NUC505 ICP Programming Tool User Guide

Application Note for 32-bit NuMicro[®] Family

Document Information

Abstract	This document introduces how to use the ICP programming tool to access SPI Flash/MTP memory during development or mass production phase.
Apply to	NuMicro [®] NUC505 Series

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1 Overview

"ICP" is the acronym of In-Circuit Programming, which makes it possible that the user can update the specified MCU's memory under the software control without removing the mounted MCU chip from target PCB. For the NUC505 series, the programmable memory includes SPI Flash and MTP memory. The Nuvoton ICP Programming Tool supports "online" and "offline" programming mode.

The NUC505 provides a mechanism to protect firmware code in internal / external SPI Flash. It uses the information in MTP (Multiple-Time Programmable) memory to encrypt / decrypt code (or data) in SPI Flash and only allows authorized code to run on NUC505 to avoid pirate. The document describe how to use ICP tool to program code, program MTP to enable the protect mechanism (cipher function), and get the encrypted file for mass production.

1.1 Features

- In-Circuit programming target chip
- Online/offline programming mode
 - Online programming mode: The target device must be connected to PC and ICP Programming Tool.
 - Offline programming mode: After saving the file data into Nu-Link dongle, user can program the target devices with this dongle alone (instead of using PC and ICP Programming Tool).
- Backup SPI 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 Protect Mechanism

2.1 **Protection for Memory Outside Chip (PMOC)**

Because code and data are stored in SPI Flash, anyone can get data from SPI Flash through SPI interface easily. The NUC505 provides a mechanism to protect the firmware code in internal / external SPI Flash. It uses the information in MTP to encrypt code (or data) when writing data to SPI Flash and decrypt code (or data) in SPI Flash. Others can't get correct data from SPI Flash without correct MTP key.

When MTP is programmed, Code Validation is active automatically. The code on Flash (or the file wants to write to SPI Flash) must pass the Code Validation flow.

The NUC505 will search the offset address 0~16KB of SPI Flash (or the file wants to write to SPI Flash) to check if there is a correct Signature at the offset address (compare with the data in NUC505 MTP, see Figure 2-1). If there is no Signature, boot or programming operation fails.



The protect mechanism is called Protection for Memory Outside Chip.

Figure 2-1 Code Validation Flow

2.2 Cipher function

The NUC505 provides Cipher function to encrypt data when writing data SPI Flash and decrypt data on SPI Flash when CPU executes code on SPI Flash or reads data from SPI Flash.

Figure 2-2 shows the path that NUC505 writes or reads data to/from SPI Flash. CPU can access SPI Flash without Cipher function, but the data is encrypted and useless without decrypted by correct Cipher Key. With Cipher function, CPU cannot execute / access correct code and data in SPI Flash if there is no correct Cipher Key.



Figure 2-2 SPI Flash Data Access Path under PMOC

The following describes the difference between Plaintext (original data) and Ciphertext (the result of encryption performed on plaintext using a Cipher function). Take USBD_HID_MOUSE sample code for example.

File Data - Source data:

The file content is selected in the "Load file" section. Figure 2-3 shows source data.

File Data	On-board Flash	Offline Flash
Code Area Data	Area Code Area Data Area	Code Area Data Area Info
00000000: 20 00000010: 00 00000020: 00 00000030: 00	0014830 00000145 00000 0000151 00000153 00000 0000000 0000000 00000 0000159 0000000 00000	014D 000000D1 0155 00000000 0000 00000157 015B 0000015D 0000 16 bits
00000040: 00 00000050: 00 00000060: 00 00000070: 00	000015F 0000015F 00000 000015F 0000015F 00000 000015F 00001093 00000 000015F 0000015F 00000	015F 0000015F 015F 0000015F 015F 0000015F 015F 0000015F 015F 0000015F
00000090: 00 00000040: 00 00000080: 00 00000080: 00	000015F 0000015F 00000 000015F 0000015F 00000 000015F 0000015F 00000 000015F 0000015F 00000	ALSF 000001SF 01SF 000001SF 01SF 000001SF 01SF D00CF8DF 441 20014830

Figure 2-3 File Data Display Field

On-board Flash - Plaintext:

The data programmed on built-in Flash of the target chip is the same as the source data when MTP had never been programmed.

File Data		On-board Fl	ash	Offline Flas	sh		
Code Area	Data Area	Code Area	Data Area	Code Area	Data Area Info		
00000000 0000020 0000030 0000050 0000050 0000050 00000050 000000	20014B3 0000015 0000005 0000015 0000015 0000015 0000015 0000015 0000015 0000015	0 000001 0 000000 9 000000 F 000001 F 000010 F 000010 F 000001 F 000001 F 000001 F 000001 F 000001 F 000001	45 00000 53 00000 00 00000 5F 00000 93 00000 5F 00000 5F 00000 5F 00000 5F 00000 5F 00000	14D 00000 15S 00000 15B 00000 15F 00000 15F 00000 15F 00000 15F 00000 15F 00000 15F 00000	0001 0000 0157 015F 015F 015F 015F 015F 015F 015F		 8 bits 16 bits 32 bits File matched Save As
000000B0:	0000015 FASOFOO	F 000001	SF 00000	15F DOOCF	SDF B30	-	Refresh

Figure 2-4 On-board Flash Data Display Field and Comparison Result

On-board Flash - Ciphertext:

When MTP had been programmed, the data programmed on built-in Flash of the target chip - Ciphertext would be different from the source data. CPU cannot access correct code and data in SPI Flash if there is no correct Cipher Key.

