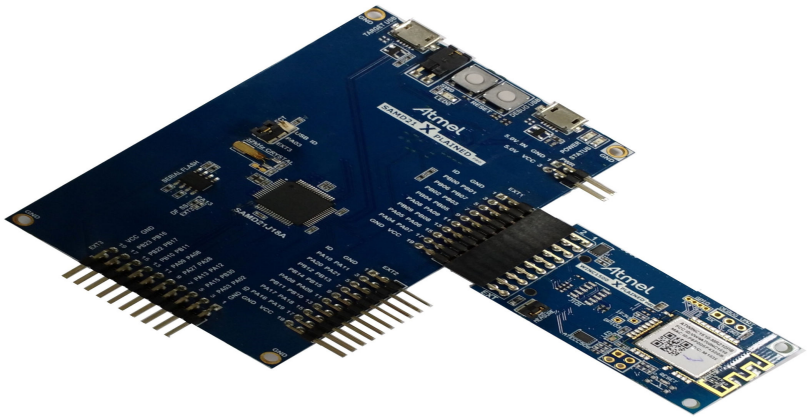
ATWINC15x0/ATWINC3400

Integrated Serial Flash Memory Download Procedure

Introduction

The ATWINC1500/ATWINC3400 features an on-chip microcontroller and integrated SPI Flash memory for the system firmware. The serial Flash memory also stores the root certificate required for the TLS/SSL connection and the power gain values used by the transceiver. This application note details the download procedure of firmware, TLS/SSL root certificates, and TX power gain values into WINC serial Flash through different supported serial interfaces like SPI/UART. This document also covers some useful troubleshooting tips for download failures.



Features

- Firmware download procedure
- Root certificate download procedure
- Gain table values download procedure
- Modified provisioning webpage download
- Troubleshooting tips
- Common download procedure for WINC1500 and WINC3400

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1. Firmware Update Project

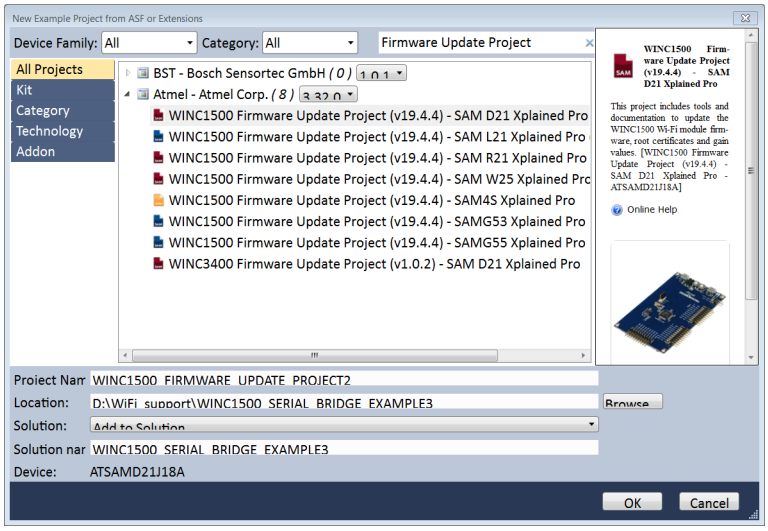
The WINC1500 or WINC3400 Firmware Update Project is retrieved through the Atmel Software Framework (ASF). The latest Firmware Update Project contains the new firmware images as well as the batch script files used to download the firmware, TLS/SSL root certificate, provisioning webpage, and TX power gain values into the Wi-Fi Network Controller (WINC) through SPI/UART.

1.1 Import Firmware Update Project

Prerequisites: Install Atmel Studio. The latest version is available on the Atmel Gallery or found on the Atmel Studio Extensions manager.

1. Search for "Firmware Update Project" from the "New Example Project" of ASF menu in Atmel Studio.

   Figure 1-1. Firmware Update Project in ASF

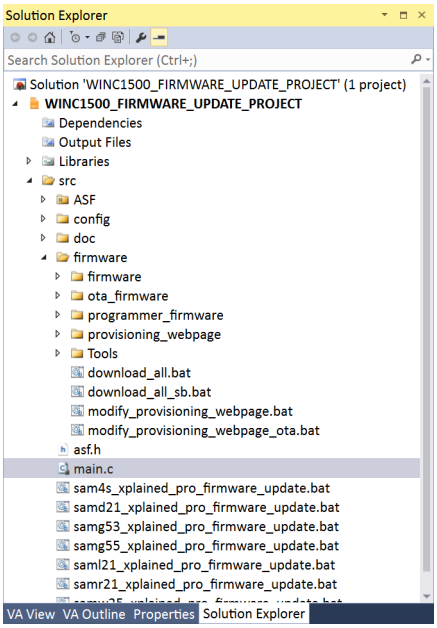


2. Select the appropriate "WINC Firmware Update Project (vxx.x.x)" corresponding to the intended host MCU Xplained Pro board and then press the **OK** button to import firmware update project and related documentation.

1.2 Project Overview

The Firmware Update Project appears as a regular project in Atmel Studio.

Figure 1-2. Firmware Update Project Overview



`/src/firmware` folder – Contains the new WINC firmware as well as:

- The `download_all.bat` script - To download the WINC firmware, TLS/SSL root certificate, and TX power gain values.
- The `modify_provisioning_webpage.bat` - To update the WINC firmware image with a custom modified HTTP provisioning webpage.

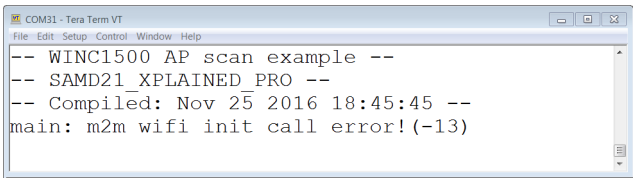
`/src` folder – Contains update scripts to download the WINC firmware, TLS/SSL root certificate, and TX power gain values at one go using a serial bridge through host MCU Xplained Pro boards.

1.3 Firmware Version Mismatch Indication

When there is an update for the WINC, it usually combines the Wi-Fi software API for the host MCU and a binary firmware for the WINC. To ensure the compatibility between the Wi-Fi software API on the host MCU and the WINC, a major/minor version number is used and verified at the Wi-Fi driver init.

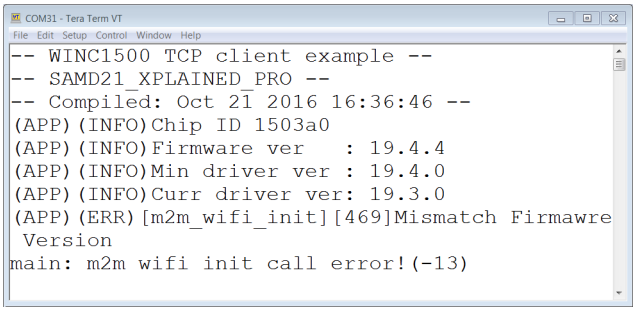
When a version mismatch is detected at start-up, the Wi-Fi driver initialization fails and the `m2m_wifi_init()` function returns the firmware version mismatch error code. The required baud rate configuration on terminal window is 115200 8-N-1-N.

