# **Nuvoton ICP Tool User Manual**

The information described in this document is the exclusive intellectual property of Nuvoton Technology Corporation and shall not be reproduced without permission from Nuvoton.

Nuvoton is providing this document only for reference purposes of NuMicro microcontroller based system design. Nuvoton assumes no responsibility for errors or omissions.

All data and specifications are subject to change without notice.

For additional information or questions, please contact: Nuvoton Technology Corporation.

www.nuvoton.com

## **Table of Contents**

1	Over	view
	1.1	Introduction5
	1.2	Supported Devices
	1.3	Features5
2	Prepa	aring for ICP Tool
	2.1	System Requirements 6
	2.2	Hardware Installation
	2.3	Software Installation6
3	Oper	ation Modes of ICP Tool and Nu-Link Adapter9
	3.1	ICP Tool Modes
	3.2	LED status of Nu-Link Adapter 10
4	Starti	ing to Use ICP Tool
	4.1	Menu Bar
	4.2	Connection Status 12
	4.3	Load File
	4.4	Configuration Bits
	4.5	Dump Data14
	4.6	Programming Options
	4.7	Programming Status
5	Code	Protection (Online Programming Mode)17
	5.1	Introduction to Nu-Link Certification
	5.2	How to use Nu-Link Certification
	5.3	Detail steps
6	Code	Protection (Offline Programming Mode)23
7	Nu-Li	ink Firmware Update
8	Featu	ures of Specific Series
	8.1	Support for NUC505 Series
	8.2	Support for M480 Series
9	Revis	sion History

## List of Figures

Figure 2-1 Chip Series and Language Selection7
Figure 2-2 Overview of Main Window 8
Figure 3-1 Offline Programming Button
Figure 4-1 ICP Tool User Interface ······11
Figure 4-2 Menu Bar ·····11
Figure 4-3 before Connected Status ······12
Figure 4-4 after USB Adapter Connected Status ······12
Figure 4-5 after Target Chip Connected Status ······13
Figure 4-6 Select File for Programming13
Figure 4-7 User Configuration Status ······13
Figure 4-8 User Configuration Settings ······14
Figure 4-9 User Configuration Setting History14
Figure 4-10 Data Information Interface ······15
Figure 4-11 Programming Options and Start Button15
Figure 4-12 Programming Blocks ······15
Figure 4-13 Programming Options·····16
Figure 4-14 Programming Status ·····16
Figure 5-1 Code Protection in Online Programming Mode17
Figure 5-2 Steps of using Nu-Link Certificate18
Figure 5-3 Connect Nu-Link······18
Figure 5-4 Create Nu-Link Certificate File19
Figure 5-5 Save Nu-Link Certificate File19
Figure 5-6 Export Project19
Figure 5-7 Enable Binding Nu-Link Settings20
Figure 5-8 Select Nu-Link Certificate File20
Figure 5-9 Set Max Programming Number
Figure 5-10 Save ICP Tool Project File ······21
Figure 5-11 Import Project······21
Figure 5-12 Start Button

## **Nuvoton ICP Tool User Manual**

# nuvoTon

Figure 5-13 Flash Programming Information
Figure 6-1 Binary Code Protection in Offline Programming Mode23
Figure 7-1 Firmware Update Selection Dialog Box ······24
Figure 7-2 Firmware Update Dialog Box ······25
Figure 7-3 Re-connect Nu-Link to Complete Firmware Update26
Figure 7-4 Update Firmware Completely ······27
Figure 8-1 Main Window for NUC505 Series······28
Figure 8-2 NUC505 Chip Information and MTP Status28
Figure 8-3 MTP Options ······29
Figure 8-4 Main Window for M480 Series ······30
Figure 8-5 SPI Flash Status ······31
Figure 8-6 SPIM Multi-function Pin Setting ······31
Figure 8-7 Plain Data Setting for SPI Flash Programming
Figure 8-8 Encrypted Data Setting for SPI Flash Programming
Figure 8-9 Read Ciphertext and Save to Binary File
Figure 8-10 KPROM Option
Figure 8-11 KPROM Key Setting Form······33
Figure 8-12 Create Secure Boot Key File Menu ······34
Figure 8-13 Secure Boot Key Form
Figure 8-14 Boot Loader Option ······35
Figure 8-15 Program Secure Boot Key and Information Block
Figure 8-16 Multi-binary Mode······35
Figure 8-17 Load Multiple Binary Files ······36

## 1 Overview

### 1.1 Introduction

Nuvoton ICP Tool is a software that can program Nuvoton Cortex<sup>®</sup>-M and 8051 1T products, which supports "online" and "offline" programming mode.

"ICP" is the acronym of In-Circuit Programming, which means user can upgrade Flash memory of MCU on board and does not need to unmount it from target PCB.

### **1.2 Supported Devices**

Download revision history from nuvoton website to see the table of supported devices.

Users can download datasheet from <a href="http://www.nuvoton.com">http://www.nuvoton.com</a>

### 1.3 Features

- In-Circuit programming target chip
- Online/offline programming mode
- Backup Flash data of target chip (If it is unprotected)
- Backup offline SPI Flash data of Nu-Link adapter (if it is unprotected)
- Write serials number (SN) to target chip
- Limit the maximum programming counts
- Data encryption for online/offline programming
- Batch mode for online/offline programming

## 2 Preparing for ICP Tool

## 2.1 System Requirements

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

- PC/AT compatible machine with Pentium or higher CPU
- XVGA(1024\*768) color monitor
- At least 512MB RAM for best performance
- At least 10GB free disk space
- Windows 7/10 or higher

## 2.2 Hardware Installation

Connect PC host and Nu-Link with USB cable.

Connect Nu-Link and target chip with debugging interface.

### 2.3 Software Installation

Please run the installer package to install the software.

After installing the package, launch ICP Tool and you can see the dialog below.

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

Nuvoton NuMicro ICP Progra	amming Tool 1.24
	Select NUC100 series
	English   Select Target Chip:
	NUC100 series
	Support Forum http://www.nuvoton-m0.com

