

Nuvoton ICP Programming Tool User Manual

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1 Overview

1.1 Introduction

“ICP” is the acronym of In-Circuit Programming, which makes it possible that the user can update the MCU’ s program memory under the software control without removing the mounted MCU chip from target PCB.

The Nuvoton ICP Programming Tool supports “online” and “offline” programming mode.

1.2 Supported Devices

Use “Ctrl + click” to open the table of supported devices: [Link of supported devices](#).

Users can download datasheet of each device from <http://www.nuvoton.com>

1.3 Features

- In-Circuit programming target chip
- Online/offline programming mode
- Backup flash data of target chip (If the target chip is not flash protected)
- Backup offline flash data of Nu-Link dongle (if offline data has been unprotected)
- Write software serials number (SN) to target chip
- Limit the maximum programming count
- Data encryption for online/offline programming
- Batch mode for online/offline programming

2 Preparing for ICP Programming Tool

2.1 System Requirements

The hardware and software requirements for installing the ICP Programming Tool system are as follows:

- PC/AT compatible machine with Pentium or higher CPU
- X VGA(1024*768) color monitor
- At least 512M RAM for best performance
- At least 20M free disk space
- Windows 2000/XP/Vista/7

2.2 Hardware Installation

Step 1: Plug USB cable into the USB port of the ICP Programming Tool board.

Step 2: Connect the ICP Programming Tool board with ICE interface of DEV board.

2.3 Software Installation

Please run the installer package to install the software.

Figure 2-1 shows the selection form at startup of the ICP Programming Tool and Figure 2-2 shows the main window of the ICP Programming Tool.

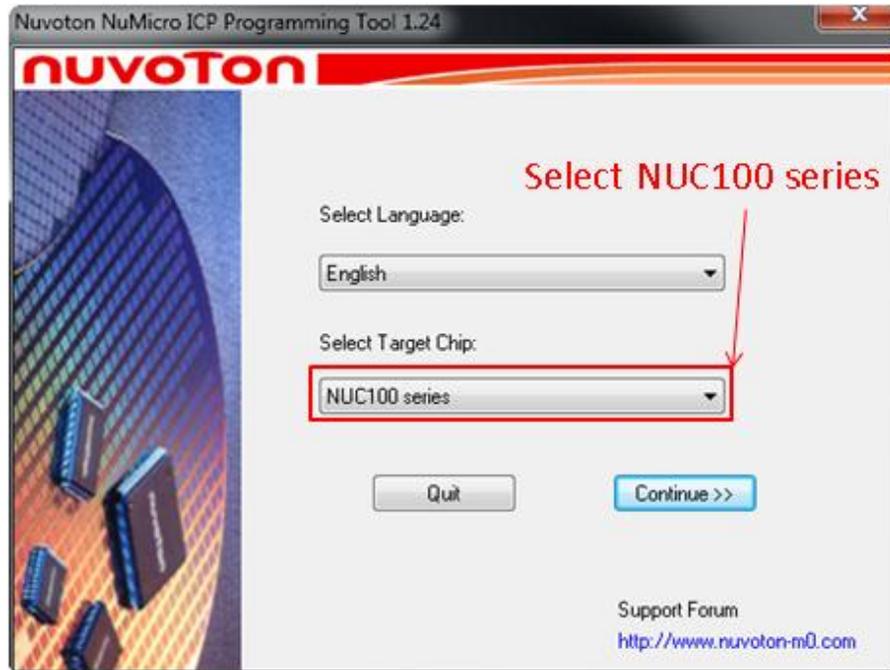


Figure 2-1 Chip Series and Language Selection

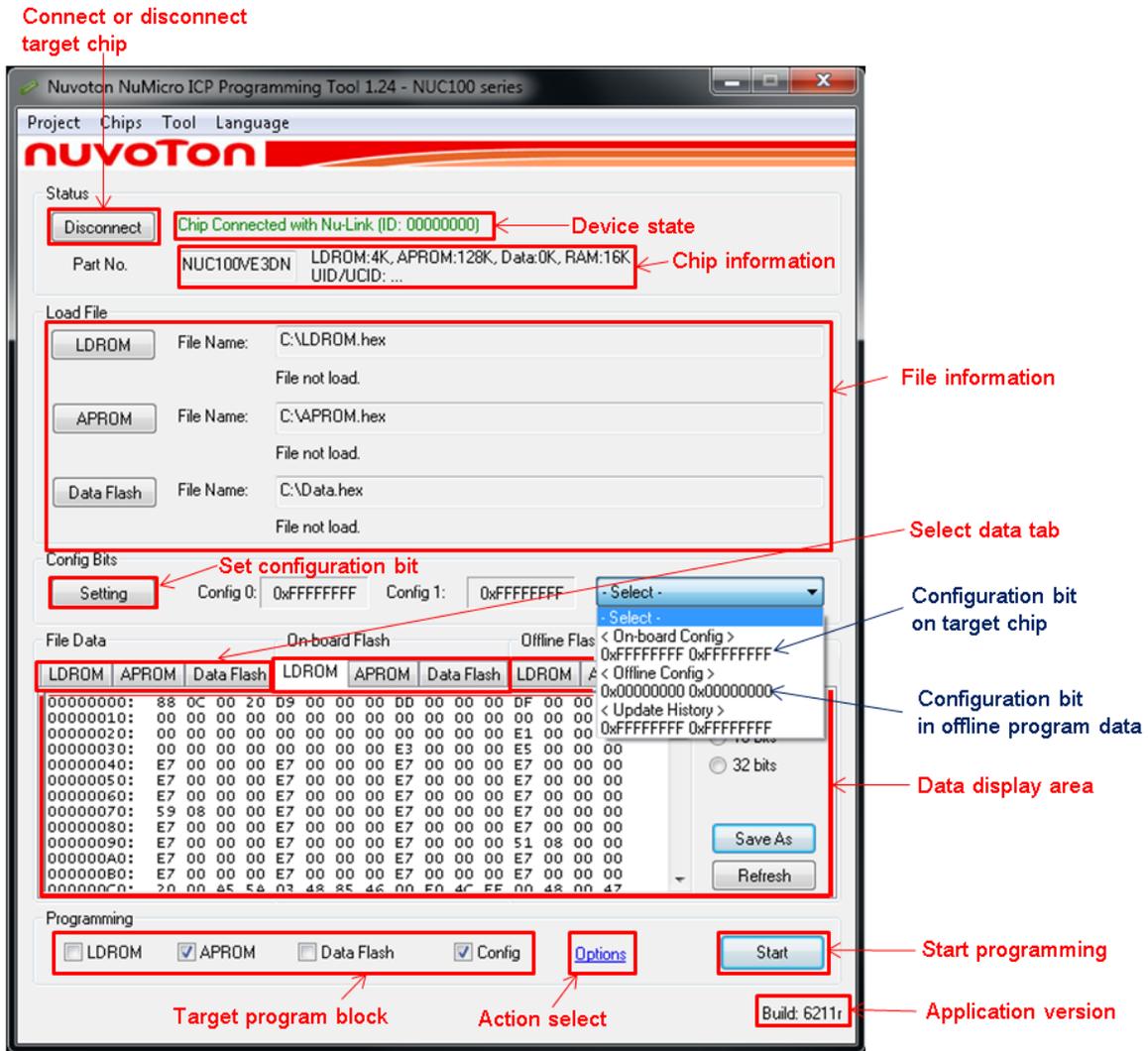


Figure 2-2 Overview of Main Window

3 Operation Modes of ICP Programming Tool and Nu-Link Dongle

This chapter describes operation modes of the ICP Programming Tool and Nu-Link dongle.

3.1 ICP Programming Tool Modes

The ICP tool supports “online” and “offline” programming mode.

3.1.1 Online Programming Mode

If the “**Offline programming mode**” option in Figure 4-14 is unchecked, ICP Programming Tool will program in online programming mode.

Click the “**Start**” button in Figure 2-2 to start to program target device immediately. The target device must be connected to Nu-Link.

3.1.2 Offline Programming Mode

If the “**Offline programming mode**” option in Figure 4-14 is checked, the ICP Programming Tool will program in offline programming mode.

Click the “**Start**” button to save the file data into Nu-Link at first, no matter a target device is connected to Nu-Link or not.

Next, user can program the target devices with this dongle alone (instead of using PC and ICP Programming Tool) by pressing the button on the Nu-Link dongle (red part in Figure 3-1).

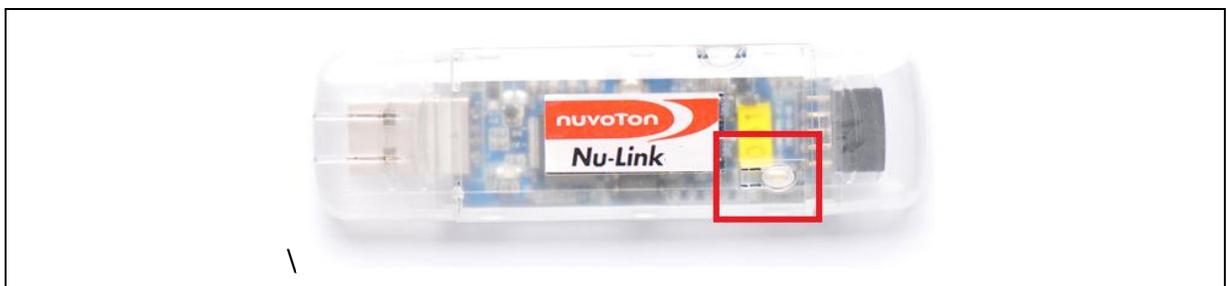


Figure 3-1 Offline Programming Button

3.2 Nu-Link Dongle Operation Modes

The Nu-Link dongle also has two modes, ICE mode and Offline Download mode. ICE mode is the default mode of Nu-Link.

Pressing the button on the Nu-Link dongle (red part in Figure 3-1) will switch the Nu-Link to Offline Download mode and start to download the offline data to target chip immediately.

