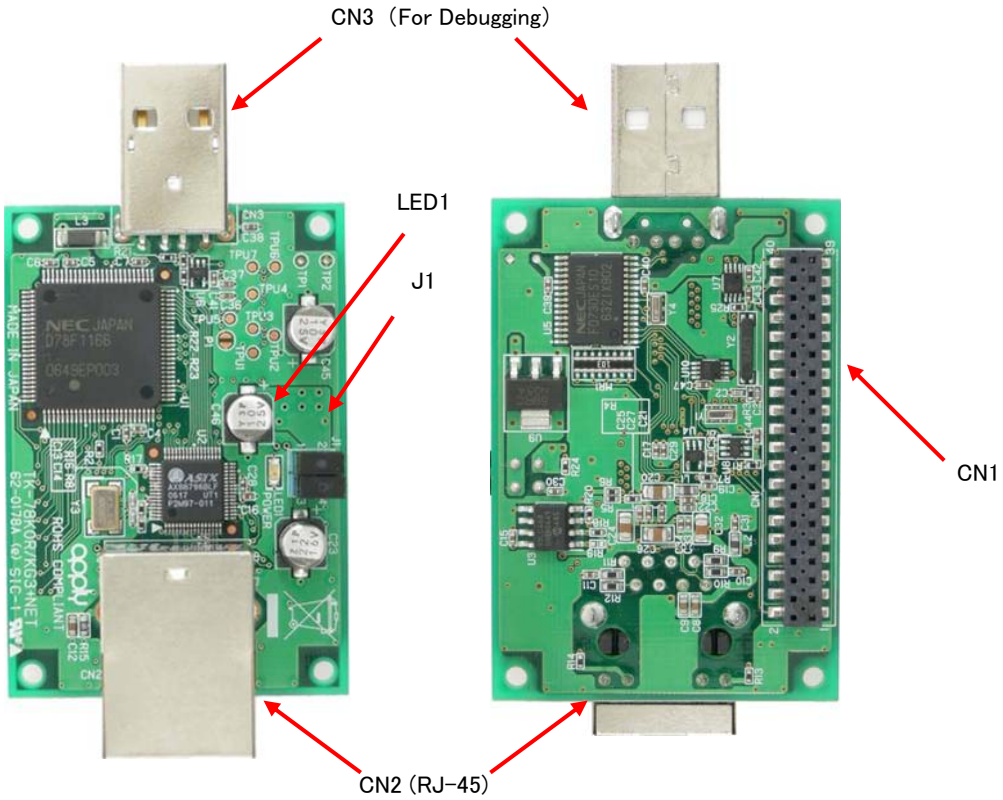
The experiences section ends now.
You can find more information how to use the development tool and information about other useful features in "Chapter 6 Other Information".

CHAPTER 3 Hardware Specifications

In this chapter, the hardware of TK-78K0R/KG3+NET will be explained.

Microcontroller		μPD78F1166GC *78K0R/KG3
Microcontroller supply Voltage		3.3V
Clock		External main system clock: 20MHz Subsystem clock: 32.768KHz Internal high-speed oscillation clock: 8MHz Internal low-speed oscillation clock: 240 kHz
Ethernet controller		ASIX AX88796B
Interface	TK-78K0R/KG3+NET	Ethernet 10/100Base-T (RJ-45) USB (A Type Connector for debugging) Extension connector (40pin 2mm pitch header socket)
	EXT-232C	Connector for TK-78K0R/KG3+NET (40pin 2mm pitch header pin) RS-232C (D-SUB 9pin plug) Extension I/O (Same as signal I/O of TK-78K0R/KG3+NET extension connector) AC adaptor input
Power supply voltage		5V (You can use USB bus power when you need to use TK-78K0R/KG3+NET stand-alone)
Dimension		W75xH38xD20mm(TK-78K0R/KG3+NET) W138xH81xD25mm

3.1 TK-78K0R/KG3+NET Function Layout



3.2 TK-78K0R/KG3+NET Function Details

3.2.1 J1

JP1 is the jumper switch pin to select power supply.

When you need to use USB bus power, short 1-2 and 3-4 with jumper pins. When you use EXT-232C board, do not use jumper pins.

J1

1-2 Short	Supply power to microcontroller by USB bus power. (Do not use EXT-232C board connected.)
3-4 Short	Supply power to LAN controller by USB bus power. (Do not use EXT-232C board connected.)
Open	Supply power to the EXT-232C board by AC adapter.

3.2.2 CN1

CN1 is the extension connector for connecting EXT-232C board.

With using Samtec TMM-120-01-G-D connector (2mm pitch header pin), you can connect other boards as well.

CN1

Pin No.	Destination CPU Pin	Remarks
1	P60/SCL0	
2	P61/SDA0	
3	RESET	CPU Reset Output
4	-	CPU Reset Input
5	P40/TOOL0	
6	P41/TOOL1	
7	FLMD0	
8	P42/TI04/TO04	
9	P43/SCK01	
10	P44/SI01	
11	P45/SO01	
12	P46/INTP1/TI05/TO05	
13	P47/INTP2	
14	P120/INTP0/EXLVI	
15	P140/PCLBUZ0/INTP6	
16	P141/PCLBUZ1/INTP7	
17	P142/SCK20/SCL20	
18	P143/SI20/RxD2/SDA20	
19	P144/SO20/TxD2	
20	P145/TI07/TO07	
21	P00/TI00	
22	P01/TO00	
23	P02/SO10/TxD1	Use for EXT-232C
24	P03/SI10/RxD1/SDA10	Use for EXT-232C
25	P04/SCK10/SCL10	
26	P131/TI06/TO06	
27	P150/ANI8	
28	P151/ANI9	
29	P152/ANI10	
30	P153/ANI11	
31	P154/ANI12	
32	P155/ANI13	
33	P156/ANI14	
34	P157/ANI15	
35	P111/ANO1	
36	P110/ANO0	
37	VDD	Power Supply for CPU (3.3V)
38	-	Power Supply for LAN Controller (3.3V)
39	GND	
40	GND	

3.2.3 CN2

CN2 is the RJ-45 connector for Ethernet 10/100Base-T.
Use cross cable when you connect to PC directly, and use straight cable when you connect to router.

3.2.4 LAN Controller

The board mounts AX88796B, LAN controller by ASIX. You can make Ethernet communication with IEEE802.3u 100BASE-TX from CN2 connector.

Connection between CPU and LAN controller

CPU Pin	Signal Direction	AX88796B Pin	Logic
EX16-EX21	→	SA0-SA5	
EX0-EX15	⇔	SD0-SD15	
P16	→	CSn	Active-Low
RD (P64)	→	RDn	Active-Low
WR0 & WR1	→	WRn	Active-Low
P17	→	RSTn	Active-Low
INTP4 (P31)	←	IRQ	Programmable
INTP3(P30)	←	PME	Programmable

- Reset LAN controller
  Use P17 port to reset the LAN controller.

- Access to LAN controller

  Access to LAN controller with setting the external bus to 16bit separate bus mode.

- For chip select (CSn) of LAN controller, use P16 port. Set this low level when you access to LAN controller.

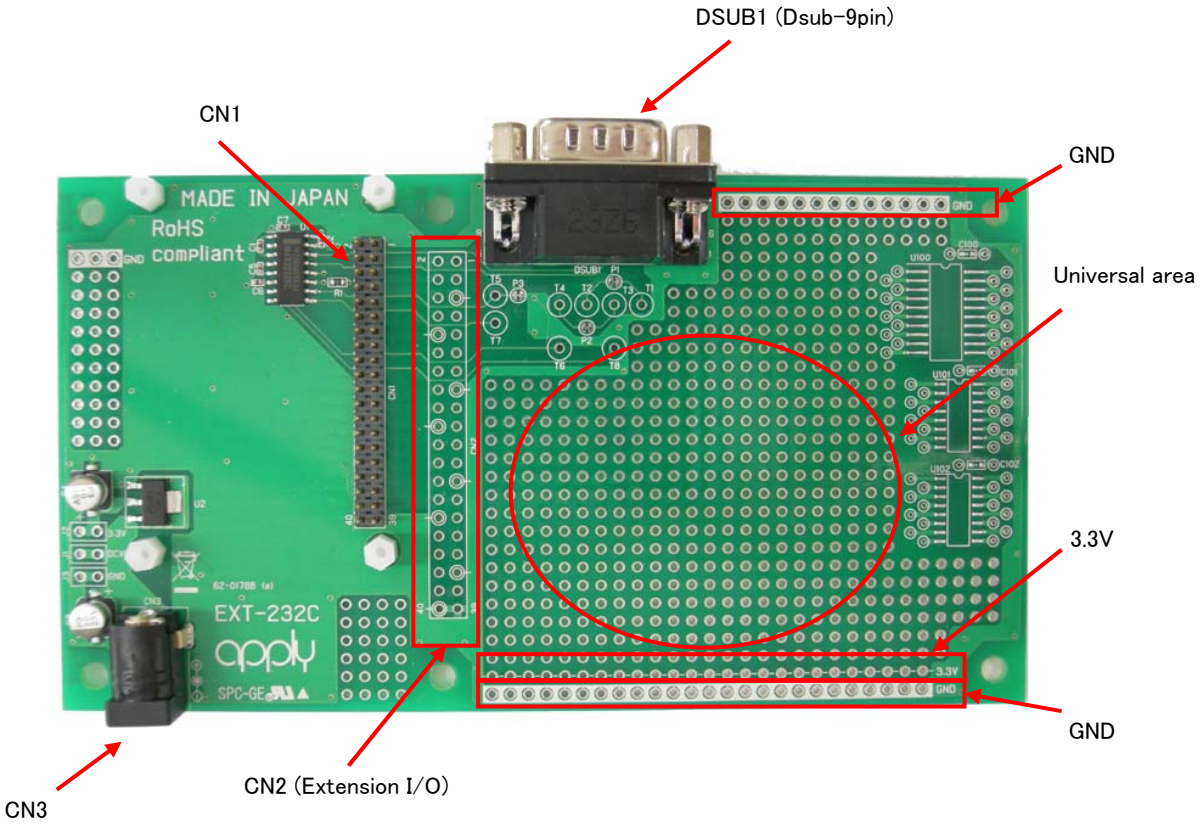
3.2.5 CN3

CN3 is a USB connector for on-chip debug

3.2.6 LED1

This is the POWER LED. It is lighted when it gets power supply.

3.3 EXT-232CFunction Layout



3.4 EXT-232C Function Details

3.4.1 CN1

CN1 is a connector for TK-78K0R/KG3+NET.

3.4.2 CN2

CN2 is an extension I/O. (connector is not mounted)
When you use TK-78K0R/KG3+NET, the same signal as CN1 connector on TK-78K0R/KG3+NET is sent.
You can connect other external circuit.

CN2

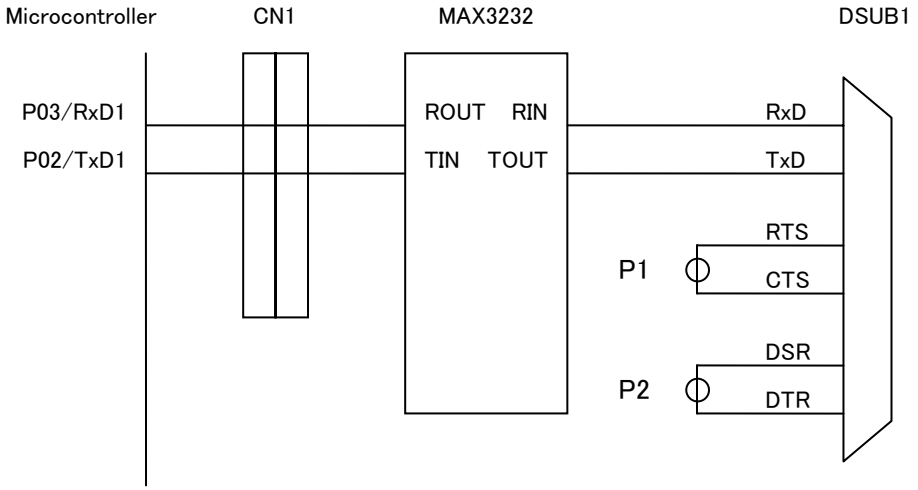
Pin No.	Signal	Remarks
1	P60/SCL0	
2	P61/SDA0	
3	RESET	Reset Input from CPU
4	T_RESET	Reset Output to CPU
5	P40/TOOL0	
6	P41/TOOL1	
7	FLMD0	
8	P42/TI04/TO04	
9	P43/SCK01	
10	P44/SI01	
11	P45/SO01	
12	P46/INTP1/TI05/TO05	
13	P47/INTP2	
14	P120/INTP0/EXLVI	
15	P140/PCLBUZ0/INTP6	
16	P141/PCLBUZ1/INTP7	
17	P142/SCK20/SCL20	
18	P143/SI20/RxD2/SDA20	
19	P144/SO20/TxD2	
20	P145/TI07/TO07	
21	P00/TI00	
22	P01/TO00	
23	P02/SO10/TxD1	Use for EXT-232C
24	P03/SI10/RxD1/SDA10	Use for EXT-232C
25	P04/SCK10/SCL10	
26	P131/TI06/TO06	
27	P150/ANI8	
28	P151/ANI9	
29	P152/ANI10	
30	P153/ANI11	
31	P154/ANI12	
32	P155/ANI13	
33	P156/ANI14	
34	P157/ANI15	
35	P111/ANO1	
36	P110/ANO0	
37	VDD	3.3V
38	VDD	3.3V
39	GND	
40	GND	

3.4.3 CN3

This is the connector for AC adapter. Please, connect the bundled AC adapter (+5V).