Figure 1-3. Firmware Version Mismatch Error Code



Setting the `CONF_WIFI_DEBUG` to `'1'` in the `conf_winc.h` configuration file of the host application project provides more information about the version mismatch error.

Figure 1-4. Firmware Version Mismatch Error



In this scenario, a firmware update with the appropriate firmware version number is expected. Each ASF release is tied to one particular WINC driver/firmware release.

1.4 Downloading Interfaces

The WINC serial Flash download (WINC firmware, TLS/SSL root certificate, and TX power gain values) is done by connecting a Windows computer to:

- Host MCU UART (typically the EDBG COM port when using an Xplained Pro board) – The host MCU is connected to the WINC via SPI, thus, host MCU UART acts as a serial bridge between a Windows computer and a WINC device.
- WINC built-in UART

2. Serial Flash Download via Serial Bridge

As the WINC device is connected to host MCU through SPI interface, upgrading the WINC serial Flash via the host MCU is an easier solution. Since the WINC provides transparent access to host MCU, the WINC serial Flash can be read/written from host MCU. The host MCU can program the serial (SPI) Flash without the need for operational firmware in the WINC. The host MCU running the serial bridge firmware is connected between a Windows computer and a WINC SPI to download the firmware to a WINC serial Flash.

2.1 Serial Flash Download Using SAM Xplained Pro Board

The `/src/firmware/Tools/serial_bridge` contains the serial bridge binary images for a few of SAM-based host MCUs. This serial bridge firmware uses UART interface available on SAM Xplained Pro boards.

The batch script files available in `/src` folder contains the scripts to program the platform specific serial bridge binary image on the host MCU before it starts the WINC serial Flash download. EDBG on SAM Xplained Pro board is used for programming serial bridge image. The script uses the Atmel Studio atprogram.exe commands for programming the host MCU via EDBG of SAM Xplained Pro boards.

2.1.1 Hardware Setup

The download procedure requires that the WINC module is attached on EXT1 of the SAM Xplained Pro kit. Plug a Micro-USB cable from a Windows computer to the debug USB port of the Xplained Pro kit.

Figure 2-1. USB Connection With Xplained Pro Kit

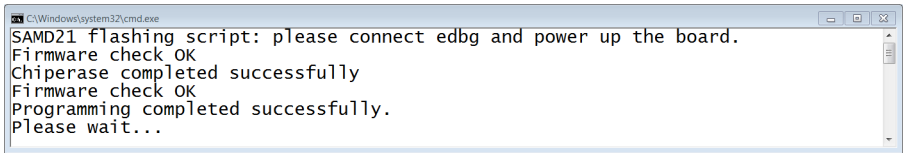
2.1.2 Batch Script

A list of batch (`.bat`) script files in the `/src` folder of "WINCXXXX_Firmware_Update_Project (vxx.x.x)" is used to trigger a WINC serial Flash download.

1. Ensure that the SAM Xplained Pro board is connected to a PC via debug USB port. The virtual EDBG COM port of the board is now listed in the device manager.

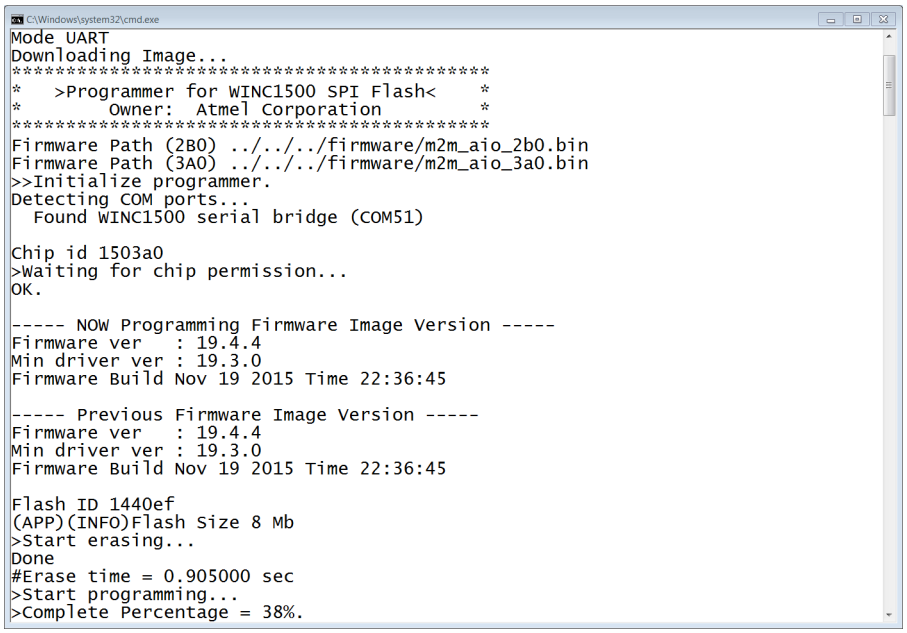
2. Run the `sam_xplained_pro_firmware_update.bat` script that corresponds to the connected SAM Xplained Pro board.
3. The batch script programs a serial bridge binary on the host MCU to redirect firmware data from the computer (EDBG virtual COM port) to the WINC chip (via SPI). The serial bridge application also performs the WINC power-up sequence, thus ensuring that the WINC bootloader is in the appropriate state to start a download.

Figure 2-2. Serial Bridge Firmware Programming : Success



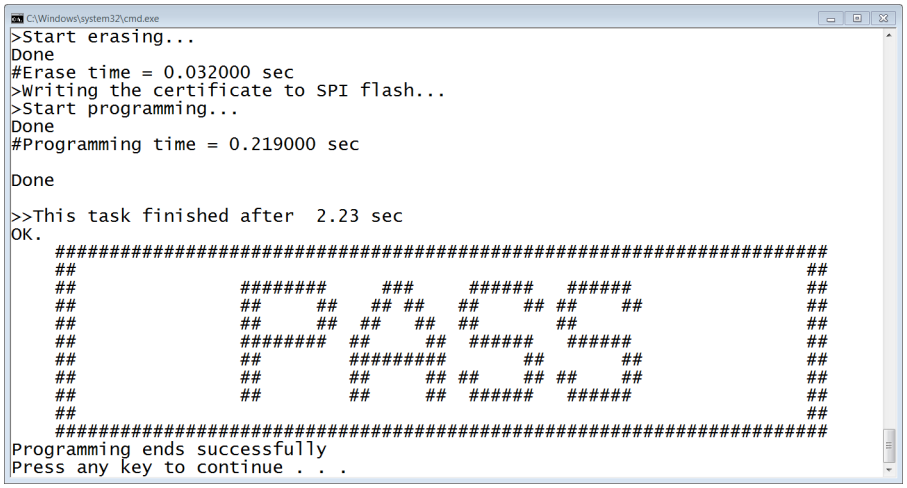
4. During the download process, the batch script provides information about the output the firmware version being programmed onto the WINC as well as the previously installed firmware version.

