Welcome to the world of TK-850/SG2+UZ.
You are now sailing into the design environment of the V850ES microcontroller for developing wireless networks to Ethernet gateway applications. Please follow the tutorial step by step.

User's Manual

TK-850/SG2+UZ

ZigBee™-ready
Wireless Networks to Ethernet Gateway
V850ES 32 bit Microcontroller Evaluation Board

Tutorial

Date published: March 2009

Printed in Japan

Preface

Targeted Readers

Software engineers, who wish to become familliar with the design environment of V850 microcontrollers to develop and evaluate applications on the TK-850/SG2+UZ evaluation boards. Readers are expected to possess the basic knowledge of microcontrollers, C language, and Windows™ OS. The sample application introduced here assumes the possession of two to four TK-78K0/KF2+UZ evaluation boards.

Objective

Readers will learn how to play around the TK-850/SG2+UZ evaluation board with the V850 design environment.

Construction

This manual consists of the following chapters

Chapter 1 Installation
→ Installation of the sample program and preparation of the TK-78K0/KF2+UZ boards.

Chapter 2 Experiences
→ Experience how to operate the project manager PM+, compiler, and the integrated debugger while preparing the implementation of the sample program.

Chapter 3 How To Use PG-FPL3
→ How to program Flash EEPROM

Chapter 4 Sample Prgram
→How to use the sample program "RF Test Program" and “Text Chat program”

Chapter 5 Mode Setting of the Board
→ Explanation of switch setting.

NOTES

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.

Trademarks

Chapter1 Installation

This chapter introduces the development tools and explains the installation of the sample program. The sample program for V850ES in TK-850/SG2+UZ board communicates with the sample program for 78K0 in TK-78K0/KF2+UZ boards. Installation of the 78K0 sample program to TK-78K0/KF2 boards is also explained.

1.1 Development Tools

The following development tools are utilized in the TK-850/SG2+UZ board.

- Device File DF703283 V2.11

  The Device File loads the CPU hardware information into the development tools.
  The sample program in this tutorial was compiled for V850ES/SG2, based on the information in the device file.

- Integrated development environment PM + V6.11

  PM stands for Project Manager. It is an integrated development environment platform, working on MS Windows. Editor, compiler, and debugger are managed on PM +.

- C compiler CA850 W3.10 (Code size limited version)

  Object code size, compiled by the C compiler CA850 W3.10, bundled in the TK-850/SG2+UZ board, is limited to the maximum of 128 KByte.

- Integrated debugger ID850-TK V1.04

  Debugging tasks are performed by the debugger ID850-TK on MS Windows communicationing with the monitor program stored in the Embedded Flash EEPROM in the microcontroller via USB-UART interface. Once the debugger is initiated, object user code is automatically downloaded onto the on-chip Flash EEPROM.

- Flash EEPROM programmer PG-FPL

  The programmer is a piece of software, operating on MS Windows. It programs, erases, and verifies object code in the embedded Flash EEPROM in the microcontroller, via USB cable from PC.

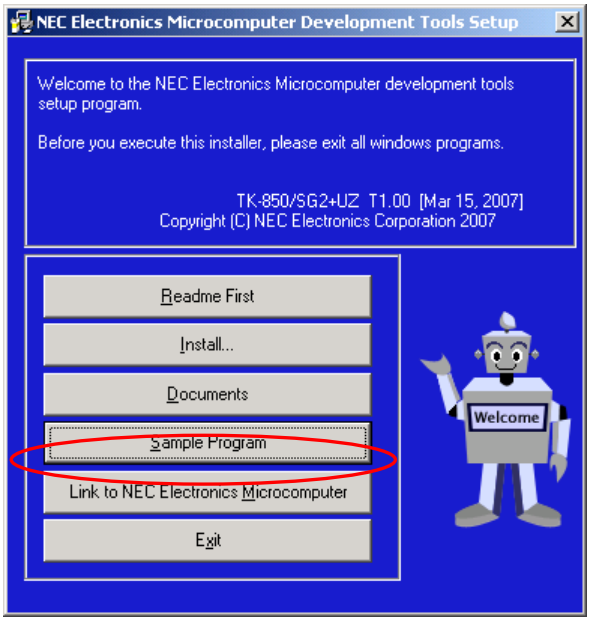
1.2 Installation of Software Development Tools

1.2.1. Explanation of this CD-ROM

The attached CD-ROM contains Development Tools, documents and sample soft ware.
You can install it using an installer.

1.2.2. Installation of the software development tools

Insert the CD-ROM in the CD-ROM drive. The installer is started automatically.
If it does not start automatically, start SETUP.EXE from Explorer, etc.



<1> Selecting Install… from “NEC Electronics Microcomputer Development Tools Setup” opens the following dialog box.

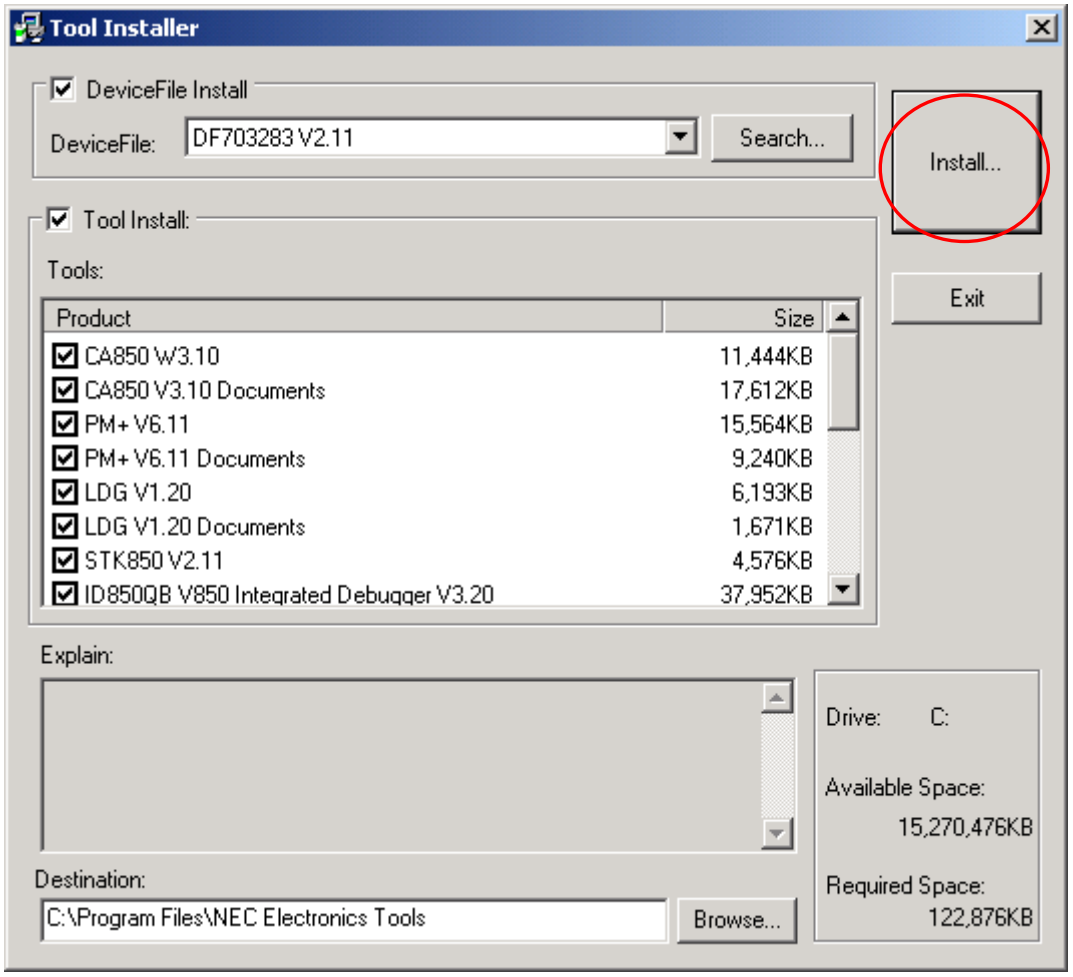
Select the device file and the tool to be installed using the check box.

By selecting Search…, a device file product can be selected by device name

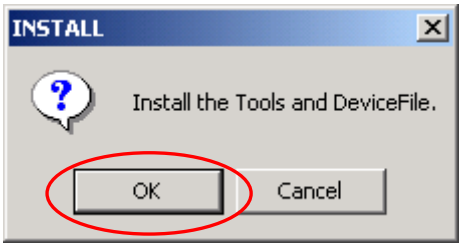
“Explain” displays an explanation of the selected device file or tool.

To change the installation destination, select Browse….

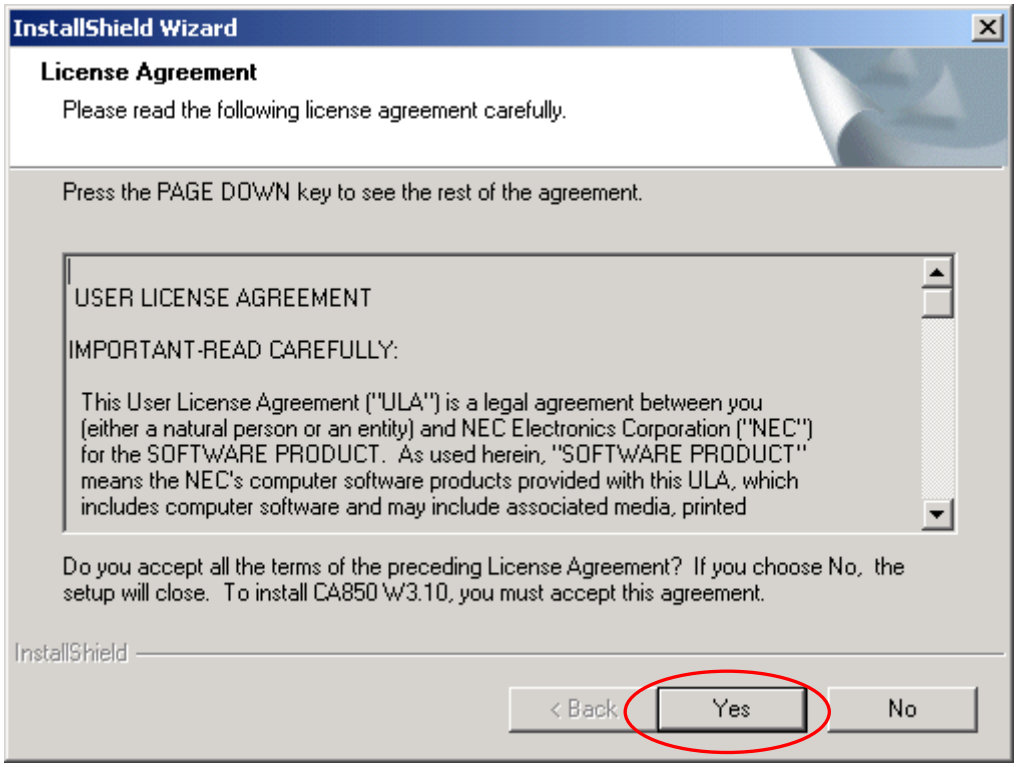
When all the settings are complete, select Install….



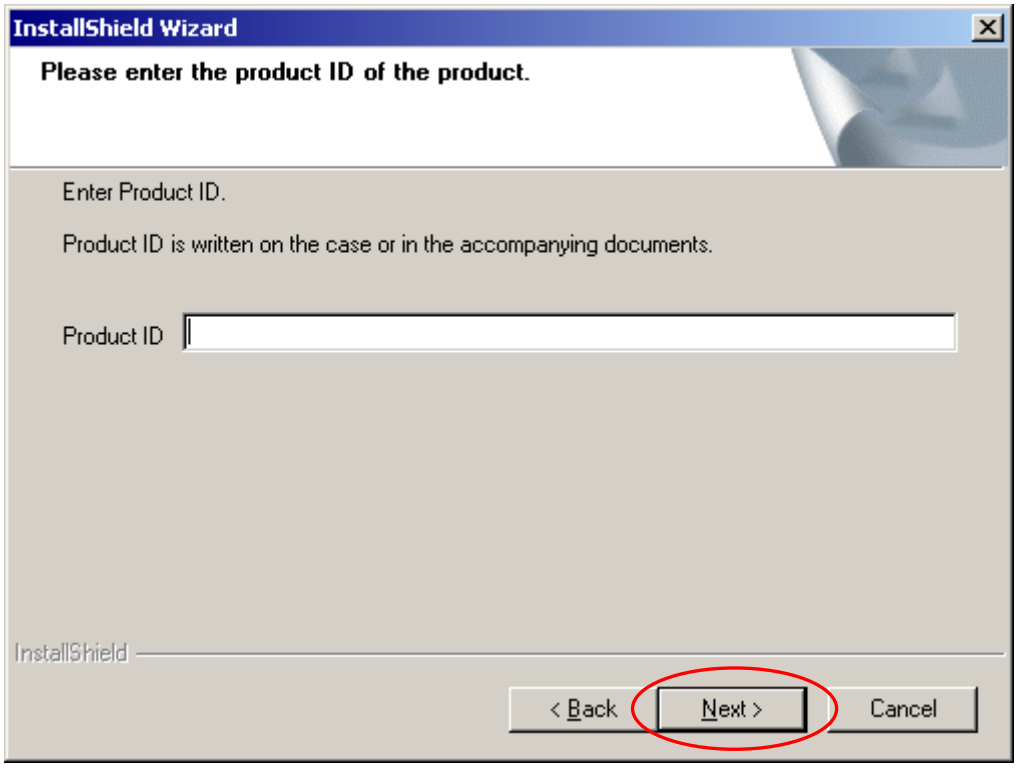
<2> To install each development tool, click OK when the install confirmation screen is displayed. To stop installation, click Cancel.



<3> To install each development tool, click Yes when the software license agreement screen is displayed. To stop installation, click No.



<4> Enter the product ID. The product ID is shown on the attached documents [README.HTML].



<5> Copying the files is started.

<6> If the setup have completed, a dialog box indicating completion of setup is displayed. Click the [OK] button. This completes installation of each development tool.

Notes on the installation

- Support OS: Windows XP and Windows 2000 (only English version)
- Administrator authority is required for this installation.
- Do not use 2-byte and /*:<>?|"¥;, characters for installation directory name and also do not select installation directory path that contains those characters.

Limitation

- C compiler CA850 W3.10 limit the object size to 128 Kbyte.

About ID850

ID850-TK is software added TK-850 supporting module to ID850QB.
ID850QB in this product is same tools in [IECUBE for V850] and [MINICUBE].
If you already have these products and installed ID850QB, you don't need to install again. But, ID850-TK have possibilities not to run by combination of each version of ID850-TK V1.04 and ID850QB V3.20. The information about combination of these software are put on TESSERA TECHNOLOGY INC. web site (http://www.tessera.co.jp/eng/index.html) as needed. (A combination of bundling software in this product is no problem.)

ID-850-TK can set following break points.

Hardware Break	2 points
Software Break	4 points (Internal flash memory)

1.2.3. Structure of Installed Files

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].

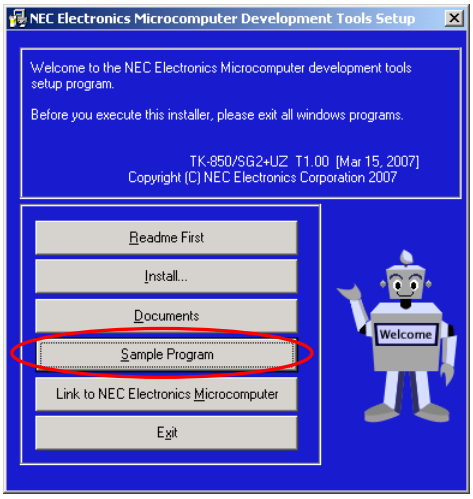
1.3 Sample Environment

This section describes the preparations for the sample programs used in this document. The preparations consist of installing the sample programs in the customer’s environment.

The installation method and the installation destination are cescribed below.

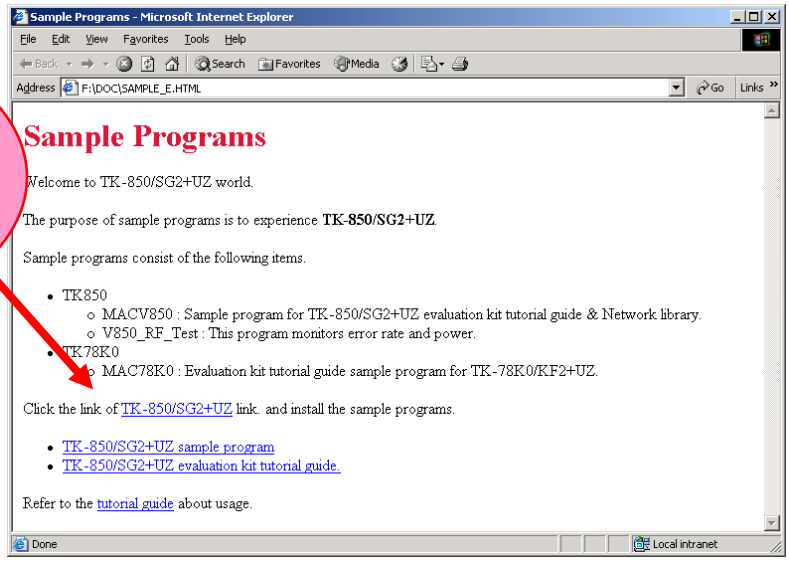
1.3.1. Installing the sample program

Insert the TK-850/SG2+UZ CD-ROM in your PC. The [NEC Electronics Microprocessor Development Tools Setup] screen will automatically show up. (if this screen does not show up automatically, please start setup.exe from Explorer.)
Press the [Sample Program] button to start the Internet Explorer, and then click the [TK-850/SG2+UZ Sample Program] link.

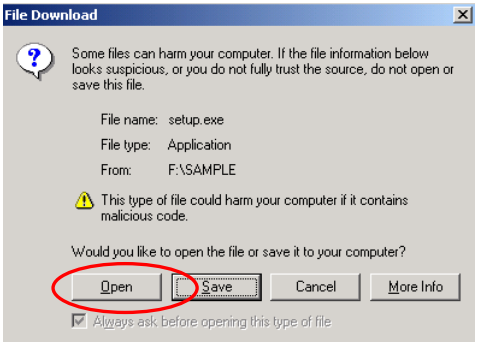


Internet Explorer will show up

Click the [TK-850/SG2+UZ Sample Program] link.
The lower line is the link to download this tutorial.



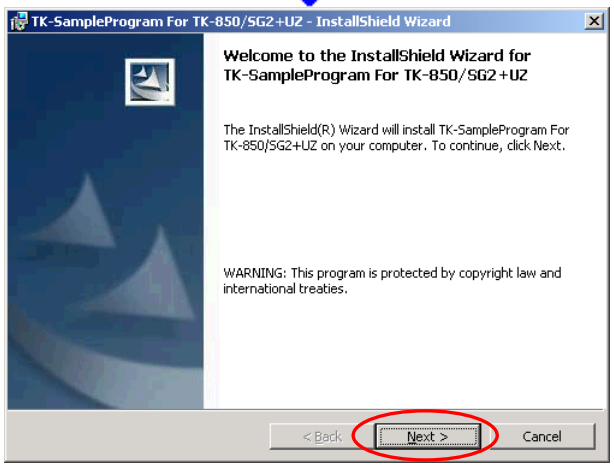
If the [TK-850/SG2+UZ Sample Program] is selected, the following window will show up.



Please click the Open button.

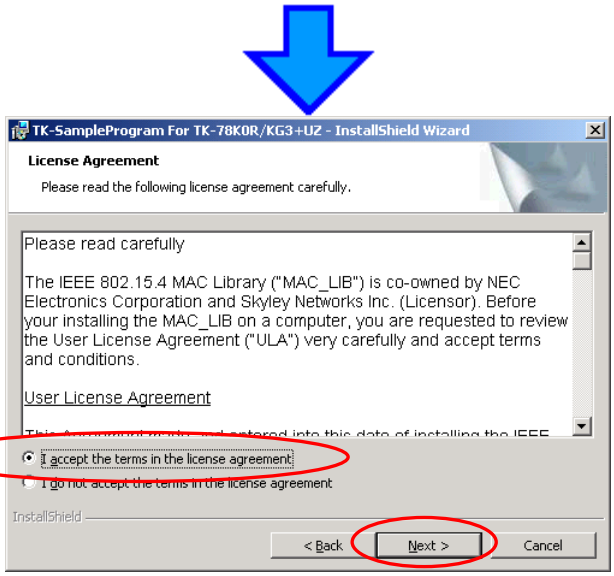
In case of windows 2000,

you will see the [Security Warning] window. Please click Run.



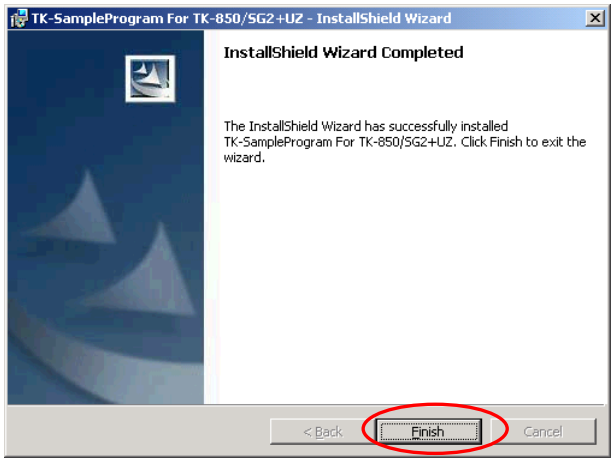
InstallShield wizard for TK-Sample Program starts up

Please click Next.



License agreement screen is displayed.

Please select "I accept the terms in the license agreement".and click Next.



Please click Finish.

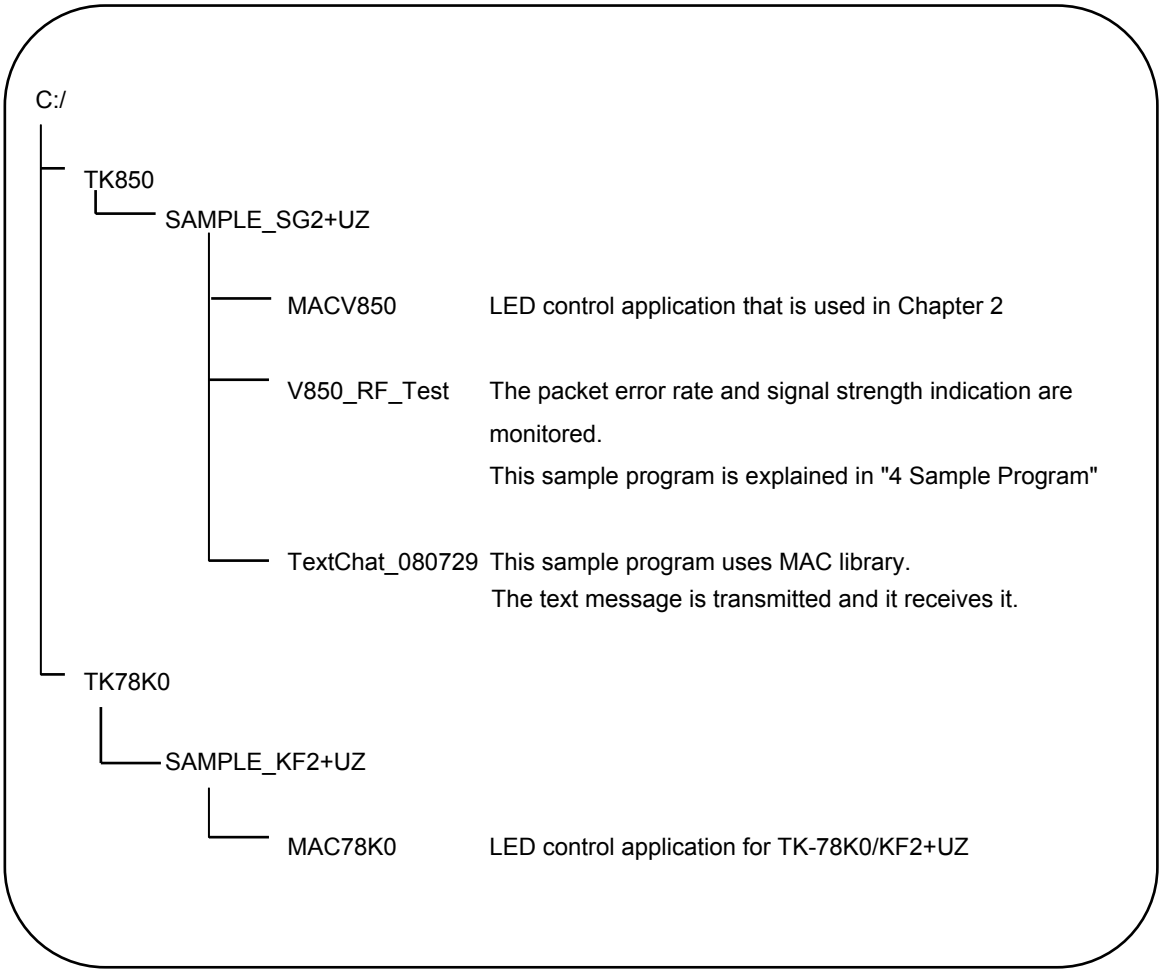
The sample programs are installded.

The sample program "TK850.EXE" with self-extract file is also intalled. When you need to use the original sample programs, you can extract the file "C:/TK850.EXE".

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

1.3.2. **File Configuration of the sample program**

The sample programs ware the following folders.



1.4 **USB Driver**

You need to install “USB Serial Converter” and “USB Serial Port” in your PC.

When TK-850 is used, it is necessary to install “USB Serial Converter” and the “ USB Serial Port” driver in the host machine. Please install the driver according to the following procedures with appending CD in the drive.

Attention **Do not use a USB hub for connecting TK-850/SG2+UZ.**

1.4.1. Installation of the USB driver

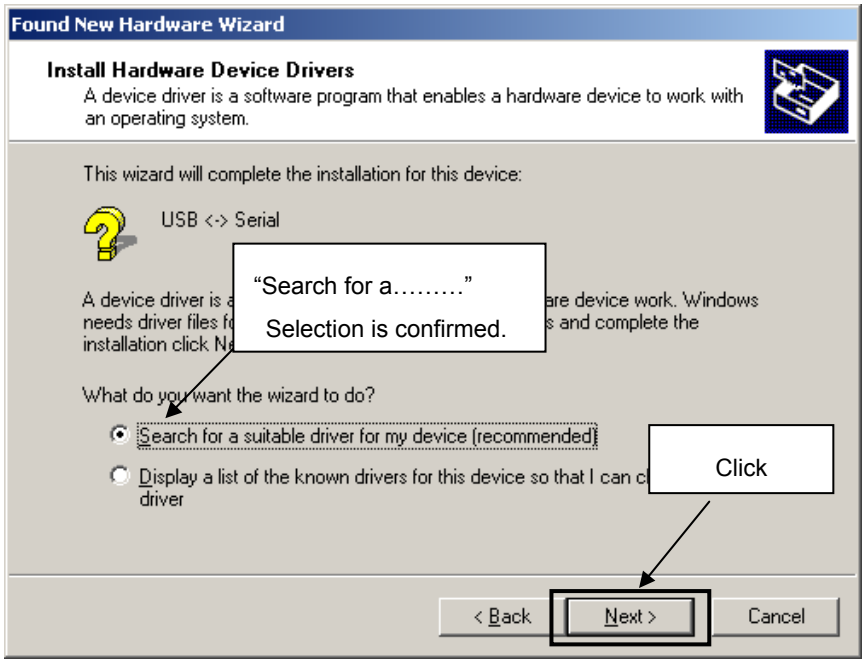
Install to Windows2000

1 . Once the TK-850/SG2+UZ board is inserted to the PC USB terminal, a wizard will be initiated by the MS Windows.