3.4.4 DSUB1

DSUB1 is a D-sub 9Pin connector for RS-232C communication. It makes serial communication with using UART1 on 78K0R/KG3.
RTS and CTS signal, DSR and DTR signal are connected on the board. To change the connection, you can cut the default short pad P1 and P2 using cutter.



DSUB1

Pin No.	Signal Name	Destination CPU Pin
1		N.C.
2	RXD	P03/SI10/RxD1/SDA10
3	TXD	P02/SO10/TxD1
4		Connected to Pin6
5	GND	GND
6		Connected to Pin4
7		Connected to Pin8
8		Connected to Pin7
9		N.C.
Shell		N.C.

3.4.5 Universal Area

The kit has the universal area. Users can use this to develop custom circuit.
Also, There are GND and 3.3V power supply upper and under the universal area.

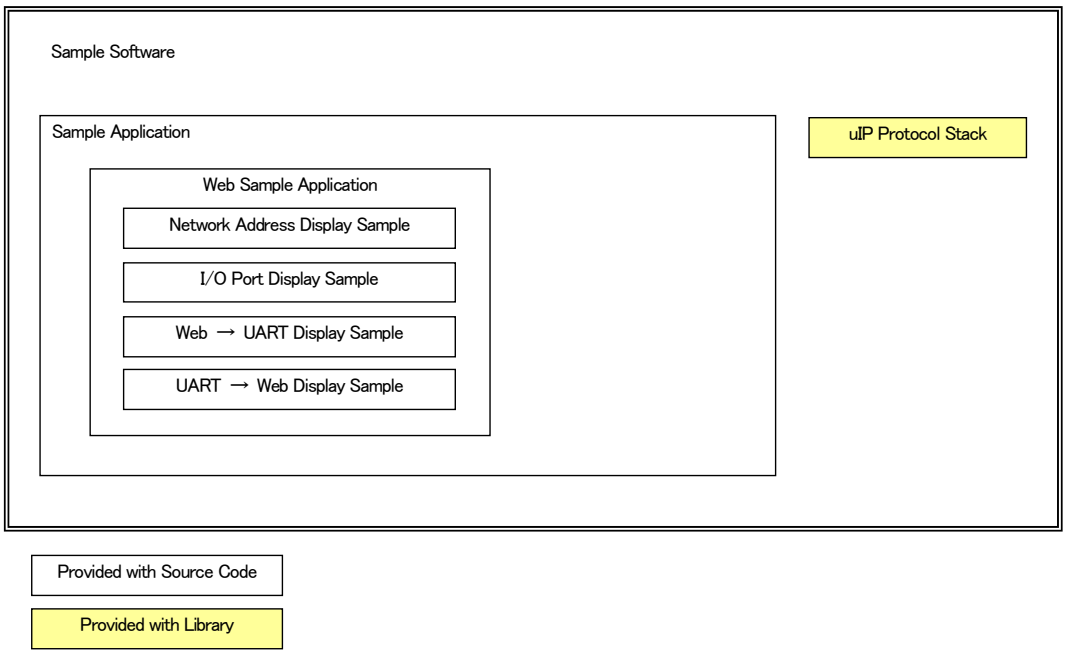
CHAPTER 4　Sample Programs

In this chapter, the sample programs are explained.

4.1 Sample Program Overview

This is the Web server program that can run with 78K0R built-in memory.
As soon as you get TK-78K0R/KG3+NET, you can start evaluating the Web server functions.
When you develop user applications, you can refer to the sample code as the source code is available.

4.2 Sample Program Structure



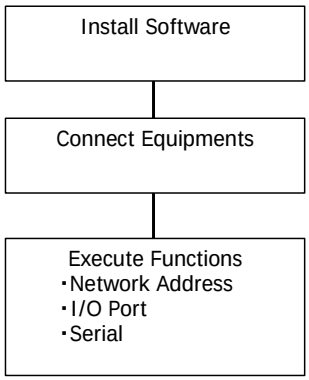
For details about the sample programs, refer to "TK-78K0R/KG3+NET Evaluation Kit User's Manual -Practice-"

4.3 Use Sample Programs

Following functions are available in the sample application.

Functions		Overview
	Display Network Address	It displays MAC address, IP address, net mask, and gateway of TK-78K0R/KG3+NET.
	Control I/O Port	It controls I/O port of TK-78K0R/KG3+NET.
	Control Serial	It makes serial communication between TK-78K0R/KG3+NET and terminal software.

Each application can be used with following steps.



→ With referring Chapter 2, start the debugger and write sample programs.

4.3.1 Preparations

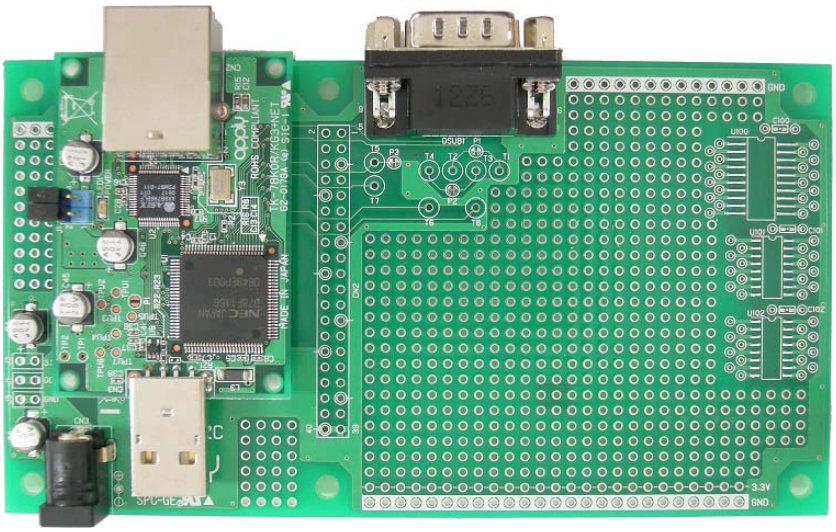
System requirements for evaluation PC.

CPU	Pentium3 800MHz, equivalent, or higher
Memory	128MB or higher (256MB recommended)
OS	Windows 2000/XP
Web Browser	Internet Explorer 6.0 or higher
Ethernet	100BASE-TX/10BASE-T (RJ-45) x1
COM Port	D-sub 9pin

4.3.2 Equipment Connections

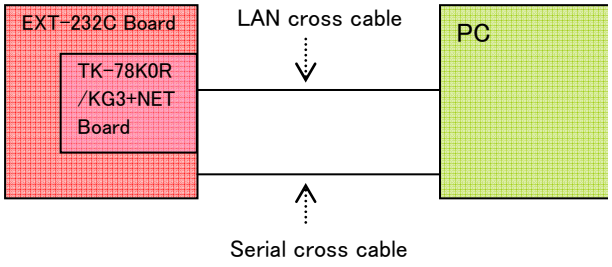
Connect PC and TK-78K0R/KG3+NET.

① As shown below, connect CN1 on TK-78K0R/KG3+NET board and CN1 on EXT-232C board.



② Connect CN2(RJ-45) connector on TK-78K0R/KG3+NET board and PC with LAN cross cable. When you use a network hub, use LAN straight cable.

Connection Example



③ Connect DSUB1(D-sub 9Pin connector) on EXT-232C board and PC with RS-232C serial cross cable.

④ Set the J1 jumper pin on TK-78K0R/KG3+NET board to open. (take out the pin)

⑤ Connect bundled AC adapter to CN3 connector on EXT-232C board. The board is booted up as soon as it gets power. (there is no power switch)

4.3.3 Setting for Network Address

To access the Web contents of Web server sample program, you need to use browser software on PC. The IP address of the Web server is 192.168.0.200. The network address of the PC must be set as follows.

Example of Network Address Settings

IP Address	192.168.0.XXX (XXX＝0～255)
Subnet Mask	255.255.255.0

4.3.4 Setting for Serial Communication

To establish the UART communication between TK-78K0R/KG3+NET board and PC, you need to use terminal software on PC. Set the network as shown below.

Baud Rate	9600bps
Data Bit	8 bit
Parity	None
Stop Bit	1 bit
Flow Control	None

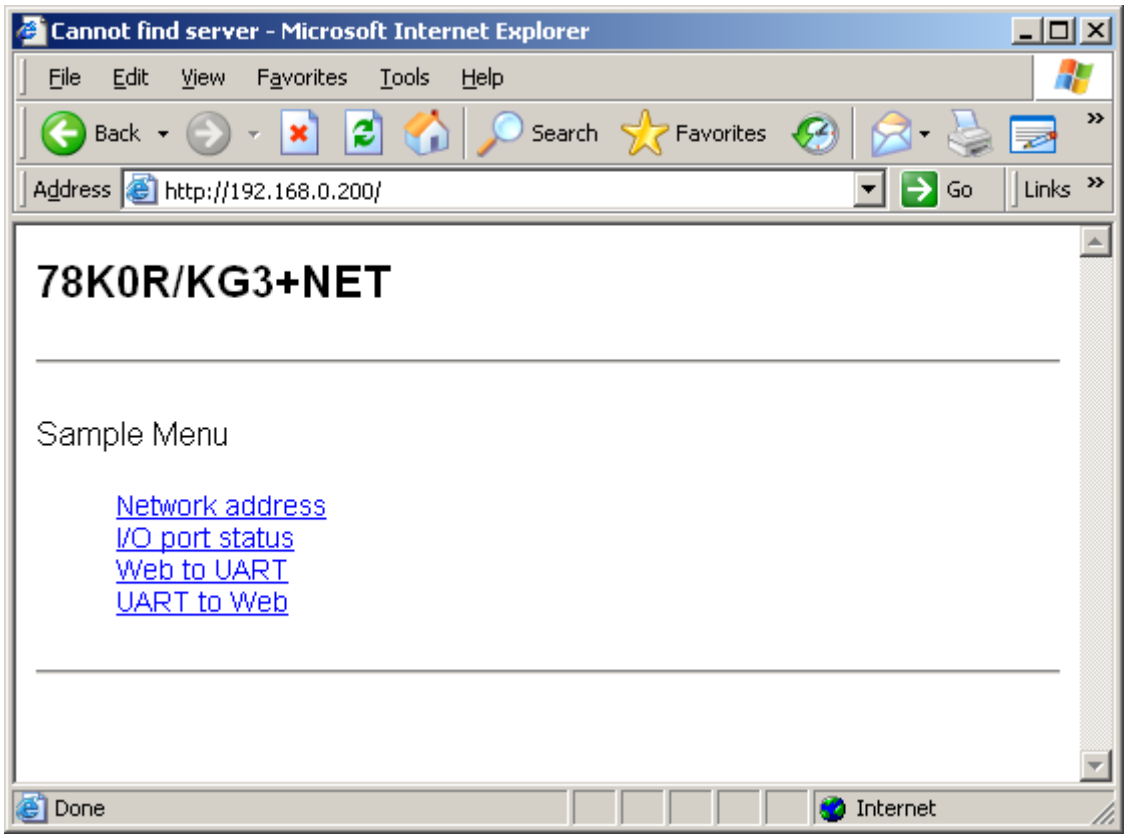
For COM port number, use the COM port that the RS-232C serial cross cable is connected.