Figure 2-3. Displaying Firmware Version



5. After several seconds, the following message appears to indicate that the WINC download procedure is successfully completed.

Figure 2-4. WINC Serial Flash Download : Success



Result: The WINC chip firmware, TLS/SSL root certificates, and TX power gain values are successfully updated. Refer to Download Failure Troubleshooting in case of failure.

Note: The serial Flash download using EDBG virtual COM of SAM Xplained Pro on Virtual OS is unsupported at present.

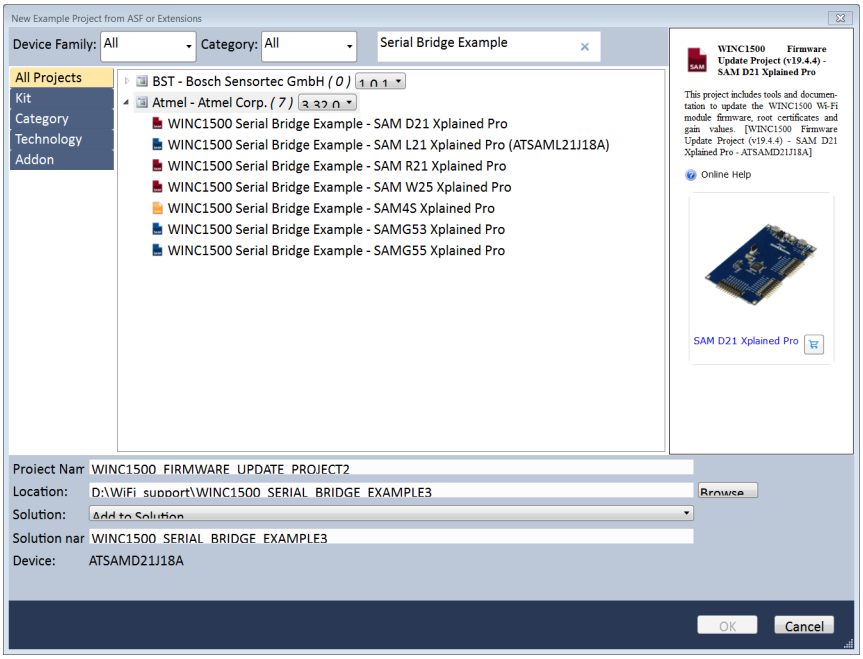
2.2 Serial Flash Download Using Custom Host MCU

The serial bridge example application is available in ASF for a few of the SAM-based host MCUs.

Prerequisites: Install latest version of the Atmel Studio.

1. Search for "Serial Bridge Example" from the "New Example Project" of ASF menu in Atmel Studio. The search result lists the available Serial Bridge example projects for supported host MCU Xplained Pro board of the WINC device.

Figure 2-5. Serial Bridge Example Projects in ASF



2. Select the appropriate “WINC Serial Bridge Example” project corresponding to the intended host MCU Xplained Pro board and then press the **OK** button to import the project and related documentation.

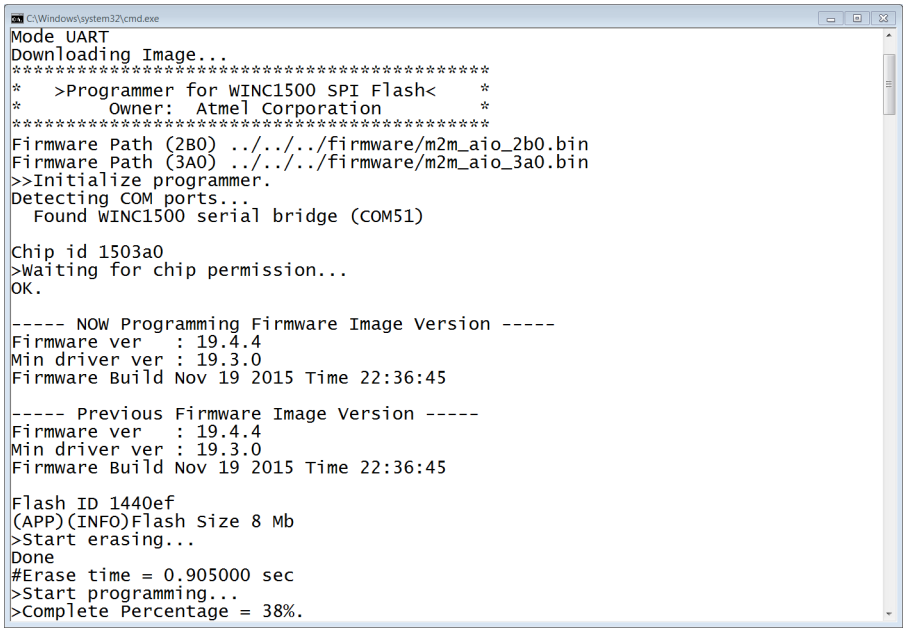
Note: This project can be considered as a base for implementing serial bridge for custom-specific host MCUs. Porting of serial bridge firmware to custom host MCU is not within the scope of this document.

2.2.1 Batch Script

The `download_all.bat` is located in the `src/firmware` folder of the “WINCXXXX_Firmware_Update_Project”, which triggers the serial Flash download.

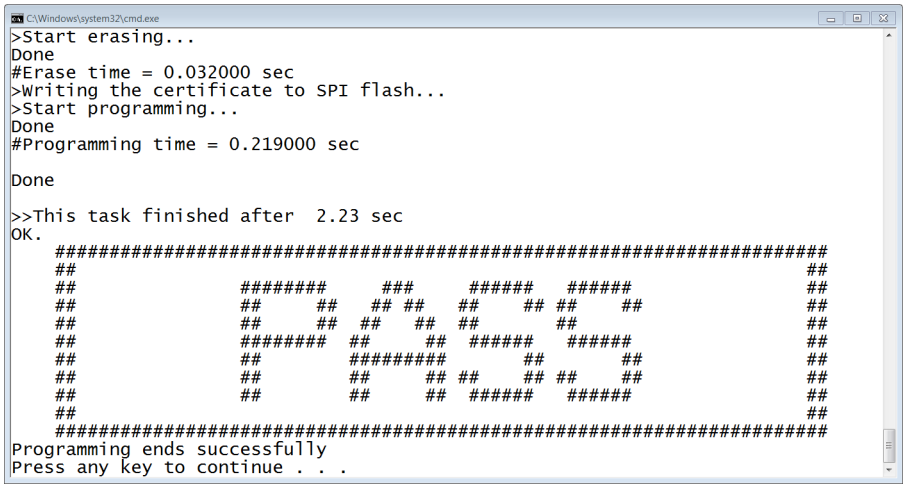
1. Program the host MCU with the custom implemented serial bridge firmware.
2. Ensure that the WINC device connected to the host MCU is powered up and that the host UART is connected to a PC.
3. In a Windows shell, run the command `download_all.bat UART` to start the download.
4. During the download process, the batch script provides information about the output firmware version being programmed onto the WINC as well as the previously installed firmware version.

