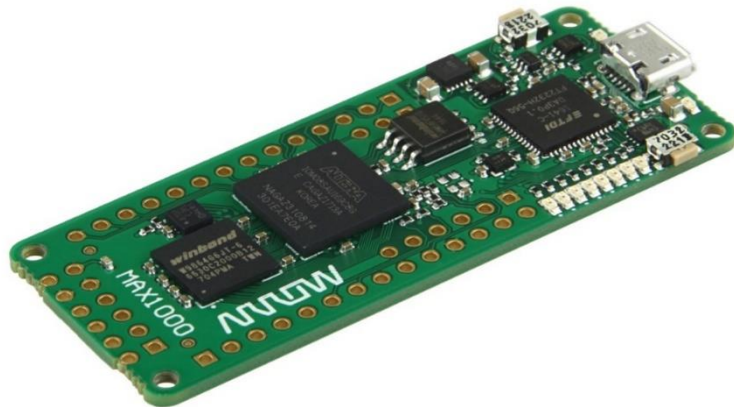




## MAX1000

# Authentication Flash Lab



### Software and hardware requirements to complete all exercises

**Software Requirements:** Quartus® Prime Lite or Standard Edition version 18.0 or 18.1

**Hardware Requirements:** ARROW MAX1000 Board



## 1. Introduction

This tutorial introduces the operation of authentication flash memory through a demo. This memory provides handshake between the controller and the memory to ensure enhanced security of the data transmitted between the two devices.

**Lab Notes:** Many of the names that the lab asks you to choose for files, components, and other objects in this exercise must be spelled exactly as directed. This nomenclature is necessary because the pre-written software application includes variables that use the names of the hardware peripherals. Naming the components differently can cause errors.

## 2. Getting Started

The first objective is to ensure that you have all the necessary hardware items and software installed so that the lab can be completed successfully. Below is a list of items required to complete this lab:

- MAX1000 Board (10M08SAU169C8G)
- USB Cable
- Lab files: Authentication\_Flash\_lab\_template: Template files are required to complete the lab. It includes the archived project and all the C code and headers file for the Nios II soft processor.
- Quartus Prime 18.0 Lite was used for this lab. Previous/newer versions should work (If no Quartus Prime is installed, refer to MAX1000 User Guide for instructions)
- Installed Arrow USB Drivers (If not, refer to MAX1000 User Guide for instructions)
- Personal computer or laptop running 64-bit Linux / Windows 7 or later with at least an Intel i3 core (or equivalent), 4GB RAM and 12 GB of free hard disk space
- A desire to learn!

## 3. Project with MAX1000

### 3.1 FPGA Configuration

#### 3.1.1 Restore archived project

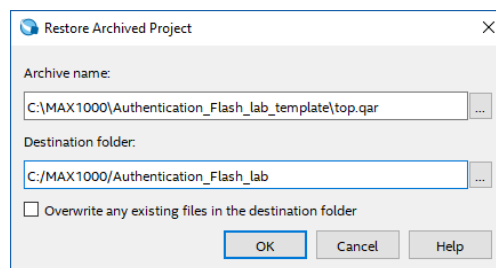
3.1.1.1 If not already open, from the Start menu or the Desktop, open the Quartus Prime 18.0 Lite software.

3.1.1.2 Select **Project** → **Restore Archived Project...**

3.1.1.3 Add archive project by clicking on the  button for archive name and browse into the lab files folder where you will locate the provided design files and add:

- **top.qar**


3.1.1.4 Enter a directory in which you will store your Quartus project files for this design, for example, **C:/MAX1000/Authentication\_Flash\_lab**.



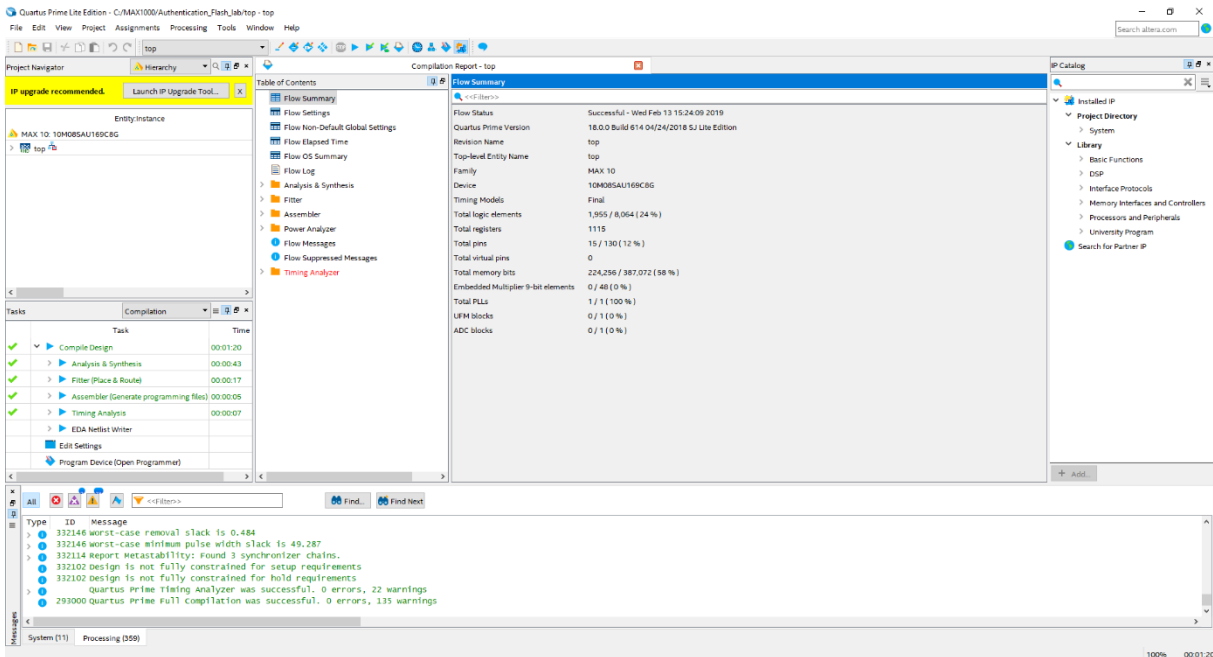
3.1.1.5 Click **OK**.