※ You can start the terminal software (Hyper Terminal) by selecting "Start", "Programs", "Accessories", "Network", then "Hyper Terminal".

4.3.5 Web Sample Programs

4.3.5.1Web Sample Top Page

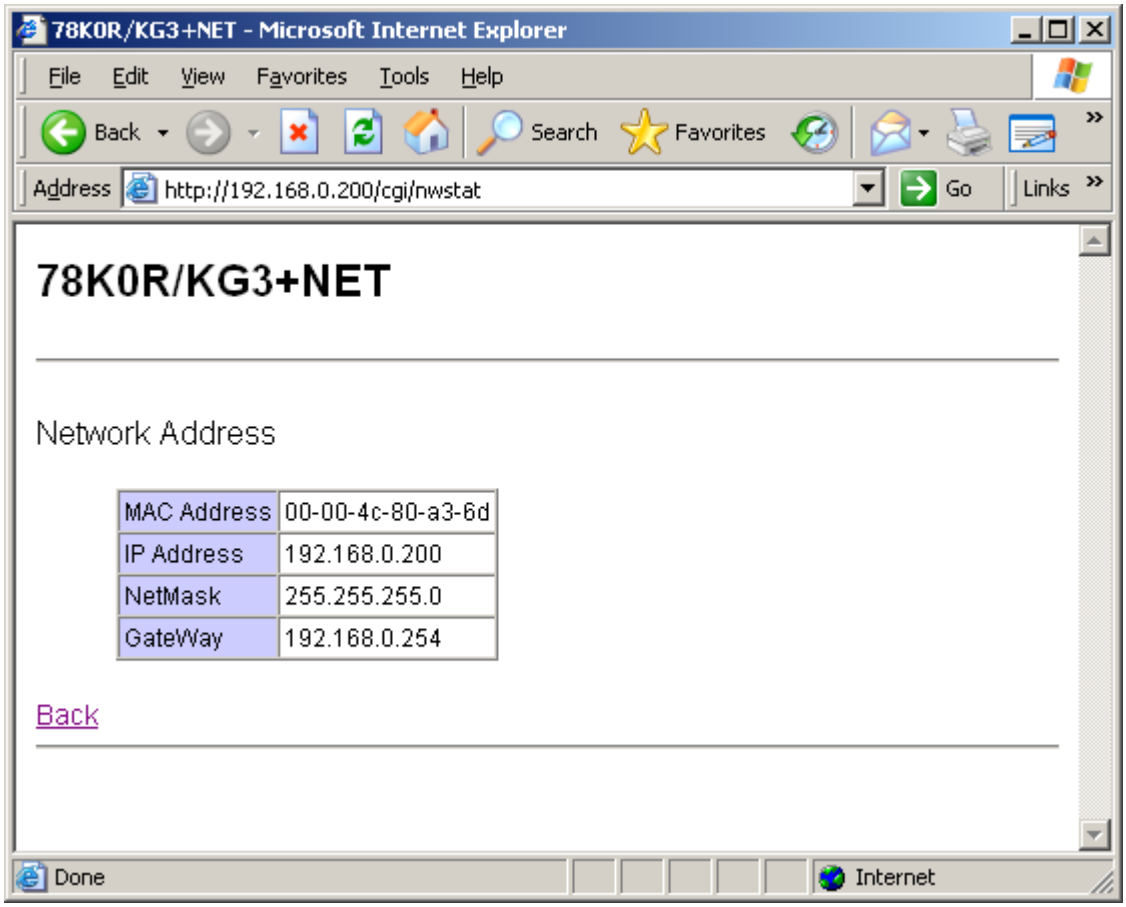
Web sample top page is displayed when you access following URL with Web browser.
http://192.168.0.200/



Network address	Go to Network address page
I/O port status	Go to I/O port page
Web to UART	Go to Web to UART page
UART to Web	Go to UART to Web page

4.3.5.2 Network Address Page

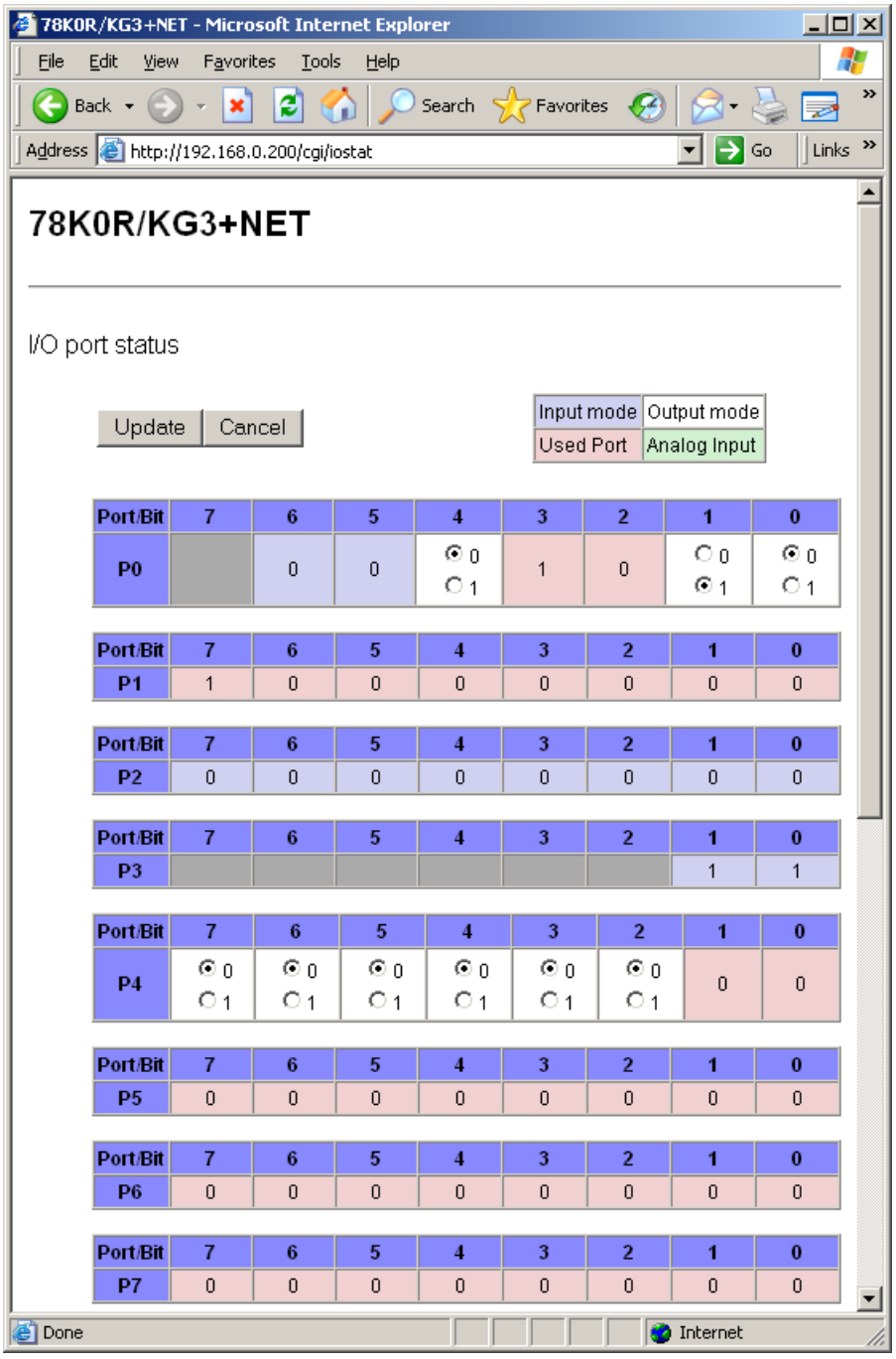
It displays MAC address, IP address, subnet mask and gateway of TK-78K0R/KG3+NET board.



By clicking the "Back" link, you can go back to Web sample top page.

4.3.5.3I/O Port Page

It displays I/O port list. The blue background color means input mode, and white means output mode. The status of each port are shown with "0" or "1". For the ports with output mode, you can change the port output by selecting "0" or "1" and clicking "Update" button. The red background indicates that the port is in use by network programs.

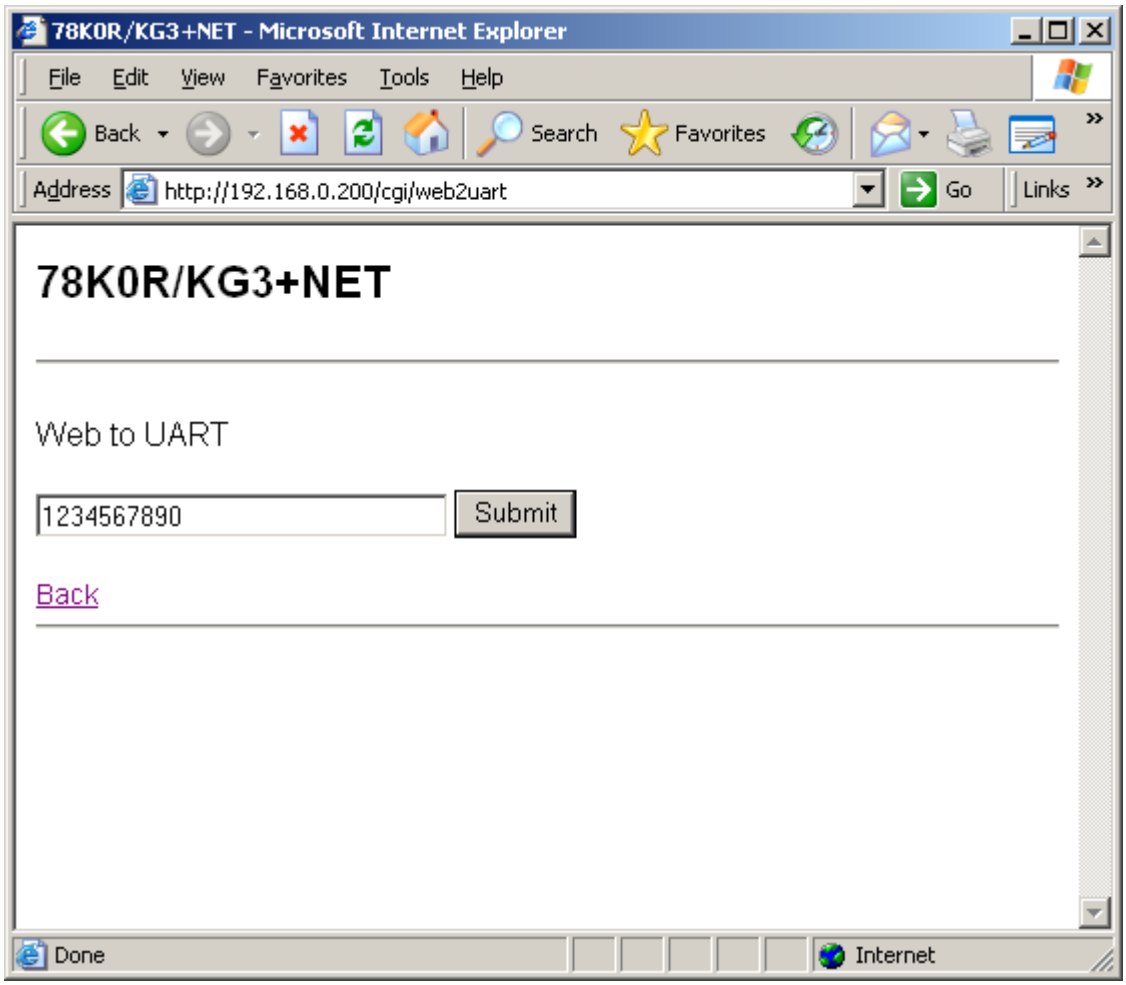


By clicking the "Back" link, you can go back to Web sample top page.

※ To update the information on the page, click "Update" button.