New hardware wizard （Windows2000）

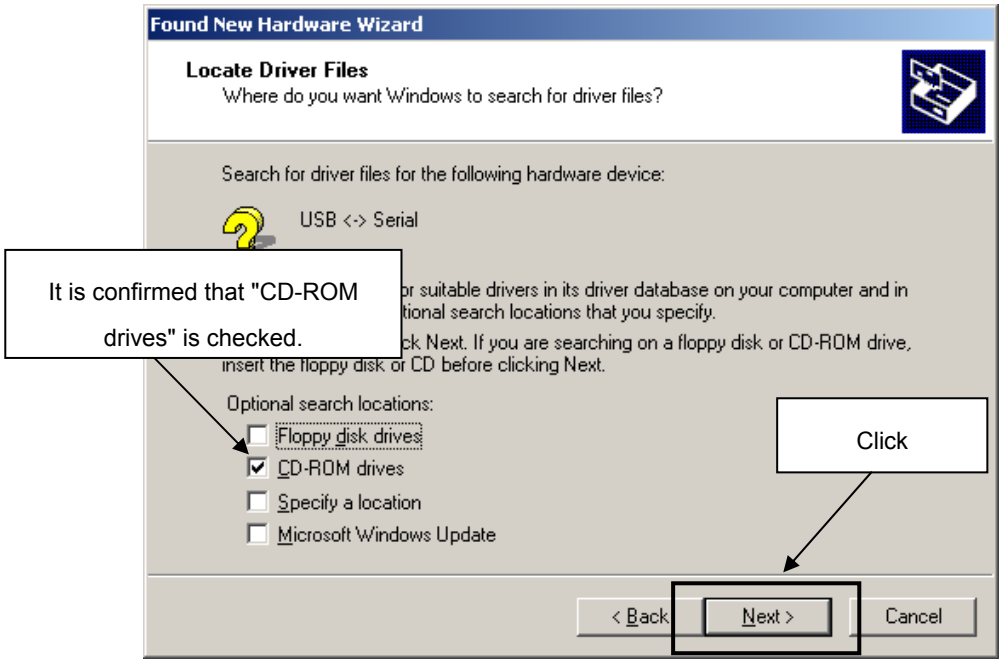
2. The following window is displayed, please click “search for a suitable driver …..”

Method 1（Windows2000）



3. Please select the “CD-ROM drives” only. and click NEXT(N)>.

driver file 1（Windows2000）



4. Please click NEXT(N)>

Instillation of the driver file 1 (Windows2000)

5. The “USB Serial Converter" driver's installation is completed. Click Finish.

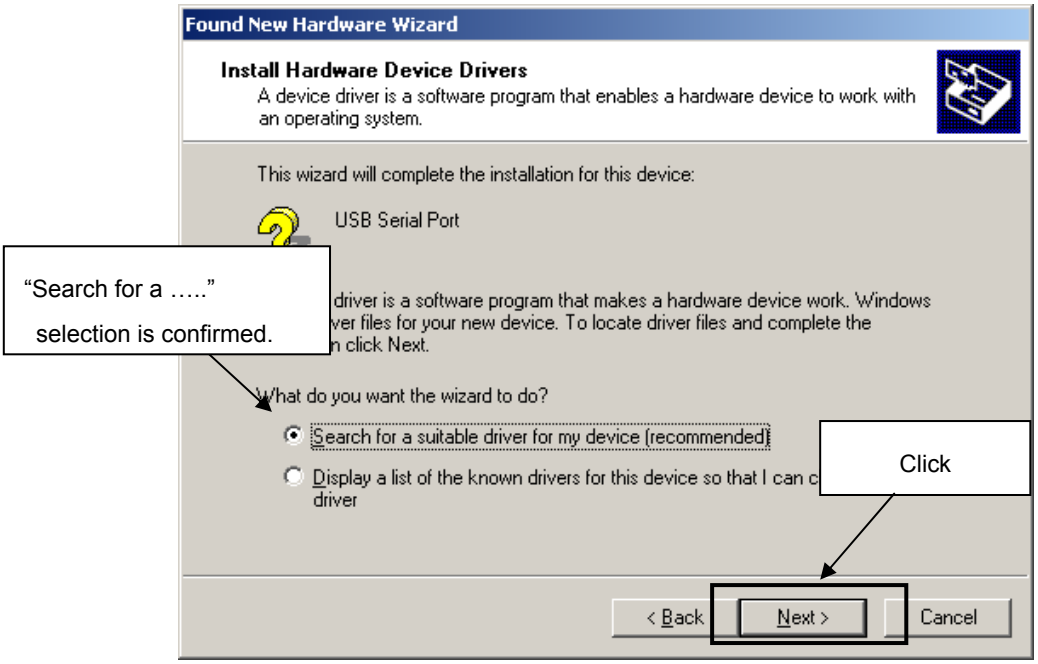
Completion of the USB Serial Converter driver installation 1 (Windows2000)

6. The “USB Serial Port" driver's installation begins continuously. Click NEXT(N)>.

New hardware wizard 2（Windows2000）

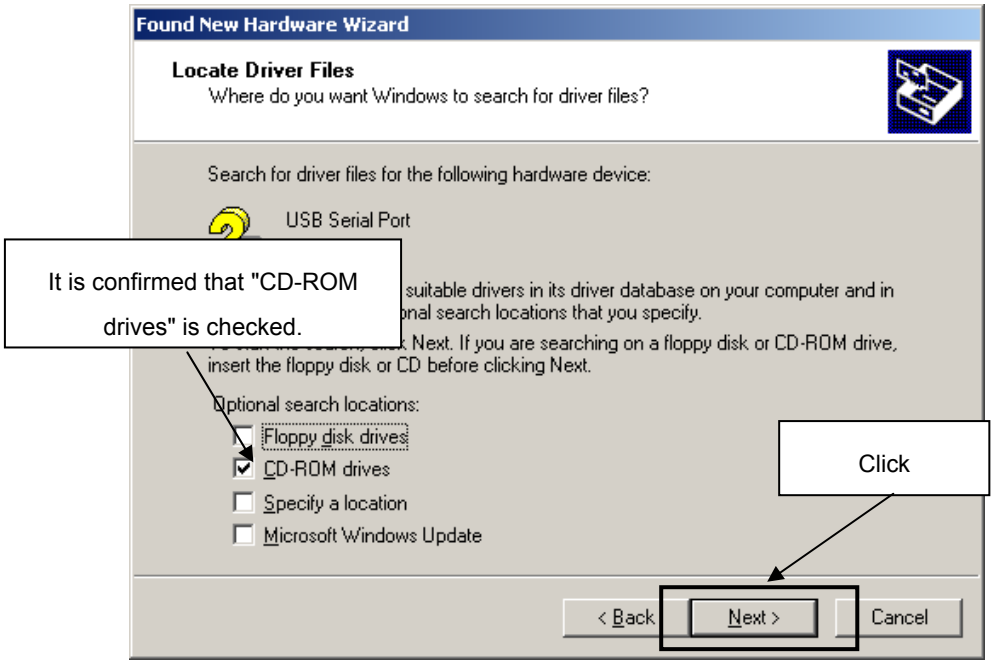
7. The following window is displayed. Select “Search for a suitable driver for my device”. and click NEXT(N)>.

method 2（Windows2000）



8. Please Select the “CD-ROM drives” only. And click NEXT(N)>.

Driver file 2（Windows2000）

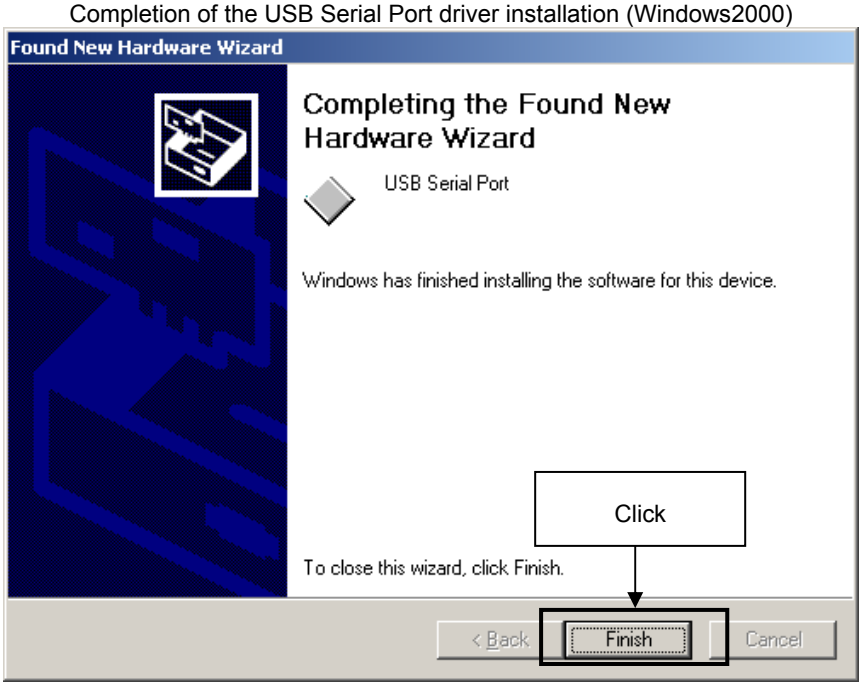


9. Please Click NEXT(N)>.

Instillation of the driver file 2(Windows2000)

１０． The“USB Serial Port”driver’s installation is completed. Click Finish.

Completion of the USB Serial Port driver installation (Windows2000)

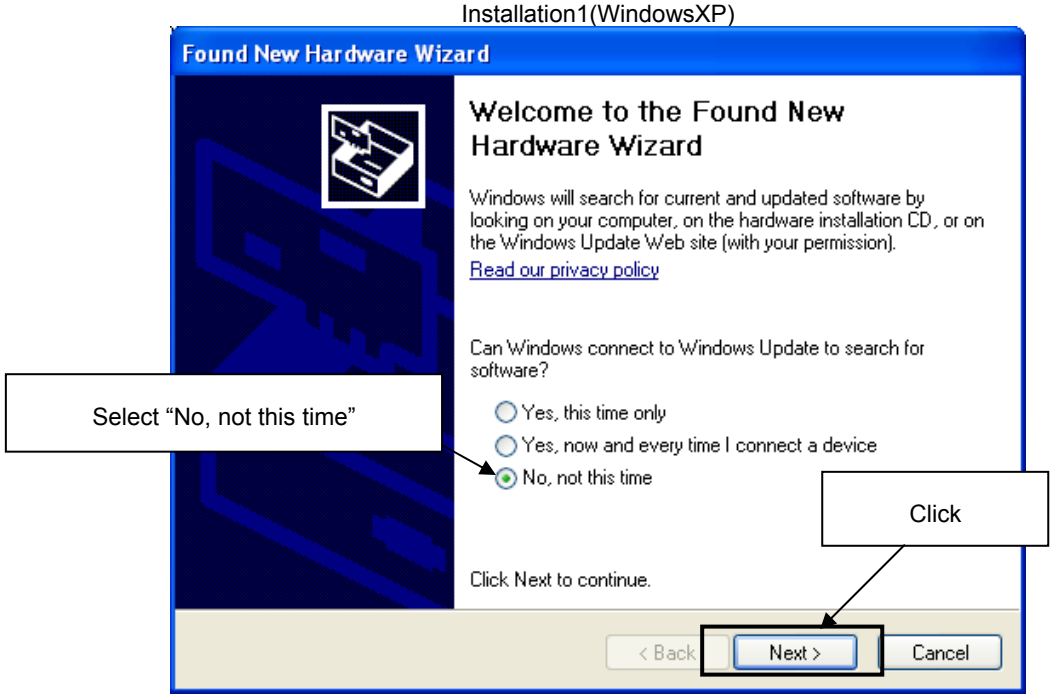


１１． Driver Install was finished.

Install to Windows XP

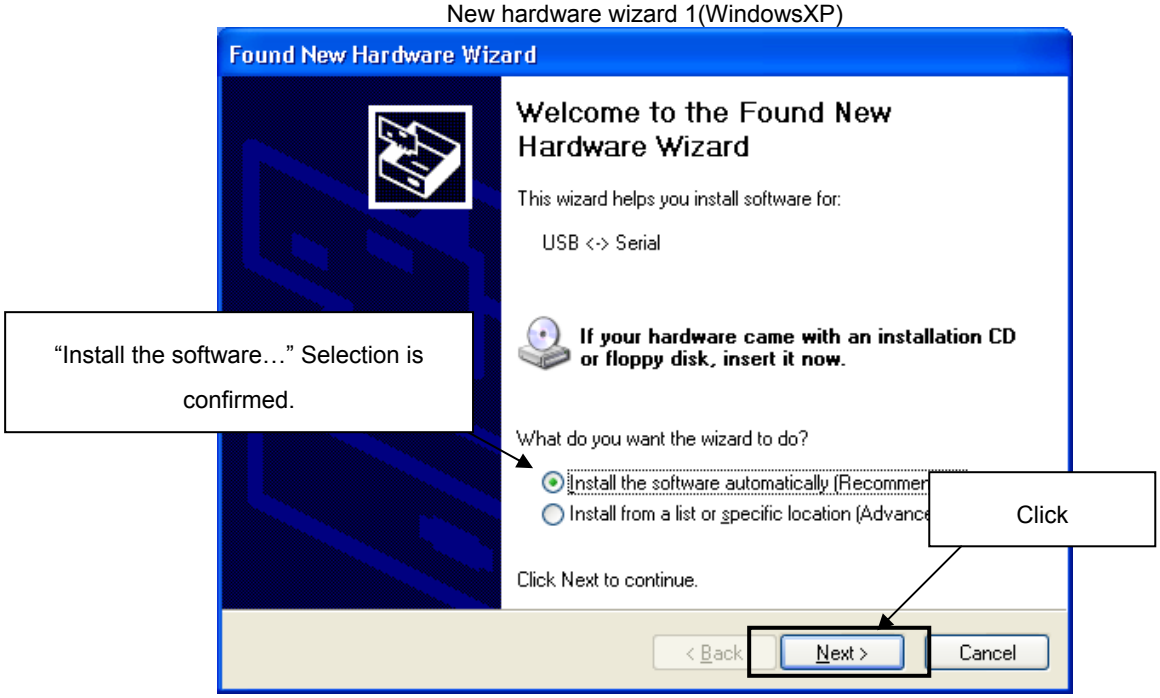
1. Once the TK-850/SG2+UZ board is inserted to the PC USB terminal, a wizard will be initiated by the MS Windows.

Installation1(WindowsXP)



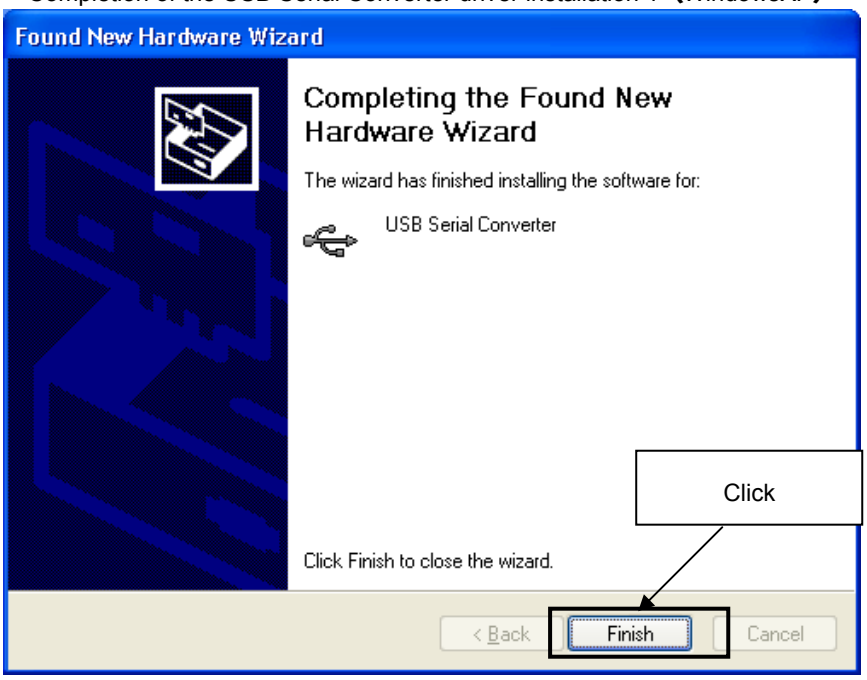
2. Select the “Install the software automatically …” has been selected, and click NEXT(N)>.

New hardware wizard 1(WindowsXP)



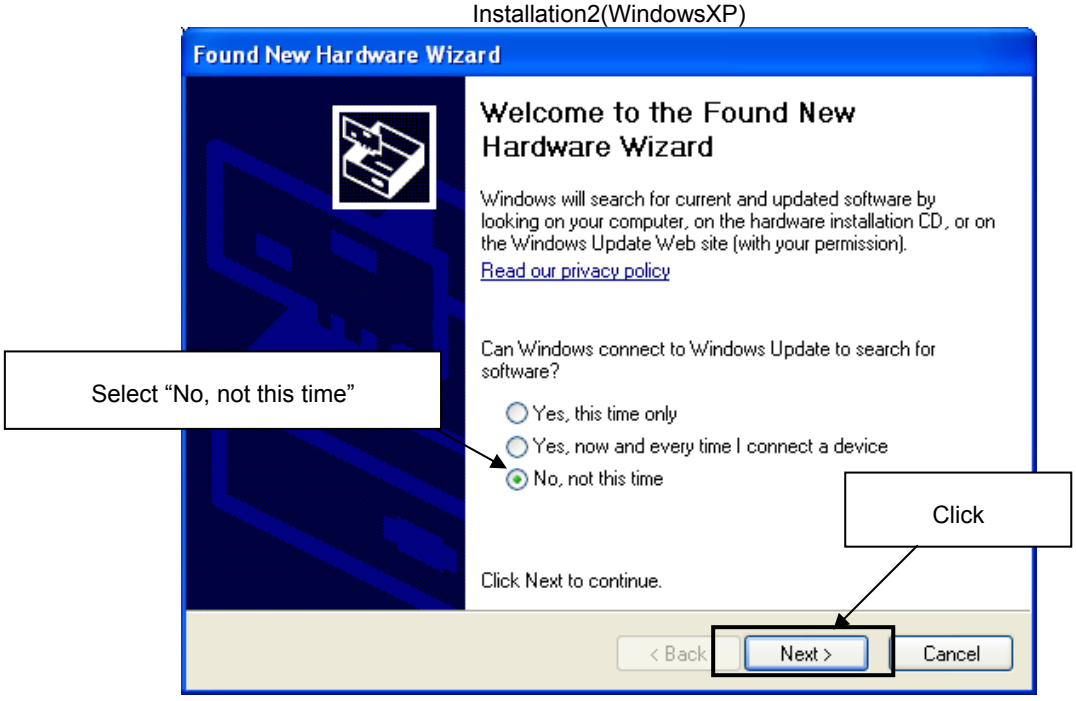
3 . The “USB Serial Converter" driver's installation is completed. Click Finish.

Completion of the USB Serial Converter driver installation 1 （WindowsXP）



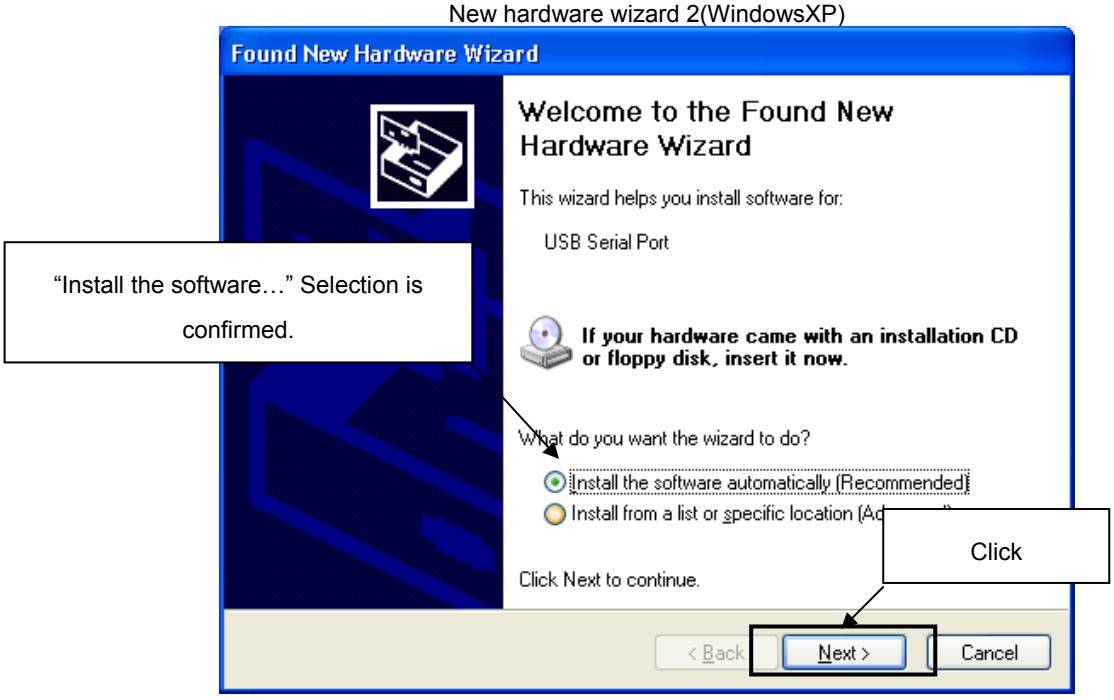
4 . The “USB Serial Port" driver's installation begins continuously. Click NEXT(N)>.

Installation2(WindowsXP)



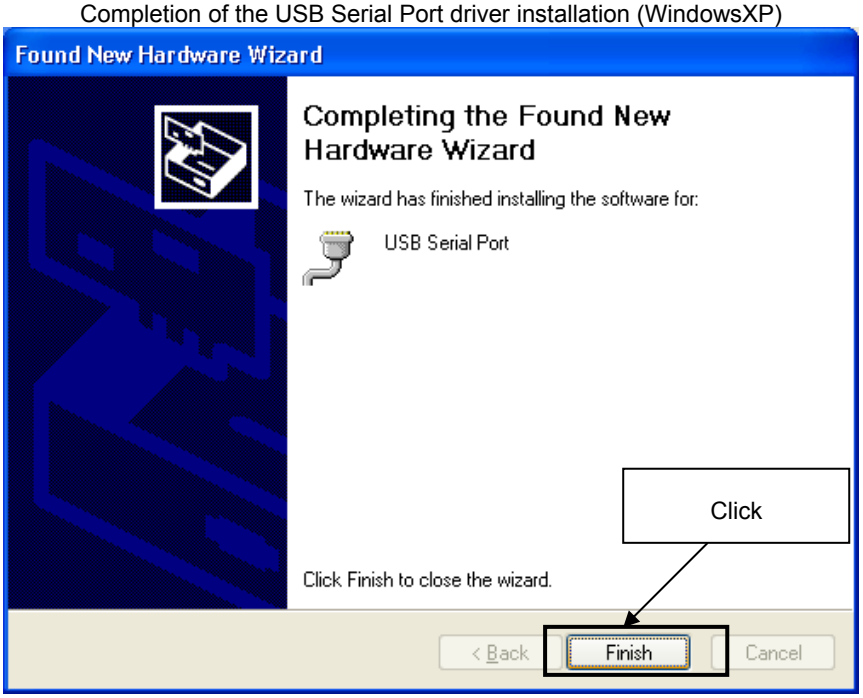
5. The “USB Serial Port" driver's installation begins continuously. Click NEXT(N)>

New hardware wizard 2(WindowsXP)



6. If the following window is displayed, the USB driver's installation is completed. Click Finish.

Completion of the USB Serial Port driver installation (WindowsXP)

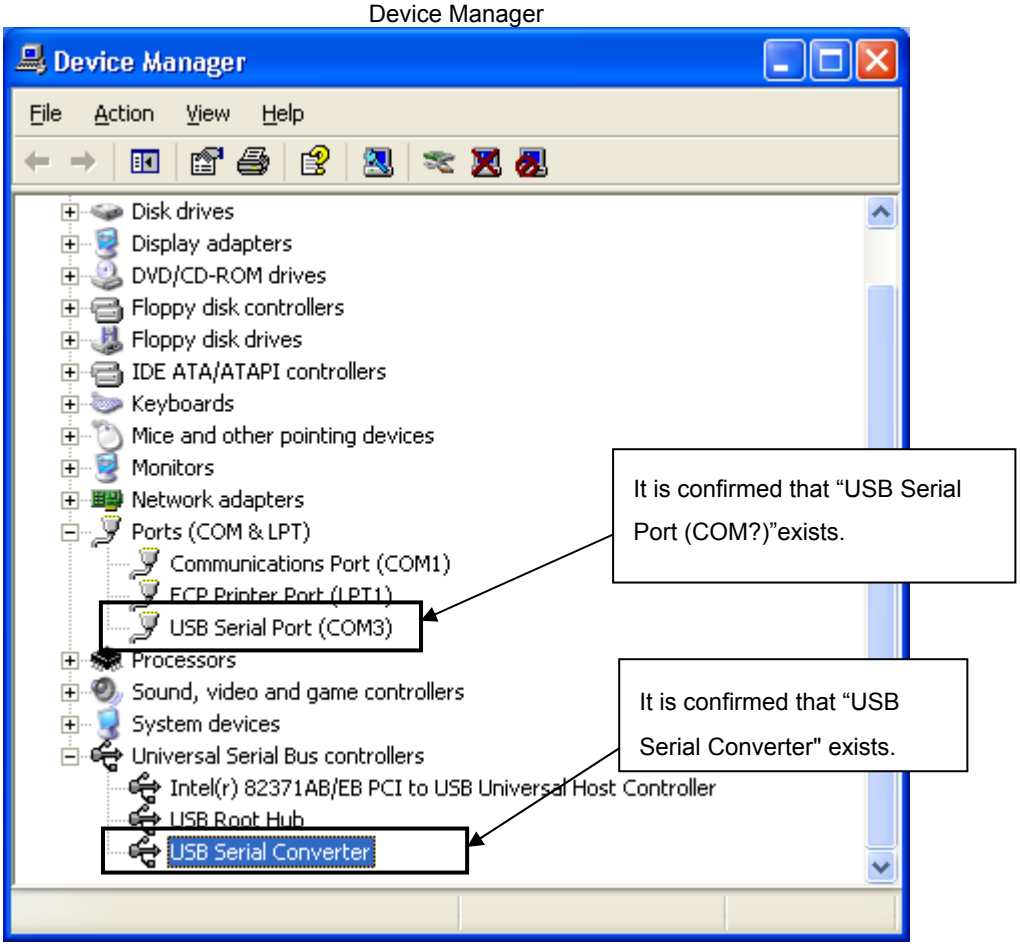


7. Driver Installation has been finished.

1.4.2. Confirmation of the installation

Please confirm “USB Serial Port (COM?)” in the device manager of system in the control panel of the MS Windows. Then, please confirm “USB Serial Converter”.

Device Manager



The screen above shows that the COM port number is "COM3".
To set the COM port for ID850-TK, use "Portconfig for ID850-TK" and specify COM3 after the software is installed.
When you change the USB port number, the COM port number will be changed as well.