3.2.1 ICE Mode

The ICP Programming Tool AP can be only connected with Nu-Link in ICE mode.

3.2.2 Offline Download Mode

In Offline Download mode, the Nu-Link dongle will try to program the target device. After the programming is finished, Nu-Link will switch back to ICE mode automatically.

PC and the ICP Programming Tool AP are not required for this operation. Please note that the file data must have been saved in Nu-Link through 3.1.2.

3.3 LED and Keypad of Nu-Link Dongle

- **Booting**
 - All LEDs (ICE_Red, ISP_Orange, Red, Green) blinking
- **ICE mode**
 - **ICE_Red** - on
 - **ISP_Orange** - blinking if the previous “Offline Download mode” operation was failed, otherwise off.
 - **Red** - on if there’s an error
 - **Green** - on if Nu-Link is active
 - **Keypad (red part in Figure 3-1)** - press the keypad to switch to “Offline Download mode”
 - Offline Download mode
 - **ICE_Red** - off
 - **ISP_Orange** - on
 - **Red** - off
 - **Green** - blinking if flash is downloading
 - **Keypad (red part in Figure 3-1)** - Not defined.
- If “**Green**” is blinking and “**ISP_Orange is on**”, this indicates that it’s downloading Flash. Any other type of LED blinking indicates an error.

4 Starting to Use ICP Programming Tool

This chapter introduces the general operations in ICP Programming Tool. Please refer the following figure for information on each section in the ICP Programming Tool Interface.

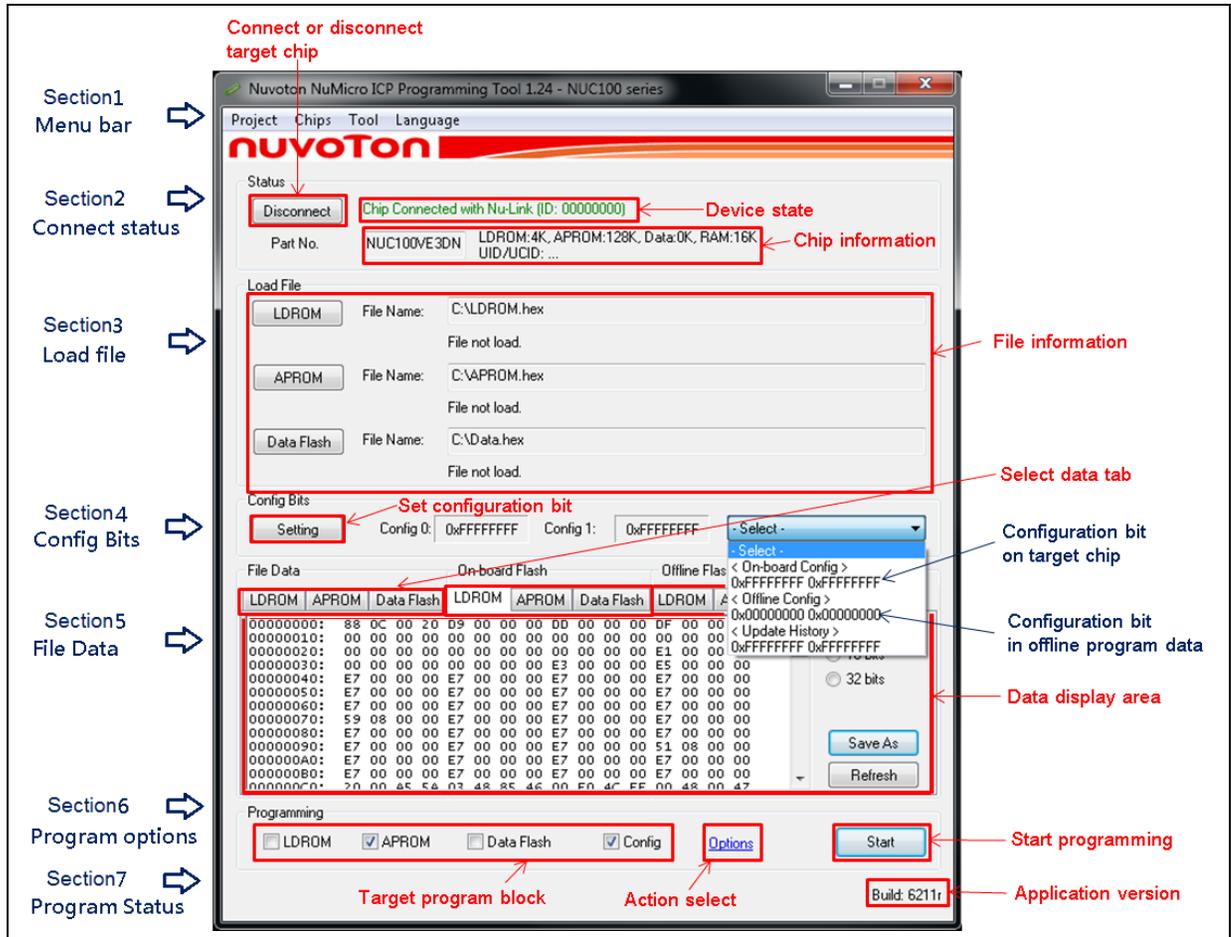


Figure 4-1 ICP Programming Tool User Interface

4.1 Menu Bar

The commands in the menu bar are described below.

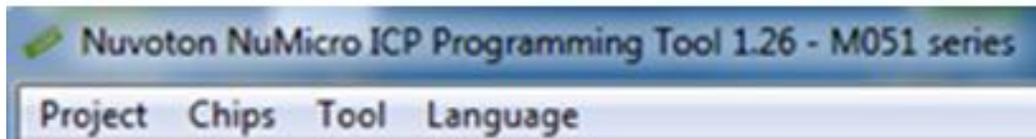


Figure 4-2 Menu Bar

- **Project**
 - Import and export the *.icp project file. This command can not only save and load user settings, but can do binary code protection through exporting with a certificate.
- **Chips**
 - Enable the main window to switch between different chips.
- **Tool**
 - **Erase offline data**
 - ◆ Erase offline data that saved in NuLink dongle.
 - **Create Nu-Link certificate file**
 - ◆ For ICP Programming Tool online programming mode security, create a certificate file to encrypt program data that saved in .icp project file, and bind this .icp project file to a certain Nu-Link dongle. Please see the “**Binary Code Protection (Online Programming Mode)**” chapter for more details.
- **Language**
 - Switch between “English”, “Simple Chinese” and “Traditional Chinese”.

4.2 Connection Status

- Before connected

The ICP Programming Tool will try to connect target chip once the user clicks the “**Connect**” button.



Figure 4-3 Before Connected Status

- After USB dongle connected successfully

The ICP Programming Tool shows “ICE Connected”.



Figure 4-4 After USB Dongle Connected Status

- After target chip connected successfully

The ICP Programming Tool shows chip information.



Figure 4-5 After Target Chip Connected Status

4.3 Load File

- Select file for programming

Select a file for programming. Then the file size and checksum information will be displayed.

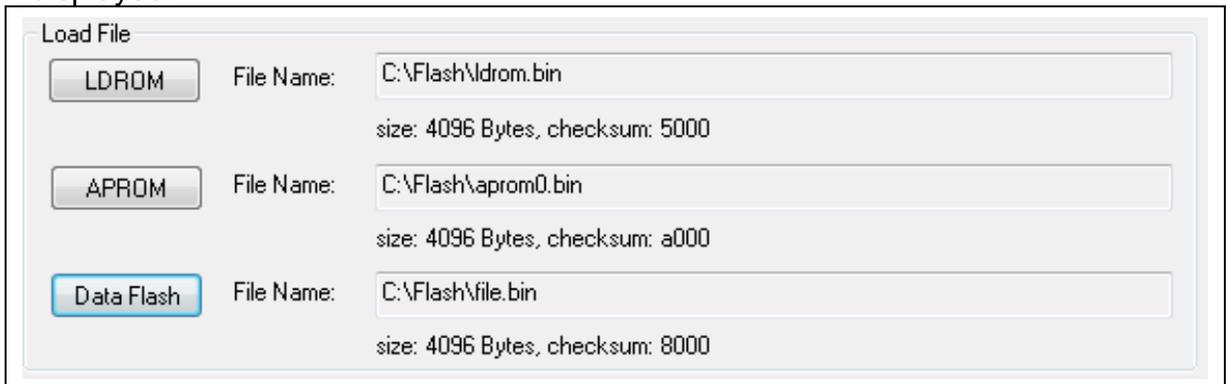


Figure 4-6 Select File for Programming

- Supported file format:

The supported file format includes **bin** or **Intel hex** (Intel 8, 16 and 32) file format.

4.4 Configuration Bits

The Config Bits section is used for configuration bits setting.



Figure 4-7 User Configuration Status

The Chip Options form will be displayed after clicking the “**Setting**” button.

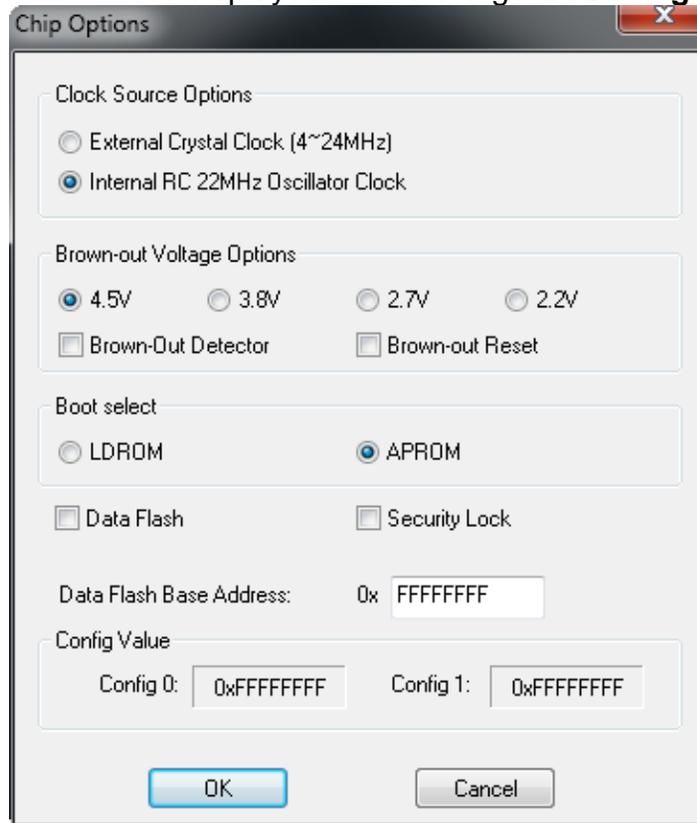


Figure 4-8 User Configuration Settings

- Configuration selection list
 - **"On-board Config"** shows the configuration bit that's read from target chip;
 - **"Offline Config"** shows the configuration bit read from Nu-Link that's saved previously for offline programming;
 - **"Update History"** shows the configuration bit that's filled by software.