4.3.5.4 Web to UART Page

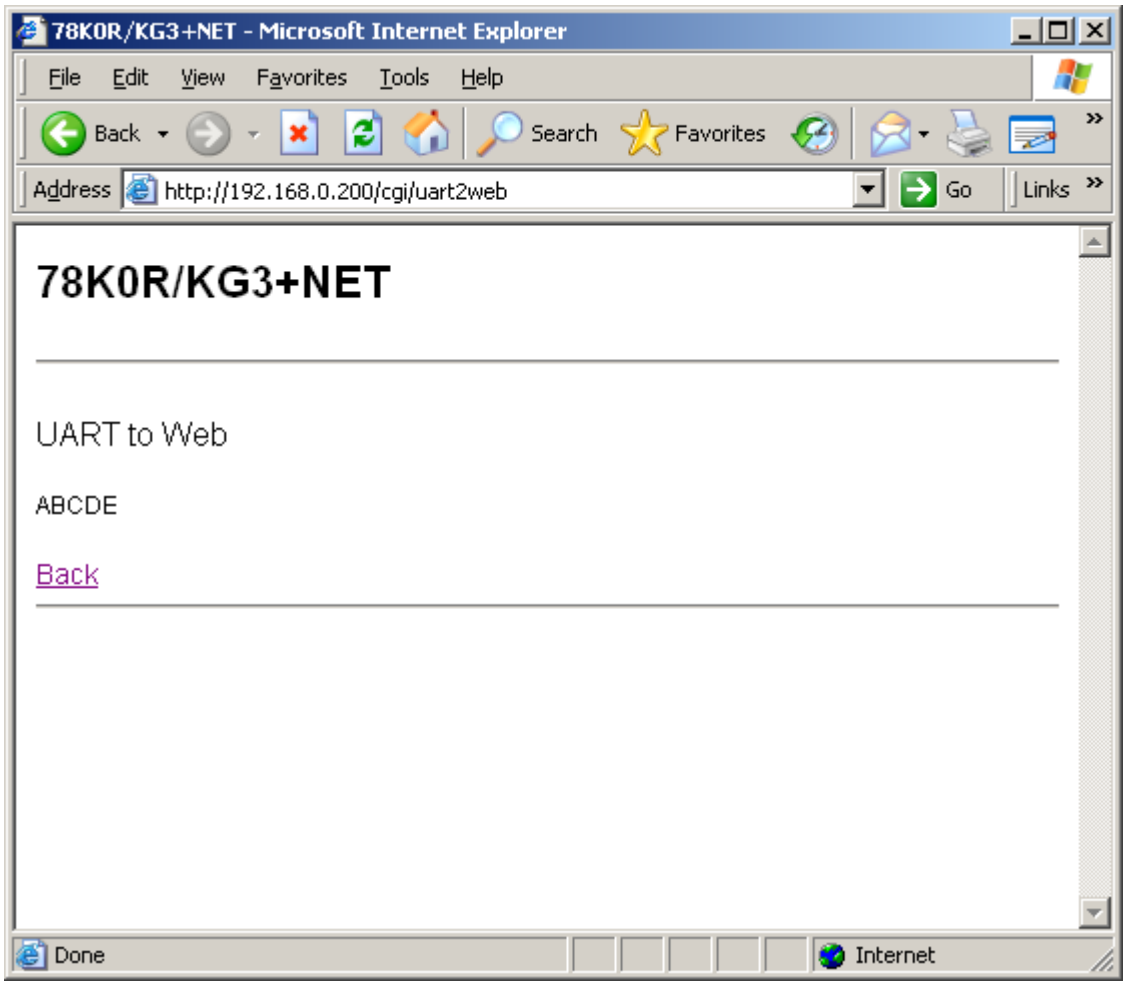
It outputs the text entered in the text box of the page to terminal software by clicking "Submit".



By clicking the "Back" link, you can go back to Web sample top page.

4.3.5.5UART to Web Page

It displays the text entered on terminal software to the browser.



By clicking the "Back" link, you can go back to Web sample top page.

※ The browser reload the data in every five seconds.

CHAPTER 5 Troubleshooting

This chapter describes how to solve troubles you may face.

5.1 If you cannot find USB driver when you connect PC to the kit

Check Point 1

If you use USB hub, do not use it. (USB hub is not supported)

Check Point 2

Check if you installed "Starter Kit USB Driver" in "1.2 Installation of Development Tools". If not, install the driver.

Check Point 3

Check if the settings of J1 on the kit are correct with referring to "3.2.1 J1". Check the power supply to microcontroller.

Check Point 4

If above 3 check points are confirmed, disconnect the USB cable from PC and re-connect again. It should show the "Found New Hardware Wizard" wizard. Operate the installation with referring to "1.3 Installation of USB Driver". After the installation, make sure you go through "1.3.3 Completion of USB Driver Installation" to confirm the USB driver installation.

5.2 Error when you start the debugger

There could be several reasons to make errors happen.
The solving processes differ depending on errors. Please check the error message first.
The solving processes for each error are as follows.

5.2.1 "Can not communicate with Emulator..." (F0100 or A0109)

Check Point 1

If you use USB hub, do not use it. (USB hub is not supported)

Check Point 2

Check if the settings of J1 on the kit are correct with referring to "3.2.1 J1". Check the power supply to microcontroller.

Check Point 3

If above 2 check points are confirmed, close the debugger and disconnect the USB cable from PC. Re-connect USB cable properly to both the PC and the kit, and then re-start the debugger.

5.2.2 "Incorrect ID Code." (Ff603)

This error occurs when the security ID stored on microcontroller built-in flash memory is different from the ID code you entered at the start of debugger.

Security ID entry area at the start of debugger

Check Point 1

Enter correct security ID and click OK on the configuration window.

Check Point 2

If you forgot the security ID, you have to erase the microcontroller built-in flash memory. Before erasing, check if you actually set the security ID with referring to "2.4 Set Linker Options". Also remember the code you set for the security ID.
After this, erase the flash memory with referring to "6.3.8 Erase microcontroller built-in flash memory".

5.2.3 "The on-chip debug function had been disabled in the device." (F0c79)

This error occurs when the value at address C3H (On-chip debug option byte) in microcontroller built-in flash memory is incorrect. You need to erase the flash memory.

Check Point 1

Check if you actually set the correct on-chip debug option byte with referring to "2.4 Set Linker Options". If it is not correct, then set correctly.

Check Point 2

Erase the flash memory with referring to "6.3.8 Erase microcontroller built-in flash memory".

5.2.4 "Disabling the on-chip debug function is prohibited." (F0c33)

Basically, this error occurs when you start (download) the debugger without doing the settings described at "2.4 Set Linker Options". Do the same checking processes as"5.2.3 The on-chip debug function had been disabled in the device. (F0c79)".

CHAPTER 6　Other Information

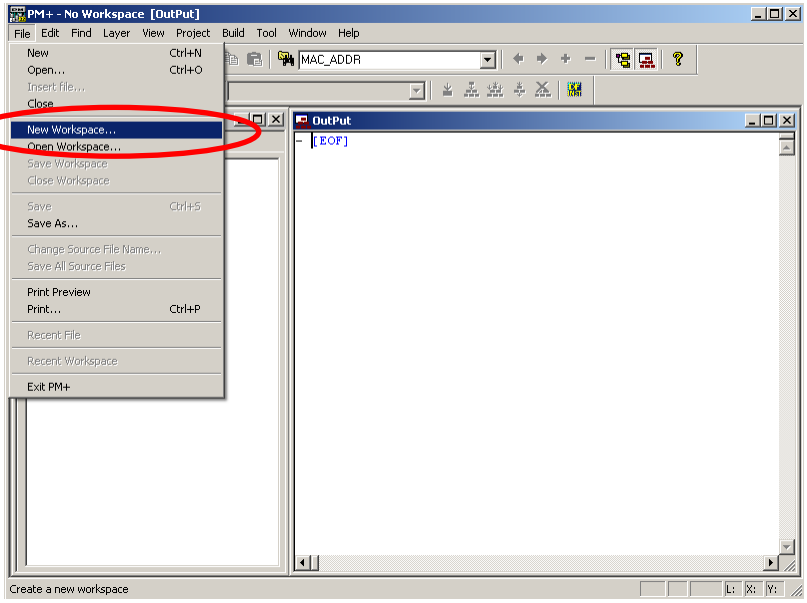
This chapter explains some useful operation techniques of development tools and circuit diagram of the kit for developing of user programs.

6.1 Create a new workspace

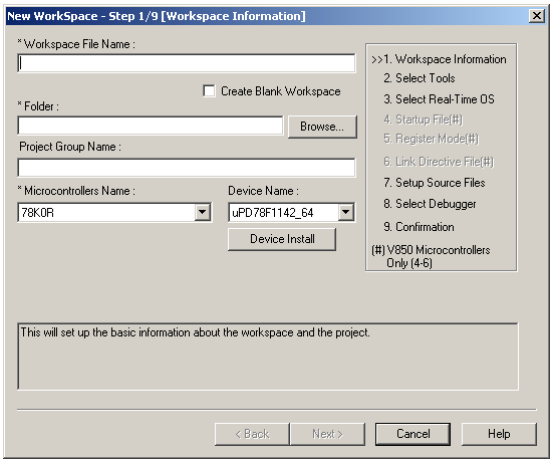
Now, create a new workspace and project.

PM+ allows you to create a new workspace with following "New WorkSpace" dialog.

Select "File" on PM+ menu bar, then "New Workspace...".



"New WorkSpace" dialog opens



<Description of items>

Workspace File Name:
-> Specify the name of the workspace file that manages the project files.
.prw is automatically suffixed as the file type.
A project file (.prj) of the same name is simultaneously created.

Folder:
-> Specify the folder for saving the workspace file by writing its absolute path.
This item can be selected from a reference dialog box by pressing the Browse... button.

Project Group Name:
-> Specify this item if wishing to manage multiple projects together in function units.
If nothing is specified, this item is the same as the workspace file name.

Microcontroller Name:
-> Specify the name of the microcontroller to be used.

Device Name:
-> Specify the name of the device to be used.

The concrete information set here is described on the following pages

Input the workspace information setting as follows.

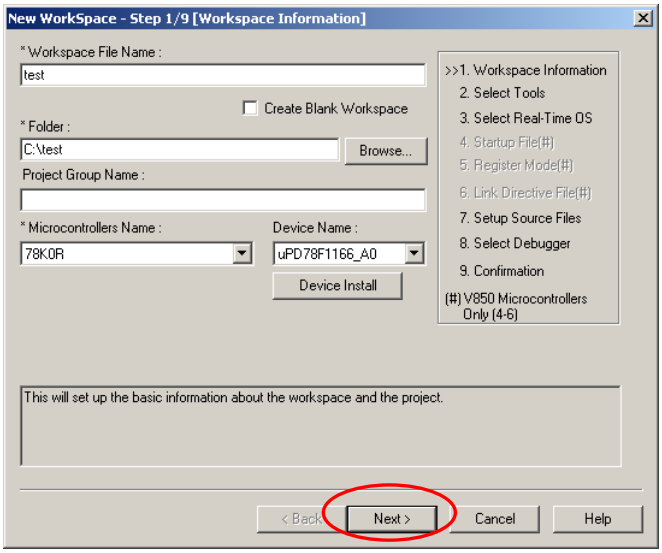
Workspace file name
→ test

Folder
→ C:¥test

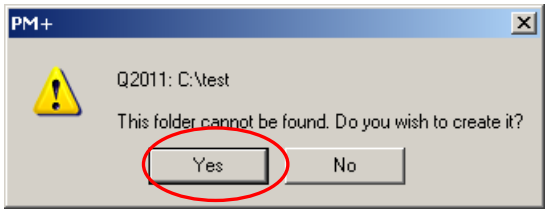
Project Group Name
→ (no input)

