

NuMicro™ ISP Programming Tool User Manual

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1 Overview

The “ISP” (In-System Programming) tool allows the embedded Flash memory to be reprogrammed under software control through the firmware using on-chip connectivity interface, such as UART and USB, without removing any microcontroller from the system.

For NuMicro™ MCU products, the on-chip Flash memory is partitioned into three blocks: APROM, Data Flash and LDROM. The APROM saves the user application program developed for a specific application; the Data Flash provides storage for nonvolatile application data; and the LDROM saves the ISP code for MCU to update its APROM/Data Flash/CONFIG. User can update the APROM, Data Flash, and User Configuration bits with ISP.

User can easily use the ISP function to update the MCU’s APROM, Data Flash, and User Configuration bits with Nuvoton standard ISP code programmed in LDROM.

The Nuvoton standard ISP code for NuMicro™ MCUs is included in the folder **[(2) Nuvoton Standard ISP Code]**. User can program the ISP code into LDROM by using a universal programmer or Nuvoton’s NuMicro™ ICP Programming Tool, and the User Configuration bit ‘CBS’ configured as Boot from LDROM. The file name of the Nuvoton standard ISP code listed the following table.

ISP Type	MCU Parts	UART Port RX/TX	Nuvoton Standard ISP Code Programmed in LDROM
ISP through COM Port	M051 Series	UART0 P3.0/P3.1	ISPCode_M051.bin
	NUC100/120/ 130/140	UART0 PB.0/PB.1	ISPCode_NUC100_UARTOnly.bin
	NUC101	UART1 PB.4/PB.5	ISPCode_NUC100_UARTOnly.bin
	Mini51	UART0 P0.0/P0.1	ISPCode_Mini51.bin
	Mini5xFDE	UART P1.2/P1.3	ISPCode_Mini5xFDE.bin
	Nano100	UART0 PA.14/PA.15	ISPCode_Nano100_UARTOnly.bin
	Nano112	UART0 PB.13/PB.14	ISPCode_Nano112.bin

	NUC122	UART1 PB.4/PB.5	ISPCode_NUC122_UARTOnly.bin
	NUC123	UART1 PB.4/PB.5	ISPCode_NUC123_UARTOnly.bin
	NUC200	UART0 PB.0/PB.1	ISPCode_NUC200_UARTOnly.bin
	NUC472/442	UART0 PG.1/PG.2	ISPCode_NUC472_UARTOnly.bin
	M451 Series	UART0 PD.0/PD.1	ISPCode_M451_UARTOnly.bin
	NUC029xAN	UART0 P3.0/P3.1	ISPCode_NUC029xAN_UARTOnly.bin
	NUC029FAE	UART P1.2/P1.3	ISPCode_NUC029FAE_UARTOnly.bin
	NUC131	UART0 PB.0/PB.1	ISPCode_NU131_UARTOnly.bin
	M0518	UART0 PB.0/PB.1	ISPCode_M0518_UARTOnly.bin
	Mini51X	UART0 P0.0/P0.1	ISPCode_Mini51X_UARTOnly.bin
	IDS9100	UART0 PA.9/PA.8	ISPCode_IDS9100_UARTOnly.bin

Table 1-1 ISP through COM Port System Setting

ISP Type	MCU Parts	I/O Pin Tied to Ground For USB	Nuvoton Standard ISP Code Programmed in LDROM
ISP through USB	NUC120/140	PB.15	ISPCode_NUC100.bin
	NUC101	PD.0	ISPCode_NUC100.bin
	NUC200	PB.15	ISPCode_NUC200.bin
	Nano100 Series	PB.15	ISPCode_Nano100.bin
	NUC122	PA.10	ISPCode_NUC122.bin
	NUC123	PB.14	ISPCode_NUC123.bin
	NUC472_442	PB.15	ISPCode_NUC472.bin
	M451 Series	PB.14	ISPCode_M451.bin

Table 1-2 ISP through USB System Setting

2 Preparing for ISP Function

Two ISP interfaces are supported, 'ISP through COM port' and 'ISP through USB'. For either of these two interfaces, the User Configuration bit 'CBS' needs to be configured as Boot from LDROM to perform ISP programming.

2.1 Pin Assignment for 'ISP through COM Port'

Table 1-1 lists the UART pins used to perform ISP program of each NuMicro MCU. UART0 is used to connect to PC's COM port for M051 Series, Mini51 Series, Mini51X Series, Nano100 Series, NUC100/120/130/140/200/400/029/131/M0518, and M451 Series while UART1 is used for NUC101/122/123 and Mini5xFDE. In addition, an RS232 transceiver (e.g. TI MAX232) is always needed between MCU chip and PC's COM port.

2.2 Hardware Connection for 'ISP through USB'

A specific I/O pin needs to be tied to ground for the target board to perform ISP through USB interface. Please connect PB.15 for Nano100 series and NUC120/140/400, connect PD.0 for NUC101, connect PA.10 for NUC122/200, and connect PB.14 for NUC123, M451 series to ground. *Table 1-2* lists the pin setting.

Note: Please refer to section 4.2 for more details about hardware connection for 'ISP' through USB'.

3 Using the Application Program in Windows

3.1 Installing the Application Program

The application program setup file is contained in the folder **[(1) Application Program]**. When using the default installation setting, you will find the item “*Nuvoton Tools \ Nuvoton NuMicro ISP Programming Tool*” appear in the Windows Start menu after the application program is installed successfully.

3.2 Introduction to the ISP Tool Interface

Figure 3-1 shows the GUI of the ISP tool. User needs to select the ISP connection type, USB, COM port or Ethernet, before using the ISP function. The ISP tool will show the hardware connection to remind user about the correct setting for connecting COM port or USB interface.

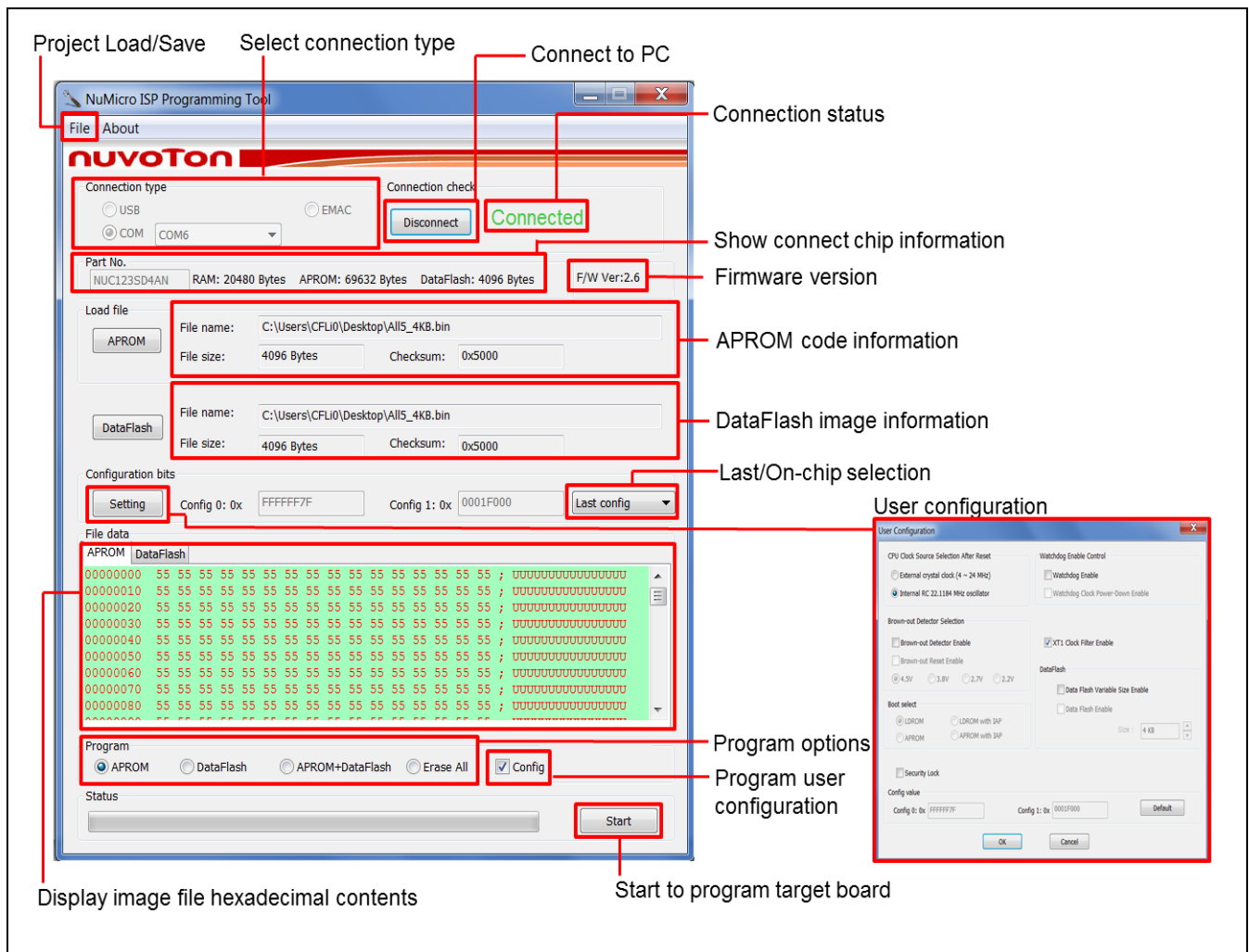


Figure 3-1 ISP Tool User Interface

3.2.1 Setting the User Configuration Bits

User needs to check the '**Config**' check box in the 'Program' area to enable the '**Setting**' button. After clicking the '**Setting**' button, a '**User Configuration**' form will open to display all User Configuration settings. The corresponding '**User Configuration**' form will be displayed according to the MCU currently connected. Figure 3-2 shows the '**User Configuration**' setting of the NUC123 series MCU.