### 3.1.2 Compiling the Design

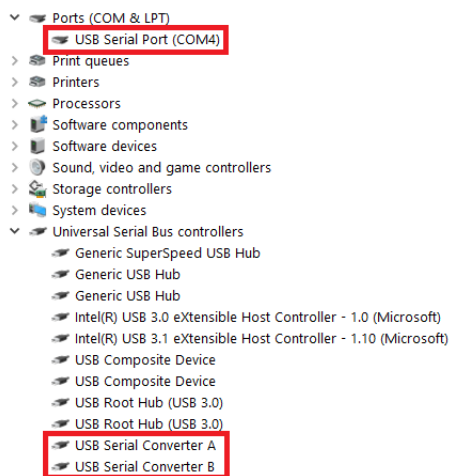
3.1.2.1 Start Compilation by clicking on  button on the toolbars, or **Processing** → **Start Compilation**.

The 100% in the lower right corner or a green checkmark next to the Compile Design in the Compilation task window indicates that the compilation was successful.

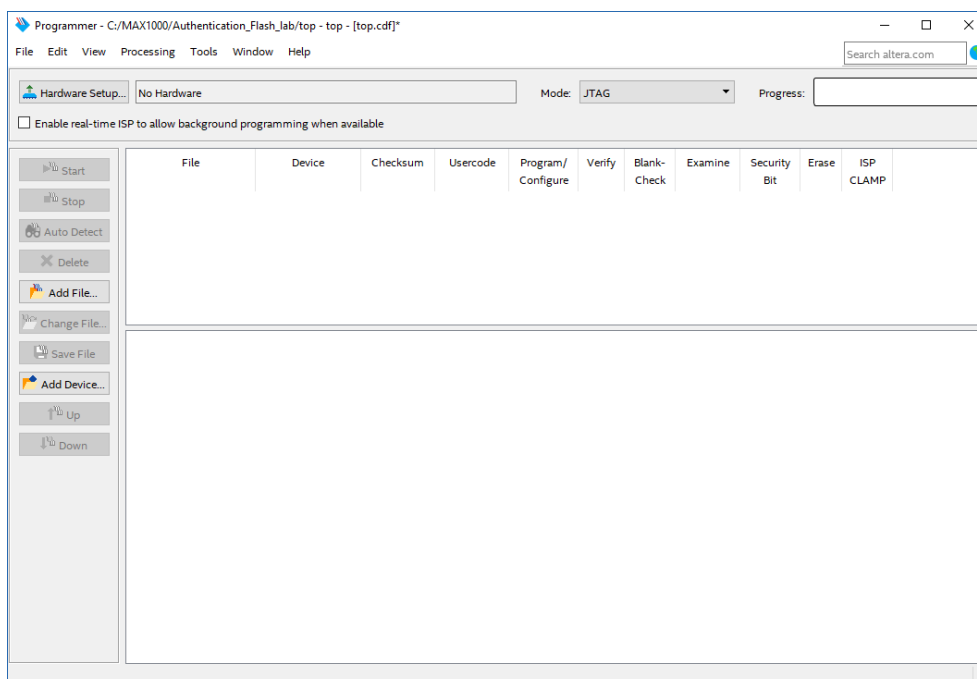


### 3.1.3 Configuration

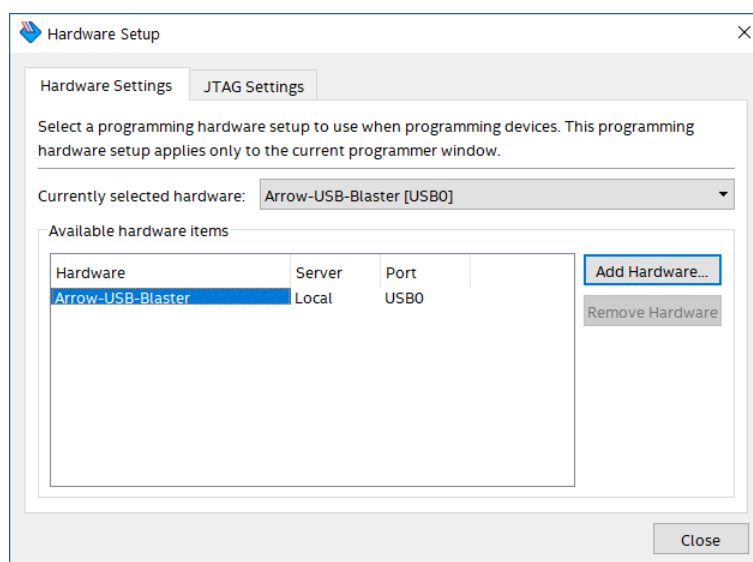
3.1.3.1 Connect your MAX1000 board to your PC using a USB cable. Since the Arrow USB Blaster should be already installed, the Window's Device Manager should display the following entries are highlighted in red (port number may differ depending on your PC):