File Data	On-board Flash Of	ffline Flash	
Code Area Data Area C	Code Area Data Area Co	de Area Data Area Info	
00000000: D2421161 00000010: 34071370	L 56AD6C8E B6A27FAC 5DEB2CB9 8439D693	0044292E BA714CF2	🕥 8 bits
00000020: 16A0B99F	F A44AB6BA 0F57780A	6007A723	🔍 🔘 16 bits
00000040: 4589D02F	5 51B1CEC7 17BB6001	7B099BC3	32 bits
00000050: 1777A579 00000060: 58F99F77	5 225935EB 6FDADCB6 7 37DB89AC DF194341	91AF40C6	
00000070: 03AE7CCE	E 8AF03D52 1927D2F0	6947FE4F	
00000090: 05578D2	3 3ACEE06A 6D027559	52993FD4	Save As
000000A0: 7957BB04 000000B0: EAA59CF0	4 90F89A86 622CCD47 5 201AFA91 D5B2CFE3	91969208 9706302C	- Refresh
1000000C0+ B3DCE240	OCC8421D 1RE4DCEE	93444000	

Figure 2-5 On-board Flash Data Display Field

2.3 Enable Cipher

The length of NUC505 Cipher Key is 64-bit and stored in MTP memory. MTP cannot be read back and modified. If the Cipher key exists (writes Key to MTP), The NUC505 Cipher is active and all data through Cipher will be encrypted / decrypted during run-time operations.

3 Preparing for ICP Programming Tool

3.1 System Requirements

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

- PC/AT compatible machine with Pentium or higher CPU
- XVGA(1024*768) color monitor
- At least 512M RAM for best performance
- At least 20M free disk space
- Windows 2000/XP/Vista/7/8

3.2 Hardware Installation

Steps of Hardware Installation:

- 1) Plug a USB cable into the USB port for Nu-Link of Tinny board.
- 2) Configure NUC505 to ICP mode (Set SW1 S3 to 0).



Figure 3-1 NUC505 Mode Switch

3) Connect the ICP Programming Tool board with the ICE interface of Tinny board.

3.3 Software Installation

Please run the installer package to install the software. The NUC505 is supported after Version 1.27. After installing the software, you can find the "Nuvoton Tools" on the "Start Menu" and the shortcut of ICP Programming Tool.

3.4 ICP Interface

Figure 3-2 shows the selection form at startup of the ICP Programming Tool.

Nuvoton NuMicro ICP Prog	ramming Tool 1.27	
ΠυνοΤο	Select Language:	
	English	•
	Select Target Chip:	
	NUC505 series	•
	Quit	Continue >>
		Support Forum http://www.nuvoton-m0.com

Figure 3-2 Chip Series and Language Selection

4 Starting to Use ICP Programming Tool

This chapter introduces the general operations in ICP Programming Tool. Please refer to Figure 4-1 for information on each section in the ICP Programming Tool Interface.

A: Connect or disconnect target chip	
Nuvoton NuMicro ICP Programming Tool 1.28 - NUC505 series	
<u>P</u> roject <u>Chips</u> <u>T</u> ool <u>L</u> anguage	
ΠυνοΤοη	
Status Status Flash Selection Disconnect Chip Connected with Nu-Link-Pro (ID: 77880837) Device state Part No. NUC505 RAM:128K, SPI Flash:2M, MTP Program Count: 1/15	B: Flash Selection
Load File	C: Chip information
Code File Name: C:\VSS\NUC505\FTP\BSP\SampleCode\StdDriver\USBD_HID_MOUSE\KEIL size: 7220 Bytes, checksum: 1c7b Bead Size: 7220	D: Load Download File for Code Area
Data File Name: C:\Data.bin size: 300.7K Bytes, checksum: fef1 Base Address: 0x 100000 Read Size: 307936 Bytes	E: Load Download File for Data Area
MTP Output File Encrypt Code File Name:	F: Save the encrypted data of Code and Data Area
Code Area Data Area Code Area Data Area Code Area Data Area Info Code Area Data Area Code Area Data Area Code Area Data Area Info Code Area Data Area Code Area Data Area Code Area Data Area Info Code October 00000000 00000155 00000000 00000000 00000000 00000000 00000000 00000000 00000000 00000000 00000000 00000000 00000000 00000000 000000000 000000000 00000000 00000000 00000000 00000000 000000000 000000000 000000000 000000000 0000000000 000000000000000000 000000000 000000000000000000000000000000000000	G: Data Dump
Programming Code Data MTP Program Options' MTP Options' Start	K: Start Programming
H: Target Program Block I: Action Select J: MTP Configuration Build: 637	3r, ← Application Version

Figure 4-1 ICP Programming Tool User Interface for NUC505

4.1 Connect Status & Chip Information

Before connected

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

Part No. O External	Status Connect Part No.	Disconnected	Flash Selection Internal External
---------------------	-------------------------------	--------------	-----------------------------------------

Figure 4-2 Connect Status - Disconnected

After the USB dongle is connected successfully

The ICP Programming Tool shows "ICE Connected".