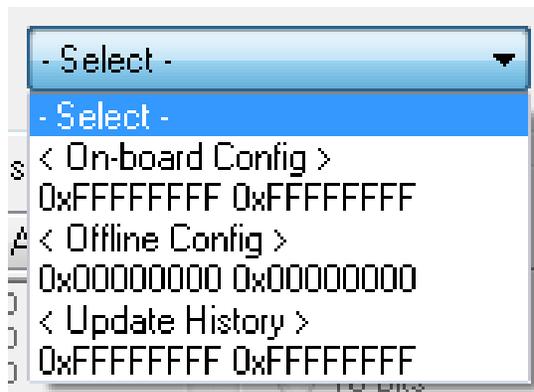


Figure 4-9 User Configuration Setting History

4.5 Dump Data

Once refresh, the data information section will show three parts of Flash data information respectively, including “File Data”, “On-board Flash”, and “Offline Flash”.

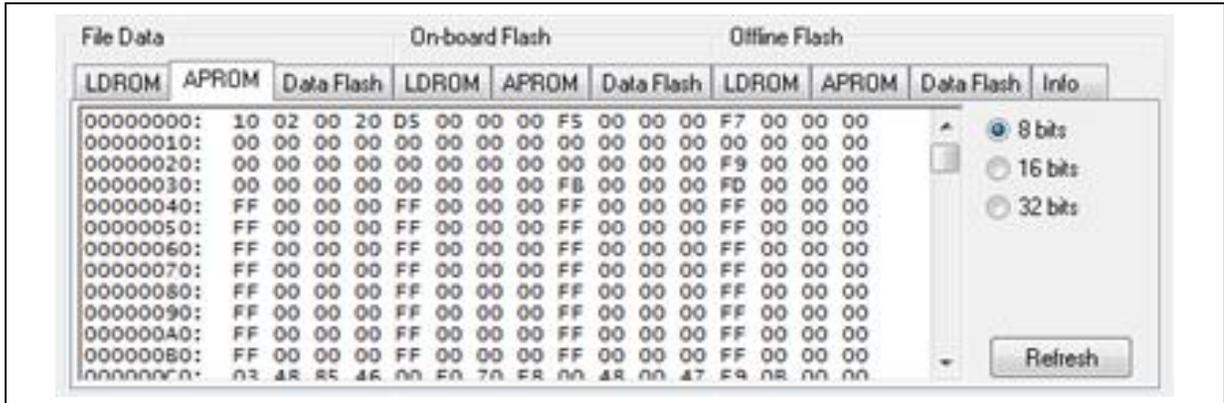


Figure 4-10 Data Information Interface

- File data
 - The file content selected in the “Load file” group.
- On-board Flash
 - The data programmed on built-in Flash of target chip.
- Offline Flash
 - The offline data on SPI Flash of Nu-Link dongle.
 - The info tab will show download information of online and offline programming mode

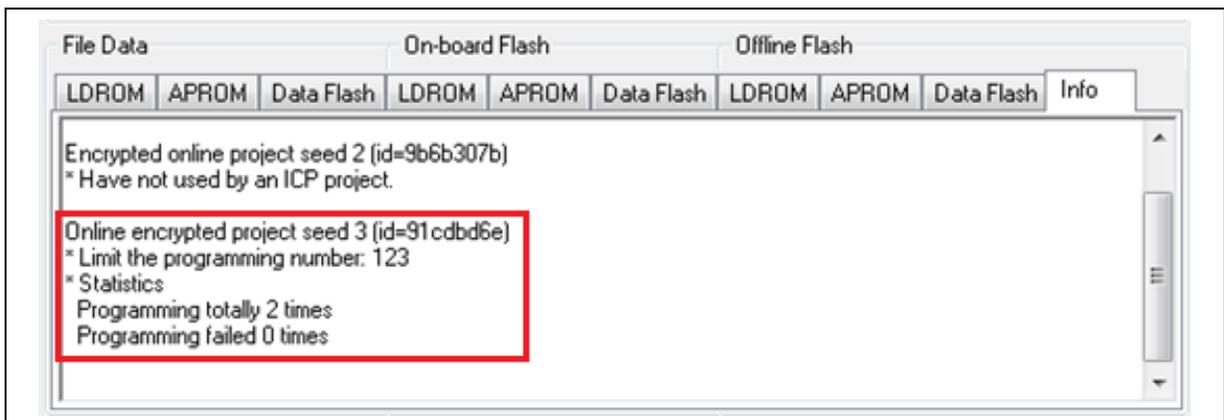


Figure 4-11 Offline Flash Programming Information

4.6 Programming Options

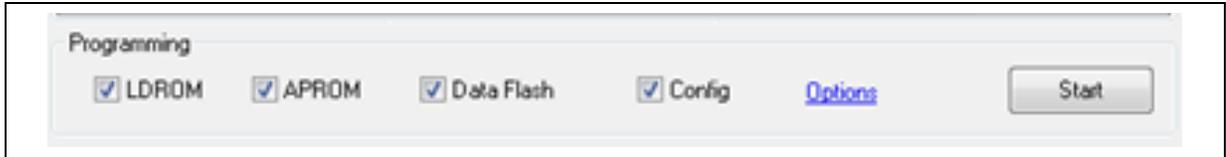


Figure 4-12 Programming Block Options and Start Button

- Target programming block

User can program APROM, Data Flash, or LDROM separately.

In online programming mode, user only needs to set the target programming block as shown in Figure 4-13.

In offline programming mode, besides the target programming block, user also needs to enable the “**Program Specific Area**” option as shown in Figure 4-14; otherwise, it will erase the whole target chip while offline downloading.

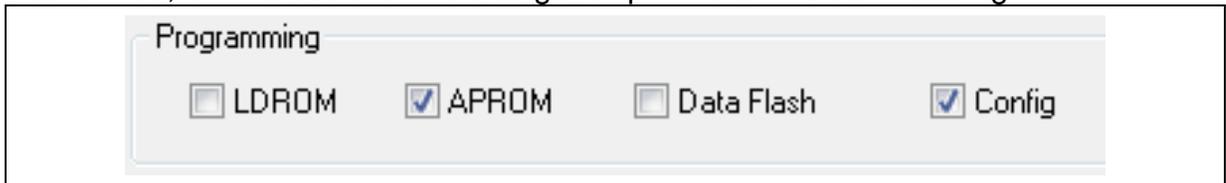


Figure 4-13 Programming Block Options

- Programming options

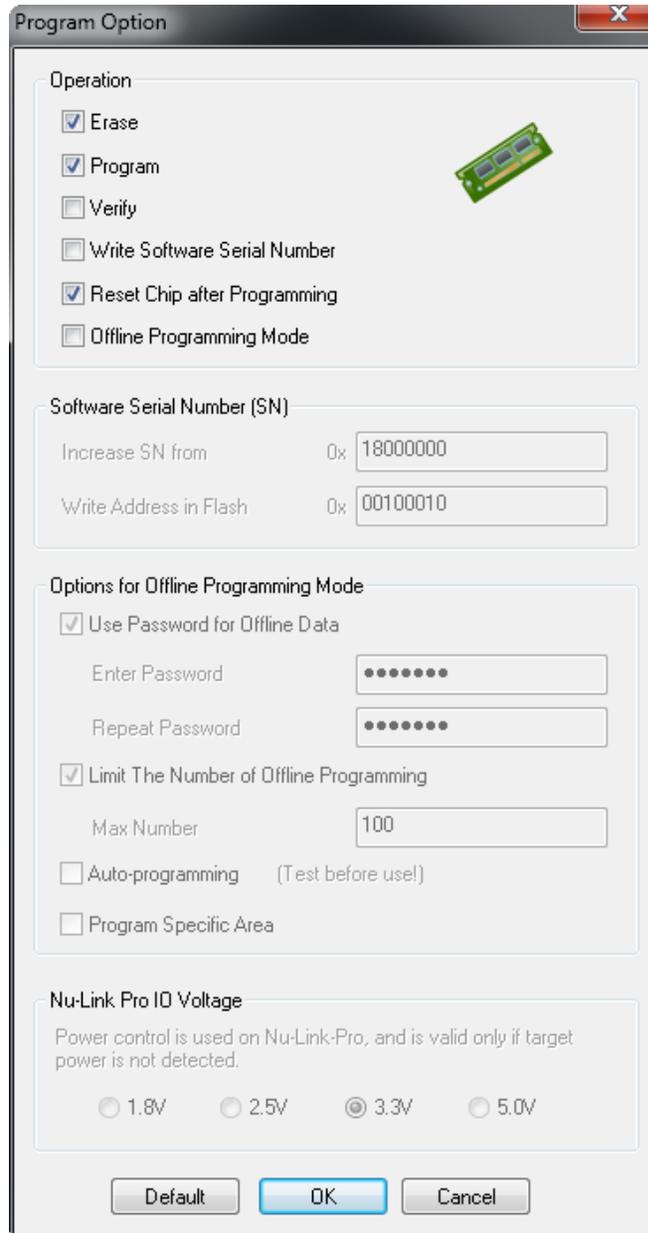


Figure 4-14 Programming Options

- The Operation group contains erase, program, verify, offline programming mode option settings.
- User can enable “**Write Software Serials Number**”, and assign “SN start value” and “target flash address where SN saved”.
- User can specify the password for offline programming mode and the limitation of maximum programming count for security issue.