Figure 2-1 Chip Series and Language Selection

Connect or disconnect	
Number NuMirro ICD Decomposing Text 1.24 NUC100 series	1
Project Chins Tool Language	
Status	
Disconnect Chip Connected with Nu-Link (ID: 00000000) Chip Connected with Nu-Link (ID: 00000000)	
Part No. NUC100VE3DN LDR0M:4K, APR0M:128K, Data:0K, RAM:16K Chip information	
Load File	
LDROM File Name: C:\LDROM.hex	
File not load.	<ul> <li>File information</li> </ul>
APROM File Name: C:\APROM.hex	
File not load.	
Data Flash File Name: C:\Data.hex	
File not load.	Select data tab
Config Bits Set configuration bit	
Setting Config 0: 0xFFFFFFF Config 1: 0xFFFFEEFF Select Select	Configuration bit
File Data Dn-board Flash Offline Flas (On-board Config) 0xFFFFFFF 0xFFFFFFF	on target chip
LDROM APROM Data Flash LDROM APROM Data Flash LDROM # < Offline Config > 0x00000000 0x00000000 0x00000000 0x000000	Configuration hit
000000001: 88 0C 00 20 D9 00 00 00 DD 00 00 DF 00 00 00 CV Update History > 00000010: 00 00 00 00 00 00 00 00 00 00 00 00 0	in offline program data
00000030: 00 00 00 00 00 00 00 00 E3 00 00 00 E5 00 00 00 00000040: E7 00 00 00 E7 00 00 00 E7 00 00 00 E7 00 00 00 00 00 00 00 00 00 00 00 00 00	
00000050: E7 00 00 00 E7 00 00 0E7 00 00 00 E7 00 00 00 00000060: E7 00 00 00 E7 00 00 0E7 00 00 00 E7 00 00 00	—— Data display area
000000000: E7 00 00 00 E7 00 00 00 E7 00 00 00 E7 00 00 00 000000000: E7 00 00 00 E7 00 00 00 E7 00 00 00 S1 08 00 00 Save As	
000000A0: E7 00 00 00 C7 00 00 00 F7 00 00 00 C7 00 00 C7 00 00 00 00 00 00 00 C7 00 00 00	
Programming	
LDROM VAPROM Data Flash V Config Options	Start programming
Target program block Action select Build: 6211r	Application version

Figure 2-2 Overview of Main Window

## **3** Operation Modes of ICP Tool and Nu-Link Adapter

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

### 3.1 ICP 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 4-13 is unchecked, ICP Tool will program in online programming mode.

Click ICP Tool "**Start**" button in Figure 2-2 to start to program target device. Target device must be connected to Nu-Link.

#### 3.1.2 Offline Programming Mode

If the "**Offline programming mode**" option in Figure 4-13 is checked, ICP Tool will program in offline programming mode.

First, click ICP Tool "**Start**" button to program the data to SPI flash of Nu-Link. (For some part numbers, target device must be connected to Nu-Link in this step.)

Next, you can do offline program without ICP Tool, just press the button on the Nu-Link adapter (see Figure 3-1).

**Note:** You can refer "3.2 Code Protection in ICP Offline Mode" in "AN0001\_NuMicro\_Cortex-M\_Code\_Protection" for detail steps.



Figure 3-1 Offline Programming Button

Nu-Link, Nu-Link-Pro and Nu-Link2-ME only have SPI flash to save offline data.

For Nu-Link2-Pro, offline data can be saved in three different places.

- 1. USB flash drive
- 2. SD card
- 3. SPI flash

The sequence above is also the priority of detecting interface for Nu-Link2-Pro offline download.

Follow the steps below to use USB flash drive or SD card interface for offline download:

- 1. Use "Tool" -> "Create Offline USB/SD File" on the menu bar to save "NuLink2.us" file and drag and drop the file into USB flash drive or SD card.
- 2. Plug USB flash drive or SD card into Nu-Link2-Pro adapter.
- 3. Pressing the button on the Nu-Link2-Pro adapter will switch the Nu-Link2-Pro to offline download mode and start to download the offline data to target chip immediately.

## 3.2 LED status of Nu-Link Adapter

Nu Link Adapter Operation Status	Status LED					
	ICE	ICP	Red	Green		
Boot	Flash*3	Flash*3	Flash*3	Flash*3		
One Nu-Link adapter selected to connect	Flash*4	Flash*4	Flash*4	On		
ICE Online (Not connected with a target chip)	On	Any	-	-		
ICE Online (Connected with a target chip)	On	Any	-	On		
ICE Online (Failed to connected with a target chip)	On	Any	Flash	On		
During Offline Programming	-	On	-	Flash Slowly		
Offline Programming Completed	On	-	-	-		
Offline Programming Completed (Auto mode)	On	On	-	-		
Offline Programming Failed	On	Flash	-	-		

Table 3-1 Status LEDs List

## 4 Starting to Use ICP Tool

This chapter introduces the general operations in ICP Tool. Please refer to Figure 4-1.

Status	Disconnect	ed									
Part No.											
Load File	Eile Namm	C.M									
APROM	File Name:	File no	-HUM.nex	(			Base:	0x 000	00000 0	)ffset: Ox	0
Data Flash	File Name:	C:\D. File pr	ata.hex								
LDROM	File Name:	C:\LE	DROM.hex	<							
		File no	ot load.								
SPROM	File Name:	C:\SF	PROM.hex	(							
		File no	ot load.						L	.ast Byte:	Ox FF
Config Bits Setting	Config 0:	0xFFFFF 0xFFFFF	FFFF F5A	Config 1:	0xFFFF	FFFF	<	Update	History >		$\vee$
File Data			On-boar	rd Flash			Offline Fl	ash			
APROM DATA	LDROM	SPROM	APROM	DATA	LDROM	SPROM	APROM	DATA	LDROM	SPROM	1 Info bits 3 bits 2 bits Refresh
Programming										F	lefresh
🗹 APROM	Data	Flash		ROM	SP	ROM	🗹 Conf	ig	Option	15	Start

Figure 4-1 ICP Tool User Interface

### 4.1 Menu Bar

The menu bar is described below.

#### • Project

Import and export the \*.icp project file. This command can not only save and load user settings, but also do binary code protection through exporting with a certificate.

#### • Chips

- To switch between different chips.
- Tool

### Create Nu-Link certificate file

- For ICP Tool online mode, user can create a certificate for a specific Nu-Link adapter. Please see the "Code Protection (Online Programming Mode)" chapter for more details.
- Create offline USB/SD file
  - ◆ This is only for Nu-Link2-Pro, refer to section 3.1.2.
- Merge file tool
  - Launch an utility that can merge several bin files to one.

#### • Operation

- Erase offline data
  - Erase offline data that saved in SPI flash of NuLink adapter.
- Erase whole target chip
  - Enforce to erase whole target chip flash in any case.
- Hardware Reset Target Chip
  - Use hardware reset target chip by NuLink adapter.
- System Reset Target Chip
  - Use system reset target chip by NuLink adapter.

#### • Language

- Switch between "English", "Simple Chinese" and "Traditional Chinese".
- Help
  - Version check
    - To check if there is any new release version on Nuvoton web site.

### 4.2 Connection Status

• Before connected

The ICP Tool will try to connect target chip once the user clicks the "Connect" button.

Status		
Connect	Disconnected	
Part No.		

Figure 4-3 before Connected Status

• After USB adapter connected successfully

The ICP Tool shows "ICE Connected".

Status	
Stop check	Nu-Link connected (ID: 778876f9)
Part No.	

Figure 4-4 after USB Adapter Connected Status

• After target chip connected successfully

The ICP Tool shows chip information.



Status		
Disconnect	Chip Connected with Nu-Link (ID: 00000000)	
Part No.	NUC100VE3DN LDROM:4K, APROM:128K, Data:0K, RAM:16K UID/UCID:	

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.