Status Stop check	Nu-Link-Pro connected (ID: 7788083f)	Flash Selection
Part No.		External

Figure 4-3 Connect Status - Nu-Link-Pro Connected

After the target chip is connected successfully

The ICP Programming Tool would read chip information (including Part No., RAM size, SPI Flash size and MTP status) and show the information on section C in Figure 4-1.



Figure 4-4 Chip Information

If MTP had been programmed, the ICP Programming Tool would show the MTP programming times and the code written into SPI Flash would be encrypted. The Cipher function can be disabled in Program Options.

Status	Chin Connected (with Nucl ink-Pro (ID: 77880838	Flash Selection
Part No.	NUC505 RAM:128K, SPI Flash:2M, MTP Program Count: 1/15		 Internal External

Figure 4-5 Chip Information - MTP Burned

If MTP is locked, MTP status shows "MTP: Locked" in red. MTP can be programmed 15 times, but MTP cannot be programmed after MTP locked.

Status			
Disconnect	Chip Connected	with Nu-Link-Pro (ID: 7788d629)	
Part No.	NUC505	RAM:128K, SPI Flash:2M, MTP: Locked	

Figure 4-6 Chip Information - MTP Locked

The "MTP" option is also disabled in the **programming** section.

Programming				
🔽 Code	🔽 Data	MTP	Program Options MTP Options Start	

Figure 4-7 MTP Option Disabled when MTP Locked

4.2 File Information

Load File:

Select a file for programming. Then the file size and checksum information will be displayed. Before starting to program a target board, user can select blocks for programming – Code / Data. The supported file format includes **bin** or **Intel hex** (Intel 8, 16, 32).

Load File		
Code	File Name:	C:\Device_HID_Mouse.bin
		size: 16.0K Bytes, checksum: 1c7b
		Read Size: 16384 Bytes
Data	File Name:	C:\Data.bin
		size: 300.7K Bytes, checksum: fef1
		Base Address: 0x 100000
		Read Size: 307936 Bytes
MTP Output File		
Encrypt Code	File Name:	

Figure 4-8 Load File Setting

Base Address & Read Size:

The field is for Data Dump function and is only enabled when Target Block "Data" is selected in the **programming** section. 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 D and E in Figure 4-1). The "Base Address" and "Read Size" show different input format respectively.

MTP Output File:

If MTP had been programmed or MTP selected for this program, user could assign the file path (referring to F in Figure 4-1). When the programming process is complete, 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.

4.3 Data Dump

Once refresh, the data information section will show three parts of Flash data information respectively, including "File Data", "On-board Flash", and "Offline Flash". Take USBD_HID_MOUSE sample code for example.

File Data:

The file content is selected in the "Load file" section.

File Data	On-board Fl	ash O	ffline Flash		
Code Area Da	ata Area Code Area	Data Area 🛛 Co	ode Area Data Area Info)	
00000000: 00000010: 00000020: 00000030: 00000040: 00000050: 00000060:	20014B30 000001 00000151 00000 0000000 000000 00000159 000000 0000015F 000001 0000015F 000001	45 00000140 53 00000155 00 00000000 00 00000158 5F 00000158 5F 00000158 93 00000158	0 000000D1 0 0000000 0 00000157 3 0000015P 0 0000015F 0 0000015F		 8 bits 16 bits 32 bits
00000070: 00000080: 00000090: 000000A0: 000000B0:	0000015F 000001 0000015F 000001 0000015F 000001 0000015F 000001 F450F001 470048	5F 0000015F 5F 0000015F 5F 0000015F 5F 0000015F 5F 0000015F	0000015F 0000015F 0000015F 0000015F D00CF8DF 20014B30	-	Refresh

Figure 4-9 File Data Display Field

On-board Flash:

The data programmed on built-in Flash of the target chip. If MTP had never been programmed, the ICP Tool shows the comparison result.

File Data		In-board Fla	sh Offline Flash					
Code Area	Data Area C	ode Area [Data Area	Code Area	Data Area	Info		
00000000 0000010 0000020 0000030 0000040 0000050 0000050 0000060 0000070	20014B30 00000151 000000055 00000155 00000155 00000155 00000155 00000155	00000014 0000005 0000000 0000000 0000015 0000015 0000015 0000015 0000015	5 000001 3 000001 0 000000 F 000001 F 000001 F 000001 F 000001 F 000001	4D 00000 55 00000 58 00000 5F 00000 5F 00000 5F 00000 5F 00000 5F 00000 5F 00000	0D1 000 157 15D 15F 15F 15F 15F 15F			 8 bits 16 bits 32 bits file matched
0000000A0 000000B0	0000015F 0000015F EASOF001	0000015	F 000001 F 000001 F 000001	SF 00000 SF 00000 SF D00CF	15F 8DF 830		-	Refresh

Figure 4-10 On-board Flash Data Display Field and Comparison Result

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If MTP had been programmed, the ICP Tool did not show the comparison result (only get the encrypted data).