The '**Config value**' area will be immediately updated when a different option is selected. Note that the ISP tool does not allow user to update User Configuration by editing '**Config value**' directly.

The ISP tool does not allow user to modify target board boot selection, either. The

'**Boot Select**' shown in the User Configuration form is for informative purpose only. This setting can be updated with NuMicro ICP Programming Tool.

Some of the items are dependent to other items. For example, user can select '**Watchdog Clock Power-down Enable Control**' only when '**Watchdog Enable**' is checked. User can select '**Brown-out Voltage Selection**' and '**Brown-out Reset Enable**' only when '**Brown-out Detector Enable**' is checked. User can select '**Data Flash Size**' only when '**Data Flash Enable**' is checked.

The 'User Configuration' dialog box contains the following sections and controls:

- CPU Clock Source Selection After Reset:**
 - ☐ External crystal clock (4 ~ 24 MHz)
 - ☒ Internal RC 22.1184 MHz oscillator
- Watchdog Enable Control:**
 - ☐ Watchdog Enable
 - ☐ Watchdog Clock Power-Down Enable
- Brown-out Detector Selection:**
 - ☐ Brown-out Detector Enable
 - ☐ Brown-out Reset Enable
 - ☒ 4.5V ☐ 3.8V ☐ 2.7V ☐ 2.2V
- XT1 Clock Filter Enable:**
 - ☒ XT1 Clock Filter Enable
- DataFlash:**
 - ☐ Data Flash Variable Size Enable
 - ☐ Data Flash Enable
 - Size : (with up/down arrows)
- Boot select:**
 - ☒ LDROM ☐ LDROM with IAP
 - ☐ APROM ☐ APROM with IAP
- Security Lock:**
 - ☐ Security Lock
- Config value:**
 - Config 0: 0x
 - Config 1: 0x
 -
- Buttons:**

Figure 3-2 User Configuration Form

3.2.2 Programming Options

The following table lists the ISP actions for different programming options.

Programming Options	ISP Actions
APROM	APROM: will be updated. Data Flash/User Configuration: will be kept unchanged.
APROM & Config	APROM/User Configuration: will be updated. Data Flash: will be kept unchanged.
Data Flash	Data Flash: will be updated. APROM/ User Configuration: will be kept unchanged.
APROM+Data Flash	APROM/Data Flash: will be updated. User Configuration: will be kept unchanged.
APROM+Data Flash & Config	APROM/Data Flash/User Configuration: will be updated.
Erase All	APROM/Data Flash/User Configuration: will be erased.

Table 3-1 ISP Programming Options

4 Starting to Use the ISP Function

4.1 ISP through COM Port

Follow the steps below to use the ISP tool through COM port.

- **Step 1:** Select the connection type as '**COM**' and the port number under the pull-down menu. Then, the ISP tool will show the Hardware Connection for ISP Through UART form which lists the UART pin for the target board to perform ISP though COM port.

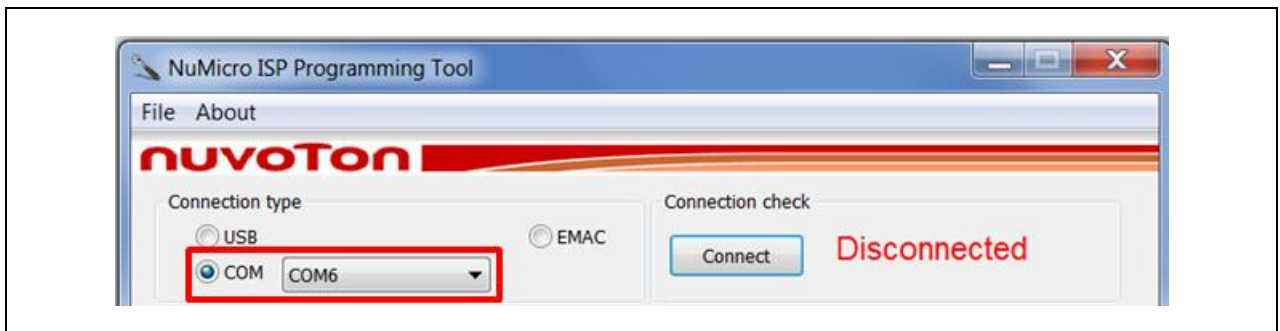
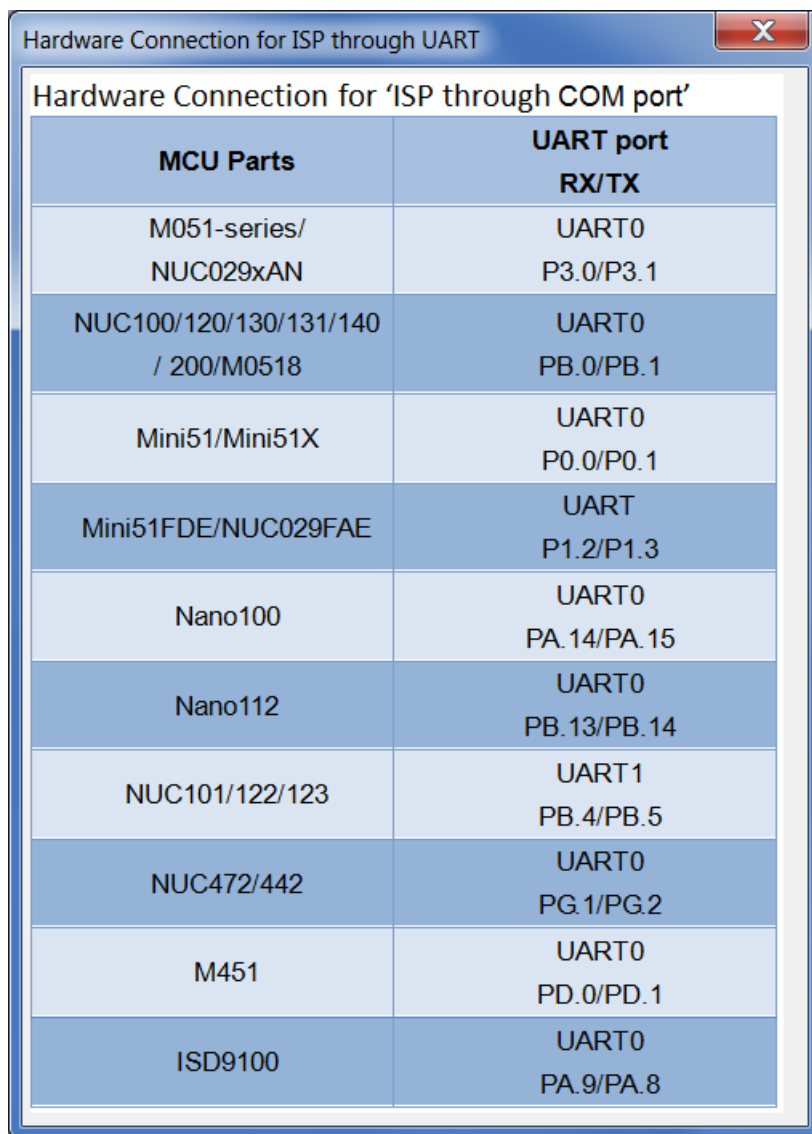


Figure 4-1 Connection Type Selected as COM Port



MCU Parts	UART port RX/TX
M051-series/ NUC029xAN	UART0 P3.0/P3.1
NUC100/120/130/131/140 / 200/M0518	UART0 PB.0/PB.1
Mini51/Mini51X	UART0 P0.0/P0.1
Mini51FDE/NUC029FAE	UART P1.2/P1.3
Nano100	UART0 PA.14/PA.15
Nano112	UART0 PB.13/PB.14
NUC101/122/123	UART1 PB.4/PB.5
NUC472/442	UART0 PG.1/PG.2
M451	UART0 PD.0/PD.1
ISD9100	UART0 PA.9/PA.8

Figure 4-2 COM Port Hardware Connection

- **Step 2:** After clicking the '**Connect**' button, the ISP tool will keep trying to connect a target board every 20 ms until the target board is successfully connected or the '**Stop**' button is clicked.

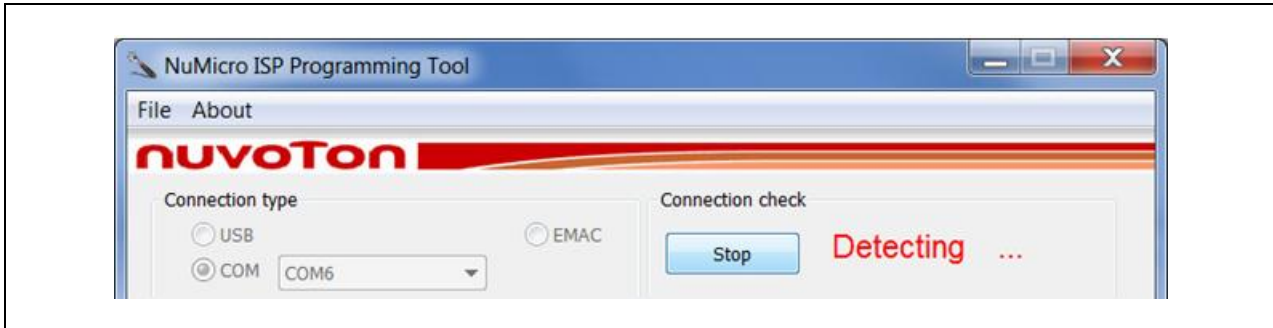


Figure 4-3 Connecting COM Port

- **Step 3:** If the target board is in power-off state, turn on the target board. Or if the target board has already been powered on, reset the MCU chip. Then click the '**Connect**' button after USB bus enumeration is completed. The connection status will switch to '**Connected**' if connected successfully.