3.1.3.2 Open the Quartus Prime Programmer from **Tools** → **Programmer** or double click on Program Device (Open Programmer) from the Task window.

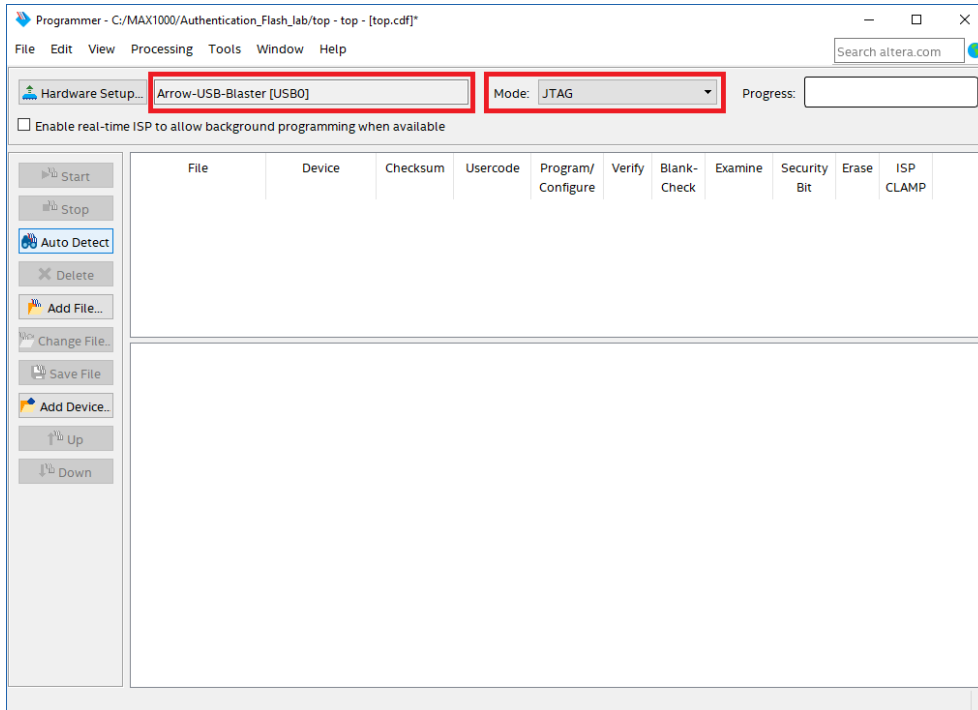


3.1.3.3 Click **Hardware Setup...** and double click **Arrow-USB-Blaster** entry in the Hardware Setup tab. The Currently selected hardware should now show Arrow-USB-Blaster [USB0] (depending on your PC, the USB port number may variant).



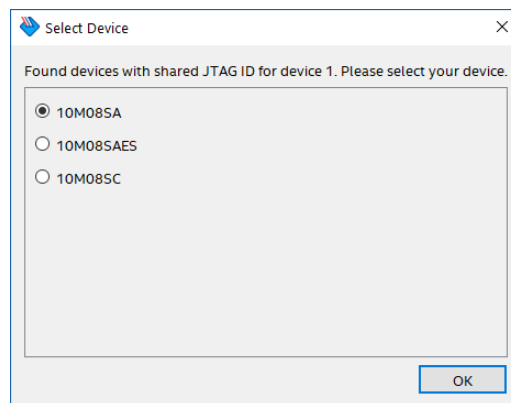
3.1.3.4 Click **Close**.

3.1.3.5 Make sure the hardware setup is Arrow-USB-Blaster [USB0] and the mode is JTAG. Click **Auto Detect**.



3.1.3.6 If the configuration has been added by default, you can skip the following steps and continue with the 3.1.3.11 point.