LDROM File Name: C:\Flash\ldrom.bin	
size: 4096 Bytes, checksum: 5000	
APROM File Name: C:\Flash\aprom0.bin	
size: 4096 Bytes, checksum: a000	
Data Flash File Name: C:\Flash\file.bin	
size: 4096 Bytes, checksum: 8000	

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 process is to erase the selected block first and program the flash block separately and perform the verification action.

The flash block burning sequence is => Configuration => APROM => LDROM => Data Flash.

The Config Bits section is used for configuration bits setting.

Config Bits			
Setting	Config 0:	0xFFFFFFFD	- Select - 🔹 🔻

Figure 4-7 User Configuration Status



The Chip Options form will be displayed after clicking the "Setting" button.

📧 Chip Settings	×
Configuration	
1/0 Initial State Selection	Disable ICE Function
RST Pin Width Selection	Chip Reset Time Extend
HXT Mode Selection © Crystal Mode O External Clock Mode	
Chip Booting Selection APROM     APROM with IAP	O LDROM O LDROM with IAP
Brown Out Voltage	Brown Out Reset
Watchdog Timer Mode Selection WDT is inactive. WDT is active and WDT clock WDT is active and WDT clock	is always on. is controlled by LIRCEN in power-down.
Data Flash Options	Base Address: 0x FFFFFFFF Data Flash Size: 0.00K
Security Lock Options	Advance Security Lock: 0x 54
Config Value Config 0: 0xFFFFFFF Config 2: 0xFFFFF5A	Config 1: 0xFFFFFFFF
	OK Cancel

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 history configuration.

Config Bits				
Setting	Config 0: 0xFFFFFFFF	Config 1: 0xFF	FFFFFF	< Update History > 🔷 🔻
				- Select -
File Data	On-board	Flash	Offline Fla:	< On-board Config > 0xFFFFFFFF 0xFFFFFFFF
LDROM APRO	M Data Flash LDROM	APROM Data Flash	LDROM	< Offline Config >
				<ul> <li>Update History &gt;</li> <li>0xFFFFFFFF 0xFFFFFFFF</li> </ul>

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".



-File Data-					0	n-bo	ard F	Flash					Of	fline	Flasl	n			
LDROM	APROM	Da	ata F	lash	LD	RON	4 /	APRI	ОМ	Da	ta Fl	ash	LD	ROM	1 4	PROM	Data	Flash	Info
0000000	00: 80	04 00	00	20 00	79 00	01 00	00	00	99 00	01 00	00	00	9B 00	01 00	00	00	•	0	8 bits
0000002	20: 00 30: 00	00 00	00 AF	00 01	00 00	00 00	AD B1	01 01	00 00	00		0	16 bits						
0000004	40: B3 50: B3	01 01	00 00	00 00	83 83	01 01	00 00	00 00	83 83	01 01	00 00	00 00	83 83	01 01	00 00	00 00		$\bigcirc$	32 bits
0000000	50: B3 70: B3	01 01	00 00	00 00	83 83	01 01	00 00	00 00	83 83	01 01	00 00	00 00	83 83	01 01	00 00	00			
0000008	30: B3 90: B3	01 01	00	00	83 83	01 01	00	00	83 83	01 01	00	00	83 83	01 01	00	00			
0000004	AO: B3 30: B3	01	00	00	B3 B3	01	00	00	B3 B3	01	00	00	B3 B3	01	00	00	-		Refresh
1000000	a• aa	FU	- 02	FX	nn	F0	48	FX.	nr.	40	-<0	1.8	-nx	~×	74	18			

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 adapter.
  - The info tab will show download information of online and offline programming mode

## 4.6 Programming Options

Program	mming					
🔽 L	DROM	📝 APROM	📝 Data Flash	🔽 Config	Options	Start
		Figure 4-11	Programming	Ontions and 9	Start Button	

Figure 4-11 Programming Options and Start Button

Target programming block

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

In online/offline programming mode, user needs to set the target programming block as shown in Figure 4-12. And user can select program, verify and erase action in program option as shown in Figure 4-13.

If user select the "Erase Whole Chip" option as shown in Figure 4-13, the ICP Tool will erase the whole target chip (APROM, LDROM, Data flash and config bits).

F	<sup>o</sup> rogramming					
	🔲 LDROM	📝 APROM	📃 Data Flash	🔽 Config	Options	Start

Figure 4-12 Programming Blocks

• Programming Options

📧 Program Option	×
Operation UErase Frogram Verify Write Software Serial Num GReset Chip after Program	Vhole Chip nber ming e
Software Serial Number (SN)	
Increase SN from	0x 18000000
Write Address in Flash	0x 00100010
Enter Password	******
Repeat Password	******
Limit The Number of Offlin	e Programming
Max Number	100
Auto-programming (Att	tention!)
Trigger by external input s	ignal
Nu-Link Pro ID Voltage Power control is used on Nu-L power is not detected. 1.8V 2.5V	ink-Pro, and is valid only if target ③ 3.3V ○ 5.0V
Default	OK Cancel

Figure 4-13 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 Tool has progress bar and program status. After programming is done, a dialog box will display the success or fail information.

	) Program 46%
Figure 4-14 Programming Status	

# ηυνοτοη

## 5 Code Protection (Online Programming Mode)

This chapter describes the code protection in online programming mode. (referring to Figure 5-1).



Figure 5-1 Code Protection in Online Programming Mode

## 5.1 Introduction to Nu-Link Certification

Each Nu-Link can create its own certificate, developer can protect his code by Nu-Link certificate mechanism.

## 5.2 How to use Nu-Link Certification

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

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

**Step 3:** Factory side imports the .icp file. Only the certificate-creating Nu-Link adapter can authenticate itself to ICPTool. Each time the ICPTool successfully decrypts code and programs to target chip, it updates the programming count till the limitation.

## The protections:

- If someone gets developer's \*.icp project file, he can't program target chips without the specific certificate-creating Nu-Link adapter.
- The content of exported \*.icp project file is encrypted.
- Factory is not allowed to do unlimited programming and production.





Figure 5-2 Steps of using Nu-Link Certificate

## 5.3 Detail steps

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

### Step 1: Connect Nu-Link.



Figure 5-3 Connect Nu-Link

# ηυνοτοη

### Step 2: Create certificate file.



Figure 5-4 Create Nu-Link Certificate File

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

Organize 🔻 New	w folde	r	⊑= <b>▼</b> (2)
<ul> <li>✓ ★ Favorites</li> <li>■ Desktop</li> <li>Downloads</li> <li>₩ Recent Places</li> </ul>	•	Libraries System Folder MU30 CHLin55 System Folder	
<ul> <li>Libraries</li> <li>Documents</li> <li>Music</li> </ul>		Computer System Folder	
<ul> <li>Pictures</li> <li>Videos</li> </ul>		Network System Folder	
⊿ rЩ Computer	-	Claire	-
File name:	Nu-Li	k.ict	•
Save as type:	Nu-Li	k certificate file (*.ict)	•

Figure 5-5 Save Nu-Link Certificate File

Step 4: Send Nu-Link certificate file to developer.