※Attention

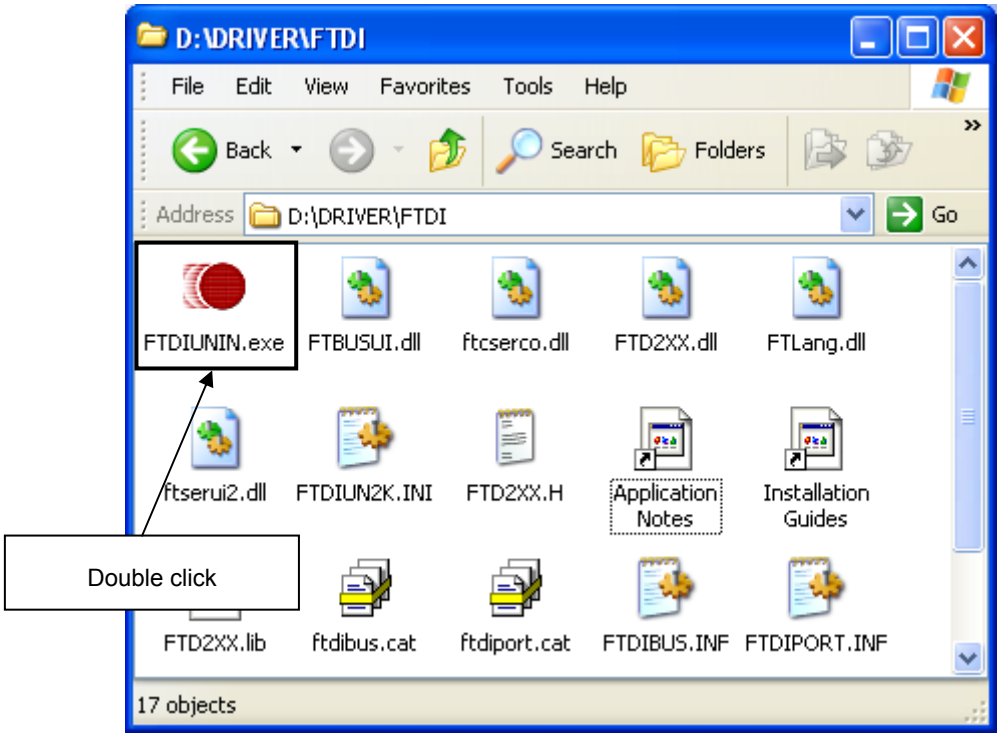
Windows2000/XP

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

1.4.3. Uninstallation of the USB driver

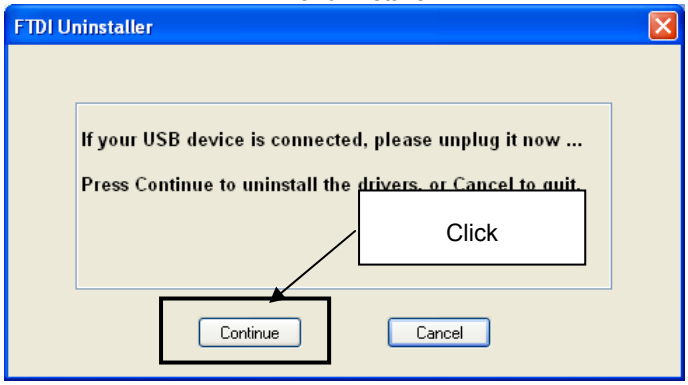
The uninstall program, Ftdiunin.exe, is available at “/DRIVER/FTDI”. Please log on as an administrator, then, execute the Ftdiunin.exe

The USB driver’s uninstall



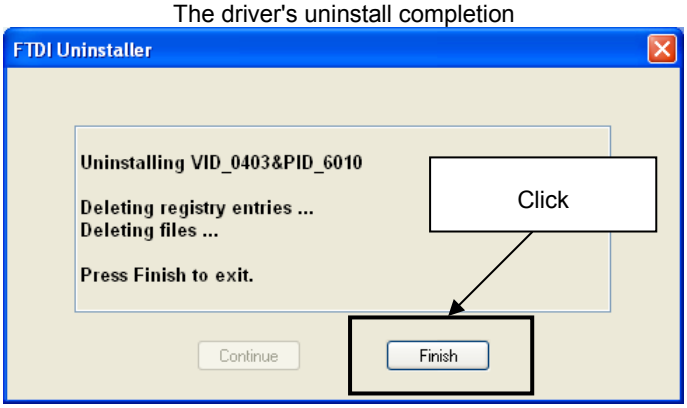
After TK-850 is detached, please click is Continue .

Driver uninstaller



Please click Finish.

The driver's uninstall completion



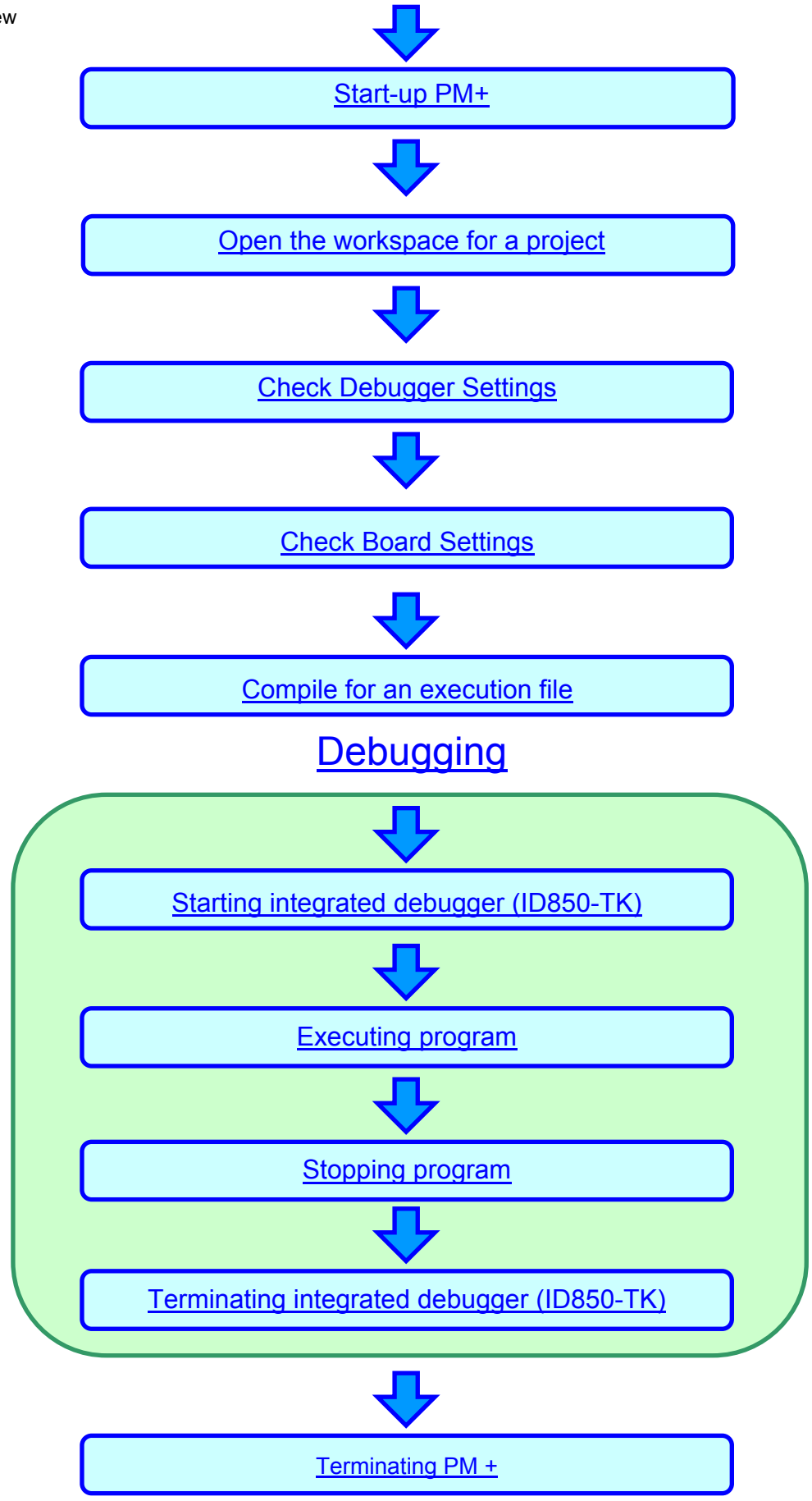
Chapter2 Experiences

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

- Integrated Development Environment, PM+
- Integrated Debugger, ID850-QB

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.

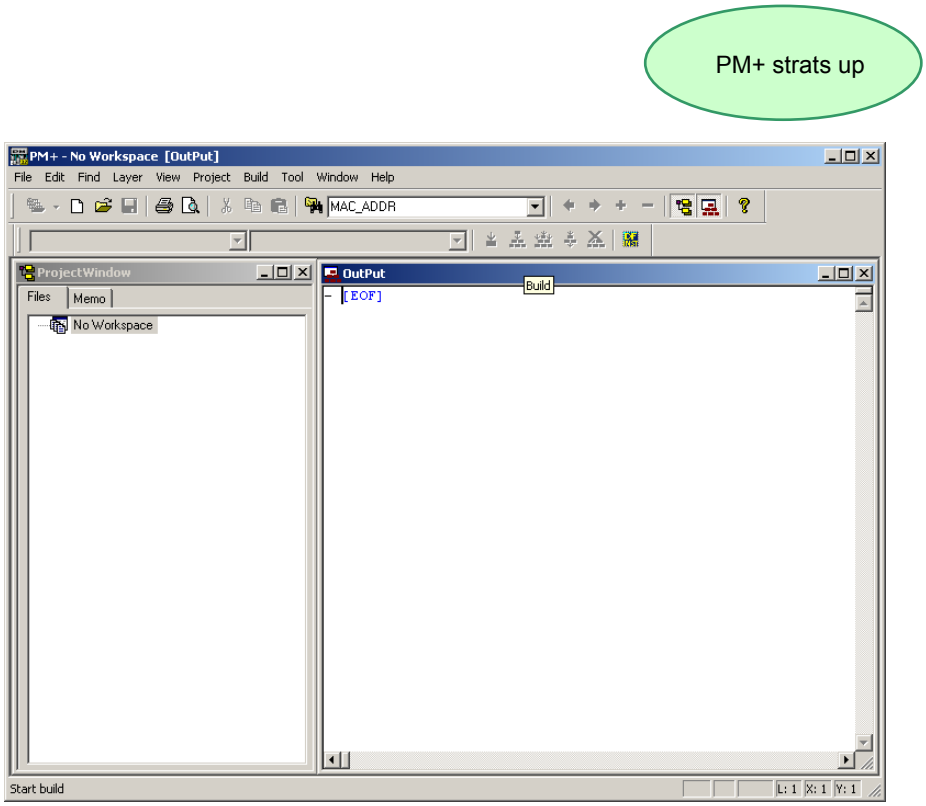
Overview


Start-up PM+
Open the workspace for a project
Check Debugger Settings
Check Board Settings
Compile for an execution file
Debugging
Starting integrated debugger (ID850-TK)
Executing program
Stopping program
Terminating integrated debugger (ID850-TK)
Terminating PM +

2.1 Starting up PM+

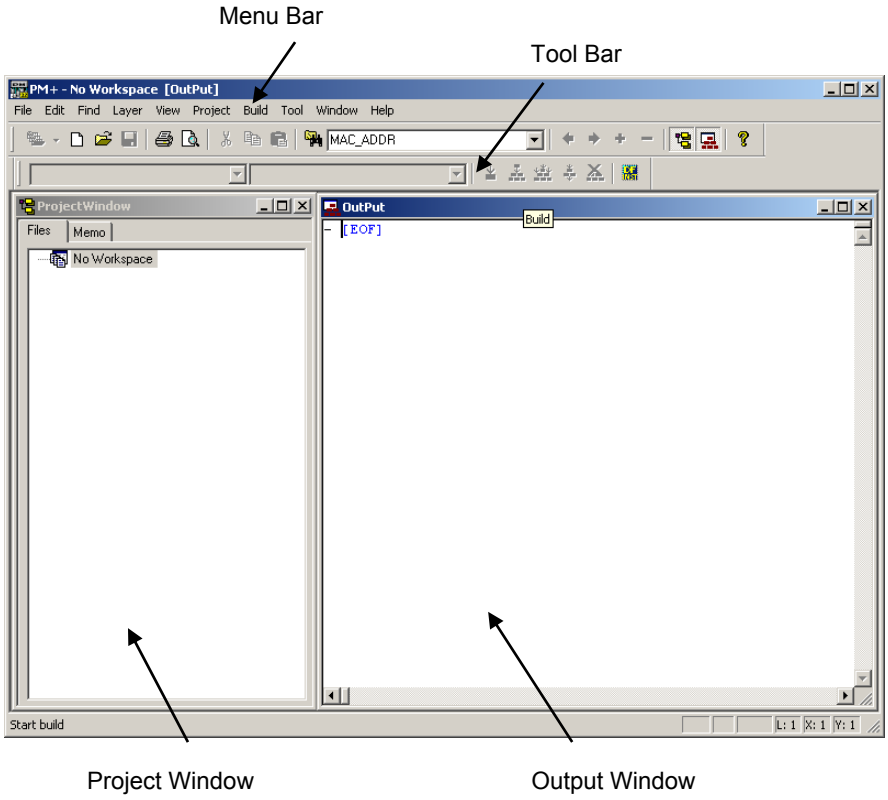
Now you start to experience development tools.

To start up PM+, please select [Programs] -> [NEC Electronics Tools] -> [PM+ V6.11] in the Windows start menu.



2.2 How PM+ looks like

In PM+, a project is defined. A project comprises of (an) application program(s) and environment. In a project, editing, building, and debugging of source codes are managed by PM+. PM+ also defines a work space. A work space comprises of one or more projects, and managed by PM+.



Project Window: A window where the project names, source files, and include files are displayed in a tree structure

Output Window: A window where build execution status is displayed

For details of the menu bar and the tool bar, please 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 + complies 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 complying, and the editor and debugger to be used have been saved as “project information”.

The file name format is “ΔΔΔΔ.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.

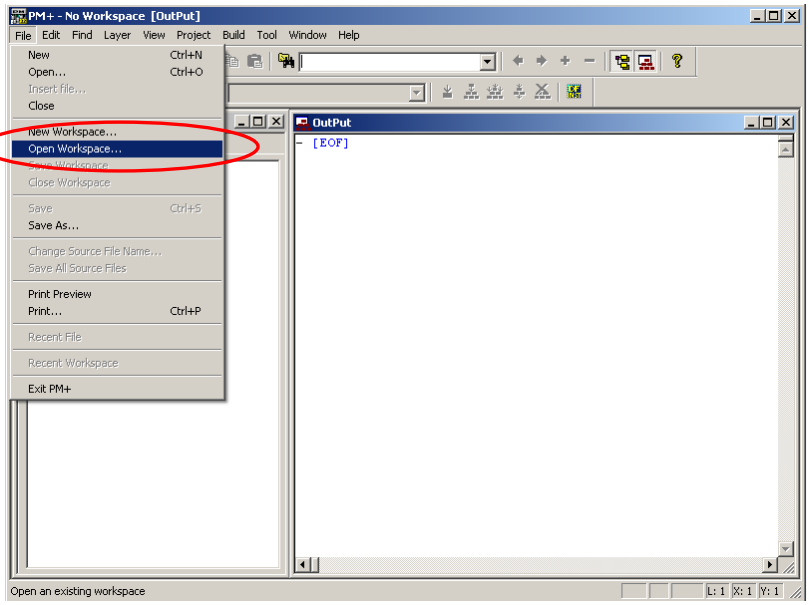
The file name format is “ΔΔΔΔ.prw”.

2.3 Open a workspace (projects)

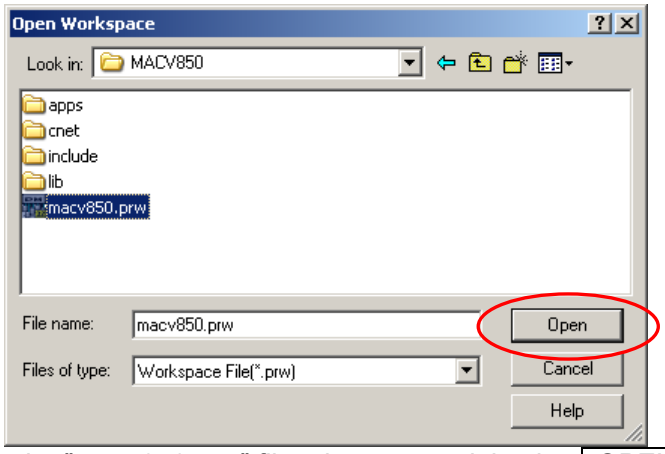
In this section, you utilize an already existing workspace.

For creation of a new workspace, please refer to the “2.14 How to create a new PM+ workspace”.
The workspace that you use in this section contains the completed version of the LED control application source files and project settings.
In the menu of the PM+, please select [Files] -> [Workspace], then, choose “C:/TK850/SAMPLE_SG2+UZ/MACV850/macv850.prw”.

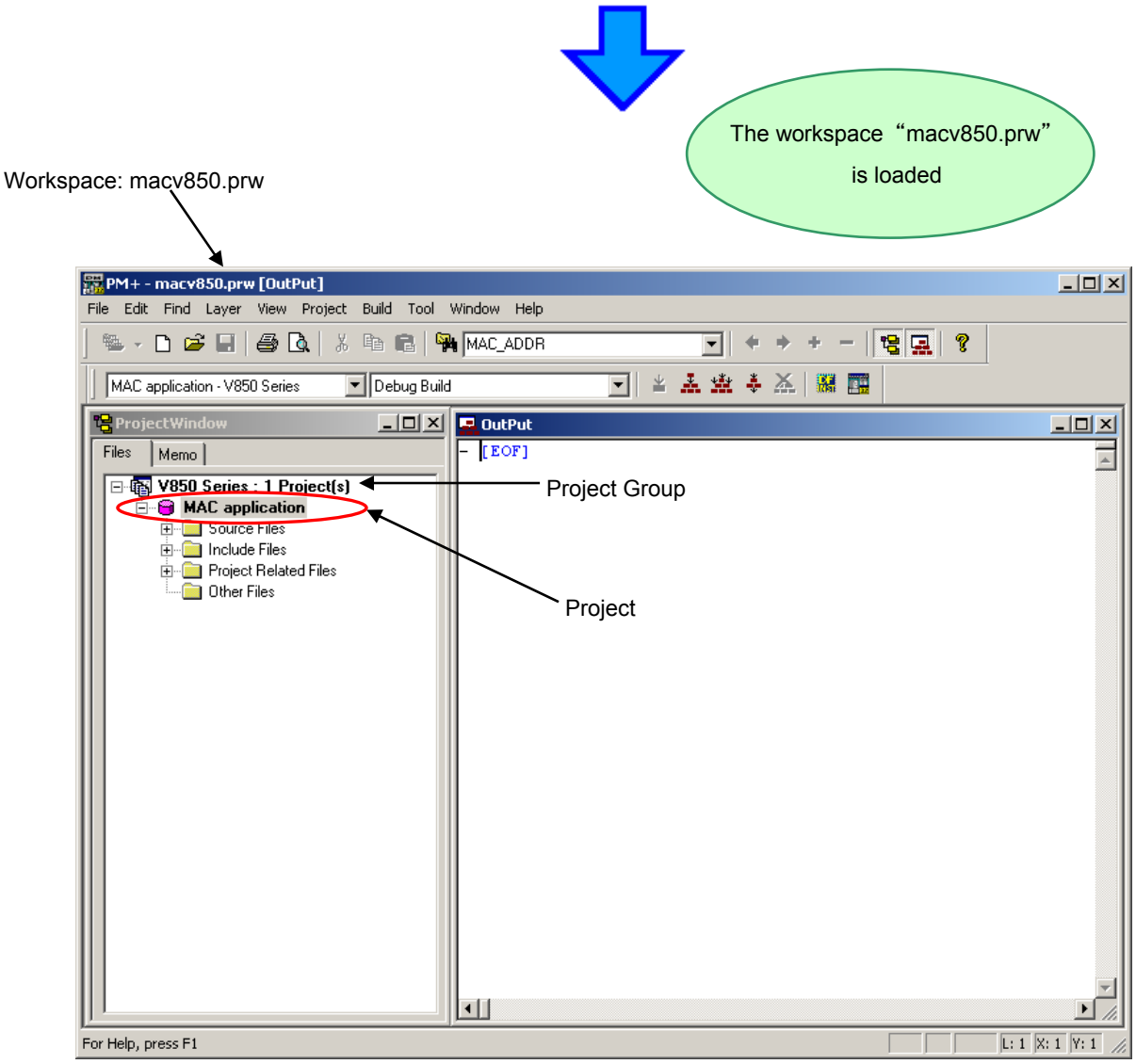
If you have not set your environment, please follow the explanation in the 1.3 Sample Environment



Please open the directory you installed the sample program



If you select the ”macv850.prw” file, please open it by the OPEN button.

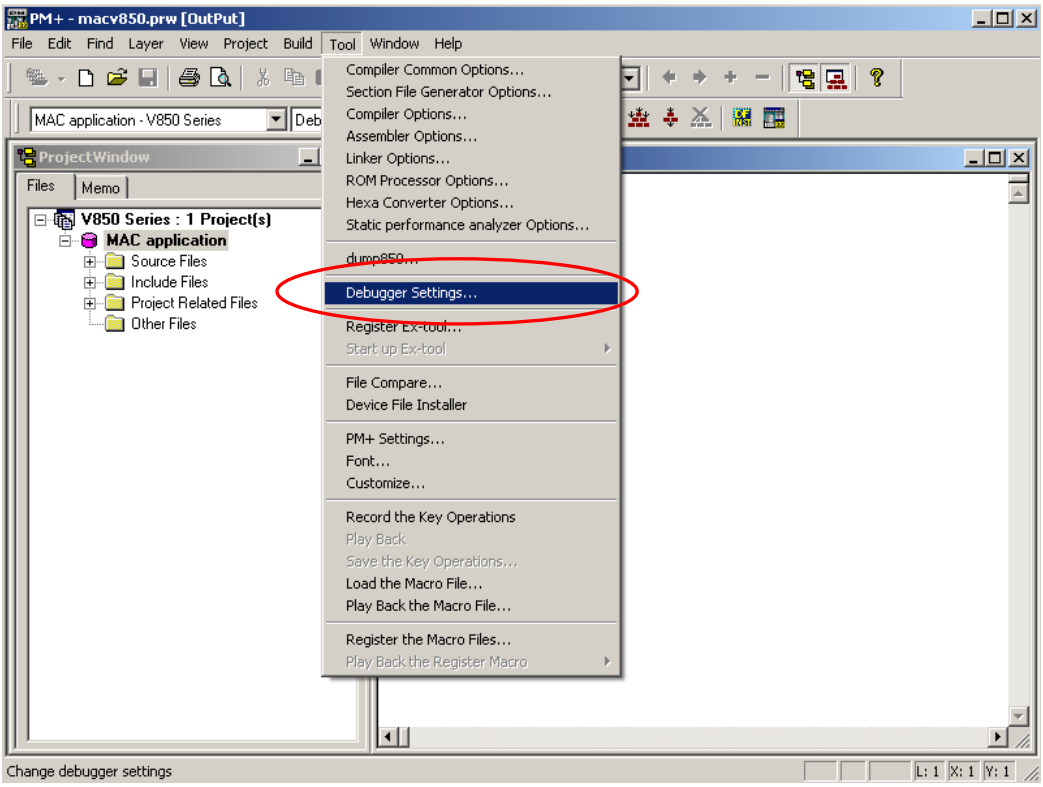


The workspace file "macv850.prw" contains one project called "MAC_application". You will use this project "MAC_application".

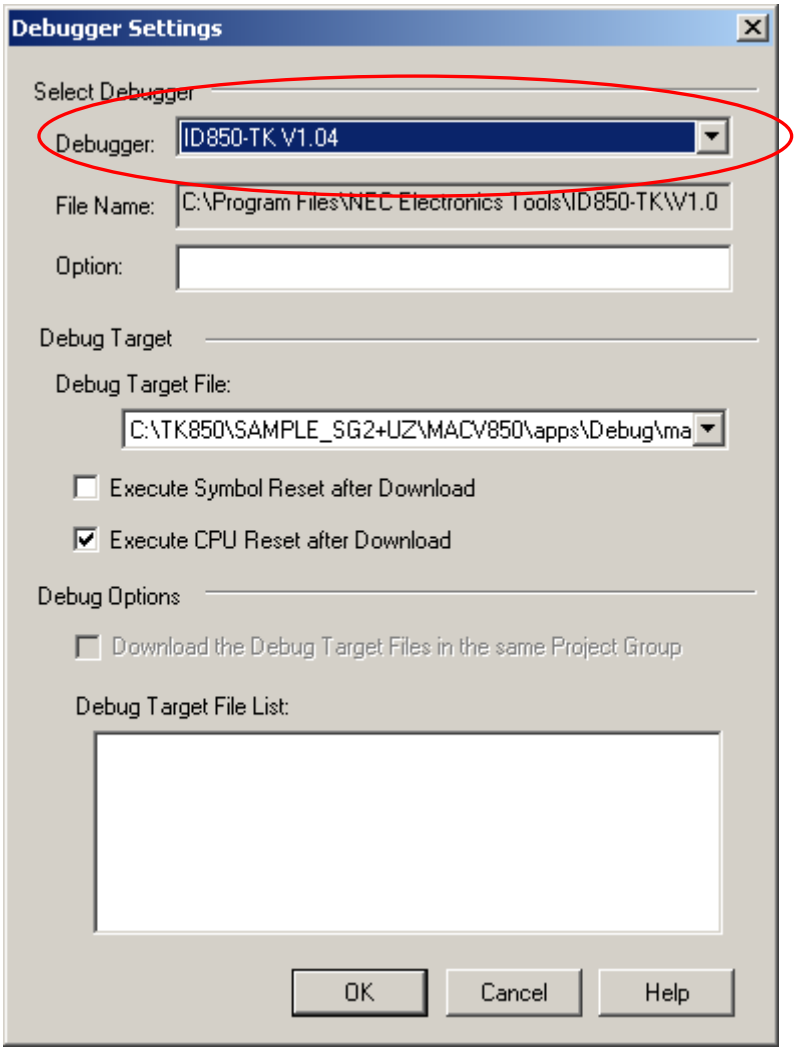
2.4 Check Debugger Settings

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 "ID850-TK V1.04" is selected on "Debugger".



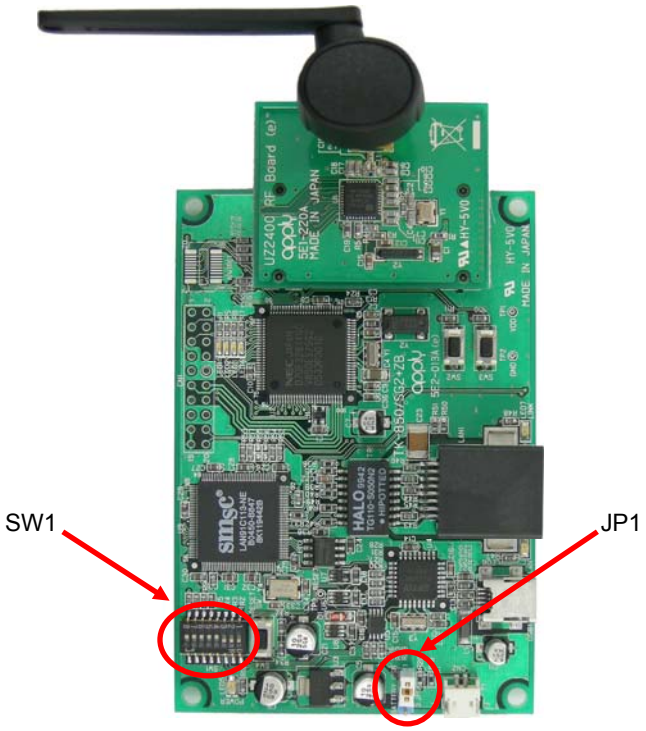
If you cannot select "ID850-TK V1.04", select "Project" on menu bar, "Project settings" -> "Tool version settings" -> "Detail settings" -> then select "ID850-TK V1.04".