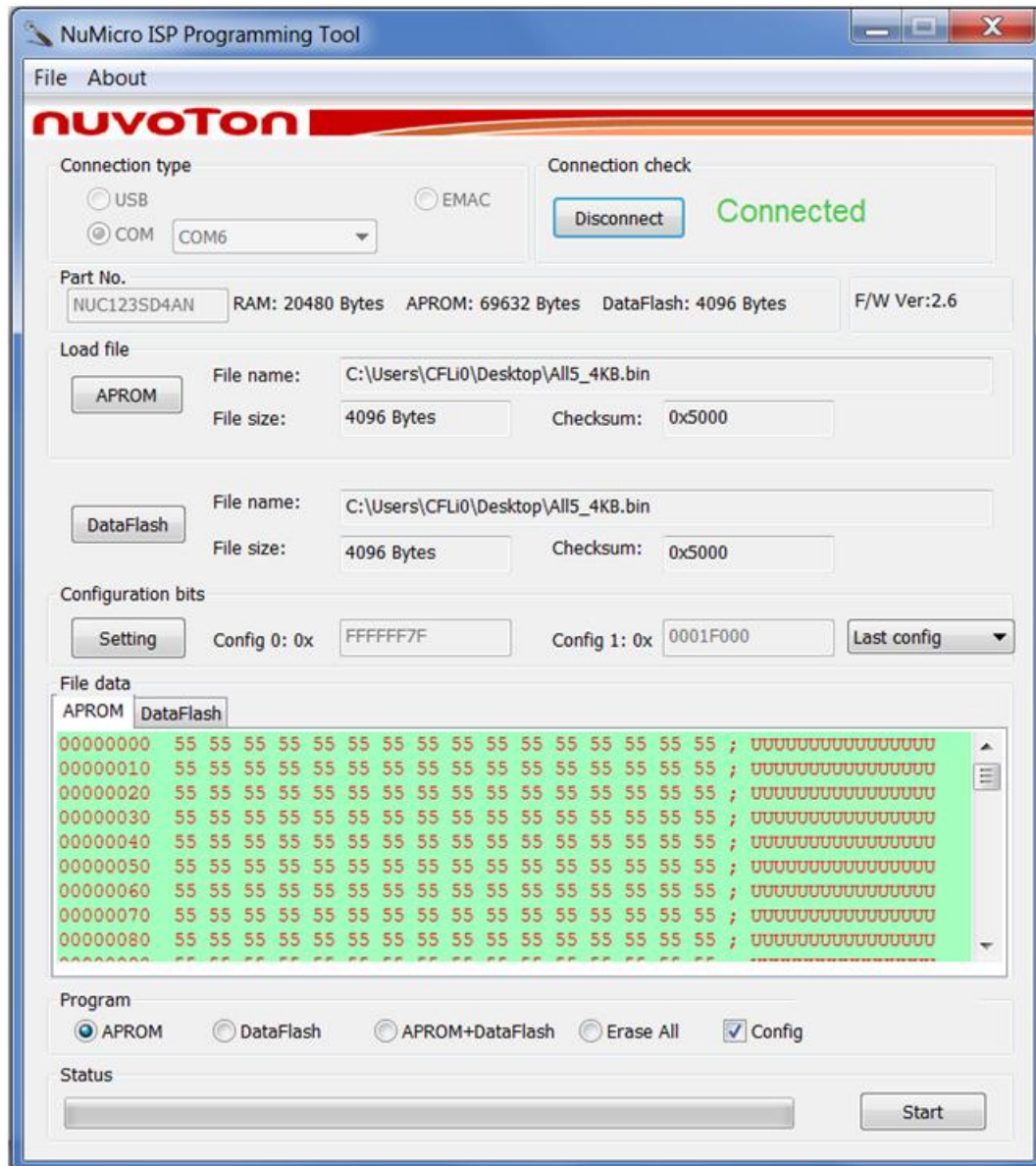


Figure 4-4 ISP Connected via COM Port

- **Step 4:** Click the '**APROM**' or '**DataFlash**' button to select the image from the pop-up window to be programmed. To modify the User Configuration bits, click the '**Setting**' button. Please refer to section 3.2.1 to configure the User Configuration before starting to program the target board.

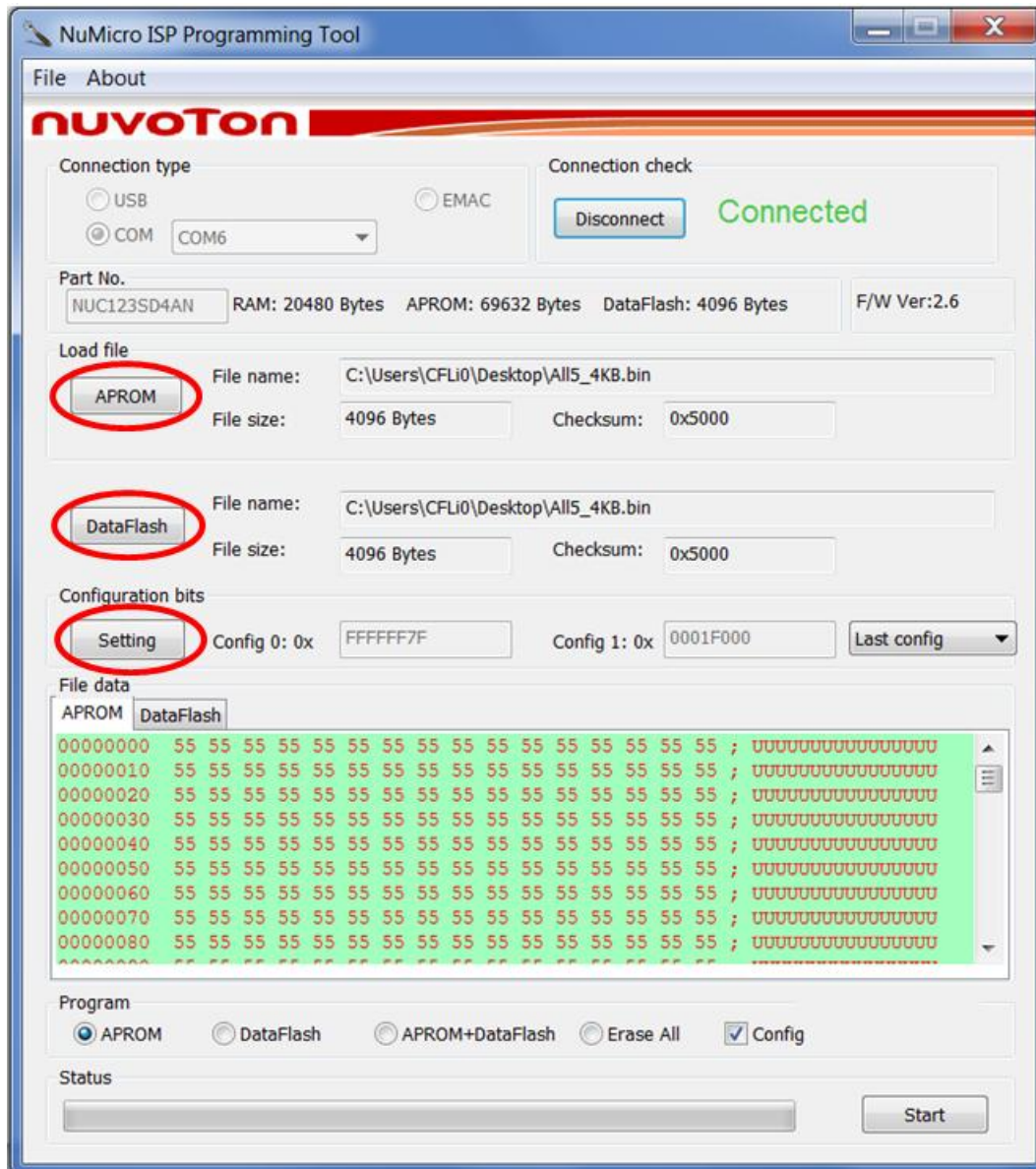


Figure 4-5 ISP Load File

- **Step 5:** Select an option from 'APROM', 'DataFlash', 'APROM+DataFlash', and 'Erase All' in the 'Program' area, and then click the 'Start' button to start programming the target board. Select 'APROM' to program APROM, 'DataFlash' to program Data Flash, and 'APROM+DataFlash' to program both APROM and Data Flash. Select 'Erase All' to erase the whole chip including User Configuration. The 'Config' option circled in the following figure is used to update the User Configuration

setting.