4.7 Programming Status

The ICP Programming Tool AP contains progress bar and program status. After programming is done, a dialog box will appear to display the success information or any other failed information.

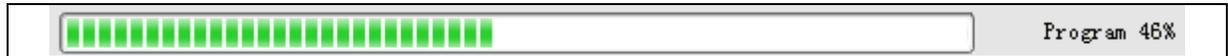
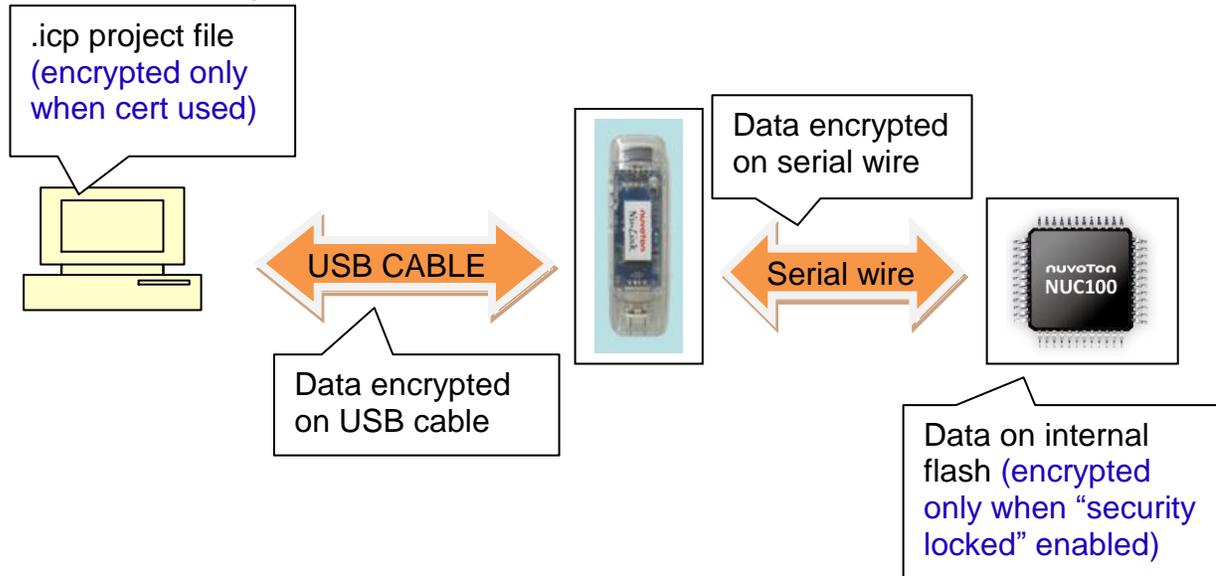


Figure 4-15 Programming Status

5 Binary Code Protection (Online Programming Mode)

This chapter describes code security for ICP Programming Tool in online programming mode.

In data delivery, binary code is encrypted in online programming mode (referring to the illustration below)



5.1 Introduction to Nu-Link Certification

To prevent factory from getting developer's code and release to someone else, developer can bind his bin file with a certain Nu-Link dongle.

The owner of Nu-Link dongle (in this case, it's owned by mass production factory) should create certificate file and send to developer, and developer can use this file to encrypt bin file and bind to this Nu-Link dongle.

Features of Nu-Link certification:

- Nu-Link is required to create a certificate file to program target chips:
 - If someone gets your *.icp project file, he cannot program target chips without the cert-creating Nu-Link dongle.
- The content of exported *.icp project file are encrypted.
- Encrypted project can program target chips in predefined maximum times.
 - Nu-Link owner is not allowed to do unlimited mass production without the permission of developer.

5.2 Procedure of Using Nu-Link Certification

Step 1: Factory creates Nu-Link's certificate file and sends it to developer.

Step 2: Developer encrypts binary file with this certificate file and exports a *.icp project file, and then sends the *.icp file to Factory.

Step 3: The cert-creating Nu-Link updates its certificate information (for example, increased programming count) after Nu-Link successfully decrypts and programs the ICP project to target chips.

Note: Only the cert-creating Nu-Link can decrypt the ICP project, by which the factory can open the project and program target chip's firmware.

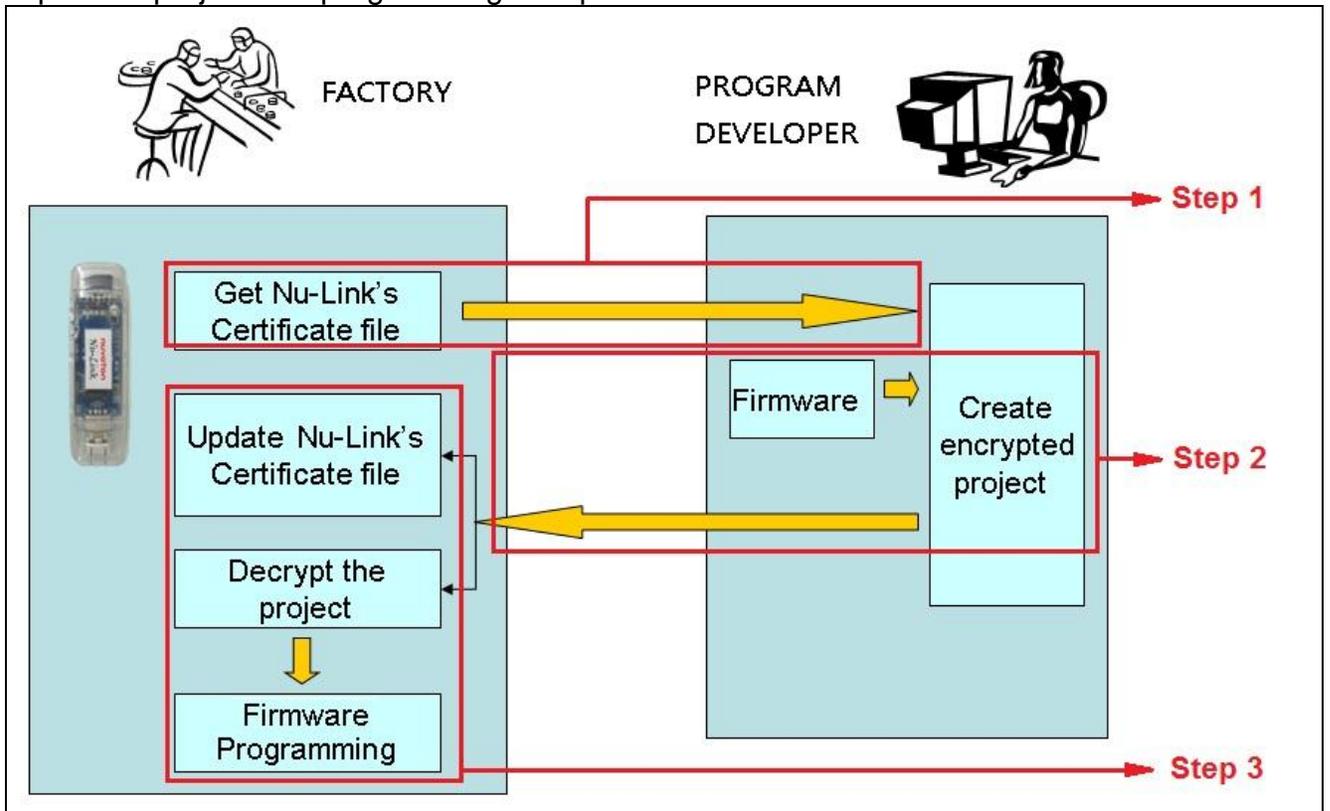


Figure 5-1 Nu-Link Certification Procedure

5.3 Operation Steps

This section describes the operation steps of Nu-Link certification.

5.3.1 Create Nu-Link Certificate File (Factory Side Operations)

Step 1: Connect Nu-Link.

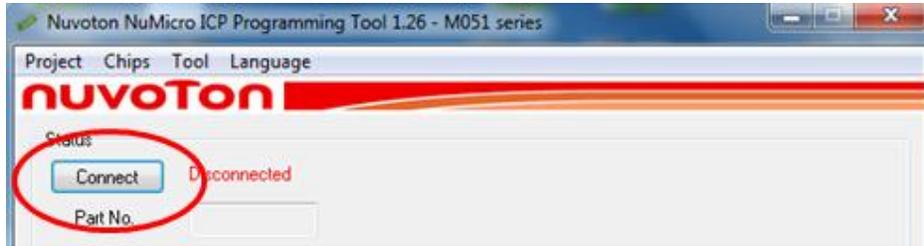


Figure 5-2 Connect Nu-Link

Step 2: Create certificate file.

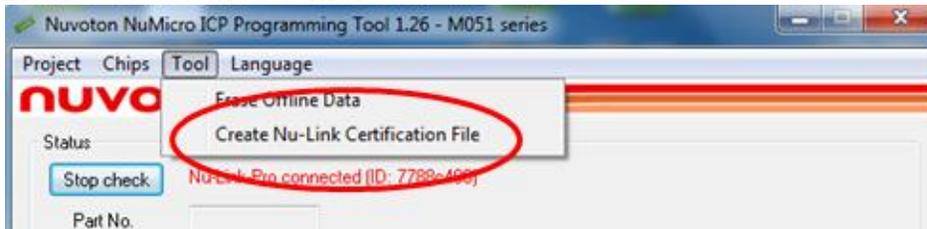


Figure 5-3 Create Nu-Link Certification File

Step 3: Save Nu-Link certificate file (*.ict).