Figure 2-6. Displaying Firmware Version



5. After several seconds, the following message appears to indicate that the WINC download procedure is successfully completed.

Figure 2-7. WINC Serial Flash Download : Success



Result: The WINC chip firmware, TLS/SSL root certificates, and TX power gain values are successfully updated. Refer to Download Failure Troubleshooting in case of failure.

3. Serial Flash Download via Built-in UART

The serial Flash download is done using the built-in UART of the WINC device. Prior to running any update script, setup the hardware as required.

Note: WINC3400 does not support download through built-in UART at present.

3.1 Hardware Setup

3.1.1 Power-On Sequence

To perform a serial Flash download using the WINC built-in UART, it is mandatory that the WINC chip is in the right bootloader state. To do so, the host MCU must power-up the WINC chip and then perform the Reset sequence as defined in the *IEEE 802.11 b/g/n SmartConnect IoT Module Datasheet (DS70005304A)*. This is done very easily from the host MCU by calling the `m2m_bsp_init()` function.

```
int main(void)
          {
             /* Initialize the board. */
             system_init();

             /* Initialize the BSP. */
             nm_bsp_init();

             while(1) {
             }
          }
```

3.1.2 UART Pin assignment

The pin assignment of WINC1500 module UART are described in the following table. On ATWINC1500 Xplained Pro, TX, and RX are available on through holes labeled as “DEBUG_UART” for easy identification.

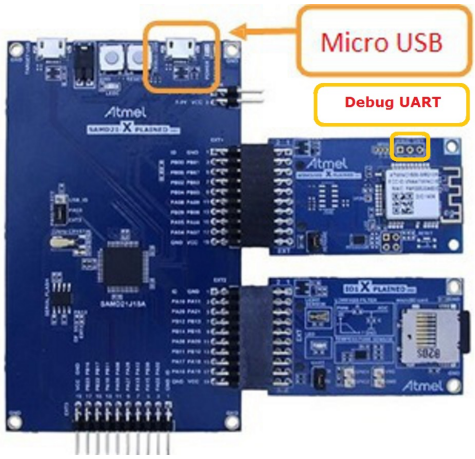
Table 3-1. UART Pin Mapping of WINC1500 Module

ATWINC1500 Module Pin Name	ATWINC1500 Xplained Pro Pin Name	Function
J14	UART_TX	TXD
J19	UART_RXD	RXD

3.1.3 Hardware Connection

Depending on the WINC-Xpro board version, it may feature a Micro-USB plug, which is connected to the WINC built-in UART via an FTDI module. In this case, the PC must have the latest FTDI driver installed to see the corresponding virtual serial COM port.

Figure 3-1. USB Connection With WINC Built-In UART



When a Micro-USB plug is not present on the WINC-Xpro board, the RX, TX, and GND UART signals (see Table 3-1) that are available on the board can be connected to a PC using a third-party serial-to-USB converter.

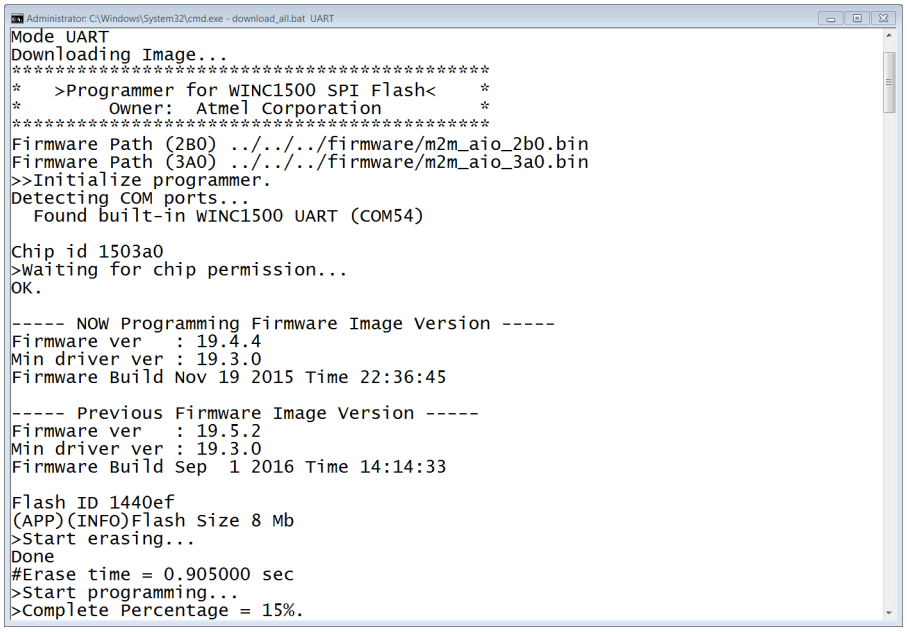
3.2 Batch Script

The `download_all.bat` batch script is located in the `src/firmware` folder of the "WINCXXXX_Firmware_Update_Project" that triggers the download through built-in UART.

1. Ensure that the host MCU is powered up and that the WINC built-in UART is connected to a PC via a serial-to-USB converter.
2. In a Windows shell, run the command `download_all.bat UART` to start the download.