2.5 Check Board Settings

Before connecting the PC and the TK-850/SG2+UZ with USB, you should check the setting of swiches on the board.

Set the switches of the TK-850/SG2+UZ as follows.

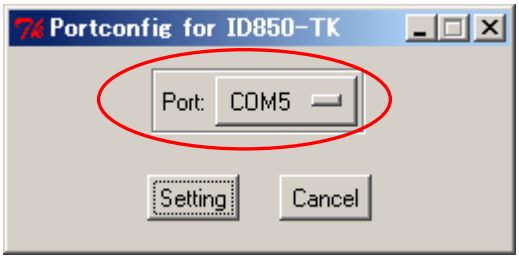
JP1		1-2 short (USB side)
SW1	Bit1	ON
	Bit2	ON
	Bit3	ON
	Bit4	OFF
	Bit5	OFF
	Bit6	OFF
	Bit7	OFF
	Bit8	OFF



Next, the COM port number allocated by connecting the TK-850/SG2+UZ board with PC is set by "Portconfig for ID850-TK".

Then, please select Portconfig
at [Programs] ->[NEC Electronics Tools]→[ID850-TK]→[V1.04]→[Portconfig for ID850-TK].
You will find the following window.

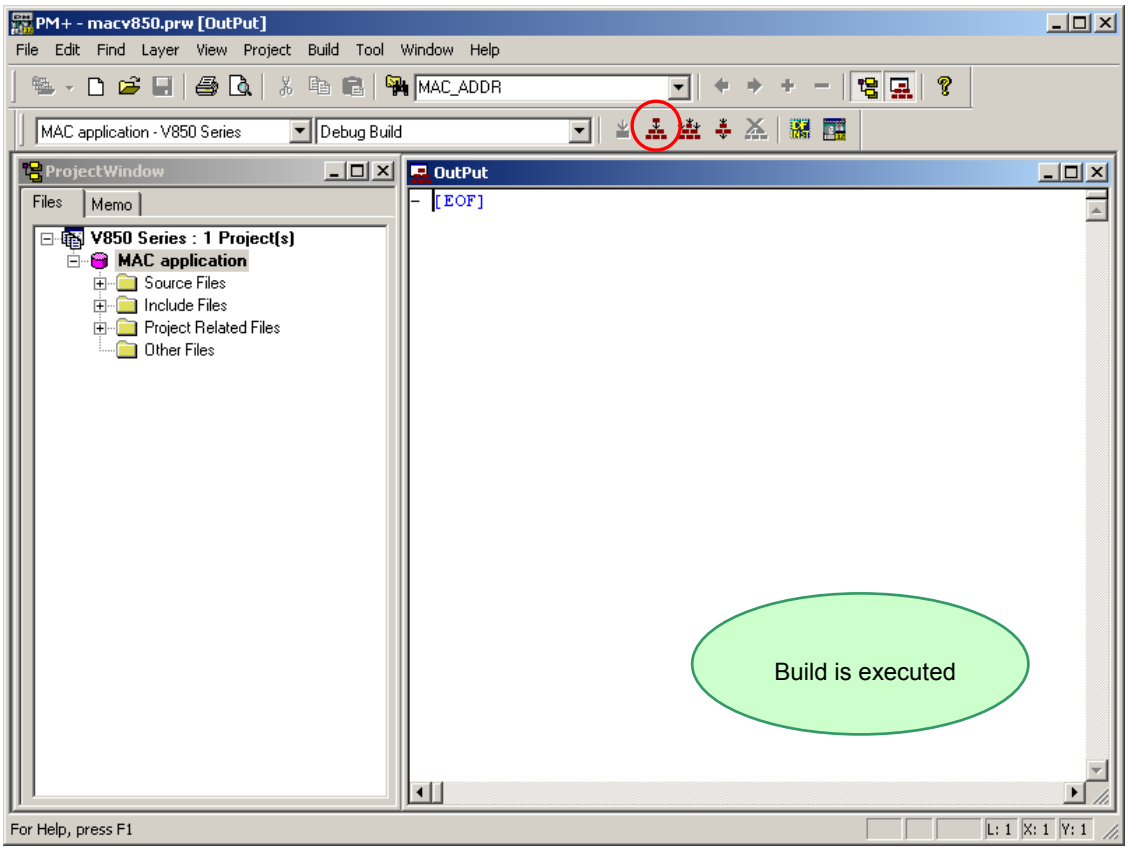
Set the COM port number, which selected by connecting TK-850/SG2+UZ board and PC and which confirmed in "1.4.2. Confirmation of the installation", by clicking "Port" on "Portconfig for ID850-TK" window.

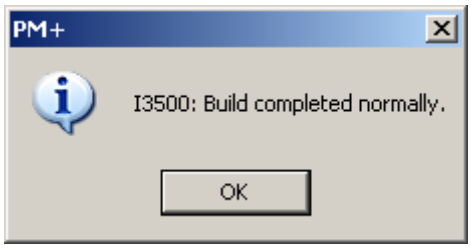


2.6 Compile for an execution file

You now create the execution file of the project. This task is called Build.

Please select the build button  , or from the menu [Build], please select [Build].





Build is completed.

What is build ?

Build is a function that creates an execution file, etc., from a source file registered to the project.
PM+ automatically performs compiling, linking, and other processes.
On the second and subsequent builds, PM+ automatically detects files that have been updated from the previous build process, and complies and assembles only the modified files, thereby saving the time required for build.

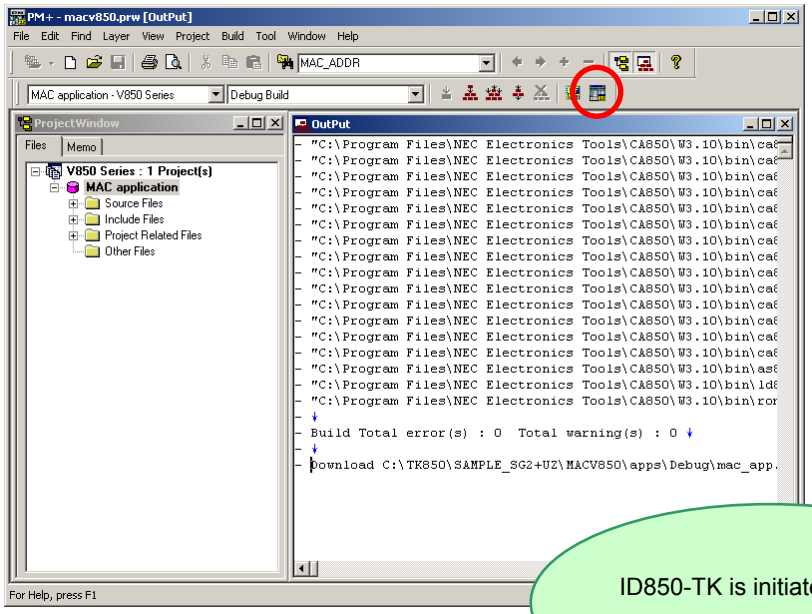
What is rebuild ?

Build compiles and assembles only the source files that have been modified since the previous build, whereas rebuild compiles and assembles all of the source files.
If you have modified compiler options or other settings, you have to execute rebuild.

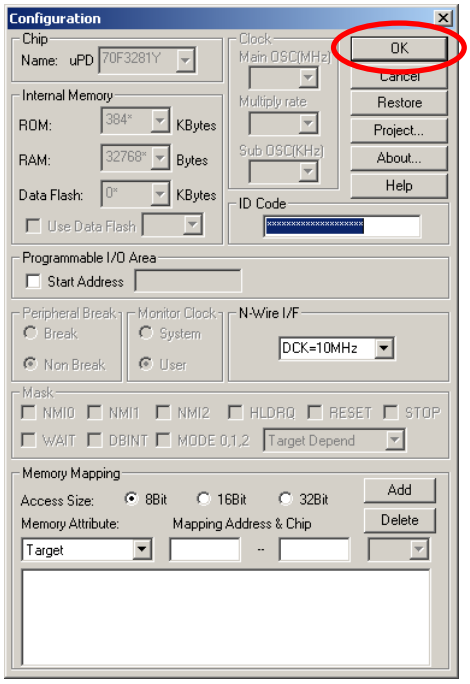
2.7 Start Debugger

In the PM+ window, please select the debug button  , or please select [Build] -> [Debug] in the menu.

If you do not see the debug button, please select [Tools] -> [Debuggers] in the menu of the PM+, then, choose “ID850-TK V6.11 Integrated Debugger”.

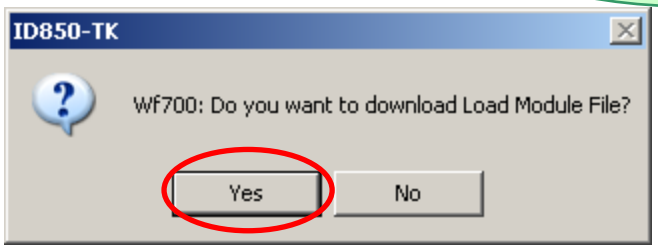


ID850-TK is initiated, and the Configuration window will show up



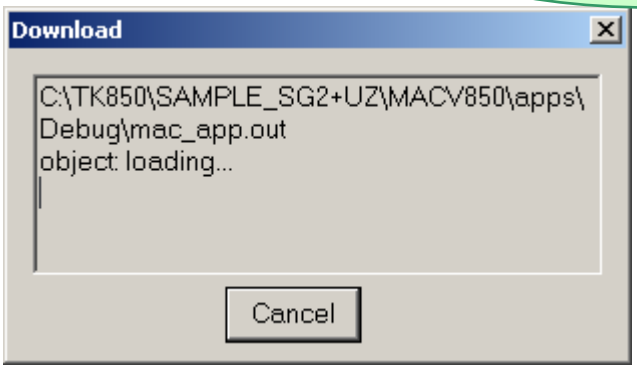
Click OK

You are asked to confirm the download of the load module file

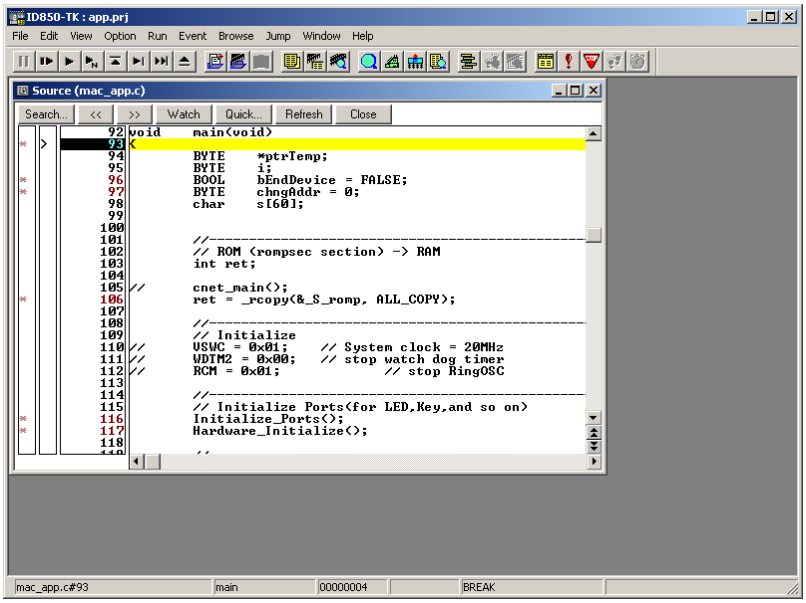


Please click [YES] to download the load module file.

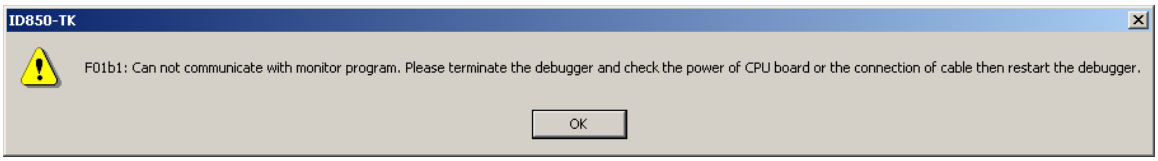
The load module file is now downloaded into the on-chip Flash EEPROM of CPU



If the download is completed, C source list will be displayed in the debugger window.



If the debugger failed to communicate with the monitor program on chip, the error message F01b1 will show up.



In this case, please confirm the following items,

1. Power supply to the TK-850/SG2+UZ board
2. Please make sure the following settings in the SW1.

SW1 - 1	ON
SW1 - 2	ON
SW1 - 3	ON
SW1 - 4	OFF

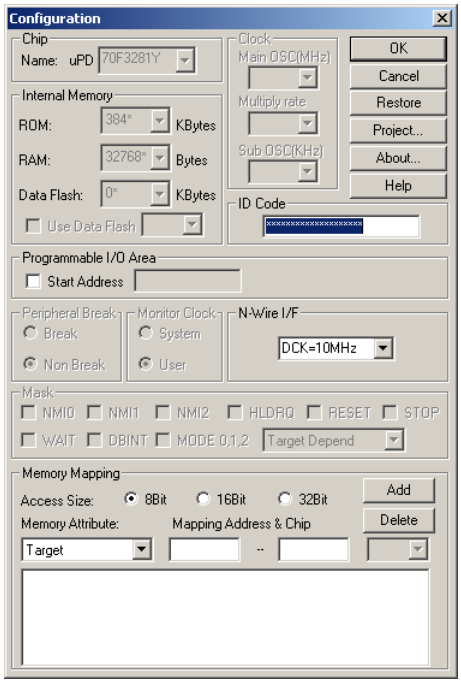
3. Please make sure the COM port, where you connected the TK-850/SG2+UZ board.
   The COM port number you set up in the utility “Portconfig for ID850-TK” shall be identical with the one found at at [Control Panel] -> [System] -> [Hardware] -> [Device Manager] -> [Port] in your PC.

   ”Portconfig for ID850-TK” may be found at [Programs] -> [NEC Electronics Tools] -> [Portconfig for ID850-TK].

If you correct one of the three items, please re-start ID850-TK.

If you find the error message Ff603, it means the ID code is wrong.

If you press OK, you will see the following Configuration window to set the ID code.



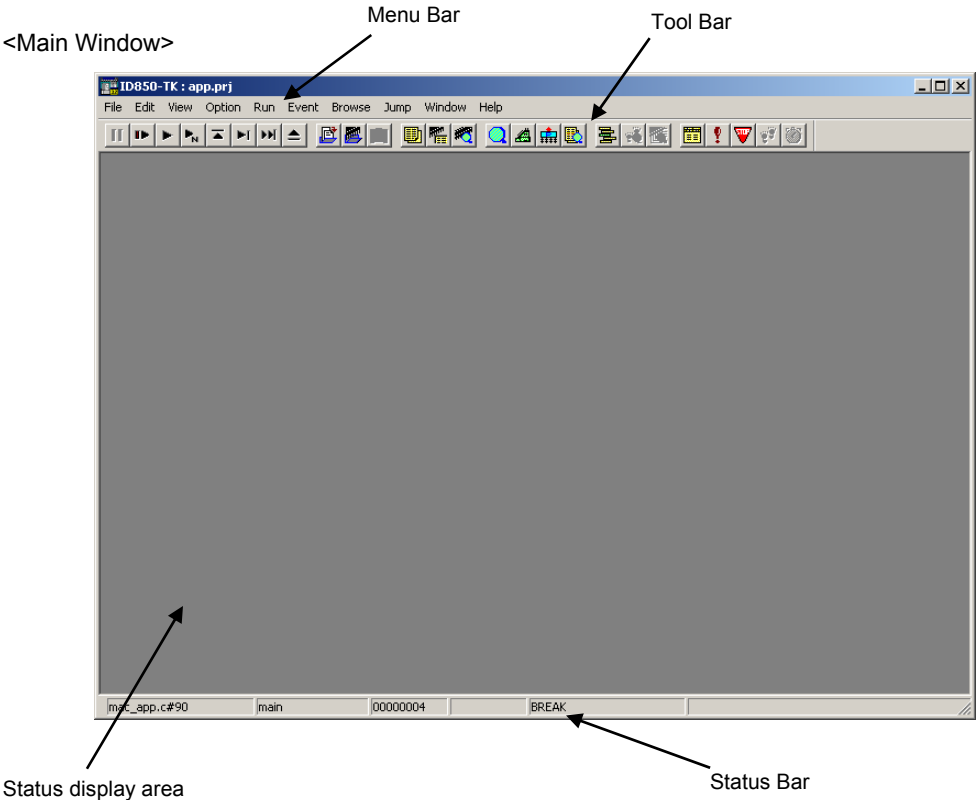
The default value of the ID code in the sample program is “FFFFFFFFFFFFFFFFFFFFh”.
This ID code can be changed on the "Device" tab screen from "Compiler Common Options…".

The intension of utilizing the unique ID code is to prevent a third party from debugging and modifying your source code.
When the ID code is forgotten, it is necessary to delete all flash memories with built-in CPU.
Please delete the flash memory by installing "PG-FPL" from CD of the attachment.
Please refer to Chapter 3 for the usage of "How to use PG-FPL".

2.8 Run Programs

Integrated DebuggerID850-TK displays the status information in the CPU. It also controls the monitor program.

The default opening window of ID850-TK looks like as follows,

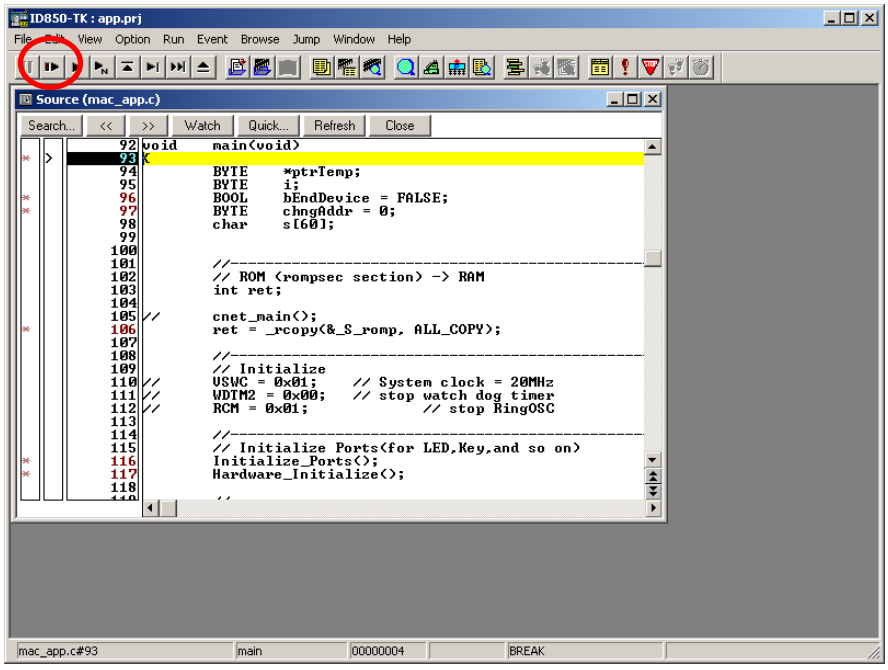


For more detail, please refer to the user's manual of ID850-TK Operation.

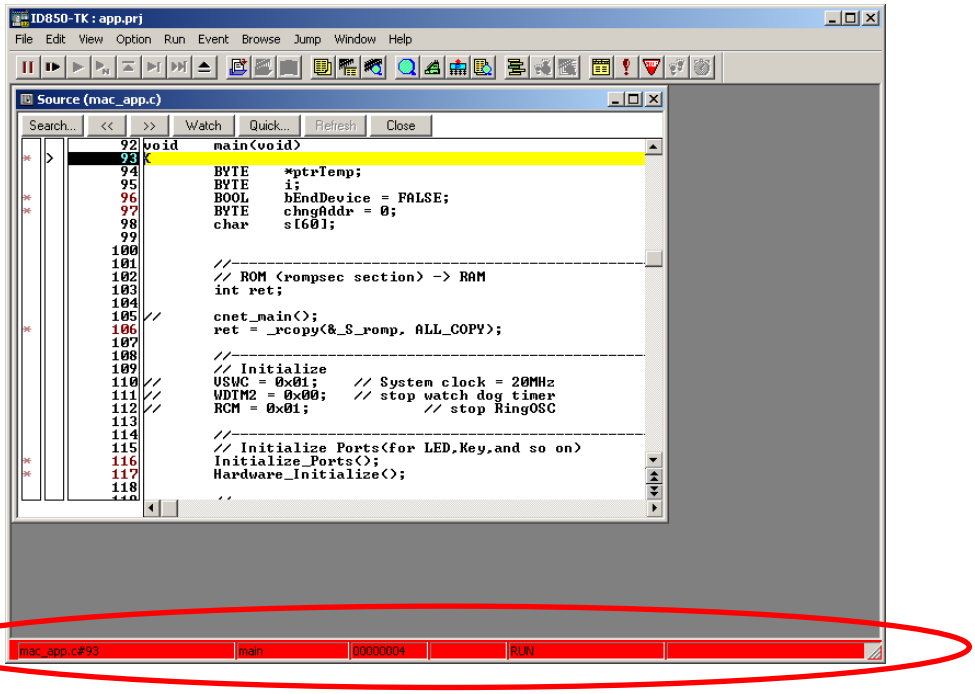
2.9 Execute the program

You now execute the program in the debugger.

In the ID850-TK window, please press the re-start button  , or please select [Run]→[Restart] in the menu bar.



Run the program

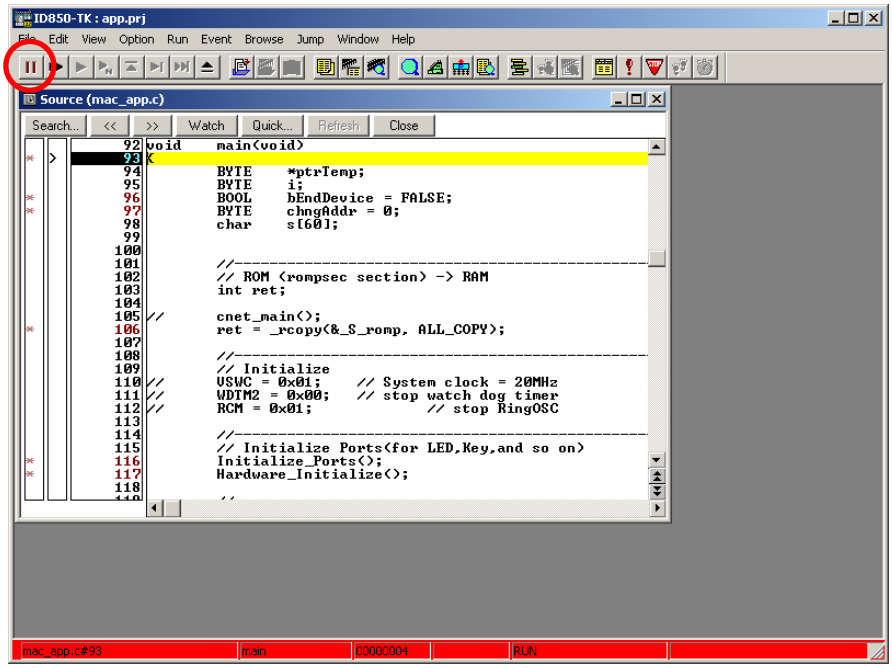


While the program is being executed, the status bar is red.

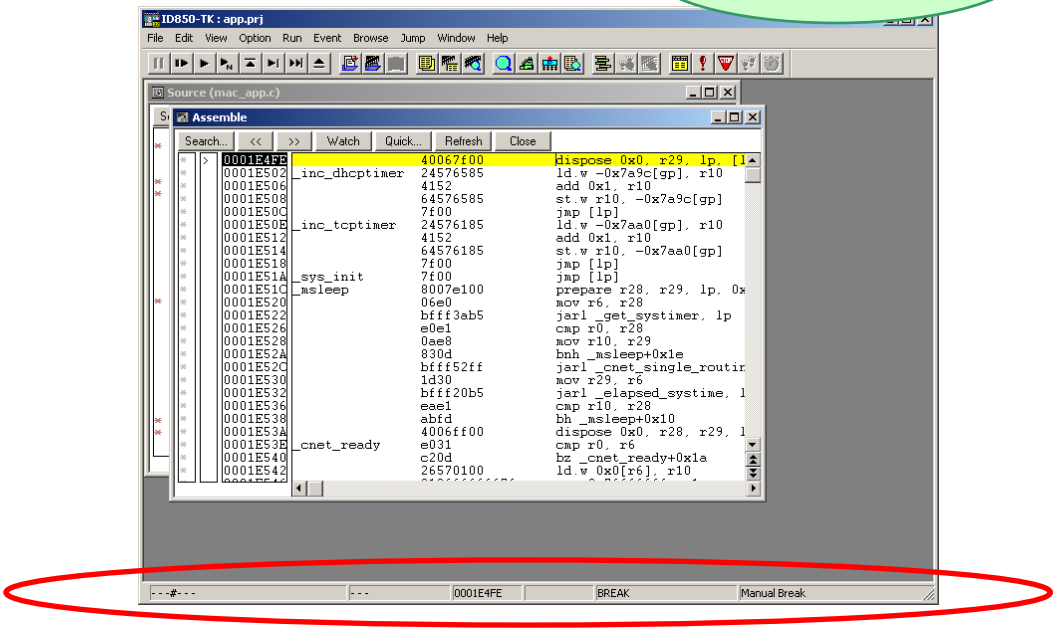
2.10 Halt the program execution

How to halt the program execution.

Press the halt button  , or please select [Run] -> [Stop] in the menu bar.



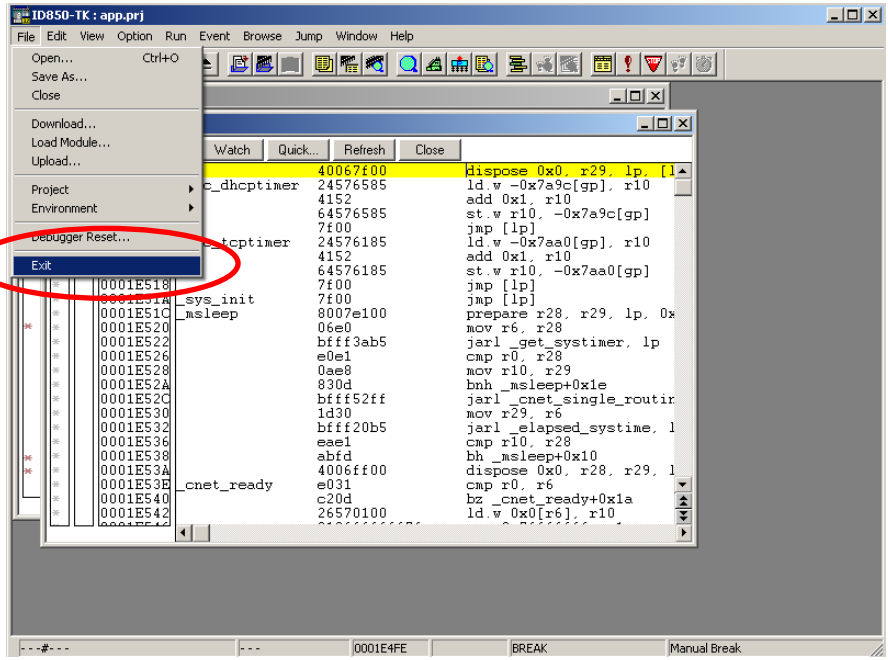
The program is halted



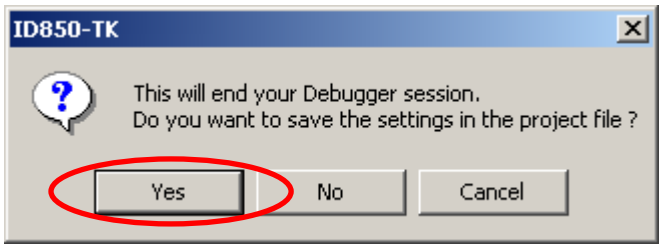
After the program is halted, the status bar is not red.