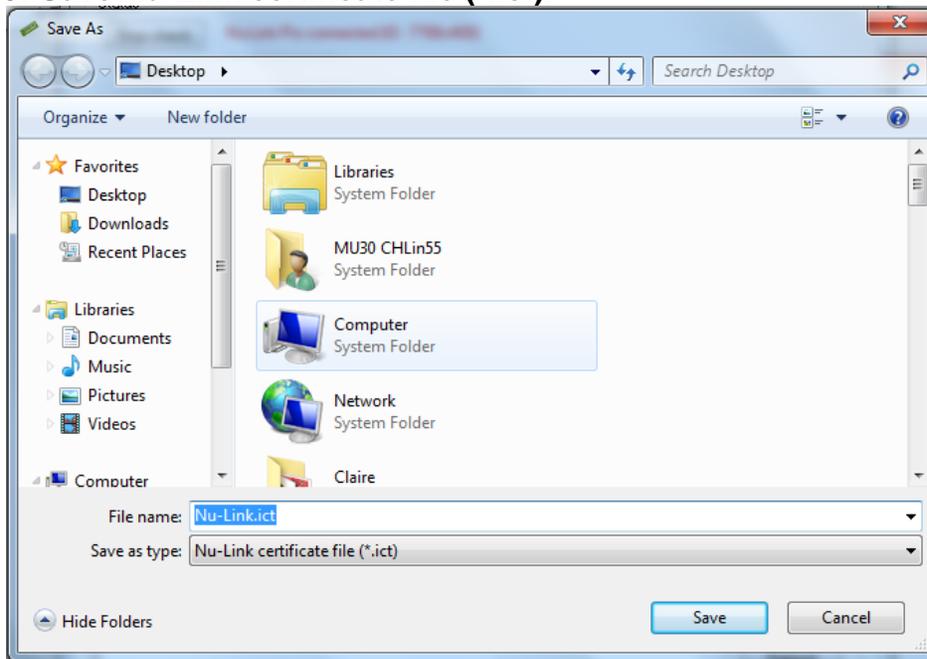


Figure 5-4 Save Nu-Link Certificate File

5.3.2 Bind Certificate File and Program Binary File to Encrypted Project (Developer Side Operations)

Step 1: Export project.

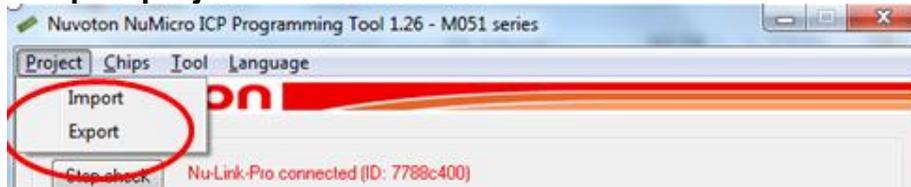


Figure 5-5 Export Project

Step 2: Enable settings.

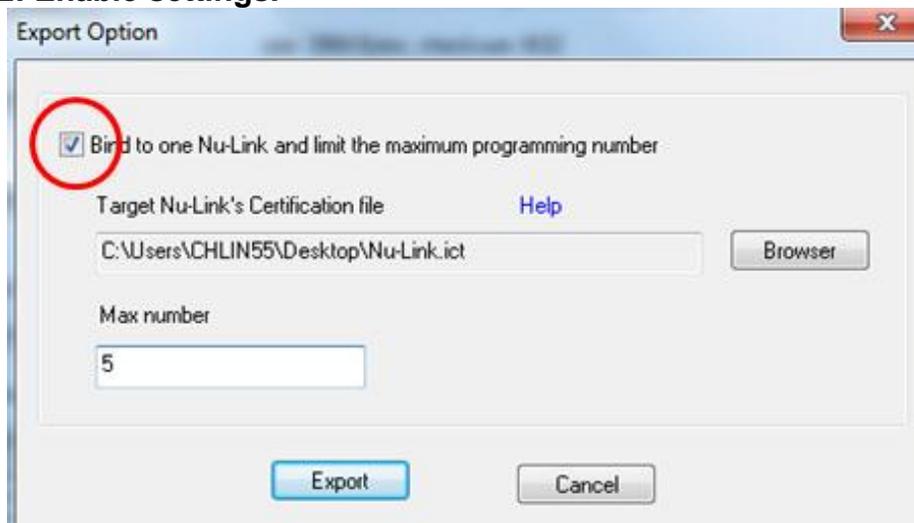


Figure 5-6 Enable Binding Nu-Link Settings

Step 3: Select the Nu-Link certificate file path.

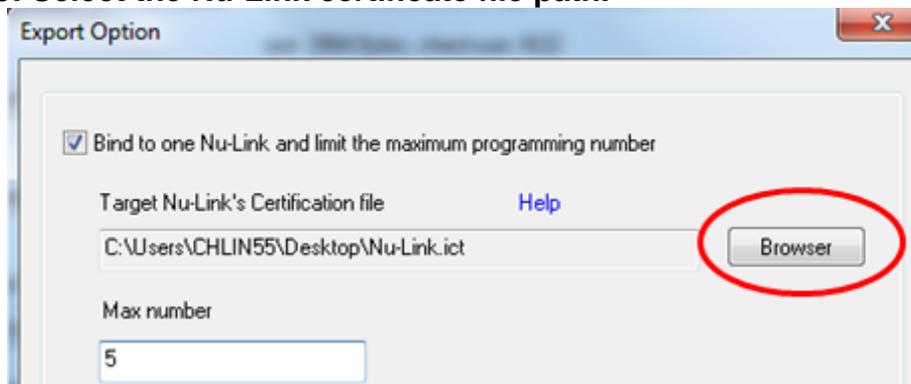


Figure 5-7 Select Nu-Link Certificate File

Step 4: Enter the maximum programming number and start to export the project.

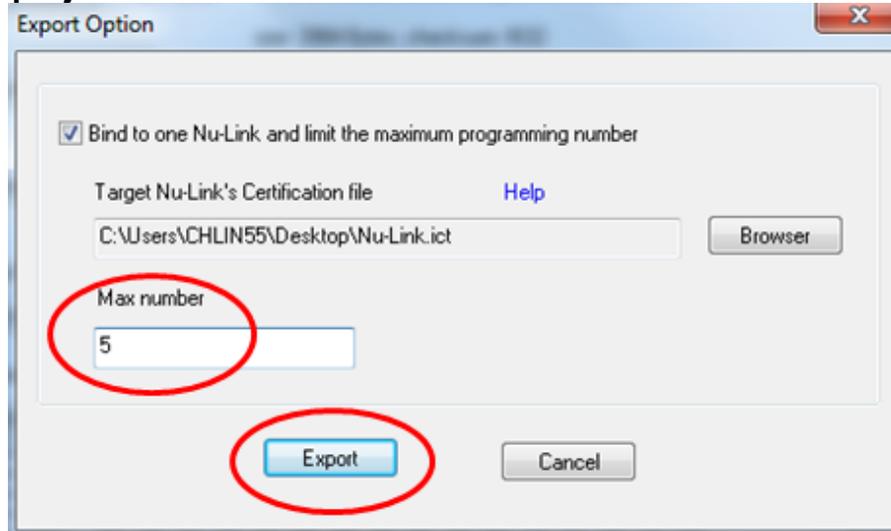


Figure 5-8 Set Max Programming Number

Step 5: Save the ICP project file (*.icp).

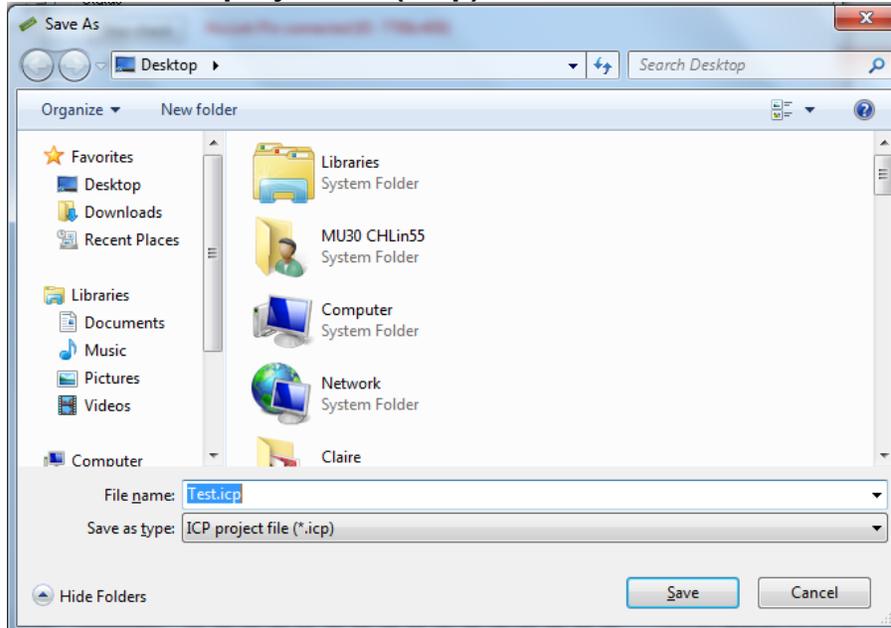


Figure 5-9 Save ICP Programming Tool Project File

Note: Once the project exceeds the maximum programming number, user needs to create a new Nu-Link certification and set the new max programming number.