5.3.2 Bind Certificate File and Code to export Encrypted Project (Developer Side) Step 1: Export project.

Nuvoton NuMicro ICP Programming Tool 1.26 - M051 series	
Project Chips Iool Language	
Import Export	
Ctro about Nu-Link-Pro connected (ID: 7788c400)	



# nuvoton

## Step 2: Enable settings.





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

$\overline{m{v}}$ Bind to one Nu-Link and limit the maximum programming number							
Target Nu-Link's Certification file	Help	$\frown$					
C:\1.ict		Browser					
Max number							
5							

Figure 5-8 Select Nu-Link Certificate File

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

Bind to one Nu-Link and limit the maximum presence of the second seco	ogramming number	
Target Nu-Link's Certification file	Help	
C:\Users\CHLIN55\Desktop\Nu-Link.ict		Browser
Max number 5		

#### Figure 5-9 Set Max Programming Number



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

Save As		
🖉 🖉 🗖 Deskto	p →	٩
Organize 🔻 Nev	v folder	= <b>▼ (</b> )
Favorites	Libraries System Folder	A E
Recent Places	E MU30 CHLin55 System Folder	
ibraries	Computer System Folder	
E Pictures	Network System Folder	
🔍 Computer	- Claire	-
File <u>n</u> ame:	Test.icp	-
Save as <u>t</u> ype:	ICP project file (*.icp)	-
Alide Folders	<u>Save</u>	Cancel

Figure 5-10 Save ICP Tool Project File

Step 6: Send back \*.icp project file to Factory.

## 5.3.3 Import \*.icp Project File (Factory Side)

Nuvoton NuMicro ICP Programming Tool 1.26 - M051 series	
Project Chips Iool Language	
Import DO	
Export	

Figure 5-11 Import Project

### Step 2: Press start button to program.

Programming LDROM	🔽 APROM	📝 Data Flash	🔽 Config	Options	Start
		Figure 5-12 S	Start Button		

Figure 5-12 Start Button

Step 3: Programming information updates.

LDROM	APROM	Data Elach	LODOLL							
		Data Hash	LURUM	APROM	Data Flash	LDROM	APROM	Data Flash	Info	
Encrypted Have no	online pro t used by a	ject seed 2 (jo an ICP project	d=9b6b307 t.	Ъ)						^
Online end Limit the Statistics Programn Programn	rypted pro programmi ning totally ning failed	oject seed 3 (i ing number: 1 2 times 0 times	d=91cdbd8 23	ie)						E

Figure 5-13 Flash Programming Information



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

**Note:** Even user sets the maximum programming number several times, the maximum programming number is the one set at first time.

- For example:
  - Use ABC.ict to create an ICP project file and set the maximum programming number to 10.
  - After programming 5 times, use ABC.ict to create the second ICP project file and set the maximum programming number to 3.
  - The second ICP project file still 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.

## 6 Code Protection (Offline Programming Mode)

This chapter describes code protection in offline programming mode. (referring to Figure 6-1).



Figure 6-1 Binary Code Protection in Offline Programming Mode

For code protection, it is suggested to set the "**password for offline data**" in Figure 4-13, and enable "**Security lock**" in Figure 4-8.

To limit offline programming counts, please enable the "Limit the number of offline programming" option as shown in Figure 4-13.

**Note:** You can refer "3.2 Code Protection in ICP Offline Mode" in "AN0001\_NuMicro\_Cortex-M\_Code\_Protection" for detail steps.

## 7 Nu-Link Firmware Update

Follow the steps below to update firmware:

**Step 1:** Run the ICP Tool. Click 'Connect' and start to connect to a device. If the firmware version and driver version are not matched, a firmware update dialog will be displayed, as shown in Figure 7-1.

Nuvoton NuM	icro ICP Prog	ramming Tool 3.04 - M03	31 Series		– 🗆 X
roject Chips 1	Fool Langua	age Help			
Status					
Stop check	Disconnecter	<b>1</b>			
Part No.					
Load File		[ <u></u>			
APROM	File Name:	C:\APROM.hex			
. 0 ○1		File not load.		Base: 0x 00000000	Offset: 0x 0
Data Flash	File Name:	C:\Data.hex			
LDROM	File N	cro ICP Programming To	ol I version is not matcl	×	
SPROM	File N	Current applicatior while the Nu-Link f The application ma	n has higher version 7 firmware's version is 1 ay work abnormally.	146, 5990.	Last Byte: 0x FF
Config Bits Setting	Config Config	Before updating th Remove any other Do you want to up	e Nu-Link firmware, j devices connected o date the Nu-Link firm	please n the Nu-Link! Iware now?	> ~
File Data			Var	No	
AFROM DATA			10	100	SPRUM Into     8 bits     16 bits     32 bits
Programming					Refresh
APROM	🗌 Data F NK1	lash 🗌 LDROM	SPROM	🗹 Config 🛛 🖸	Iptions Start
					Build: 7146b

Figure 7-1 Firmware Update Selection Dialog Box

## Step 2: Click "Yes" to update firmware, as shown in Figure 7-2.

nuvoTon

IUVO	Tool Langua	age Help								
Status										
Stop check	Disconnected	£								
Part No.										
.oad File										
APROM	File Name:	C:VAPRO	vl.hex							
.00 ⊙1		File not loa	ıd.			Base:	0x 0000	0000	Offset: Ox	0
Data Flash	File Name:	C:\Data.h	ex							
		File not loa	ıd.							
LDROM	File Name:	C:\LDR0	M.hex							
onfig Bits Setting	Verify 16%								:	Ox FF
ïle Data		Or	1-board Flash			Offline Fla	ash			
	LDBOM SE		DOM DATA							
APROM DATA			NUM DATA	LDROM	SPROM	APROM	DATA	LDROM	SPROM	1 Info
APROM DATA			NUM DATA	LDROM	SPROM	APROM	DATA	LDROM	SPROM	1 Info bits 5 bits 2 bits
APROM DATA			NUM DATA	LDROM	SPROM	APROM	DATA	LDROM	SPRON	1 Info bits 3 bits 2 bits Refresh
Yogramming ✓ APROM □ APROM □ APROM BAI	Data F	lash	LDROM	LDROM	SPROM	APROM	DATA	LDROM Option	SPROM	I Info bits 6 bits 2 bits Refresh

Figure 7-2 Firmware Update Dialog Box

Once the update is completed, user needs to re-connect the Nu-link to PC, as shown in Figure 7-3.