2.11 Terminate the debugger

To terminate ID850-TK, please select [Files] -> [Exit] in the menu bar.



The dialog to confirm termination is displayed

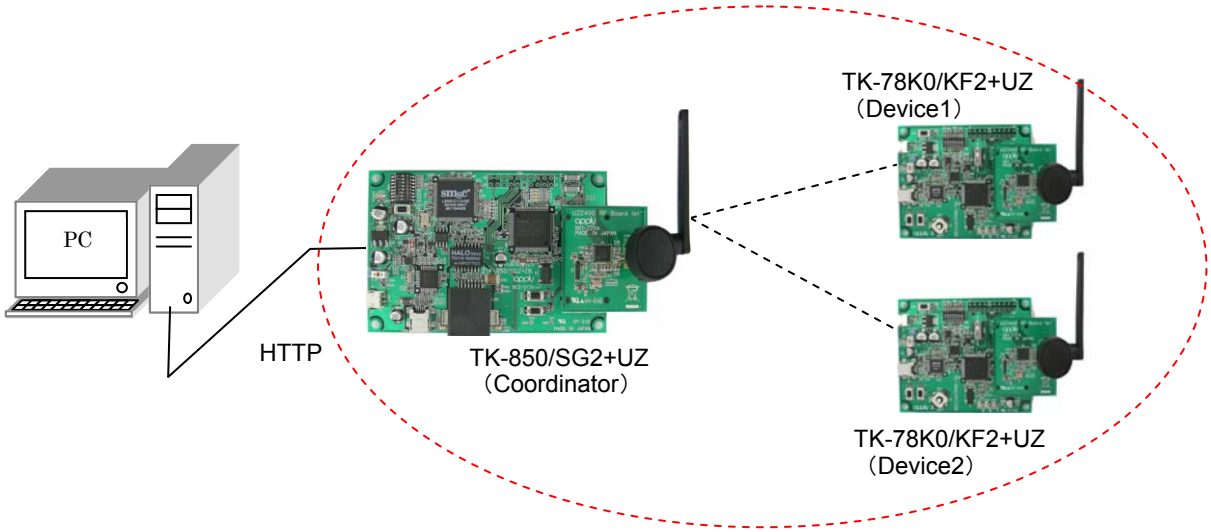


Please press [Yes], to store the environment and terminate ID850-TK.

Please press [No], to abandon the environment and terminate ID850-TK.

2.12 Sample Application

This sample program utilizes TCP/IP and HTTP on the TK-850/SG2+UZ board, and wireless communications of IEEE 802.15.4 between one TK-850/SG2+UZ board and up to 4 TK-78K0/KF2+UZ boards.
We call the TK-850/SG2+UZ board “Coordinator” and the TK-78K0/KF2+UZ boards “Devices”.



Preparation of TK-78K0/KF2+UZ

Now, you are going to write the sample programs to 78K0/KF2 built-in flash memory with using the writing software PG-FPL3, which is bandled to TK-78K0/KF2+UZ.

Set the switches of TK-78K0/KF2+UZ as shown below, then write the file "mac_app.hex" under the directory "C:/TK78K0/SAMPLE_KF2+UZ/MAC78K0/apps/Release", which is installed in the section "1.3.1. Installing the sample program".

SW1 - 1	ON
SW1 - 2	ON
SW1 - 3	OFF
SW1 - 4	OFF
SW1 - 5	OFF
SW5	UART side

Write the same sample programs to the other TK-78K0/KF2+UZ.

When you run the application, you can run it as stand-alone system by setting JP1 to 2-3 pin short and using 006P battery connected to CN2.

Operation Procedure

(1) In case you intend to execute the sample program without using the debugger, please set the mode switch as shown below, and then, please make a hardware reset by the reset push switch.

TK-850/SG2+UZ

SW1 - 1, 2, 3, and 4	OFF
SW1 – 5, 6, 7, and 8	Not cared

TK-78K0/KF2+UZ

SW1 - 1, 2, 3, 4, 5, 6, and 7	OFF
SW1 - 8	ON
SW5	UART

(2) Please connect your PC to the TK-850/SG2+UZ board with a LAN cable.
The LAN cable shall be cross, not straight.

(3) Please apply the power source to the TK-850/SG2+UZ board, batteries or powered USB.
Then,

[1] In your PC, please open [Control Panel] -> [Networks] -> [Property] -> [TCP/IP] -> [Property]. Please set the following IP address and the subnet mask.

・IP address: 192.168.0.x x can be any value between 1 to 99, or 101 to 25.

・Sunet mask: 255.255.255.0

Please close the TCP/IP set up window.

[2] Please start you web browser, such as MS Internet Explorer.

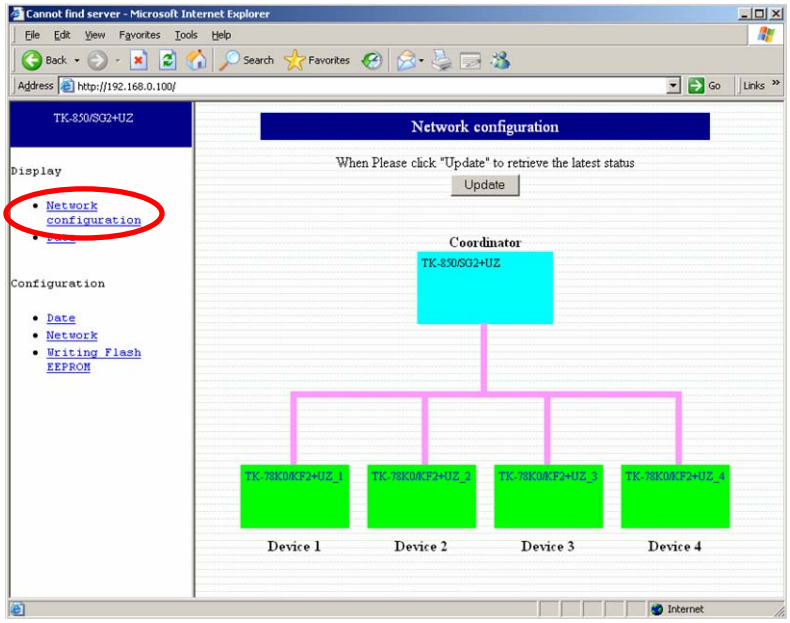
[3] Please connect your browser to http://192.168.0.100

You can modify the URL later at [8] Configuration -> Network

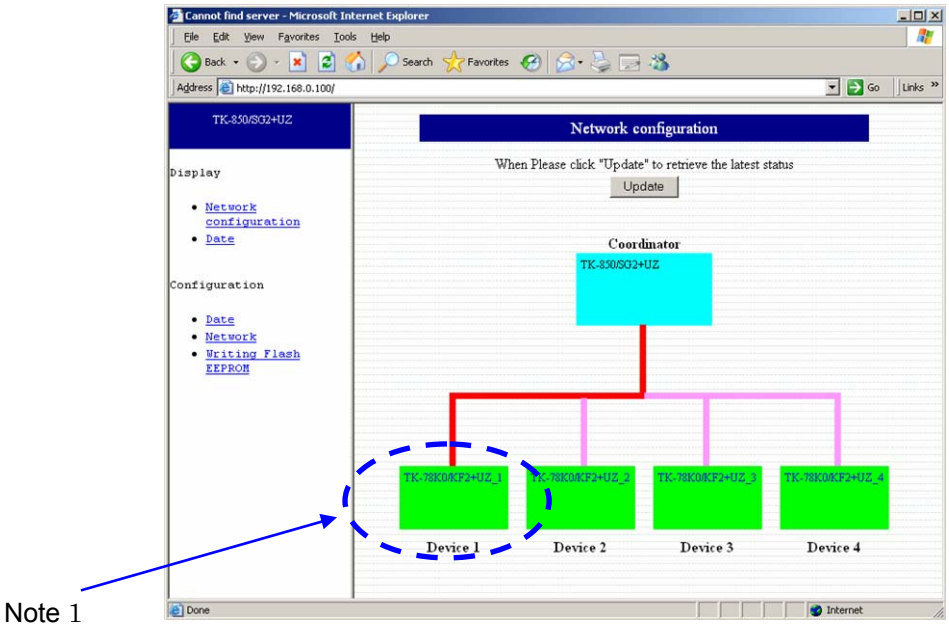
[4] Please apply power to the TK-78K0/KF2+UZ boards.

(4) You may see the following image in your browser.

You can come back to this image, anytime if you select [Display] -> [Network Configuration].



(5) If a Device is connected wirelessly, you can see the red line.

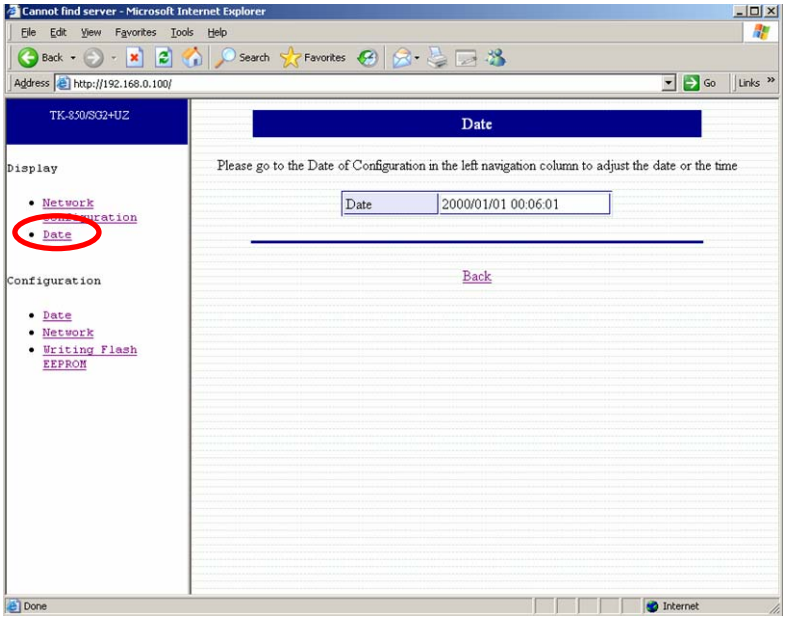


Upto 4 devices can be connected in the sample program. To display the latest status, please click the “Update” button. The pink line indicates it is not connected.

The coordinator checks a device in every 30 seconds.

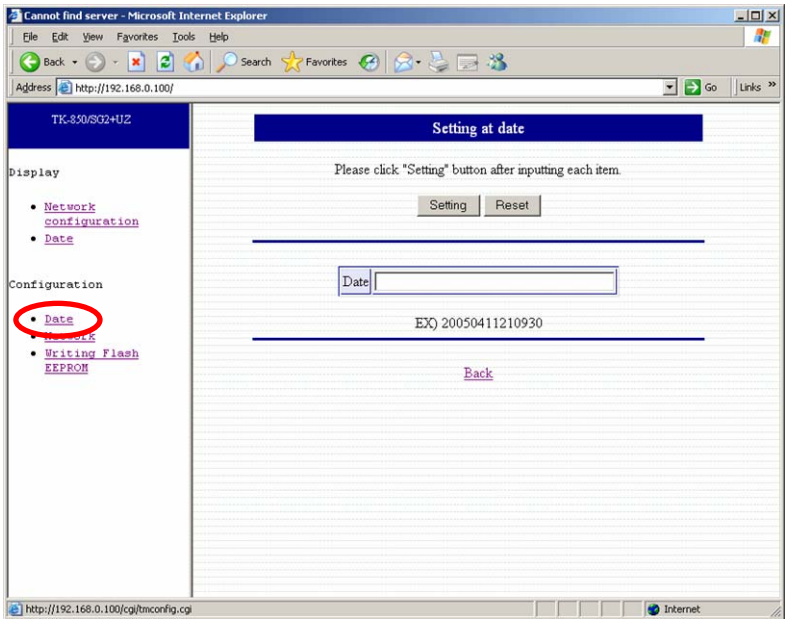
Note 1: If you double click one of the device green box connected with a red line, you will jump to (10).

(6) If you select [Display] -> [Date], you can find the time the sample program has.



※ The default time is 2000/01/01 00:00:00.

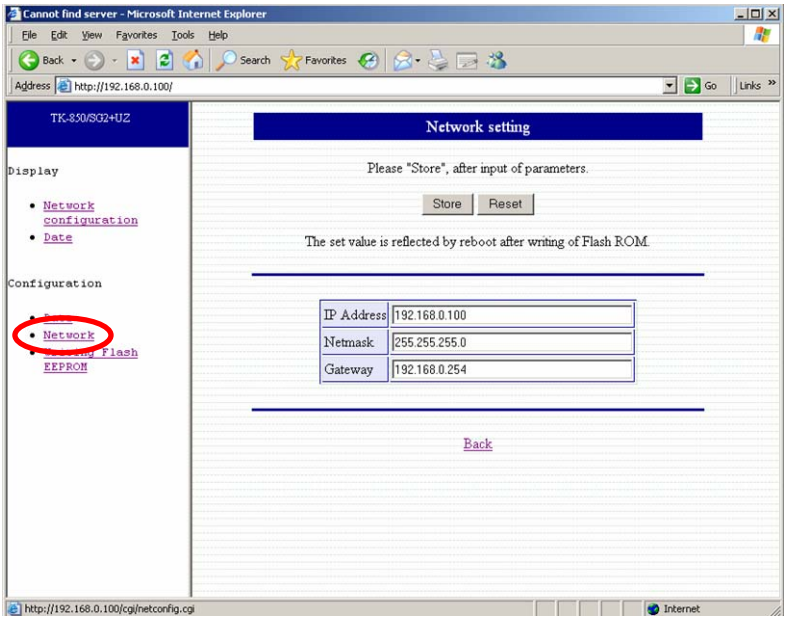
(7) 「You can set your time by selecting [Configuration] -> [Date]



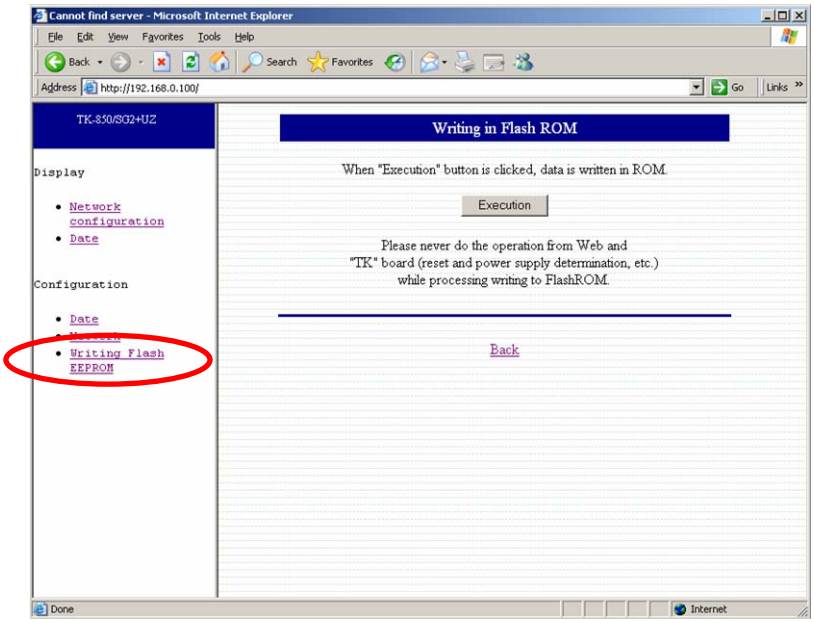
※ If you want to set 9 minuts and 30 seconds past 9pm on April 11th in 2005, please input 20050411210930.

(8) To setup networks, please select [Configuration] -> [Network].

You can modify the network configuration in this window. However it will be adopted only after the new configuration is downloaded in the Flash EEPROM.

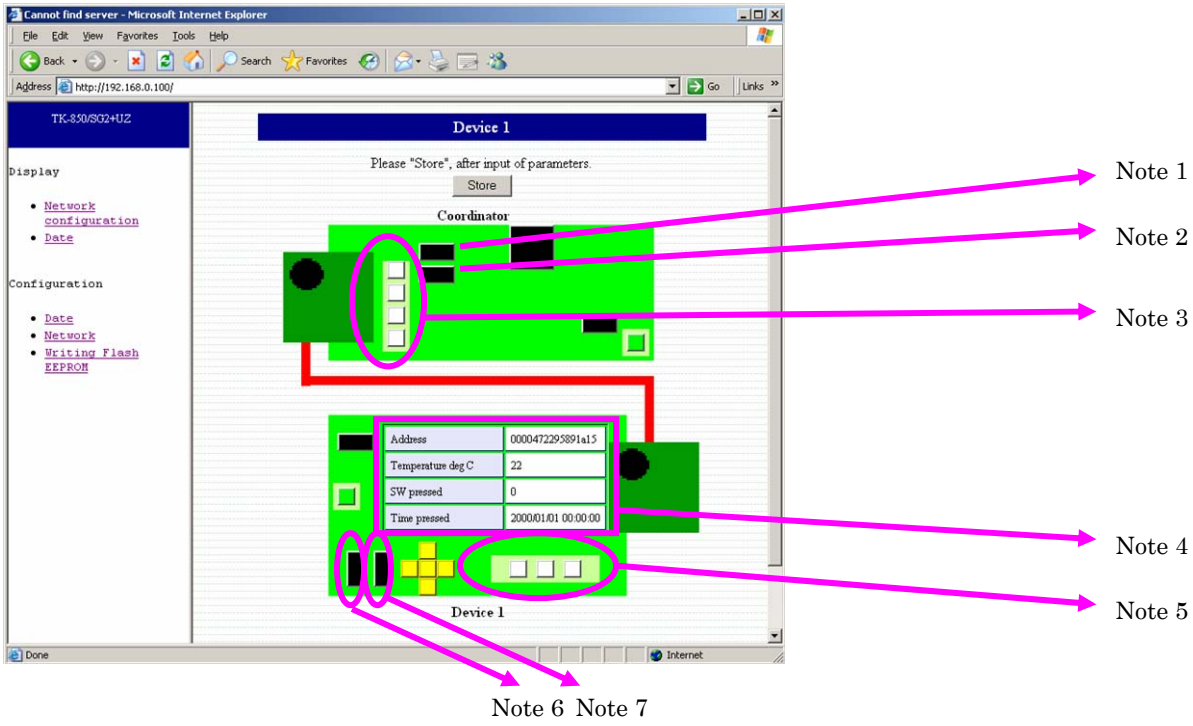


(9) You can open the Flash programming window by selecting [Configuration] -> [Writing Flash EEPROM]



※ Please click Execution to store the current settings.

(10) If you click a connected device, you can find the following window



Operation on the WEB browser:

Upper half is the coordinator,

Note 1: If you click the SW3 of the coordinator, LED3 on the physical Device 1 becomes on, and then, off.

Note 2: If you click the SW2 of the coordinator, LED2 on the physical Device 1 bewcomes on, and then, off.

Note 3: If you click any LEDs of LED1, LED2, LED3, or LED4, the corresponding LED on the physical board will become on, and off.

Lower half of the window indicates a Device:

Note 4: Status information of the Device,

- Address：This is the Mac address of the Device in IEEE 802.15.4.
- Temperature：Measured on the Device
- SW pressed：Indicates which switch was pressed on the Device.
- Time pressed：Time stamp of the pressed switch.

Note 5: LEDs, LED2, LED3, or LED4, can be on and off.

Note 6: If the SW3 of the Device is clicked, LED1 of the coordinator is on and off.
The information at the Note 4, SW pressed, and Time stamp, will be updated.

Note 7: If the SW4 of the Device is clicked, LED2 of the coordinator is on and off.
The information at the Note 4, SW pressed, and Time stamp, will be updated.

To update to the latest status, please click the “Store” button.

Operation on the board:

On the TK-850/SG2+UZ board,

(1) By pressing SW3 on the TK-850/SG2+UZ board, LED3 on the Device1 becomes on and off.

(2) By pressing SW2 on the TK-850/SG2+UZ board, LED2 on the Device1 becomes on and off.

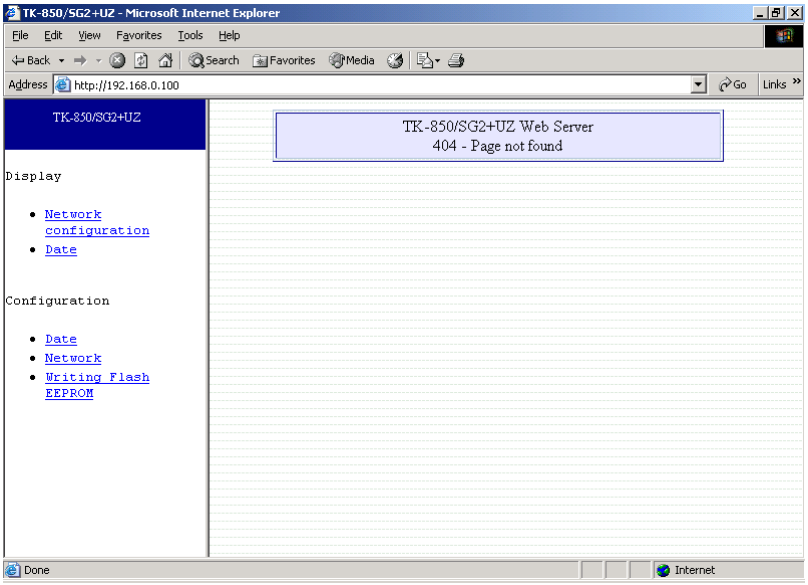
On a TK-78K0/KF2+UZ board,

(1) By pressing SW3 on a TK-78K0/KF2+UZ board, LED1 of the coordinator becomes on and off.

(2) By pressing SW4 on a TK-78K0/KF2+UZ board, LED2 of the coordinator becomes on and off.

Please note an LED manipulated on board is not reflected on the Web browser.

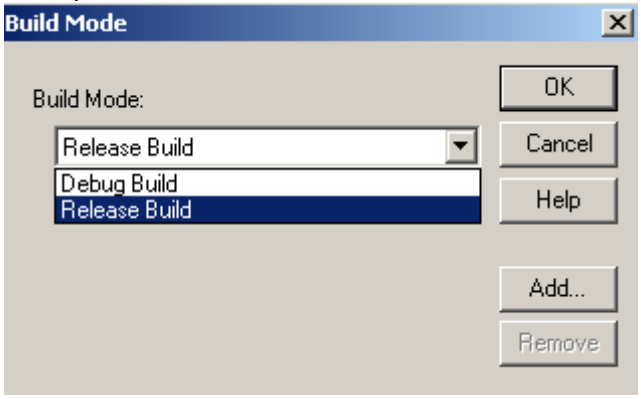
(11) If you click a device, not connected with a red line, you will see the following window.



2.13 Create hex files

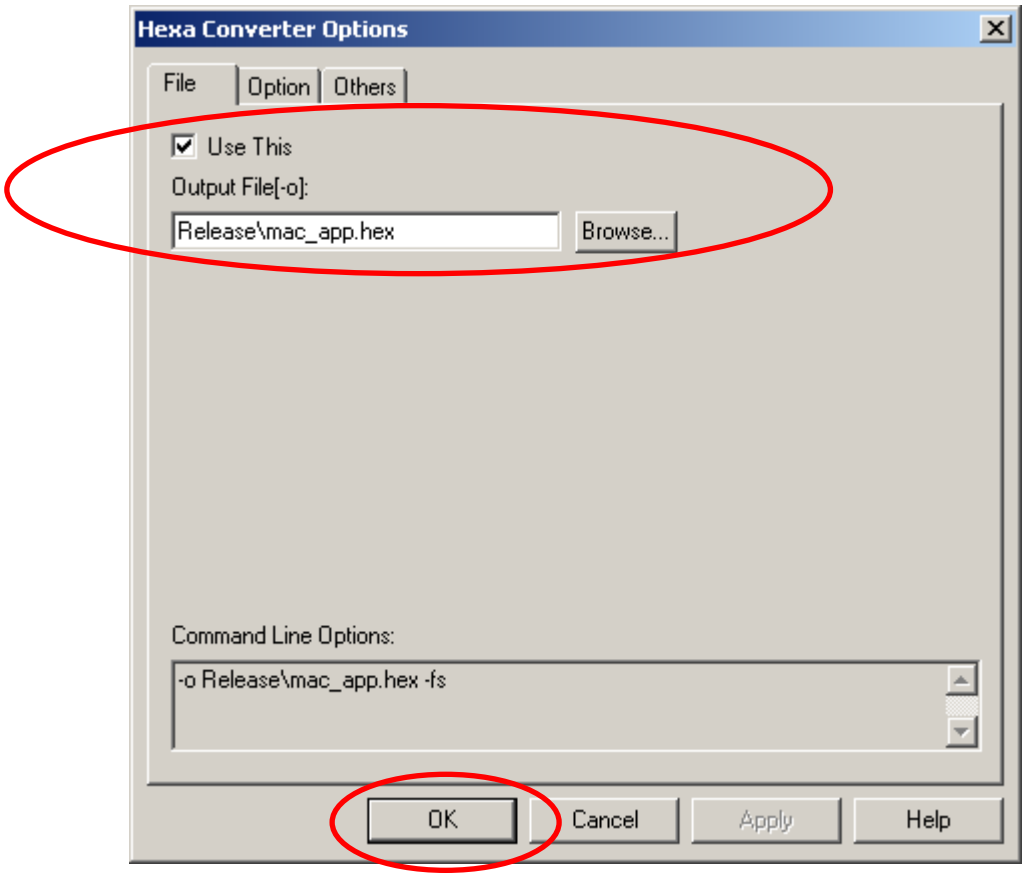
In this section, how to create a HEX file, which you need for writing programs to TK board with PG-FPL (without debugger), will be explained.

Select "Build" on menu bar, then "Select Build Mode".
The window "Build Mode" is opened.