3.1.3.7 Select **10M08SA** device and click **OK** in the pop-up window.

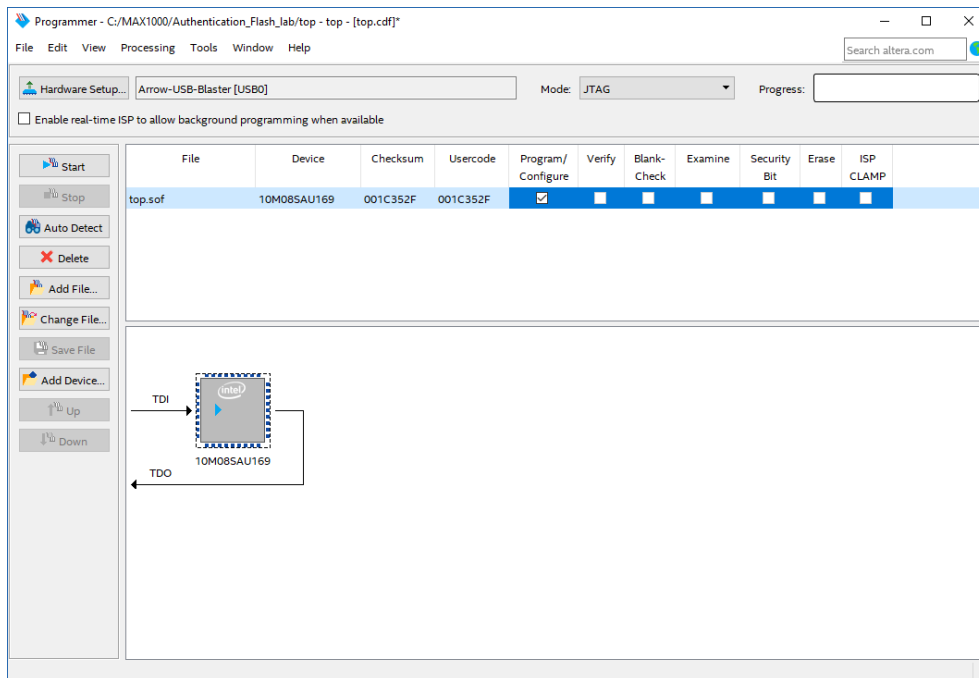


3.1.3.8 Click **Change File...** or double click <none> to choose the programming file.

3.1.3.9 Navigate to the <project\_directory>\ and select the **top.sof** file.

3.1.3.10 Click **Open**.

3.1.3.11 Make sure the Programmer shows the correct file and the correct part in the JTAG chain and check the Program/Configure checkbox.



3.1.3.12 Click **Start** to program the board. When the configuration is complete, the Progress bar should show 100% (Successful).

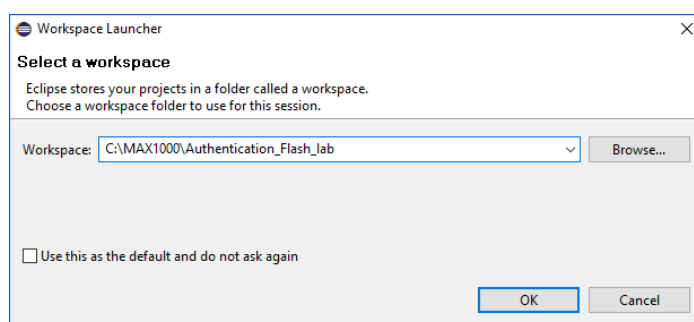


## 3.2 Software implementation

### 3.2.1 Create a new software project

3.2.1.1 From the main Quartus Prime window, start STB from **Tools → Nios II Software Build Tools for Eclipse**.

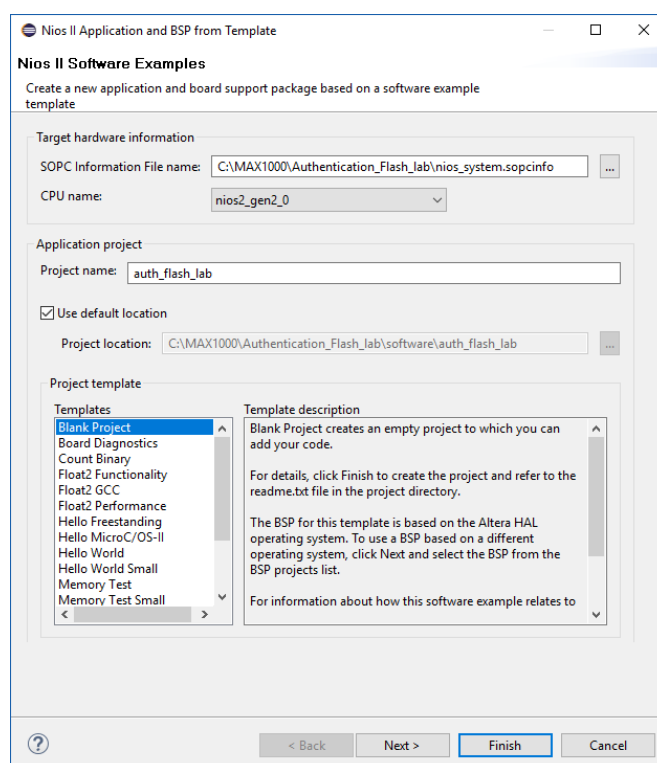
3.2.1.2 The Eclipse Workspace Launcher will open. Click **Browse...** and choose the directory of your project. In this case it was C:\MAX1000\Authentication\_Flash\_lab.