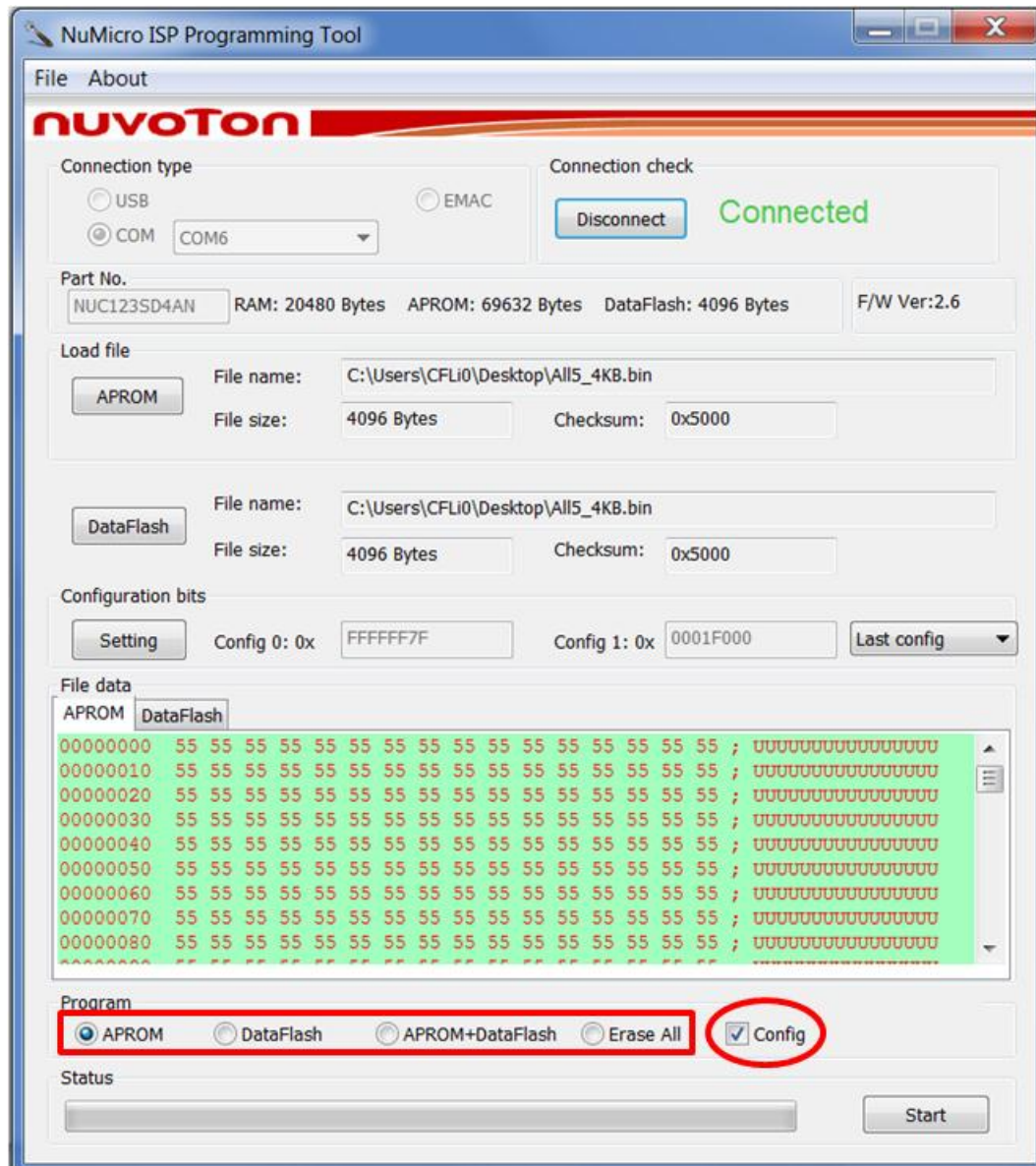


Figure 4-6 Select Program Options

Click the **'Start'** button to start programming the target board. A progress bar in the **'Status'** area shows the current progress. The final result, ether pass or fail, can be found in the **'Program'** area. Once the programming is finished, and the MCU chip will automatically jump to APROM to execute the APROM image. At this time the connection status on ISP tool will switch to **'Disconnected'** state. To connect the target

system to the host once again, please reset the target system and repeat Steps 2-6.

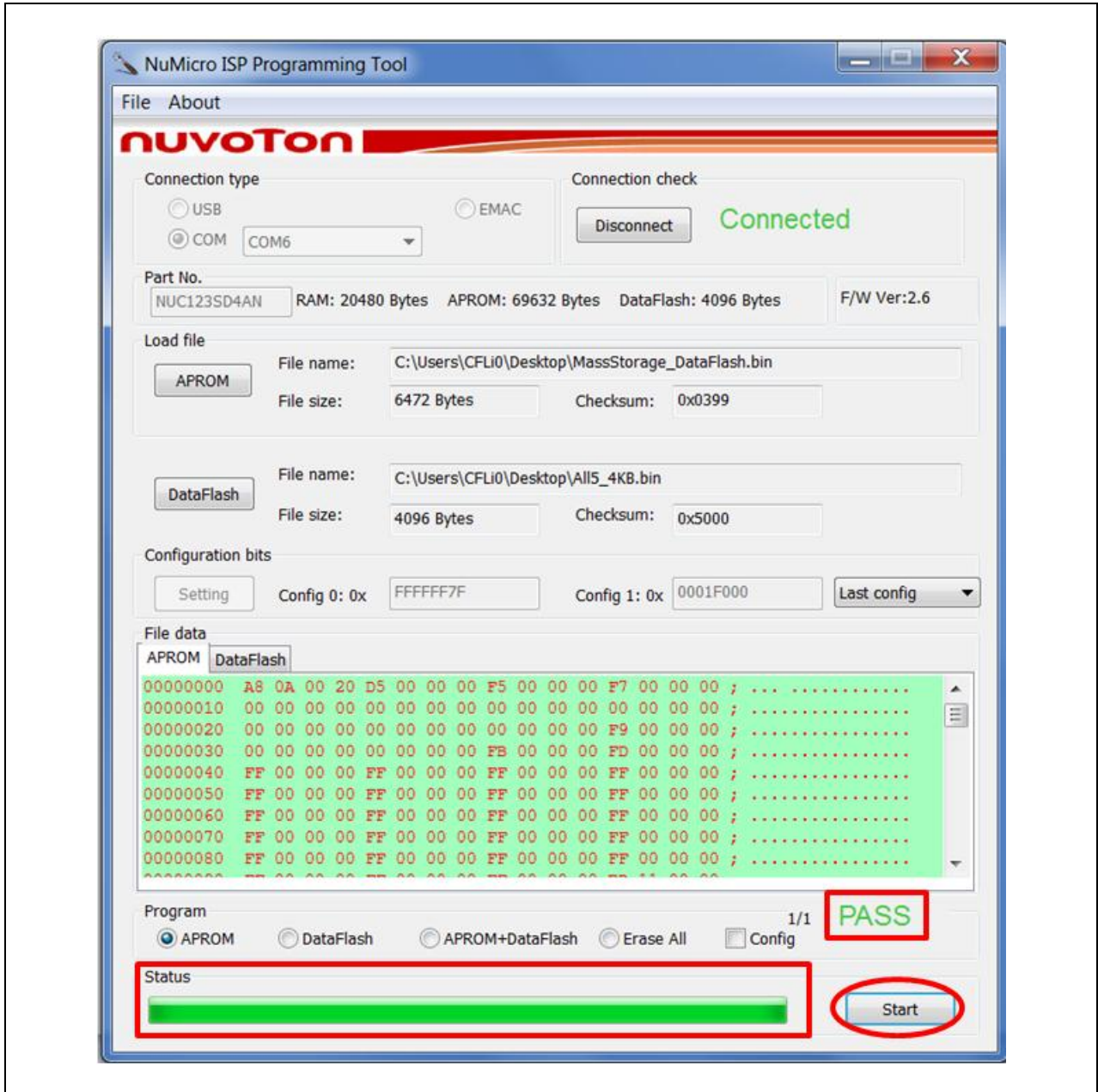


Figure 4-7 Programming Result

4.2 ISP through USB

Follow the steps below to use the ISP tool through USB interface.

- **Step 1:** When the connection type is selected as '**USB**', the ISP tool will show the Hardware Connection for ISP through USB form which lists the hardware setting for the target board to perform ISP though USB interface.

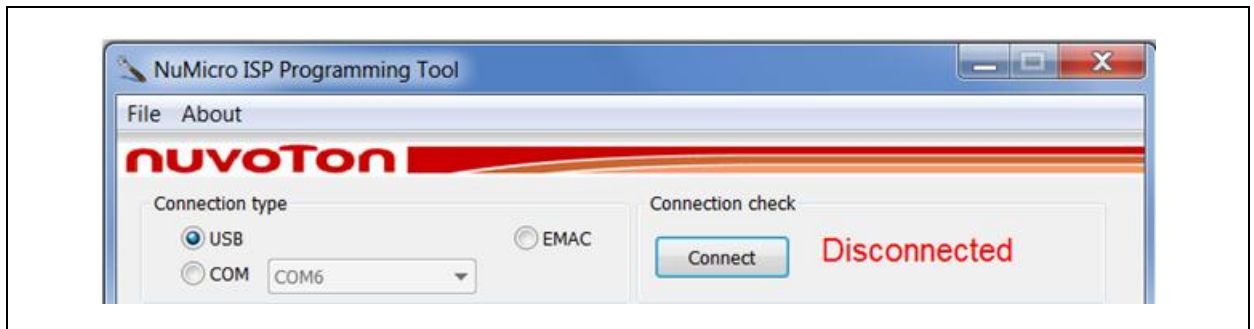


Figure 4-8 Connection Type Selected as USB

Hardware Connection for 'ISP through USB'	
MCU Parts	I/O Pin Tied to Ground
NUC120/140/442/472 Nano100-series	PB.15
NUC101	PD.0
NUC122/200	PA.10
NUC123 M451-series	PB.14

Figure 4-9 USB Hardware Connection

- **Step 2:** If the target board is in power-off state, turn on the target board. Or if the

target board has already been powered on, reset the MCU chip. Then, click the '**Connect**' button after USB bus enumeration is completed. The connection status will switch to '**Connected**' if connected successfully.