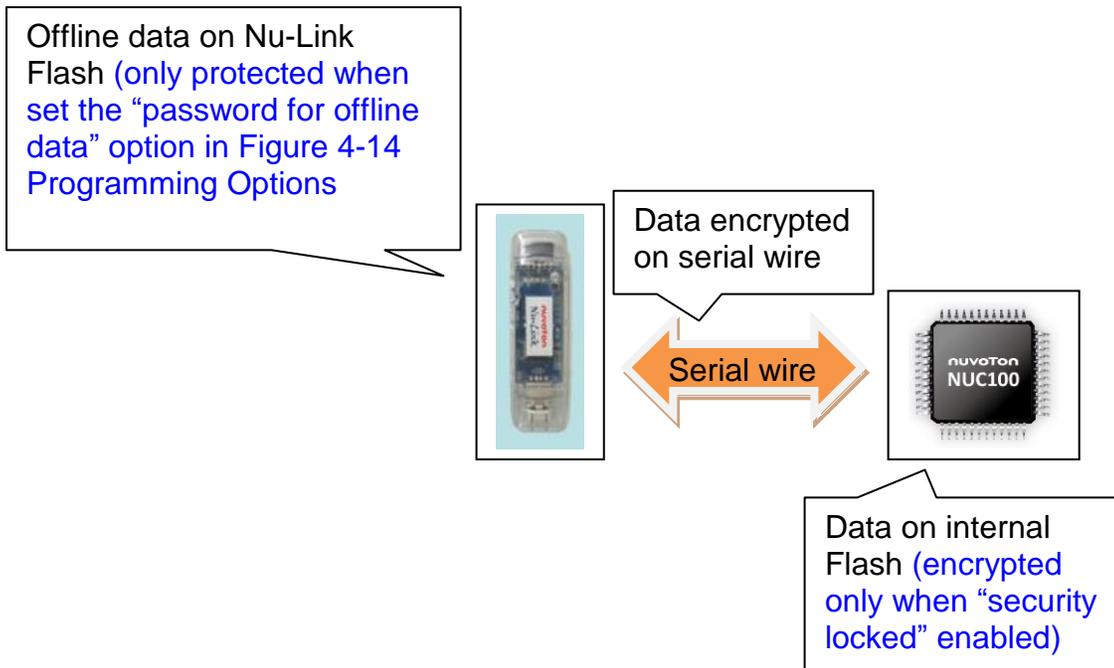
- By performing above steps, another setting can be used to create an ICP project file:
 - Use B.ict to create an ICP project file and set the maximum programming number to 10.
 - After programming 5 times, use B.ict to create the second ICP project file and set the maximum programming number to 3.
 - The second ICP project file can program 5 times.
 - Set the maximum programming number carefully at first time and it is better to create different certification for different ICP projects.

Note: The maximum programming number is determined at first time when using the certification to create an ICP project file. Even user sets the maximum programming number several times, the maximum programming number is the one set at first time.

6 Binary Code Protection (Offline Programming Mode)

This chapter describes code security for ICP Programming Tool in offline programming mode.

In data delivery, binary code is encrypted in offline programming mode (referring to the illustration below).



If code security is your concern, it is suggested to set the “**password for offline data**” in Figure 4-14, and enable “**Security lock**” in Figure 4-8.

To limit offline download times for Nu-Link, please enable the “**Limit the number of offline programming**” option as shown in Figure 4-14.

7 Nu-Link Firmware Update

Follow the steps below to update firmware update:

Step 1: Run the ICP Programming Tool. Click 'Connect' and start to connect to a device. If the firmware version and driver version are not matched, a firmware update form will be displayed, as shown below.

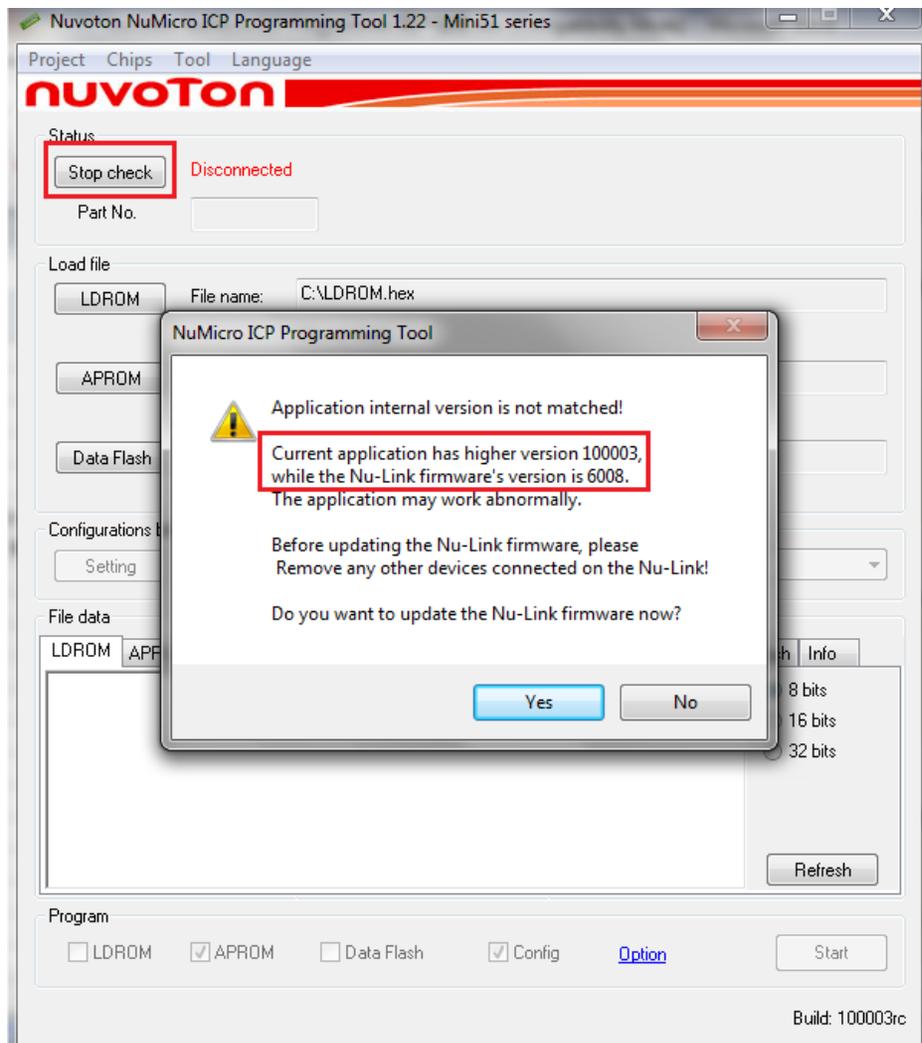


Figure 7-1 Firmware Update Selection Dialog Box

Step 2: Click “Yes” to update firmware, as shown below.

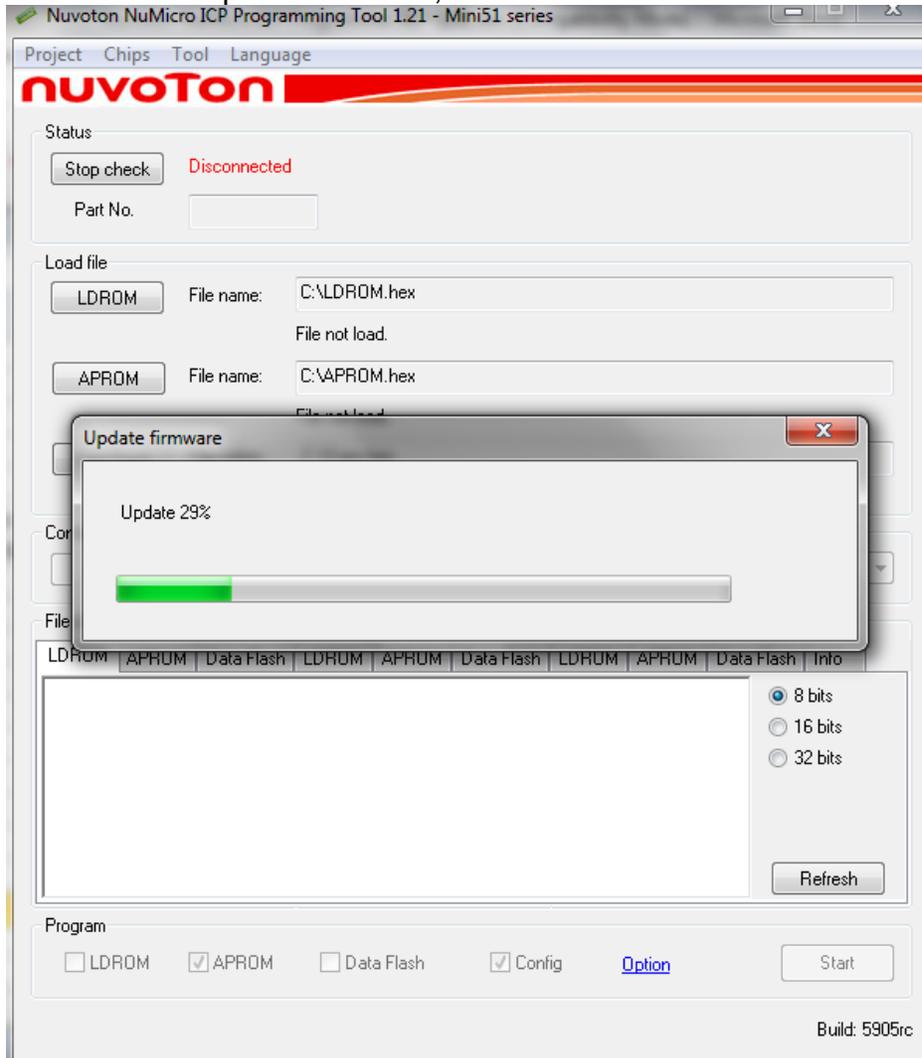


Figure 7-2 Firmware Update Dialog Box

Once the update is completed, user needs to re-connect the Nu-link to PC, as shown below.

