

**User's Manual**

**78K0R UD Stick**

**ZigBee™-ready**

**Wireless Network Evaluation Board**

**Using the UD2400 RF chip**

**and the 78K0R/KE3 Microcontroller**

**Tutorial**

**Date published: October 2009**

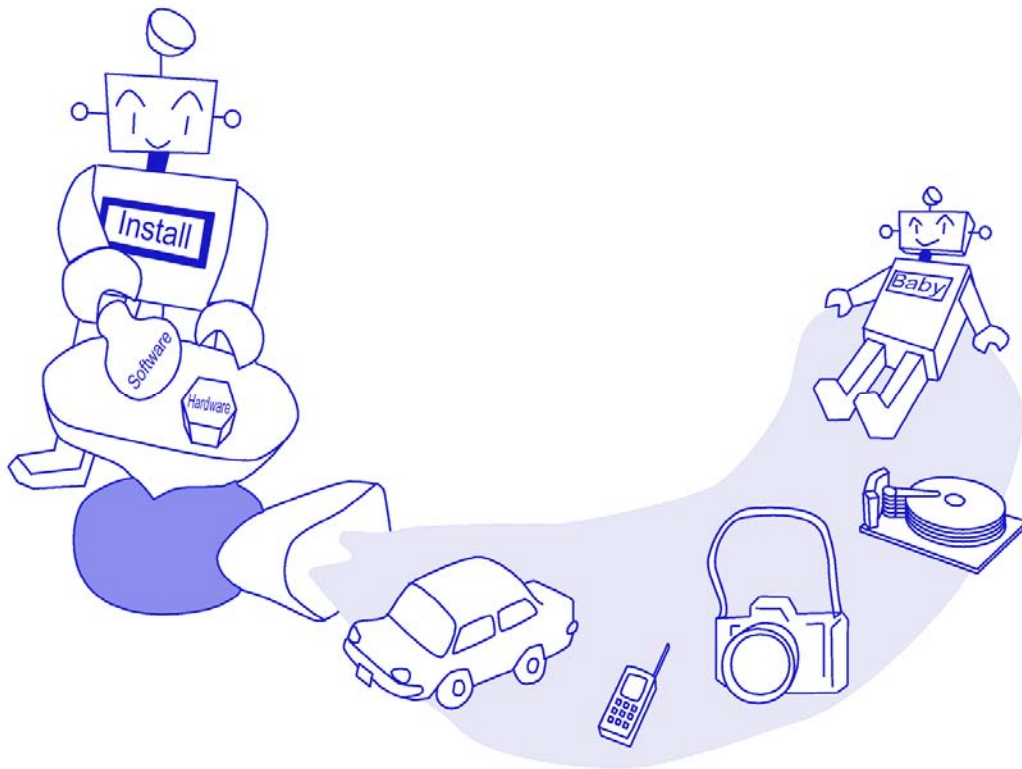
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**Printed in Japan**

**Welcome to the world of 78K0R UD Stick.**

**You are now being navigated to the design environment of the 78K0R microcontroller for developing wireless network applications. Please follow the tutorial step by step.**



**[NOTES]**

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**[CAUTION]**

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.

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# 1 Introduction

Target Reader	Software development engineers who wish to become familiar with the development environment of the 78K0R microcontrollers. It is assumed that the readers have been familiar with basics of microcontrollers, C and assembler languages, and the Windows™ operating system.
Purpose	For readers to become familiar with the design environment and the application examples of wireless networks.
Overview	This manual consists of the following contents
	<a href="#">Chapter 1 Introductions</a> →Overview of this manual
	<a href="#">Chapter 2 Preparations</a> →Introduction of soft tools, and sample programs and installation
	<a href="#">Chapter 3 Experiences</a> → Guide to the basic operations of PM + and the integrated debugger using sample programs.
	<a href="#">Chapter 4 Hardware Specifications</a> →Explain the hardware of 78K0R UD Stick
	<a href="#">Chapter 5 IEEE 802.15.4 MAC Sample Programs</a> → Learn sample programs, which utilize the MAC library
	<a href="#">Chapter 6 Troubleshooting</a> →Describe how to solve troubles you may face, such as errors when starting the integrated debugger (ID78K0R-QB)
	<a href="#">Chapter 7 Other Information</a> →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.

## Chapter 8 Mode Setting of the Board

→ Explanation of switch setting.

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## 2 Preparations

This chapter introduces the development environment and describes how to install the sample programs. The sample program can be tested on this hardware platform of the evaluation kit.

## 2.1 Development Tools, Sample Programs, and the MAC Library

This section outlines the development tools, sample programs and the MAC library used in this tutorial.

### 2.1.1 Integrated Development Environment PM + V6.31

This is a project manager, where you work for editing the source code, compiling it, and initiating the debugger. The project manager works on MS Windows 2000 or XP.

### 2.1.2 Device file DF781188 V3.00

A device file contains an MCU specific information. It instructs the development tools what kind of an MCU the tools shall work for.

### 2.1.3 C Compiler CC78K0R W2.12 : Code size limited version

This is a free compiler for the 78K0R microcontrollers. The object code size is limited to 64 Kbytes. It works on MS Windows 2000 or XP.

### 2.1.4 Assembler RA78K0R W1.33 : Code size limited version

This is a free assembler for the 78K0R microcontrollers. The object code size is limited to 64 Kbytes. It works on MS Windows 2000 or XP. The RA78K0R Assembler Package contains Structured Assembler Preprocessor, Assembler, Linker, Object Converter, Librarian, and List Converter.

### 2.1.5 78K0R integrated debugger ID78K0R-QB V3.60

The Integrated Debugger ID78K0R-QB offers a debug environment on your PC, where the MS Windows 2000 or XP runs, if the TK board is connected to the PC with USB. The USB I/F accesses to the OCD, On Chip Debug, interface on the microcontroller.

### 2.1.6 Built-in Flash Memory Writing Program WriteEZ5

This is the Windows software to write programs on built-in flash memory. By connecting, you can write/delete programs on the built-in flash memory.

### 2.1.7 Starter kit USB driver

This is a software driver for PC to access to the USB interface of the 78K0R UD Stick board.

### 2.1.8 The RF Test Program

The RF Test Program is used in [chapter 3 Experiences].

The RF Test Program is provided in the form of the C source codes.

If you wish to tailor the RF Test Program to meet your specific needs, you can edit the source code, re-compile it with debug build to generate a load module file, then, start the debugger to load the tailored execution code on to the microcontroller for further debugging on the project manager PM +.

Alternatively, if debugging is not required, you can make a release build to achieve a new hex file, on the project manager PM +.

As a general remark, please respect your local regulation of electro-magnetic emission. In general, it is suggested to use the 78K0R UD Stick board in a radio anechoic chamber.

### 2.1.9 IEEE 802.15.4 MAC Library

The IEEE 802.15.4 MAC Library offers an executable object-code library of the MAC stack specified in the IEEE 802.15.4. Please refer to the MAC Library manual for further details.

### 2.1.10 The MAC Sample Program: Text Chat Program

The MAC Sample program is developed to provide with a simple example to construct a star network utilizing the IEEE 802.15.4 PHY/MAC standard.

The MAC Sample Program offers,

- 1). Designation of a network coordinator in a star configuration
- 2). Text chat between a coordinator and an end device

To use the MAC Sample Program, you need to prepare at least two PC with a USB interface and two 78K0R UD Stick boards.

The MAC Sample Program is provided in the form of the C source codes.

If you wish to tailor the sample program to meet your specific needs, you can edit the source code, re-compile it with debug build to generate a load module file, then, start the debugger to load the tailored execution code on to the microcontroller for further debugging on the project manager PM +. However, because the USB connection to instruct operation to the program is occupied for the debugging purpose,

alternatively, you can make a release build to achieve a new hex file, on the project manager PM +.

As a general remark, please respect your local regulation of electro-magnetic emission. In general, it is suggested to use the 78K0R UD Stick board in a radio anechoic chamber.

## 2.2 Installation of Software Development Tools

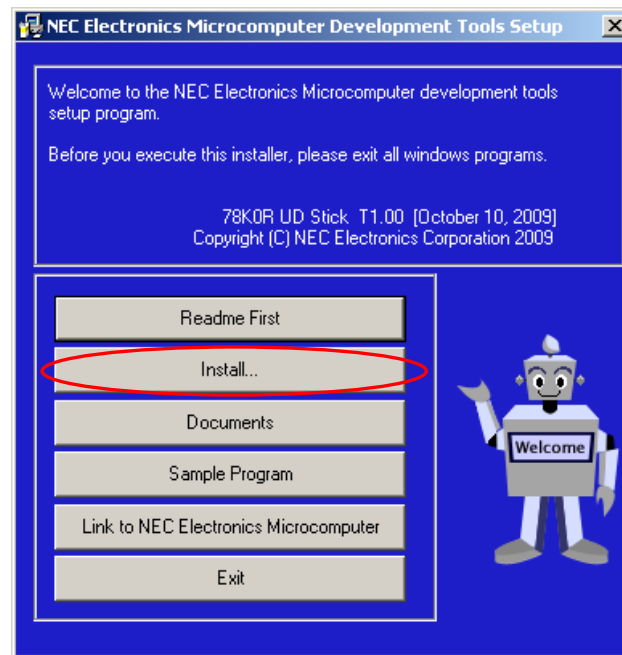
### 2.2.1 Start-up of the installation CD-ROM

The attached CD-ROM contains Development Tools, documents and sample software.

You can install it using an installer.

### 2.2.2 Installation of the software development tools.

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](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.

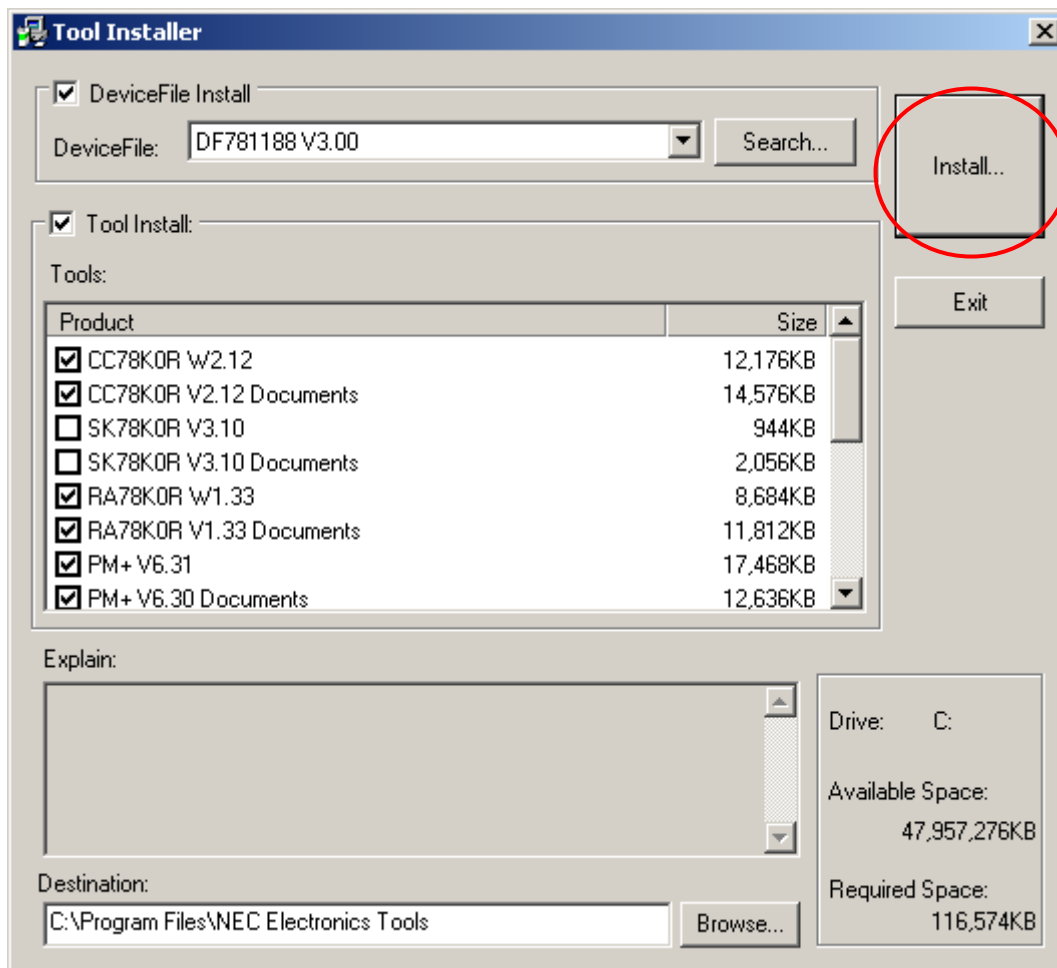
- ① Select products that you need to install.  
(as default, all the products that you need to use the demonstration kit are selected.)

"Explain" area displays an explanation of the selected product.

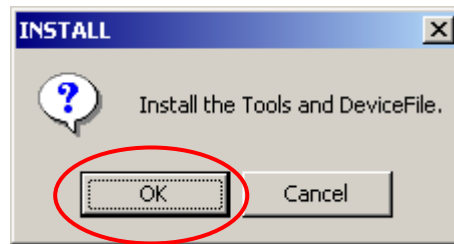
To change the installation destination, click  .

When all the settings are completed, click  .

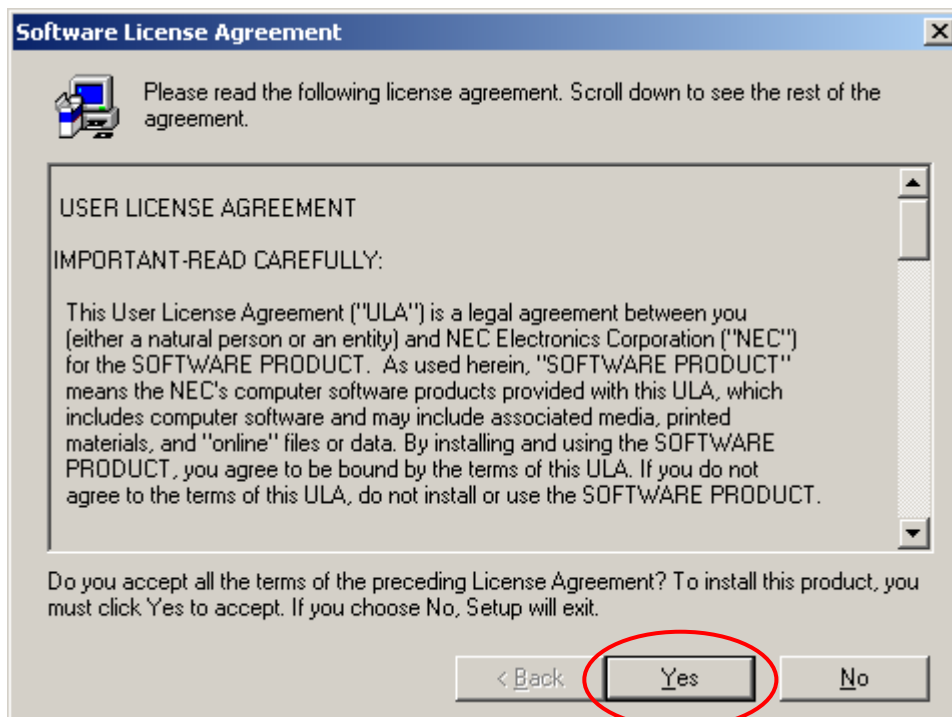
- \* In this document, it is assumed that users install the programs under "NEC Electronics Tools" directory (default installation directory). Users can find the tools by selecting "Start Menu" -> "Programs" -> "NEC Electronics Tools".



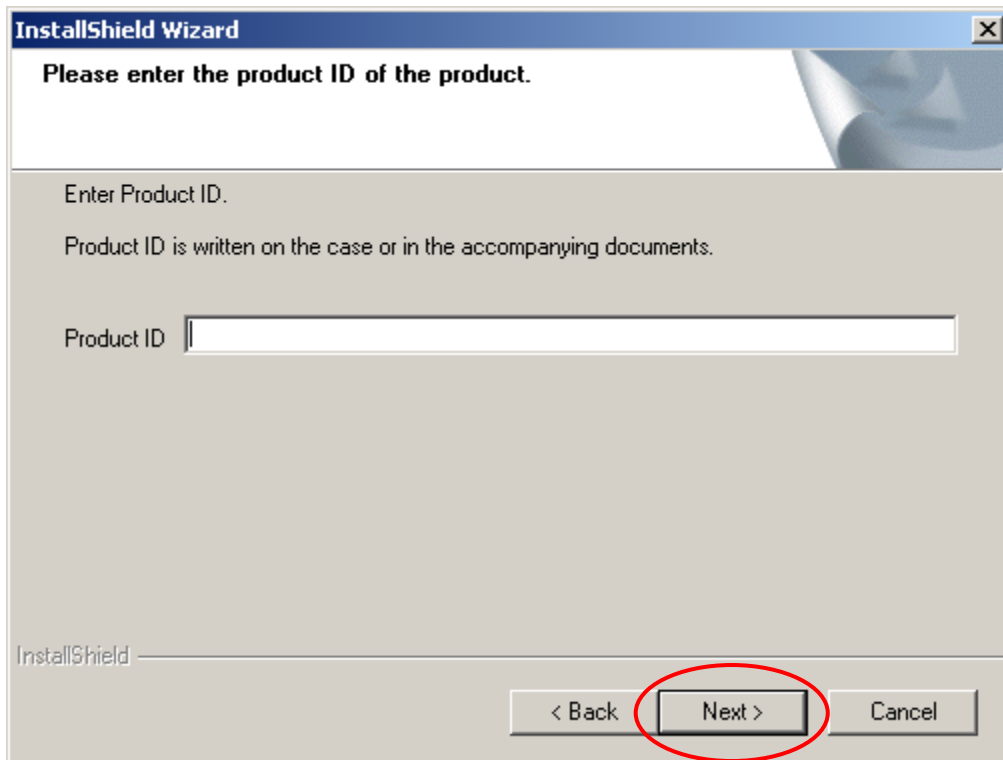
- ② Click  when "Install" confirmation dialog box is opened.



- ③ Read "software license agreement" and click  for continuing the installation. To stop the installation, click .

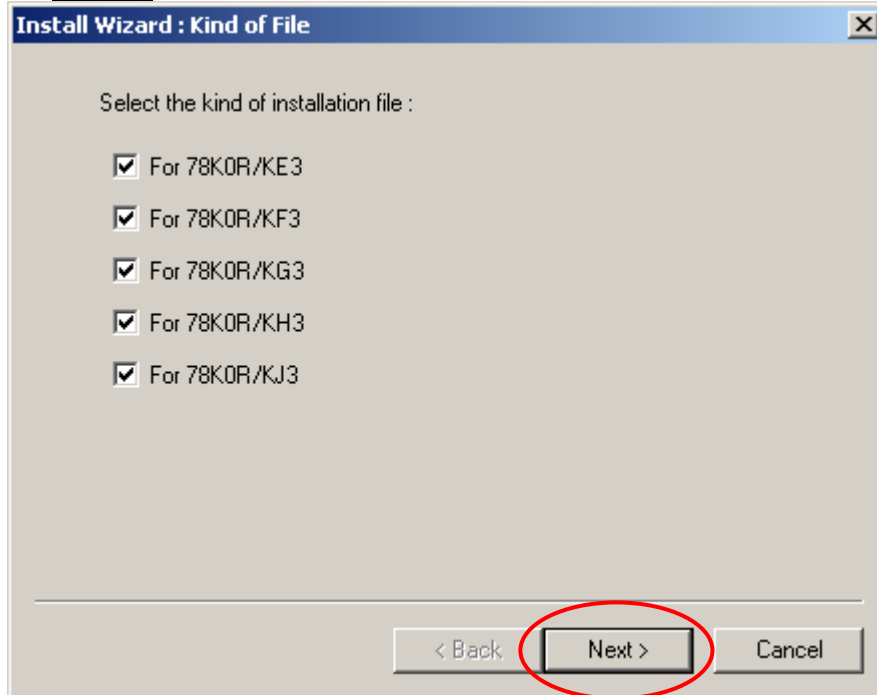


- ④ Enter the product ID, and click **Next** .  
\* The product ID is available on the “README.html” the other sheet.

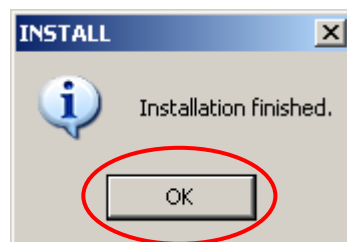


- ⑤ It starts copying the files.

- ⑥ Click **Next** when "Select Files" installation wizard dialog opened.



- ⑦ When the installation is completed, the following dialog opens. Click **OK**.



- ⑧ "NEC Electronics Starter Kit Virtual UART" USB driver must be installed on PC before you connect to 78K0R UD Stick. Install the USB driver by referring "2.3USB 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.

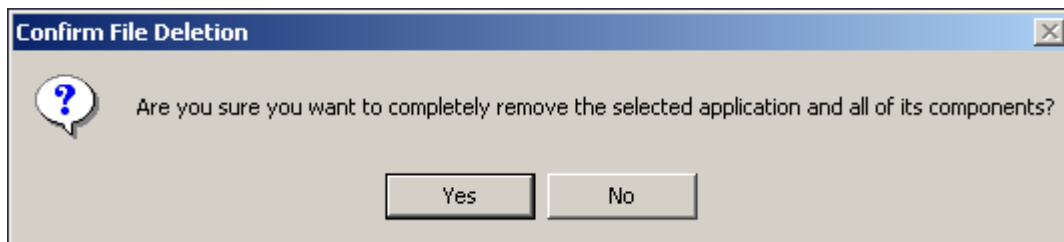
The identical problem may be observed, if a language other than English is specified as the system language in the “Regional Settings Properties” tab.

### 2.2.3 Uninstall

- <1> Start "Add /Remove Programs" in the Control Panel.  
(Example here is based on Windows2000)



- <2> Select the tool that you want to uninstall from the list displayed in "Install/Uninstall" and click [Add/Remove...].
- <3> A dialog box for confirming deletion of files will be displayed. Click . Deleting of the files will be started.



- <4> When the completion message is displayed, click .

**Caution:**

Deletion of some files may be asked during uninstallation. Normally, deletion of these files causes no problem.

- <5> This completes uninstalling this tool.

#### 2.2.4 File Configuration in PC

Software Development Tools are installed in "C:\Program Files\NEC Electronics Tools" on default setting.

When you use the tools, please open the tools from [Start menu] -> [Programs]->[NEC Electronics Tools].

## 2.3 USB Driver

You need to install “NEC Electronics Starter Kit Virtual UART” in your PC.

When TK-78K0R is used, it is necessary to install the “NEC Electronics Starter Kit Virtual UART” driver in the host machine. Please install the driver according to the following procedures with appending CD in the drive.

“Starter Kit USB Driver” must be installed on the PC. If not, please refer to “2.2 Installation of Software Development Tools” to install the “Starter Kit USB Driver” first.

**Attention Do not use a USB hub for connecting 78K0R UD Stick.**

Depending on the version of Windows OS, the installation will be differed.

Please check your Windows version, and follow the instructions

- Windows XP -> “2.3.1Install to Windows XP”
- Windows 2000 -> “2.3.2Install to Windows2000”

After the installation, go to “2.3.3Confirmation of the installation”

### 2.3.1 Install to Windows XP

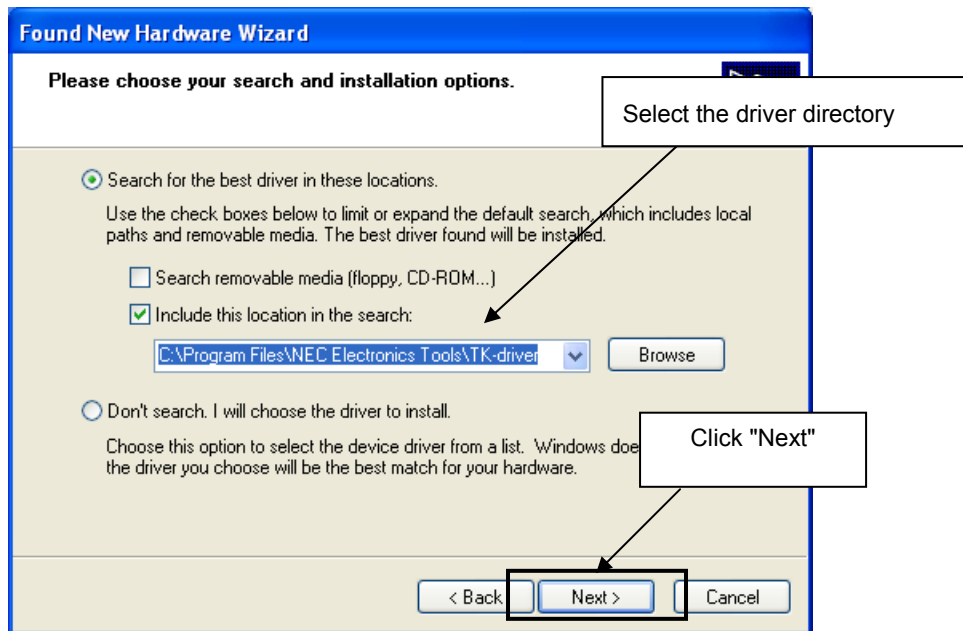
1. Once the 78K0R UD Stick is connected with USB, the "Found New Hardware Wizard" will be started. Select "No, not this time" and click **Next >** .



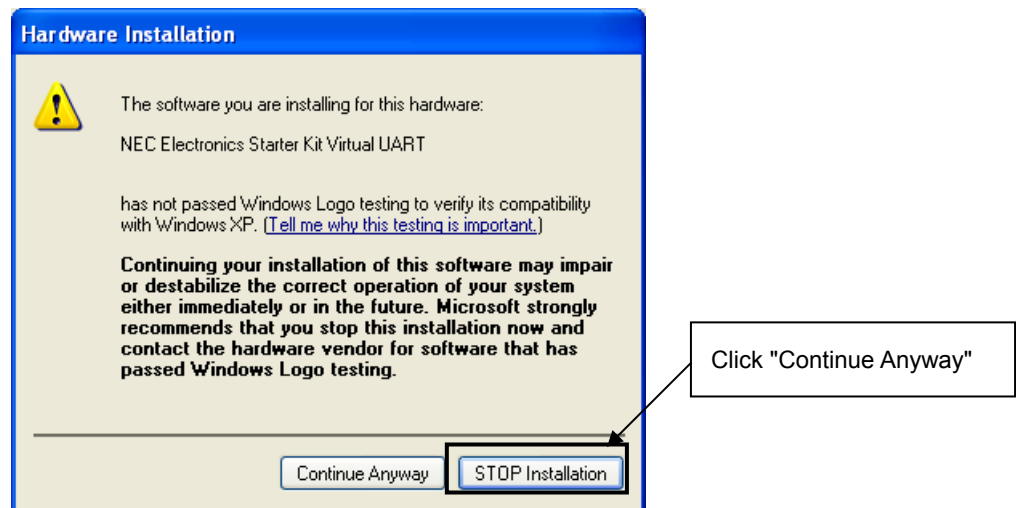
2. Select "Install from a list or specific location" and click **Next >** .