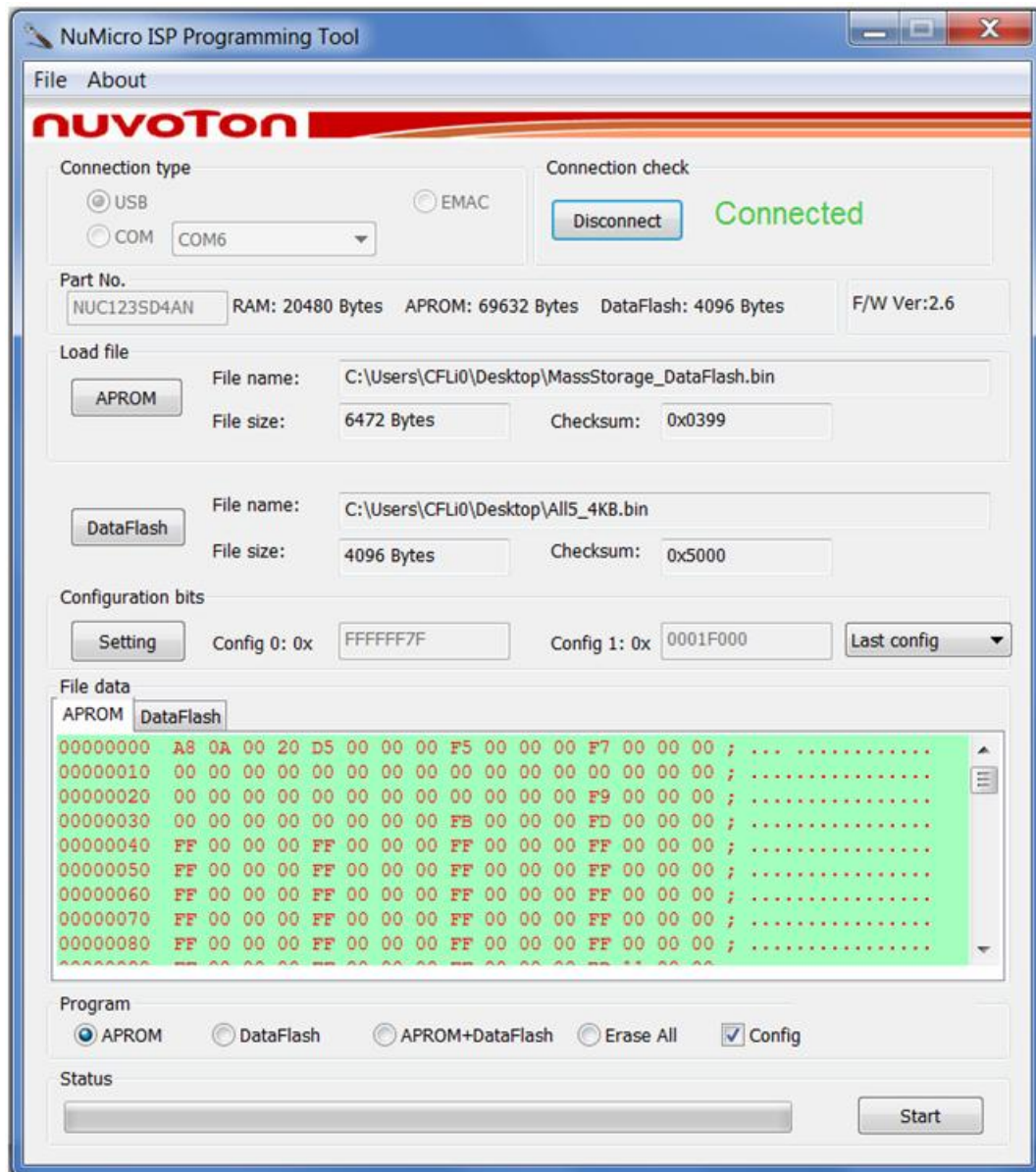


Figure 4-10 ISP connected via USB

- **Step 3:** Click the '**APROM**' or '**DataFlash**' button to select the image from the pop-up window to be programmed. To modify the User Configuration bits, click the '**Setting**' button. Please refer to section 3.2.1 to configure the User Configuration before starting to program the target board.

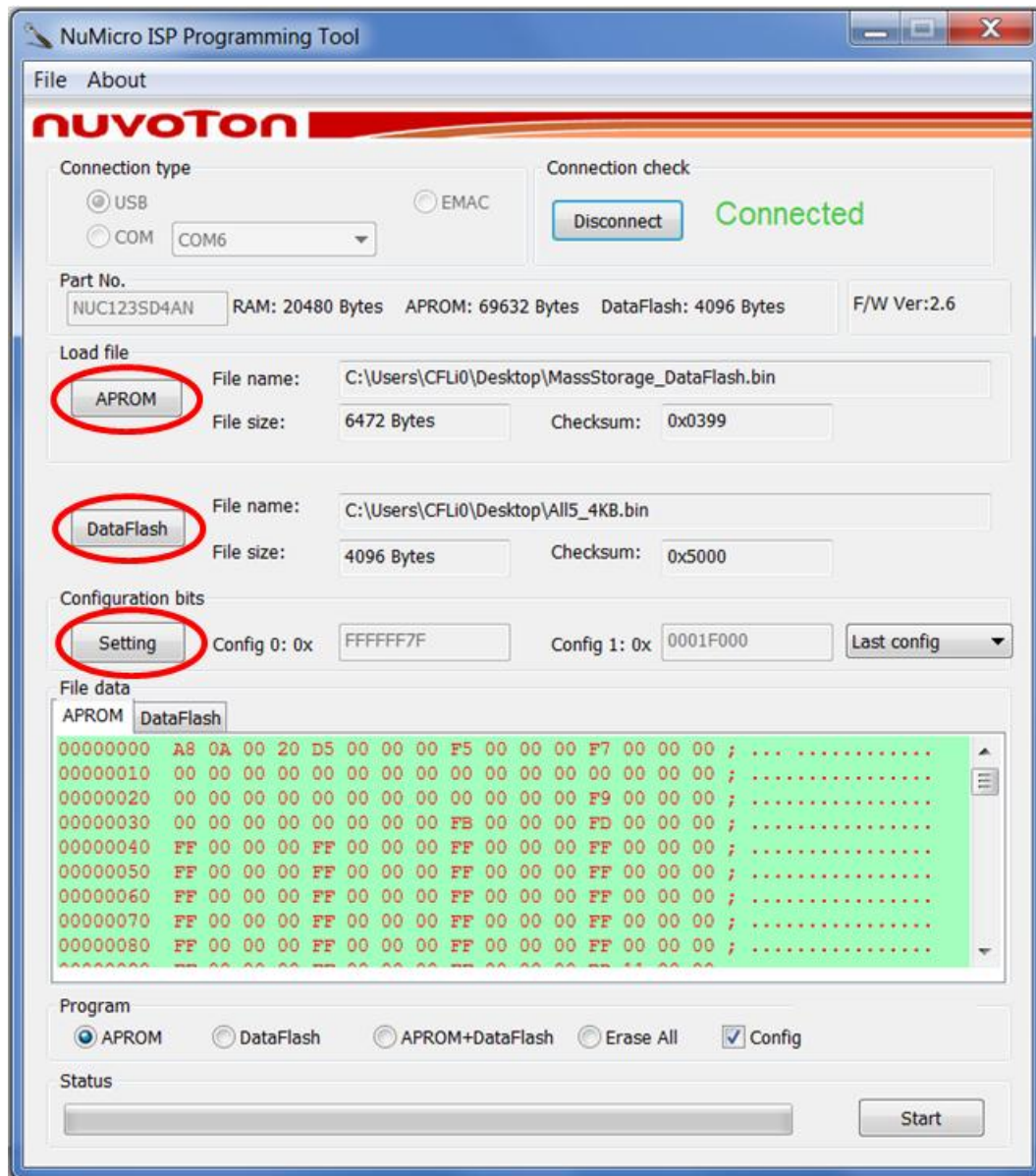


Figure 4-11 ISP Load File

- **Step 4:** Select an option from 'APROM', 'DataFlash', 'APROM+DataFlash', and 'Erase All' in the 'Program' area, and then click the 'Start' button to start programming the target board. Select 'APROM' to program APROM, 'DataFlash' to program Data Flash, and 'APROM+DataFlash' to program both APROM and Data Flash. Select 'Erase All' to erase the whole chip including User Configuration. The 'Config' option circled in the following figure is used to update the User Configuration setting.