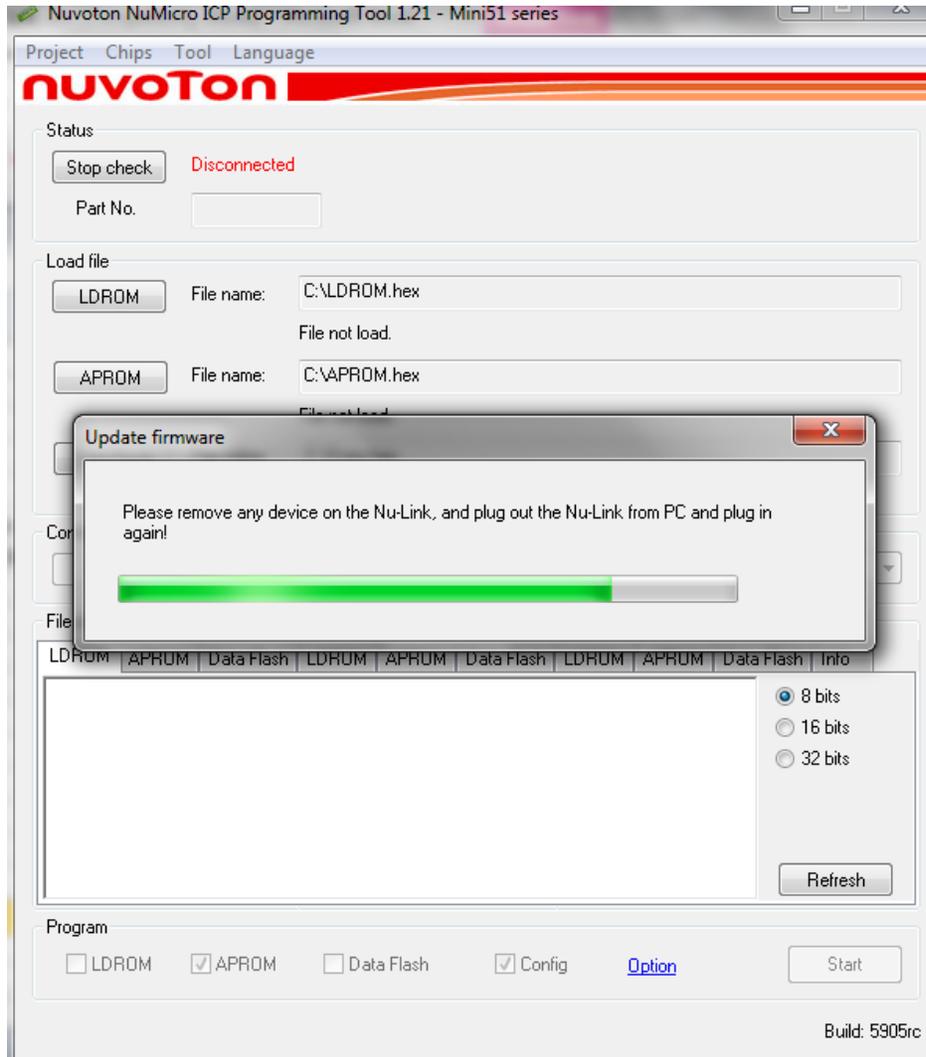


Figure 7-3 Re-connect Nu-Link to Complete Firmware Update

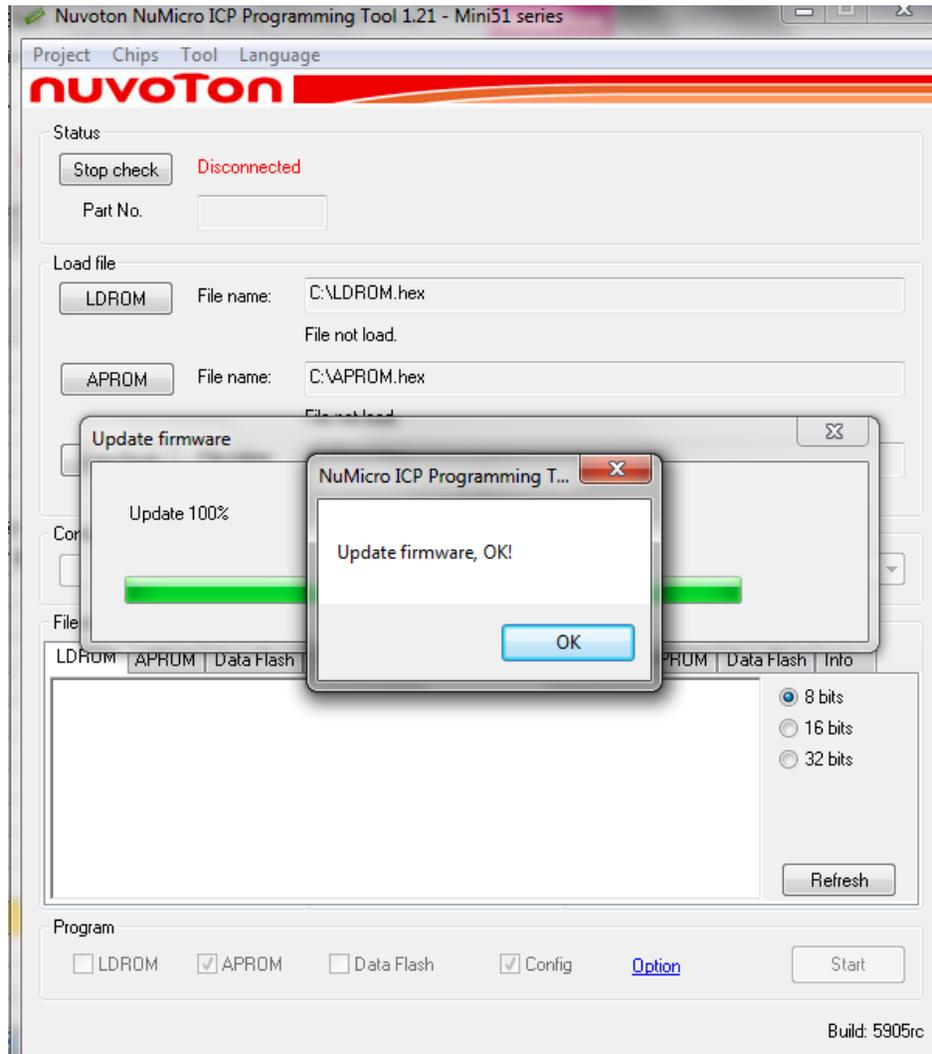


Figure 7-4 Update Firmware Completely

8 Support for NUC505 Series

8.1 Main Window for NUC505 Series

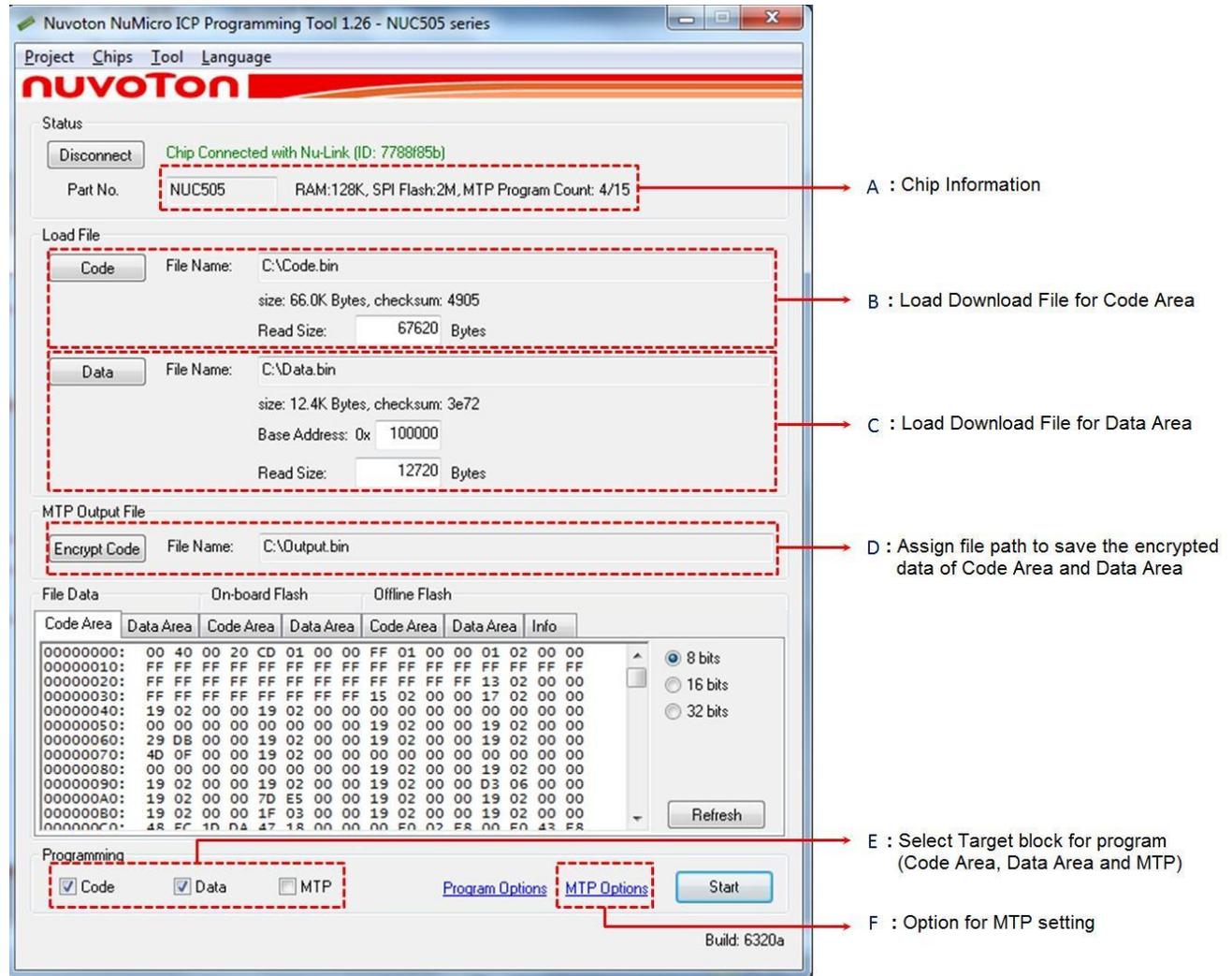


Figure 8-1 Main Window for NUC505 Series

After a target chip is detected, the ICP Tool would read chip information (including Part No., RAM size, SPI Flash size and MTP status) and show the information on section A in Figure 8-1. If MTP is locked, MTP status shows “MTP: Locked” in red and the “MTP” option is also unchecked.