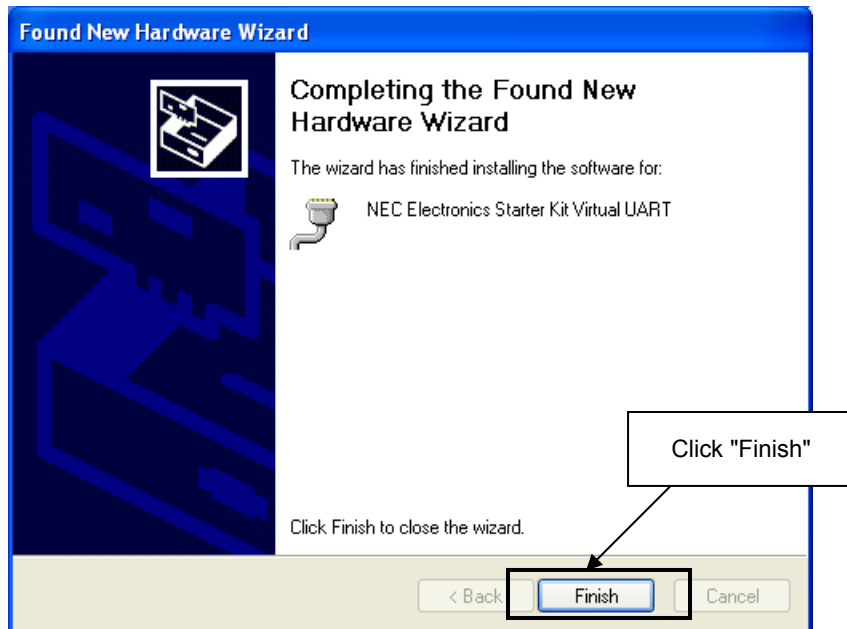
3. Select "Search for the best driver in these locations.", check "Include this location in the search:", and then click "Browse..." to select the driver directory path. The path should be "C:\Program Files\NEC Electronics Tools\TK-driver" as default installation. If the installation directory is not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



4. If the following dialog is opened, click .



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



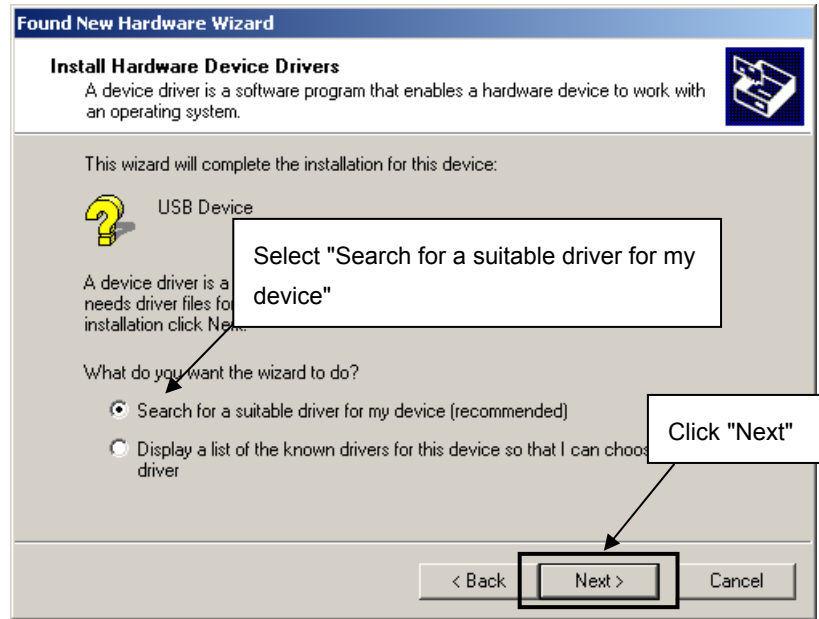
6. Go to "1.3.3 Completion of the installation".

## 2.3.2 Install to Windows2000

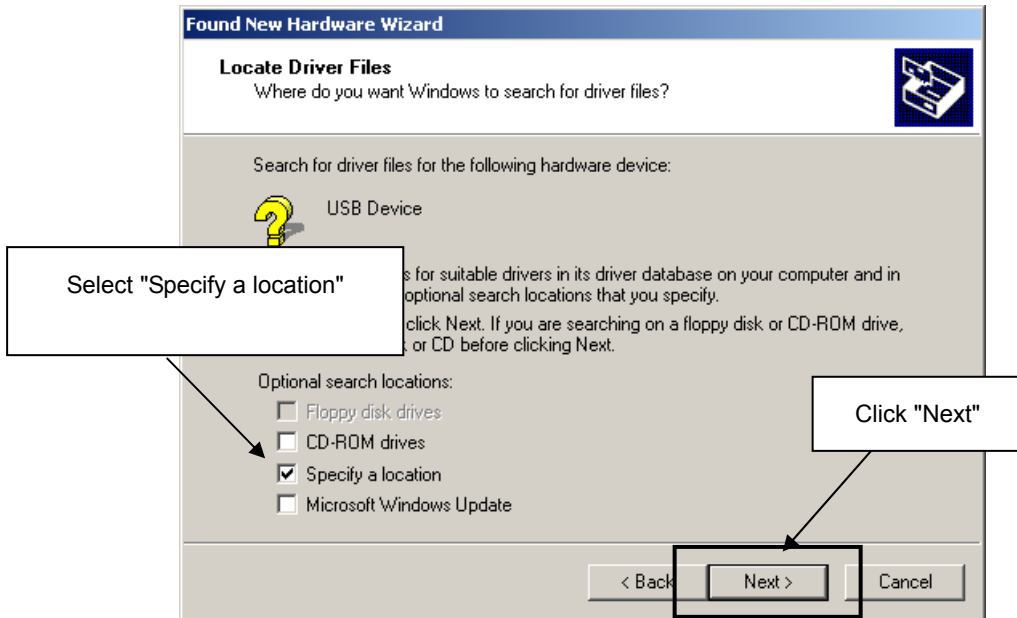
1. Once the 78K0R UD Stick is connected with USB, the "Found New Hardware Wizard" will be started.  
Select "No, not this time" and click  .



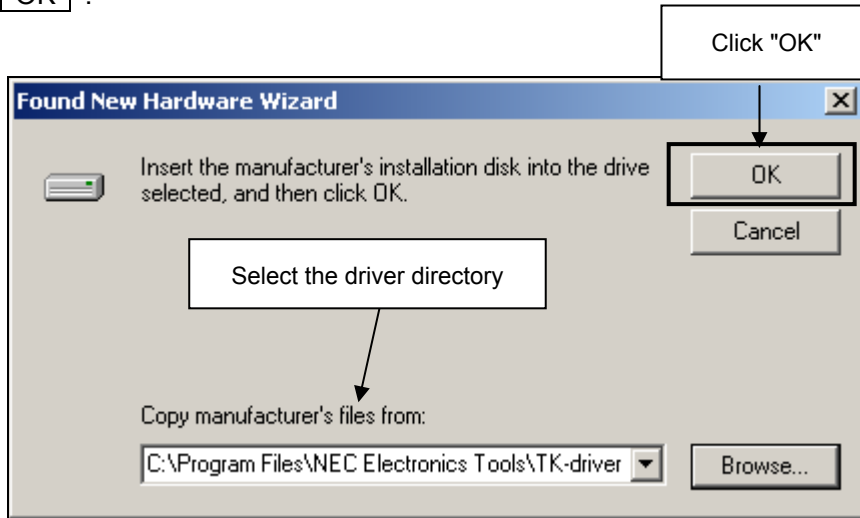
2. Select "Search for a suitable driver for my device".  
Click **Next >** .



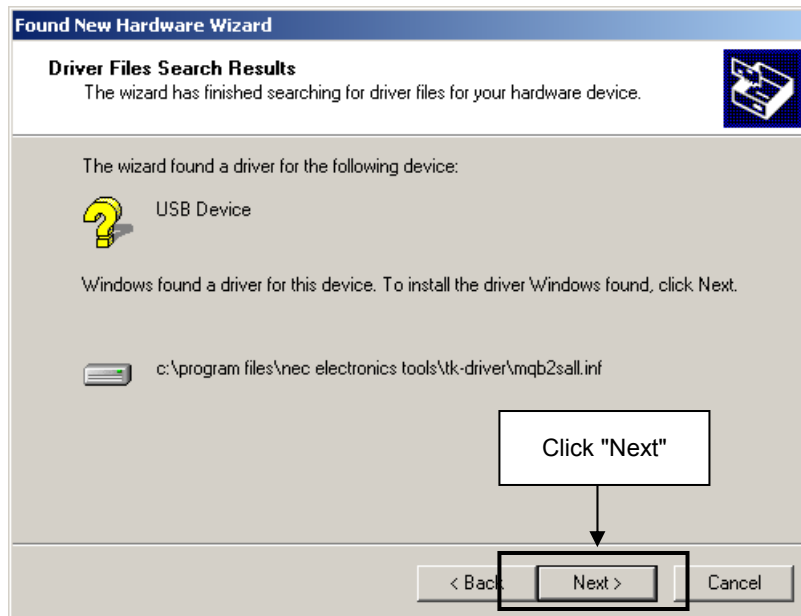
3. Select "Specify a location".  
Click **Next >** .



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 >** .



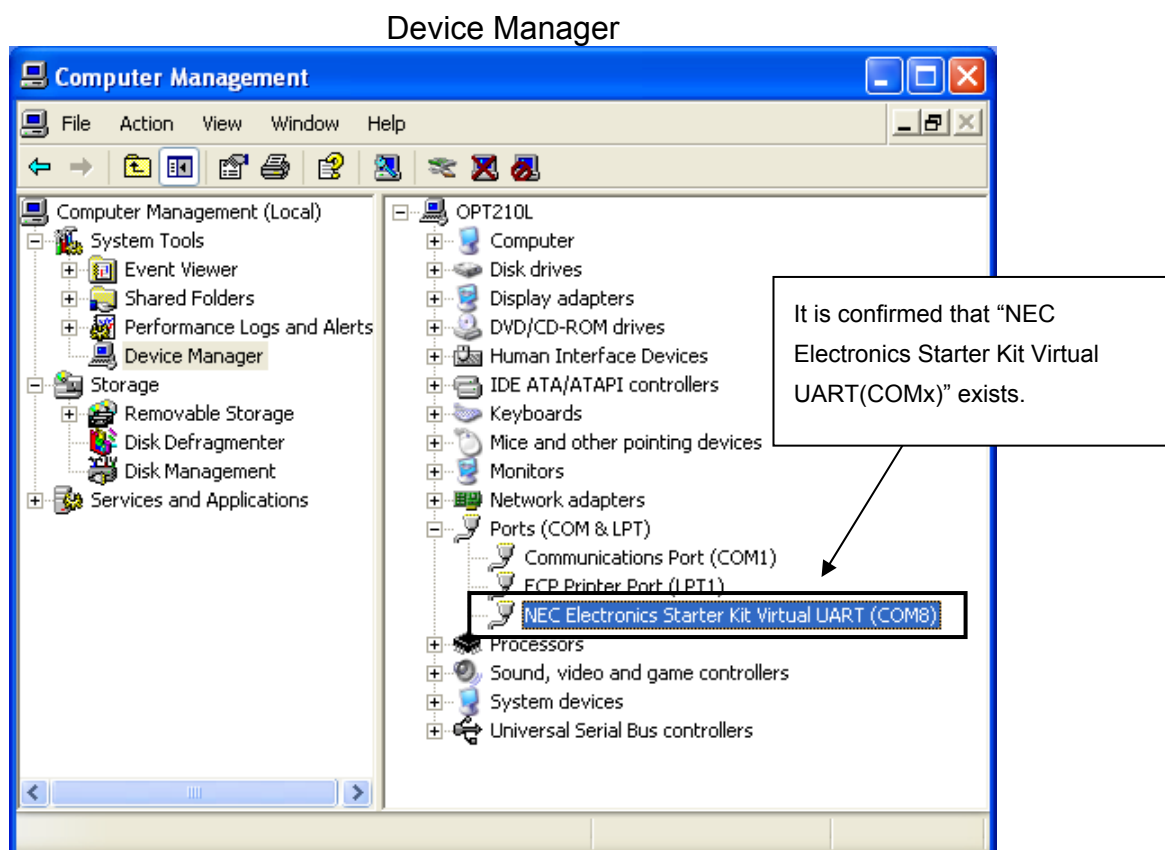
6. The installation of "NEC Electronics Starter Kit Virtual UART" driver is completed. Click **Finish** .



7. Go to "1.3.3 Confirmation of the installation".

### 2.3.3 Confirmation of the installation

Please confirm “NEC Electronics Starter Kit Virtual UART(COMx)” in the device manager of system in the control panel of the MS Windows.



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 78K0R UD Stick. When you change the USB port connection, the COM port number will be changed as well.

**Select this COM port number when you use WriteEZ5.**

#### CAUTION

- Do not do “Hardware Modification Scan” when you communicate with the target device.

## 2.4 Sample Environment

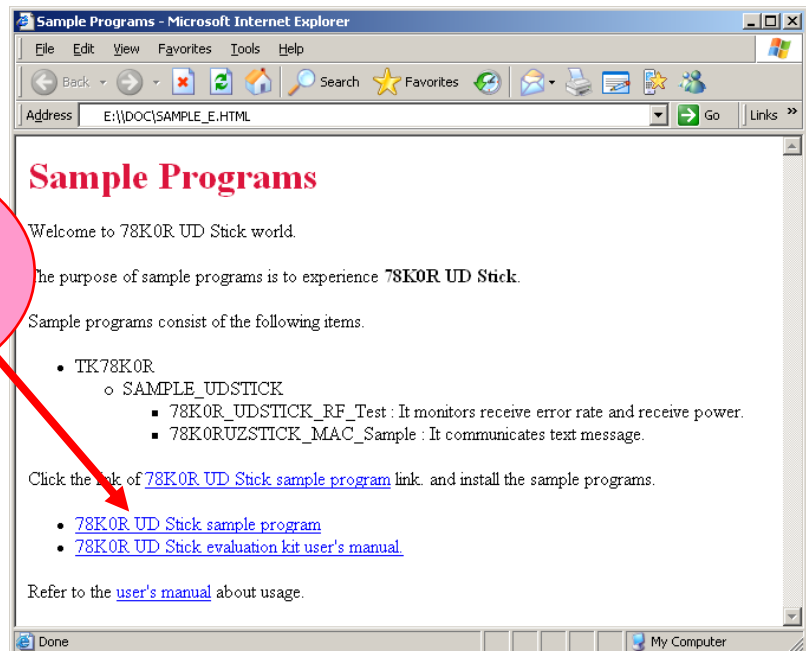
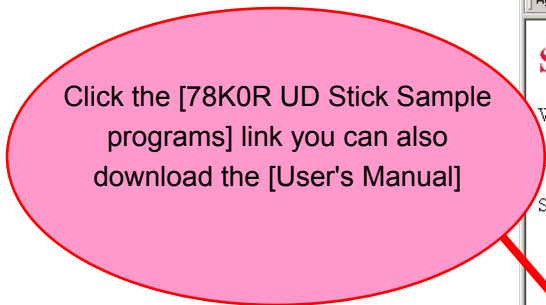
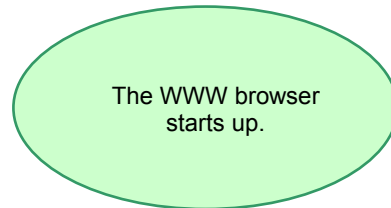
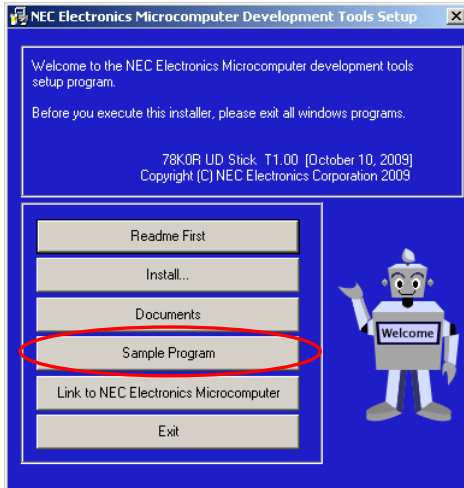
This section explains the overview and preparation of sample programs. You need to install the sample programs on your system first before using them.

How to install the sample programs and where they should be installed on your system will be explained.

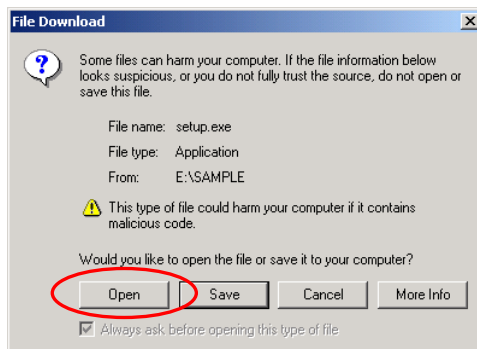
## 2.4.1 Installation of the sample programs

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.)

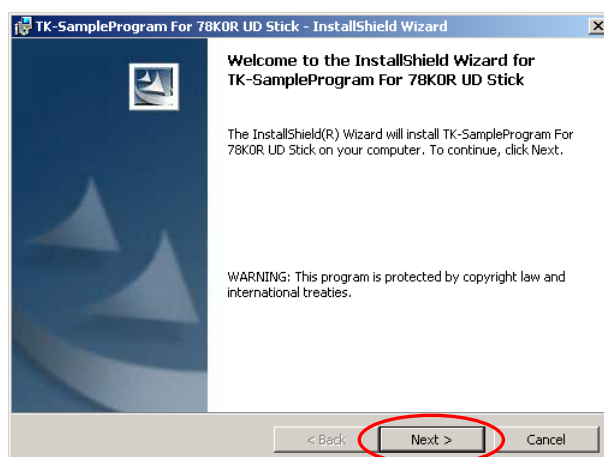
Press the [Sample Program] button to start the WWW browser, and then click the [78K0R UD Stick Sample Programs] link.



When[78K0R UD Stick Sample Programs] is clicked, the following download confirmation window appears.

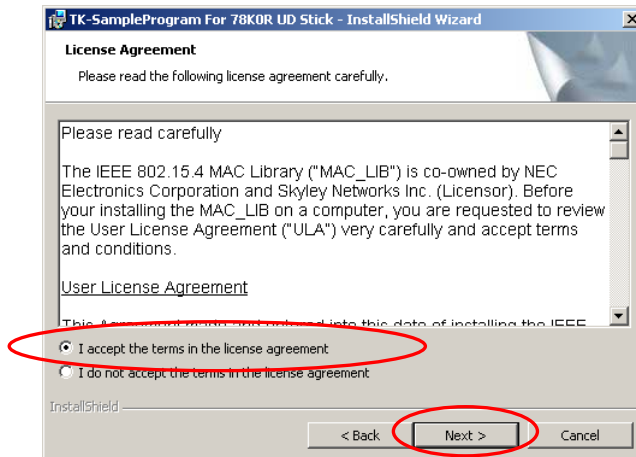


Please click the **Open** button.  
In case of windows 2000,  
you will see the [Security Warning] window. Please click **Run**.

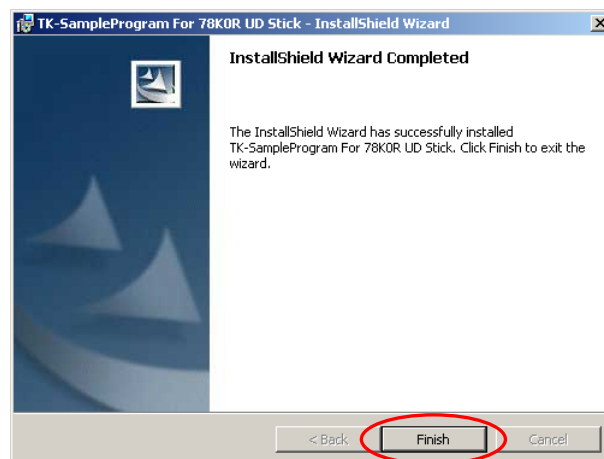


InstallShield wizard for TK-Sample Program starts up  
Please click **Next**.





License agreement screen is displayed.  
Please select "I accept the terms in the license agreement".and click **Next**.



Please click **Finish**.

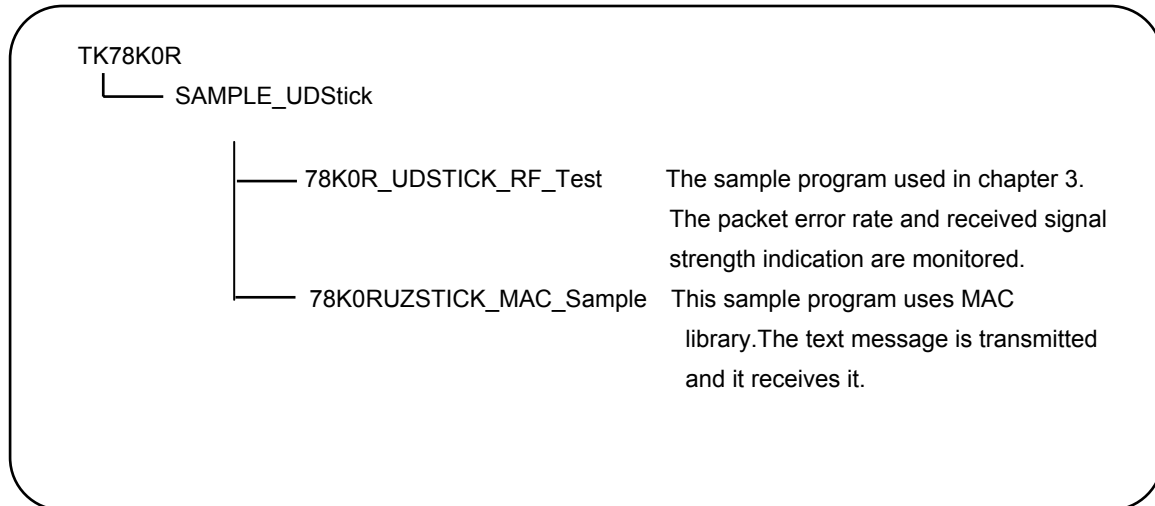
The sample programs are installed under "C:¥" now.

The sample program "TK78K0R.EXE" with self-extract file is also installed. When you need to use the original sample programs, you can extract the file "C:¥TK78K0R.EXE".

When you uninstall the sample program.  
Please use "Add /Remove Programs" in the Control Panel.

## 2.4.2 File Configuration of the sample program

The sample programs were the following folders.



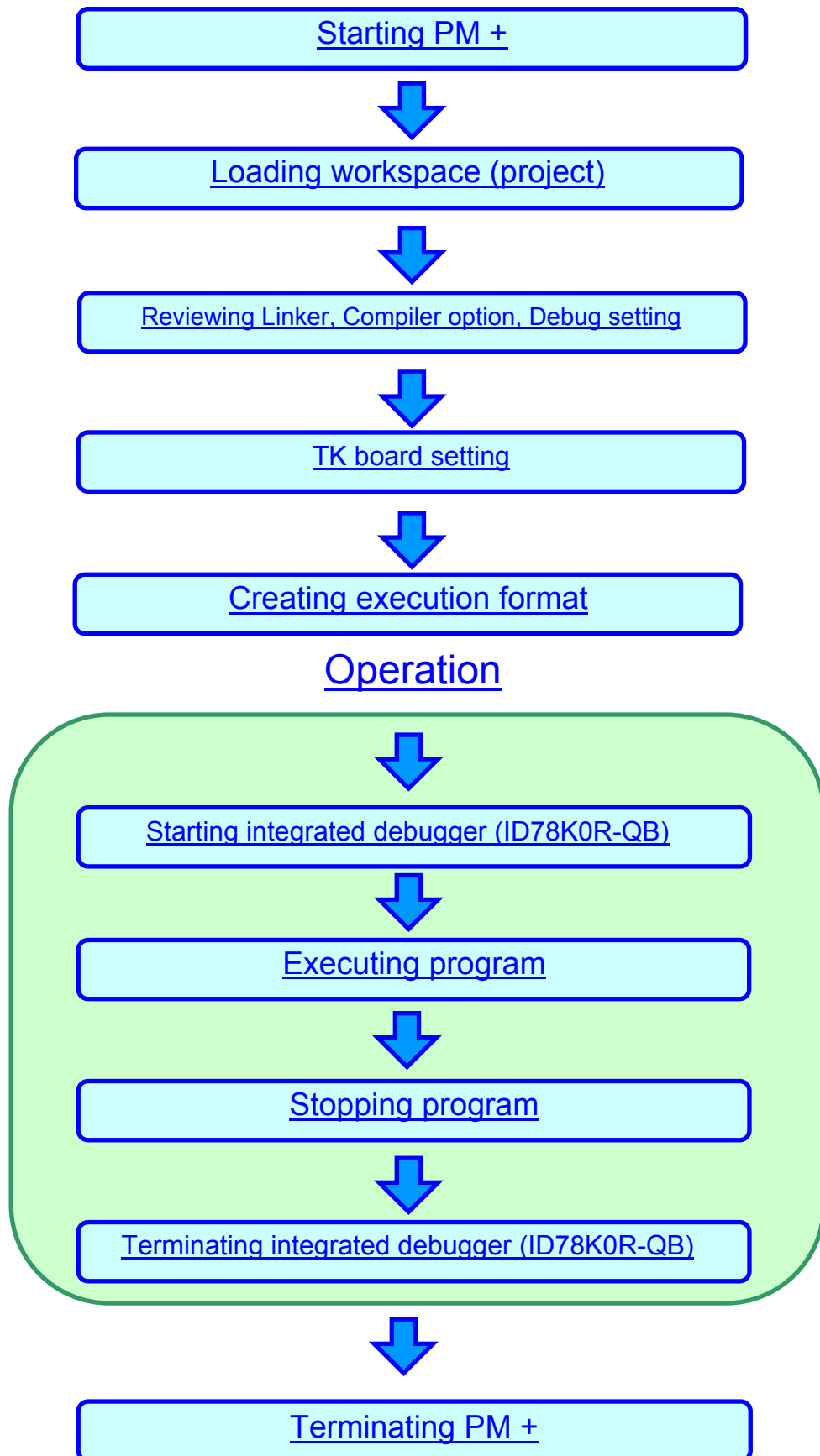
## 3 Experiences

Now you are ready to experience the operation of the 78K0R UD Stick using the integrated development environment, PM +.

As a program for the 78K0R/KE3, the RF test program (RF\_Test) which you installed in "2.4.1 Installation of the sample programs" is used.

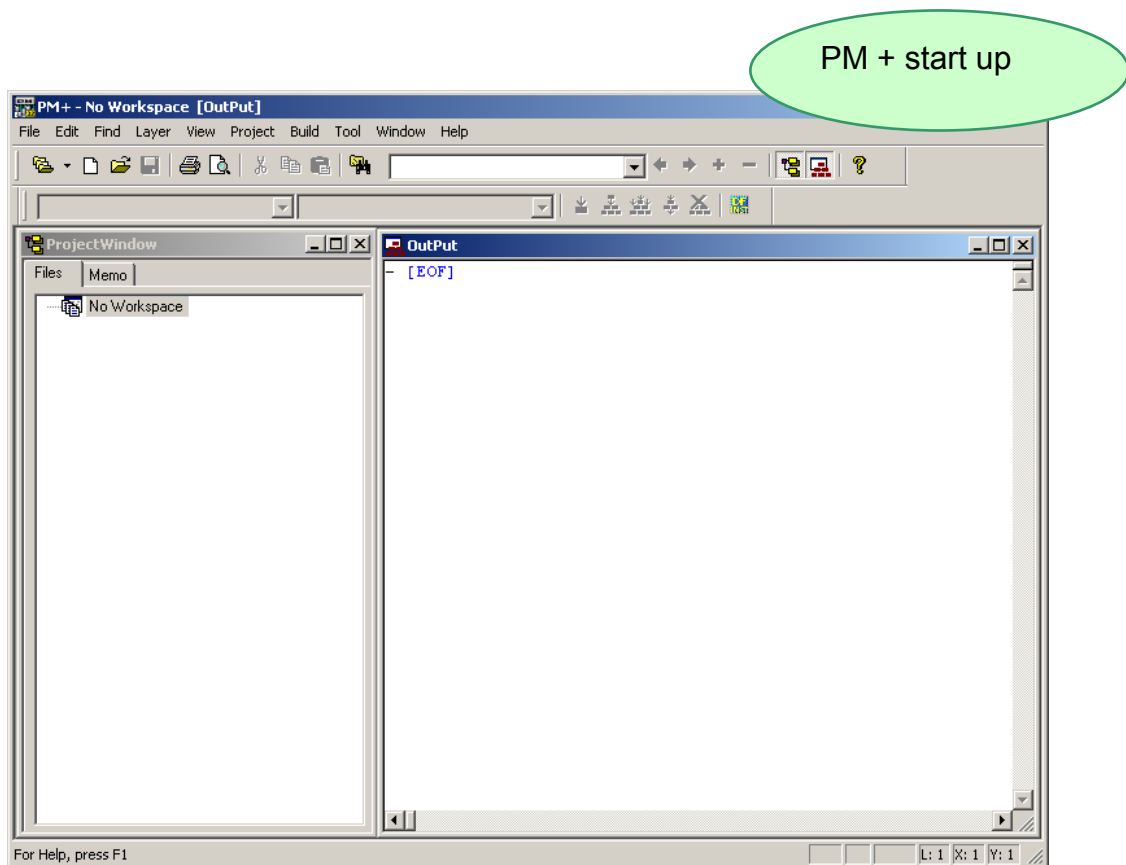
You use two of 78K0R/KE3. One is the stand-alone system with USB power supply. Another is connected to the debugger and run user programs. By building the sample programs and operating with ID78K0R-QB, you can understand the basic operation of the development tools (PM+, ID78K0R-QB) and the basics of the project files that you need when you develop application programs.