3.2.1.3 Click **OK** and the Eclipse will open.

3.2.1.4 Select **File → New → Nios II Application and BSP from Template**.

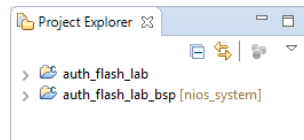
3.2.1.5 Click to select the **nios\_system.sopcinfo** from your project directory and name the project **auth\_flash\_lab**. Select **Blank Project** from the Templates.





3.2.1.6 Click **Finish**.

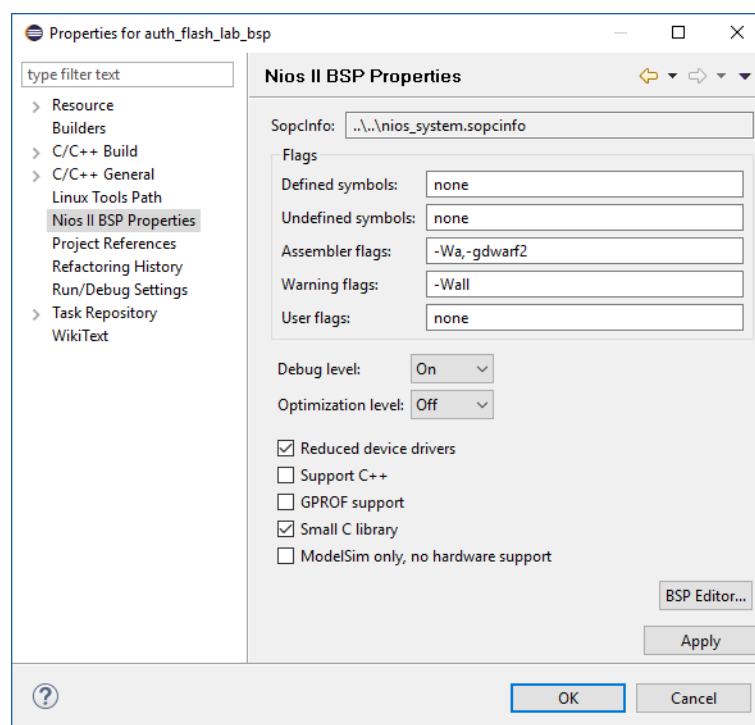
3.2.1.7 Eclipse will create two directories in the workspace, one for the application project and one for the BSP.



3.2.1.8 Right click on the `auth_flash_lab_bsp` project and select **Properties** from the pop-up menu.

3.2.1.9 In the Properties window select the **Nios II BSP Properties** tab. It may take a moment to load the settings.

3.2.1.10 To keep the software footprint small so fits our device, enable **Reduced device drivers** and **Small C library** options. As there is no C++ code, uncheck the Support C++ option.



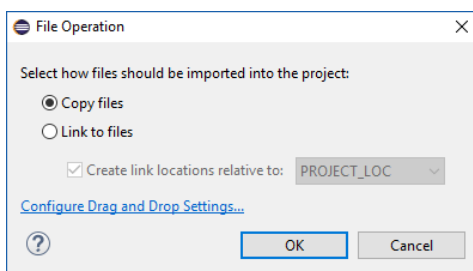
3.2.1.11 Click **Apply**, and then **OK**.

### 3.2.2 Add source code to the project

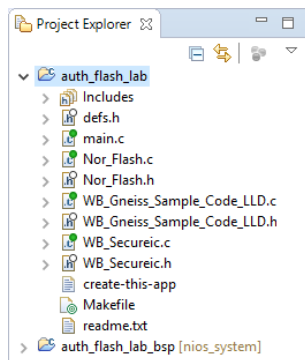
**Note:** The source files have been provided for you in this lab. All that needs to be done is to copy it to your workspace.

3.2.2.1 From Windows Explorer, navigate to the lab files folder where you locate the provided design files.

3.2.2.2 Select all files in **source** folder and drag it into the auth\_flash\_lab directory in Eclipse. Select the **Copy files** option in the pop-up and click **OK**.

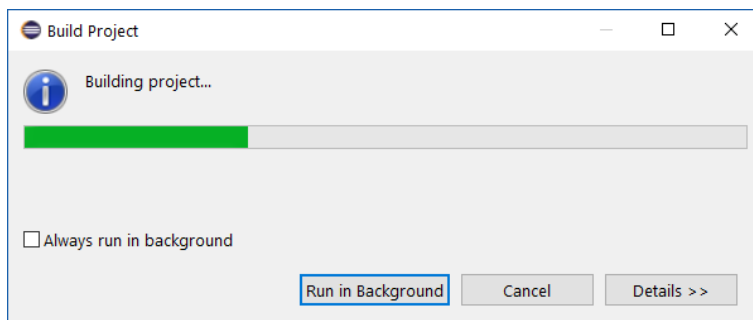


You should now see the new files appear under the auth\_flash\_lab project in the Project Explorer.