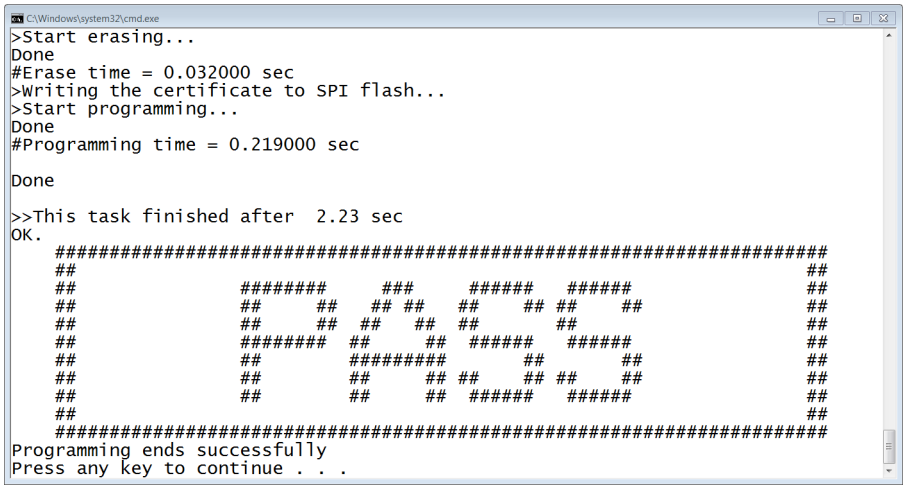
   Note: The gain setting values for the SAMW25 module is different than the gain setting values of the WINC1500 module. The above command downloads the WINC1500 module gain values. The command for the SAMW25 module to incorporate the gain values is:
   `download_all.bat UART SAMW25`
3. During the download process, the batch script provides information about the output firmware version being programmed onto the WINC as well as the previously installed firmware version.

Figure 3-2. Displaying Firmware Version



4. After several seconds, the following message appears to indicate that the WINC download procedure is successfully completed.

Figure 3-3. WINC Serial Flash Download : Success



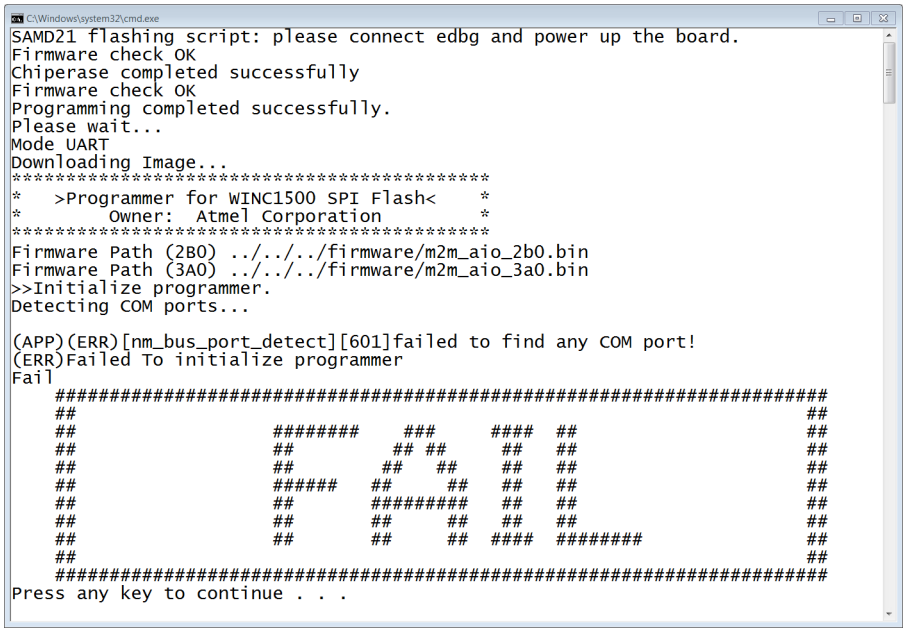
Result: The WINC chip firmware, TLS/SSL root certificate, and TX power gain values are successfully updated. Refer to Download Failure Troubleshooting in case of failure.

4. Download Failure Troubleshooting

This section provides the troubleshooting tips for a specific error while downloading using batch script.

4.1 Failed To Find Any COM Port

Figure 4-1. Error : Failed To Find Any COM Port



The image downloader tool used to perform a serial bridge or a built-in UART download tries to look for available COM ports using Windows API. It attempts to match each COM port name with “EDBG” string or a port number “COM” string. If one of the two conditions is true, the program attempts to send a `0x12` character on the UART line. The host device is then expected to answer `0x5A` for a built-in UART update or `0x5B` for a serial bridge update.

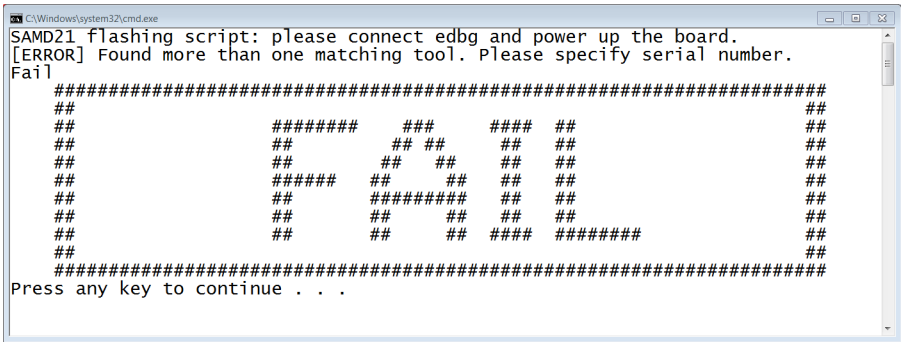
The `Failed to find any COM port` error is expected when there are no response for the command.

How to fix it:

- Ensure the WINC COM port is listed in the device manager.
- Ensure the WINC COM port is not opened by any other application. For verification, try to open and close the COM port with a terminal application.
- Low quality USB cable or serial-to-USB converter (built-in UART) can introduce garbage on the UART line, thus, fail to detect the WINC COM port. Use another cable.
- When performing a built-in UART download, it is expected that the WINC bootloader is in a particular state that is only achievable after doing a clean power-up and Reset sequence. Therefore, before downloading, it is recommended to ensure a clean power-up and Reset sequence.
- Ensure that no other extension board is connected to the Xplained Pro board while performing the download.
- Ensure the project path is not exceeding the Windows maximum path length of 260 characters.

4.2 Found More Than One Matching Tool

Figure 4-2. Error : Found More Than One Matching Tool



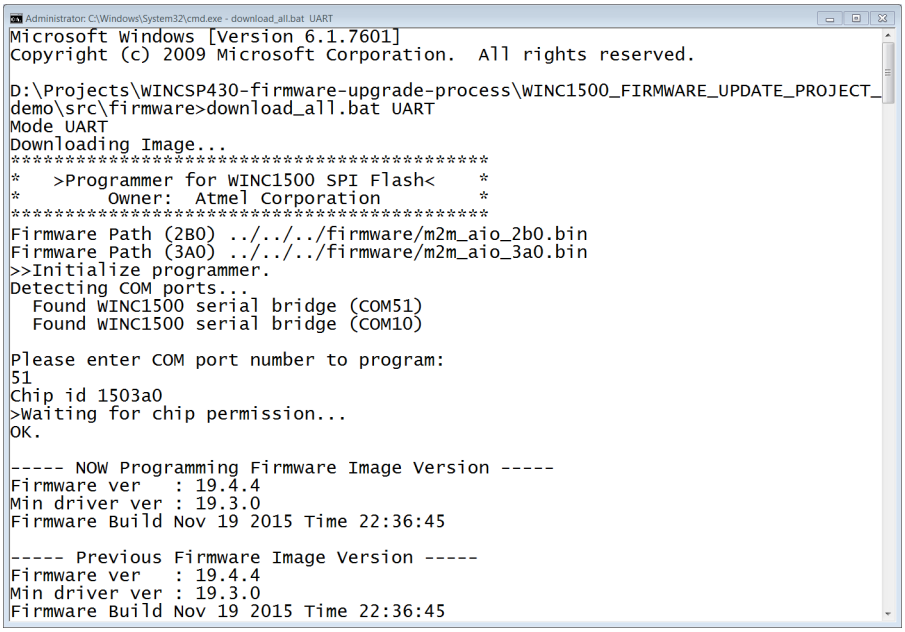
The `Found more than one matching tool` error is observed when downloading using Xplained Pro board serial bridge with `sam_xplained_pro_firmware_update.bat` batch script. The image downloader tool tries to look for available COM ports and attempts to match each COM port name with “EDBG” string to program the serial bridge binary image on the host MCU.