File Data	On-board Flash	Offline Flash
Code Area Data	Area Code Area Data Area	Code Area Data Area Info
00000000: D2 00000010: 34 00000020: 16 00000030: 4E 00000040: 45 00000050: 17 00000050: 58	421161 56AD6C8E B6A2 07137C 5DEB2CB9 84390 A0B99F A44AB6BA 0F57 BF7833 E84930D7 EAFAA 89D02F 51B1CEC7 178B 077A575 225935EB 6FDA F99F77 37DB89AC DF19	7FAC 0044292E 8 bits 98 bits 16 bits 16 bits 32 bits 001 780998C3 32 bits 32 bits 34341 91AF40C6
00000070: 03 00000080: 66 00000090: 05 00000000: 79 00000000: EA	AE7CCE 8AF03D52 1927[E64482 F4CD33DC 4D09] 578D23 3ACEE06A 6D02 578D4 90F89A86 622C A59CF6 201AFA91 D582(DCF240 0CC8421D 1864	D2F0 6947FE4F A2B0 EE9293F2 7559 52993FD4 CD47 91969208 CFE3 9706302C DCFE 934444D0

Figure 4-11 On-board Flash Data Display Field

4.4 **Programming Options**

There are three Programming options available for selection: Code, Data, and MTP.

Code:

If MTP had been programmed, the Code area must be programmed (target block "Code" must be selected) for PMOC validation. Otherwise, user would get the warning message "Code Area must be programmed!".



Figure 4-12 Warning Message - "Code Area must be programmed!"

If MTP had been programmed, the code (plaintext) must meet PMOC mechanism (MTP signature and offset rule, please refer to section 2.1). Otherwise, the code could not be written into SPI Flash successfully.



Figure 4-13 Warning Message - "Write flash data error"

Data:

It's optional. The Base address can be assigned after Data Block is selected.

Data File Name:	C:\Data.bin
	size: 16.0K Bytes, checksum: 1c7b
	Base Address: 0x 100000
	Read Size: 16384 Bytes

Figure 4-14 Data Area Base Address Setting

MTP:

If MTP is locked, the "MTP" option is also disabled.

Programming			
🔽 Code	📝 Data	MTP	Program Options MTP Options Start
			2

Figure 4-15 MTP option Disabled when MTP Locked

4.5 Program Options

Program Option	X
Operation	mber ming
	-
Software Serial Number (SN) Increase SN from Write Address in Flash	0x 18000000 0x 00180000
Options for Offline Programmin	g Mode Data
Enter Password	•••••
☑ Limit The Number of Offlir	ne Programming
Max Number	100
Auto-programming (Te	est before use!)
Program Specific Area	
Nu-Link Pro IO Voltage Power control is used on Nu-l power is not detected. 0 1.8V 0 2.5V	Link-Pro, and is valid only if target
Default	OK Cancel

Figure 4-16 Program Option Window

- 1. The operation options includes erase, program, verify, and offline programming mode settings.
- 2. User can enable "Write Software Serials Number", and assign "SN start value" and "target Flash address where SN saved".
- 3. User can specify the password for offline programming mode and the limitation of maximum programming count for security issue.
- 4. If MTP had been programmed, an additional option "Disable Cipher" would be shown on the "Program Option".



Figure 4-17 Disable Cipher

If you want to write the encrypted code (Ciphertext, such as the file created by "MTP Output File"), the "Disable Cipher" option must be selected (The validation function for Writing Flash will be disabled). Then any code can be written into SPI Flash. Therefore, the encrypted code must be valid, otherwise the code cannot boot successfully.

4.6 MTP Options

MTP Option	X	
MTP Settings		
Write MTP MTP KEY (Hex) 12345578 · 87654321		A: Option for record of MTP related setting
MTP Signature (Hex)		B: MTP Write Settings
Signature 20014B30		b. WITE Write Settings
Offset 000		
Lock MTP (Be careful! MTP cannot be programmed al	fter lock.)	C: Option for MTP operation
	Cancel	

Figure 4-18 MTP Setting Window

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:

- 1. Write MTP: Write 64-bit key, 32-bit Signature, 12-bit Offset, and 1-byte option with hexcode input format. If the file for Code Area is loaded, the Tool will search the corresponding 32-bit value and fill in the "Signature" automatically according to the address of "Offset".
- 2. Lock MTP: Lock MTP. MTP cannot be programmed after lock.

3. **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.

5 Programming User Guide

Before MTP is programmed, user can read / write the SPI Flash like general SPI Flash (Cipher function is disabled). But after MTP is programmed, Cipher function is active automatically and the behavior of SPI Flash access is different from general SPI Flash (see Section 2.2). The descriptions are divided into two parts: Cipher Function Disabled and Cipher Function Enabled.

5.1 Cipher Function Disabled

The section describes the flow to write/read SPI Flash when Cipher function is disabled. The behavior is the same as general SPI Flash.

5.1.1 Program Code to SPI Flash without Cipher

Steps of Programming Code to SPI Flash:

 Please click the "Code" button to set a file for code and the "Data" button for data if needed.