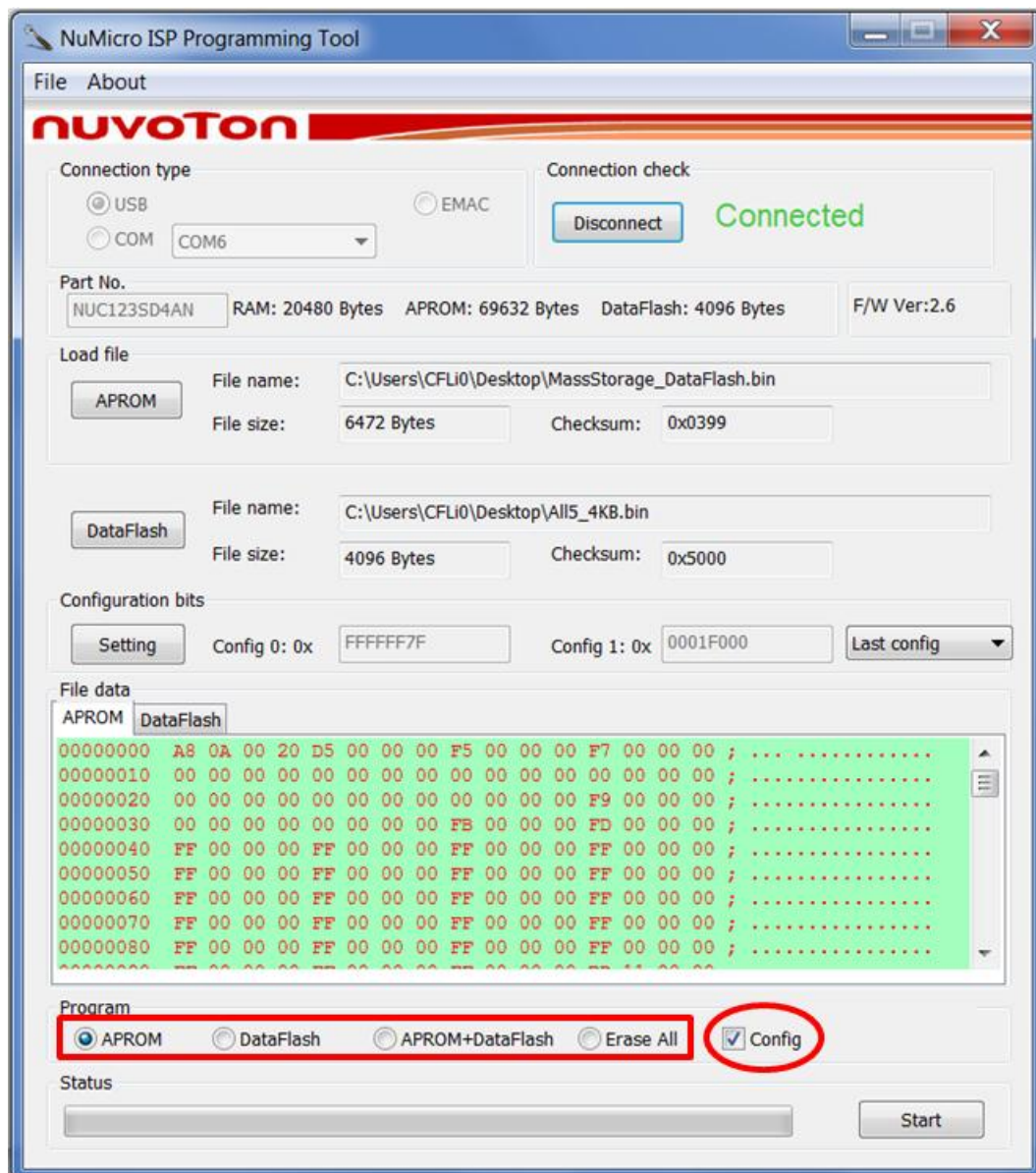


Figure 4-12 Select Programming Items

- **Step 5:** Click the '**Start**' button to start programming the target board. A progress bar in the '**Status**' area shows the current progress. The final result, either pass or fail, can be found in the '**Program**' area. Once the programming is finished, the MCU chip will automatically jump to APROM to execute the APROM image, while the connection status on ISP tool will switch to '**Disconnected**' state. To connect the target system to the host once again, please reset the target system and repeat Steps 2-5.

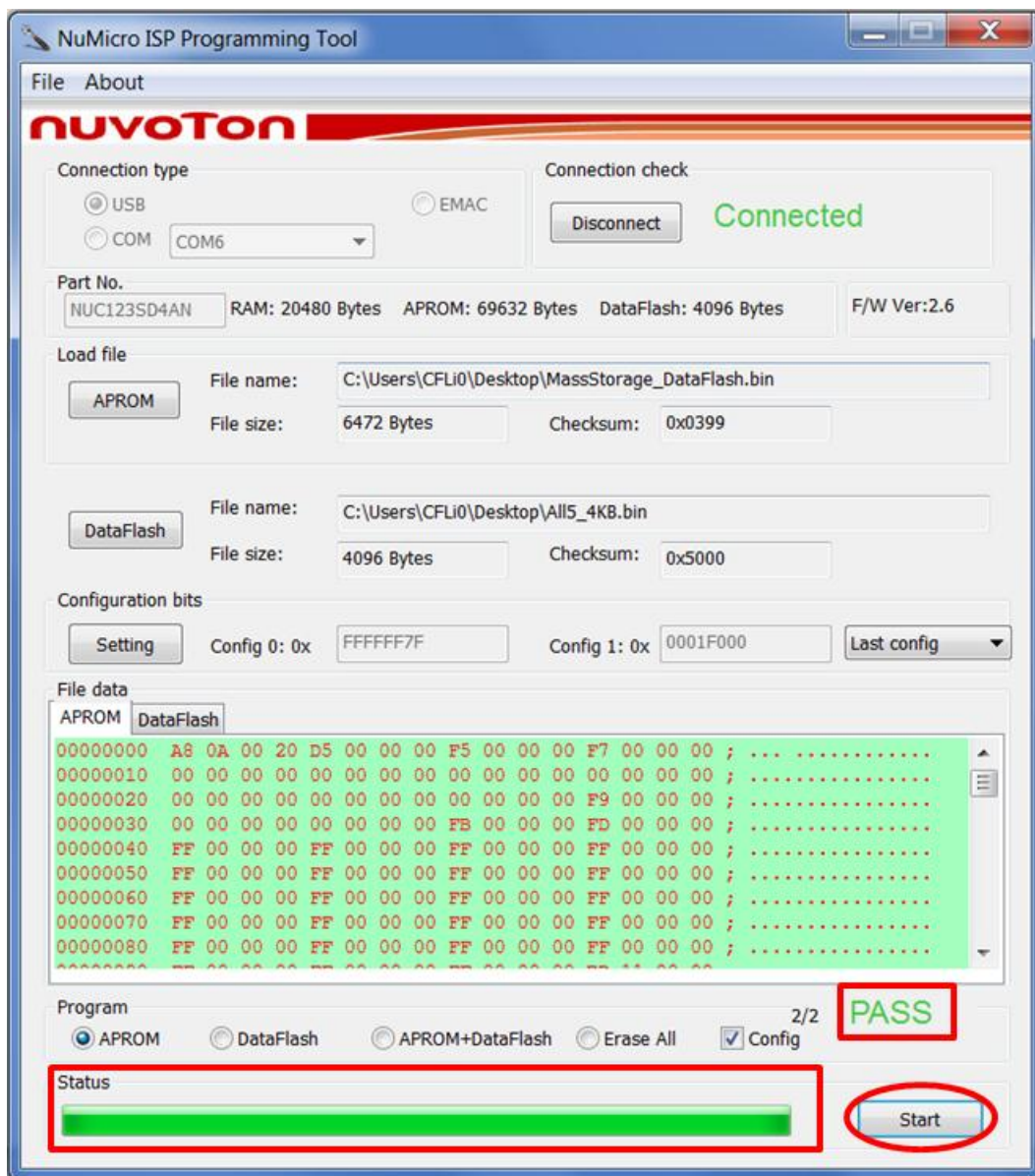


Figure 4-13 Programming Result

4.3 ISP through Ethernet

Follow the steps below to use the ISP tool through Ethernet interface.

- **Step 1:** Select the connection type as '**EMAC**'.

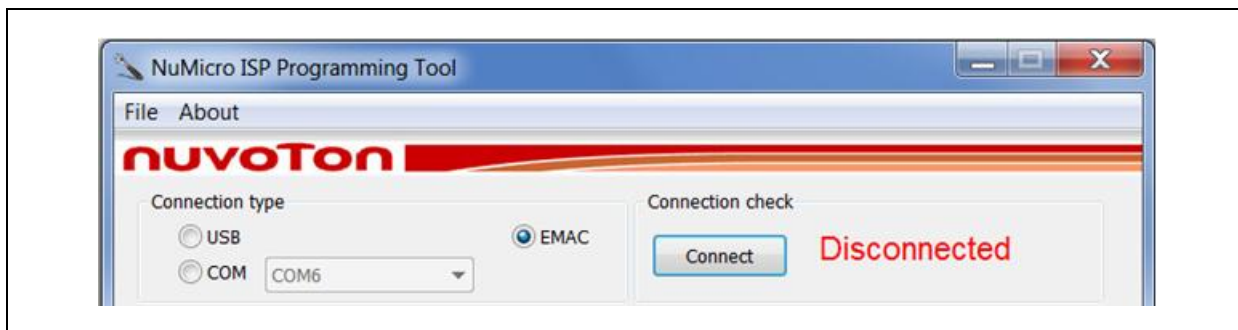


Figure 4-14 Connection Type Selected as Ethernet

- **Step 2:** Click the '**Connect**' button after a target system receives an IP address from DHCP server. The connection status will switch to '**Connected**' if connected successfully.