Microcontroller Name
→ 78K0R

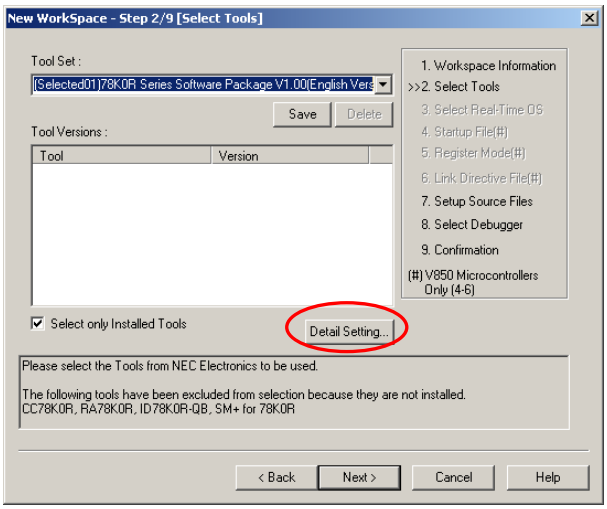
Device Name
→ uPD78F1166_A0



Click Next > button

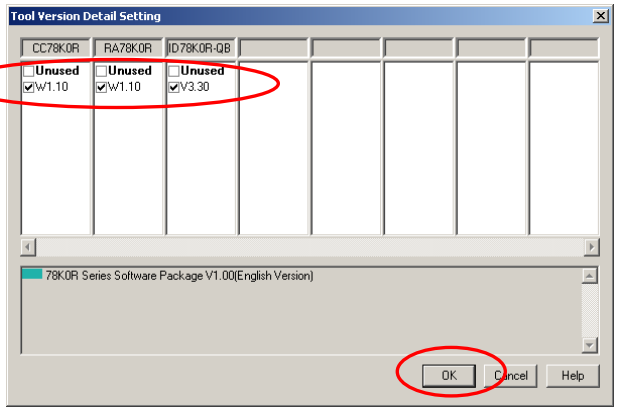


Click Yes button

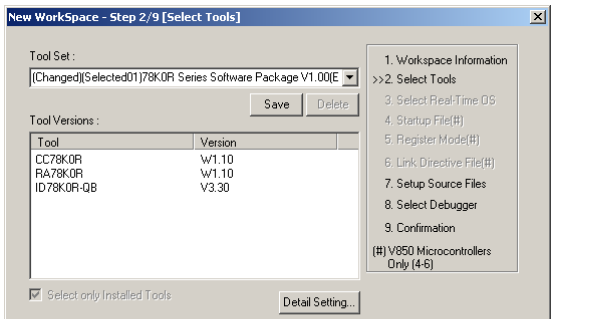


Click Detail Setting button

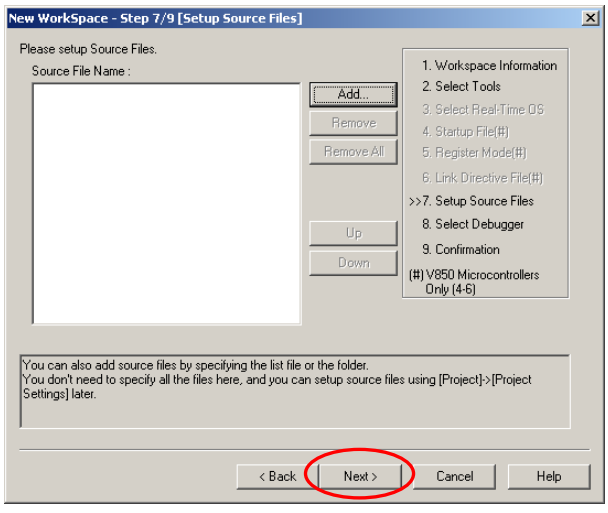
Set the version of tools as follows.
CC78K0R：W1.10
RA78K0R：W1.10
ID78K0R-QB：V3.30



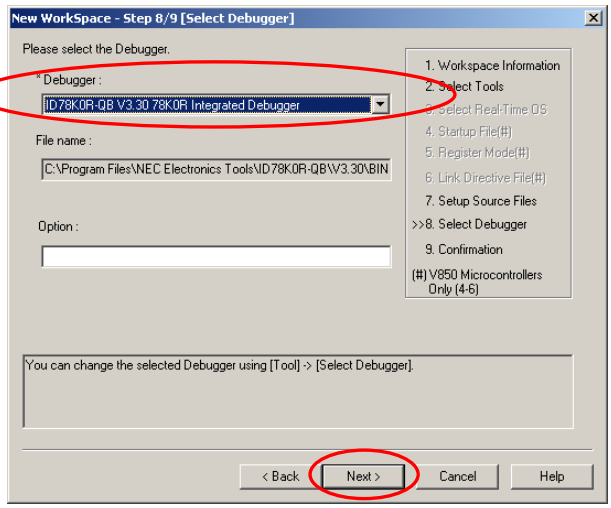
Select tools as above screenshot, then click OK .



Click Next >

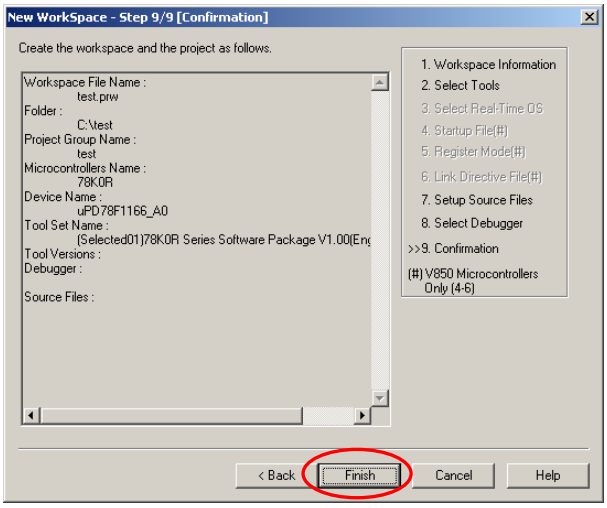


Click Next >



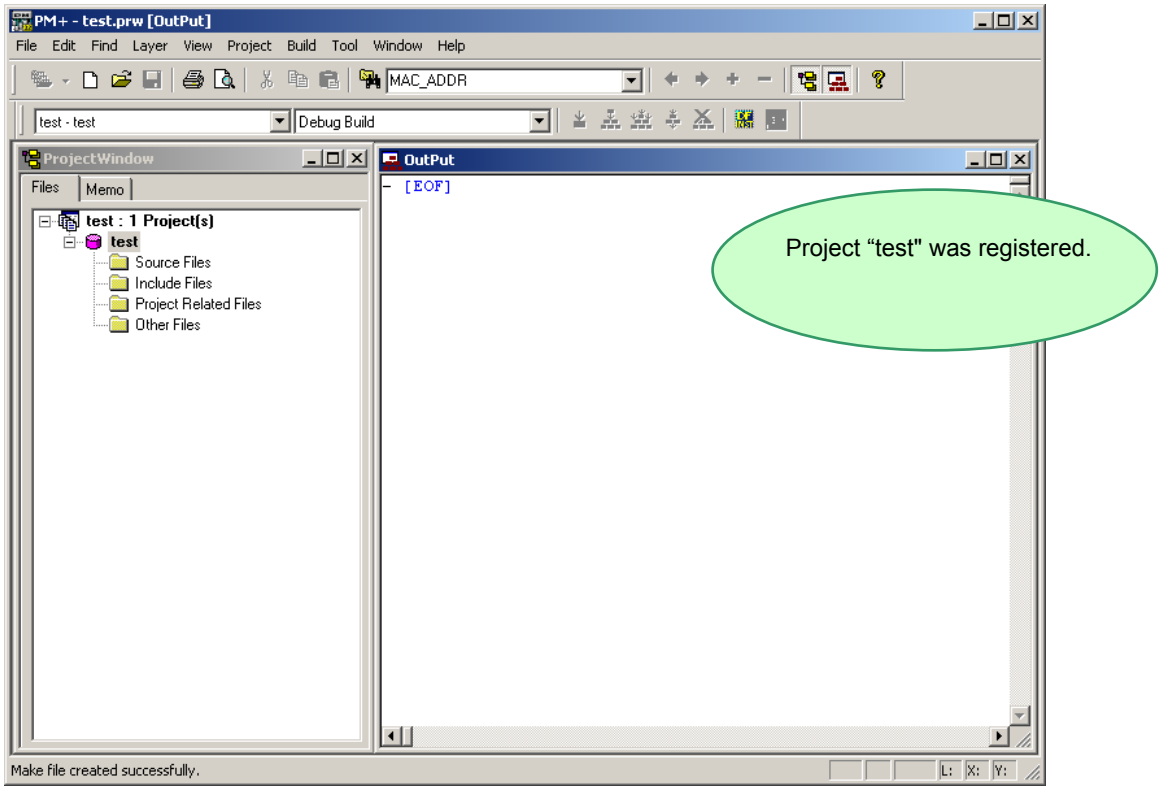
Select ID78K0R-QB V3.30

Click Next >



Check the project information settings

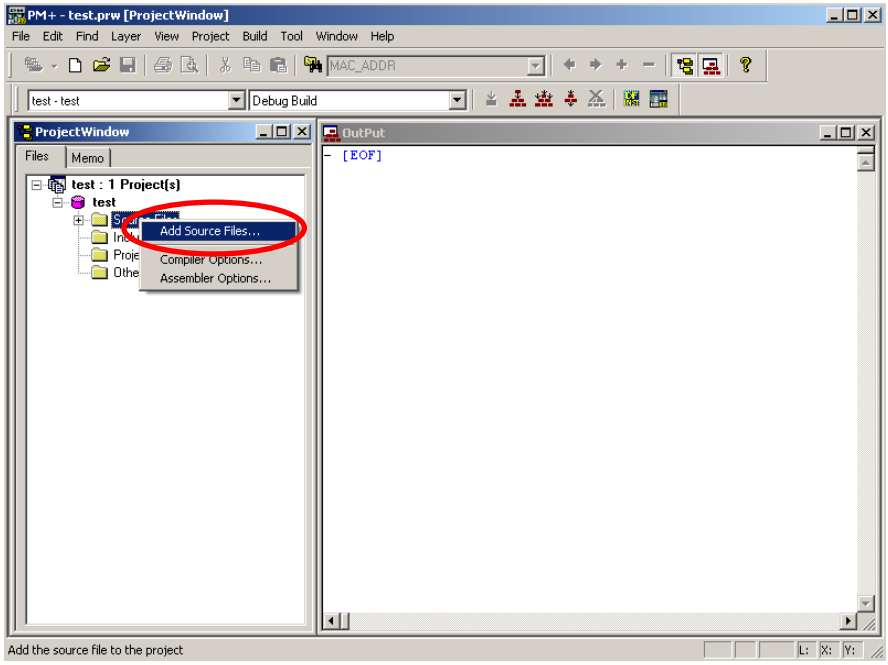
Click Finish



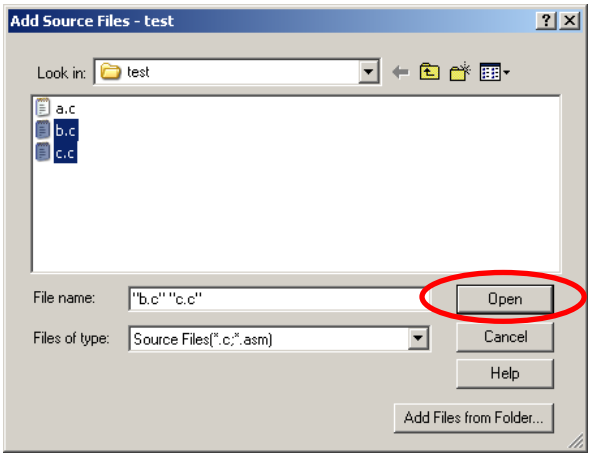
This completes workspace and project creation.
Additional source files can be registered at any time thereafter.
For details, refer to "6.2 Register additional source file".
Also, you need to do the settings for on-chip debug. Please refer to "2.4 Set Linker Options", "2.5 Set Compiler Options", and "2.7 Check Debugger Settings".

6.2 Register additional source file

Now, register additional source files.
The following example shows the additional registration of source files "b.c" and "c.c" with source file "a.c" already registered.
Place the cursor on the source file in the Project window of PM+, and select [Add Source Files...] displayed in the right-click menu.

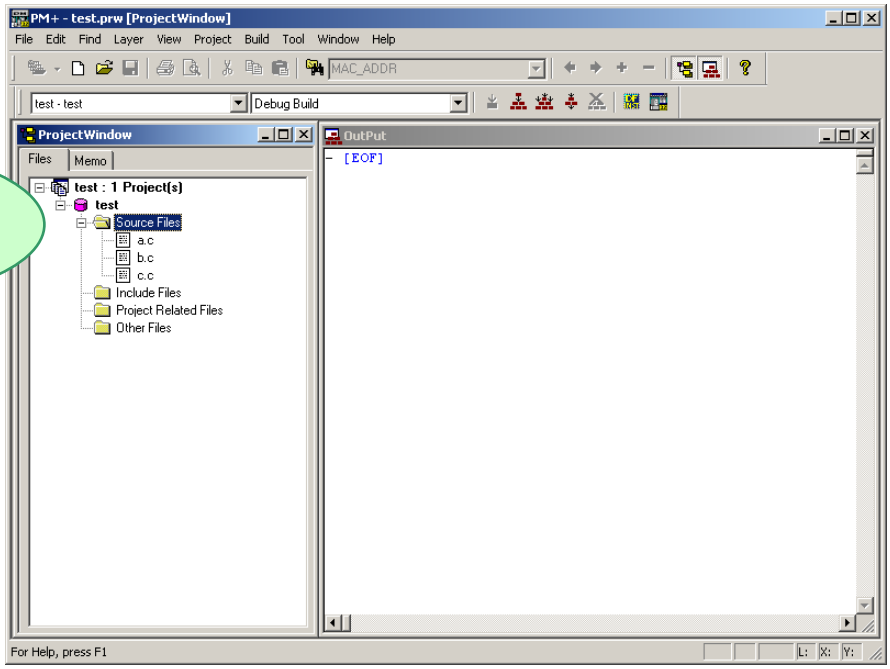


Select source files "b.c" and "c.c", then click Open



Multiple source files can be selected by clicking them with pressing Ctrl key.