Load File		
Code	File Name:	C:\Device_HID_Mouse.bin
		size: 16.0K Bytes, checksum: 1c7b
		Read Size: 16384 Bytes
Data	File Name:	C:\Data.bin
		size: 300.7K Bytes, checksum: fef1
		Base Address: 0x 100000
		Read Size: 307936 Bytes

Figure 5-1 Load File Setting

The "Data" button is only enabled when the "Data" checkbox in the **Programming** section is selected.

Programming				
📝 Code	🔽 Data	MTP	Program Options MTP Options Start	

Figure 5-2 "Programming" Setting - Data

2) Select the operations you want to include in the procedure through "Program Options" in the **Programming** section – Erase, Program, or Verify.



Operation	
V Erase	
🔽 Program	
🔲 Verify	•
Write Software Serial Number	
Reset Chip after Programming	
C Offline Programming Mode	

Figure 5-3 Program Option - Operation

3) Click the "**Start**" button to program SPI Flash.

Programming				
🔽 Code	📝 Data	MTP	Program Options MTP Options	Start

Figure 5-4 "Start" Button

5.1.2 Read Code/Data from SPI Flash without Cipher

Steps of Reading Code/Data from SPI Flash:

1) Please set the "Read Size" field for code and "Read Size" & "Base Address" for Data if needed (User needs to know the size of code area to load the data size).

Load File		
Code	File Name:	C:\Device_HID_Mouse.bin
		size: 16.0K Bytes, checksum: 1c7b
		Read Size: 16384 Bytes
Data	File Name:	C:\Data.bin
		size: 300.7K Bytes, checksum: fef1
		Base Address: 0x 100000
		Read Size: 307936 Bytes

Figure 5-5 Load File Setting

The field is for Data Dump function and is only enabled when Target Block "Data" is selected in the **Programming** section

Programming			
🔽 Code	🔽 Data	MTP	Program Options MTP Options Start

Figure 5-6 "Programming" Setting - Data

2) Please click the "Refresh" button for "On-board Flash" to see dump data in "Code Area" window or "Data Area" window (it shows the comparison result); click "Save as" for "On-board Flash" to save data to file.

File Data		On-board Flash		Offline Flash		
Code Area	Data Area	Code Area	Data Area	Code Area Data Area Info	1	
00000000:	200148	30 000001	45 00000	14D 000000D1		O hite
00000010:	000001	51 000001	153 00000	155 00000000	-	O O Dits
00000020:	000000	00 000000	00000 000	000 00000157		C 16 bite
00000030:	000001	59 000000	00000 000	15B 0000015D		0.10.000
00000040:	000001	5F 000001	LSF 00000	15F 0000015F		32 bits
00000050:	000001	5F 000001	LSF 00000	15F 0000015F		
00000060:	000001	5F 000010	00000 293	15F 0000015F		file matched
00000070:	000001	SF 000001	LSF 00000	15F 0000015F		The matched
00000080:	000001	SF 000001	LSF 00000	15F 0000015F		
00000090:	000001	SF 000001	LSF 00000	15F 0000015F		Save As
000000A0:	000001	5F 000001	LSF 00000	15F 0000015F		
00000B0:	000001	5F 000001	LSF 00000	15F DOOCF8DF	-	Befresh
000000000	FASOFO	01 470048	800 00001	441 20014830		Laurantering

Figure 5-7 On-board Flash Data Display Field and Comparison Result

5.2 Cipher Function Enabled

This section describes the flow to write/read SPI Flash with Cipher function and program MTP. The NUC505 Cipher function will be enabled after MTP is programmed. Therefore, MTP should be programmed or will be programmed later to enable Cipher function.

User can check the following table to find out what file / information he should have and the subsection he should focus on

Section	File Format	Program MTP?	Read back?	Comment
5.2.1	Plaintext	Yes	Yes	Use updated MTP info to encrypt.
5.2.2	Plaintext	Yes	No	Use updated MTP info to encrypt
5.2.3	Plaintext	No	Yes	Use current MTP info to encrypt
5.2.4	Plaintext	No	No	Use current MTP info to encrypt
5.2.5	N/A	Yes	No	Only update MTP
5.2.6	N/A	No	Yes	Only Read back data
5.2.7	Ciphertext	Yes	No	Disable Cipher
5.2.8	Ciphertext	No	No	Disable Cipher

Table 5-1

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5.2.1 Program MTP and Plaintext Code with Cipher, and Get Encrypted File

Steps of Program MTP and Plaintext Code with Cipher, and Get Encrypted File:

1) Please click the "**Code**" button to set a file for code and the "**Data**" button for data if needed.

Load File								
Code File Nam	e: C:\Device_HID_Mouse.bin							
	size: 16.0K Bytes, checksum: 1c7b							
	Read Size: 16384 Bytes							
Data File Nam	e: C:\Data.bin							
	size: 300.7K Bytes, checksum: fef1							
	Base Address: 0x 100000							
	Read Size: 307936 Bytes							

Figure 5-8 Load File Setting

The "**Data**" button is only enabled when the "**Data**" checkbox in the **Programming** section is selected.