The overall flow is as follows.



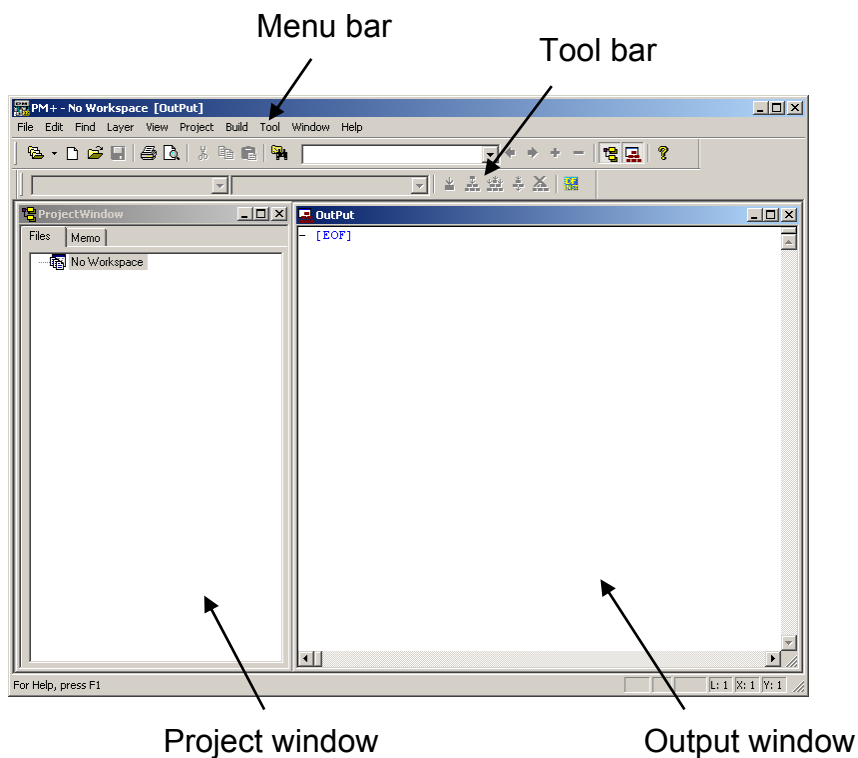
### 3.1 Starting PM +

In the Windows Start menu, select [Programs]->[NEC Electronics Tools]->[PM + V6.31]



## 3.2 Introduction to 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 or 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 the PM + User's Manual.

**What is a project?**

A project is the unit in which PM + executes management, and refers to an application system and environment development based on PM +.

PM + compiles project information and saves it in a “project file”, from which it is then referenced.

**What is a project file?**

A project file is a file to which information such as the source file to be used in the project, the device name, the tool options for compiling, and the editor and debugger to be used have been saved as “project information”.

The file name format is “`△△△△prj`”.

Project files are created in folders that are set when creating new workspaces.

**What is a project group?**

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

The target devices of each project that can be registered to one project group must be the same.

**What is a workspace?**

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

The file name of multiple project files is saved to a workspace file for referencing.

The file name format is “`△△△△prw`”.

### 3.3 Loading Workspace (Project)

In this section, you will use the workspace that you created in "2.4.1 Installation of the sample programs"

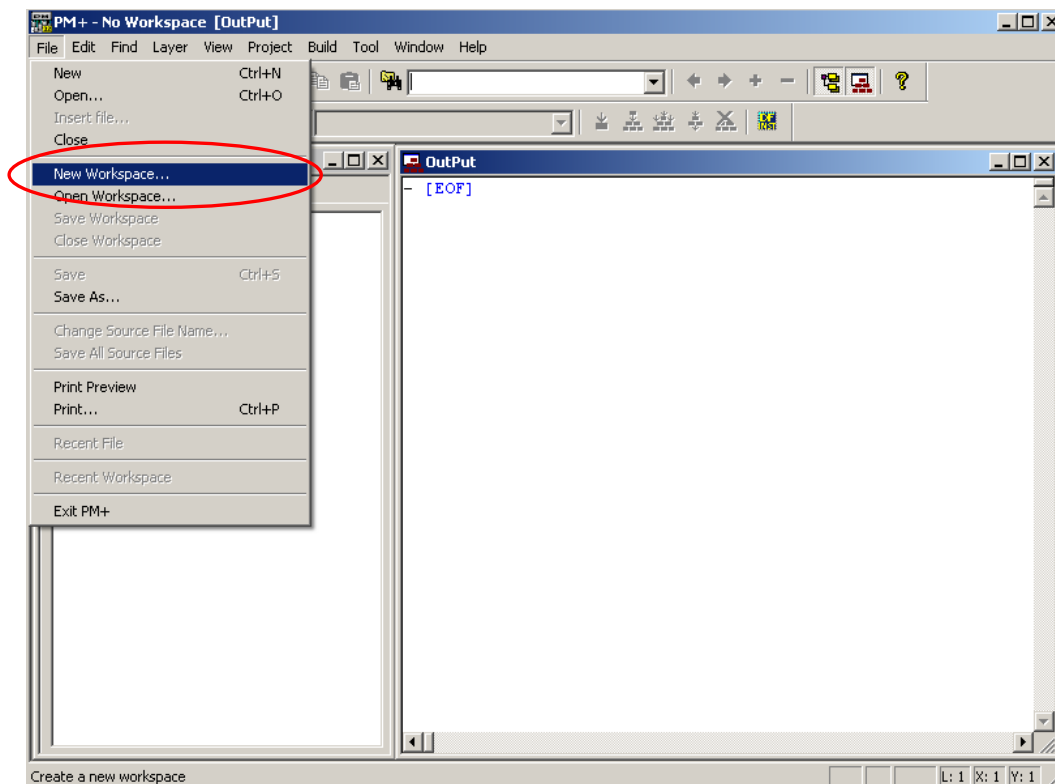
For creating a new workspace, refer to "7.1 Create a new workspace".

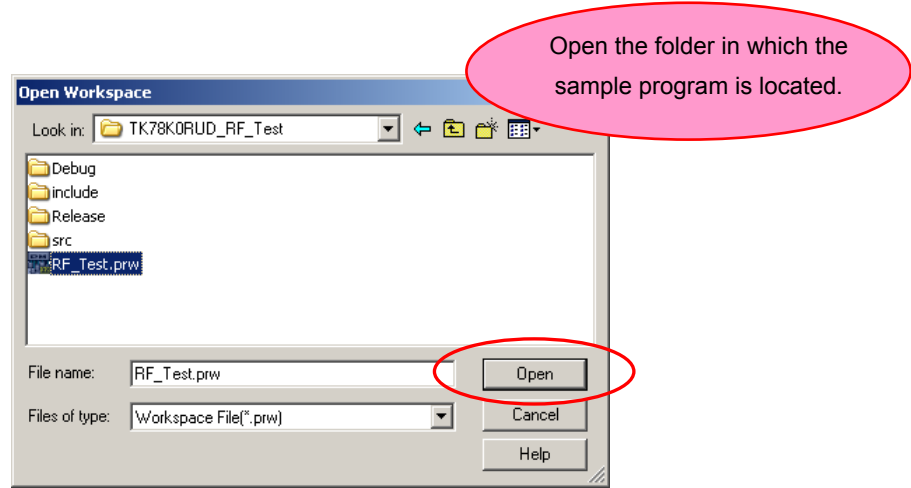
The workspace has information about the build environment for the sample programs.

Select "File" on menu bar and "Open Workspace...".

Then, select

"C:\TK78K0R\SAMPLE\_UDstick\78K0R\_UDSTICK\_RF\_Test\RF\_Test.prw".

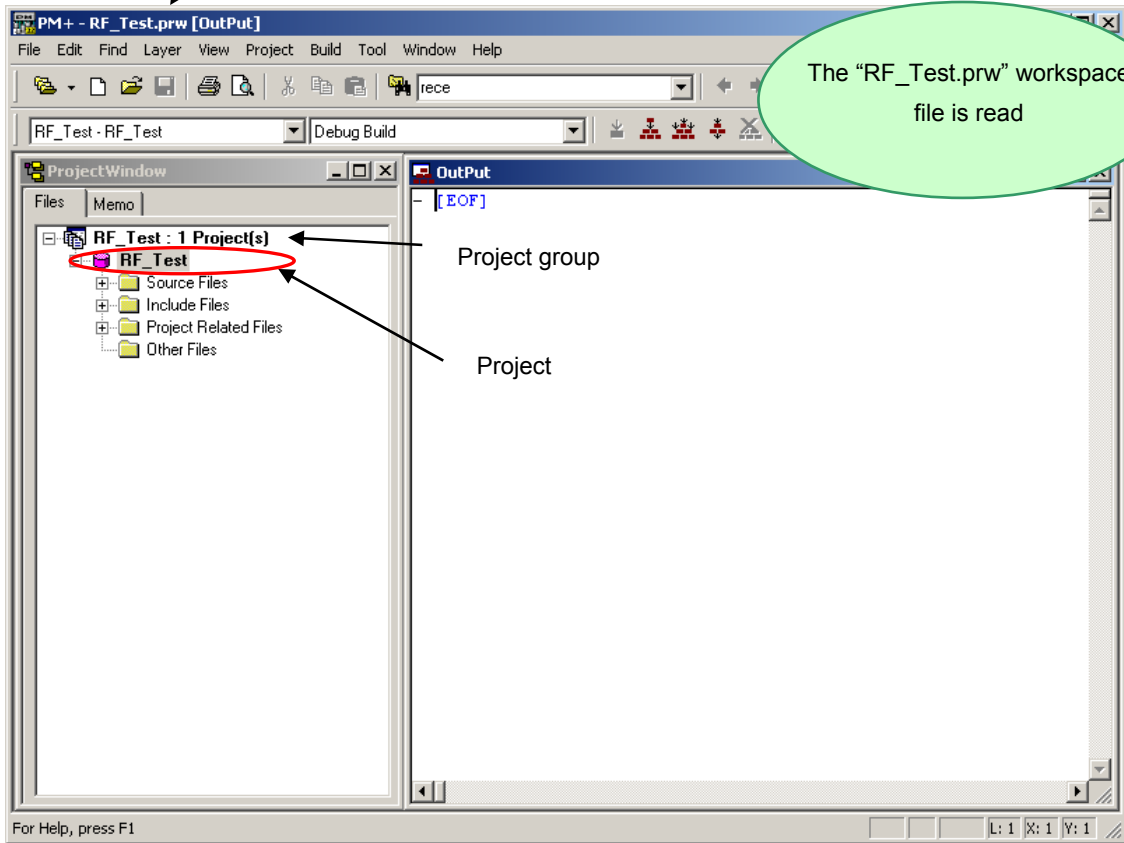




“RF\_Test.prw” and then press the **Open** button.



Workspace file name :RF\_Test.prw



## 3.4 Configuration of Linker Option

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.

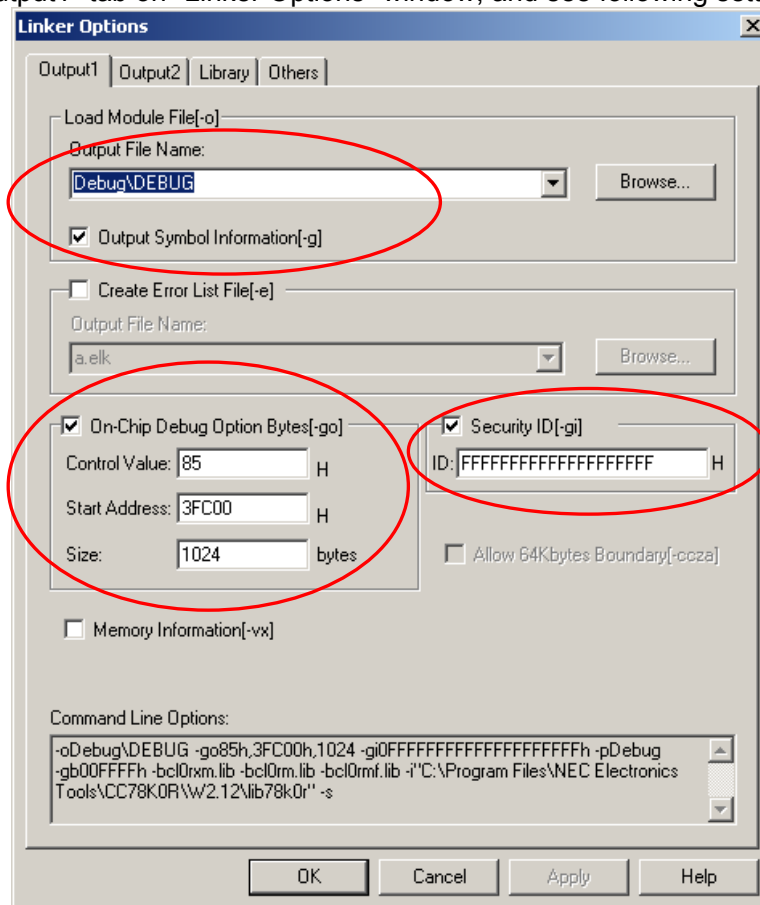
Following three settings are covered specifically.

- Outputs from debugging
- On-chip debug (bytes, security ID)
- Watchdog timer

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

### 3.4.1 "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/KE3 (U17854E). 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 "FFFFFFFFFFFFFFFF" as this is the initial code.

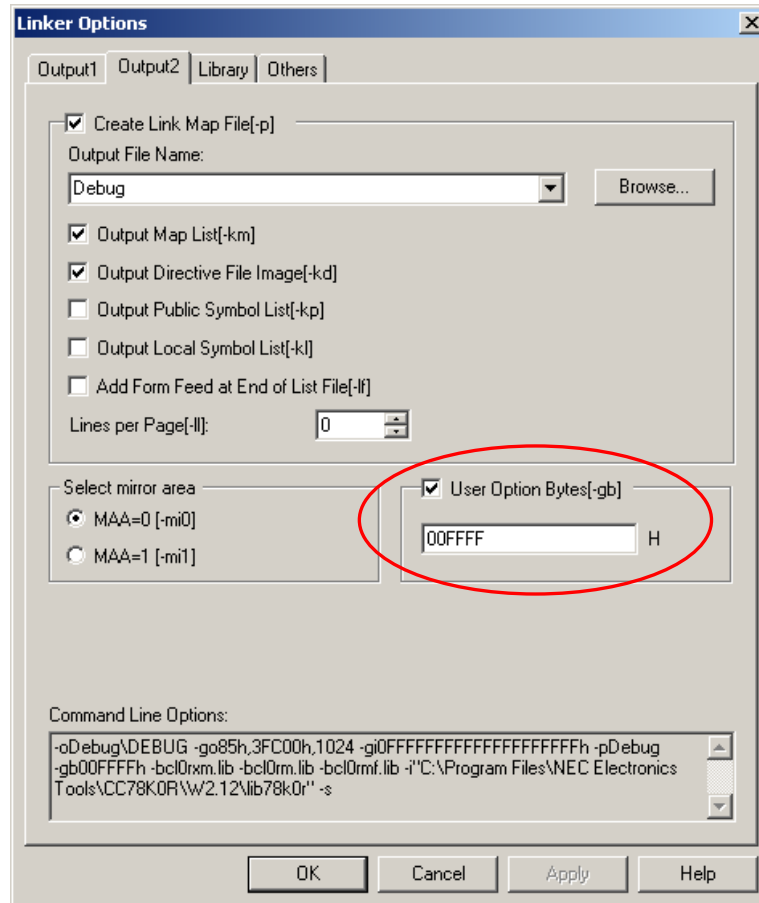
If you forget about the security ID (stored in the address of C4H-CDH) or if you set wrong on-chip debug option byte, you will not be able to use the debugger (ID78K0R-QB).

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 "7.4Erase of flash memory".

### 3.4.2 "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/KE3 (U17854E).

## 3.5 Configuration of Compiler Option

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.

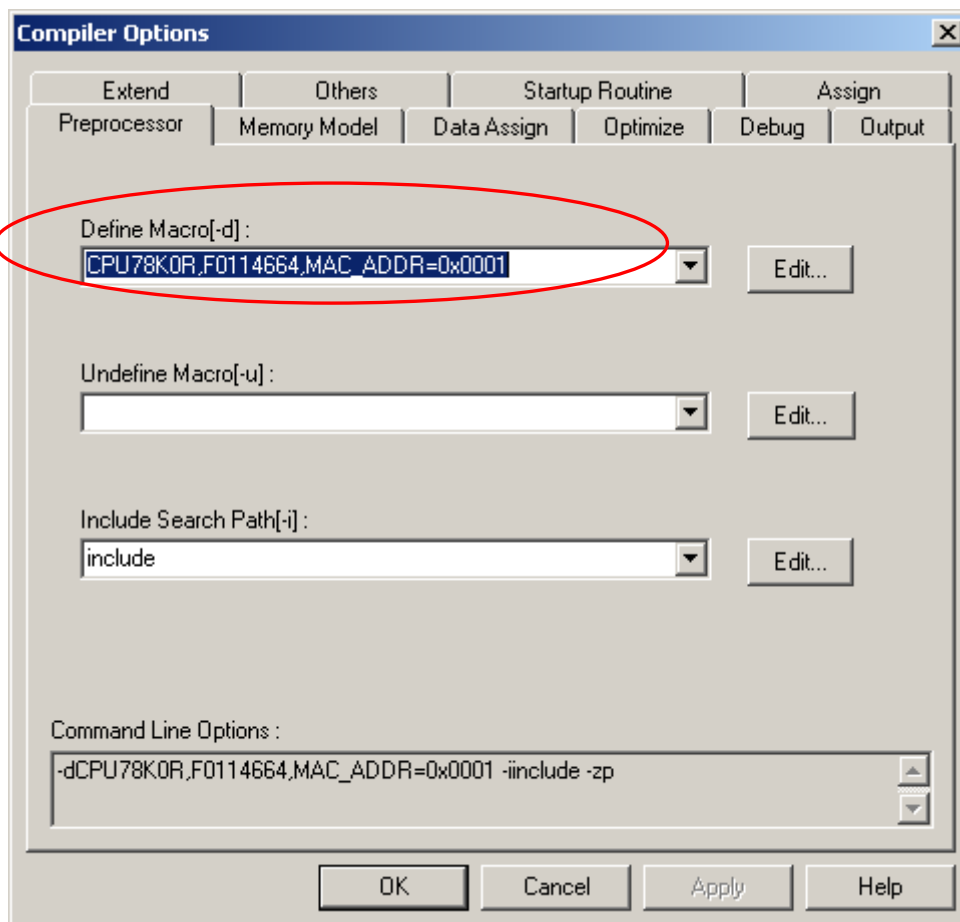
- Setting for Define Macro
- Enable C++ comments
- Use multiplier and divider

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

### 3.5.1 "Preprocessor" Tab

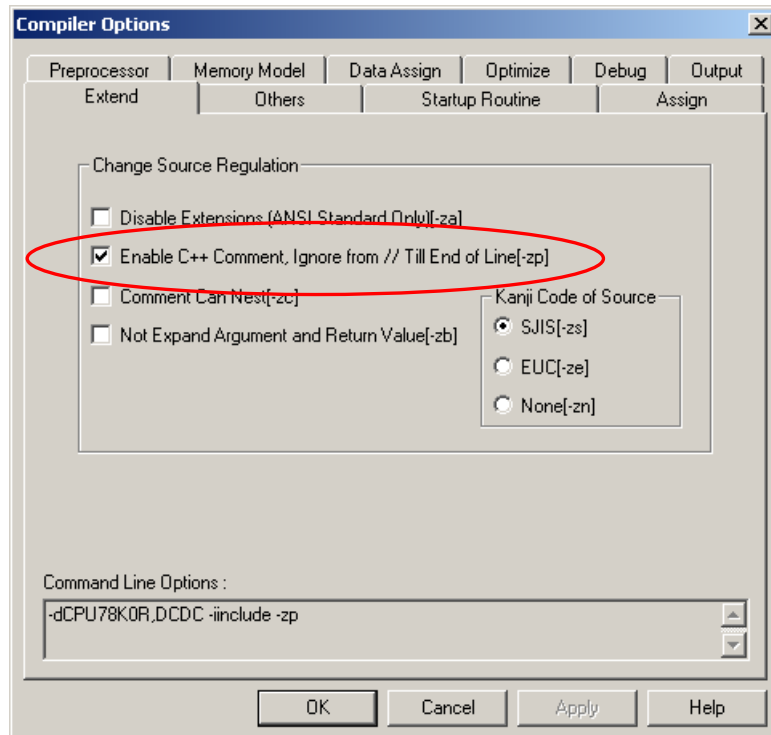
As "Define Macro", three macros, CPU78K0R, F0114664, and MAC\_ADDR=0x0001, are set. These regard to "ifdef" statement in the source code. "MAC\_ADDR=0x0001" indicates that the MAC short address is "0001" as the wireless node. (Also the 5th - 6th byte of extended address is set to 0x0001.)

Enter "include" in "Include Search Path" field.



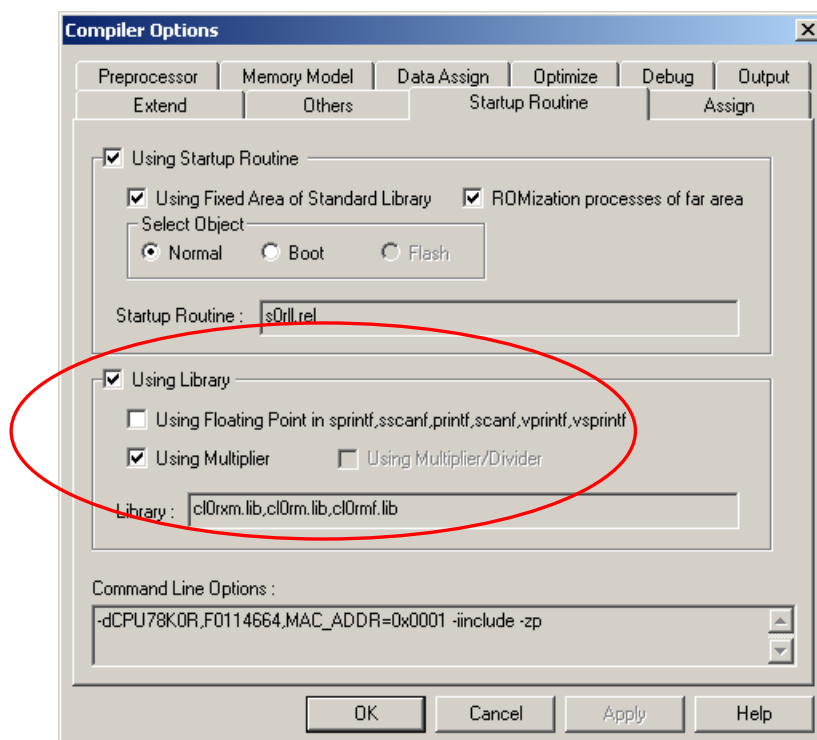
### 3.5.2 "Extend" Tab

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.



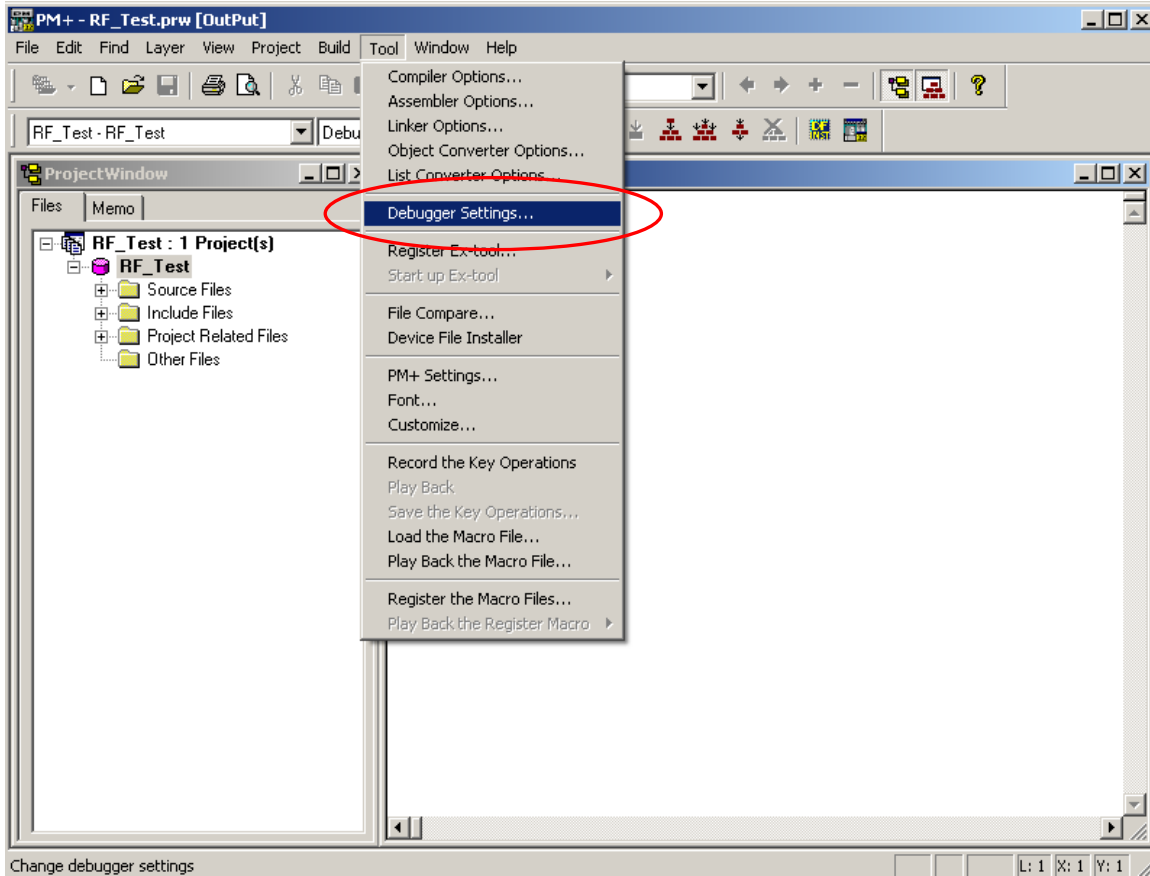
### 3.5.3 "Startup Routine" Tab

Select "Startup Routine" tab, and check "Using Library" and "Using Multiplier/Divider". The 78K0R/KE3 has feature of multiplier/divider to increase those calculation speed.