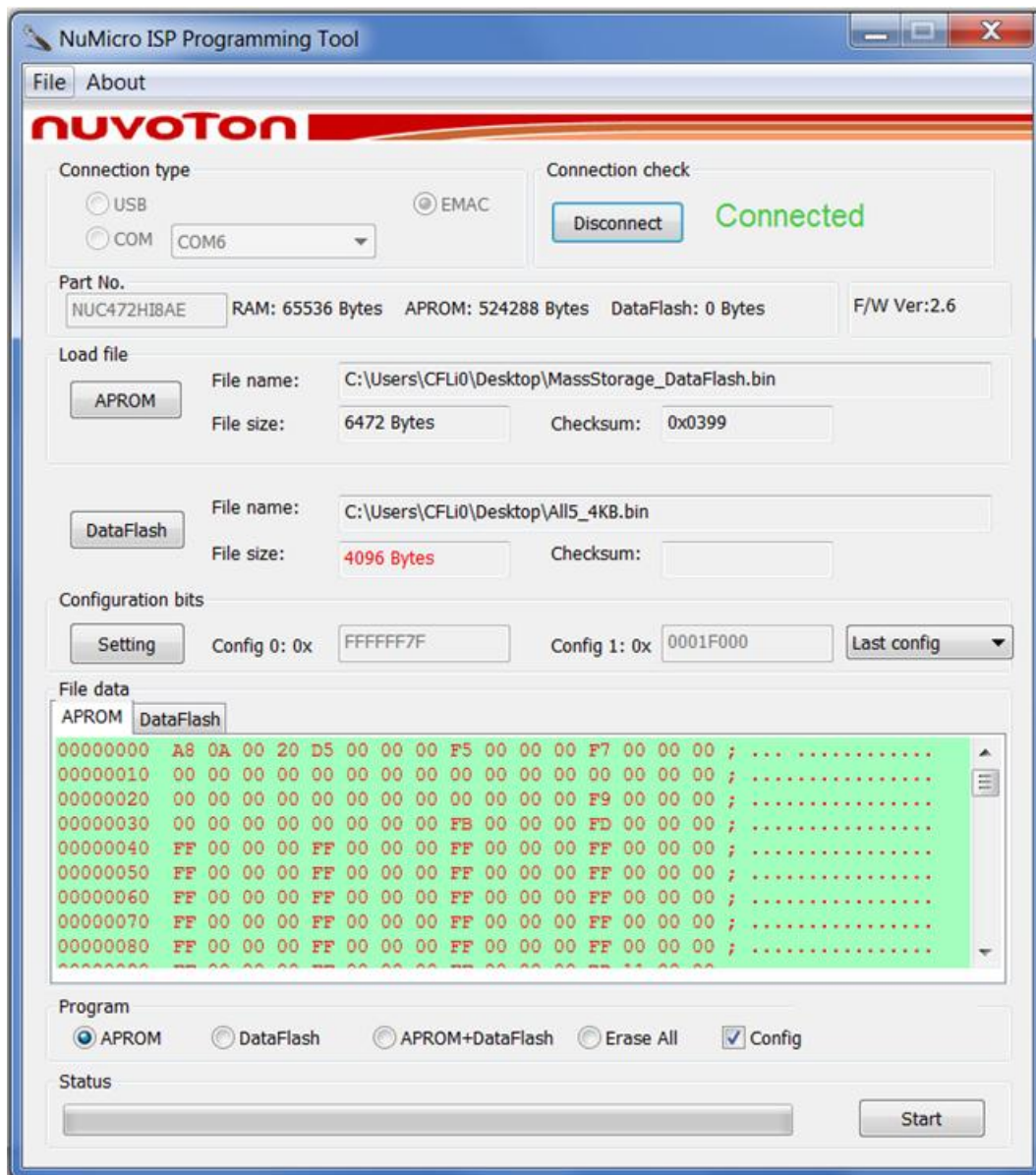


Figure 4-15 ISP Connected via Ethernet

- **Step 3:** Click the '**APROM**' or '**DataFlash**' button to select the image from the pop-up window to be programmed. To modify the User Configuration bits, click the '**Setting**' button. Please refer to section 3.2.1 to configure the User Configuration before starting to program the target board.

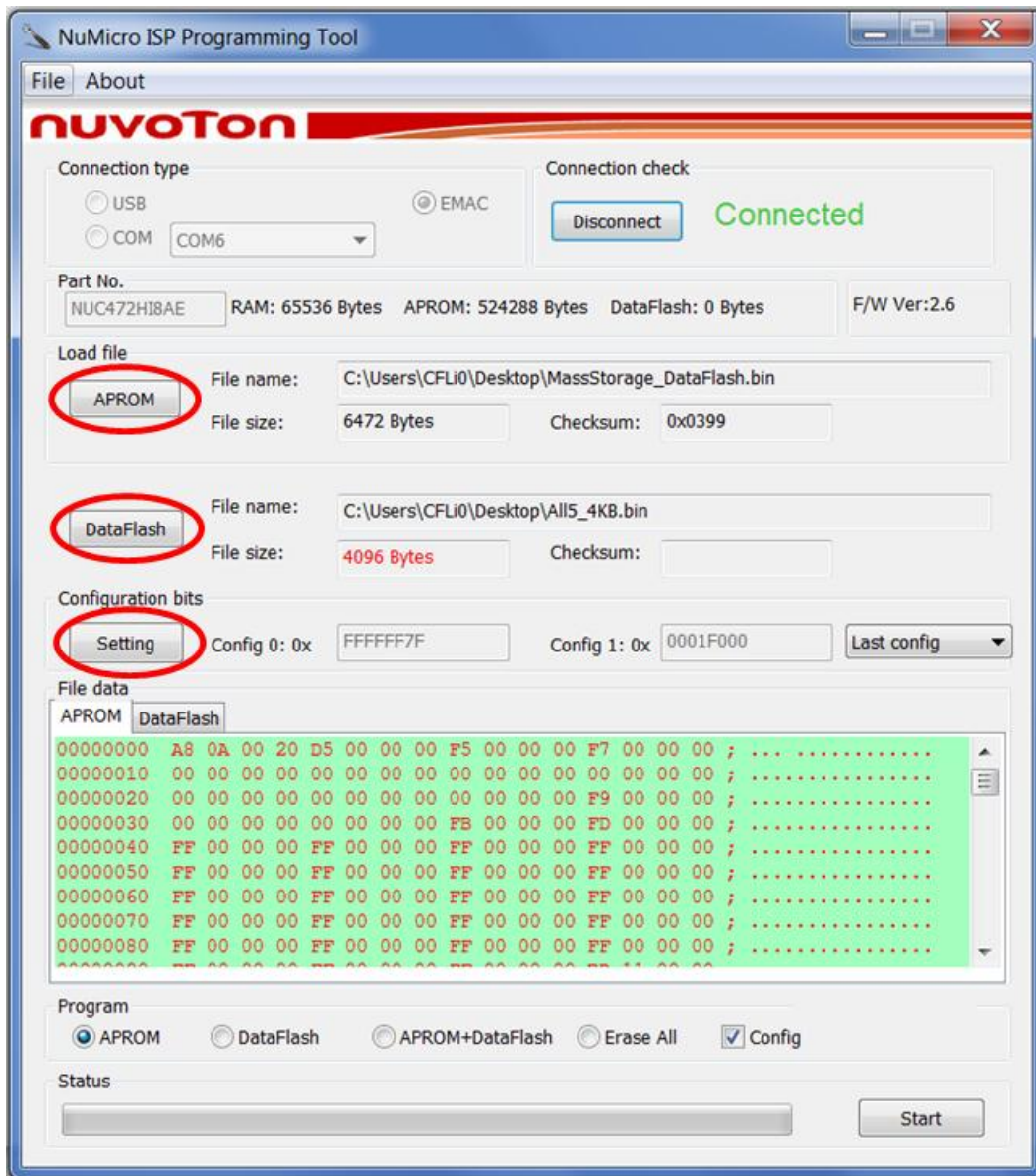


Figure 4-16 ISP Load File

- **Step 4:** Select an option from 'APROM', 'DataFlash', 'APROM+DataFlash', and 'Erase All' in the 'Program' area, and then click the 'Start' button to start programming the target board. Select 'APROM' to program APROM, 'DataFlash' to program Data Flash, and 'APROM+DataFlash' to program both APROM and Data Flash. Select 'Erase All' to erase the whole chip including User Configuration. The 'Config' option circled in the following figure is used to update the User Configuration

setting.