UVO	Ton										
itatus											
Stop check	Disconnecte	d									
Part No.											
oad File											
APROM	File Name:	C:\AF	PROM.hex								
●0 ○1		File no	ot load.				Base: 0	к 0000000	0 Of	fset: Ox	0
Data Flash	File Name:	C:\Da	ata.hex								
		File no	ot load.								
LDROM	File Name:	C:\LE	ROM.hex								
		Eile no	nt load								
SPROM onfig Bits	date firmware Please remov again! Before plug in	File no e re any de n, please	evice on th econfirm th	ne Nu-Lini nat the Nu	k, and plug r-Link is in l	out the Nu	I-Link from P(	C and plug ir	n	×	: Ox FF
SPROM onfig Bits Setting	date firmware Please remov again! Before plug in	Eile no e n, please	evice on th	ne Nu-Lin nat the Nu	k, and plug I-Link is in l	out the Nu	u-Link from P(	C and plug ir	n	×	: Ox FF
SPROM onfig Bits Setting	date firmware Please remov again! Before plug in	Eile no e re any de n, please	evice on th e confirm th On-board	ne Nu-Lini nat the Nu d Flash	k, and plug I-Link is in l	out the Nu CP/ICE mo	I-Link from P ode. Offline Flas	C and plug ir	n	×	: Ox FF
SPROM Up onfig Bits Setting lie Data .PROM DATA	date firmware Please remov again! Before plug in	Eile nr e any de n, please PROM	evice on th econfirm th On-boar APROM	ne Nu-Lini nat the Nu d Flash DATA	k, and plug ⊩Link is in l	out the Nu CP/ICE mc	U-Link from Pool ode. Offline Flas APROM	C and plug ir h DATA LDF	n ROM	SPROI	: 0x FF
SPROM Up onfig Bits Setting le Data .PROM DATA	date firmware Please remov again! Before plug in LDROM S	Eile no e any da n, please PROM	evice on the confirm the On-board APROM	ne Nu-Lini nat the Nu d Flash DATA	k, and plug +Link is in l LDROM	out the Nu CP/ICE mc	Hink from Plade.	C and plug ir	n ROM	SPR0	: 0x FF M Info
SPROM Up onfig Bits Setting le Data PROM DATA	date firmware Please remov again! Before plug in LDROM S	PROM	evice on th e confirm th On-board APROM	ne Nu-Lini nat the Nu d Flash DATA	k, and plug HLink is in I	out the Nu CP/ICE mc	⊧Link from P( ode. Offline Flas APROM [	C and plug in	n ROM	SPROI	: 0x FF M Info 8 bits 6 bits
SPROM Up onfig Bits Setting ile Data .PROM DATA	date firmware Please remov again! Before plug in	Eile no e n, please PROM	evice on th confirm th On-boar APROM	ne Nu-Lini nat the Nu d Flash DATA	k, and plug «Link is in l	out the Nu CP/ICE mc	Link from P0 ode. Offline Flas	C and plug in	n ROM	SPR01	: 0x FF M Info 9 bits 6 bits 12 bits
SPROM onfig Bits Setting le Data .PROM DATA	date firmware Please remov again! Before plug in	PROM	evice on th e confirm th On-boar APROM	ne Nu-Lini uat the Nu d Flash DATA	k, and plug r-Link is in l	out the Nu CP/ICE mo	Link from P( ode. Offline Flas	C and plug in	n	SPR01	: 0x FF M Info 9 bits 6 bits 12 bits
SPROM Up onfig Bits Setting le Data PROM DATA	date firmware Please remov again! Before plug in	PROM	evice on the confirm the On-board APROM	ne Nu-Lini nat the Nu d Flash DATA	k, and plug Link is in l	out the Nu CP/ICE mo	-Link from P( ode. Offline Flas APROM [	C and plug ir	n ROM	× SPRDI	: 0x FF M Info I bits 6 bits 12 bits
SPROM onfig Bits Setting ile Data APROM DATA	date firmware Please remov again! Before plug in	re any de	evice on th confirm th On-boar APROM	ne Nu-Lini nat the Nu d Flash DATA	k, and plug +Link is in l	out the Nu CP/ICE mo	⊦Link from P( ode. Offline Flas	C and plug in	n	SPR01	: 0x FF M Info B bits 6 bits 12 bits Refresh
SPROM Up onfig Bits Setting ile Data PROM DATA	date firmware Please remov again! Before plug in	re any de pre any de pre any de PROM	evice on the confirm the On-board	ne Nu-Lini nat the Nu d Flash DATA	k, and plug	OUL THE NU	Link from PO	C and plug in h DATA LDF	n ROM	SPR01	: 0x FF M Info P bits 6 bits 12 bits Refresh

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

Status											
Stop check	Disconnected	ł									
Part No.											
Load File											
APROM	File Name:	C:VAPF	IOM.hex								
.0 ⊙1		File not	load.				Bas	e: 0x 0000	00000	Offset: Ox 0	
Data Flash	File Name:	C:\Data	a.hex								
		File not	load.								
LDROM	File Name:	C:\LDF	OM.hex								
		File not	load.								
SPROM Upo	late firmware									× —	
	Undata 100%		NuMi	icro ICP	Programr	ning Tool	×			: Ox F	F
Config Pite											
Cotting			Upo	late firm	ware, OK!						~
Jetting											
						ОК					
File Data			0					Flash			
APROM DATA	LDROM SP	ROM	APROM	DATA	LDROM	SPROM	APROM	1 DATA	LDROM	SPROM Inf	0
										8 bits	
										<ul> <li>16 bits</li> <li>22 bits</li> </ul>	
										Refres	h
Programming											

Figure 7-4 Update Firmware Completely

If you are using Nu-Link2 adapter, you can also use drag and drop method to upgrade firmware. Press the button on Nu-Link2 adapter and plug in USB cable, you will see a disk name "Nu-Link2". Drag and drop bin file into it will upgrade Nu-Link2 firmware. (Note: if you see disk name "NuMicro MCU" it will upgrade the target device firmware instead of Nu-Link2 itself.)

For more information about the role of Nu-Link2 adapter, Please refer to the following link:

https://github.com/OpenNuvoton/Nuvoton\_Tools

https://gitee.com/OpenNuvoton/Nuvoton\_Tools

- 8 Features of Specific Series
- 8.1 Support for NUC505 Series
- 8.1.1 Main Window for NUC505 Series