Source file "b.c" and "c.c" are additionally registered to the project.



6.3 Debugger tips

This section describes some useful techniques for the debugger (ID78K0R-QB).

6.3.1 Change display of buttons

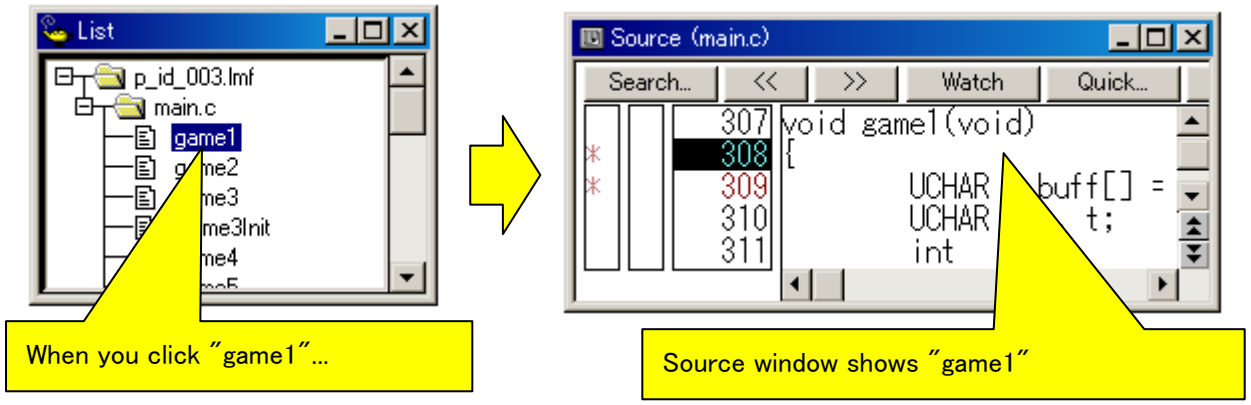
Execution controls (run, stop, step-in debugging, reset, etc) and opening functional window can be made by below buttons. However, it could be difficult to know which button does what.

In this case, select "Options" on menu bar, then "Debugger Options". Check "Pictures and Text" on setting area.

With this setting, the buttons display the text as well, so that it is easier to know what they are.

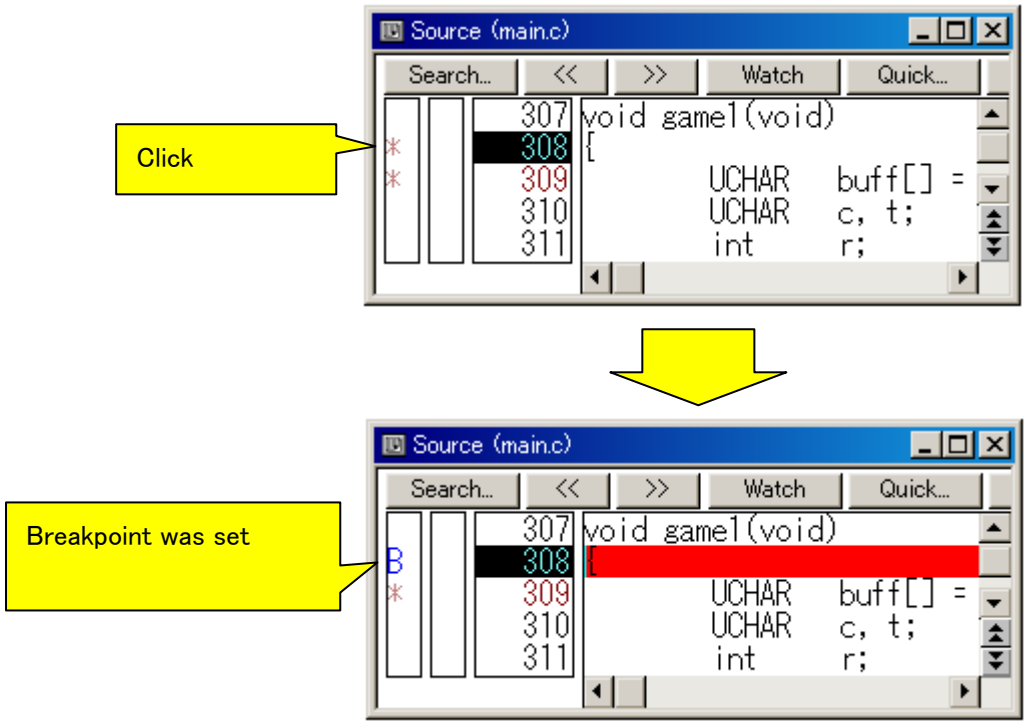
6.3.2 Display source list and function list

When you wish to see source file list or function list, select "Browse" on menu bar, then "Other" -> "List" to open the list window. The information in the windows is synchronized. Therefore, it is not just for referring to the list, but it is useful when you wish to update files or functions.



6.3.3 Set/delete breakpoints

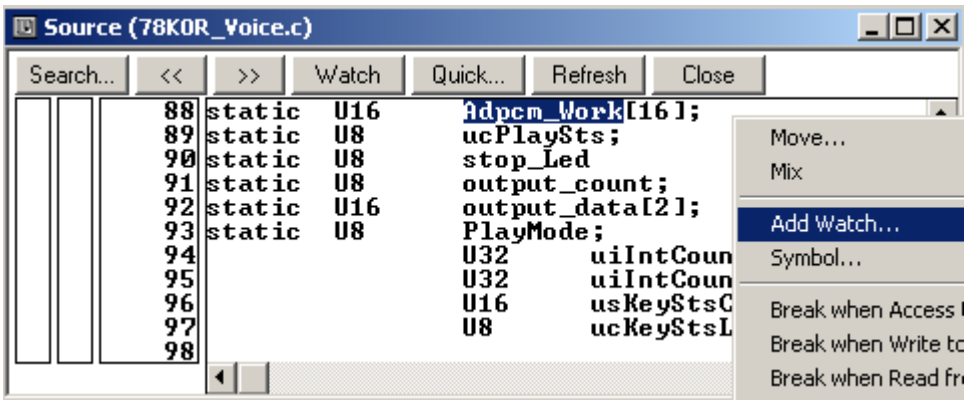
Breakpoints are executed by clicking lines in which " * " is displayed
"B" is displayed in the line where a breakpoint is set.
Breakpoints are deleted by clicking "B".



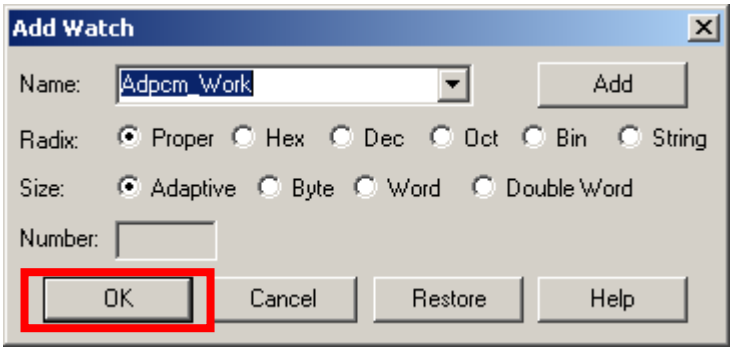
6.3.4 Display global variables

With using Watch Window, you can display global variables. There are several ways to register global variables to watch window. In this section, how to register from source window is described.

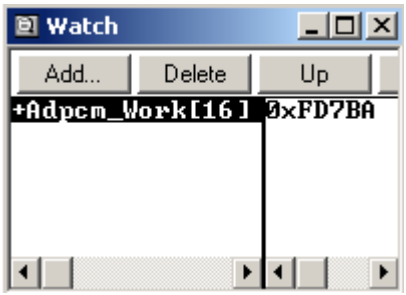
①Right-click the variable on source window, then select "Add Watch..."



②Add Watch dialog opens. Click OK .



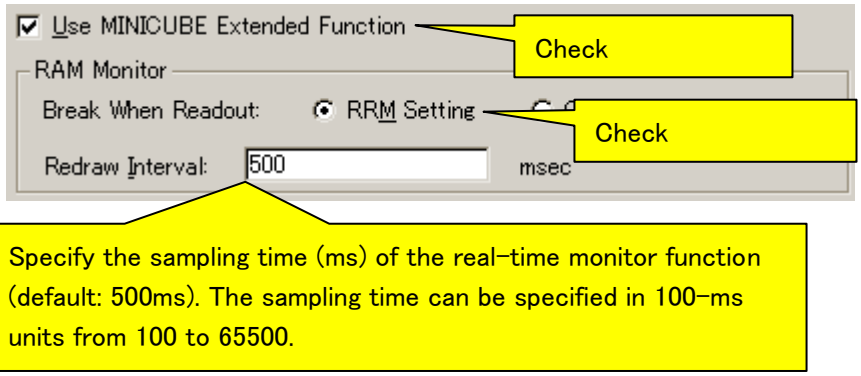
③Adding a variable to watch window is completed.



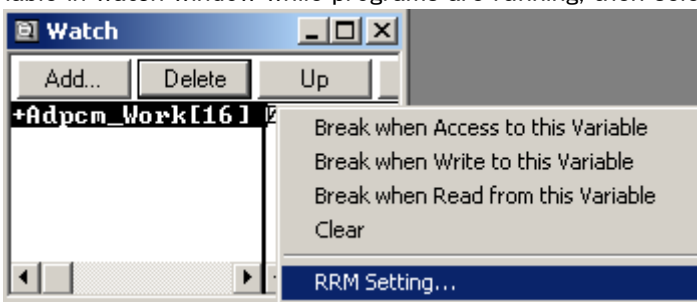
6.3.5 Display global variables while programs are running

Global variable could be referred even when the programs are running.

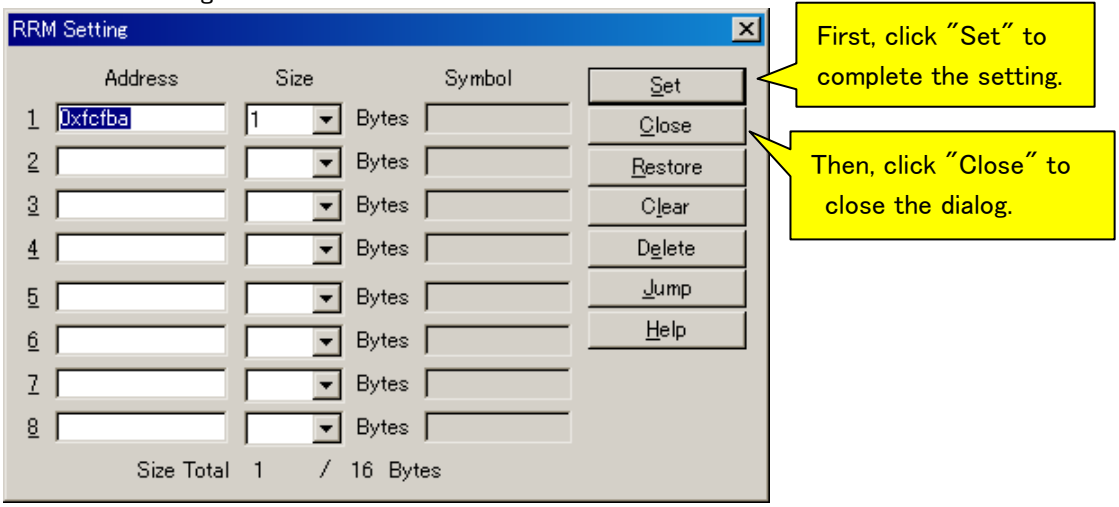
①Select "Option" menu -> "Extended Option...". Follow below settings.