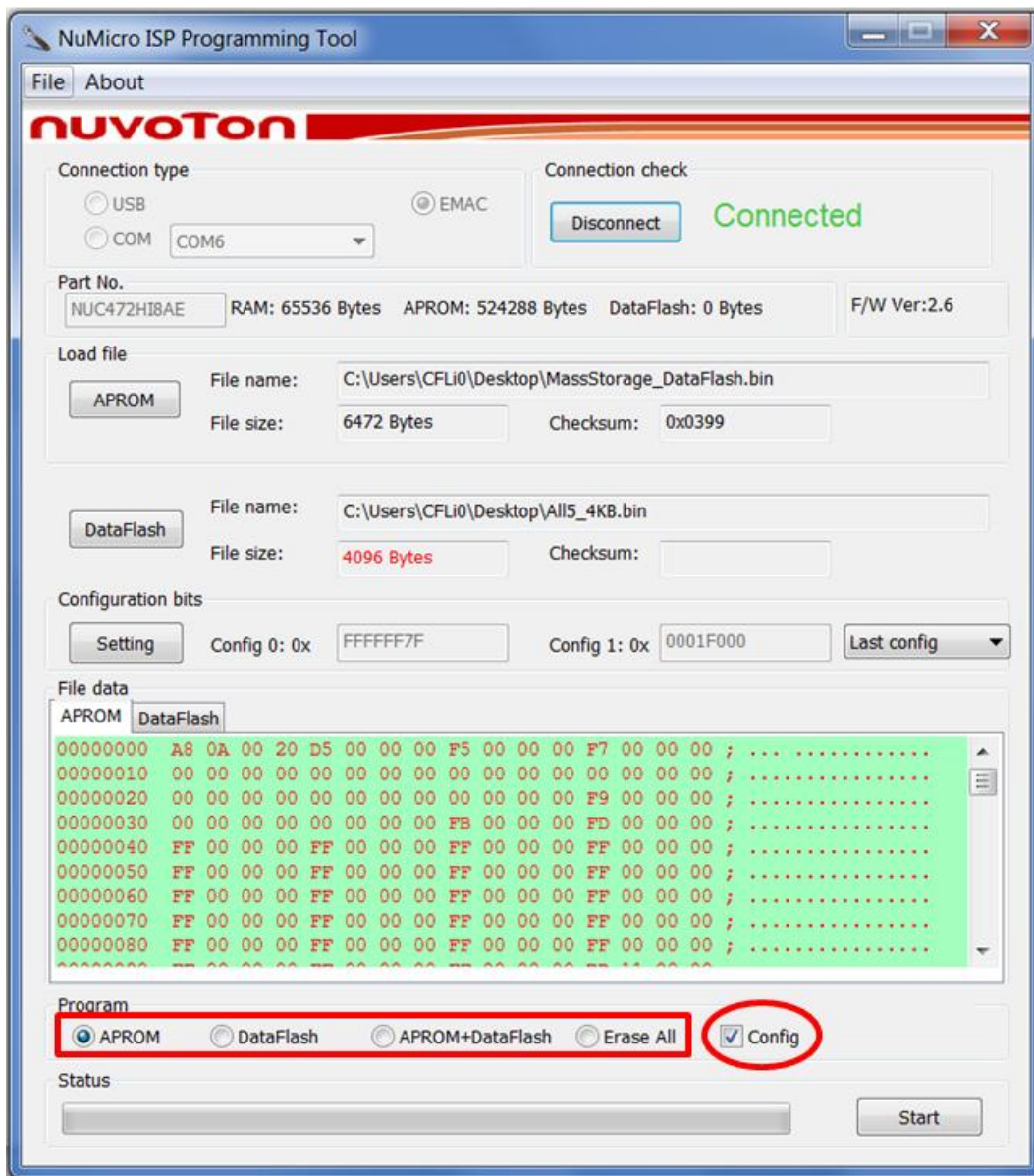


Figure 4-17 Select Programming Items

- **Step 5:** Click the '**Start**' button to start programming the target board. A progress bar in the '**Status**' area shows the current progress. The final result, ether pass or fail,

can be found in the '**Program**' area. Once the programming is finished, the MCU chip will automatically jump to APROM to execute the APROM image, while the connection status on ISP tool will switch to '**Disconnected**' state. To connect the target system to the host once again, please reset the target system and repeat Steps 2-5.

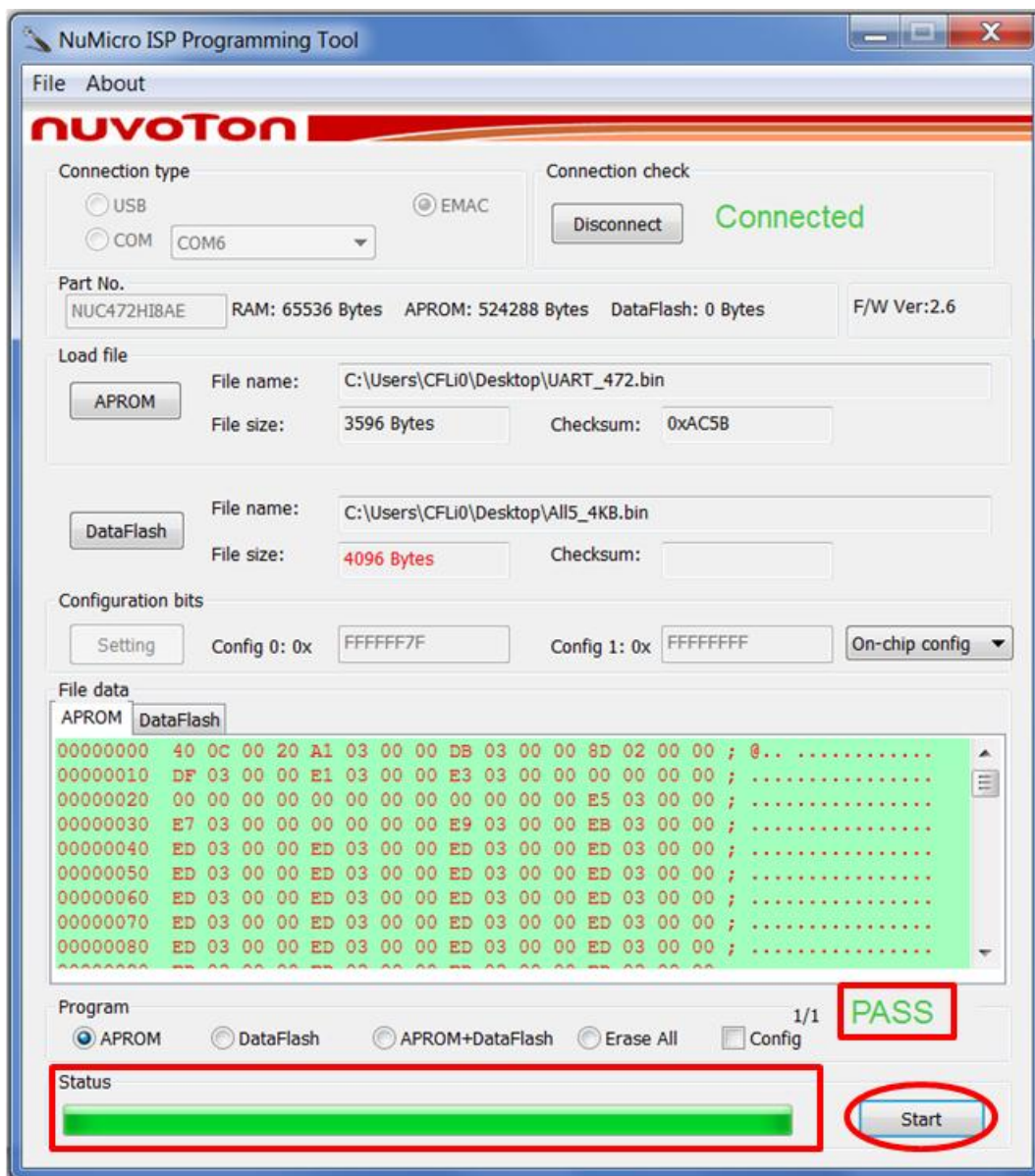


Figure 4-18 Programming Result

5 ISP Project File

The ISP tool v1.44 or later supports a project file with the extension '.isp' which saves the current settings and data image for user to retrieve the current setting and image later on different computer.

5.1 Save Project

Click the **"Save project"** button in the **"File"** menu to save current setting including User Configuration, APROM image file path, Data Flash image file path, ISP connection setting, APROM raw data, and Data Flash raw data to a project file. A file selection form will be displayed for user to select the file name. After a file name is selected, click **"OK"** to save the current state to a project file.

5.2 Load Project

User can load the previous setting from the project file that includes User Configuration, APROM raw data image, Data Flash raw data image and the file path of APROM image and Data Flash image will be loaded.

User can save the project in one computer and then load it on another computer. It's possible that other computer does not have any APROM or Data Flash image file in the file path recorded by a project file. To avoid such inconsistency, the ISP tool always loads APROM and Data Flash raw data images from a project file and does not read images from local image files. To use local images instead of the images stored in a project file, the user must reselect APROM and Data Flash files from the ISP tool by clicking the **"APROM"** and **"DataFlash"** buttons.

5.3 Auto Reload

The ISP tool automatically records the last operation state. Upon opening the ISP tool, the last operation state, including User Configuration, connection port, APROM image file path, and Data Flash file path, is automatically reloaded. The ISP tool will also load the raw image data from APROM file and Data Flash file if they exist.

On the ISP tool interface, user can select User Configuration setting from "Last config" or "On-Chip config", where the "Last config" is the User Configuration setting of the last operation state, while "On-Chip config" is the setting read from current connected MCU.

6 Revision History

Revision	Date	Description
1.32	Dec. 08, 2010	First formal released version.
1.40	Mar. 21, 2011	<ol style="list-style-type: none"> Updated Nuvoton Standard ISP Code to v2.3, which <ol style="list-style-type: none"> Integrated the 'ISP through COM port' and 'ISP through USB' function for NUC120/140/101; and Improved the operation stability. Added 'Erase Flag' for erasing control of Data Flash during ISP operation. Fixed some application program bugs.
1.41	Apr. 29, 2011	Added support for ISP project file.
1.41.2	Aug. 29, 2011	Added support for Nano100 and Mini51 series.
1.41.3	Nov. 17, 2011	Modified Data Flash base address error for Nano100 and Mini51 series.
1.42.1	Aug. 28, 2012	Added NUC123 support.
1.44	Jan. 20, 2014	<ol style="list-style-type: none"> Added Mini51BN, MINI51DE, M051CN, M051DE, NUC200, and Nano112 support. Added the User Configuration form for M051AN/BN, M051CN/DE, MINI51AN, MINI51BN, MINI51DE, Nano100, Nano112, NUC100, NUC122, NUC123, and NUC200 series. Updated the project file format to include APROM and Data Flash images file body, not only file path. Removed "Erase Flag", which causes Data Flash be erased. Also, updated all ISP firmware to version 2.4. Provided Nano112 ISP firmware.
1.45	Jun. 10, 2014	<ol style="list-style-type: none"> Added M451 Series and NUC029 support. Added the form of the hardware connection for COM port or USB interface. Modified description for Hardware Connection for 'ISP through COM Port or USB'.
1.45.1	Jul. 31, 2014	Added NUC131/M0518 support.

1.46	Nov. 28, 2014	<ol style="list-style-type: none">1. Support NUC472 ISP connected via Ethernet interface.2. Added Mini51X/ISD9100/M45xD/M45xC support.
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Important Notice

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