Nuvoton NuM oject <u>C</u> hips	cro ICP Programming Tool 1. <u>T</u> ool <u>L</u> anguage	26 - NUC505 series		
UVO	TON			
Status				
Disconnect	Chip Connected with Nu-Link	ID: 7788f85b)		
Part No.	NUC505 RAM:128	K, SPI Flash:2M, MTP Program Count: 4	/15	A : Chip Information
Load File				
Code	File Name: C:\Code.bin			
	size: 66.0K Byte	s, checksum: 4905	-	B: Load Download File for Code Area
L	Read Size:	67620 Bytes	j	
Data	File Name: C:\Data.bin			
	size: 12.4K Byte	s, checksum: 3e72		
	Base Address:	0x 100000	-	C: Load Download File for Data Area
	Read Size:	12720 Bytes		
L				
	51.0 L L L			D - Annian file weath to accurate a second
Encrypt Code	File Name: U:\Uutput.bin			data of Code Area and Data Area
File Data	On-board Flash	Offline Flash		
Code Area Da	a Area Code Area Data Area	Code Area Data Area Info		
00000000:	00 40 00 20 CD 01 00 00	FF 01 00 00 01 02 00 00	<ul> <li>Ø 8 bits</li> </ul>	
00000020:	FF FF FF FF FF FF FF	FF FF FF FF 13 02 00 00	16 bits	
00000040:	19 02 00 00 19 02 00 00		32 bits	
00000060:	29 DB 00 00 19 02 00 00	19 02 00 00 19 02 00 00		
00000080:	$\begin{array}{cccccccccccccccccccccccccccccccccccc$	19 02 00 00 19 02 00 00		
00000090:	19 02 00 00 19 02 00 00 19 02 00 00 7D E5 00 00	19 02 00 00 19 02 00 00		
00000080:	19 02 00 00 1F 03 00 00 48 FC 10 D4 47 18 00 00	19 02 00 00 19 02 00 00 00 F0 02 F8 00 F0 43 F8	+ Hetresh	E : Select Target block for program
Programming				(Code Area, Data Area and MTP)
🔽 Code	🔽 Data 🛛 🥅 MTP	Program Options MTP C	Iptions Start	
		·1		F : Option for MTP setting
			Build: 6320a	

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.

Status Disconnec Part No.	t Chip Conne NUC505	cted with Nu-Li	nk (ID: 7788/85b)  28K, SPI Flash:2M <mark>, MTP: Lock</mark> r
P	rogramming Code	📝 Data	MTP

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. User can use ciphertext/plaintext binary to do ICP online/offline programming, based on whether target chip MTP key has been pre-programmed or not. In General, has to use ciphertext when MTP has been pre-programmed. For more detail, please refer to "AN 0010 ICP\_Programming\_Guide".

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.

8.1.2	MTP	Options
-------	-----	---------

MTP Settings		
Write MTP	Record MTP Settings	→ C : Option for the record of MTP related setting
MTP Signature (Hex)		A : MTP Write Settings
Signature 20000400		
Offset 000		
MTP Option (Hex) 00		
Lock MTP (Be careful! MTP cannot be progr	ammed after lock)	B : Option for MTP Lock operatio

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".

32-bit Signature is used to authenticate programmed binary, if the Signature on SPI Flash is not matched with user's input, system will boot up fail.

It is suggested to locate Signature after the end of interrupt vector table. (e.g. 0x100).

MTP Option (Hex) byte is another method to do authentication and is optional, user can ignore this if there is no special need.

- "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.

### 8.2 Support for M480 Series

#### 8.2.1 Main Window for M480 Series

Nuvoton NuMicro ICP Program	nming Tool 2.04 - M480 Series		- X		
roject Chips Tool Langua	ge				
10001011					
Discoursest Chip Connects	d with Nucl.ink-Pro (ID: 18000000)				
Disconnect	LIDROM-4K APROM-512K Date 0K SPROM	W DAM-160K	KE: (0/21)	-	A: Chip Information
Part No. M487JIDAE	UID/UCID:, SPI_ID: 0x001240EF	NR, HMM, FOUR	KP: (0/7)		
Load File					
LDROM File Name: C	VLDROM.hex	File not load.			
APROM File Name: C	VAPROM.hex	File not load.	Offset: 0x 0		B: Load file and multi-binary
Multi-binary			Multi-binary mode		mode for APROM.
Data Flash File Name: C	\Data.hex	File not load.			
	1000011		Last Date: Or		
SPROM File Name: U	:\SPRUM.nex	File not load.	Last Byte: UK FF		
SPI Flash File Name: C	\SPIFlash.hex	File not load.	Base Address: 0x 0000000	-	C: Load file and read range
	10 K I.		Read Size: 262144 Bytes		setting for SPI flash
Secure Key File Name: U	NSecureKey.bin				
Config Bits			SPI Flash		
Setting Config 0: 0x	FFFFFFFF Config 1: 0xFFFFFFFF Upda	e History >	<ul> <li>SPI Key0: 0x 00000000</li> </ul>	-	D: Key for encrypted SPI flash
Config 2: 0x	FFFF5A5A Config 3: 0xFFFFFDD		SPI Key1: 0x 00000000		
File Data	On-board Flash	Offline Flash			
LDROM APROM Data Flash	SPROM SPI Flash LDROM APROM Data	lash SPROM SPI Flash LDROM A	PROM Data Flash SPROM Info		
			<ul> <li>8 bits</li> </ul>		
			16 bits		
			© 32 bits		
			Refresh		
Programming					
LDROM APROM	Data Flash Config	Start			
SPROM SPI Flack	KPROM Secure Key KPRO	4 Onlines			
			Build: 6725r		
				-	E: Select target block for programmi

Figure 8-4 Main Window for M480 Series

- Section A: Show the part no., LDROM, APROM, data Flash, SPROM, RAM size and SPI Flash ID of target chip information.
- **Section B:** Load programming APROM file path or Load multiple binary file path using multibinary mode.
- Section C: Load programming SPI Flash file path and setting start address and read size for programming or reading SPI Flash. Due to reading all contents of SPI Flash is timeconsuming, partial-read from the assigned base address and read size are provided. 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 specific range of SPI Flash by clicking "Refresh" button.
- Section D: User can assign SPI key0 and key1 to program encrypted file data to SPI Flash. If SPI key0 value is 0 or SPI key1 value is 0, ICP tool will not encrypt file data.

**Section E:** Select a target chip block for programming.

After clicking the "Connect" button, the ICP Tool would read chip information (including Part No., internal Flash size, RAM size, SPI Flash ID and KPROM status) and show the information. If SPI Flash is not detected, the value is 0xFFFFFFFF and the "SPI Flash" option is also unchecked in Figure 8-5.

Status				
Disconnect	Chip Connected with Nu-	Link-Pro (ID: 18000000)		
Part No.	M487JIDAE LDR( UID/	0M:4K, APROM:512K, Data:( UCID:, SPI_ID: 0x00FFFFF	OK, SPROM:4K, RAM:160 F	К
Programming				
🔳 LDROM	📝 APROM 📃 Data	a Flash 🛛 📝 Config	Options	Start
SPROM	SPI Flash	OM Secure Key	KPROM Options	

Figure 8-5 SPI Flash Status

Click config bits **"Setting"** button in Figure 8-4 and show the Chip Options form. In Chip Options form, user can select the SPIM multi–function pin option base on SPIM function pin status of target chip in Figure 8-6. After programming config of SPIM setting, ICP tool will detect the valid SPI ID value and enable **"SPI Flash"** option.

sh SPR	<ul> <li>Boot Loader SPIM CLK/SS/MISO/I</li> <li>PA.2/PA.3/PA.1/PA.0</li> <li>PG.12/PG.11/PG.13/PG.14</li> </ul>	MOSI Multi-function Pin Select PC.2/PC.3/PC.1/PC.0 PE.4/PE.5/PE.3/PE.2	ROM Data
	<ul> <li>Boot Loader UART1 TXD/RXD Mu</li> <li>PB.3/PB.2</li> <li>PA.3/PA.2</li> </ul>	lti-function Pin Select O PA.9/PA.8 PB.7/PB.6	

Figure 8-6 SPIM Multi-function Pin Setting

### 8.2.2 SPI Flash Programming

The ICP tool SPI Flash programming can be ciphertext or plaintext by assigned SPI key. If SPI key0 or key1 value is 0, ICP tool will program data without encrypting binary file to SPI Flash. Due to the SPI Flash data is plaintext, user can verify SPI Flash data by checking the verify SPI option in Program Option form in Figure 8-7.