②Right-click the variable in watch window while programs are running, then select "RRM Setting...".



③RRM Setting dialog opens. Click [Set] button to complete the setting, then [Close] button to close the dialog.



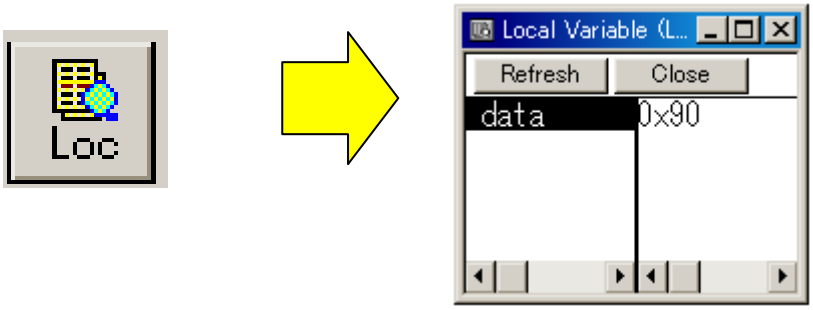
This completes the settings.

CAUTION:

- The maximum size of variable area is as total of 16byte when programs are running.
- The maximum number of variable area is 8 locations
- The user program momentarily breaks upon a read.

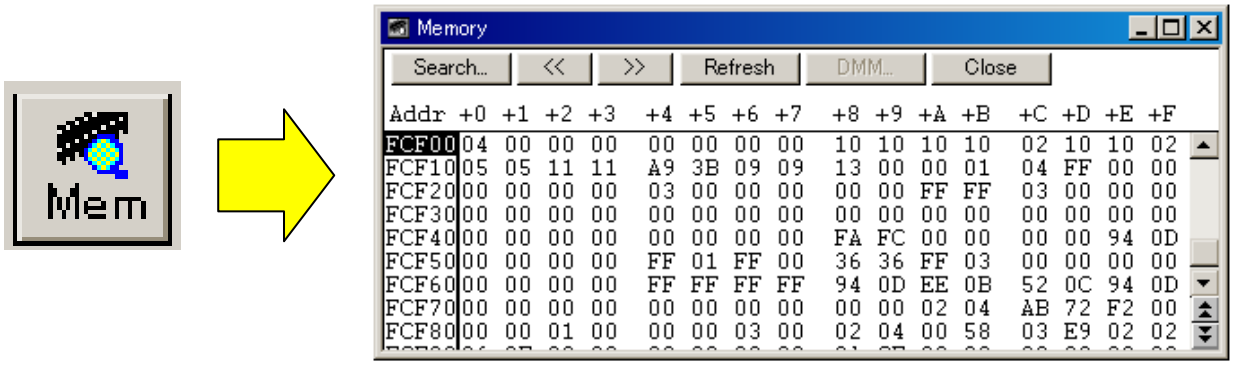
6.3.6 Display local variables

Local variable window is used to display local variables.
By clicking the button below, you can open the local variable window.
Unlike global variables, local variables cannot be displayed when programs are running.

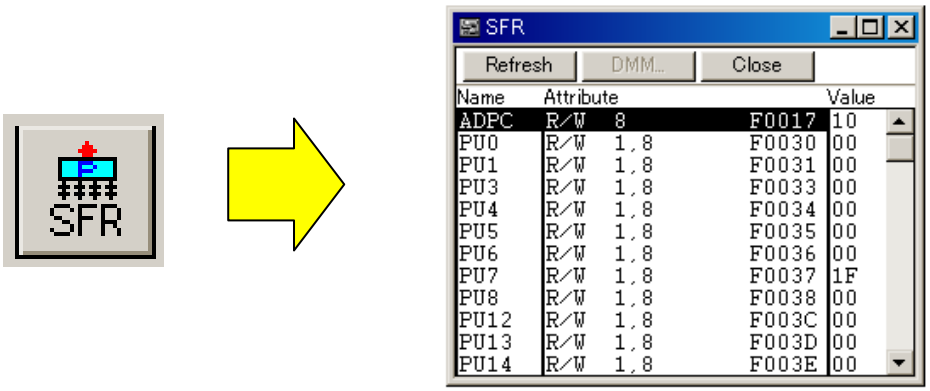


6.3.7 Display memory and SFR contents

By clicking the button below, you can open the memory window.



By clicking the button below, you can open the SFR window.

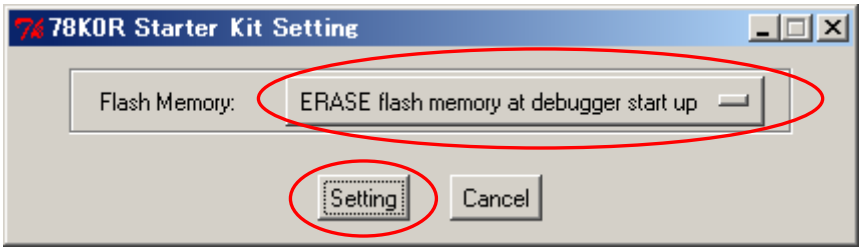


6.3.8 Erase microcontroller built-in flash memory

If you forgot the security ID or if you set On-Chip Debug Option Byte to disable the on-chip debug function, you cannot start debugger. For the case like this, there is the function to erase the flash memory.

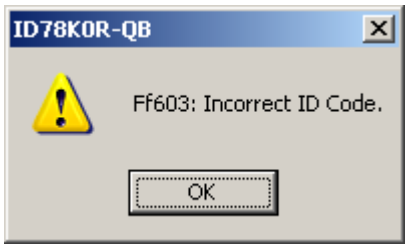
①First, check if you actually set the correct On-Chip Debug Option byte with referring to "2.4 Set Linker Options". If it is not correct, then set correctly. Remember the security ID you set.

②Use Windows Explorer to go to the path "C:¥Program Files¥NEC Electronics Tools¥TK-driver", then open "exk0r32ocfg.exe". (the directory path is for the default installation directory)
The "78K0R Starter Kit Setting" starts. Select "Erase flash memory at debugger start up" at Flash Memory, then click Setting .



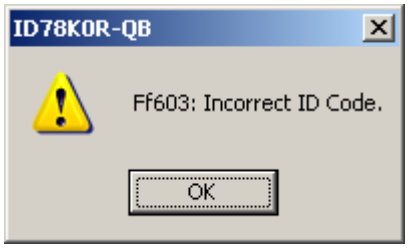
③Now, start the debugger. As you erased the flash memory with above processes, you need to enter "FFFFFFFFFFFFFFFFFFFF" (F x 20) in ID code on the configuration window of the debugger.

If you start the debugger with using PM+ debug button, the below error dialog may displayed because the debugger remember the ID Code from previous use. In this case, click OK to close the dialog, open the configuration dialog to enter "FFFFFFFFFFFFFFFFFFFF" (F x 20) in ID code, and then re-start the debugger again.



④When you could confirm the debugger is working, open "exk0r32ocfg.exe" again. This time, select "KEEP flash memory at debugger start up", then click Setting .
(Because there is a limit of erasing times for flash memory, it is recommended to try not to erase flash memory many times)

⑤After the debugger is started and programs are downloaded, the security ID on microcontroller changes to the code that you set at "2.4 Set Linker Options". On the other hand, the debugger stores the security ID "FFFFFFFFFFFFFFFFFFFF" (F x 20). Therefore, when you close and start the debugger again, you may get below error.