How to fix it:

- All the Xplained Pro boards are enumerated with “EDBG Virtual COM Port”. Ensure to connect one Xplained Pro board at a time on a PC.

4.3 Listing More Than One COM Port

Figure 4-3. Listing More Than One COM Port



The `More than one COM port` is listed when downloading using `download_all.bat` where the host MCU contains the serial bridge firmware or download through built-in UART. The image downloader tool used to perform a serial bridge or a built-in UART download tries to look for available COM ports and attempts to match each COM port name with “EDBG” string or a port number “COM” string. If one of the two conditions is true, the program attempts to send a `0x12` character on each UART line. The host

device is then expected to answer `0x5A` for a built-in UART update or `0x5B` for a serial bridge update. If the expected response is received on all UART lines, the script lists all the detected COM ports.

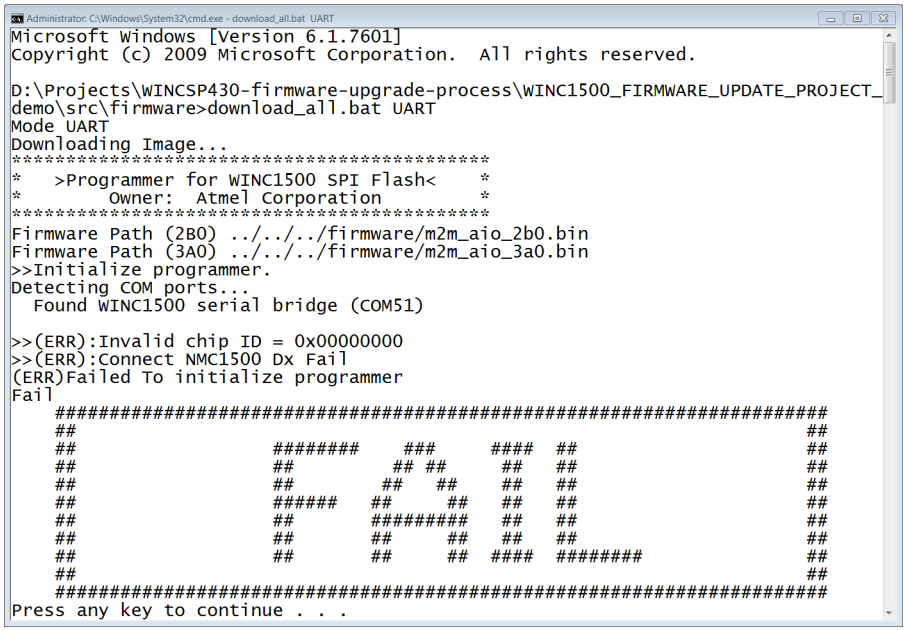
How to fix it:

- Input COM port number of the intended device to be downloaded when `Please enter COM port number to program:` displays as shown in the preceding figure.

Note: For each downloading of WINC chip firmware, TLS/SSL root certificates, and TX power gain values, it is required to provide a COM port number. To avoid this, it is possible to force the image downloader tool to use a specific COM port number from the start. For example, to use COM56, run the script such as this: `download_all.bat UART 56`.

4.4 Failed To Initialize Programmer: Invalid Chip ID

Figure 4-4. Error : Failed To Initialize Programmer - Invalid Chip ID



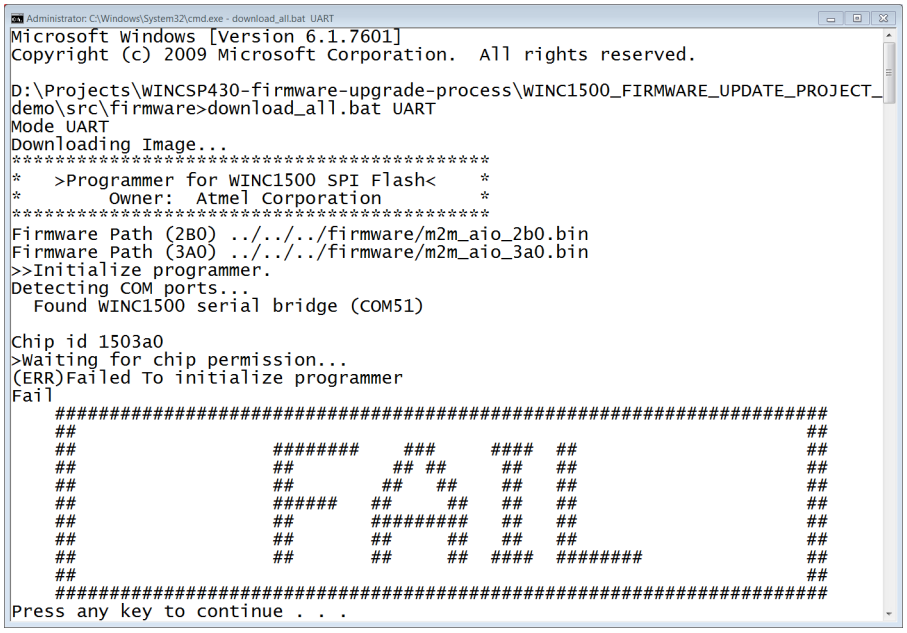
The `Failed to initialize programmer with Invalid chip ID` error typically happens when there is garbage or noise on the UART line preventing from reading the correct chip ID value.

How to fix it:

- Try connecting the PC and the WINC with a different cable. A clean power-up and Reset sequence of the WINC is necessary to start over with the WINC bootloader in the appropriate state.