Program Option	
Operation	Last Byte: 0x FF
🔽 Erase 🔲 Erase Whole Chip	Base Address: 0x 0000000
Program	Read Size: 262144 Bytes
Verify Verify SPI Unlock KPROM Key	
Write Software Serial Number KeyU: 8x	SPI Flash
Reset Chip after Programming Key1 : 0x	SPI Key0: 0x 00000000
Offline Programming Mode     Key2 : 0x	SPI Key1: 0x 00000000

Figure 8-7 Plain Data Setting for SPI Flash Programming

If SPI key0 and key1 value is not 0, ICP tool will use SPI key0 and key1 to encrypt binary file and program to SPI Flash. Due to the SPI Flash data is ciphertext, the "Verify SPI" option disable in Program Option form in Figure 8-8.

Program Option				×					
Operation						Last By	yte: Ox	FF	
🔽 Erase	Erase Whole Cl	hip			Bas	e Addres:	s: Ox	0000000	
Program	Disable Cipher				Rea	ad Size:		262144 Bytes	
Verify	Verify SPI	Unlock KP	ROM Key	_					
Write Software S	Serial Number	Кеу0:0х				SPI Flas	h		
📝 Reset Chip after	Programming	Key1 : Ox	•••••			SPI Key	0: 0x	12345678	
🔲 Offline Programm	ning Mode	Key2:0x	•••••			SPI Key	1: Ox	98765432	
					μĮ				

Figure 8-8 Encrypted Data Setting for SPI Flash Programming

User can also keep the SPI key value and program data to SPI Flash without encrypting binary file by checking the "**Disable Cipher**" option in Figure 8-8.

After programming ciphertext data to SPI Flash, User can save the encrypted SPI Flash data to file in Figure 8-9. Follow the steps below:

Step 1: Select "SPI Flash" On-board Flash tab.

Step 2: Click "Refresh" button and ICP tool read back the Flash data.

Step 3: Click "Save As" button and save ciphertext to binary file.

SPI Flash	File Name:	C:\SemiHost	128.Din				SIZE: 128.UN	Bytes, check	sum: 0210		se Address. c		
Secure Ken	File Name:	C:\SecureKe	u hin							Re	ad Size:	131072	Bytes
Jecule Key	The Maine.		<i></i>										
Config Bits										[	SPI Flash		
Setting	Config 0:	0xFFFFFFFF	Config 1:	0xFFFFFFF	F	< Update H	istory >			•	SPI Key0: I	Dx 123456	578
	Config 2:	0xFFFF5A5A	Config 3:	0xFFFFFFD	D						SPI Key1: I	Dx 987654	32
File Data				On-board Fla	ash				Offline Flash	, L			
LDROM APRO	DM Data Fla	sh SPROM	SPI Flash	LDROM AF	PROM	Data Flas	h SPROM	SPI Flash	LDROM A	PROM	Data Flash	SPROM	Info
00000000: 00000010: 00000020: 00000030:	62 40 7C 5A CE 0A 7A ED 12 20 76 3A	41 D3 A2 B9 76 DA 61 88 52 B8 9B 8/ 98 06 5F 90	C2 F9 F4 4A ( 5F 12 ( E0 DF (	3F 13 EC 0 2 EO 00 3 0C EA D5 B 57 B3 5F B	03 EB 0C 2E 07 02 0F 13	09 0B 6A E3 7B FA 71 C9					Î	<ul> <li>8 bits</li> <li>16 bits</li> </ul>	
00000040: 00000050: 00000060: 00000070:	77 28 48 7D 4F 73 C1 D9 EF FB 1E 95	7A 7B FO 19 DE 23 05 39 25 33 4B E9 3 A3 EC 00	D9 9F 9A 83 7A 73 C3 1F	31 C7 AE C 6 65 6A F 50 79 D0 3 59 99 49 5	D D7 5 D8 3 36 3 45	F3 61 89 C6 28 51 F1 88						③ 32 bits	
000000000: 000000000: 000000000:	90 19 77 FB F5 B5 80 89 85 A3 11 B7 68 4F 2F	25 83 85 At 3A 05 F4 B9 50 5B A0 9F 25 91 54 EE 12 CC FF F3	BA 9F 0 86 C7 2A 23 46 FC	-8 3D 26 6 -0 4D DC 0 3D 67 DB 6 	0F 68 0B 5D 55 2A 0F 46 58 02	1D 30 19 E8 E3 41 R4 87						Save Refre	As sh
Programming													
C LDROM	APRO	M 📃 Data	a Flash	Config		Options		Start					
	I SPI FI	eh 🕅 KPB	ом	Secure Ke	eu	КРВОМ О	ntions						

Figure 8-9 Read Ciphertext and Save to Binary File

## 8.2.3 KPROM Setting

ICP tool provide KPROM programming for writing protection of KPROM and APROM region. Select "**KPROM**" option in programming options and click "**KPROM options**" to set KPROM key setting in Figure 8-10.

P	rogramming						
	🔳 LDROM	📝 APROM	📃 Data Flash	🔽 Config	Options	Start	
	SPROM	📰 SPI Flash	🔽 KPROM	Secure Key	KPROM Options		

Figure 8-10 KPROM Option

On the KPROM Key Setting form, user can select the desired operation and fill in KPROM keys and error key retry counts. KPROM keys are three 32-bit with hex-code input format. User can set the key0 ~ key2, error key retry counts and the optional write-protected region of Config or SPROM in Figure 8-11.

KPROM key setting will be recorded after clicking "OK" button. But the ICP tool is reopened, the previous KPROM key setting will not be recorded. User need to set the KPROM key setting again.

File Nam	KPROM Key Setting	Base A
	Kay Option	Read !
File Nam		
	Key0:0x ••••••	S
Config 0:	Key1:0x ••••••	🖵 S
Config 2:	Key2:0x ••••••	S
	Show characters	lash
M Data I	Power-On Maximum Number of Error Key Entry (1~7): 2	APROM Da
	Maximum Number of Error Key Entry for Each Power-on (0~31) : 3	
	Data write protection : 🖉 KPROM, LDROM, APROM 🔲 Config 🔲 SPROM	
	Export OK Cancel	
l		

Figure 8-11 KPROM Key Setting Form

## 8.2.4 Secure Boot Key and Information Block Programming

ICP tool provide secure boot key and information programming. Secure boot key programming need to load secure boot key file, so user can generate secure boot key file by using "**Tool**" -> "Create Secure Key File" menu item in Figure 8-12.