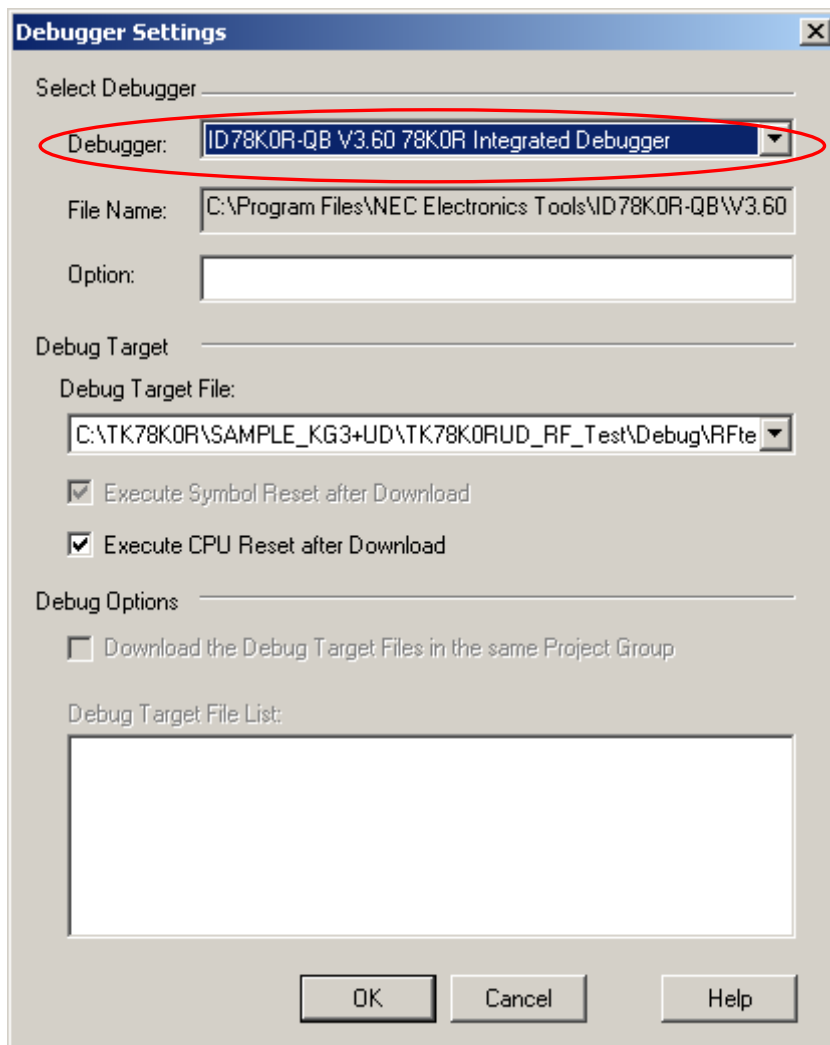


## 3.6 Configuration of Debugger setting

Please Choose [Tool] -> [Debugger Setting] at the pull-down menu.

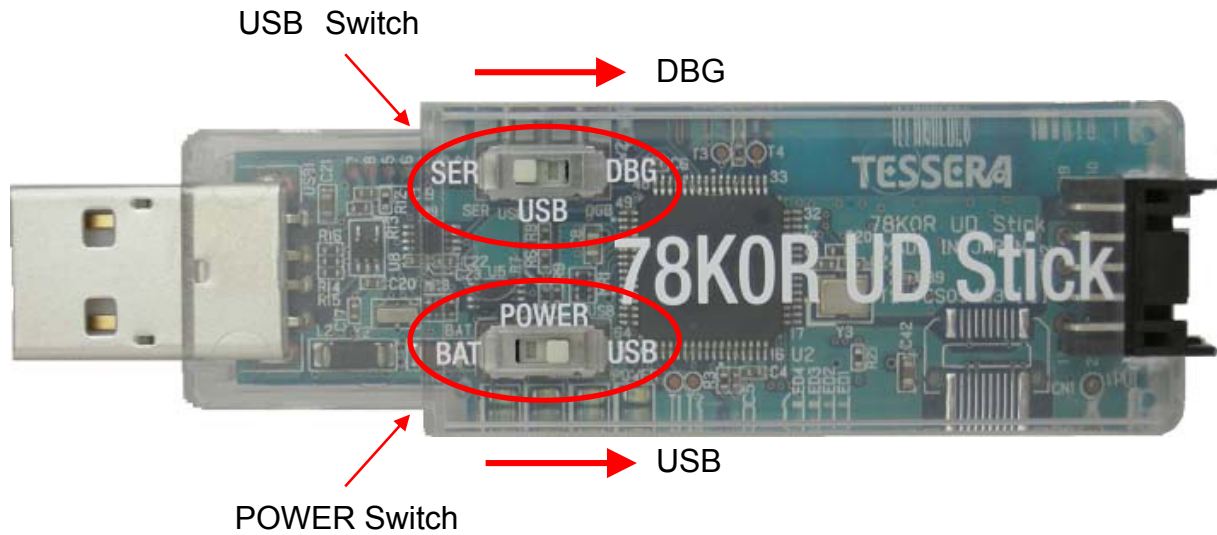


Check if "ID78K0R-QB V3.60 78K0R Integrated Debugger" is selected on "Debugger".



### 3.7 TK board setting

Please set the switches on the 78K0R UD Stick board as follows.



Switch	Setting
USB	DBG
POWER	USB

After the switch settings are completed, connect the PC to USB connector on 78K0R UD Stick with USB cable. If the "Found New Hardware Wizard" is started, install USB driver with referring "2.3USB Driver".



**What is build ?**

Build is a function that creates an executable file, etc., from a source file registered to a project.

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


On the second and subsequent build, PM + also automatically detects files that have been updated from the previous build processing, and compiles and assembles only the relevant files, thereby reducing the time required for build processing.

**What is rebuild ?**

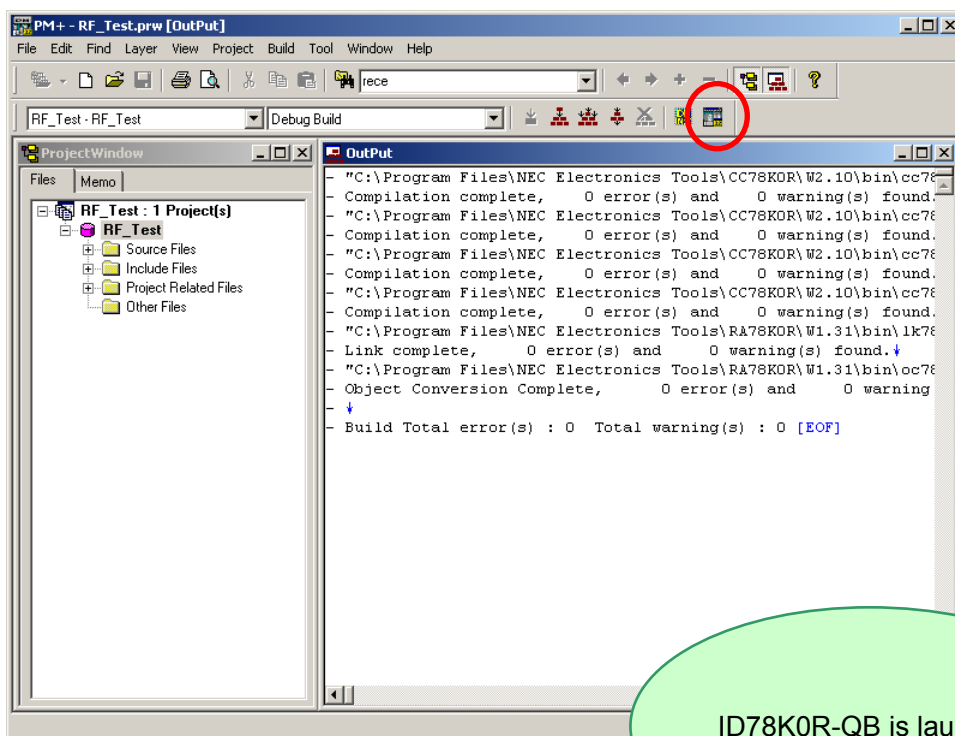
Build compiles and assembles only the source files that have been updated since the previous time, whereas rebuild compiles and assembles all the source files.

When settings, such as compiler options, have been changed, not build, but rebuild, must be Selected.

### 3.9 Starting integrated debugger (ID78K0R-QB)

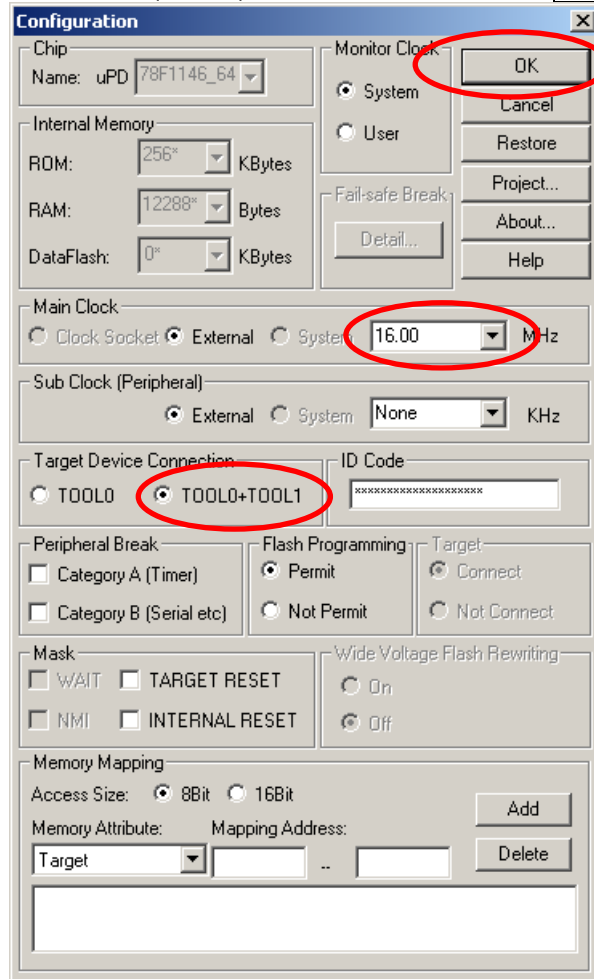
Please select the Debug button  , of PM +, or in the menu, select [Build(B)] → [Debug(D)].

If the debug button is not displayed, in the menu, select [Tool] → [Debugger Setting...] “ID78K0R-QB V3.60 78K0R Integrated Debugger”

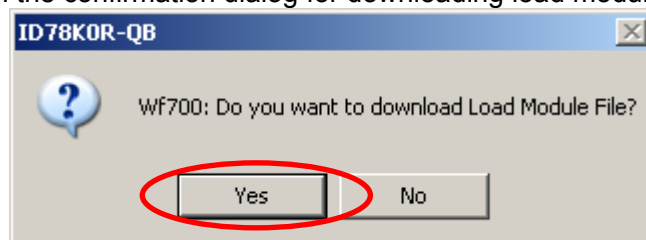


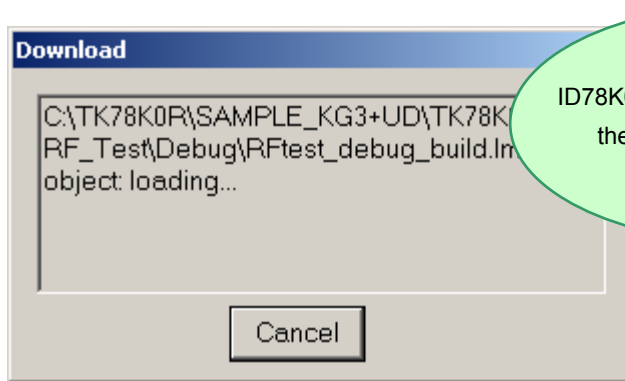
"Configuration" dialog is opened.

Enter "FFFFFFFFFFFFFFFFFFFFFF" (F x 20) in "ID Code", then click **OK**.



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

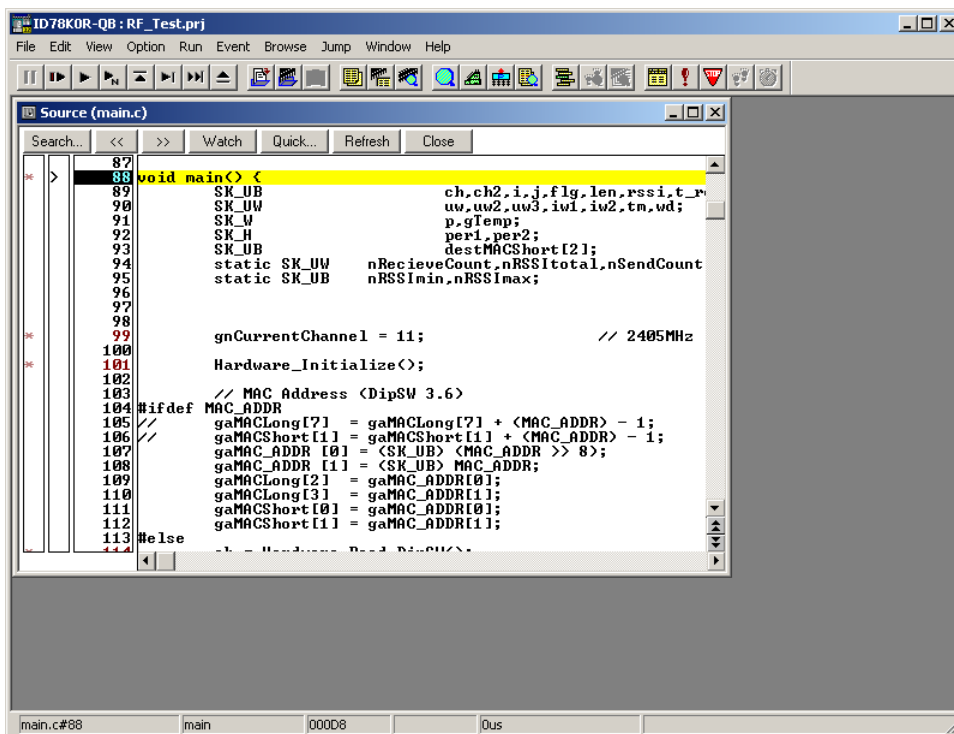




ID78K0R-QB starts and downloading the program to flash memory.



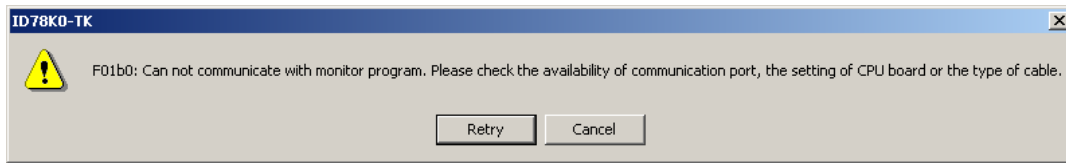
When the download is completed, the source code will be displayed



**NOTE:**

Completion of the download does not mean running the programs. To run the sample programs, go to "3.11 Executing program".

Normally, if communication with the CPU fails, the following error messages are output.



If you observe the message please confirm the following items.

1. Please confirm the switch on the 78K0R UD Stick is set as follows.

Switch	Setting
USB	DBG
POWER	USB

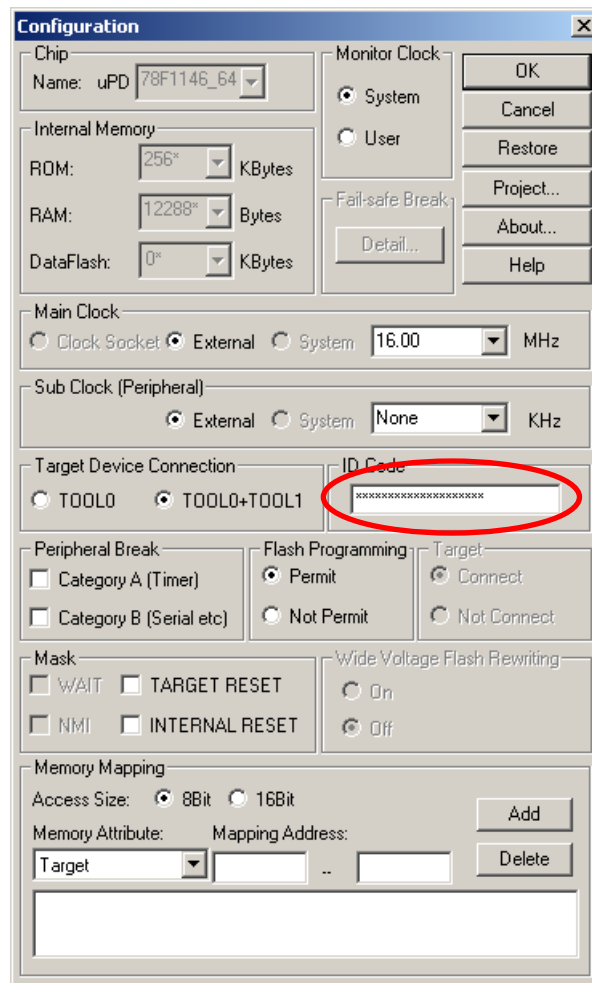
2. Please confirm the power LED1 is lighted.

After checking the above items, start ID78K0R-QB again.

If the ID code is wrong, you may find the following messages on the display.



The following "Configuration" screen is displayed when **OK** is pushed and input a correct ID code, please.



The default setting of the ID code is "0xFFFFFFFFFFFFFFFF". You can set an alternative ID code on the linker option tab.

If the setting of On-Chip Debug Option Byte is "Does not erase data of flash memory in case of failures in enabling on-chip debugging" and if you forget the security ID, you need to erase the flash memory completely.

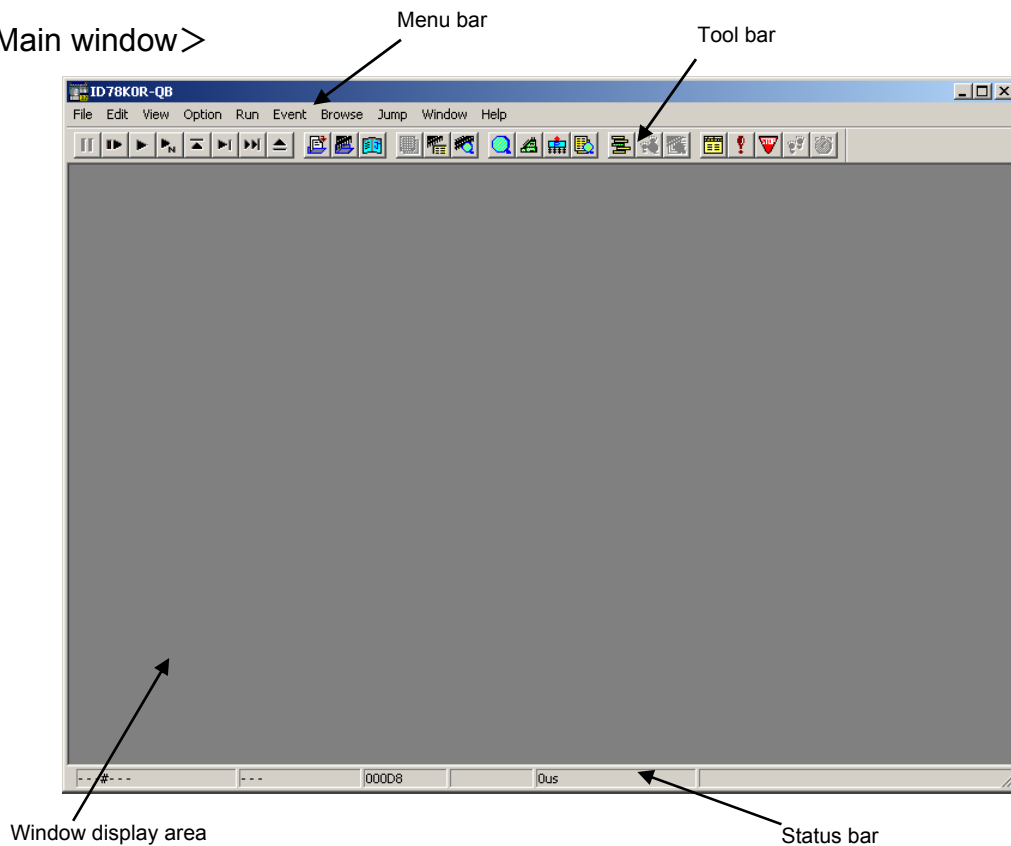
To erase the flash memory, please refer to the section 7.4, "Erasing the Flash Memory".

## 3.10 Introduction of the integrated debugger (ID78K0R-QB)

ID78K0R-QB displays the internal status of the CPU and controls monitor functions in the main window.


The initial screen of ID78K0R-QB is as follows.

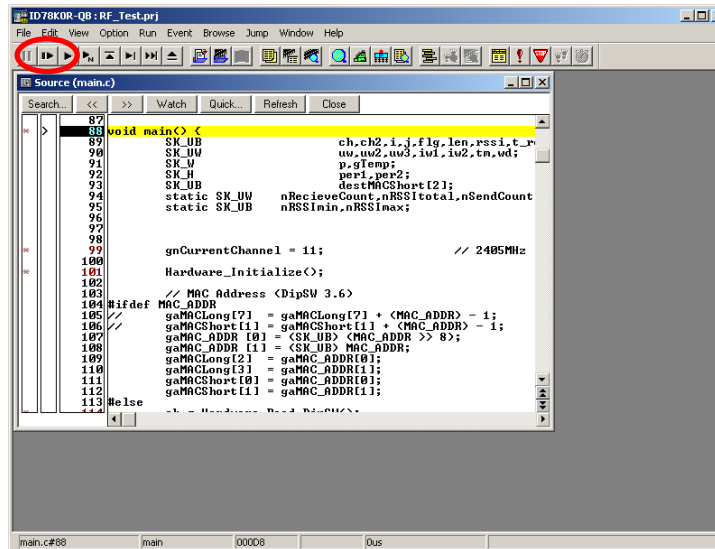
< Main window >



➡ For more details, please refer to the user's manuals of ID78K0R-QB.

## 3.11 Executing a program

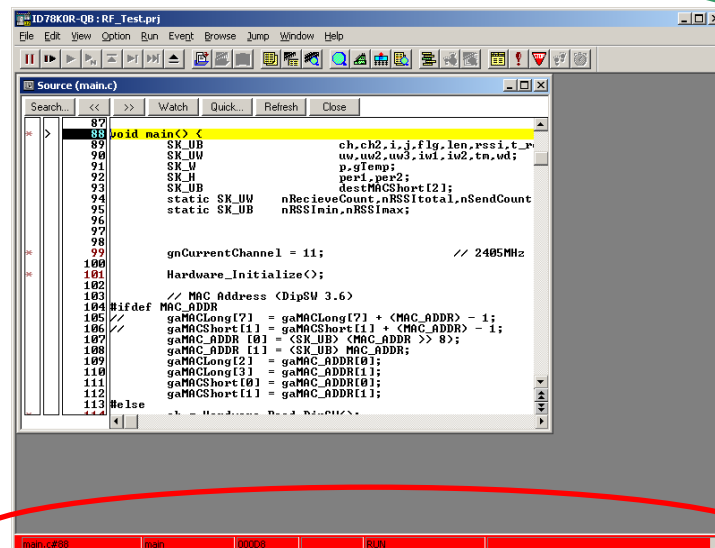
If you click “GO” , the execution of the code will start. You can know it by the red bar at the bottom.



The screenshot shows an IDE window titled "ID78KOR-QB: RF\_Test.prj". The menu bar includes File, Edit, View, Option, Run, Event, Browse, Jump, Window, and Help. The toolbar contains various icons, with the "GO" button (a play icon) circled in red. The main area displays the source code for "main.c" starting with a yellow highlight on the "void main() {" line. The status bar at the bottom shows "main.c#88", "main", "00008", and "0us".



Execute the program



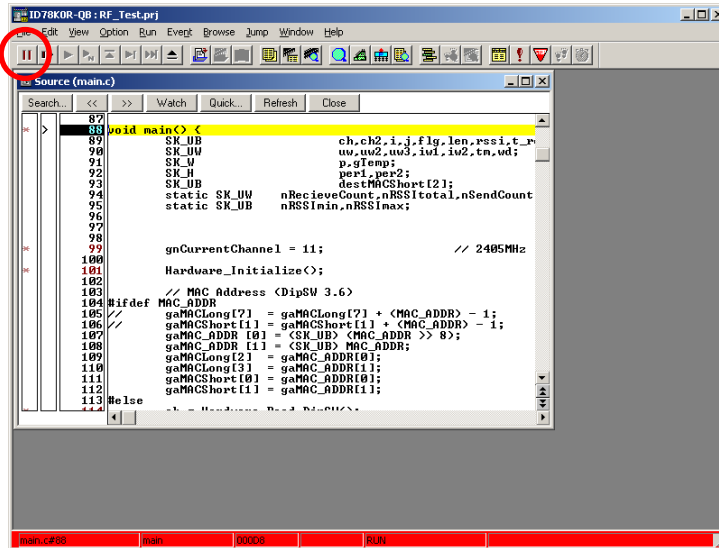
This screenshot shows the same IDE window after execution has started. The "GO" button is no longer circled. The status bar at the bottom is now highlighted in red and shows "main.c#88", "main", "00008", and "RUN".

While a program is running, the status bar will be red.

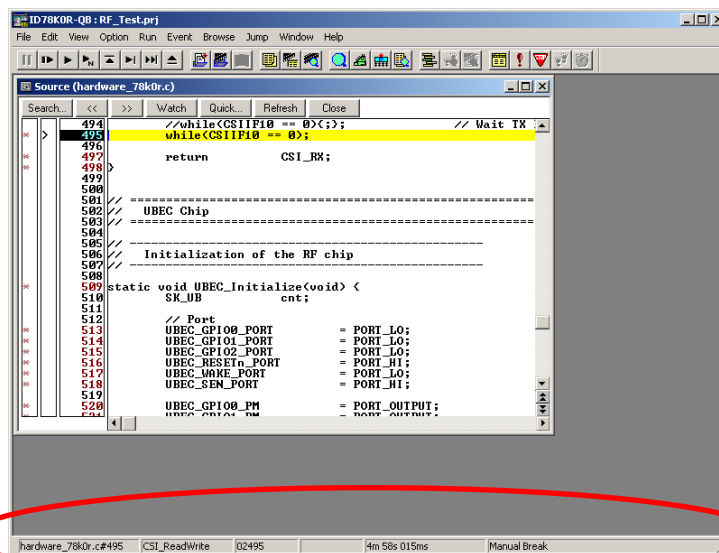
## 3.12 Stop a program

Now, you are going to stop the program.

Press the ID78K0R-QB's stop button , or in the menu, select [Run]→[Stop].