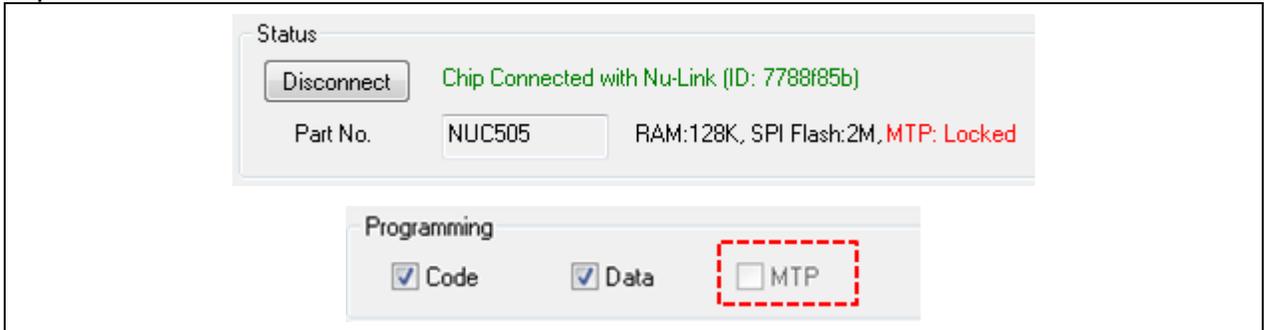


Figure 8-2 NUC505 Chip Information and MTP Status

Due to reading all contents of SPI Flash is time-consuming, partial-read from the assigned base address (Code Area is fixed at 0x0) and read size are provided (referring to section B and C in Figure 8-1). The “**Base Address**” and “**Read Size**” show different input format respectively. The “**Base Address**” is hex-coded, and “**Read Size**” is decimal-coded. User can read any range of SPI Flash by clicking “**Refresh**”.

If MTP had ever been programmed or MTP is selected for this program, user can assign the file path (section D in Figure 8-1). When the programming process is ended, the ICP tool would merge the encrypted data of Code Area and Data Area into a binary file and save it to the assigned path.

Before starting to program a target board, user can select target blocks for programming (section E in Figure 8-1).

By clicking “**MTP Options**” (section F in Figure 8-1), user can open the MTP Option form and configure MTP related settings.

8.2 MTP Options

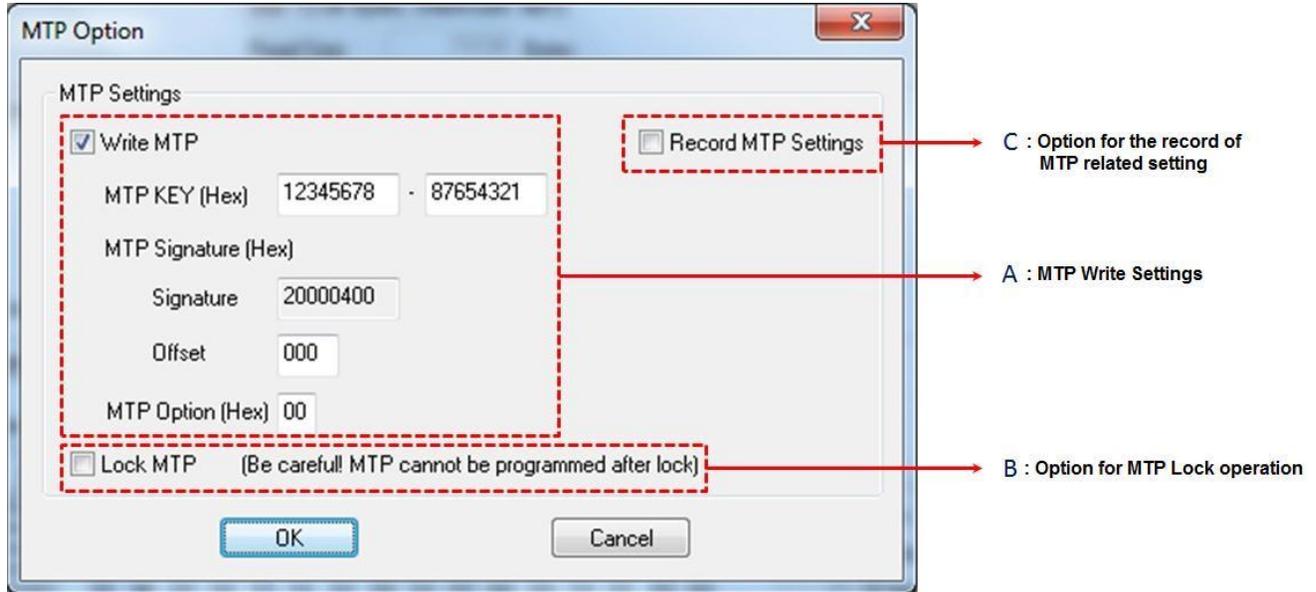


Figure 8-3 MTP Options

On the *MTP Option* form, user can select the desired operation and fill in MTP keys and signature. The options and fields are described below:

- **“Write MTP”**: Write 64-bit key, 32-bit Signature, 12-bit Offset, and 1-byte Option with hex-code input format. If the file for Code Area is loaded, Tool will search the corresponding 32-bit value and fill in the “Signature” automatically according to the address of “Offset”.
- **“Lock MTP”**: Lock MTP. MTP cannot be programmed after lock.
- **“Record MTP Settings”**: If this option is checked, the MTP settings including MTP Key and Signature on MTP Option Dialog will be recorded after clicking “OK”. When the ICP Tool is reopened, the previous MTP settings will be restored.

9 Nuvoton Announcement

When PC is online, Nu-Link driver will check if there is any updated driver or announcement on Nuvoton website automatically, it will do the check when users run the ICP tool. User may see the message below:

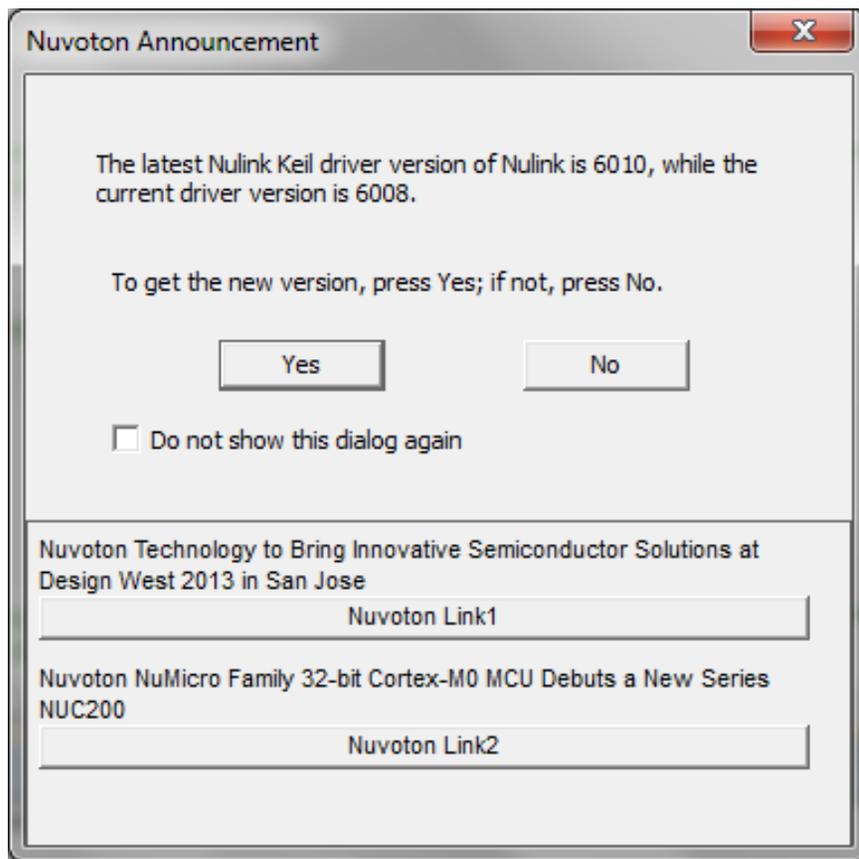


Figure 9-1 Nuvoton Announcement

The message above means there is a new version of Nu-Link driver updated on Nuvoton website. Click '**Yes**' will download the driver from Nuvoton website; clicking '**No**' will close the pop-up form.

Note: Even the user installs the latest driver, this dialog box may pop-up again for updated “Nuvoton News” below. If users don’t want this dialog box to appear again, enable the '**Do not show this dialog again**' and click the '**No**' button.

10 Revision History

Revision	Date	Description
1.01.001	Jan. 28, 2010	First version.
1.01.002	Feb. 24, 2010	Added offline programming mode.
1.01.003	Jun. 04, 2010	Changed key & LED definition.
1.02.001	Jun. 22, 2010	Added chip select and offline security.
1.03.001	Jul. 22, 2010	Supported M502x series.
1.17.001	Aug.03,2011	Supported Mini51/Nano100 series. Added more features in offline programming mode.
1.19.001	Aug.10,2012	Supported NUC200.
1.20.001	Jul. 01,2013	Supported NUC200 and NUC123 series. Added firmware update and Nuvoton announcement.
1.21.001	Feb. 10, 2014	Changed document format.
1.21.002	Aug. 08, 2014	Added security chapter and reorganized document.
1.22.001	Sep. 05, 2014	Changed document and figure format.

Important Notice

Nuvoton Products are neither intended nor warranted for usage in systems or equipment, any malfunction or failure of which may cause loss of human life, bodily injury or severe property damage. Such applications are deemed, "Insecure Usage".

Insecure usage includes, but is not limited to: equipment for surgical implementation, atomic energy control instruments, airplane or spaceship instruments, the control or operation of dynamic, brake or safety systems designed for vehicular use, traffic signal instruments, all types of safety devices, and other applications intended to support or sustain life.

All Insecure Usage shall be made at customer's risk, and in the event that third parties lay claims to Nuvoton as a result of customer's Insecure Usage, customer shall indemnify the damages and liabilities thus incurred by Nuvoton.

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