4.5 Failed To Initialize Programmer: Waiting For Chip Permission

Figure 4-5. Error : Failed To Initialize Programmer - Waiting For Chip Permission



After printing the correct chip ID of the WINC, the image downloader tool programs a small binary (programmer firmware) to assist with WINC Flash programming. At this stage the image downloader changes the UART baud rate from 115200 to 500000 to speed up the actual transfer of the firmware image. Once the baud rate change is made, the chip permission is verified to ensure the UART connection is reliable. Failing at this stage means that the current setup does not support such a high baud rate.

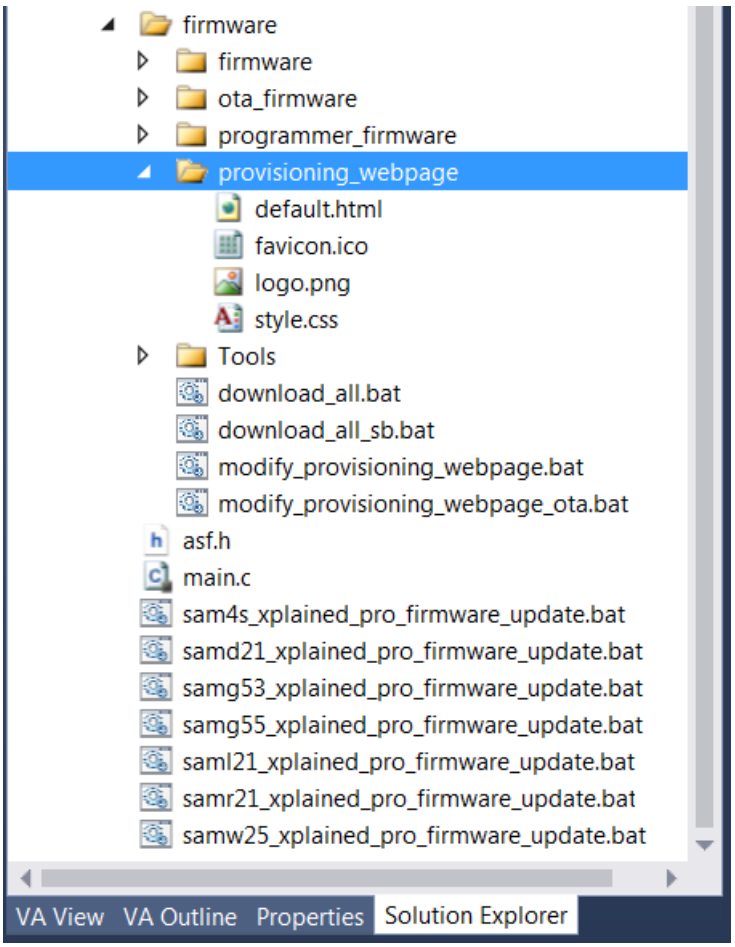
How to fix it:

- It is recommended to try connecting a PC and the WINC with a different cable. Also, a clean power-up and Reset sequence of the WINC is necessary to start over with the WINC bootloader in the appropriate state.

5. Customized Provisioning Webpage Download

The WINC device features a Provisioning Webpage mode that can be used to enter user credentials to connect the WINC device to the desired Access Point. The HTTP server and the actual HTML provisioning webpage is embedded in the WINC firmware, therefore, it cannot be modified from the host MCU. The firmware update project includes the HTML code used by the WINC for HTTP provisioning and also the necessary scripts to generate a new WINC firmware image with the modifed provisioning web page.

Figure 5-1. Provisioning Webpage Folder Structure



The `/src/firmware` – Contains the script to generate an updated WINC firmware image:

- The `modify_provisioning_webpage.bat` script to generate a new WINC firmware image that includes the HTML code provided in the `/provisioning_webpage` folder.
- The `modify_provisioning_webpage_ota.bat` script to generate a new WINC firmware OTA image that includes the HTML code provided in the `/provisioning_webpage` folder.

The `/src/firmware/provisioning_webpage` – Contains the WINC HTML code:

- *logo.png* - Logo image displayed at the top of the provisioning page.
- *favicon.ico* - Icon that appears inside the browser tab displaying the WINC provisioning page.
- *default.html* - The default HTML file that appears in the browser when the user requests the WINC Home Page.

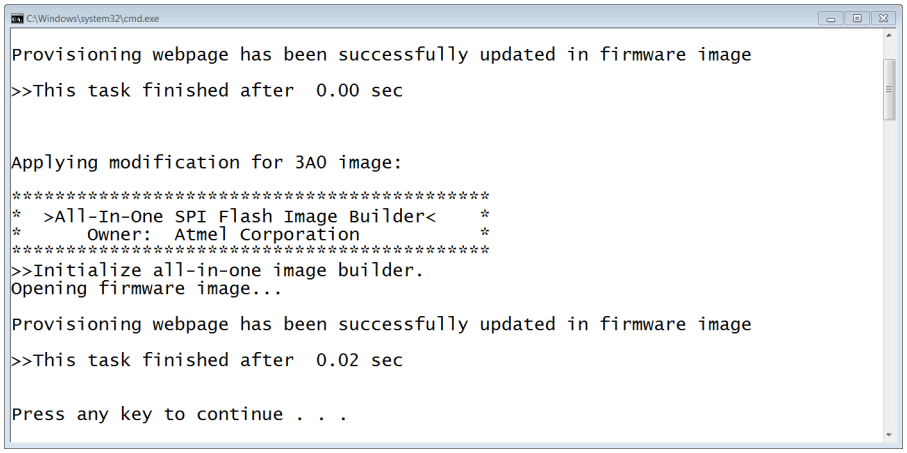
- *style.css* - Cascading Style Sheet (CSS) used for describing the look and formatting of the default.html contents.

5.1 Batch Script

The `modify_provisioning_webpage.bat` batch script is located in `src/firmware` folder of the "WINCXXXX_Firmware_Update_Project". This script triggers the generation of new WINC firmware image that includes the HTML code provided in the `src/firmware/provisioning_webpage` folder.

1. Modify WINC HTML code in `/src/firmware/provisioning_webpage` folder as required.
2. Run the `modify_provisioning_webpage.bat` script.
3. The generated new firmware image overwrites the default firmware image located in the `src/firmware` folder. The following message appears to indicate that the new WINC firmware is successfully generated.

Figure 5-2. WINC Firmware Generated with Modified Provisioning Webpage



4. Follow the steps mentioned in Serial Flash Download via Serial Bridge or Serial Flash Download via Built-in UART for specific interface to download the modified Provisioning Webpage.