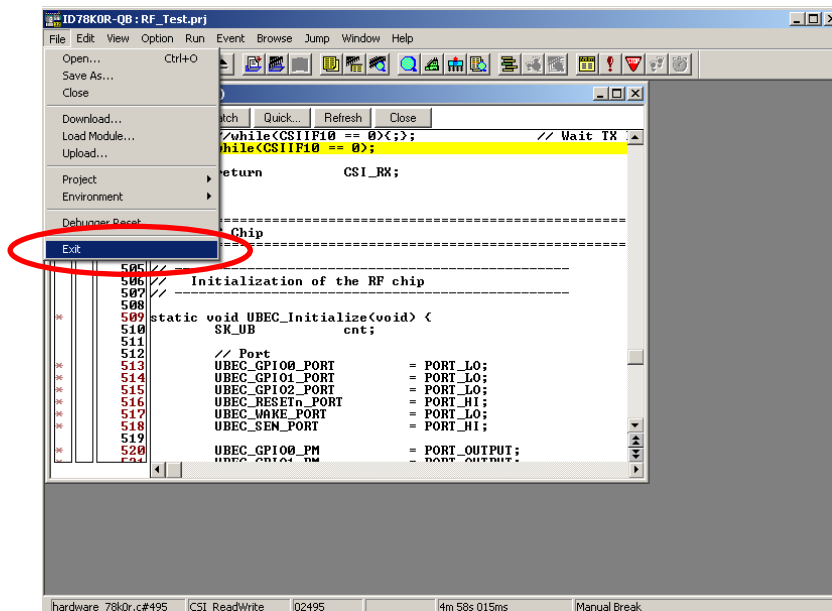
Stop the program



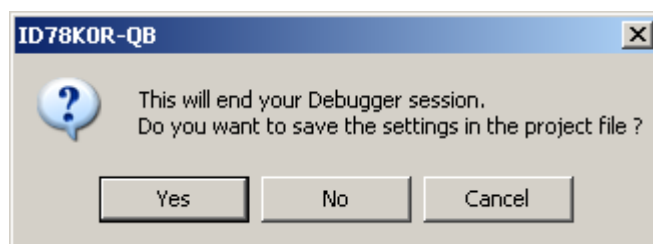
When the program stops, the status bar changes back to the original color.

### 3.13 Terminating integrated debugger (ID78K0R-QB)

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



The Exit confirmation dialog box is displayed.



If you push the "Yes", ID78K0R-QB is terminated after preserving a present environment.

If you push the "No", ID78K0R-QB is terminated without preserving a present environment.

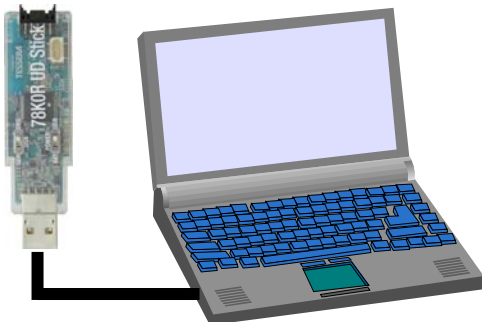
## 3.14 The RF Test Program

### 3.14.1 Procedure for one to one transmit/receive test

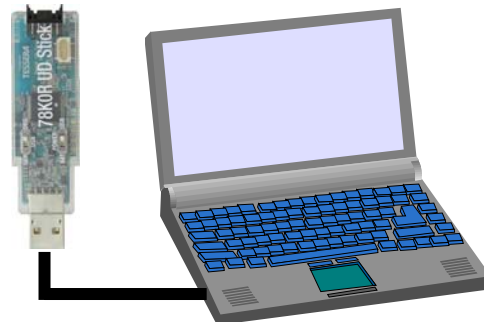
- 1). Assumption here in this section is, you have two 78K0R UD Stick. and you need identical number of PCs or one PC with more than one USB interface, Hereinafter, the 78K0R UD Stick, which you have loaded programs to, is referred as to the "**transmitter**" and the other one with USB interface to the second PC for debugging is referred as to "**receiver**", which send back the test result to the Transmitter. The receiver can work without PC, but now, you set this 78K0R UD Stick to the debug mode.

**Transmitter** use as Stand alone.  
Execute terminal software.

**Receiver** Debugger use.  
Execute ID78K0R-QB.



Short address : 0001



Short address : 0002

- 2). Preparation for Receiver

Start PM+ with referring to Chapter 3, then open "C:¥TK78K0R¥SAMPLE\_UDStick¥78K0R\_UDSTICK\_RF\_Test¥RF\_Test.prw".

Select "Tool" on menu bar, then "Compiler options..." to open "Compiler Options" window.

Select "Preprocessor" tab.


The statement "CPU78K0R,F0114664,MAC\_ADDR=0x0001" is in "Define Macro" field.

Change the statement to "

CPU78K0R,F0114664,MAC\_ADDR=0x0002,RECEIVER".

By defining "MAC\_ADDR=0x0002", the MAC short address of the receiver is set to "0002".

By defining "RECEIVER", the receiver is set to "receiver mode" as soon as the program starts.

Click the rebuild button  or select "Build", then "Rebuild", to rebuild. Set the switches on the Receiver "78K0R UD Stick" as shown below.

Switch	Setting
USB	DBG
POWER	USB

Start the debugger, load the module file, and then run the program on the debugger, with referring to "3.9 Starting integrated debugger". Now, the receiver "78K0R UD Stick" is standing by for receiving commands with wireless data from the transmitter.

### 3). Preparation for Transmitter

Next, you need to set for the transmitter "78K0R UD Stick" and the PC.

Set the switches on the transmitter "78K0R UD Stick" as shown below.

Switch	Setting
USB	SER
POWER	USB

Connect USB cable to the second PC, which you do not use for debugging. Confirm the power LED is lighted.

### 4). Hyper Terminal

On MS-Windows in your PC, please select [All Programs] -> [Accessory] -> [Communication] -> [HyperTerminal]

## Setting of HyperTerminal

Bits per second	115200
Data bits	8
Parity	None
Stop bits	1
Flow control	None

(Property -> Setting -> ASCII)

Local Echo OFF

No Line Feed

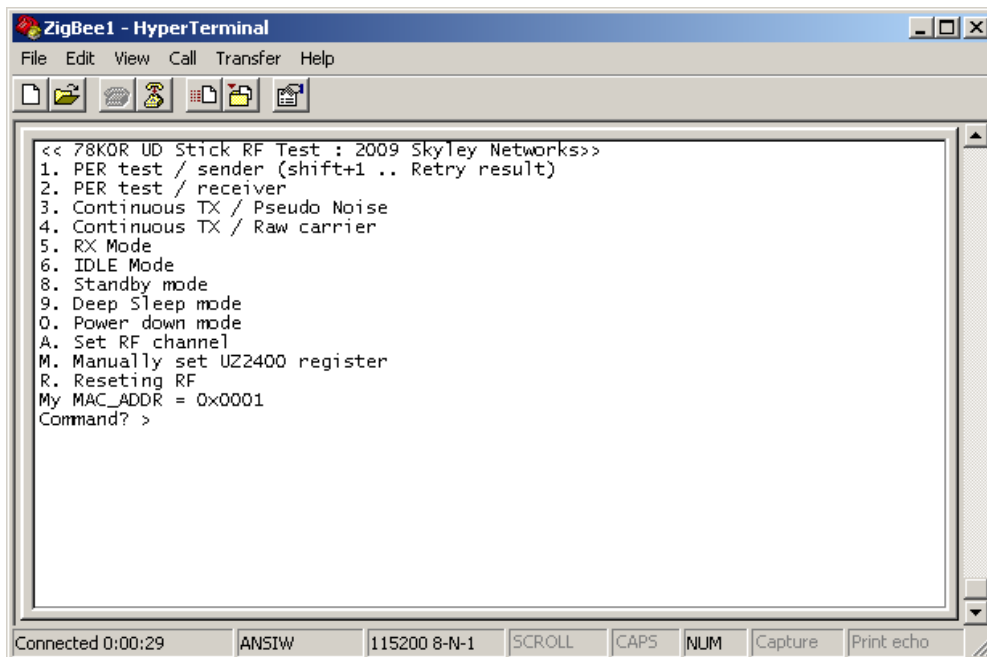
If you are not sure about the COM port number, click "Start" -> "Settings" -> "Control Panel" -> "System" -> "Hardware" -> "Device Manager" and check the number at NEC Electronics Starter Kit Virtual UART" under "Ports (COM & LPT)".

Press [ENTER] on your keyboard.

Now you will find the following opening menu in the window.

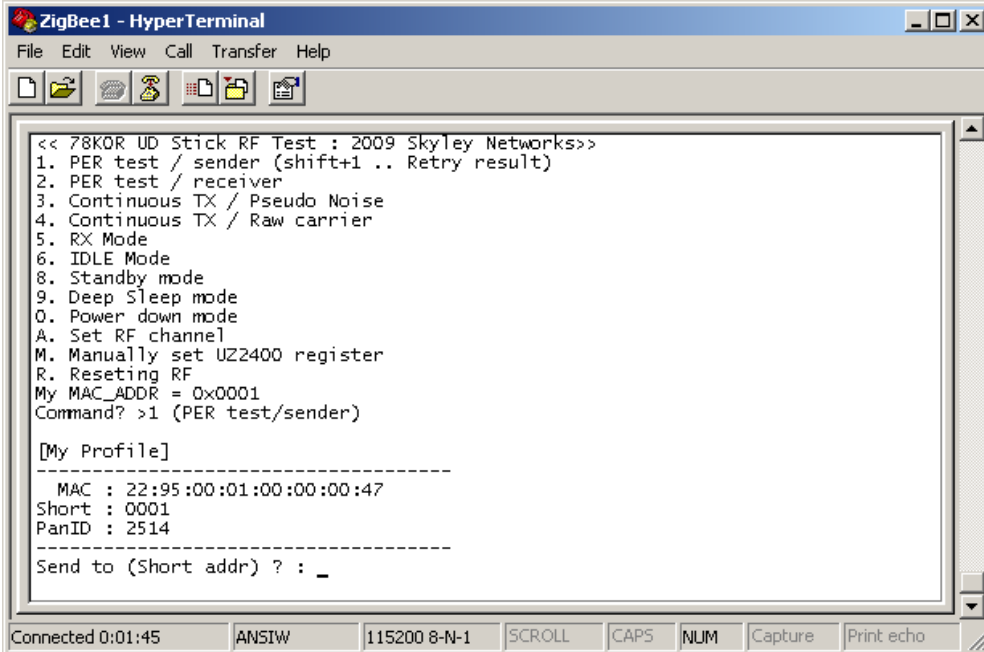
If the window is not displayed, check followings.

- Set the power switch of the transmitter "78K0R UD Stick" to "BAT" once, then set back to "USB" again.
- Re-confirm the setting for the COM port of hyper terminal is correct.



## 5). Execution of the Transmit/Receive Test

To initiate the PER, Packet Error Rate, test, please press “1” in the menu. You will see [My Profile], then, be asked for the destination of the PER test, as shown below.



```
<< 78KOR UD Stick RF Test : 2009 Skyley Networks>>
1. PER test / sender (shift+1 .. Retry result)
2. PER test / receiver
3. Continuous TX / Pseudo Noise
4. Continuous TX / Raw carrier
5. RX Mode
6. IDLE Mode
8. Standby mode
9. Deep Sleep mode
0. Power down mode
A. Set RF channel
M. Manually set UZ2400 register
R. Resetting RF
My MAC_ADDR = 0x0001
Command? >1 (PER test/sender)

[My Profile]
-----
MAC : 22:95:00:01:00:00:47
Short : 0001
PanID : 2514
-----
Send to (Short addr) ? : _

Connected 0:01:45  ANSIW  115200 8-N-1  SCROLL  CAPS  NUM  Capture  Print echo
```

Now, you may input “0002”.

Then, you will be asked how many packets you wish to consume in the PER test.

You may input “1000”.

Then, you will be asked the interval of packets in msec.

You may input 3 msec.

Then, the PER test will be executed.

You will see,

the number of packets sent, that is, 1000 as you input,

the number of the received packets,

the calculated PER in %

and the maximum and minimum RSSI values in the PER test.

[Note]

PER= Packet Error Rate

RSSI= Received Signal Strength Indication

```
ZigBee - HyperTerminal
File Edit View Call Transfer Help

PanID : 2514
-----
Send to (Short addr) ? : 0002
Send count (dec) ? : 1000
Interval (dec/msec) ? : 3
[Set channel to 11 (Cmd)]
Prepare to send..OK
[Set channel to 11 (Current)]
Request to result..OK

[Results]
-----
From      : 0001
To        : 0002
-----
Sent      : 1000
Recieved  : 1000
PER       : 0.0000%
RSSI      : max FF / min FD
-----

Press any key to the menu

Connected 0:04:57  ANSIW  19200 8-N-1  SCROLL  CAPS  NUM  Capture  Print echo
```

RSSI is expressed in the hexagonal value of 256 levels, which indicates the signal strength in the received signal. For more details of the RSSI value, please refer to the datasheet of the UZ2400 RF chip.

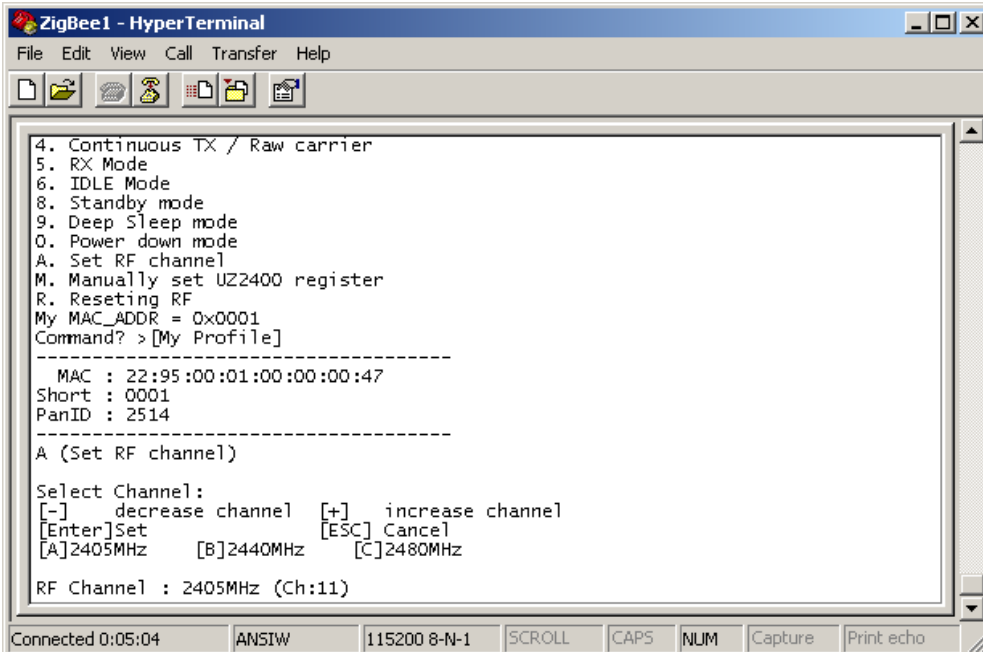
Please note the PER and the RSSI are measured at the receiver side. The receiver does not send back the test packets, but only the test result.

## 6). Channel setting

In the previous example, you may have also found the RF channel used in this test is the Channel 11. The channel is specified by the IEEE 802.15.4 specification.

The channel 11 is assigned at 2405 MHz. You can change the channel in the PER test in 5MHz step to the maximum channel of 26th at 2480 MHz.

To do it, please press “A” in the command prompt. Then, please choose the channel by [+], [-], [A], [B], or [C]. In the example below, the channel 23th, 2465 MHz, was selected.



```
ZigBee1 - HyperTerminal
File Edit View Call Transfer Help
[Icons]
4. Continuous TX / Raw carrier
5. RX Mode
6. IDLE Mode
8. Standby mode
9. Deep Sleep mode
0. Power down mode
A. Set RF channel
M. Manually set UZ2400 register
R. Resetting RF
My MAC_ADDR = 0x0001
Command? > [My Profile]
-----
MAC : 22:95:00:01:00:00:47
Short : 0001
PanID : 2514
-----
A (Set RF channel)
Select Channel:
[-] decrease channel  [+] increase channel
[Enter]Set           [ESC] Cancel
[A]2405MHz          [B]2440MHz          [C]2480MHz
RF Channel : 2405MHz (Ch:11)
Connected 0:05:04  ANSIW  115200 8-N-1  SCROLL  CAPS  NUM  Capture  Print echo
```

To execute the PER test at the channel 23, press [Enter] in your keyboard, then, choose "1" to initiate the PER test mode. Then, you may input 1000 packet in 5 msec interval to see the following example. Please confirm the channel used is 23th in the display. Please note the receiver will learn which channel is to be used for the test automatically.

```
[My Profile]
-----
MAC : 22:95:78:01:00:00:00:47
Short : 0001
PanID : 2514
-----
Send to (Short addr) ? : 02
Send count (dec) ? : 1000
Interval (dec/msec) ? : 5
[Set channel to 11 (Cmd)]
Prepare to send..OK
[Set channel to 23 (Current)]
Send.. 0
Request to result..OK

[Results]
-----
From : 0001
To : 0002
-----
Sent : 1000
Recieved : 1000
PER : 0.0000%
RSSI : max FF / min FF
-----
```

## 7). Adjusting the output power

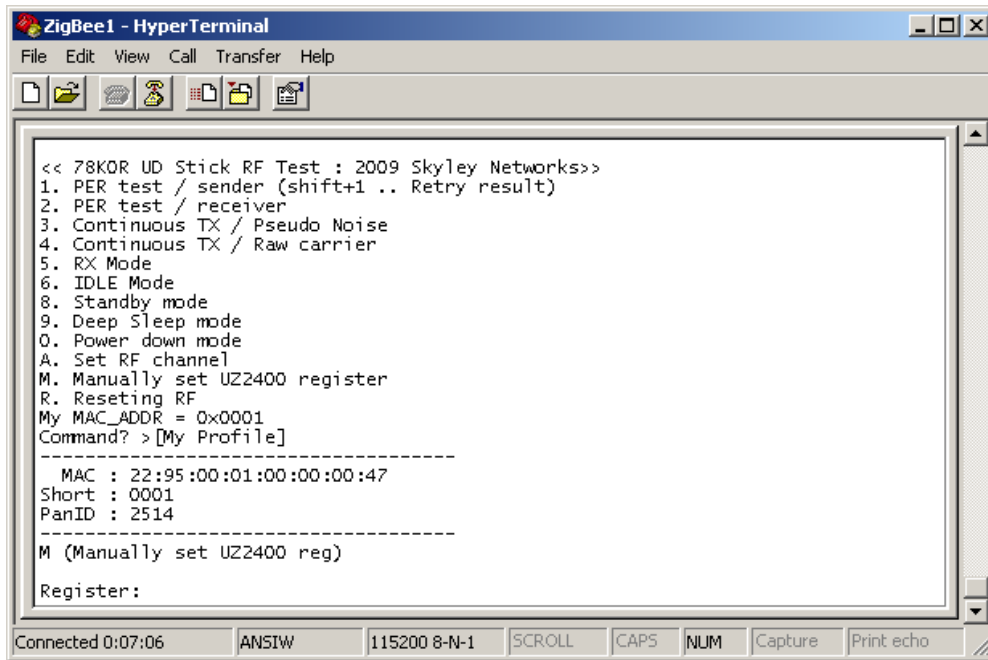
You may wish to control the output power in the PER test.

For it, please select “M” in the menu.

You will be asked the register ID. Please input “274”.

Then you will see, “LREG[274] : C4 >”.

It means the current value at the register [274] is 0xC4h, which means 0 dB.  
0xC4h is the reset default.



```
<< 78K0R UD Stick RF Test : 2009 Skyley Networks>>
1. PER test / sender (shift+1 .. Retry result)
2. PER test / receiver
3. Continuous TX / Pseudo Noise
4. Continuous TX / Raw carrier
5. RX Mode
6. IDLE Mode
8. Standby mode
9. Deep Sleep mode
0. Power down mode
A. Set RF channel
M. Manually set UZ2400 register
R. Resetting RF
My MAC_ADDR = 0x0001
Command? > [My Profile]
-----
MAC : 22:95:00:01:00:00:47
Short : 0001
PanID : 2514
-----
M (Manually set UZ2400 reg)
Register:
```

The register bits are defined as follows,

LREG[274]: [7:6] -> large scale tuning

C4: 0 dB

81: -8 dB

09: -16 dB

01: -24 dB

LREG[203]: [7:3] -> small scale tuning

000000: 0 dB

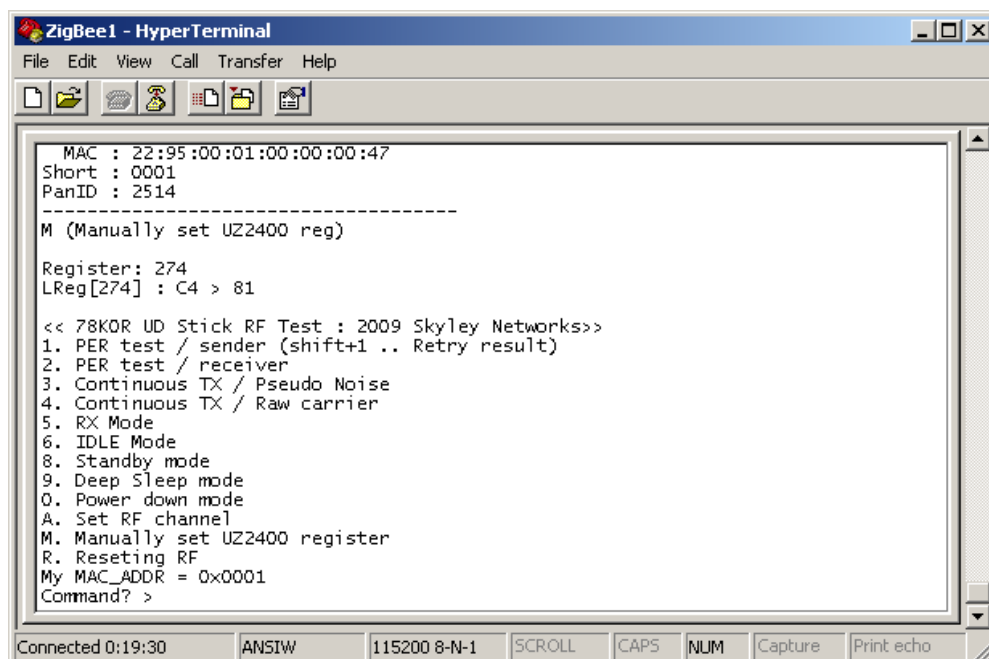
000001: -0.1dB

|  
111111: -8.00 dB

For instance, if you wish -8 dB, please input “81”, as follows,

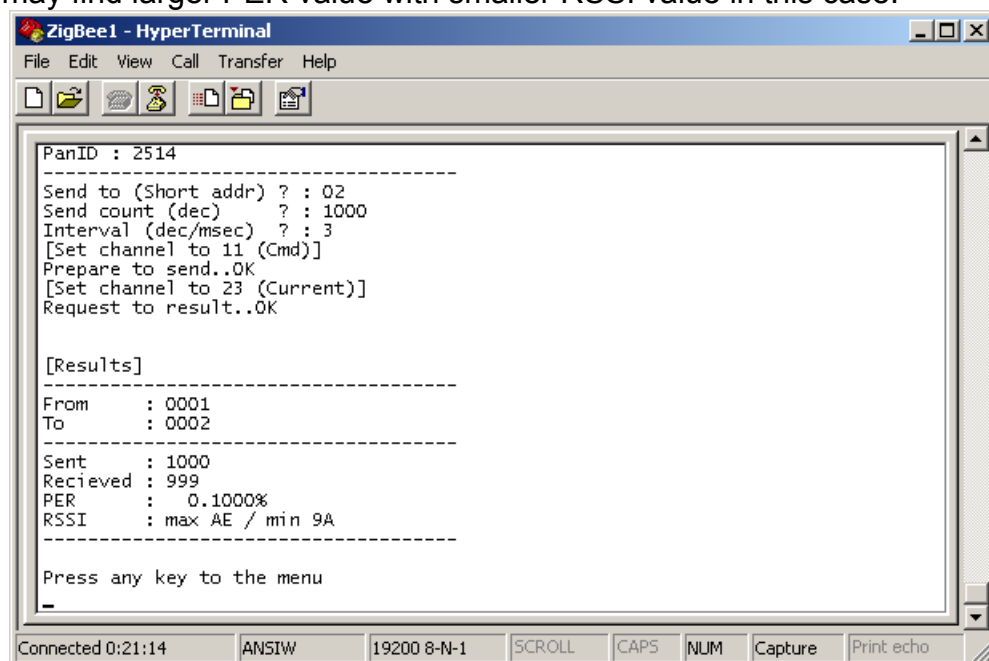
“LREG[274] : C4 > 81”

Then, you will start the PER test.



```
ZigBee1 - HyperTerminal
File Edit View Call Transfer Help
[Icons]
MAC : 22:95:00:01:00:00:00:47
Short : 0001
PanID : 2514
-----
M (Manually set UZ2400 reg)
Register: 274
LReg[274] : C4 > 81
<< 78K0R UD Stick RF Test : 2009 Skyley Networks>>
1. PER test / sender (shift+1 .. Retry result)
2. PER test / receiver
3. Continuous TX / Pseudo Noise
4. Continuous TX / Raw carrier
5. RX Mode
6. IDLE Mode
8. Standby mode
9. Deep Sleep mode
0. Power down mode
A. Set RF channel
M. Manually set UZ2400 register
R. Resetting RF
My MAC_ADDR = 0x0001
Command? >
```

You may find larger PER value with smaller RSSI value in this case.



```
ZigBee1 - HyperTerminal
File Edit View Call Transfer Help
[Icons]
PanID : 2514
-----
Send to (Short addr) ? : 02
Send count (dec) ? : 1000
Interval (dec/msec) ? : 3
[Set channel to 11 (Cmd)]
Prepare to send..OK
[Set channel to 23 (Current)]
Request to result..OK

[Results]
-----
From : 0001
To : 0002
-----
Sent : 1000
Recieved : 999
PER : 0.1000%
RSSI : max AE / min 9A
-----
Press any key to the menu
_
```

Please note this adjustment is applied only to the transmitter. The receiver always sends back the test results with the 0 dB output power using the channel 11<sup>th</sup>.

### **3.14.2 PER test / receiver**

The Menu 2 sets the 78K0R UD Stick to the receiver in the PER test. If you have two PCs, you can connect two 78K0R UD Stick to each of two PCs, then, you will apply this mode to one of them. In your current case, your receiver board is now being connected to the debugger. Therefore, you cannot access to these menu to utilize this mode setting. Alternatively, you have set the receiver 78K0R UD Stick to the receiver mode by setting the compiler option.

### **3.14.3 Continuous TX / Pseudo Noise**

The Menu 3 initiates the modulated RF transmission. The data carried are pseudo random numbers. You can define the channel using the menu 9, and the output power using the menu 0.

### **3.14.4 Continuous TX / Raw carrier**

The Menu 4 initiates the carrier transmission. The output power is not 0 dB as a reset default. You can define the channel using the menu 9.

### **3.14.5 RX Mode**

The Menu 5 initiates the receiver mode.

### **3.14.6 IDLE MODE**

The Menu 6 sets the UZ2400 into the IDLE mode.

### **3.14.7 Standby MODE**

The Menu 8 sets the UZ2400 into the Standby mode.

### **3.14.8 Deep Sleep mode**

The Menu 9 sets the UZ2400 into the Deep Sleep mode.

### **3.14.9 Power down mode**

The Menu 0 sets the UZ2400 into the Power down mode.

### **3.14.10 Set RF channel**

The Menu A allows you to set the RF channel.

### **3.14.11 Manually set UZ2400 register**

The Menu M allows you to set the UZ2400 registers.  
Please refer to the datasheet of the UZ2400 RF chip for the definition of registers.