Programming			
🔽 Code	🔽 Data	📝 MTP	Program Options MTP Options Start

Figure 5-9 "Programming" Setting - Data

2) Set MTP information through the "MTP Option" in the **Programming** section

MTP Option	× •
MTP Settings	
Write MTP	Record MTP Settings
MTP KEY (Hex)	12345678 - 87654321
MTP Signature (He	x)
Signature	E28F8090
Offset	0000
MTP Option (Hex)	00
🗖 Lock MTP (Be	careful! MTP cannot be programmed after lock.)
C	OK Cancel

Figure 5-10 MTP Setting Window

• User can select "Write MTP" or "Lock MTP" only.

- Please make sure that code can run before selecting the Lock MTP option.
- "Signature" is filled automatically according to whether the "Offset" when "Code" in <u>Load File</u> section is set. Please make sure that the "Signature" is correct if you fill it by yourself.
- Cipher is disabled and Code Validation is also disabled (you can write any file into SPI Flash). Please make sure that the binary file is a valid encrypted file.
- "MTP" checkbox in the **Programming** section must be selected.



Figure 5-11 "Programming" Setting - MTP

3) Select the operations you want to include in the procedure through "Program Options" in the **Programming** section – Erase, Program, or Verify.



Figure 5-12 Program Option - Operation

4) Click the "MTP Output File" button to set the encrypted file name and path.



Figure 5-13 Encrypted File Output Setting

5) Click the "**Start**" button to program SPI Flash with Cipher, program MTP, and get the encrypted file.

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Programming				
Code	📝 Data	V MTP	Program Options MTP Options	Start

Figure 5-14 "Start" Button

5.2.2 Program Plaintext Code with Cipher and MTP

Steps of Program Plaintext Code with Cipher and MTP:

1) Please click the "**Code**" button to set a file for code and the "**Data**" button for data if needed.

Load File		
Code	File Name:	C:\Device_HID_Mouse.bin
		size: 16.0K Bytes, checksum: 1c7b
		Read Size: 16384 Bytes
Data	File Name:	C: \Data.bin
		size: 300.7K Bytes, checksum: fef1
		Base Address: 0x 100000
		Read Size: 307936 Bytes

Figure 5-15 Load File Setting

The "**Data**" button is only enabled when the "**Data**" checkbox in the **Programming** section is selected.

Programming				
🔽 Code	🔽 Data	📝 MTP	Program Options MTP Options Start	

Figure 5-16 "Programming" Setting - Data

2) Set MTP information through the "MTP Option" in the **Programming** section

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MTP Option	or the loss station of	X
MTP Settings		
Vrite MTP		Record MTP Settings
MTP KEY (Hex)	12345678 - 87654321	
MTP Signature (He	ж)	
Signature	E28F8090	
Offset	0000	
MTP Option (Hex)	00	
🔲 Lock MTP (Be	careful! MTP cannot be programmed	after lock.)
C	ОК	Cancel

Figure 5-17 MTP Setting Window

- User can select "Write MTP" or "Lock MTP" only.
- Please make sure that code can run before selecting the **Lock MTP** option.
- "Signature" is filled automatically according to whether the "Offset" when "Code" in Load File section is set. Please make sure that the "Signature" is correct if you fill it by yourself.
- Cipher is disabled and Code Validation is also disabled (you can write any file into SPI Flash). Please make sure that the binary file is a valid encrypted file.
- "MTP" checkbox in the **Programming** section must be selected.

Programming				
🔽 Code	🔽 Data	V MTP	Program Options <u>MTP Options</u> Start	

Figure 5-18 "Programming" Setting - MTP

3) Select the operations you want to include in the procedure through "Program Options" in the **Programming** section – Erase, Program, or Verify.



Figure 5-19 Program Option - Operation

4) Click the "**Start**" button to program SPI Flash with Cipher and MTP.

Programming	🔽 Data	MTP	Program Options MTP Options Start	

Figure 5-20 "Start" Button

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5.2.3 Program Plaintext Code with Cipher and Get Encrypted File

Steps of Program Plaintext Code with Cipher and Get Encrypted File:

1) Please click the "**Code**" button to set a file for code and the "**Data**" button for data if needed.

Load File		
Code	File Name:	C:\Device_HID_Mouse.bin
		size: 16.0K Bytes, checksum: 1c7b
		Read Size: 16384 Bytes
Data	File Name:	C:\Data.bin
		size: 300.7K Bytes, checksum: fef1
		Base Address: 0x 100000
		Read Size: 307936 Bytes

Figure 5-21 Load File Setting

The "**Data**" button is only enabled when the "**Data**" checkbox in the **Programming** section is selected.



Figure 5-22 "Programming" Setting - Data

MTP certainly is programmed. After MTP is programmed, PMOC protection is also active. User must pass the PMOC validation (The code (plaintext) must meet the MTP signature and offset rule). Otherwise, the code cannot be written into SPI Flash successfully. Please check if the source code is valid for PMOC. 2) Select the operations you want to include in the procedure through "Program Options" in the **Programming** section – Erase, Program, or Verify.

~

Figure 5-23 Program Option - Operation

3) Click the "MTP Output File" button to set the encrypted file name and path.

ſ	MTP Output File			
	Encrypt Code	File Name:	C:\Cipher.bin	

Figure 5-24 Encrypted File Output Setting

4) Click the "Start" button to program SPI Flash with Cipher and get the encrypted file.