### 3.2.3 Build the software

3.2.3.1 Right click on the auth\_flash\_lab\_bsp project and select **Build Project** from the pop-up menu.



3.2.3.2 Repeat the previous step for the auth\_flash\_lab application project.

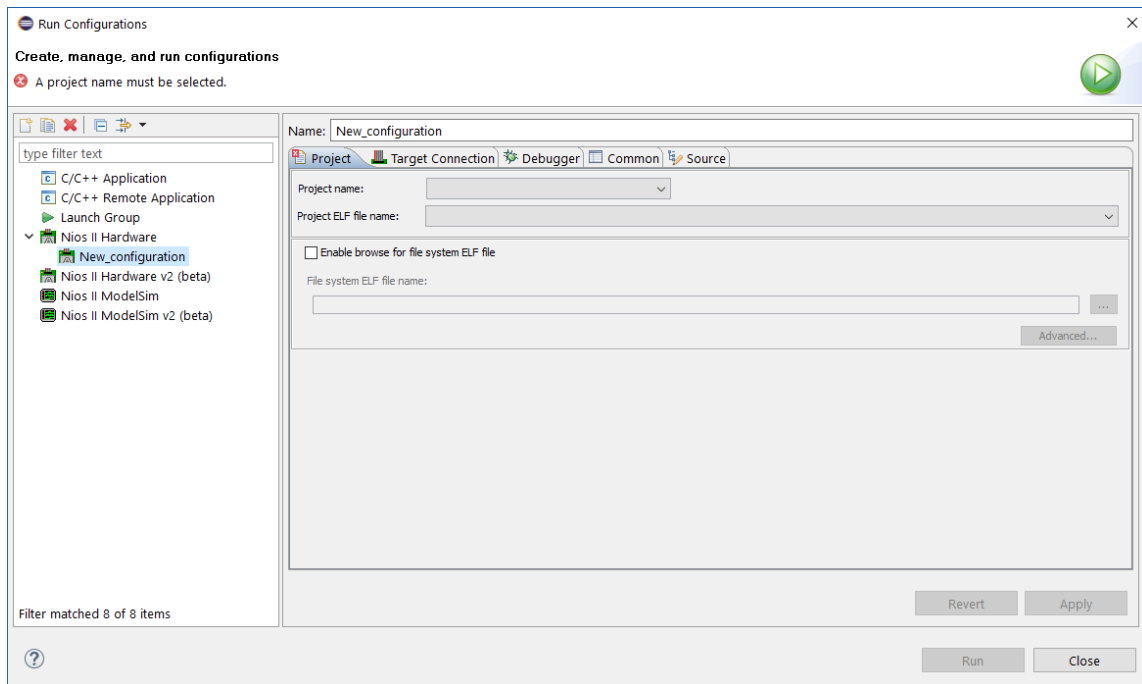
```

CDT Build Console [auth_flash_lab]
Info: Linking auth_flash_lab.elf
nios2-elf-g++ -T'../auth_flash_lab_bsp//linker.x' -msys-crt0='../auth_flash_lab_bsp//obj/HAL
nios2-elf-insert auth_flash_lab.elf --thread_model hal --cpu_name nios2_gen2_0 --qsys true --
Info: (auth_flash_lab.elf) 19 KBytes program size (code + initialized data).
Info:          5556 Bytes free for stack + heap.
Info: Creating auth_flash_lab.objdump
nios2-elf-objdump --disassemble --syms --all-header --source auth_flash_lab.elf >auth_flash_1
[auth_flash_lab build complete]

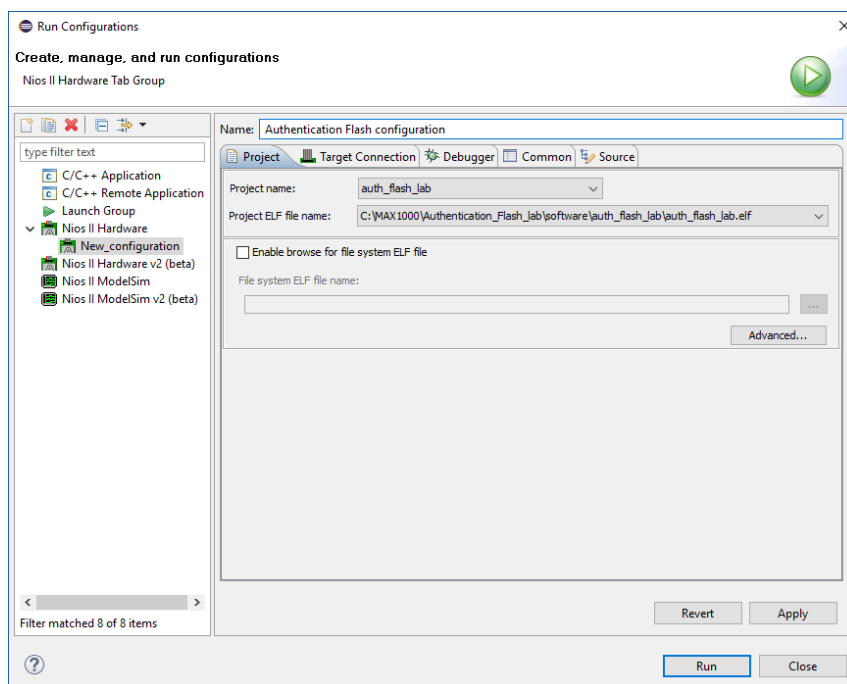
16:25:45 Build Finished (took 4s.493ms)
  