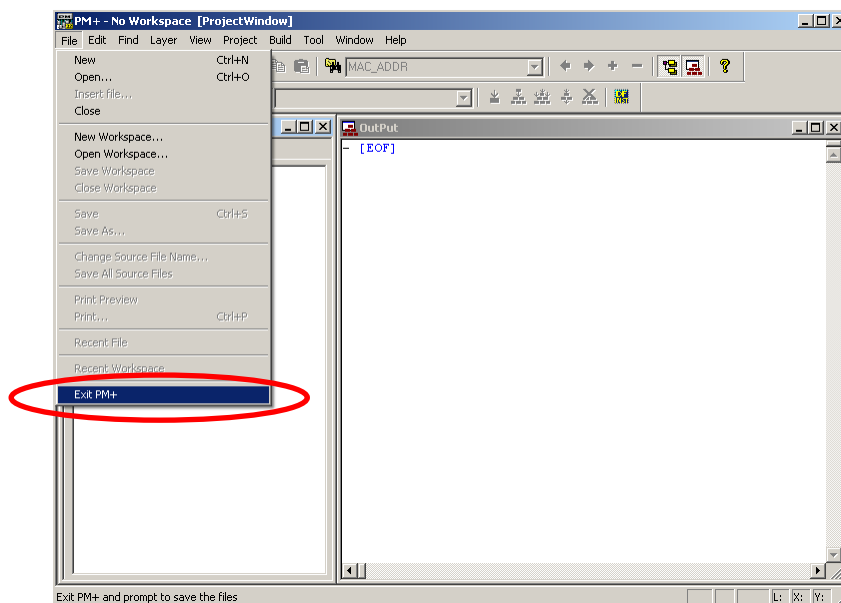
### **3.14.12 Resetting RF**

The Menu R allows you to reset the UZ2400 registers.

## 3.15 Terminating PM +

In the PM + menu, select [File]→[Save Workspace].  
Then, select [File]→[Close Workspace].

In the PM + menu, select [File]→[Exit PM +].



PM + ends.

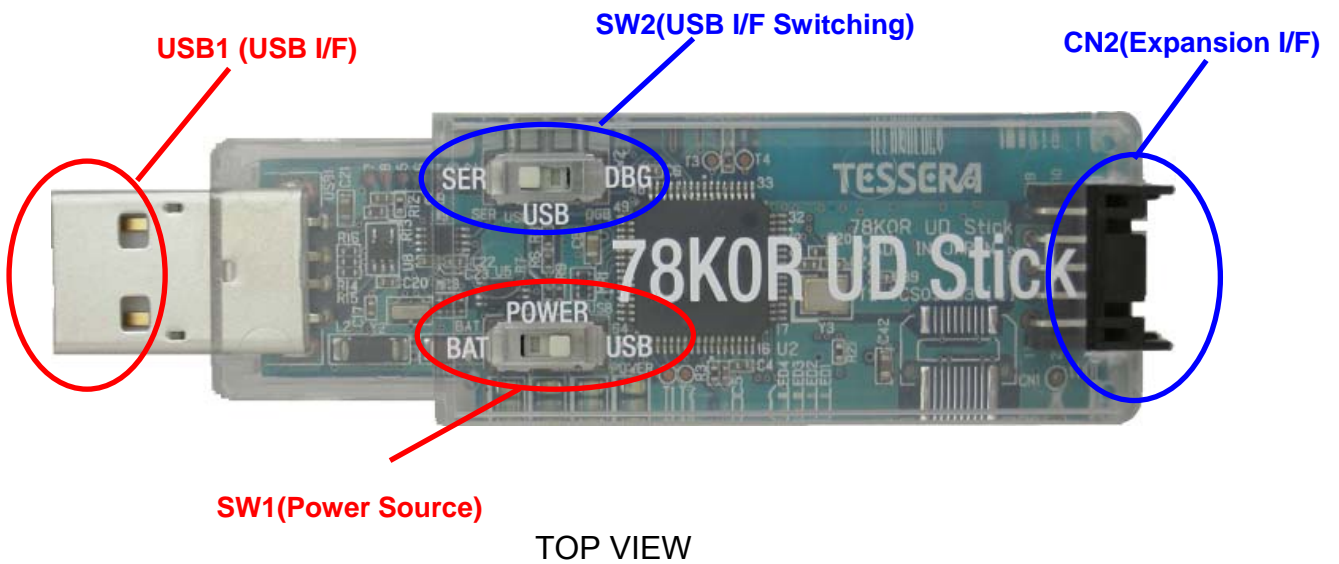
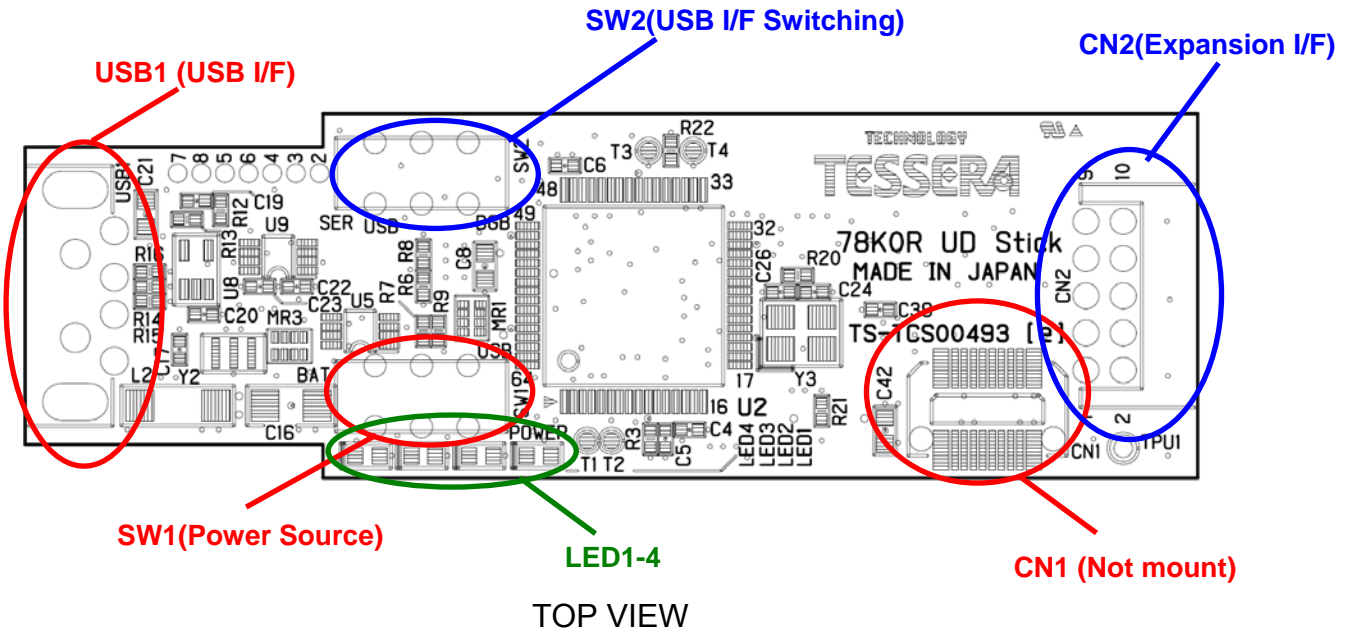
## 4 Hardware Specifications

In this chapter, the hardware of 78K0R UD Stick will be explained.

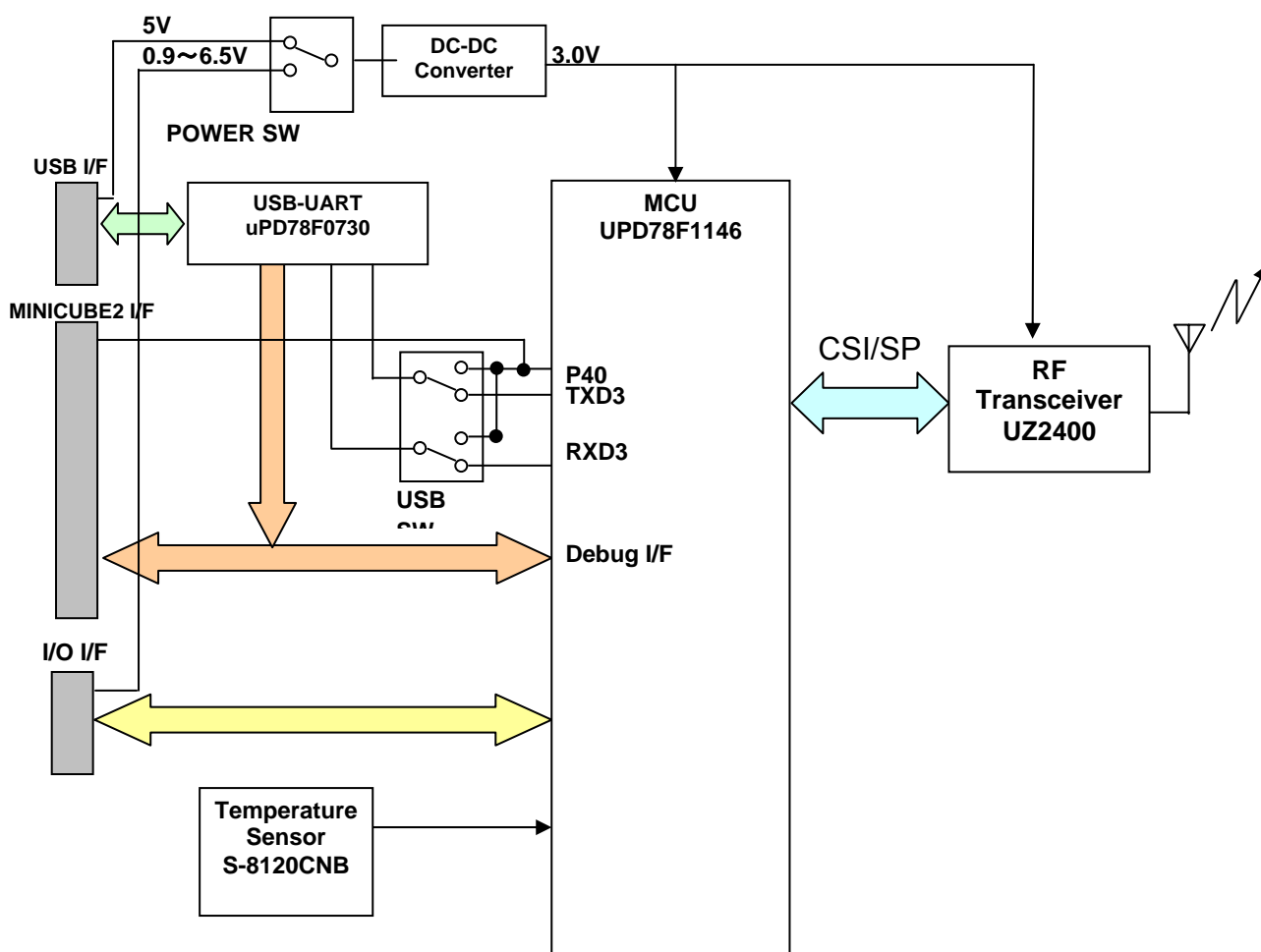
Microcontroller	uPD78F1146A ※78K0R/KE3
Clock	CPU Main Clock: 8MHz(Internal oscillator) 16/8/4/2/1MHz(Generated from the RF transceiver clock) CPU Sub Clock : 32.768KHz
Interface	USB [Type A] (USB1) Expansion Connector (CN2) MINICUBE2 connector(CN1, NotMounted)
Power supply voltage	5.0V(Supply from USB)、 1.5V(Supply from a AA battely)
Input/output for operation check use	LED x3 (LED2, LED3, LED4) Temperature sensor(U1)
Other hardware	Power LED(LED1)

\* The name with bracket is the name printed on the board.

## 4.1 Layout of hardware functions



## 4.2 Block diagram



## 4.3 Switches and LEDs

### 4.3.1 SW1: POWER

Selection of power source: USB power or Expansion I/F (CN2)

Setting of SW1 (Power supply select)

USB Power	USB
CN2: Expansion I/F	BAT



SW1: TOP VIEW

### 4.3.2 SW2: USB

The switch for selecting the USB I/F use. : Debug or General Serial Communication

When it is set to "SER", it enables serial communication using UART3. Connect 78K0R UD Stick to the USB I/F after switch setting.

Setting of SW2 (USB I/F setting)

Normal mode	SER
Debug mode (USB use)	DBG



SW2: TOP VIEW

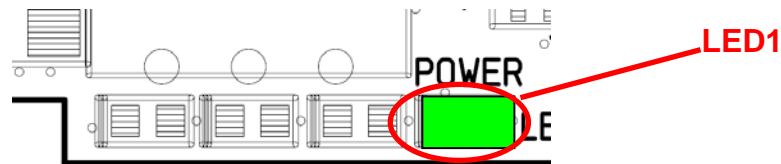
### 4.3.3 LED1: Power Indication

LED1 is a green LED to indicate the availability of power.

You can turn off the LED1 with the output high from the " P17/TI02/TO02" .

LED1 status

Status	LED	
Power ON	Green	If port P17 is output high, LED is off.
Power ON	Off	
Power OFF	Off	



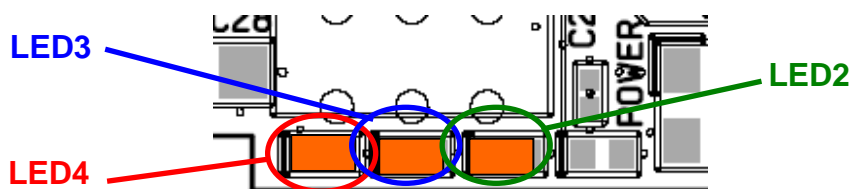
LED1 layout(TOP VIEW)

### 4.3.4 LED2, LED3, and LED4

LED2, LED3, and LED4 are for application. They emit orange by setting the port output of P40, P41, or P40 of the MCU low, respectively.

LED2, LED3, and LED4

	Name	MCU PIN	Port Level
LED2	P62	P62	Low for orange High for off
LED3	P61	P61/SDA0	Low for orange High for off
LED4	P60	P60/SCL0	Low for orange High for off



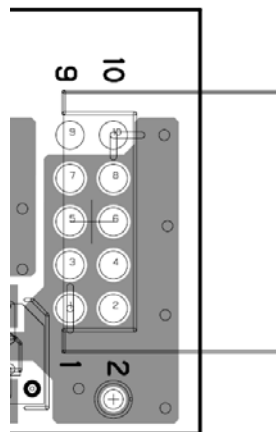
LED2, LED3, and LED4: TOP VIEW

### 4.3.5 CN2

Expansion connector: CN2

CN2: Hirose DF11-10DP-2DS

CN2	Name	Connection to MCU	Notes
1	GND	GND	
2	BATTERY	N.C.	Battery supply
3	P12	P12/SO00/TxD0、 P77/KR7/INTP11	
4	P11	P11/SI00/RxD0、 P76/KR6/INTP10	
5	P141	P141/PCLBUZ1/INTP7、 P05/TI05/TO05	
6	P10	P10/SCK00、 P75/KR5/INTP9	
7	P25	P25/ANI5	
8	P23	P23/ANI3	
9	P24	P24/ANI4	
10	GND	GND	



Location of CN2: TOP VIEW

### 4.3.6 U1

Temperature sensor (SII S-8120CNB)

Temperature sensor "U1" is connected to the port "P27/ANI7".

You can read the temperature sensor output voltage from "ANI7" for converting to the temperature

Please refer to the data sheet for detail of temperature sensor.

Temperature sensor

Terminal CPU name at connection destination	Notes
P27/ANI7	Temperature Coefficient : $-8.20 \text{ mV/}^\circ\text{C}$ Typ. Output voltage : $1.474\text{V}$ Typ $T_a=30^\circ\text{C}$  For instance) Temperature $40^\circ\text{C}$ : $P27/ANI7 = 1.474 + ((40-30) \times (-0.0082))$ $= 1.392(\text{V})$

## 4.4 Power supply

There are two choices to supply power to the board, USB or a AA battery via CN2. Please refer to "4.3.1SW1: POWER".

Please replace the battery with a new one, if the voltage level goes down to 0.9V.

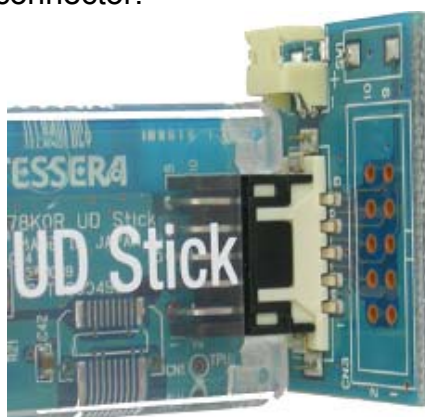
Below the voltage level of 0.9V, functions of the board are not guaranteed. The battery voltage can be checked at the port as shown below.

Battery check

Signal name	Terminal CPU name at connection destination	Notes
BT_MONI	P26/ANI6	26.4% of the battery output is available at ANI6 For instance, If the battery level is 1.5V, the level of the BT_MONI = $0.264 \times 1.5 \text{ V}$ = 0.397V
LOW_BAT	P30/INTP3/RTC1HZ	If supply voltage is fall below 1V, the signal will be Low output. Use the internal pull-up resister(PU3).

## 4.5 Connection of the adapter board

Adapter board is connected to expansion connector(CN2). You can connect the battery to the "CN2" on the adapter board. CN3 is the multipurpose connector.



Connection of the adapter board

## 5 The IEEE 802.15.4 MAC Sample Program

Two sample implementations utilizing the MAC stack are offered in this evaluation kit.

## 5.1 The MAC Sample program :TextChat

This chapter introduces the usage of MAC application

The MAC Sample program is developed to provide with a simple example to construct a star network utilizing the IEEE 802.15.4 PHY/MAC standard.

The MAC Sample Program offers,

1. Designation of a network coordinator in a star configuration
2. Text chat between a coordinator and an end device

To use the MAC Sample Program, you need to prepare at least two PC with a USB interface or one PC with more than one USB interface, and two 78K0R UD Stick.

The MAC Sample Program is provided in the form of the C source codes.

If you wish to tailor the sample program to meet your specific needs, you can edit the source code, re-compile it with debug build to generate a load module file, then, start the debugger to load the tailored execution code on to the microcontroller for further debugging on the project manager PM +. In this procedure, the Flash programmer is not required. However, because the USB connection to instruct operation to the program is occupied for the debugging purpose, alternatively, you can make a release build to achieve a new hex file, on the project manager PM +.

As a general remark, please respect your local regulation of electro-magnetic RFssion. In general, it is suggested to use the 78K0R UD Stick in a radio anechoic chamber.

It supports text chat for one coordinator and 4 end devices.

### 5.1.1 Programming to the 78K0R UD Stick

For chatting, please prepare minimum 2 78K0R UD Stick.  
You need identical numbers of PCs. or one PC with more than one USB interface,

One 78K0R UD Stick will be "Coordinator". Other 1-4 78K0R UD Stick will be "End device".

You use the same project files for both "Coordinator" and "End device".

Start PM+, and open the file "

C:\TK78K0R\SAMPLE\_UDStick\78K0RUZSTICK\_MAC\_Sample\78K0RUZSTICK\_MAC\_Sample.prw".

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

Select "Preprocessor" tab on "Compiler Options" window.

To write programs to the first 78K0R UD Stick, enter

"CPU78K0R,F114664,MAC\_ADDR=0x0001" on "Define Macro". For the second and third 78K0R UD Stick, enter "CPU78K0R, F114664,MAC\_ADDR=0x0002" and "CPU78K0R, F114664,MAC\_ADDR=0x0003". The number "x" of " MAC\_ADDR=x" must be a unique number.

Click rebuild button on PM+ or select "Build" -> "Rebuild" on menu bar to rebuild.

Start the debugger from PM+, then write different programs to each 78K0R UD Stick (for the information about how to write programs, refer to "3.1 Starting PM+" through "3.9 Starting integrated debugger".)

### 5.1.2 Setting up the 78K0R UD Stick to your PC

Set the 78K0R UD Stick as shown below. Then, connect to USB interface on the PC.

Switch	Setting
USB	SER
POWER	BAT

Start Hyper Terminal with referring to "3.14 RF Test Program".

Settings of the Hyper Terminal should be set as follows

Bits per second	115200
Data bits	8
Parity	None
Stop bits	1
Flow control	None

When the Hyper Terminal starts, run the sample application by setting the POWER switch to USB.

In the same way, connect the other 78K0R UD Stick to PC, and start Hyper Terminal. If the PC has more than one USB ports, you can connect to more than one 78K0R UD Stick, and you can start more than one Hyper Terminals for those COM ports on each 78K0R UD Stick.

#### 4). Hyper Terminal

Now you will find the following opening menu in the window.  
If not, please try Power On Reset by switching the POWER switch to BAT,  
and, then, back to the USB position.

```
<< 78K0R+UD Sample Application: Skyley Networks >>
My MAC extended address
= 22950000100000047

Command >
```

Then, press Enter,

```
[Help] -----
S: Send Message
M: MLME Associate test
C: Start Coordinator test
-----

Command? >
```

Please do the same for your other 78K0R UD Stick and PCs.

### 5.1.3 Designation of a coordinator

Now, you must decide which 78K0R UD Stick is a coordinator.  
Go to the PC of the coordinator, and press C.

```
Command? >C  
  
> MLME-START.request  
> MLME-START.confirm  
> Status:00  
  
Command? >
```

Now the coordinator has started.

### 5.1.4 Network Association

For other PCs for other 78K0R UD Stick, please press M.

```
Command? >M  
  
> MLME-ASSOCIATE.request  
> MLME-ASSOCIATE.confirm  
> Associated ShortAddr:4321  
> Status:00  
  
Command? >
```

Now, this particular 78K0R UD Stick was associated to the network as an end device with the short address of 4321. Please repeat this step for your third, fourth, and possibly fifth 78K0R UD Stick.

On the coordinator side, you will find the following message, if the association is successful.

```
> MLME-ASSOCIATE.indication
> from 2295000200000047 associated to 4321

[Help] -----
S: Send Message
-----

Command? >
```

### 5.1.5 Text Chat

Now the network is prepared for you to start text chat between an end device and the coordinator.

At first, you may start with the coordinator.

Press S, then input the short address of an end device, 4321 in this example, then, input your text message, up to 102 bytes.

```
Command? >S

> MCPS-DATA.request
> Send to (short address) ? 4321
> Message ? Hello!

Command? >
```

You will find the following message on the end device, 4321.  
The sender's short address is "1975", and the PAN ID is 2420 in this example.

```
Command? >  
> MCPS-DATA.indication  
> from 1975/2420  
Hello!
```

Now, you can reply from the end device "4321" to the coordinator "1975" by inputting S, 1975, and your reply text.

# 6 Troubleshooting

This chapter describes how to solve troubles you may face.

## 6.1 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 the switch on the kit are correct with referring to "[1.3 Installation of USB Driver](#)".

### 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.

## 6.2 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.

## 6.2.1 "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 the switch on the kit are correct with referring "[1.3 Installation of USB Driver](#)".

### Check Point 3

Confirm the USB driver installation with referring to "[1.3.3 Completion of USB Driver Installation](#)".

### Check Point 4

If above 3 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.

## 6.2.2 "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 "3.4 Configuration of Linker Option". Also remember the code you set for the security ID.

After this, erase the flash memory with referring to "[7.4 Erase of flash memory](#)".

### **6.2.3 "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 "3.4 Configuration of Linker Option". If it is not correct, then set correctly.

#### **Check Point 2**

Erase the flash memory with referring to "[7.4 Erase of flash memory](#)".

### **6.2.4 "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 "3.4 Configuration of Linker Option". Do the same checking processes as "[4.2.3 The on-chip debug function had been disabled in the device. \(F0c79\)](#)".

## 7 Other Information

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

[7.1 Create a new workspace \(project\)](#)

[7.2 Register additional source file](#)

[7.3 Debugger tips](#)

[7.4 Erase microcontroller built-in flash memory](#)

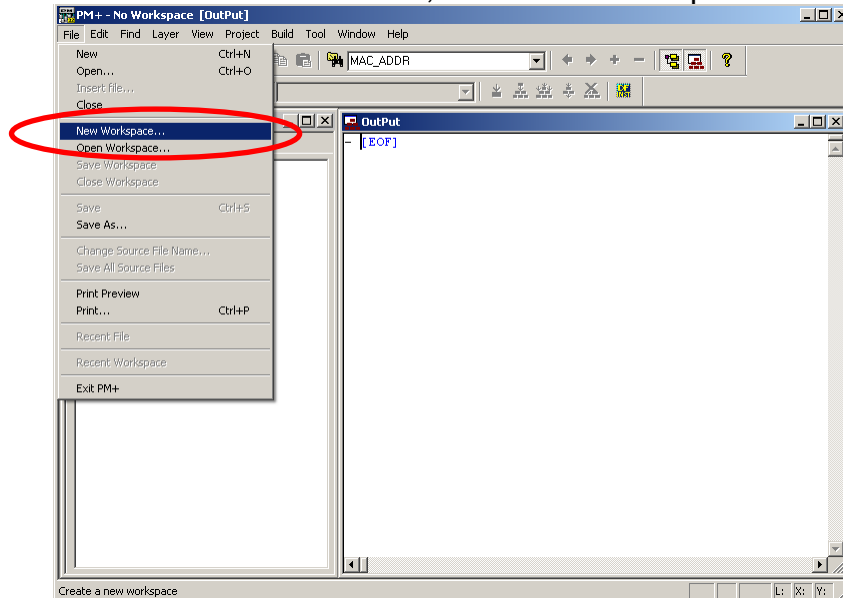
[7.5 Circuit diagram](#)

## 7.1 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:**

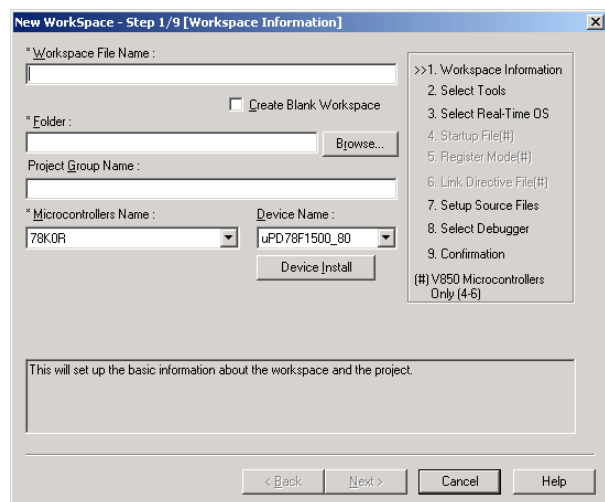
-> Specify this item if wishing to manage multiple projects together in function units.  
If nothing is specified, this item is the same as the workspace file name.