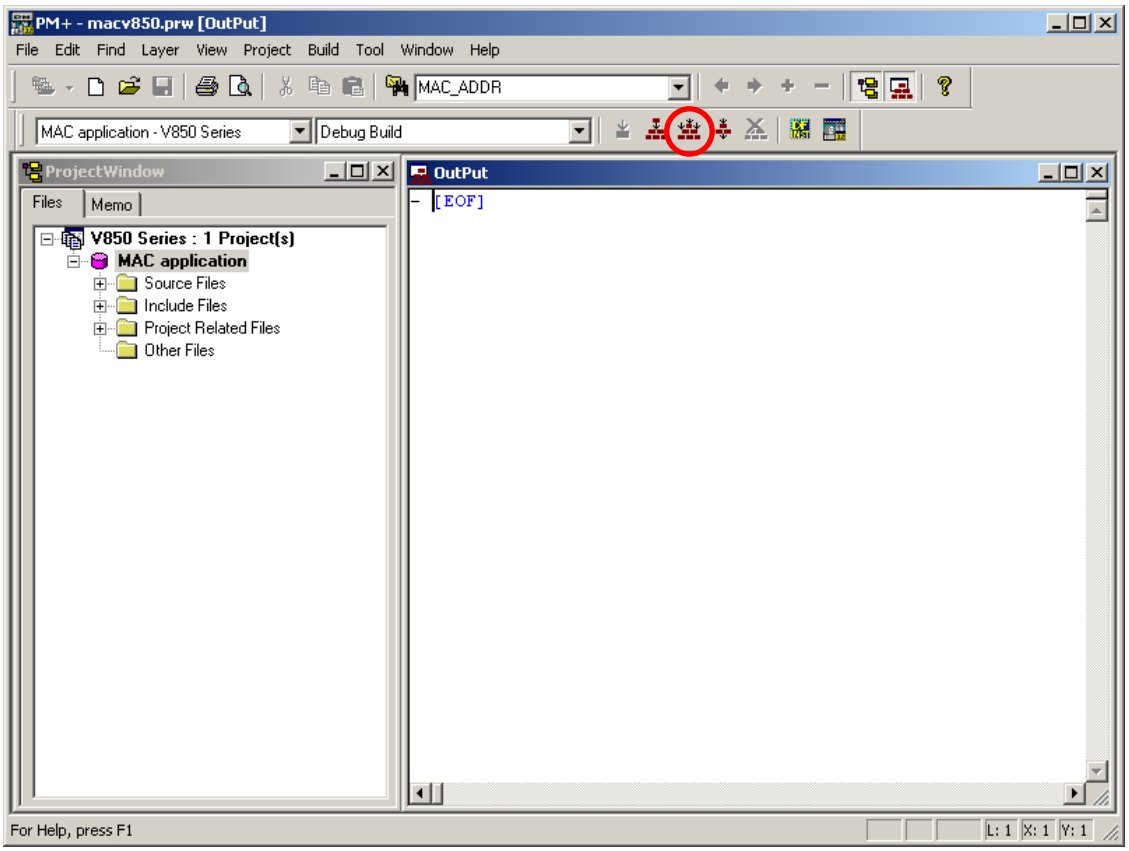


Select "Release Build" for "Build Mode", then click OK .

Next, select "Tool" on menu bar, then "Hexa Converter Option".
The window "Hexa Converter Option" is opened.
Confirm "Use This" is checked and the file path/name for HEX file is specified on "File" tab.
The screenshot below shows to create a HEX file with the name of "mac_app.hex" in "Release" directory under the project directory.



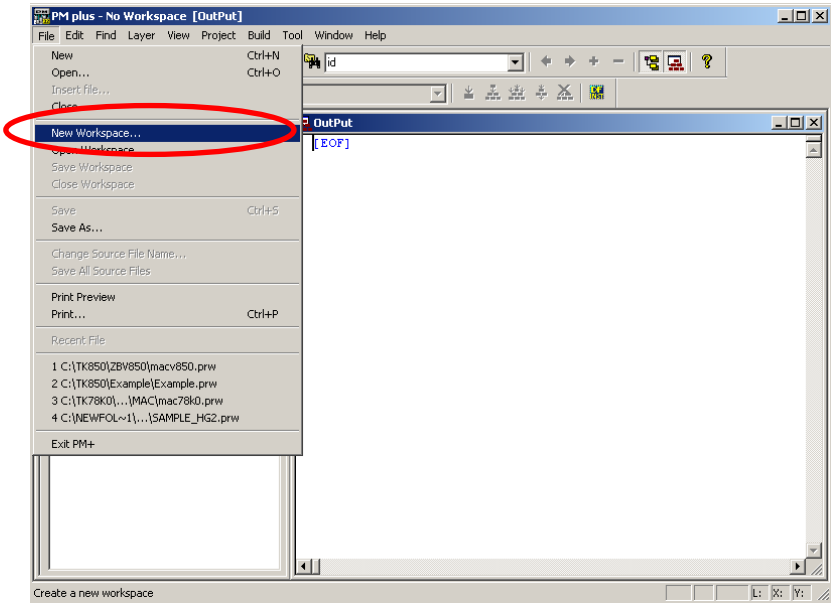
Click rebuild button  on PM+ or select "Build" on menu bar, then "Rebuild" to create the Hex file.



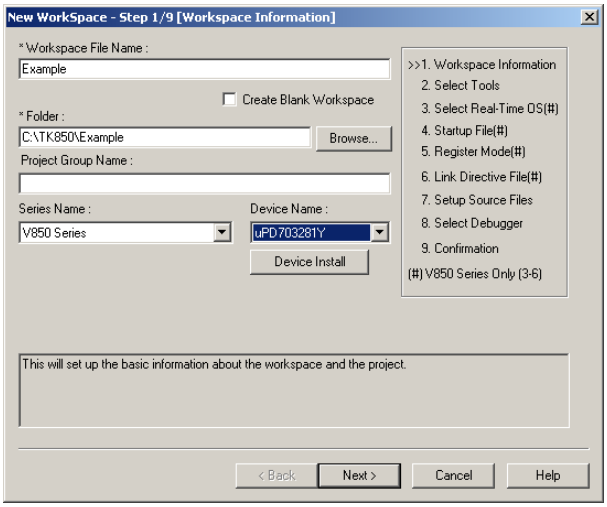
To write programs to TK board, refer to "Chapter 3 How to use PG-FPL".

2.14 How to create a new PM+ workspace

You now create a new workspace and a project.
Please follow the step by step approach.
Please select [Files] -> [New Workspace] in the PM+.



A new window to create a workspace is displayed



Workspace File Name (W):
-> Specify your favorite name of the new workspace.
.prw is automatically added to indicate a file type.
A project file (.prj) with the identical name is automatically created.

Folder:
-> Specify a folder for saving the workspace file by writing its absolute path.
The directory can be selected from a reference dialog box by selecting the Browse… button.

Project Group Name:
-> Assign a project group name, if you wish to manage multiple projects together. If nothing is assigned, the workspace file name is used.

Series Name:
-> Specify the series name of the device to be used from the pull-down menu.

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

You will see some examples in the next pages

For instance, please input the following text,

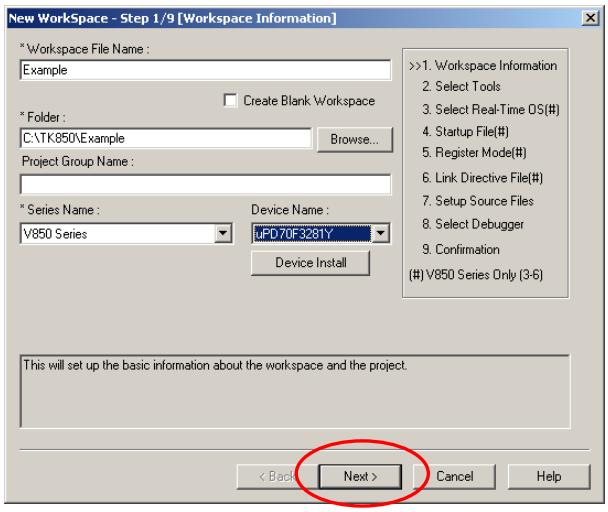
Workspace file name (W)
-> Example

Folder(F)
-> C:/TK850/Example
Please find it from the Reference

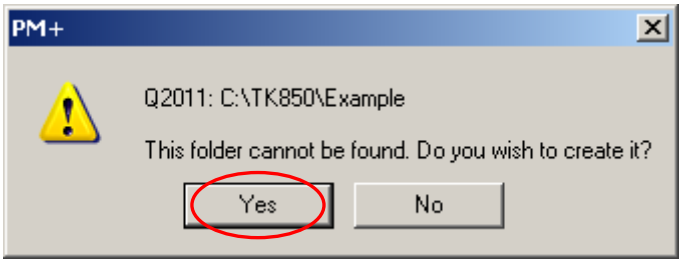
Project Group Name (G)
-> None

Series Name (S)
-> V850 Series

Device Name (D)
-> uPD70F3281Y

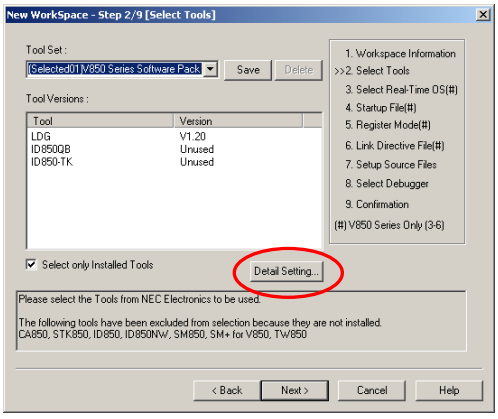


Select NEXT(N)> ,



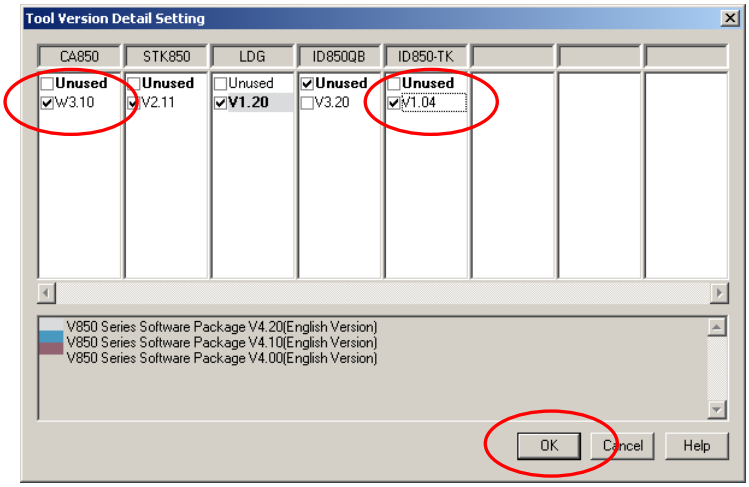
Click Yes button

To setup tools, select [Detail Setting…]

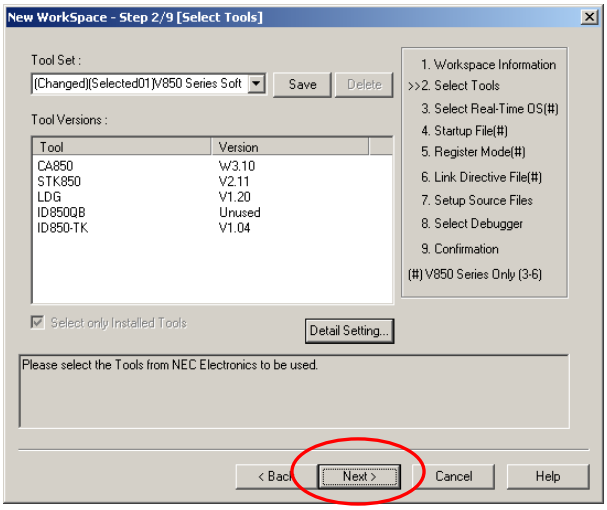


Click Detail Settings button

Please set the following tools with the version
CA850 : W3.10
ID850-TK : V1.04

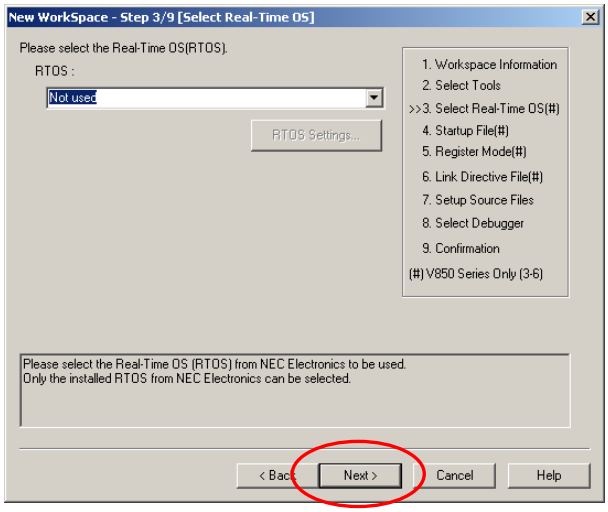


Please select OK

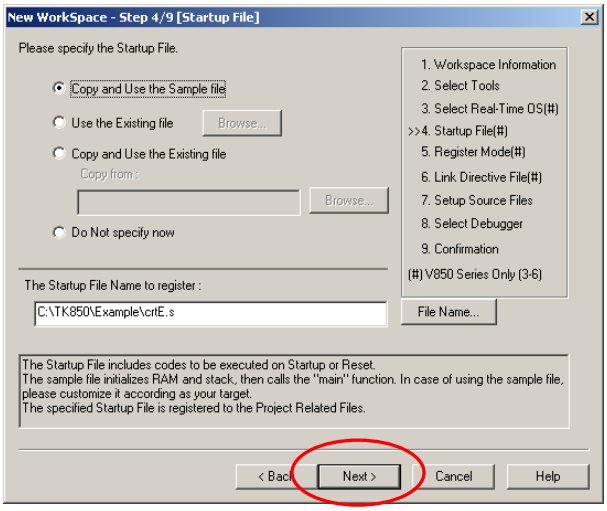


Please select NEXT(N)>

We do not use RTOS.
Select “Not used”.



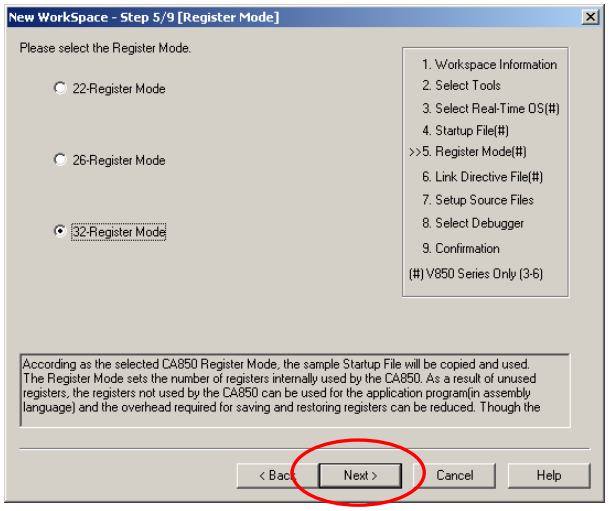
Please select NEXT(N)> .



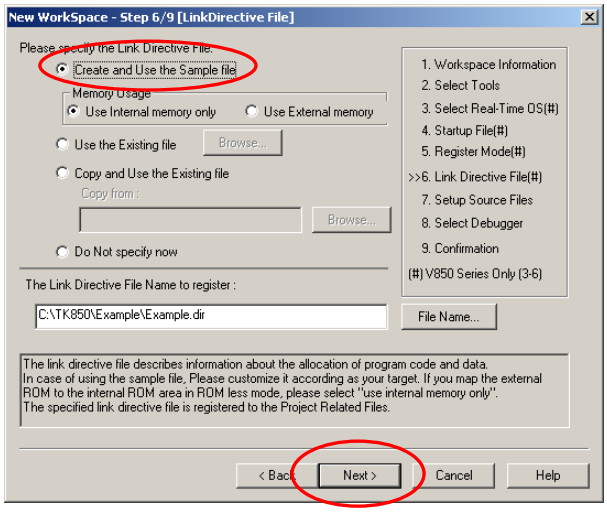
Select [Copy and Use the Sample file]

Please Select NEXT(N)> .

Please select [32 registor mode]

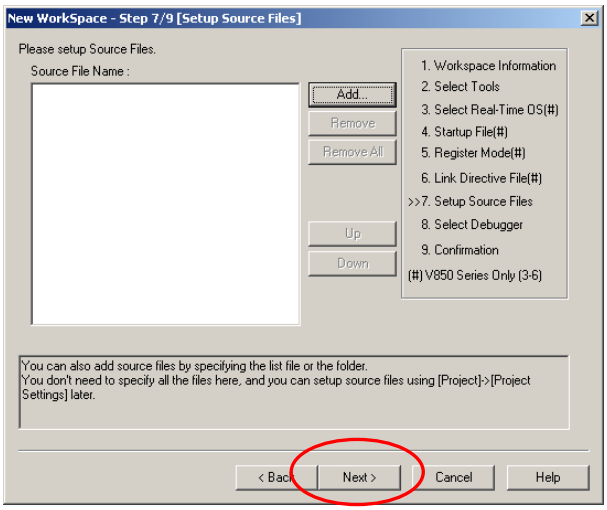


Please select NEXT(N)>.

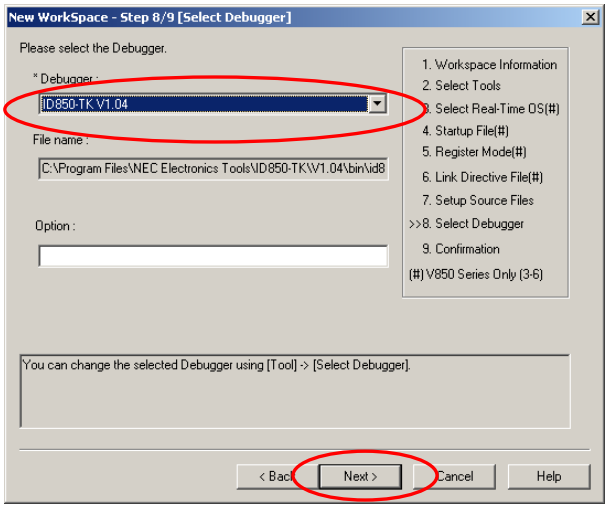


Please select [Create and Use the Sample file]

Please select NEXT(N)>.



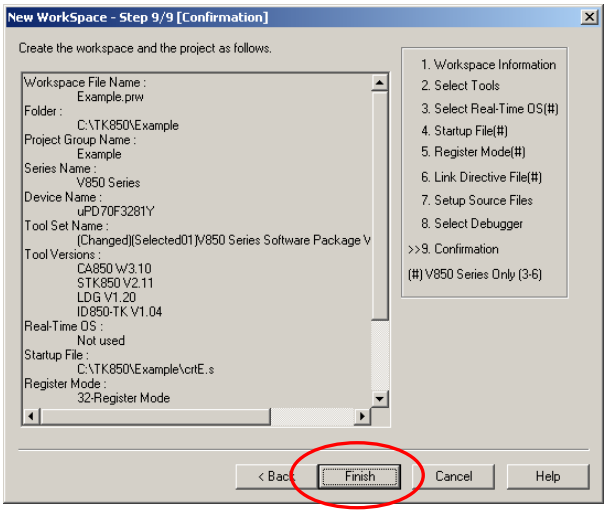
Please select NEXT(N)>.



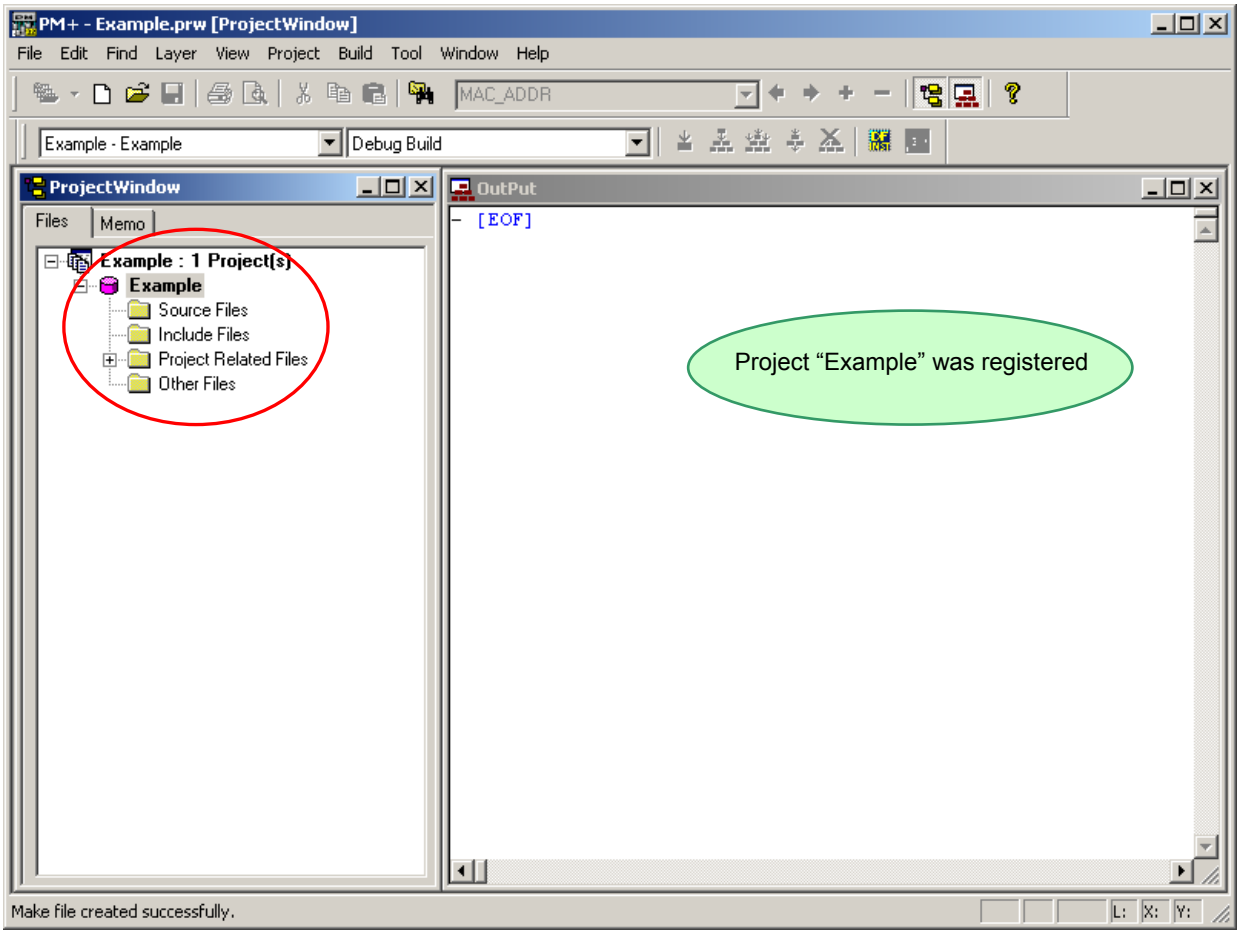
Please select ID850-TK V1.04

Please select NEXT(N)>.

Please confirm your configuration



Please select Finish

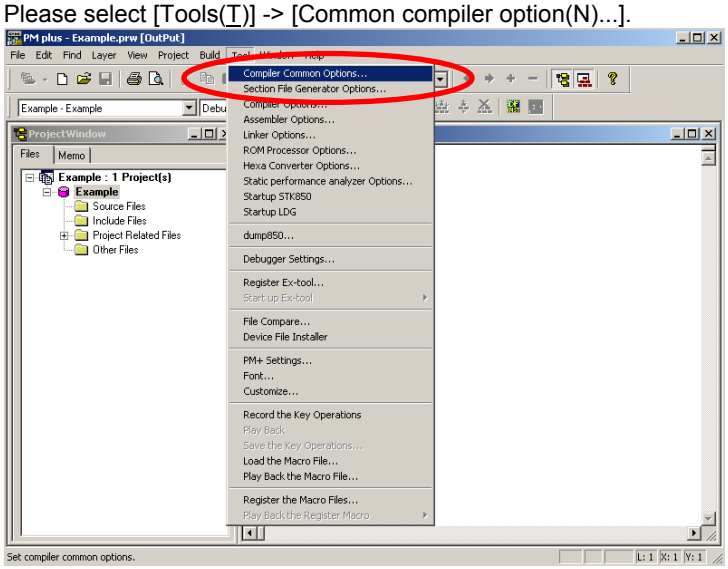


Now you have completed the creation of your workspace and project.

You can add source files, whenever you like to add later.

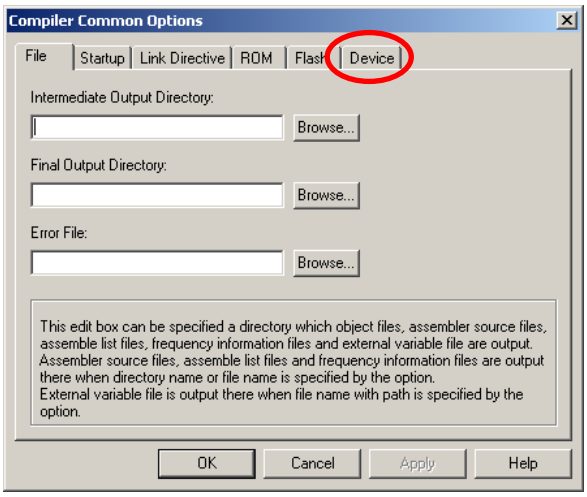
For more detail, please see the next section, How to add source files.

Now you set up the security ID.
Please select [Tools(T)] -> [Common compiler option(N)...].

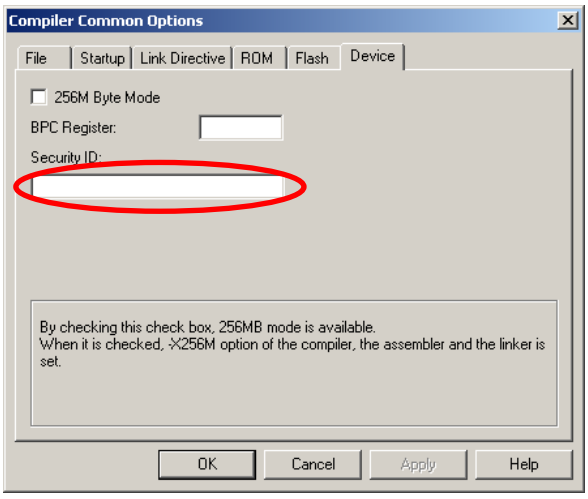


Window for compiler option shows up

Please select [Device] tab.

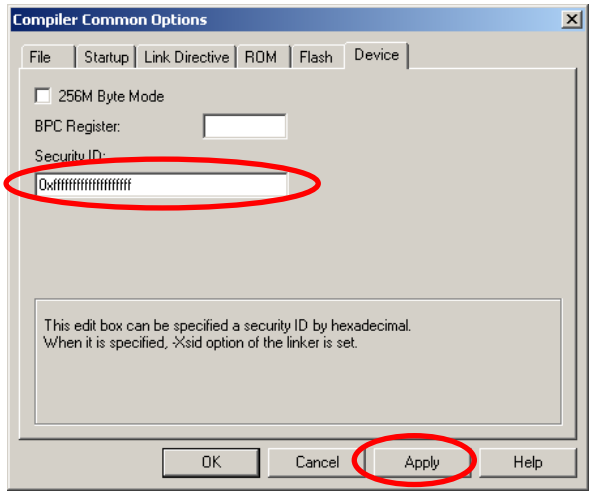


Please select Device tab.

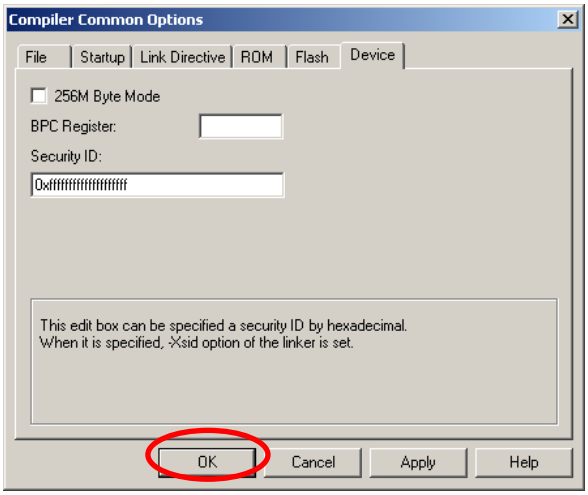


Please input your Security ID.

The default security ID is input as an example here: 0xffffffffffffffffffff



Please select Apply .



Please select OK

You have completed the configuration of the security ID.