Project       Chips       Tool       Language         COUVO       Erase Offline Data       Image: Create Nu-Link Certification File         Status       Create Nu-Link Certification File         Disconnect       Create Secure Boot Key File	
Status     Create Nu-Link Certification File       Disconnect     Create Secure Boot Key File	
Status Create Nu-Link Certification File Create Secure Boot Key File	
Disconnect Create Secure Boot Key File	
Part No. Create OTP Memory File ta:0K, SPR0M:4K, RAM:16 Erase Whole Target Chip 40EF	DK

Figure 8-12 Create Secure Boot Key File Menu

On the Create Secure Key File form, user can select the desired operation in Figure 8-13. The options and fields are described below:

- "Generate": Random generate a secure boot key. User can also edit the key in key field.
- **"Export":** Save current secure boot key in key field to file.
- "Import": Select a secure boot key file and load key in the field.

File Name	Create Secure Boot Key File	Address: 0x 000
File Name	Provide or generate 256-bit key	202
	FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF	PI Flash
Config 0:	Import Export Generate	PI Key0: 0x 12
Config 2:		PI Key1: 0x 98

Figure 8-13 Secure Boot Key Form

To program secure boot key and information block, follow the steps below:

- Step1: Click "Secure Key" button to load secure boot key file.
- **Step2:** Select the target block in programming options and load the corresponding binary file of target block (LDROM, APROM or SPI Flash).
- Step3: Click "Setting" button to enable "boot Loader" option in Figure 8-14
- Step4: Select "KPROM" button and click "KPROM Options" to set KPROM key setting.
- **Step5:** Select "**Secure Key**" option in programming options and click "**Start**" button to program in Figure 8-15.

**Note:** Once the **"Boot Loader"** option is enabled, Config, KPROM and Secure Key options must be enabled in programming options.

## **Nuvoton ICP Tool User Manual**

# nuvoTon

Brown-out Volt	age Options		
OV	© 2.8V	© 2.6V	© 2.4V
© 2.2V	© 2.0V	🔘 1.8V	© 1.6V
🔲 Brown-oul	t Detector	🔲 Brown-ou	t Reset
Boot Options			
🔘 LDROM	APR	юм	
💿 LDROM v	vith IAP 🛛 🔘 APR	IOM with IAP	Boot Loader

Figure 8-14 Boot Loader Option

Secure Key	File Name:	C:\SecureB	lootKey.bin							
Setting	Config 0:	0xFFFFFFDF	Config 1:	0xFFFF	FFFF	< Update Histo	ory >			•
	Config 2:	0xFFFF005A	, Config 3:	0xFFFFf	FFDD					
File Data				On-board	d Flash				Offline F	lash
LDROM APRO	DM Data Fla	ish SPROM	SPI Flash	LDROM	APROM	Data Flash	SPROM	SPI Flash	LDROM	APROM
				1					1.	
Programming										
Programming LDROM	▼ APRO	M 🔲 Da	ta Flash	Config	1	Options		Start		

Figure 8-15 Program Secure Boot Key and Information Block

#### 8.2.5 Multi-binary Mode

User can load multiple binary files to program APROM region separately. In multi-binary mode, user needs to enable the "**Multi-binary mode**" option as shown in Figure

8-	16. <sup>°</sup>			,	1	0
F	APROM	File Name:	C:\APROM.hex	File not load.	Base A	\ddress: 0x 0
	Multi-binary				📝 Mu	lti-binary mode

Figure 8-16 Multi-binary Mode

The "Load Multiple Binary File" form will be displayed after clicking the "Multi-binary" button as shown in Figure 8-17.

In "Load Multiple Binary File" form, user can load multiple files and set the start address and protection property.

• Use "Add" button to load a file and insert an item to the list.

- Use "**Remove**" button to delete an item from the list.
- Use "Modify" button to set offset value and protection column item to the list.
- Set the "Offset" value to define the start address of file programming.

File Name:	Load Multiple Binary File		
File Name:	Start Address File Size (Bytes) File Path		
File Name:	▼ 0x0         0x1000         C:\All5_4KB.bin           ▼ 0x2000         0x2000         C:\All4_8KB.bin		
File Name:	▼ 0x6000 0x800 C:\AllC_2KB.bin		
File Name:			
Config 0:			
Config 2:			
1 Data Fla:	Offset: 0x 6000 Modify Add Remove OK Cancel		

Figure 8-17 Load Multiple Binary Files

## 9 Revision History

Date	Revision	Description
2010.01.28	1.01.001	First version.
2010.02.24	1.01.002	Added offline programming mode.
2010.06.04	1.01.003	Changed key & LED definition.
2010.06.22	1.02.001	Added chip select and offline security.
2010.07.22	1.03.001	Supported M502x series.
2011.08.03	1.17.001	Supported Mini51/Nano100 series. Added more features in offline programming mode.
2012.08.10	1.19.001	Supported NUC200.
2013.07.01	1.20.001	Supported NUC200 and NUC123 series. Added firmware update and Nuvoton announcement.
2014.02.10	1.21.001	Changed document format.
2014.08.08	1.21.002	Added security chapter and reorganized document.
2014.09.05	1.22.001	Changed document and figure format.
2018.05.24	2.04.001	Added M480 series
2018.12.21	2.06.001	Changed document and figure format.
2020.11.27	3.05.001	Changed document and figure format.



Please note that all data and specifications are subject to change without notice

All the trademarks of products and companies mentioned in this datasheet belong to their respective owners

Notice: Using this software indicates your acceptance of the disclaimer hereunder: THIS SOFTWARE IS FOR YOUR REFERENCE ONLY AND PROVIDED "AS IS" AND ANY EXPRESS OR IMPLIED WARRANTIES, INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE ARE DISCLAIMED. YOUR USING THIS SOFTWARE/FIRMWARE IS BASED ON YOUR OWN DISCRETION, IN NO EVENT SHALL THE COPYRIGHT OWNER OR PROVIDER BE LIABLE TO ANY DIRECT, INDIRECT, INCIDENTAL, SPECIAL, EXEMPLARY, OR CONSEQUENTIAL DAMAGES (INCLUDING, BUT NOT LIMITED TO, PROCUREMENT OF SUBSTITUTE GOODS OR SERVICES; LOSS OF USE, DATA, OR PROFITS; OR BUSINESS INTERRUPTION) HOWEVER CAUSED AND ON ANY THEORY OF LIABILITY, WHETHER IN CONTRACT, STRICT LIABILITY, OR TORT (INCLUDING NEGLIGENCE OR OTHERWISE) ARISING IN ANY WAY OUT OF THE USE OF THIS SOFTWARE, EVEN IF ADVISED OF THE POSSIBILITY OF SUCH DAMAGE.



nuvoTon