Programming Code	V Data	MTP	Program Options MTP Options Start	

Figure 5-25 "Start" Button

5.2.4 Program Plaintext Code with Cipher

Steps of Program Plaintext Code with Cipher:

1) Please click the "**Code**" button to set a file for code and the "**Data**" button for data if needed.

Load File		
Code	File Name:	C:\Device_HID_Mouse.bin
		size: 16.0K Bytes, checksum: 1c7b
		Read Size: 16384 Bytes
Data	File Name:	C: \Data.bin
		size: 300.7K Bytes, checksum: fef1
		Base Address: 0x 100000
		Read Size: 307936 Bytes

Figure 5-26 Load File Setting

The "**Data**" button is only enabled when the "**Data**" checkbox in the **Programming** section is selected.



Figure 5-27 "Programming" Setting - Data

MTP certainly is programmed. After MTP is programmed, PMOC protection is also active. User must pass the PMOC validation (The code (plaintext) must meet the MTP signature and offset rule). Otherwise, the code cannot be written into SPI Flash successfully. Please check if the source code is valid for PMOC.

2) Select the operations you want to include in the procedure through "Program Options" in the **Programming** section – Erase, Program, or Verify.



Operation		
C Erase		
V Program		
C Verify		
Write Software Serial Number		
Reset Chip after Programming		
Offline Programming Mode		

Figure 5-28 Program Option - Operation

3) Click the "**Start**" button to program SPI Flash with Cipher.



Figure 5-29 "Start" Button

5.2.5 Program MTP Only

Steps of Program MTP Only:

1) Set MTP information through the "MTP Option" in the **Programming** section

MTP Option	on 19.8 Spin. And up 45	×
MTP Settings		
Write MTP		Record MTP Settings
MTP KEY (Hex)	12345678 - 87654321	
MTP Signature (He	x)	
Signature	E28F8090	
Offset	0000	
MTP Option (Hex)	00	
🔲 Lock MTP (Be	careful! MTP cannot be programmed after	lock.)
C	OK Car	ncel

Figure 5-30 MTP Setting Window

- User can select "Write MTP" or "Lock MTP" only.
- Please make sure that code can run before selecting the **Lock MTP** option.
- "Signature" is filled automatically according to whether the "Offset" when "Code" in Load File section is set. Please make sure that the "Signature" is correct if you fill it by yourself.
- Cipher is disabled and Code Validation is also disabled (you can write any file into SPI Flash). Please make sure that the binary file is a valid encrypted file.
- "MTP" checkbox in the **Programming** section must be selected.



Figure 5-31 "Programming" Setting - MTP

 Select the operations you want to include in the procedure through "Program Options" in the **Programming** section – Erase, Program, or Verify.



Figure 5-32 Program Option - Operation

3) Click the "Start" button to program MTP.

Code D	ata 📝 MTP	Program Options MTP Options	Start

Figure 5-33 "Start" Button

5.2.6 Get Encrypted File

Steps of Get Encrypted File:

1) Please set the "Read Size" field for code and "Read Size" & "Base Address" for Data if needed (User needs to know the size of code area to load the data size).

- Load File	
Code File Name:	C:\Device_HID_Mouse.bin
	size: 16.0K Bytes, checksum: 1c7b
	Read Size: 16384 Bytes
Data File Name:	C:\Data.bin
	size: 300.7K Bytes, checksum: fef1
	Base Address: 0x 100000
	Read Size: 307936 Bytes

Figure 5-34 Load File Setting

The field is for Data Dump function and is only enabled when Target Block "Data" is selected in the **Programming** section

	<u>n</u>			AN0010
Programming Code	V Data	MTP	Program Options MTP Options	Start

Figure 5-35 "Programming" Setting - Data

2) Please click the "**Refresh**" button for "On-board Flash" to see dump data in "Code Area" window or "Data Area" window (it shows the comparison result); click "Save as" for "On-board Flash" to save data to file.

File Data	On-board Flash	Offline Flash	
Code Area Data Area	Code Area Data Area (Code Area Data Area Info	
00000000: D2421 00000010: 34071	161 56AD6C8E B6A27F/ 37C 5DEB2C89 8439D69	AC 0044292E	🔨 🔘 8 bits
00000020: 16A0B 00000030: 4EBEZ	99F A44AB6BA 0F57780 833 E84930D7 EAFA6B	DA 6007A723	🗏 🔘 16 bits
00000040: 4589D 00000050: 1777A	02F 51B1CEC7 17BB60	D1 7B099BC3 B6 FE50E54B	32 bits
00000060: 58F99 00000070: 03AE7	F77 37DB89AC DF19434 CCE 8AF03D52 1927D24	41 91AF40C6 F0 6947FE4F	
00000080: 66E64 00000090: 05578	4B2 F4CD33DC 4D09A28 D23 3ACEE06A 6D0275	B0 EE9293F2 59 52993FD4	Save As
000000A0: 7957B 000000B0: EAA59	B04 90F89A86 622CCD4 CF6 201AFA91 D5B2CFF	47 91969208 3 9706302C	Befresh
00000000 B3DCF	240 0CC8421D 1RE4DC	FF 934444D0	* Incircan

Figure 5-36 On-board Flash Data Display Field

5.2.7 Program Ciphertext Code without Cipher and MTP

Steps of Program Ciphertext Code with Cipher and MTP:

1) Please click the "**Code**" button to set a file for code and the "**Data**" button for data if needed.