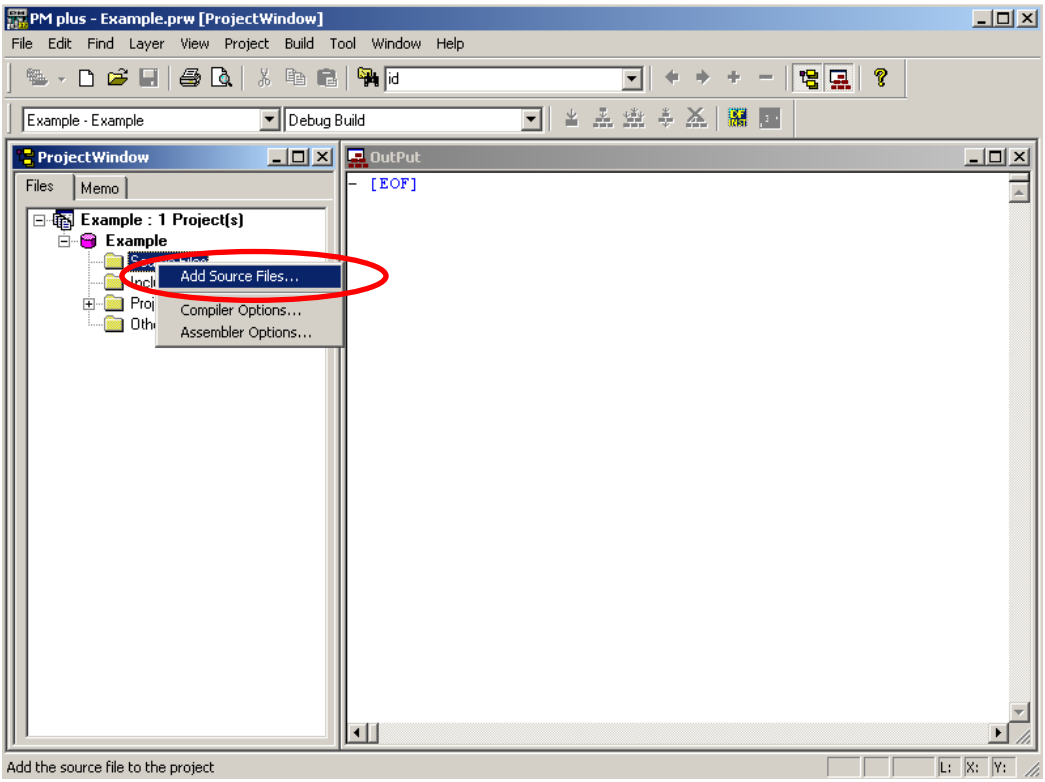
2.15 How to add source files

You now learn how to add source files in your project.

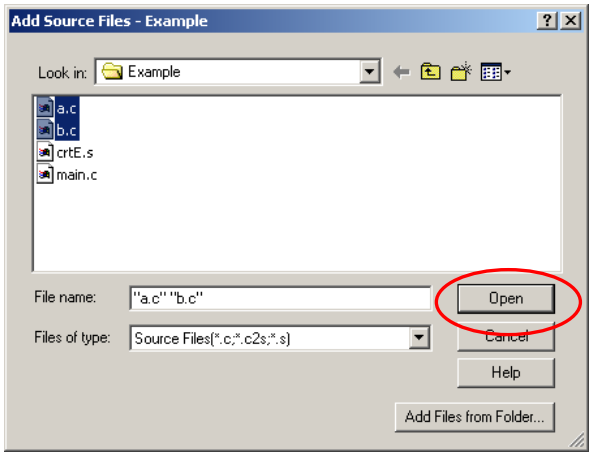
Let's assume the file, "main.c", has been registered. You now intend to add two files, "a.c" and "b.c".

Right click on your mouse the "Source file" in the project window. You will find "Add Source Files (S)".

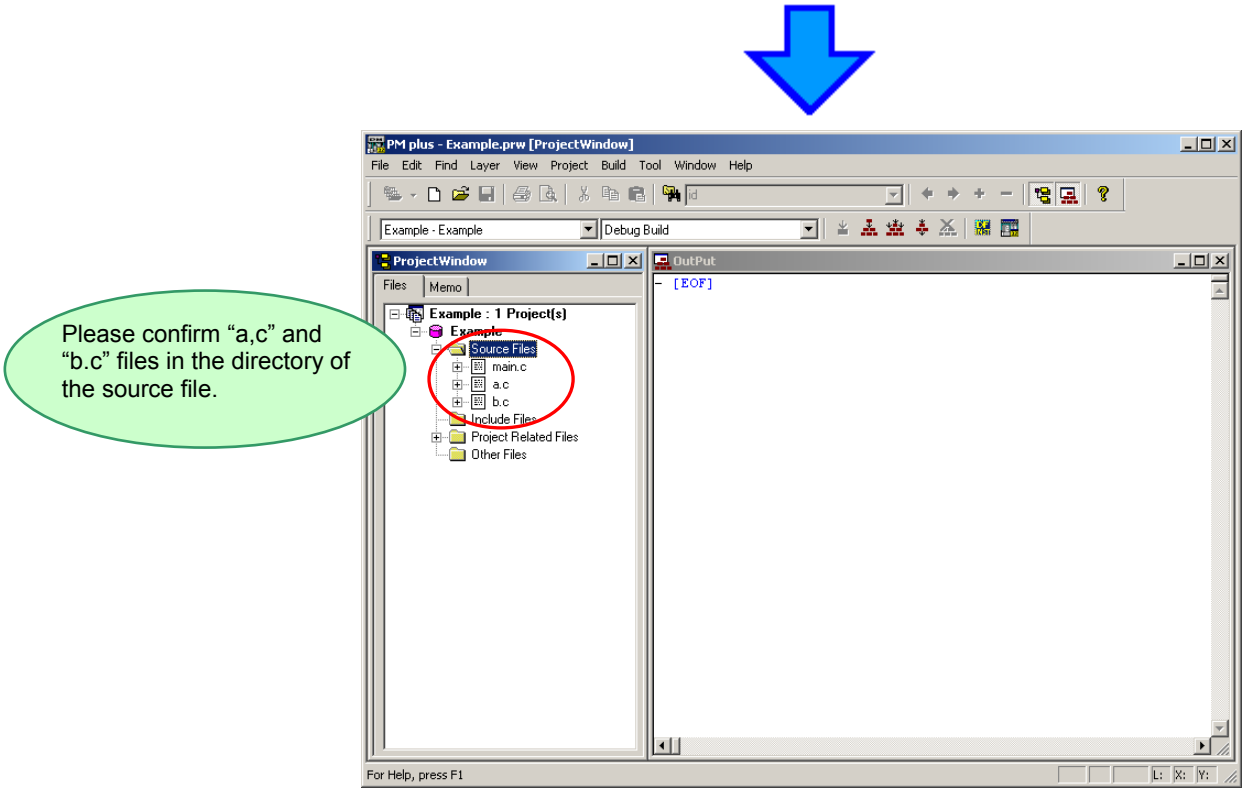
Please click it.



Please select the two source files"a.c" and "b.c". Then, please select Open (O) .

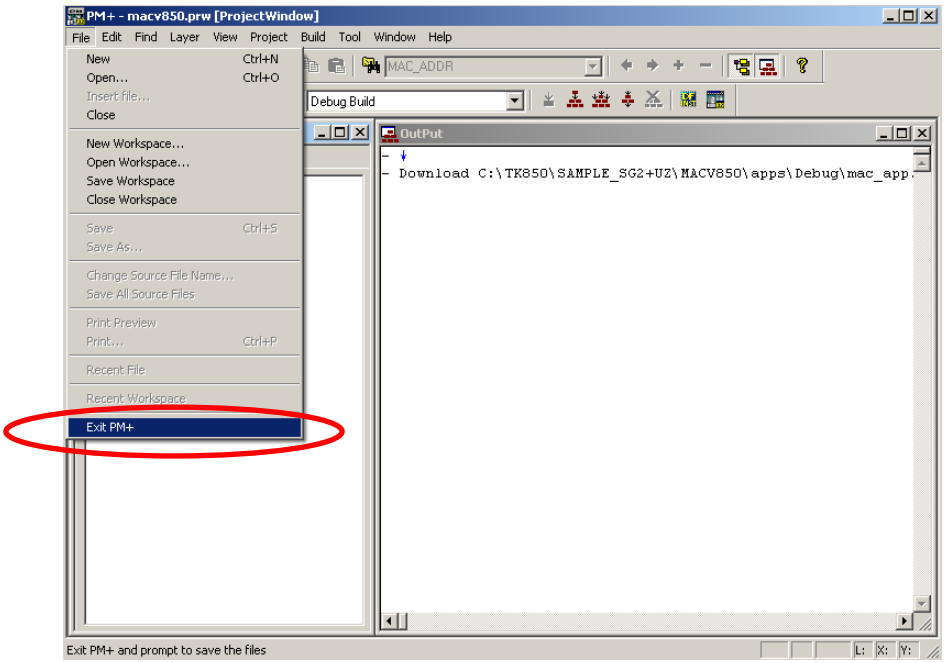


By keep pressing Ctrl , you can choose multiple of files at the same time.


Please confirm “a,c” and “b.c” files in the directory of the source file.
PM plus - Example.prw [ProjectWindow]
File Edit Find Layer View Project Build Tool Window Help
Example - Example
Debug Build
ProjectWindow
Files
Memo
Example : 1 Project(s)
Example
Source Files
main.c
a.c
b.c
Include Files
Project Related Files
Other Files
OutPut
[EOF]
For Help, press F1

2.16 Terminate PM+

To terminate PM+, please select [File] -> [Exit PM+].



PM+ is terminated.

Chapter3 How to use PG-FPL

You now learn how to write Flash EEPROM on the V850ES/SG2 microcontroller using PG-FPL in your PC.
PG-FPL is also required, in case the security ID does not match. Installation of PG-FPL cannot be done from the integrated installer of the TK board, but please execute the following setup.exe from explorer.

/FPL/fpl_v150/Setup.exe

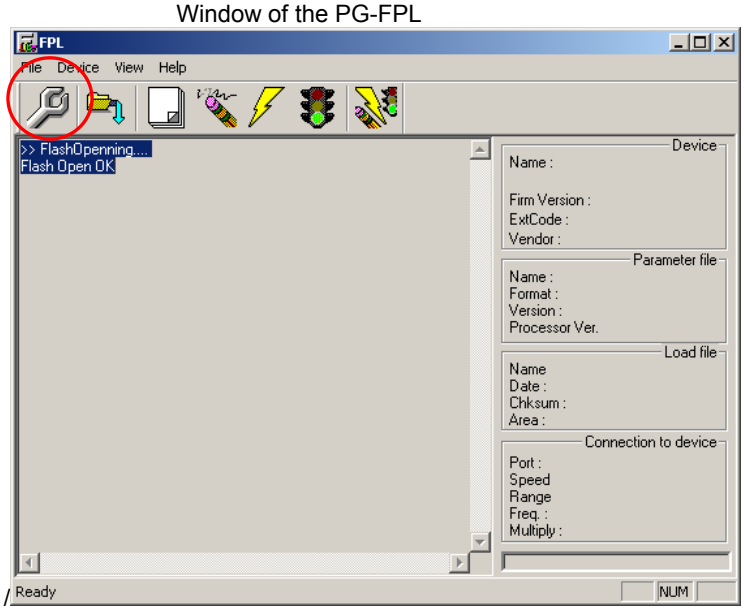
For more detail of installation, please refer to the user's manual of PG-FPL. However, you don't need installation of any hardware and driver, because the hardware is ready on the TK board.

To use PG-FPL, please set the mode switch on the TK-850/SG2+UZ board as follows. Then, please connect the board to your PC with a USB cable.

JP1		1-2short (USB side)
SW1	Bit1	ON
	Bit2	OFF
	Bit3	ON
	Bit4	ON
	Bit5	OFF
	Bit6	OFF
	Bit7	OFF
	Bit8	OFF

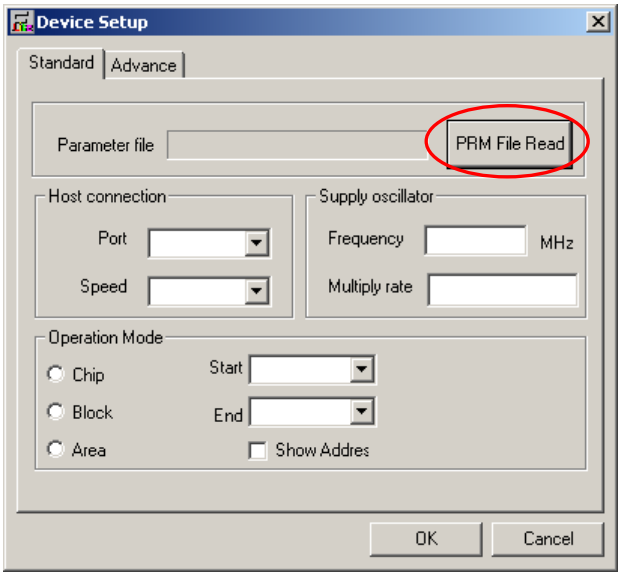
Please start PG-FPL by selecting [Programs] -> [NEC Tools32] -> [PG-FPL] in your Windows start-up menu.

Window of the PG-FPL



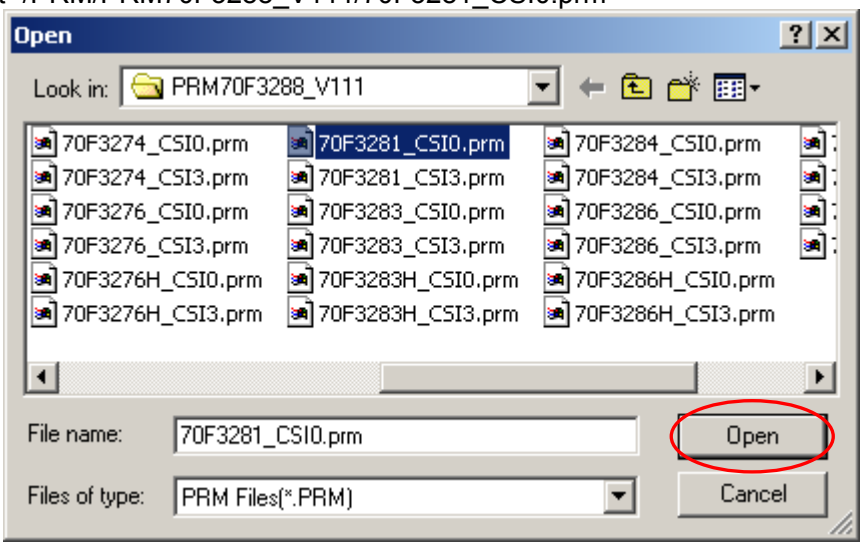
Please select “Setup”.

Please select ”PRM File Read”



You will find the PRM files in the CDROM.

Please select” /PRM/PRM70F3288_V111/70F3281_CSI0.prm”

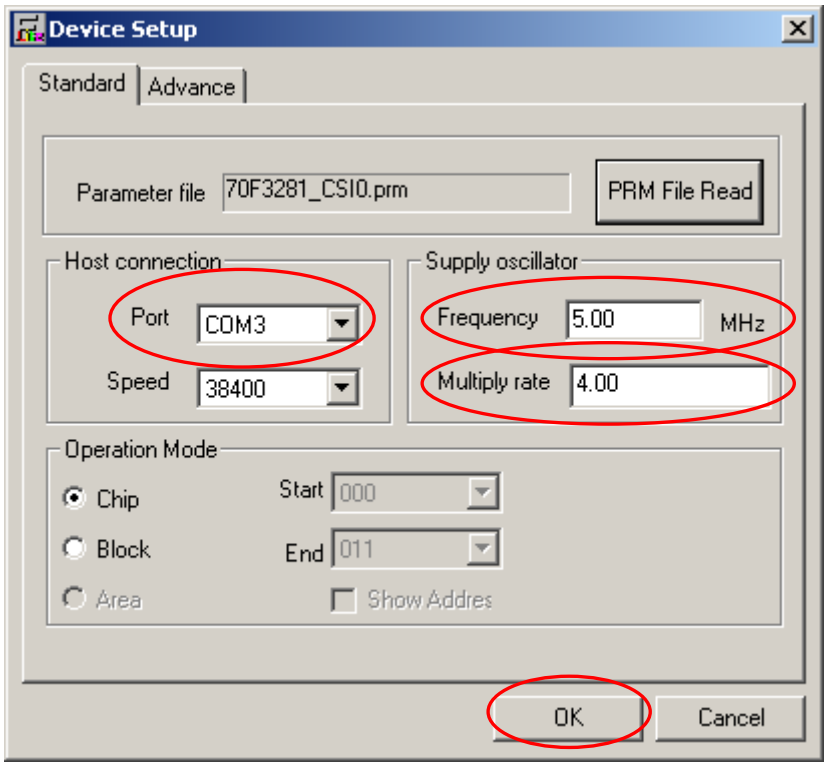


Please select the COM port number you connected your PC with the TK board.

All of COM port numbers available on your PC will be displayed.

Please set ”Speed” 38400, ”Frequency” 5.00, “Multiply rate” 4.00.

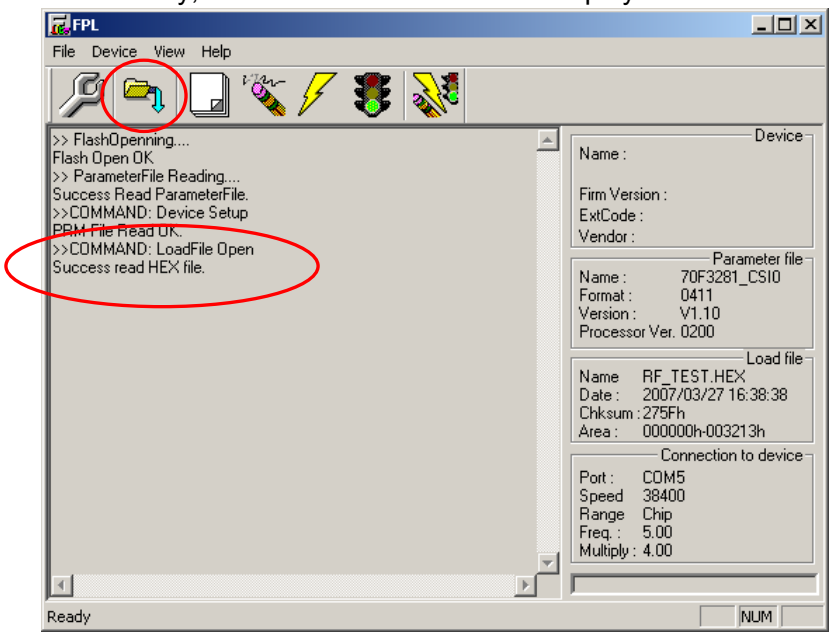
Then, please press OK.



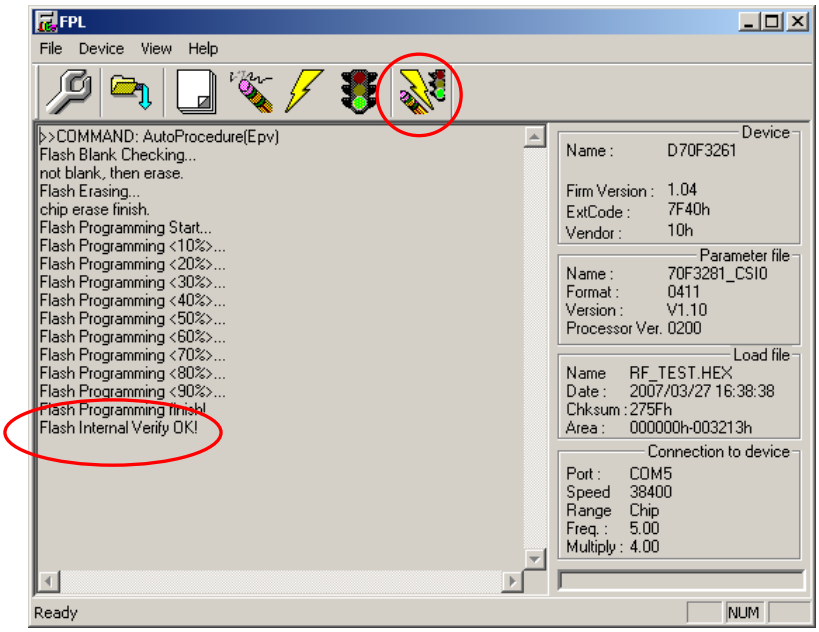
Next, load the HEX file to PG-FPL.

Click "Load" to open the file "mac_app.hex", which you created in "2.13 Create hex files".

When it completes successfully, "Success read HEX file." is displayed.



Next, write the programs by clicking "Auto procedure".
When "Auto procedure" is clicked, it processes the "Erase" and "Program" commands.



When it shows "Flash internal Verify OK!", it means the writing completed.
The programs are successfully written to EEPROM.
Disconnect the USB cable from TK-850/SG2+UZ board

Chapter4 Sample Program

This chapter introduces the usage of other sample programs.

4.1 RF Test Program

This chapter describes how to run the RF test program using TK-850/SG2+UZ and TK-78K0/KF2+UZ.
The RF test program can monitor the “Packet Error Rate”, “Received Signal Strength Indication”, etc.
The RF test program uses USB interface on TK board for the serial port. If you try to write programs with using ID-850TK debugger, the monitor program will be written as well. This causes programs not to work appropriately. Therefore, you need to use the flash memory program software (PG-FPL) to write programs.

4.1.1. Procedure for one to one transmit/receive test

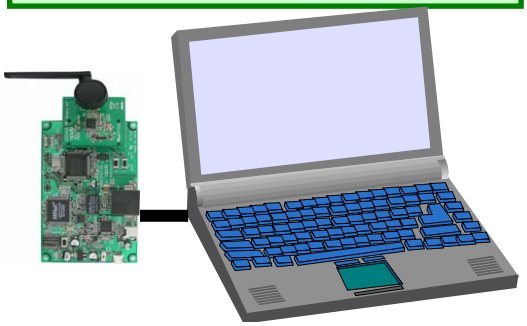
For the RF test, prepare one TK-78K0/KF2+UZ board and write the program "TK78K0KF2UZ_RF_Test", which is bundled with TK-78K0/KF2+UZ.

In the same way, prepare one TK-850/SG2+UZ board, write the program "C:/TK850/SAMPLE_SG2+UZ/V850_RF_Test/Release/RF_TEST.hex", by using PG-FPL.
For creating hex object code, refer to "2.13 Create hex files".
For writing programs to flash memory, refer to "Chapter 3 How to use PG-FPL".

∗ The RF Test Program uses USB interface on TK board for the serial port. If you try to write programs with using ID-850TK debugger, the monitor program will be written as well. This causes programs not to work appropriately. Therefore, you need to use the flash memory program software to write programs. In the same way, you cannot debug the programs using ID-850TK.

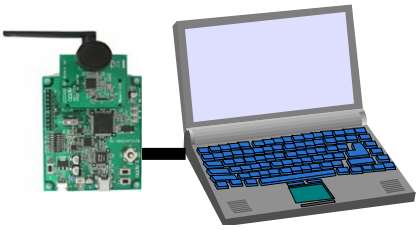
(Hereinafter, TK-850/SG2+UZ board and TK-78K0/KF2+UZ board are reffered as to the transmitter and the receiver, respectively).

Transmitter TK-850/SG2+UZ
Write "V850_RF_Test"



Short address：0001

Receiver TK-78K0/KF2+UZ
Write "TK78K0KF2UZ RF Test"



Short address：0002

Please set the switches on the receiver board(TK-78K0/KF2+UZ) as follows.

JP1		1-2 Short (USB side)
SW1	Bit1	OFF
	Bit2	OFF
	Bit3	OFF
	Bit4	OFF
	Bit5	OFF
	Bit6	**ON for address setting**
	Bit7	OFF for address setting
	Bit8	**ON for the Receive mode**

The above example is for the short address of 0002.

There are four ways of the address setting as follows,

		Short Address			
		0001	0002	0003	0004
SW1	Bit6	OFF	ON	OFF	ON
	Bit7	OFF	OFF	ON	ON

By setting SW1-8 to ON, it becomes the receive mode. If you set them to OFF, it becomes hyperterminal key input mode (this mode will be explained later in this document)
Please connect the receiver board (TK-78K0/KF2+UZ) to your first PC with a USB cable.

Now the receiver board(TK-78K0/KF2+UZ) is ready.

Next, you will set the transmitter (TK-850/SG2+UZ) and PC.
Please set the transmitter(TK-850/SG2+UZ) board as follows,

JP1		1-2 short(USB side)
SW1	Bit1	ON
	Bit2	OFF
	Bit3	OFF
	Bit4	OFF
	Bit5	OFF
	Bit6	OFF **for address setting**
	Bit7	OFF **for address setting**
	Bit8	OFF **for the transmitter mode**

This example is for the short address of 0001.

This board is designated as the transmitter.

Then, please connect it to your PC with a USB cable.

Then, please identify the COM port number of the USB in your PC
at [Control Panel] → [System] → [Hardware] → [Device Manager] → [Ports (COM&LPT)]

Hyper Terminal

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

Setting of Hyperterminal

Bits per second	19200
Data bits	8
Parity	None
Stop bits	1
Flow control	None

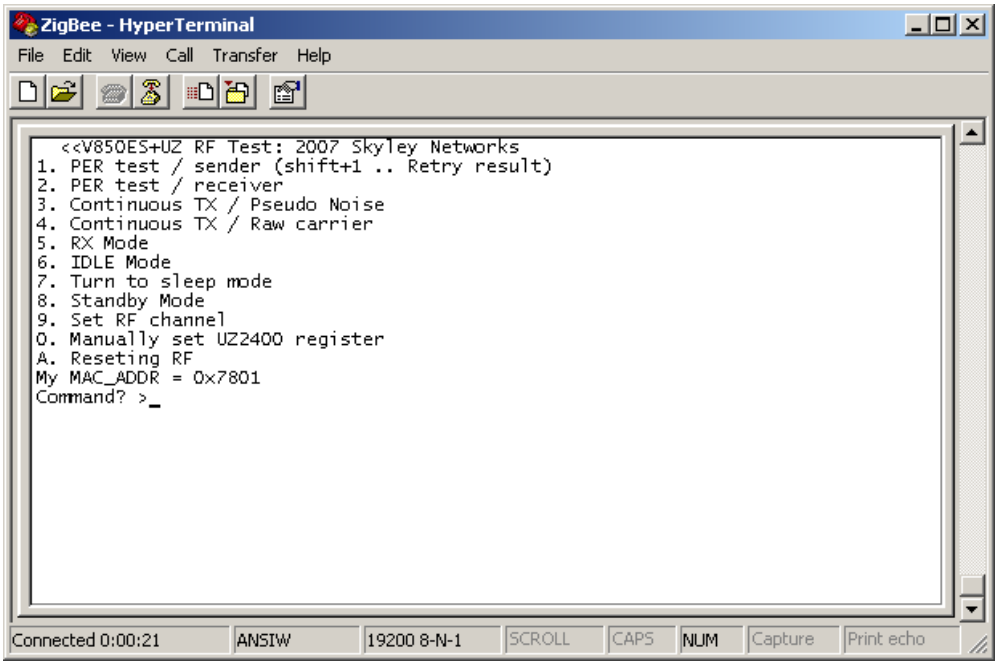
(Property -> Setting -> ASCII)

Local Echo OFF

No Line Feed

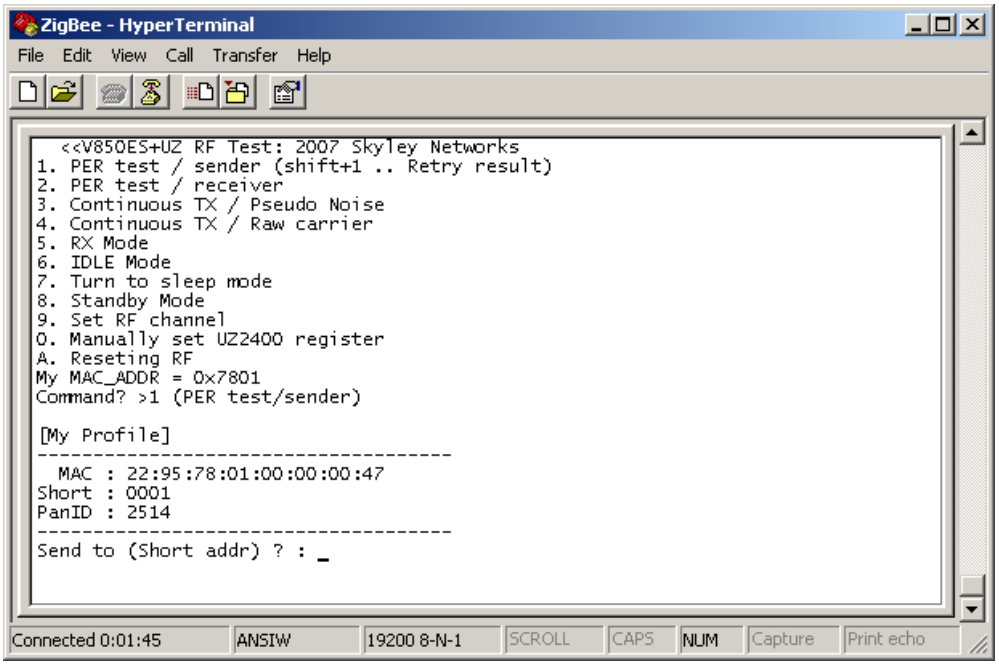
Reset the transmitter board.
Press RESET (SW4) on transmitter board (TK-850/SG2+UZ).