**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.

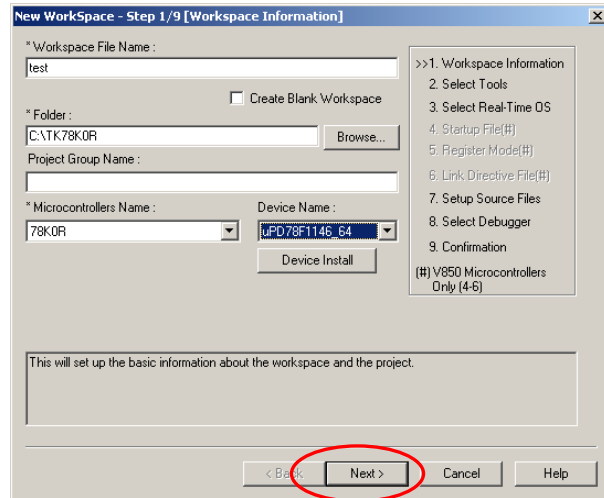
Workspace file name  
→ test

Folder  
→ C:\TK78K0R

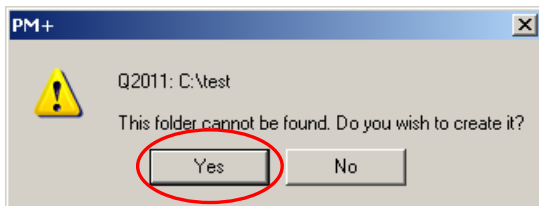
Project Group Name  
→ (no input)

Microcontroller Name  
→ 78K0R

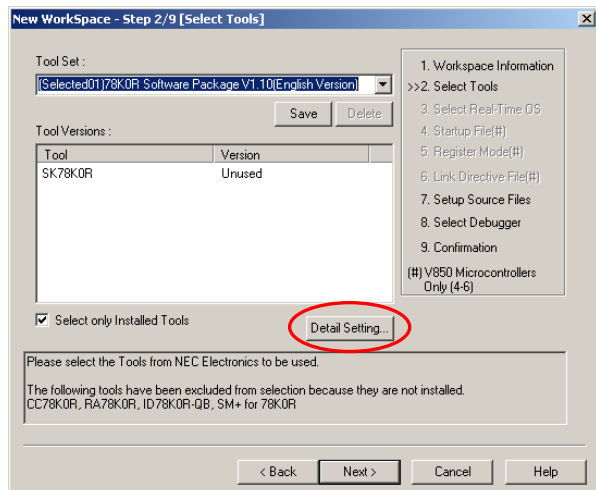
Device Name  
→ uPD78F1146\_64



Click **Next >** button



Click **Yes** button



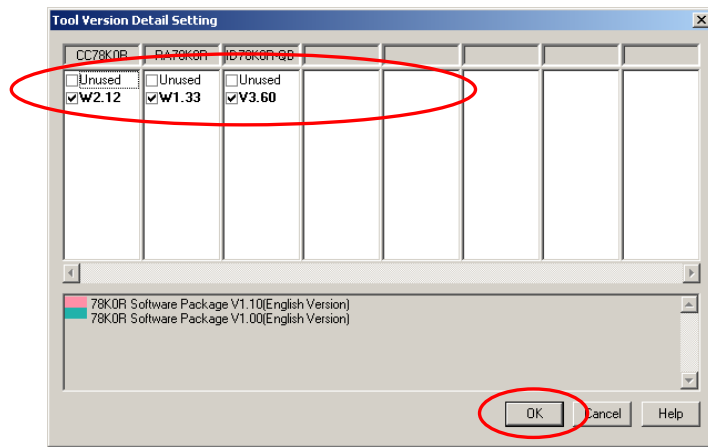
Click **Detail Setting** button

Set the version of tools as follows.

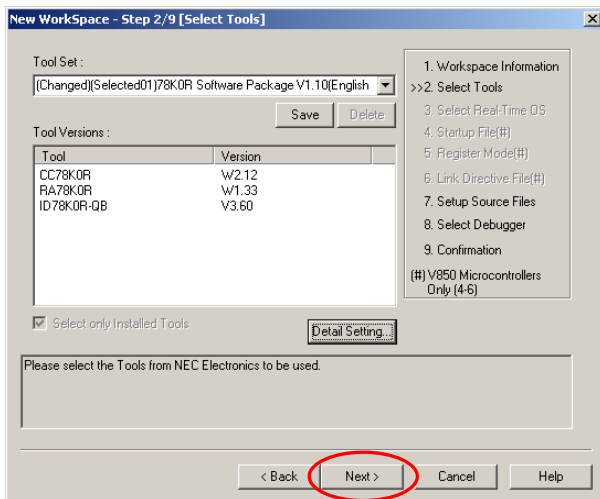
CC78K0R: W2.12

RA78K0R: W1.33

ID78K0R-QB: V3.60

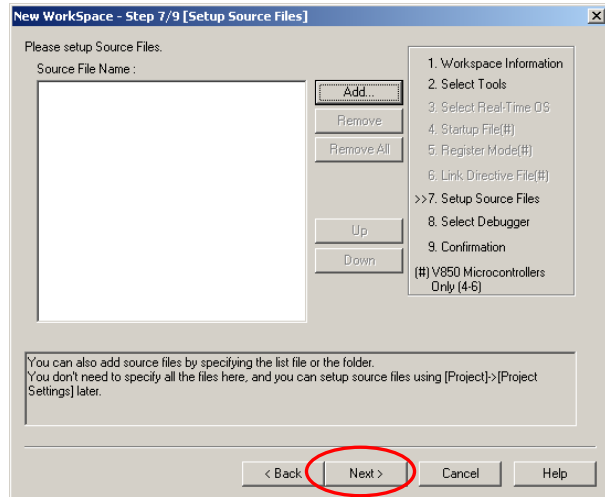


Select tools as above screenshot, then click **OK** .

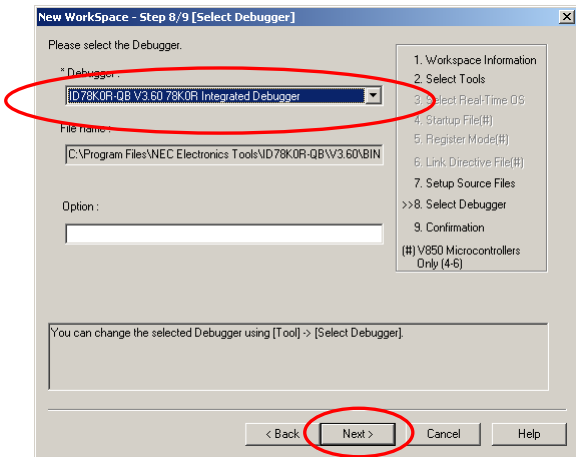


Click **Next >**





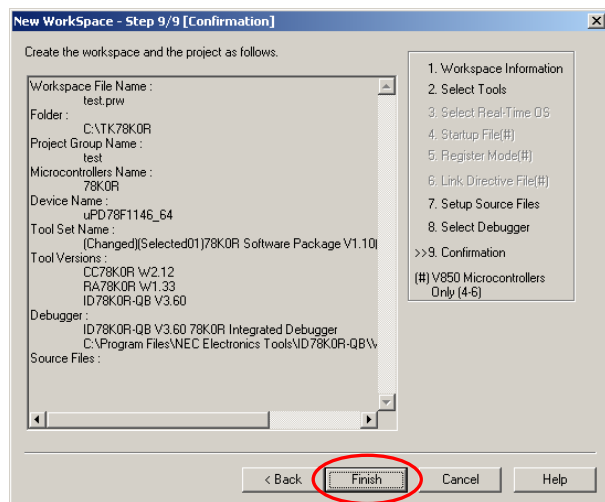
Click **Next >**



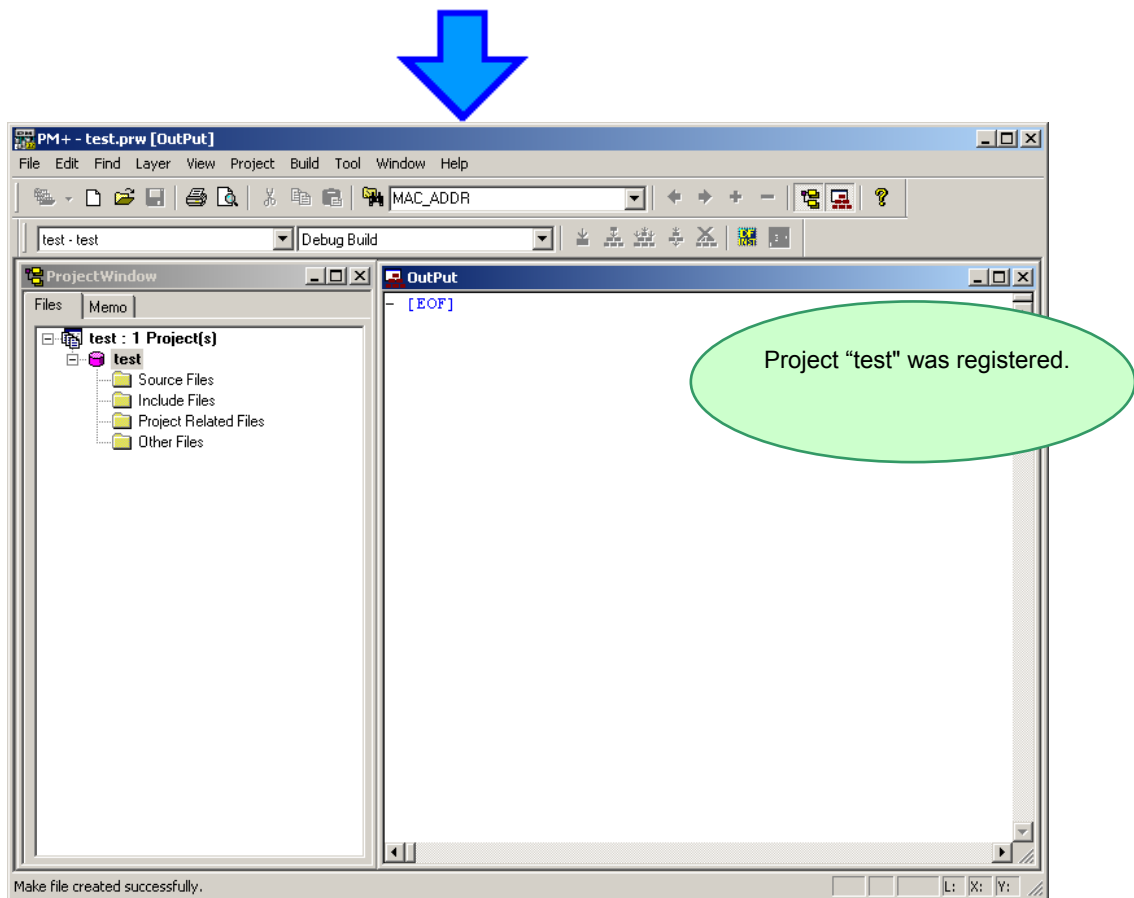
Click **Next >**

Select **ID78K0R-QB V3.60**

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 "[7.2 Register additional source file](#)".

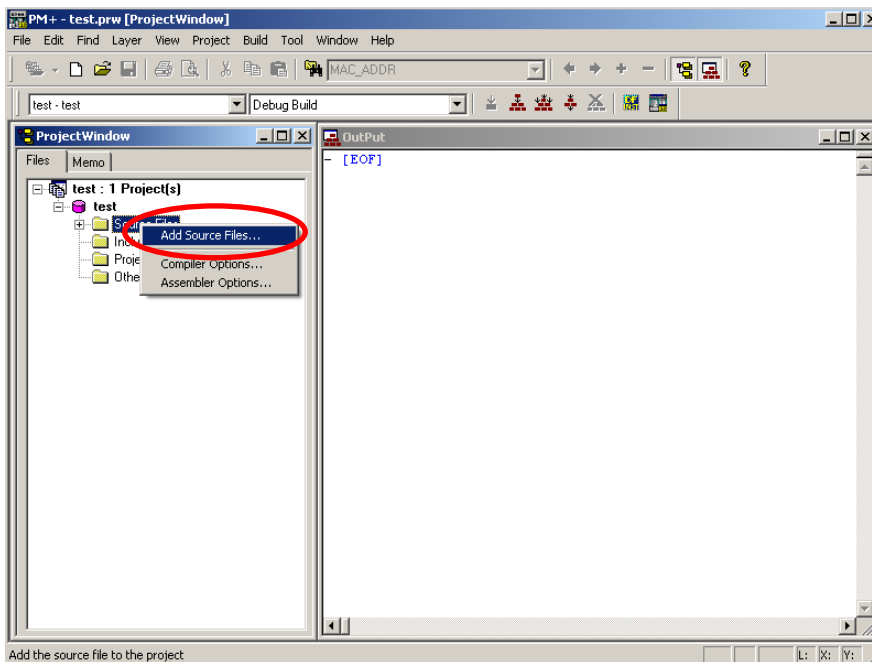
Also, you need to do the settings for on-chip debug. Please refer to "[3.4 Set Linker Options](#)", "[3.5 Set Compiler Options](#)", and "[3.7 Check Debugger Settings](#)".

## 7.2 Registration of new source files

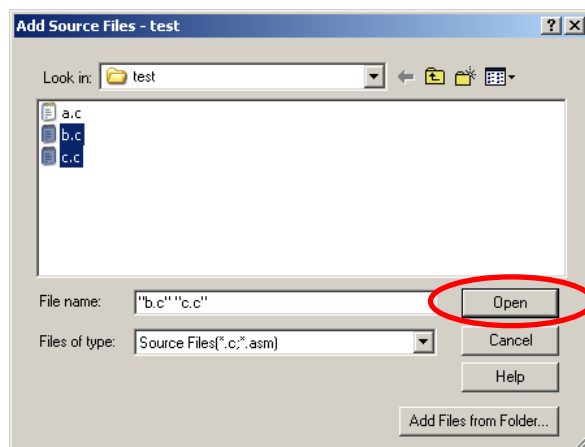
Now, we learn how to register new source files.

The following example shows how to register two additional source files of "b.c" and "c.c" with source file "a.c" already registered.

Place the cursor on a source file in the Project window of PM+, and select [Add Source Files...] displayed in the right-click menu.



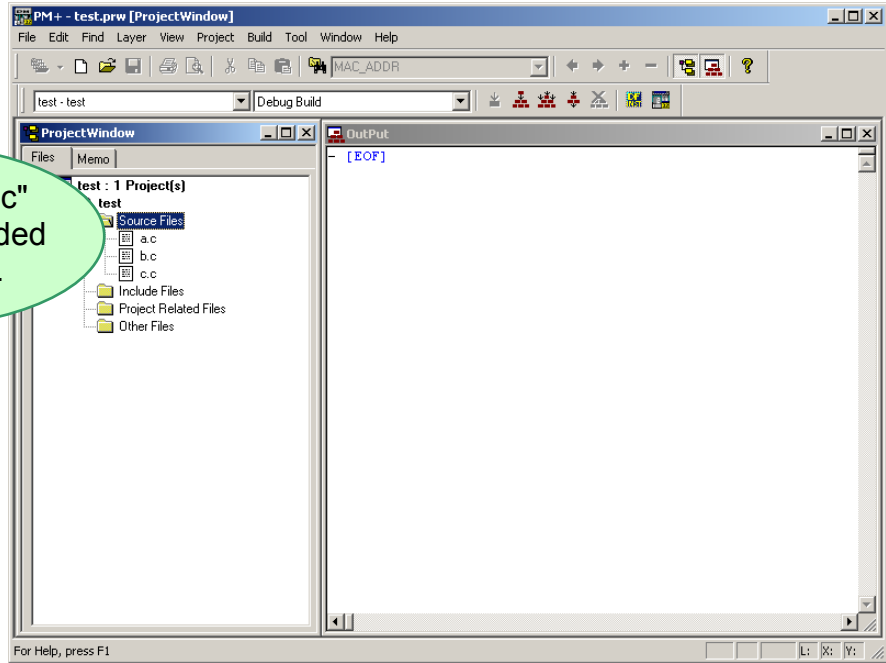
Select source files "b.c" and "c.c", then click **Open**



Multiple source files can be selected by clicking them while keep pressing **Ctrl** key.



Source files "b.c" and "c.c" are added to the project.



## 7.3 Debugger tips

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

### 7.3.1 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.

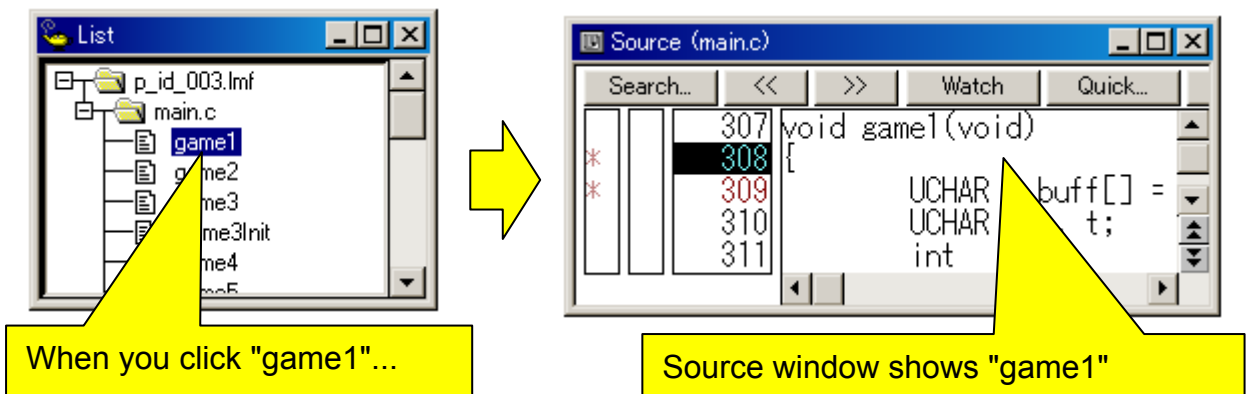


With this setting, the buttons display the text as well, so that it is easier to know what they are.



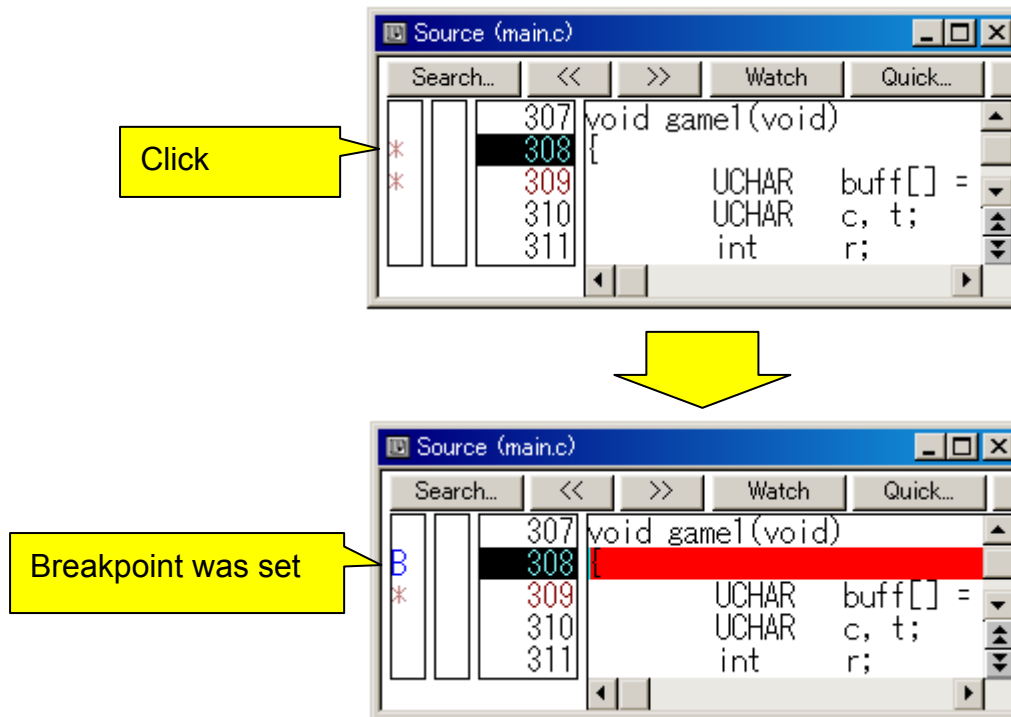
### 7.3.2 Display source list and function list

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.



### 7.3.3 Set/delete breakpoints

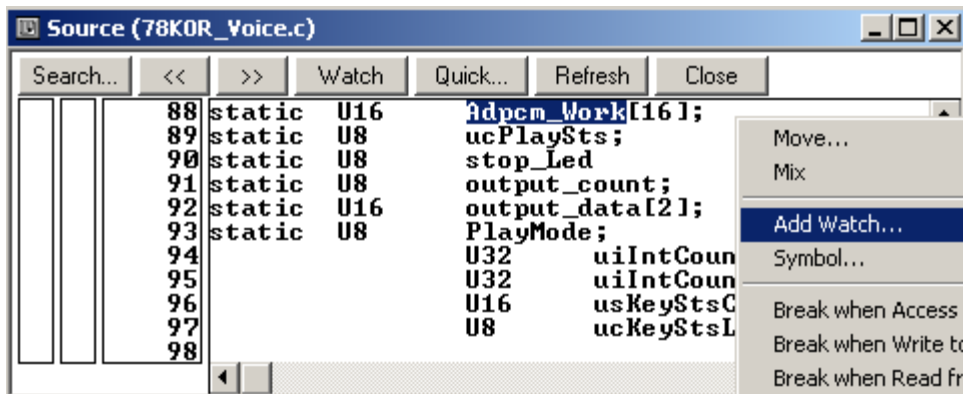
Breakpoints are executed by clicking lines in which " \* " is displayed  
"B" is displayed in the line where a breakpoint is set.  
Breakpoints are deleted by clicking "B".



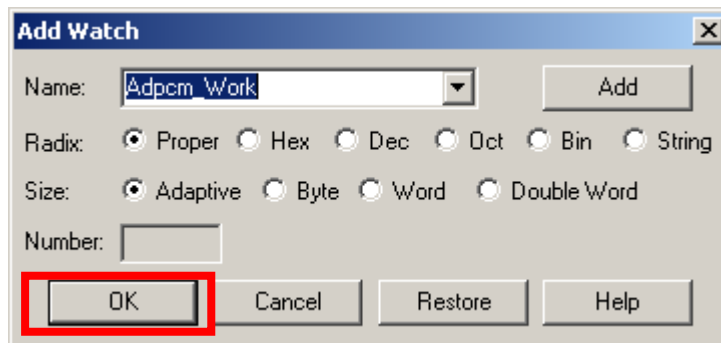
### 7.3.4 Display global variables

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.

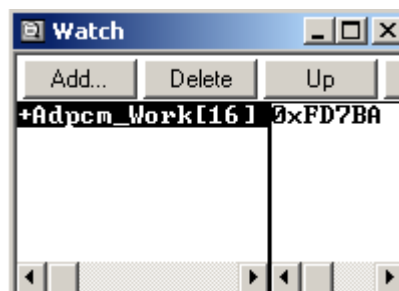
① Right-click the variable on source window, then select "Add Watch..."



② Add Watch dialog opens. Click **OK**.

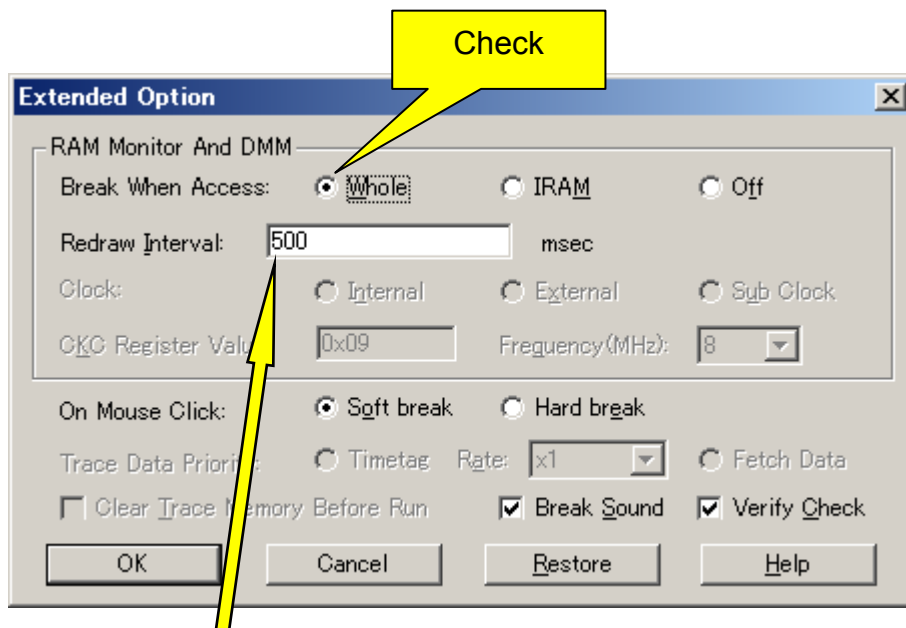


③ Adding a variable to watch window is completed.



### 7.3.5 Display global variables while programs are running

RAM, general-purpose register, and SFR can be referred by the pseudo real-time monitor function even when the programs are running. Select "Option" on menu bar, then "Extended Option...". Configure the settings for "RAM Monitor And DMM".



Specify the sampling interval time of the pseudo real-time monitor function. The sampling time can be specified from 0 to 65500 with unit of 100ms. It will not monitor if it is set to "0" or blank.

This completes the settings.

Note:

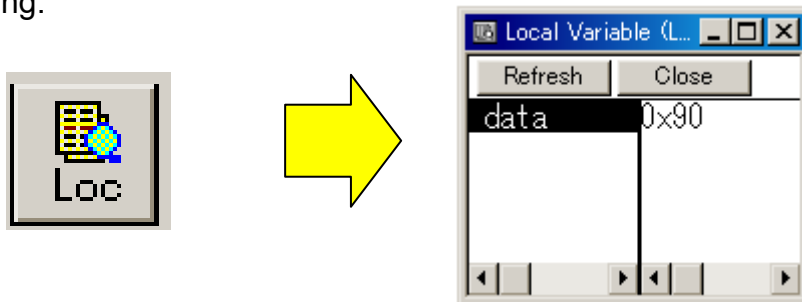
- The user program momentarily breaks upon a read.
- Do not use the pseudo real-time monitor function while using the memory window. It uses the system resources significantly as it monitors the displaying memory as well.
- It is recommended to close the memory window when you use the pseudo real-time monitor function.

### 7.3.6 Display local variables

Local variable window is used to display local variables.

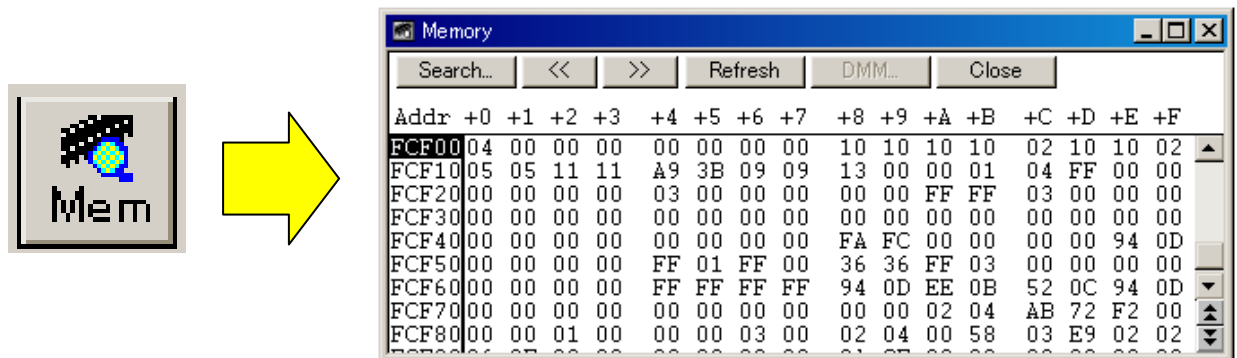
By clicking the button below, you can open the local variable window.

Unlike global variables, local variables cannot be displayed when programs are running.

