Hosted Mode – AT Interface Loading/Updating Guide

Pinnacle 100

Version 1.0

REVISION HISTORY

Version	Date	Notes	Contributors	Approver
1.0	20 Apr 2020	Initial Release	Jamie Mccrae	Jonathan Kaye

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1 PREFACE

This document guides you through the process of the loading or updating the AT interface firmware to a Pinnacle 100 module from the official firmware images distributed by Laird Connectivity. The firmware can be loaded via SWD or via UART.

This guide is a miniaturized version of the *Pinnacle 100 Programming Guide*, which can be referred to for details on generating/programming the Pinnacle 100 module using custom user application files. Once the AT interface is loaded to the module, you can refer to the *AT Interface User Guide* which contains a list of Bluetooth commands and instructions for how to use the AT interface firmware or refer to the HL7800 guide for a list of modem/cellular commands. These documents are accessible from the Pinnacle 100 product page.

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2 HARDWARE SETUP

2.1 Pinnacle 100 Development Board

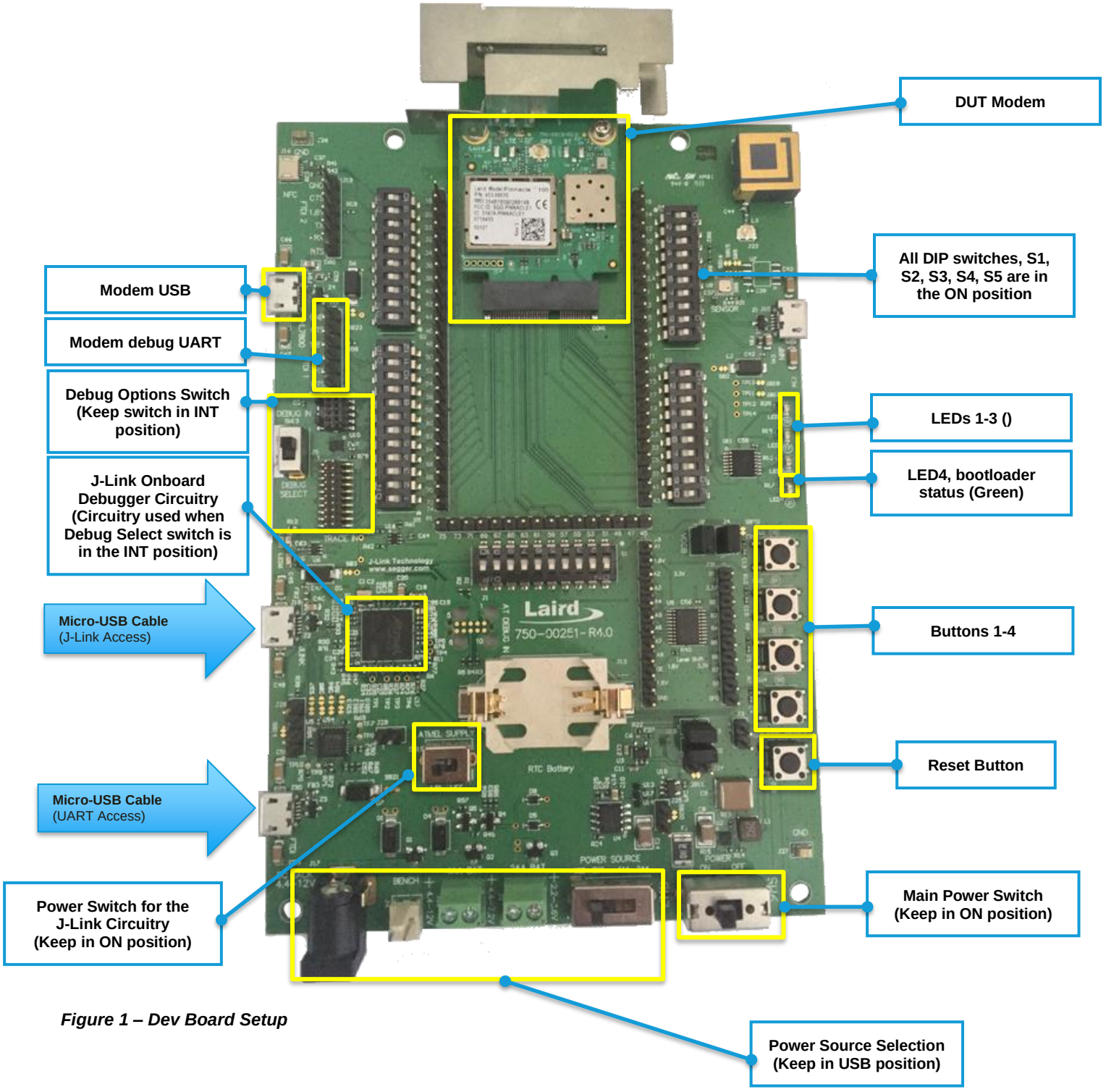

Figure 1 – Dev Board Setup

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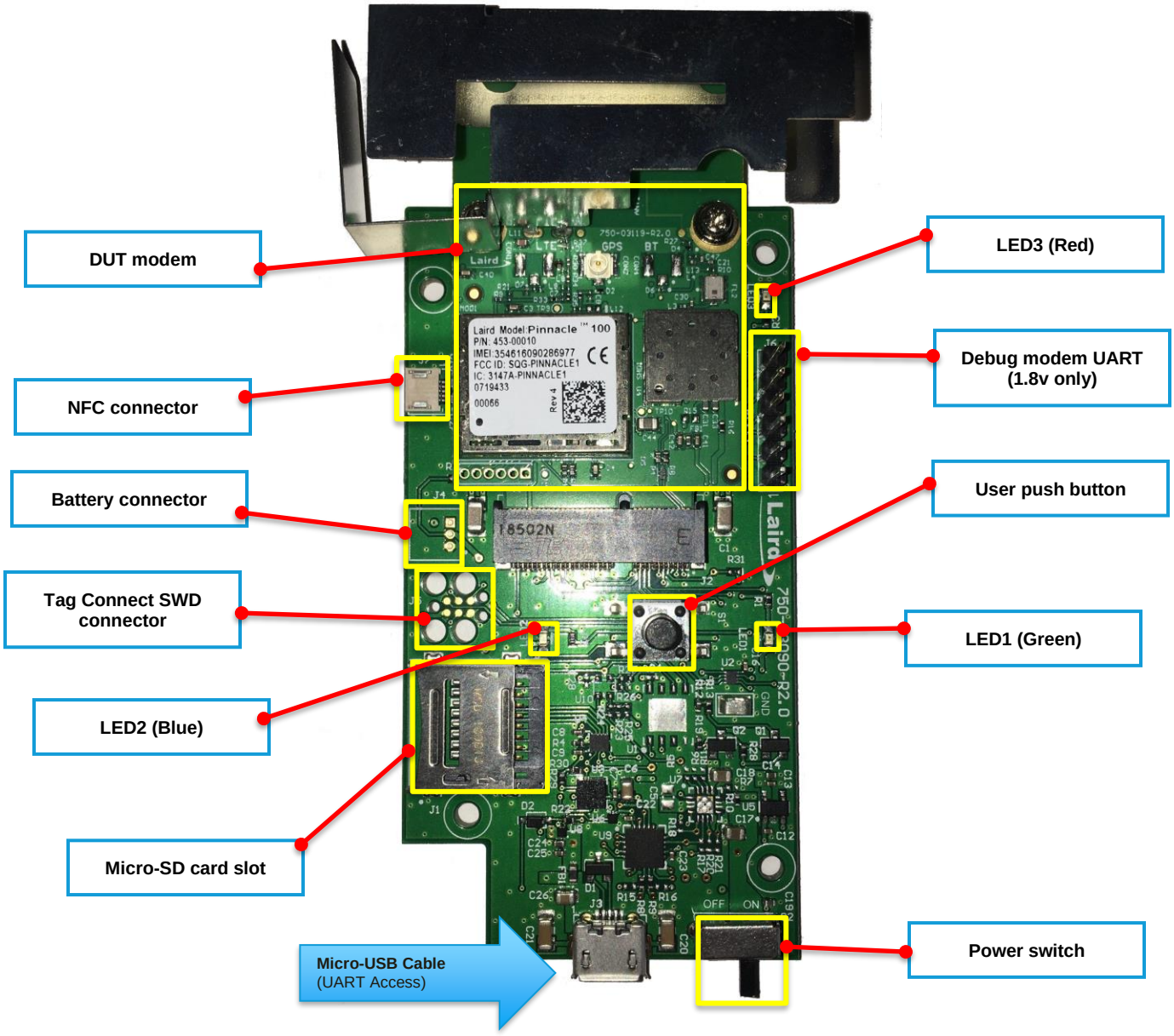
2.2 MG100 Micro Gateway Board



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2.3 Upgrade Types