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



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.



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

```
Command? >1 (PER test/sender)

[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)   ? : 3
[Set channel to 11 (Cmd)]
Prepare to send..OK
[Set channel to 11 (Current)]
Send..        0
Request to result..OK


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

[Set channel to 11 (Current)]
```

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.

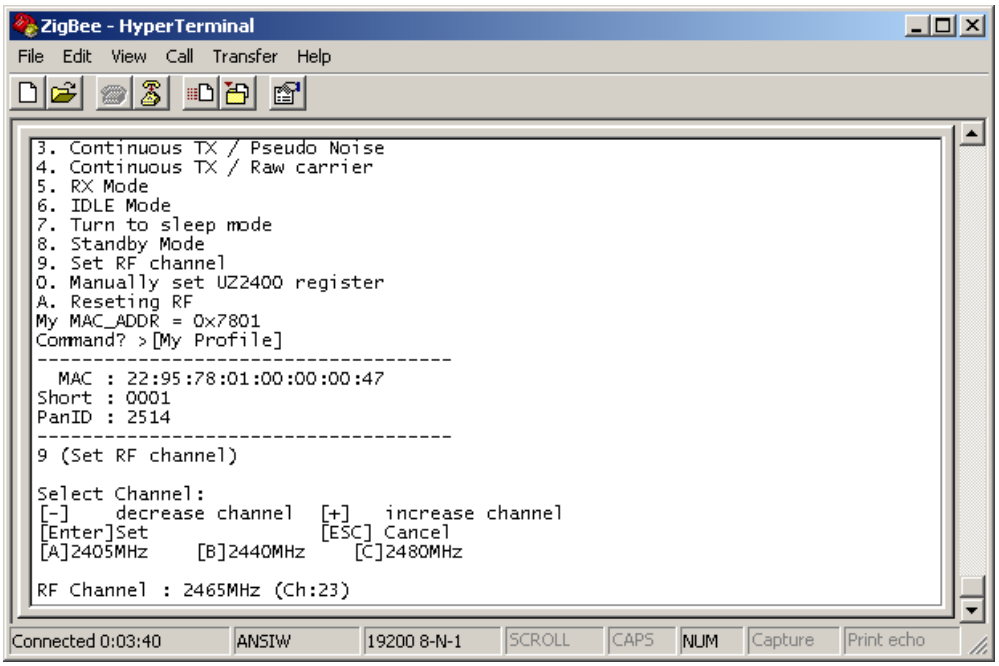
Please note the PER and the RSSI are measured at the receiver side.
The receiver does not send back the test packets, but only the test result.

4.1.2. Channel setting

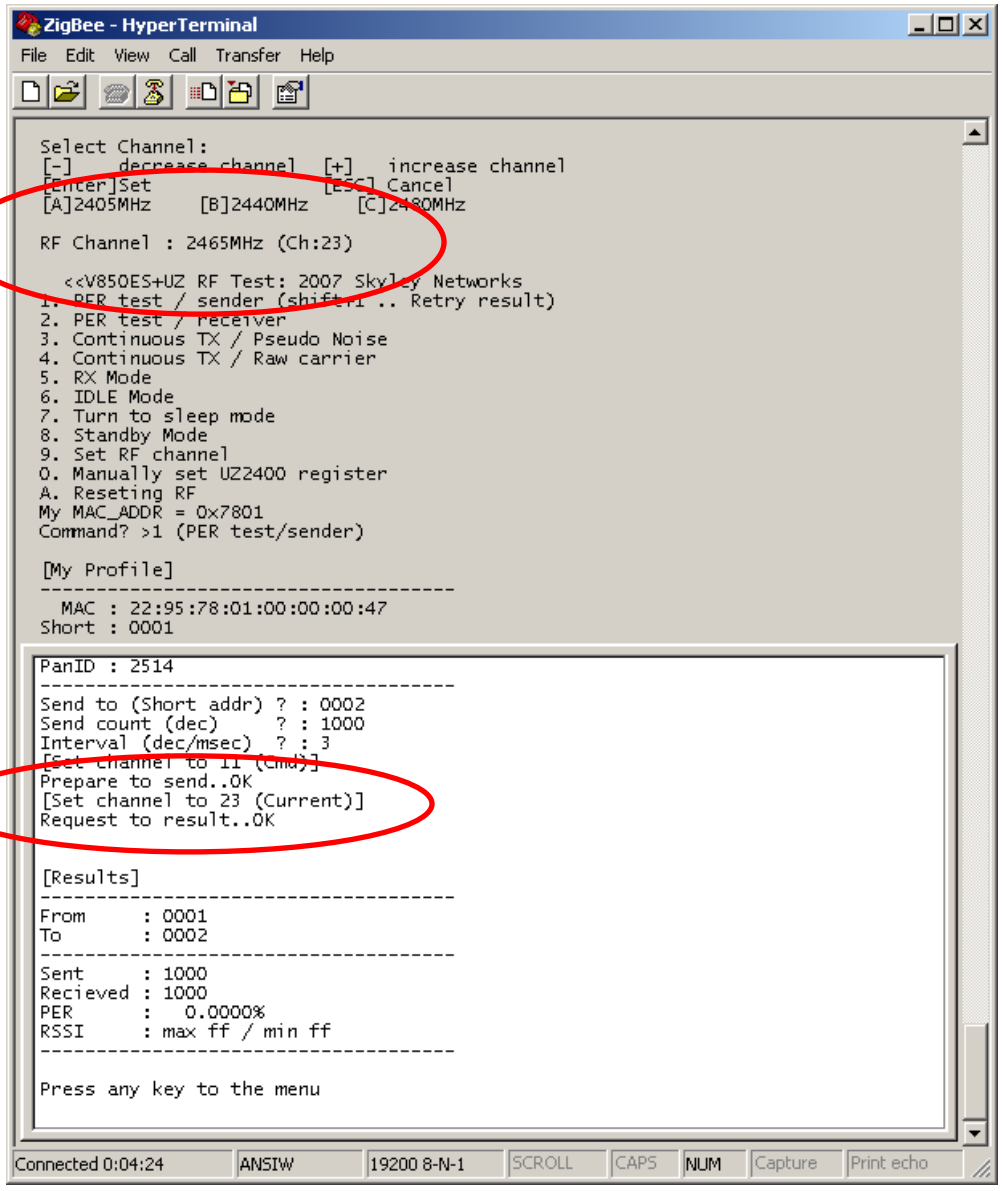
In the previous example, you may have also found the RF channel used in this test is the Channel 11. The channel is specified by the IEEE 802.15.4 specification.

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 “9” 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.



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.



4.1.3. Adjusting the output power

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

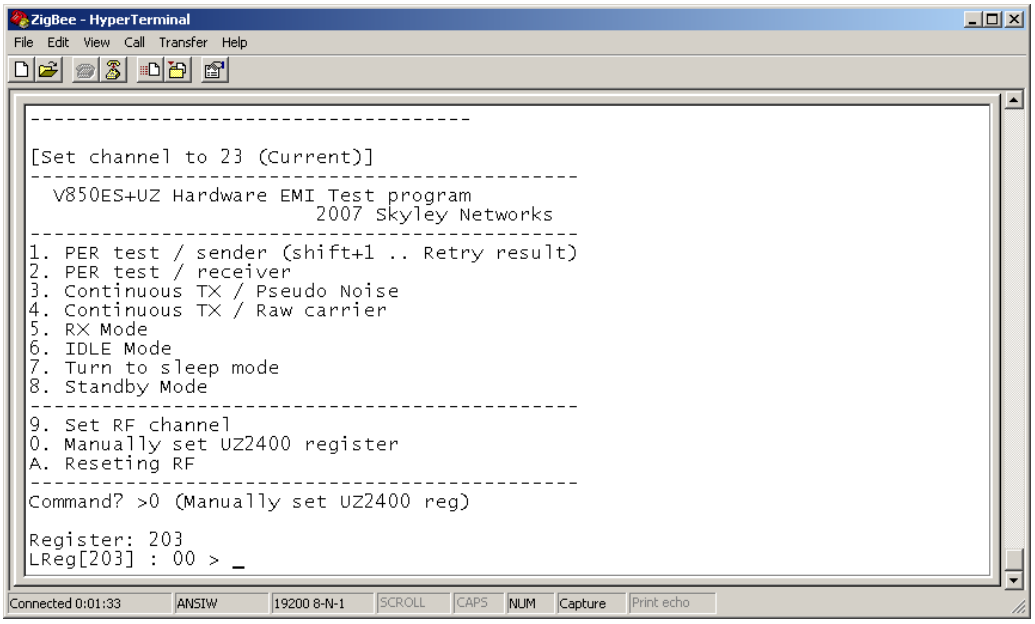
For it, please select “0” in the menu.

You will be asked the register ID. Please input “203”.

Then you will see, “LREG[203] : 00 >”.

It means the current value at the register [203] is 0x00h, which means 0 dB.

0x00h is the reset default.



The register bits are defined as follows,

LREG[203]:

[7:6] -> large scale tuning

00: 0 dB

01: -10 dB

10: -20 dB

11: -30 dB

[5:3] -> small scale tuning

000: 0 dB

001: -1.25 dB

010: -2.5 dB

011: -3.75 dB

100: -5 dB

101: -6.25 dB

110: -7.5 db

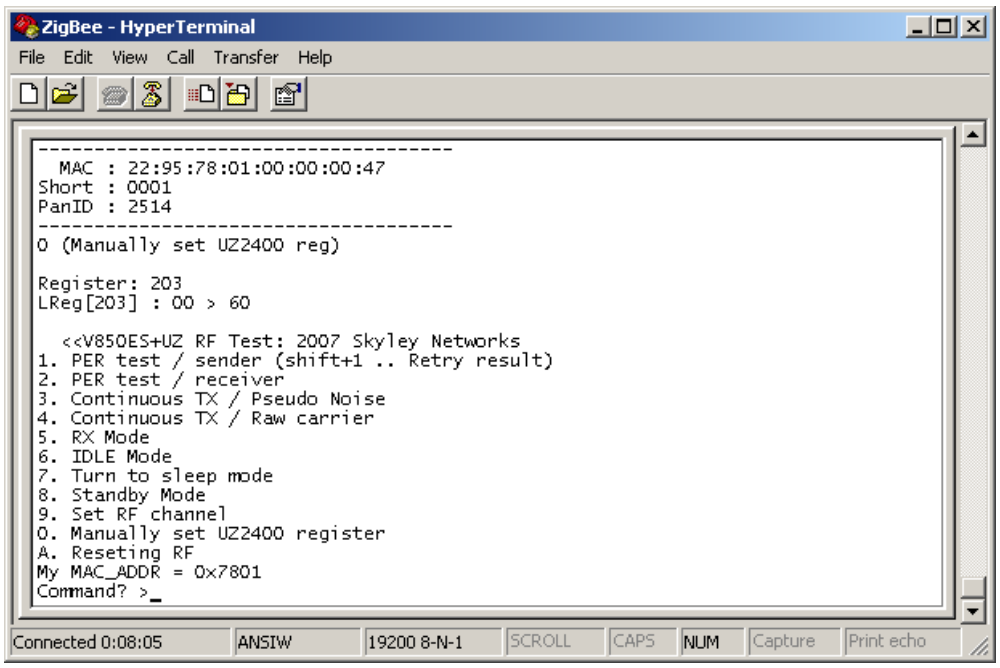
111: -8.75 dB

[2:0] -> 000

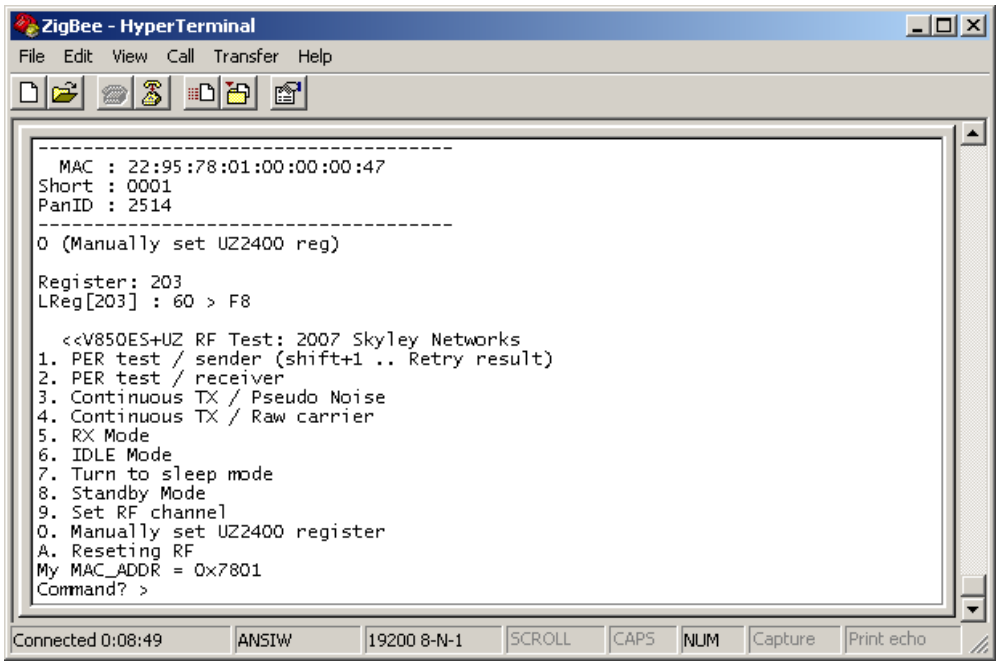
For instance, if you wish -15 dB, please input “60”, as follows,

“LREG[203] : 00 > 60”

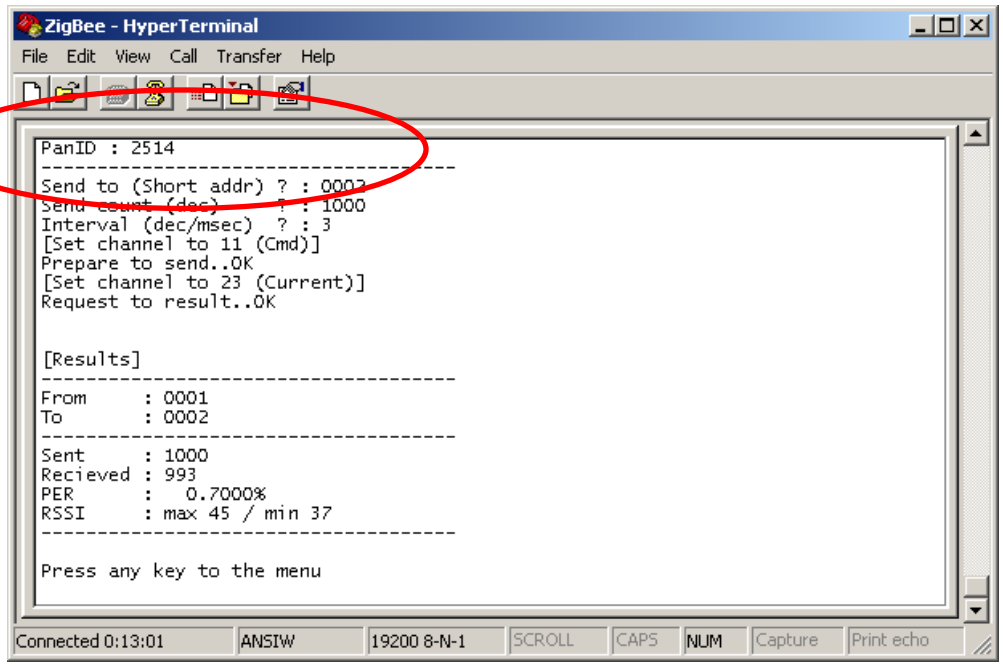
Then, you will start the PER test.



The minimum output power is set by “F8”.



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



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 11th.

4.1.4. PER test / receiver

The Menu 2 sets the board to the receiver in the PER test.
If you have two PCs, you can connect two boards 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 board to the receiver mode by setting the switch 1-8.

4.1.5. 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.

4.1.6. 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.

4.1.7. RX Mode

The Menu 5 initiates the receiver mode.

4.1.8. IDLE MODE

The Menu 6 sets the UZ2400 into the IDLE mode.

4.1.9. Sleep MODE

The Menu 7 sets the UZ2400 into the Deep Sleep mode.

4.1.10. Standby MODE

The Menu 8 sets the UZ2400 into the Standby mode.

4.1.11. Set RF channel

The Menu 9 allows you to set the RF channel.

4.1.12. Manually set UZ2400 register

The Menu 0 allows you to set the UZ2400 registers.
Please refer to the datasheet of the UZ2400 RF chip for the definition of registers.

4.1.13. Resetting RF

The Menu A allows you to reset the UZ2400 registers.

4.2 **RF Test Program**

This chapter introduces the usage of Text Chat Prgram

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

The Text Chat Prgram offers,

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

To use the Chat Program, you need to prepare at least two PC with a USB interface or one PC with more than one USB interface, and two TK-850/SG2+UZ boards.

The Text Chat Prgram 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 emission. In general, it is suggested to use the TK-850/SG2+UZ board in a radio anechoic chamber.

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

4.2.1. Programming to the TK boards

For chatting, please prepare minimum 2, or maximum 5 TK-850/SG2+UZ boards. You need identical numbers of PCs.

Start PM+, and open the file
" C:¥TK850¥SAMPLE_SG2+UZ¥TextChat¥macv850.prw ".

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

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

To write programs on the first TK-850/SG2+UZ, enter " MAC_ADDR=0x0001" on "Define Macro". For the second and third TK-850/SG2+UZ, enter "MAC_ADDR=0x0002" and " MAC_ADDR=0x0003". The number "x" of " MAC_ADDR=x" must be a unique number.

Click re-build button on PM+ or select "Build" -> "Rebuild" on menu bar to rebuild. then write different programs to each TK-850/SG2+UZ by using PG-FPL.

For creating hex object code, refer to "2.13 Create hex files".
For writing programs to flash memory, refer to "Chapter 3 How to use PG-FPL".

4.2.2. Setting up the board to your PC

Set the TK-850/SG2+UZ as shown below.
Connect it to PC with USB cable.
Confirm the power LED on TK-850/SG2+UZ is lighted.

JP1		1-2short (USB side)
SW1	Bit1	ON
	Bit2	OFF
	Bit3	OFF
	Bit4	OFF
	Bit5	OFF
	Bit6	OFF
	Bit7	OFF
	Bit8	OFF

Start the Hyper Terminal.
Settings of the Hyper Terminal should be set as follows.

Bits per second	19200
Data bits	8
Parity	None
Stop bits	1
Flow control	None

Press SW4 (RESET SW) once after Hyper Terminal is started. The sample application starts after resetting.

In the same way, connect the other TK-850/SG2+UZ board to PC, and start Hyper Terminal. If the PC has more than one USB ports, you can connect to more than one TK-850/SG2+UZ boards, and you can start more than one Hyper Terminals for those COM ports on each board.

4.2.3. Hyper Terminal

Now you will find the following opening menu in the window.
If not, please try the RESET button on the board.

```
----------------------------------------
  TK-78K0R+UZ Sample Application
----------------------------------------
  2007 Skyley Networks

  MY MAC extended address
  =123412349ABC001

  Command >
```

Then, press Enter,

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

Command? >
```

Please do the same for your other boards and PCs.

4.2.4. Designation of a coordinator

Now, you must decide which board is a coordinator.
Go to the PC of the coordinator board, and press C.

```
Command? >C

> MLME-START.request
> MLME-START.confirm
>  Status:00

Command? >
```

Now the coordinator has started.

4.2.5. Network Association

For other PCs for other boards, please press M.

```
Command? >M

> MLME-ASSOCIATE.request
> MLME-ASSOCIATE.confirm
>  Associated ShortAddr:4321
>                Status:00

Command? >
```

Now, this particular board 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 board.

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

```
> MLME-ASSOCIATE.indication
>  from 123400019ABC0001 associated to 4321

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

Command? >
```

4.2.6. 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? >
```

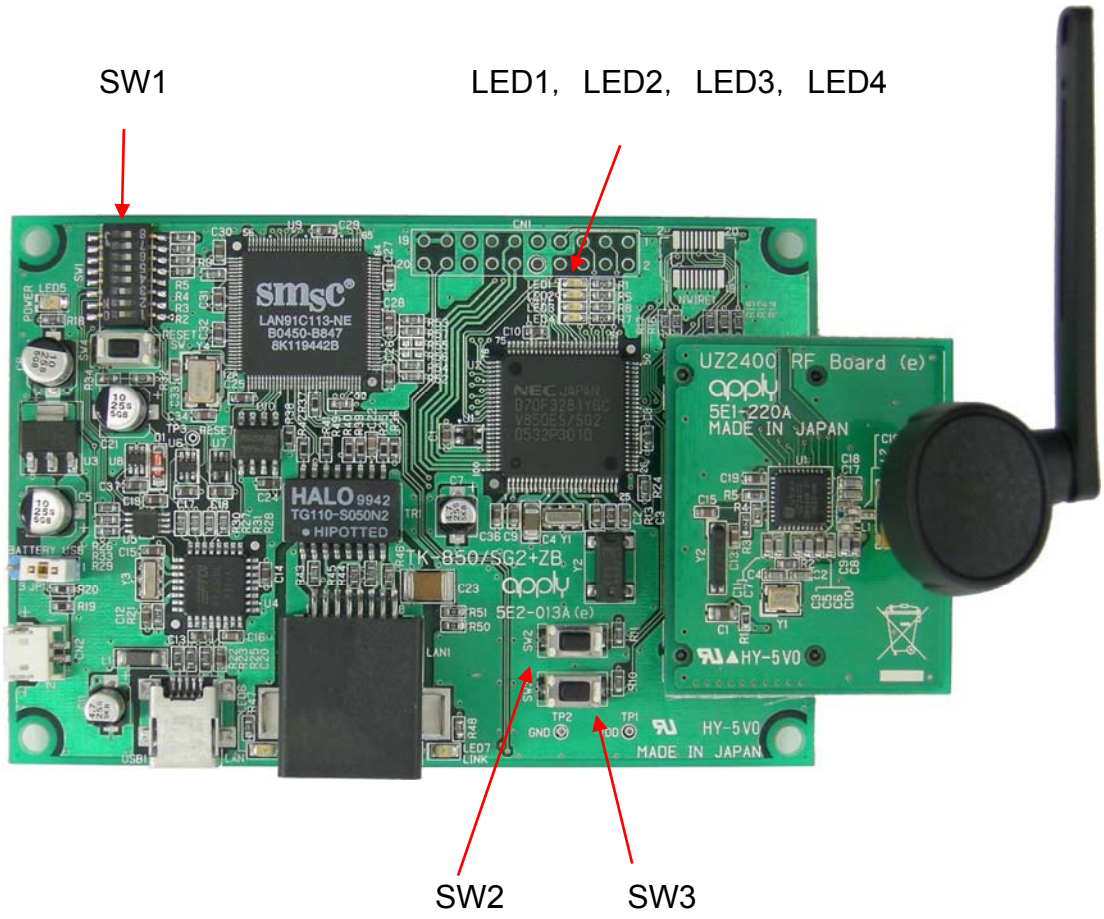
You will find the following message on the end device, 4321.
The sender's short address is "1975", and the PAN ID is 2420 in this example.

```
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.

Chapter5 Mode setting of the TK-850/SG2+UZ board

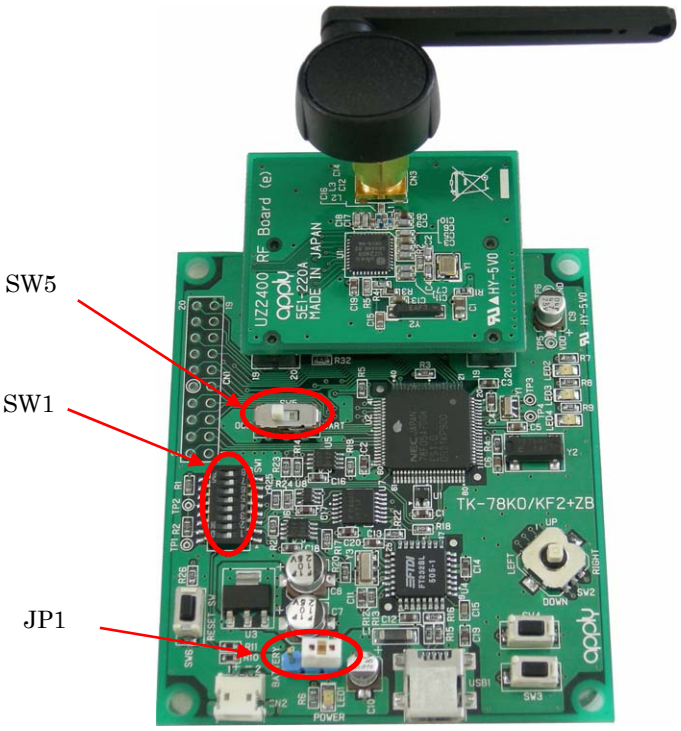
The combination table of the switch of this board is shown.



Case / Switch	Normal mode	Debug Mode with USB connectionUSB	PG-FPL
SW1 - 1	OFF/ON ＊	ON	ON
SW1 - 2	OFF	ON	OFF
SW1 - 3	OFF	ON	ON
SW1 - 4	OFF	OFF	ON
SW1 - 5	Don't care	Don't care	Don't care
SW1 - 6	Don't care	Don't care	Don't care
SW1 - 7	Don't care	Don't care	Don't care
SW1 - 8	Don't care	Don't care	Don't care

＊ Set this ON when you use serial communication through USB connection.

Mode setting of the TK-78K0/KF2+UZ board



SW \ Usage case		Normal (Written program works)	Debug (USB Connection)	Writing flash
SW5		UART side	OCD side	UART side
JP1		Select by power supply source	1-2short (USB side)	1-2short(USB side)
SW1	Bit1	OFF	ON	ON
	Bit2	OFF	ON	ON
	Bit3	OFF	ON	OFF
	Bit4	OFF	ON	OFF
	Bit5	OFF	ON	OFF

Revision History

Revision	Updated	Pages
Ver 1.0 April 5, 2007	Initial Version	-
Ver 1.1 June 25, 2008	Manufacturer change	-
Ver 2.0 March 06, 2008	Change with Sample program change	-