Load File	
Code File Na	e: C:\Device_HID_Mouse.bin
	size: 16.0K Bytes, checksum: 1c7b
	Read Size: 16384 Bytes
Data File Na	ie: C:\Data.bin
	size: 300.7K Bytes, checksum: fef1
	Base Address: 0x 100000
	Read Size: 307936 Bytes

Figure 5-37 Load File Setting

The "**Data**" button is only enabled when the "**Data**" checkbox in the **Programming** section is selected.



Figure 5-38 "Programming" Setting - Data

2) Set MTP information through the "MTP Option" in the **Programming** section

MTP Option	an 1818 feet metals iff	x
MTP Settings		
Vrite MTP	Record MTP Settings	
MTP KEY (Hex)	12345678 - 87654321	
MTP Signature (He	ex)	
Signature	E28F8090	
Offset	0000	
MTP Option (Hex)	00	
🔄 Lock MTP (Be	e careful! MTP cannot be programmed after lock.)	
	OK Cancel	

Figure 5-39 MTP Setting Window

- User can select "Write MTP" or "Lock MTP" only.
- Please make sure that code can run before selecting the Lock MTP option.
- "Signature" is filled automatically according to whether the "Offset" when "Code" in **Load File** section is set. Please make sure that the "Signature" is correct if you fill it by yourself.
- Cipher is disabled and Code Validation is also disabled (you can write any file into SPI Flash). Please make sure that the binary file is a valid encrypted file.
- "MTP" checkbox in the **Programming** section must be selected.

Programming			
🔽 Code	🔽 Data	V MTP	Program Options MTP Options Start

Figure 5-40 "Programming" Setting - MTP

 Select the operations you want to include in the procedure through "Program Options" in the **Programming** section – Erase, Program, or Verify. The most important is to select the **Disable Cipher** option and make sure that the encrypted file is valid. If the file is invalid, the code cannot run (You can write any file into SPI Flash). Please make sure that the binary file is a valid encrypted file.



Figure 5-41 Program Option - Operation & Disable Cipher

4) Click the "Start" button to program SPI Flash with Cipher and MTP.

Programming	🔽 Data	MTP	Program Options MTP Options Start	

Figure 5-42 "Start" Button

5.2.8 Program Ciphertext without Cipher

Steps of Program Ciphertext Code without Cipher:

1) Please click the "**Code**" button to set a file for code and the "**Data**" button for data if needed.

Load File			
Code	File Name:	C:\Device_HID_Mouse.bin	
		size: 16.0K Bytes, checksum: 1c7b	
		Read Size: 16384 Bytes	
Data	File Name:	C:\Data.bin	
		size: 300.7K Bytes, checksum: fef1	
		Base Address: 0x 100000	
		Read Size: 307936 Bytes	

Figure 5-43 Load File Setting

The "**Data**" button is only enabled when the "**Data**" checkbox in the **Programming** section is selected.

	ION			AN0010
Program	nming ode 🔽 Data	⊘ MTP	Program Options MTP Options	Start

Figure 5-44 "Programming" Setting - Data

2) Select the operations you want to include in the procedure through "Program Options" in the **Programming** section – Erase, Program, or Verify.

The most important is to select the **Disable Cipher** option and make sure that the encrypted file is valid. If the file is invalid, the code cannot run (You can write any file into SPI Flash). Please make sure that the binary file is a valid encrypted file.



Figure 5-45 Program Option - Operation & Disable Cipher

3) Click the "Start" button to program SPI Flash

Programming			
🔽 Code	🔽 Data	V MTP	Program Options MTP Options Start

Figure 5-46 "Start" Button

6 Troubleshooting

6.1 Code Cannot Run

Code cannot run and there is no warning message when writing code into SPI Flash correctly (Read back data is the same as source binary file)

Possible Cause:

- MTP had been programmed and the "Disable Cipher" option had been selected, the Cipher function would be disabled when programming SPI Flash.
 Solution: Please follow the step to check the situation
- Please check if the "Disable Cipher" option is selected or not. If "Disable Cipher" option is selected, user must make sure that the file is the Ciphertext for the MTP information of the NUC505.



Figure 6-1 Program Option - Disable Cipher

6.2 Write SPI Flash Always Failed with Warning Message

The ICP Tool cannot write data into SPI Flash and ICP Programming Tool reports a "warning message" when writing Code Area.

NuMicro ICP Programming Tool
ICE: Cmd error: Write flash data error.
ОК

Figure 6-2 Warning Message - "Write flash data error"

Cause: MTP certainly is programmed. Because the Signature of the code is not the same as the Signature in NUC505 MTP to pass the PMOC validation, code can't program to SPI Flash.

Solution:

Please check if the source code is valid for PMOC rule (see Section 2.1).

Revision History

Date	Revision	Description
2015.10.06	1.00	1. Initially issued.

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