```

### 3.2.4 Run the application

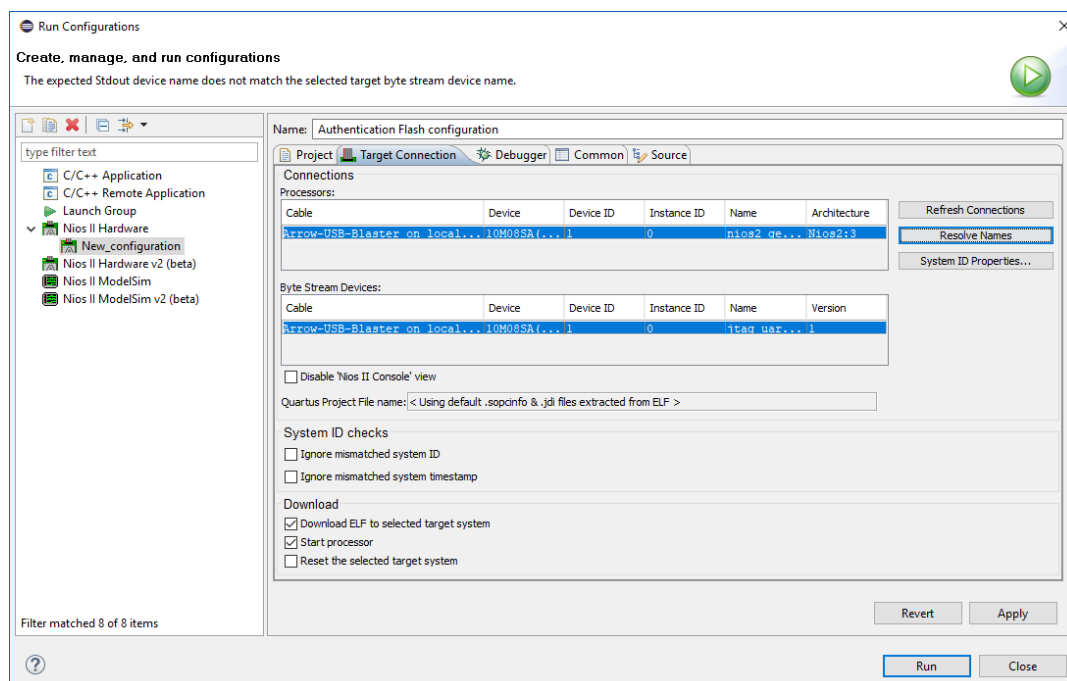
3.2.4.1 Select auth\_flash\_lab and go to **Run → Run Configurations...** and double click to **Nios II Hardware** to add a new configuration.



3.2.4.2 Rename it to **Authentication Flash configuration** and on the Project tab select **auth\_flash\_lab** from the drop-down menu for the Project name.



3.2.4.3 Click on the **Target Connection** tab and click **Refresh Connections** button. The configured MAX1000 board should appear.




3.2.4.4 Click **Apply** and **Run**.



3.2.4.5 After a few second, the Nios II Console should open at the bottom of the Eclipse.

```
Problems Tasks Console Nios II Console Properties
Authentication Flash configuration - cable: Arrow-USB-Blaster on localhost [USB0] device ID: 1 instance ID: 0 name: jtag_uart_0_jtag
== MAX1000 WB_SPI_Flash Demo ==
JEDEC ID : ef4017
Write RootKey : Success!
update HMACKey : Success!
Requester signature:
46 252 96 83 115 94 167 201 249 201 156 54 212 220 2 27 7 127 99 19 184 120 180 56 77 152 177 240 204 94 110 188
ReadStatus tag:
50 48 49 53 49 49 49 49 50 52 53 55
ReadStatus Counter Data:
0 0 0 2
ReadStatus Signature:
149 100 11 49 70 102 89 159 18 64 168 165 10 120 76 228 193 84 150 206 135 65 95 13 218 142 91 87 25 97 67 26
Increase counter : Success!
RPMC_Counter Data = 2
----Challenge-----
Requester signature:
46 252 96 83 115 94 167 201 249 201 156 54 212 220 2 27 7 127 99 19 184 120 180 56 77 152 177 240 204 94 110 188
ReadStatus tag:
50 48 49 53 49 49 49 49 50 52 53 55
ReadStatus Counter Data:
0 0 0 3
ReadStatus Signature:
220 183 92 244 249 197 130 214 77 118 222 203 22 255 136 203 121 179 161 139 93 70 27 126 159 89 240 171 209 91 103 47
Verify_signature:
220 183 92 244 249 197 130 214 77 118 222 203 22 255 136 203 121 179 161 139 93 70 27 126 159 89 240 171 209 91 103 47
Challenge Success!
```

After this message, the software downloaded to MAX1000 and start to test the external flash memory.