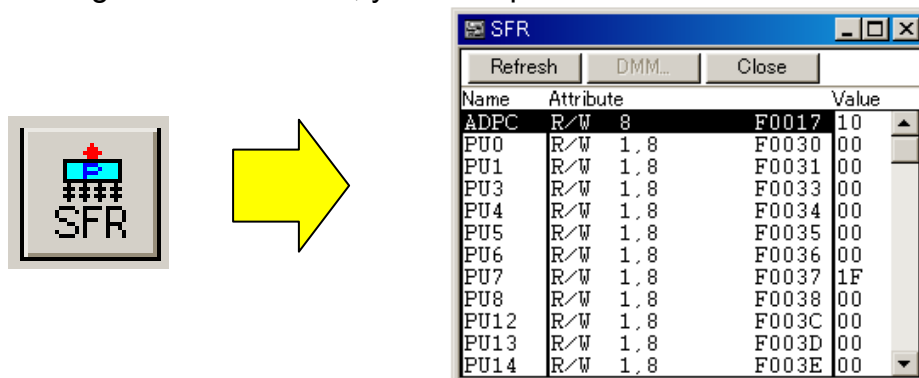


### 7.3.7 Display memory and SFR contents

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



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



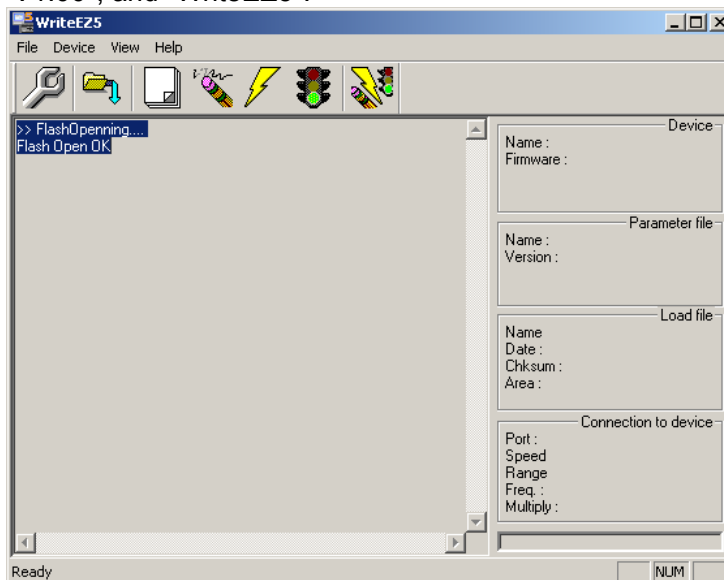
## 7.4 Erase of flash memory

If the On-Chip Debug Option Byte is set to "Do not erase data of flash memory in case of failures in enabling on-chip debugging" and if you forget the security ID, you need to erase the flash memory completely.

To erase the flash memory, please follow the steps below.

WriteEZ5 is installed at "1.2.2 Installation of Development Tools".

- ① Start WriteEZ5 by selecting "Windows Start" menu, "Programs", "NEC Electronics Tools", "WriteEZ5", "V1.00", and "WriteEZ5".

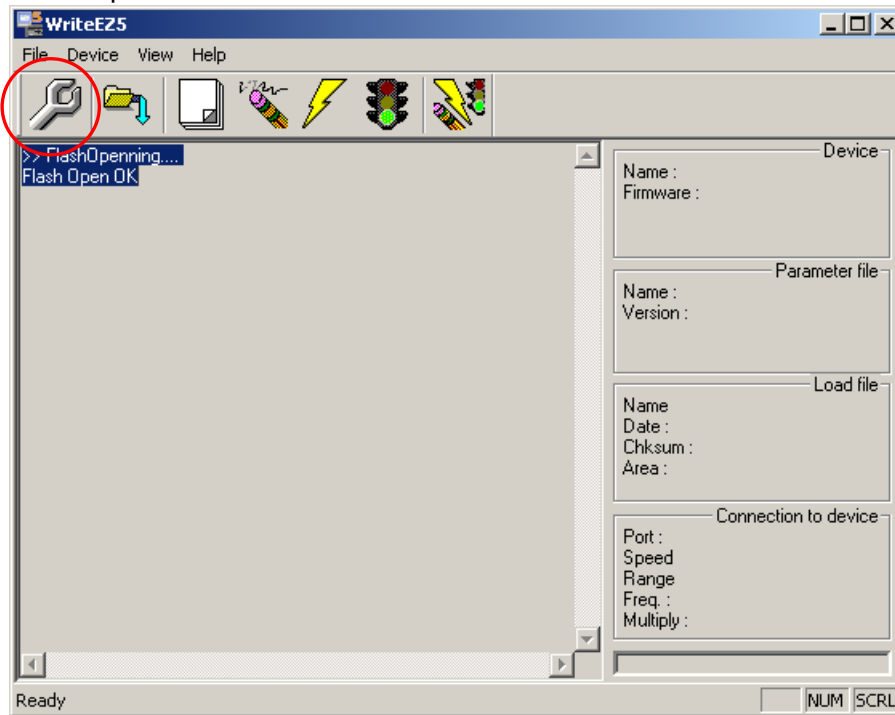


- ② The switch of 78K0R UD Stick is set as follows.

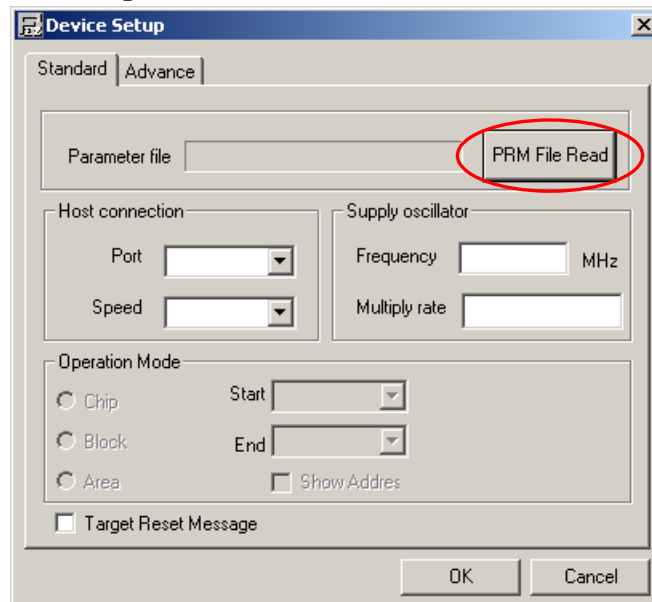
Switch	setting
USB	DBG
POWER	USB

③ Then, please connect the “USB1” connector on the 78K0R UD Stick with the USB connector of your PC.

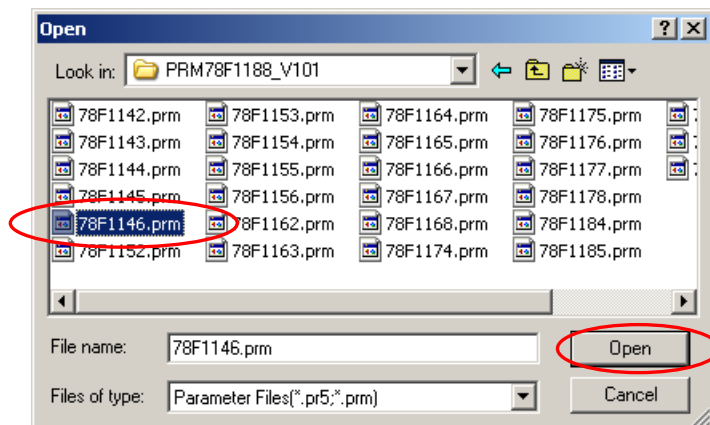
④ Push the 「Setup」 button.



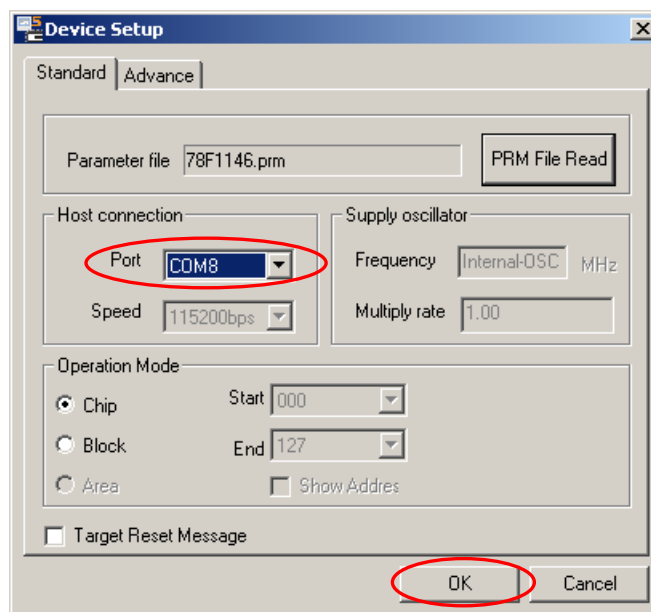
⑤ Push the 「PRM File Read」 button.



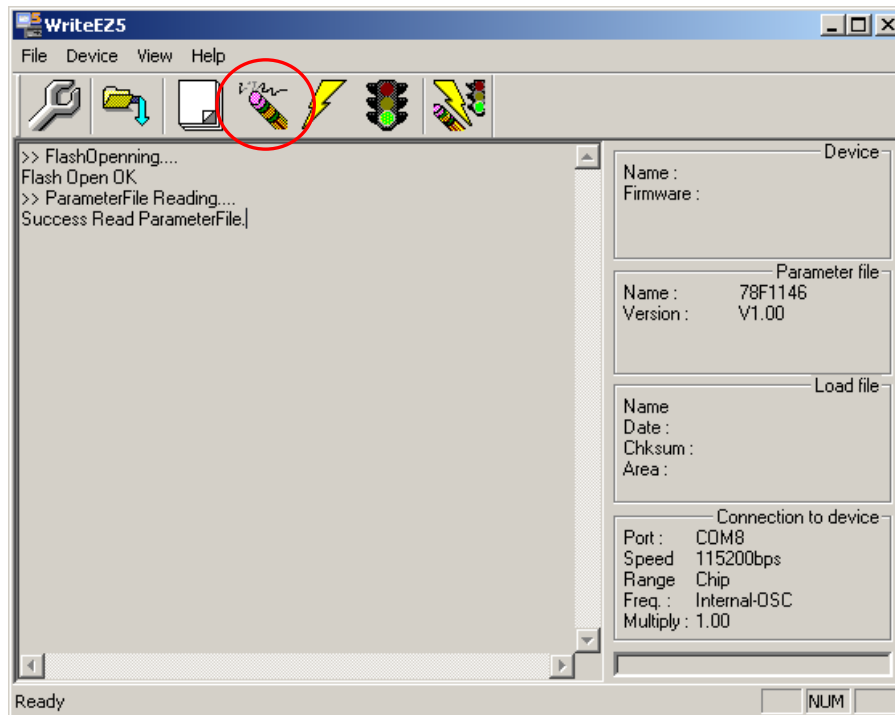
- ⑥ Please select “78F1146.prm” in the directory of “¥PRM¥PRM78F1188\_V101” in the CD-ROM.



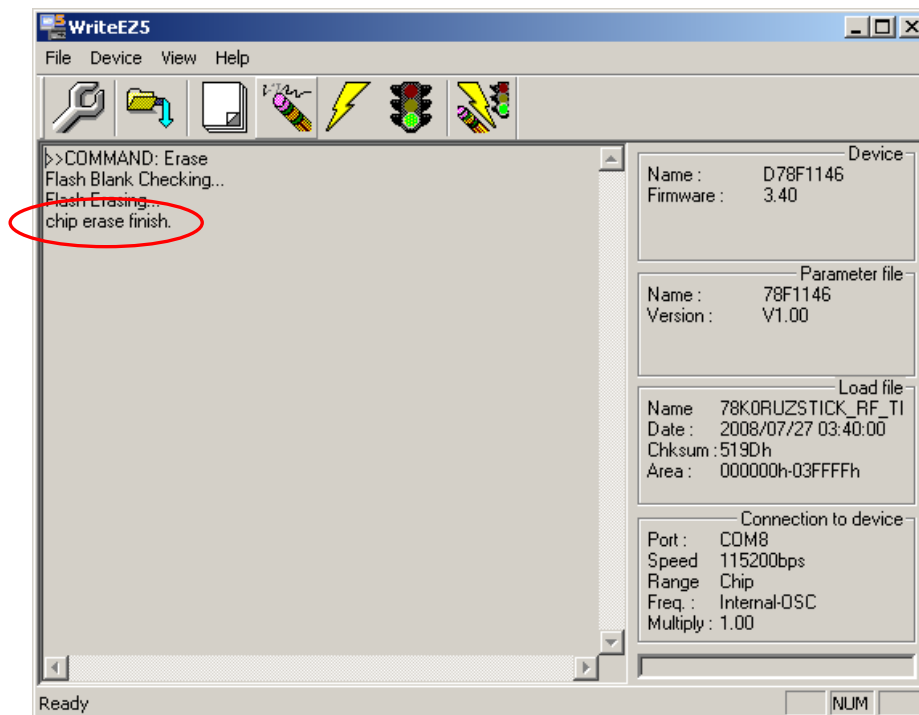
- ⑦ "Port" selects the COM port number where 78K0R UD Stick is allocated.  
\* Only the COM port number that the personal computer has is displayed in this pull-down menu.



- ⑧ "Erase" The deletion of the flash memory begins when the button is pushed.



- ⑨ If Flash EEPROM has been erased successfully, "chip erase finish" will be displayed as shown below.



#### ※ ID Code

The ID Code is a mechanism to prevent an unwelcome third party from accessing your source code by initiating the debugger. Therefore, it is recommended to modify the ID Code from the default value to secure your original source code. However, once you modify it, then, if you forget the security ID or mistakenly over-write 0x00(value) to the address of 0xC3, the debugger ID78K0R-QB is unable to access to the CPU via OCD interface. In this case, you have to start over from erasing all data in the Flash EEPROM. Then, you can define the new ID Code. You may load your source code from the debugger with a load module file.

## 7.5 BOM List & Circuit diagram

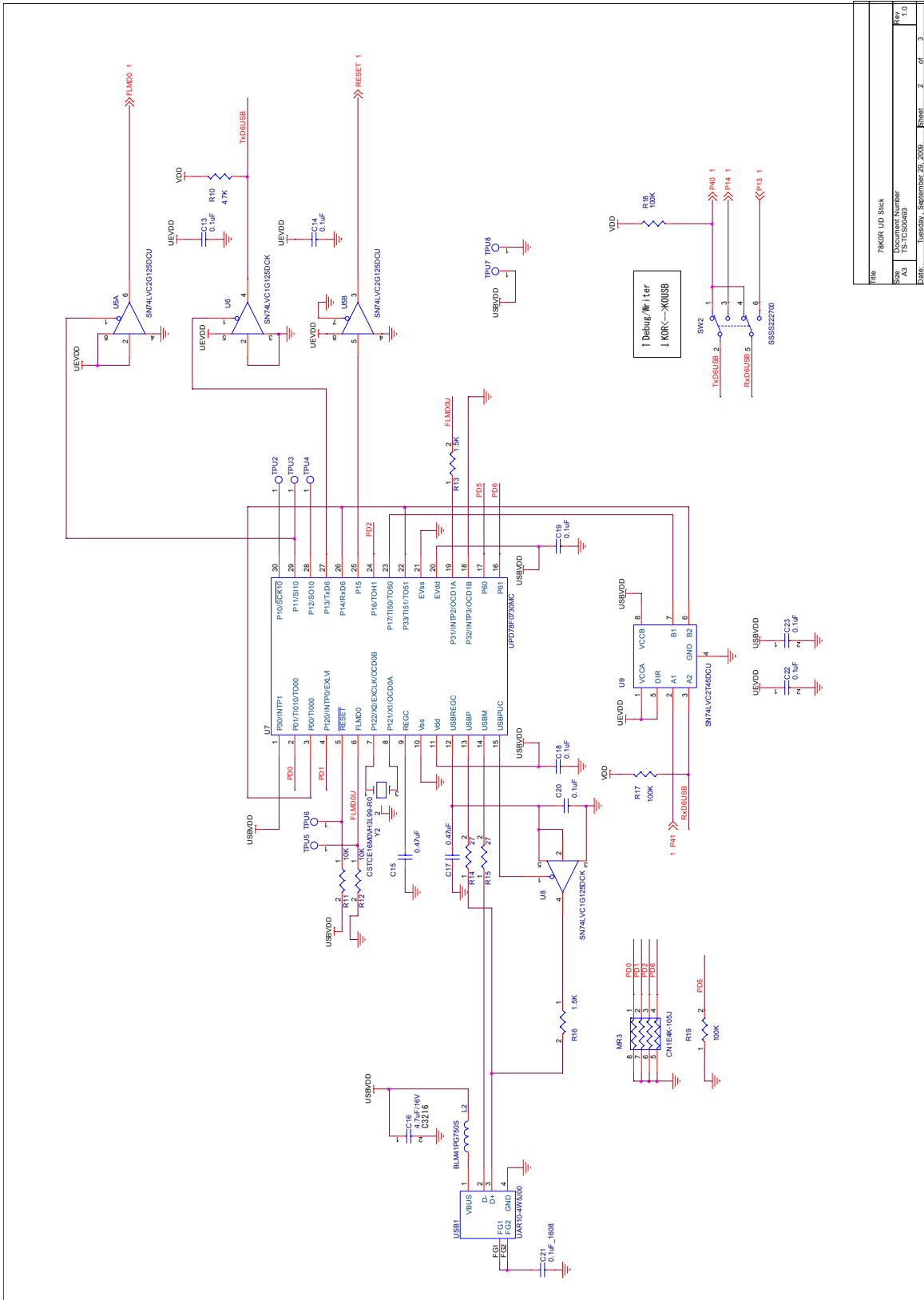
Here is the BOM List & circuit diagram of the evaluation kit.

### ● BOM list

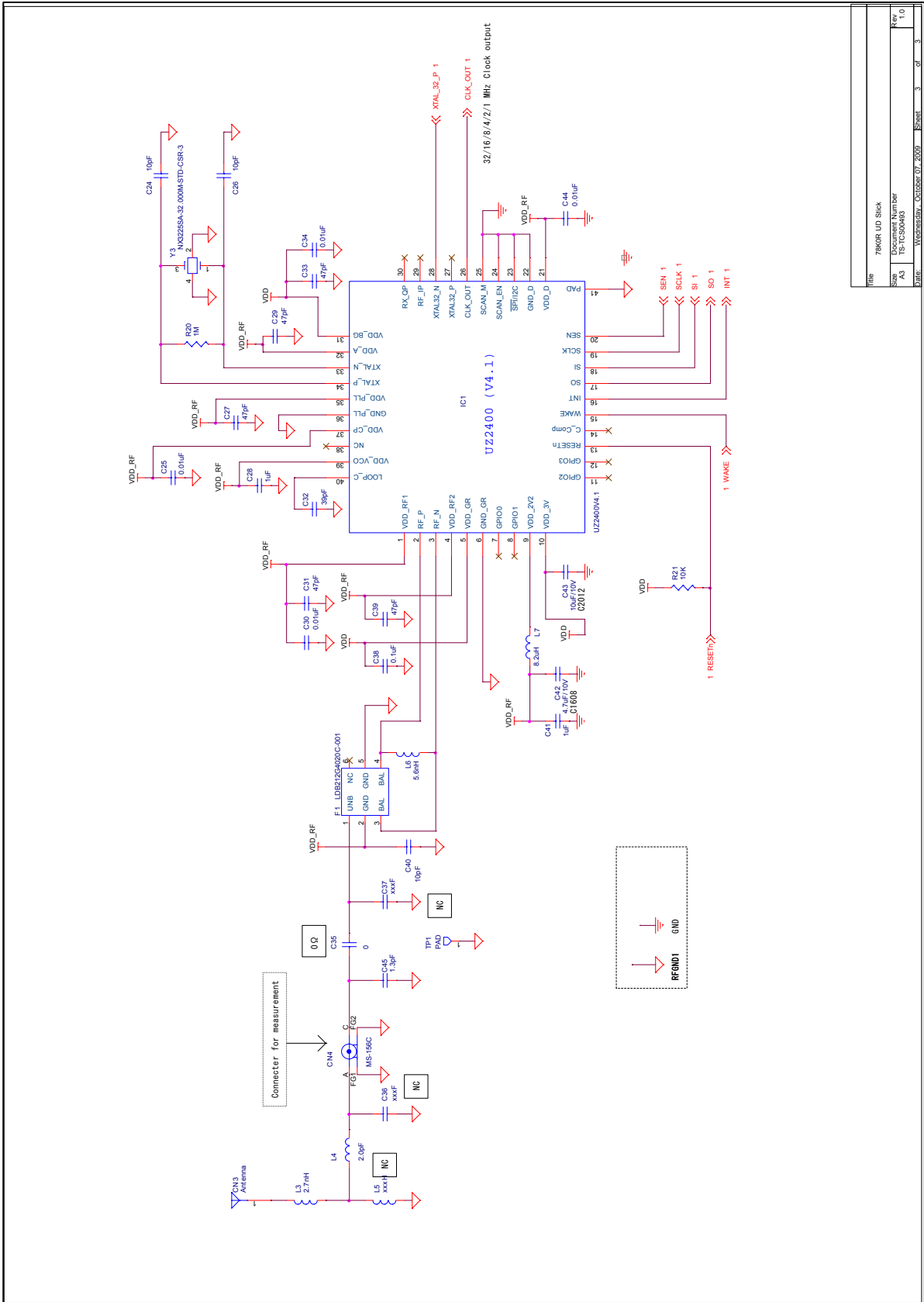
No.	Mount Quantity	Mount Parts Reference	Unmount Reference	Parts	Type	Parts No	Manufacturer
1	0		CN1		Connector	SICA2P20S	TET
2	1	CN2			Connector	DF11-10DP-2DS(24)	Hirose
3	0		CN3		Patern anntena	-	
4	1	CN4			Connector	MS-156C	Hirose
5	12	C1,C4,C6,C7,C13,C14,C18, C19,C20,C22,C23,C38			Chip ceramic cap	0.1uF	
6	2	C2,C3			Chip ceramic cap	18pF	
7	3	C5,C15,C17			Chip ceramic cap	0.47uF	
8	1	C8			Chip ceramic cap	2.2uF	
9	1	C9			Chip tantal cap	F931A476MCC	Nichicon
10	2	C16,C10			Chip ceramic cap	4.7uF/16V	
11	1	C11			Chip ceramic cap	10uF/16V	
12	1	C21			Chip ceramic cap	0.1uF	
13	3	C24,C26,C40			Chip ceramic cap	10pF	
14	4	C25,C30,C34,C44			Chip ceramic cap	0.01uF	
15	5	C27,C29,C31,C33,C39			Chip ceramic cap	47pF	
16	2	C41,C28			Chip ceramic cap	1uF	
17	1	C32			Chip ceramic cap	39pF	
18	2	R4,C35			Chip resister	0	
19	0		C36		Chip ceramic cap		
20	0		C37		Chip ceramic cap		
21	1	C42			Chip ceramic cap	4.7uF/10V	
22	1	C43			Chip ceramic cap	10uF/10V	
23	1	F1			Chip inductor	LDB212G4020C-001	Murata
24	1	IC1			IC	UZ2400V4.1	UBEC
25	1	LED1			LED	PG1111C	Stanly
26	3	LED2,LED3,LED4			LED	AA1111C	Stanly
27	1	L1			inductor	VLCF4020T-6R8N1R0	TDK
28	1	L2			Filter	BLM41PG750S	Murata
29	1	L3			Chip inductor	HK10052N7S-T	Taiyo Yuden
30	0		L5		Chip inductor		
31	1	L6			Chip inductor	HK10055N6S-T	Taiyo Yuden
32	1	L7			inductor	LQH2MCN8R2M02	Murata
33	2	MR3,MR1			resister module	CN1E4K-105J	KOA
34	1	MR2			resister module	CN1E4K-122J	KOA

35	1	R1		Chip resister	100	
36	6	R2,R3,R5,R11,R12,R21		Chip resister	10K	
37	2	R6,R8		Chip resister	390K	
38	1	R7		Chip resister	1M,1%	
39	1	R9		Chip resister	360K,1%	
40	1	R10		Chip resister	4.7K	
41	3	R13,R16,R22		Chip resister	1.5K	
42	2	R15,R14		Chip resister	27	
43	3	R17,R18,R19		Chip resister	100K	
44	1	R20		Chip resister	1M	
45	2	SW2,SW1		Switch	SSSS222700	ALPS
46	8	TPU1,TPU2,TPU3,TPU4,TPU5, TPU6,TPU7,TPU8		Pad	TPU	
47	1	TP1		Pad	PAD	
48	4	T1,T2,T3,T4		Pad	T	
49	1	USB1		Connecter	UAR10-4W5J00	Hirose
50	1	U1		IC	S-8120CNB	Seiko
51	1	U2		IC	uPD78F1146AGB-GAH-AX	NECEL
52	3	U3,U6,U8		IC	SN74LVC1G125DCK	TI
53	1	U4		IC	TPS61024DRC	TI
54	1	U5		IC	SN74LVC2G125DCU	TI
55	1	U7		IC	UPD78F0730MC	NECEL
56	1	U9		IC	SN74LVC2T45DCU	TI
57	1	Y1		Resonator	FC-135(32.768KHz)	Epson
58	1	Y2		Resonator	CSTCE16M0VH3L99-R0	Murata
59	1	Y3		Resonator	NX3225SA-32.000M-STD-CSR-3	NDK
60	1	L4		Chip ceramic cap	UVK105CH020BW-F	Taiyo Yuden
61	1	C45		Chip ceramic cap	UVK105CH1R3BW-F	Taiyo Yuden





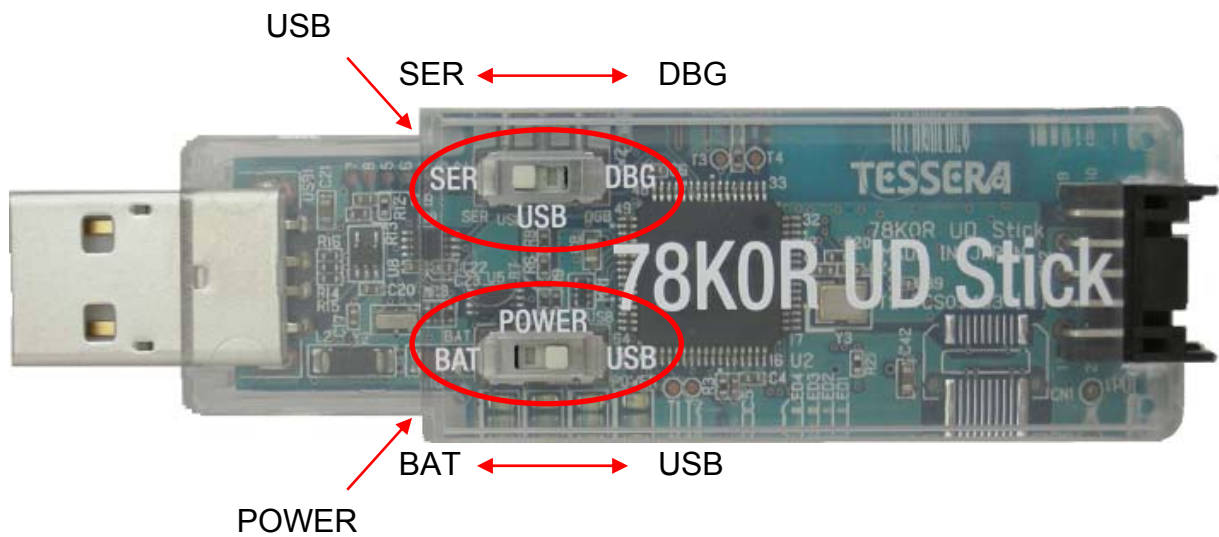
File	78KOR UD Stick
Size	Document Number
A3	TS-TC500493
Date	Tuesday, September 29, 2009
Sheet	2 of 3
Rev	1.0



File	78K0R UD Stick
Size	Document Number
A3	TS-10500493
Rev	1.0
Date	Wednesday, 03 October 2009
Sheet	3 of 3

## 8 Mode setting of the board

The combination table of the switch of the 78K0R UD Stick is shown.



Usage case / Switch	Normal (USB Power Supply)	Normal (Battery Power Supply)	Use ID78K0R-QB or Write EZ5 with USB
USB	SER	SER	DBG
POWER	USB	BAT	USB

### CAUTION

Disconnect the USB cable from the PC when you need to change to Normal use, after Debug use.