6. TLS/SSL Certificates Download

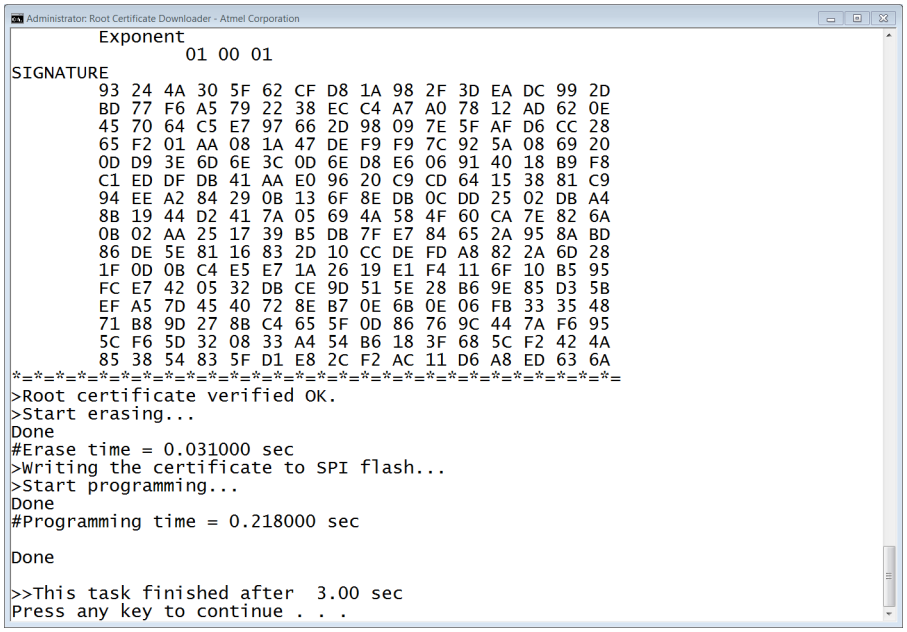
The WINC saves the TLS/SSL certificates inside the serial Flash in 4K sector (the maximum size of all certificates in Flash must be less than 4K). The serial Flash download process as explained in Serial Flash Download via Built-in UART also downloads the TLS/SSL certificates. However, it is also possible to download only the certificates without downloading the WINC chip firmware. For generating the certificate, refer to the *Wi-Fi Network Controller Software Design Guide Application Note (DS00002389A)*. The following procedure explains how to download the TLS/SSL certificates.

6.1 Batch Script

The `RootCertDownload.bat` batch script is located in `src/firmware/Tools/root_certificate_downloader/debug_uart` folder of the "WINCXXXX_Firmware_Update_Project". This script triggers the certificate to download into WINC device.

1. Ensure that the host MCU is powered up as mentioned in the Power-On sequence and that the WINC built-in UART is connected to a PC via a serial-to-USB converter. If the host MCU is running the serial bridge firmware, then it is also possible to download the certificates through host MCU.
2. Paste the certificates in the `/src/firmware/Tools/root_certificate_downloader/crt` folder.
3. Run the `RootCertDownload.bat` to start the download.
4. After a few seconds, the following message appears to indicate that the root certificates are successfully downloaded.

Figure 6-1. Root Certificates Download : Success



Result: TLS/SSL root certificates are successfully downloaded.

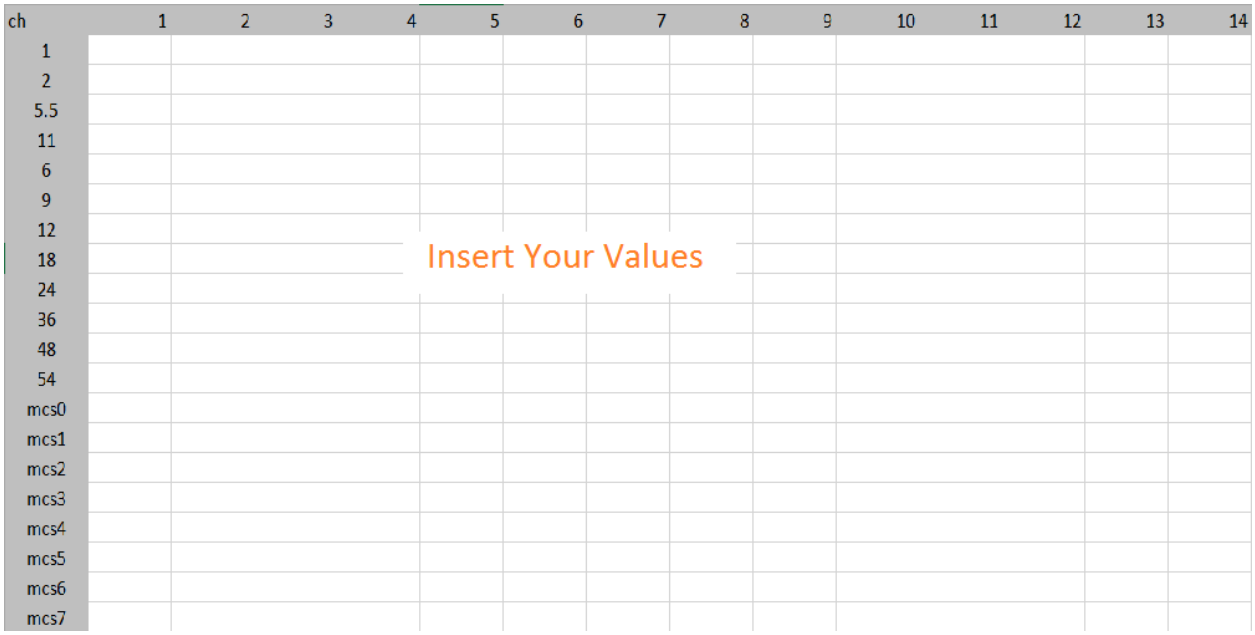
7. Gain Values Download

Gain setting values are used by the RF with different rates to configure the transmission power.

7.1 Modify Gain Values

The `.csv` file in the `src/firmware/Tools/gain_builder/gain_sheets` folder holds the gain values. The following figure shows the template of the `.csv` file. The `.csv` file must be sorted based on the gain rates (Row) and for all the channels (Column).

Figure 7-1. Gain Sheet Template



7.2 Batch Script

The gain values are downloaded as part of the complete download process explained in the previous sections. It is impossible to download the gain values alone. The modified gain values can be downloaded as follows:

1. The `.csv` file in the `src/firmware/Tools/gain_builder/gain_sheets` folder holds the gain values. The values can be changed in the default `.csv` file.
2. If the new gain values are available in a different file, but with a different path, then open the `download_all.bat` from the `src/firmware` and update it with the new path and file such as: `GAIN_FILE=-hp ../gain_sheets/samd21_gain_setting_hp.csv → GAIN_FILE=-hp c:/gain_values.csv`
3. After modifying the gain values using either of the steps above, follow the steps mentioned in the Serial Flash Download via Serial Bridge or Serial Flash Download via Built-in UART to download the new gain values.

8. Document Revision History

Rev. A - 03/2017

Section	Changes
Document	• Updated from Atmel to Microchip template. • Assigned a new Microchip document number. Previous version is Atmel 42809 revision A. • ISBN number added.

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