3.2.4.6 Stop the program running by clicking on  button on the top right corner of Nios II Console window.

**CONGRATULATIONS! YOU HAVE SUCCESSFULLY COMPLETED THE AUTHENTICATION FLASH LAB!**



## 5 Revision History

| Version | Change Log   | Date of Change |
|---------|--|----------------|
| V1.0    | Initial Version  | 15/11/2017     |
| V1.1    | <ul style="list-style-type: none"><li>- Remove Arrow MAX1000 USB Driver installation</li><li>- Remove Nios II EDS installation</li><li>- Correction / clarity changes</li><li>- Formal changes</li></ul> | 13/02/2019     |



## 6 Legal Disclaimer

### ARROW ELECTRONICS

#### EVALUATION BOARD LICENSE AGREEMENT

By using this evaluation board or kit (together with all related software, firmware, components, and documentation provided by Arrow, "Evaluation Board"), You ("You") are agreeing to be bound by the terms and conditions of this Evaluation Board License Agreement ("Agreement"). Do not use the Evaluation Board until You have read and agreed to this Agreement. Your use of the Evaluation Board constitutes Your acceptance of this Agreement.

#### PURPOSE

The purpose of this evaluation board is solely intended for evaluation purposes. Any use of the Board beyond these purposes is on your own risk. Furthermore, according to the applicable law, the offering Arrow entity explicitly does not warrant, guarantee or provide any remedies to you with regard to the board.

#### LICENSE

Arrow grants You a non-exclusive, limited right to use the enclosed Evaluation Board offering limited features only for Your evaluation and testing purposes in a research and development setting. Usage in a live environment is prohibited. The Evaluation Board shall not be, in any case, directly or indirectly assembled as a part in any production of Yours as it is solely developed to serve evaluation purposes and has no direct function and is not a finished product.

#### EVALUATION BOARD STATUS

The Evaluation Board offers limited features allowing You only to evaluate and test purposes. The Evaluation Board is not intended for consumer or household use. You are not authorized to use the Evaluation Board in any production system, and it may not be offered for sale or lease, or sold, leased or otherwise distributed for commercial purposes.

#### OWNERSHIP AND COPYRIGHT

Title to the Evaluation Board remains with Arrow and/or its licensors. This Agreement does not involve any transfer of intellectual property rights ("IPR") for evaluation board. You may not remove any copyright or other proprietary rights notices without prior written authorization from Arrow or its licensors.

#### RESTRICTIONS AND WARNINGS

Before You handle or use the Evaluation Board, You shall comply with all such warnings and other instructions and employ reasonable safety precautions in using the Evaluation Board. Failure to do so may result in death, personal injury, or property damage.

You shall not use the Evaluation Board in any safety critical or functional safety testing, including but not limited to testing of life supporting, military or nuclear applications. Arrow expressly disclaims any responsibility for such usage which shall be made at Your sole risk.

#### WARRANTY

Arrow warrants that it has the right to provide the evaluation board to you. This warranty is provided by Arrow in lieu of all other warranties, written or oral, statutory, express or implied, including any warranty as to merchantability, non-infringement, fitness for any particular purpose, or uninterrupted or error-free operation, all of which are expressly disclaimed. The evaluation board is provided "as is" without any other rights or warranties, directly or indirectly.

You warrant to Arrow that the evaluation board is used only by electronics experts who understand the dangers of handling and using such items, you assume all responsibility and liability for any improper or unsafe handling or use of the evaluation board by you, your employees, affiliates, contractors, and designers.





#### **LIMITATION OF LIABILITIES**

In no event shall Arrow be liable to you, whether in contract, tort (including negligence), strict liability, or any other legal theory, for any direct, indirect, special, consequential, incidental, punitive, or exemplary damages with respect to any matters relating to this agreement. In no event shall arrow's liability arising out of this agreement in the aggregate exceed the amount paid by you under this agreement for the purchase of the evaluation board.

#### **IDENTIFICATION**

You shall, at Your expense, defend Arrow and its Affiliates and Licensors against a claim or action brought by a third party for infringement or misappropriation of any patent, copyright, trade secret or other intellectual property right of a third party to the extent resulting from (1) Your combination of the Evaluation Board with any other component, system, software, or firmware, (2) Your modification of the Evaluation Board, or (3) Your use of the Evaluation Board in a manner not permitted under this Agreement. You shall indemnify Arrow and its Affiliates and Licensors against and pay any resulting costs and damages finally awarded against Arrow and its Affiliates and Licensors or agreed to in any settlement, provided that You have sole control of the defense and settlement of the claim or action, and Arrow cooperates in the defense and furnishes all related evidence under its control at Your expense. Arrow will be entitled to participate in the defense of such claim or action and to employ counsel at its own expense.

#### **RECYCLING**

The Evaluation Board is not to be disposed as an urban waste. At the end of its life cycle, differentiated waste collection must be followed, as stated in the directive 2002/96/EC. In all the countries belonging to the European Union (EU Dir. 2002/96/EC) and those following differentiated recycling, the Evaluation Board is subject to differentiated recycling at the end of its life cycle, therefore: It is forbidden to dispose the Evaluation Board as an undifferentiated waste or with other domestic wastes. Consult the local authorities for more information on the proper disposal channels. An incorrect Evaluation Board disposal may cause damage to the environment and is punishable by the law.