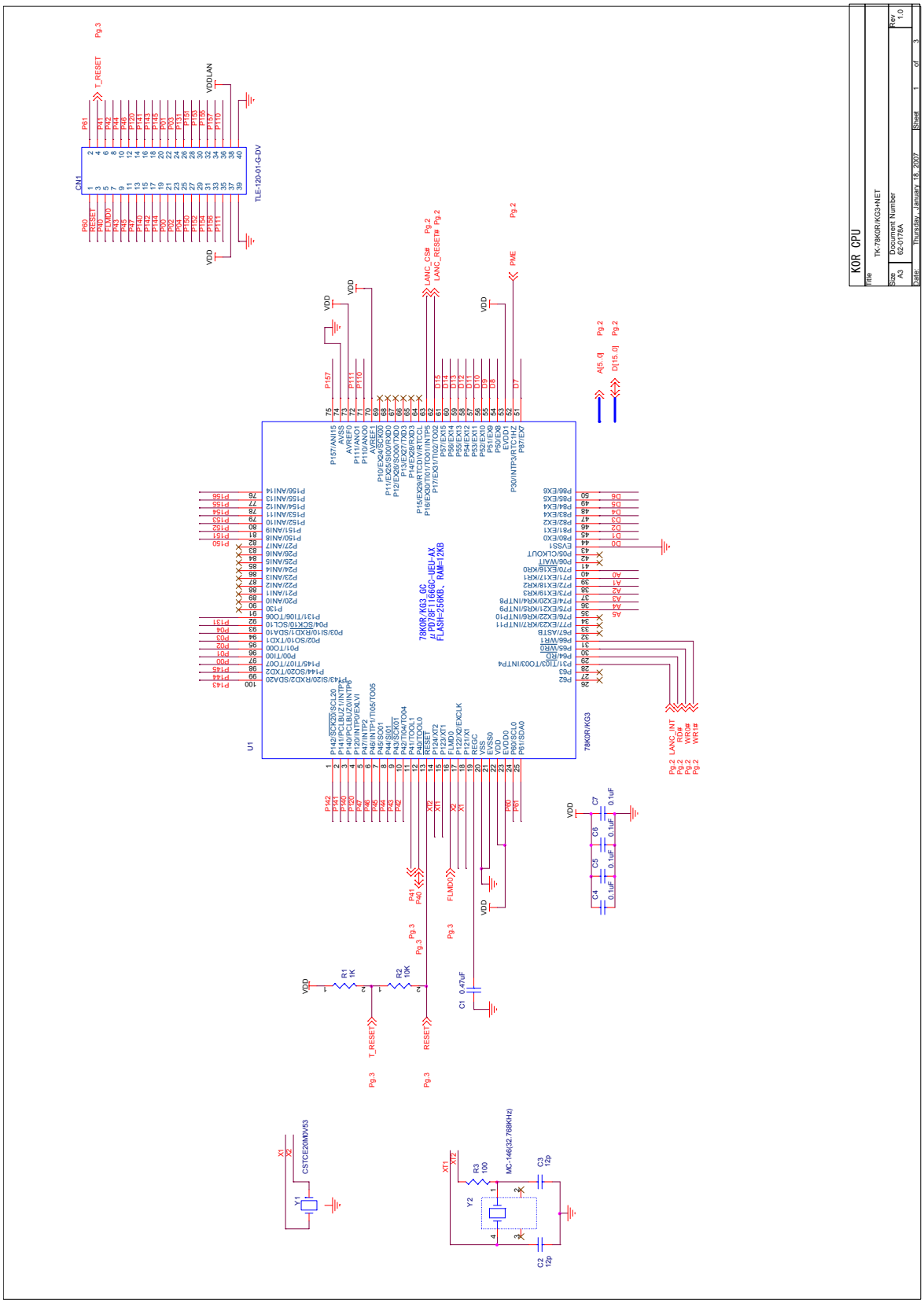


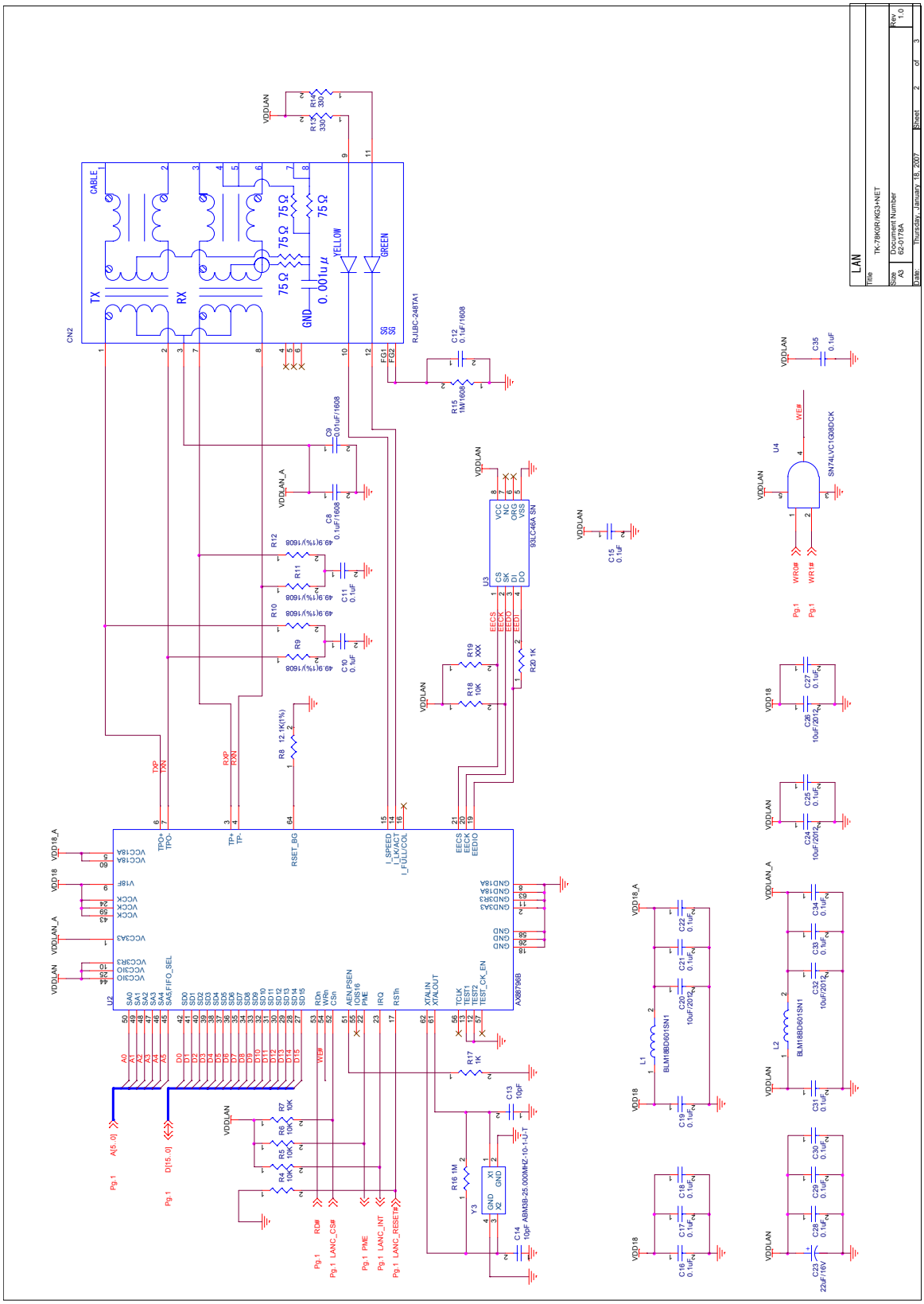
In this case, click OK to close the dialog, then enter the code you entered at "2.4 Set Linker Options" to "ID Code" on the configuration dialog.

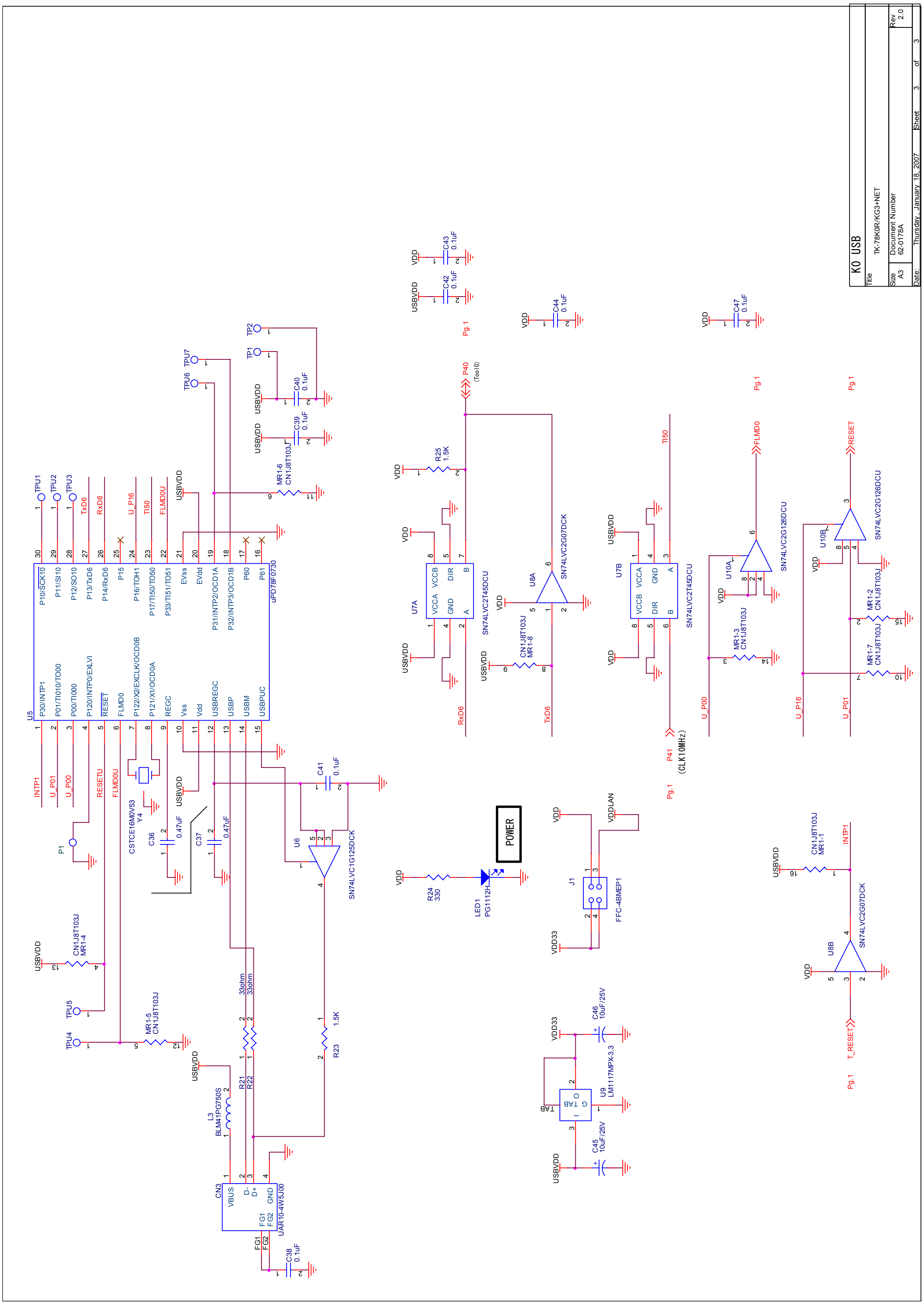
For other information, refer to the user's manual "ID78K0R-QB Integrated Debugger -Operation-".

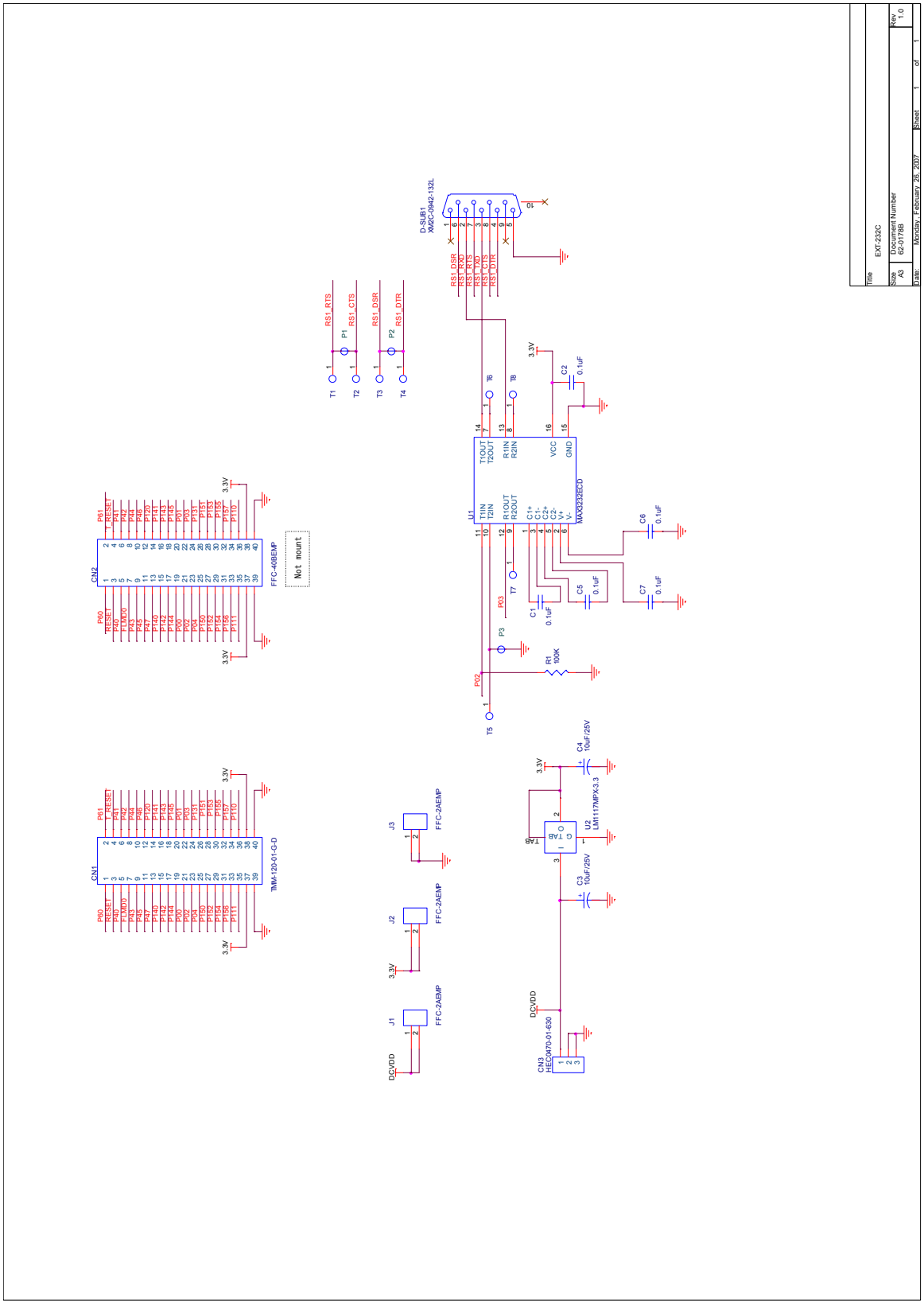
6.4 Circuit diagram

From following page, it shows the circuit diagram of the demonstration kit.


K0R CPU
TK-78K0R/KG3+NET
Document Number
62-0178A
Rev 1.0
A3
Thursday, January 18, 2007
Sheet 1 of 3
78K0R/KG3_GC
μPD78F1166GC-UEU-AX
FLASH=256KB, RAM=12KB
TLE-120-01-G-DV
CSTCE20M0V53
MC-146(32.768KHz)
0.47uF
0.1uF
1K
10K
100
12p


LAN
TK-78K0R/KG3+NET
Document Number 62-0178A
Rev 1.0
Thursday, January 18, 2007
Sheet 2 of 3
CN2
RJLBC-248TA1
U2
AX88796B
U3
93LC46A SN
U4
SN74LVC1G08DCK
L1
L2
Y3
X1
ABM3B-25.000MHZ-10-1-U-T
A[5..0]
D[15..0]


K0 USB
Title
TK-78K0R/KG3+NET
Size
A3
Document Number
62-0178A
Rev
2.0
Date: Thursday, January 18, 2007
Sheet 3 of 3


Title
EXT-232C
Size
A3
Document Number
62-01788
Rev
1.0
Date:
Monday, February 26, 2007
Sheet
1
of
1
CN1
TMM-120-01-G-D
CN2
FFC-40BEMP
Not mount
J1
J2
J3
FFC-2AEMP
CN3
HEC470-01-630
U1
MAX3232ECD
U2
LM1117MPX-3.3
D-SUB1
MDEC-09H2-132L
RS1_RTS
RS1_CTS
RS1_DSR
RS1_DTR
C1
C2
C3
C4
C5
C6
C7
0.1uF
10uF/25V
R1
100K
3.3V
DCVDD