The AT interface firmware can be loaded to the module using SWD or UART. Please note that if a signed non-AT interface firmware is loaded to the Pinnacle 100 module, a factory default command must be issued to the module in bootloader mode over the UART which erases the contents and settings of the module.

Table 1 gives an overview of the supported firmware upgrade methods and the feature set of them.

Table 1: Firmware upgrade methods

	UwFlashX	SWD
Required hardware	UART (FTDI)	SWD (J-Link)
Required software	FTDI drivers, UwFlashX	JLink drivers, Nordic nRF command line tools
Transfer speed	Medium	Fast
Upgrade time	Slow	Fast
Works with readback protection enabled	✔	x
Keeps existing QSPI data	x	x
OS Support	Windows/Linux (x86, x86_64 and ARM)/mac	

Note: Segger J-Link supports CLI programming operation only using nrfjprog. The Pinnacle 100 development board has a J-Link OB which allows for debugging and testing applications on the module present on the development board only. For further details, refer to the Segger website: https://www.segger.com/products/debug-probes/j-link/

2.4 Driver Verification

For driver verification, follow these steps:

1. Verify that the driver for the FTDI virtual serial port or Segger J-Link is installed from device manager.
2. For FTDI: Expand *Ports (COM & LPT)* and ensure that you see the FTDI device as *USB serial device*.
   For Segger J-Link: Expand *Universal Serial Bus Controllers* and ensure that you see the J-Link device as *J-Link driver*.

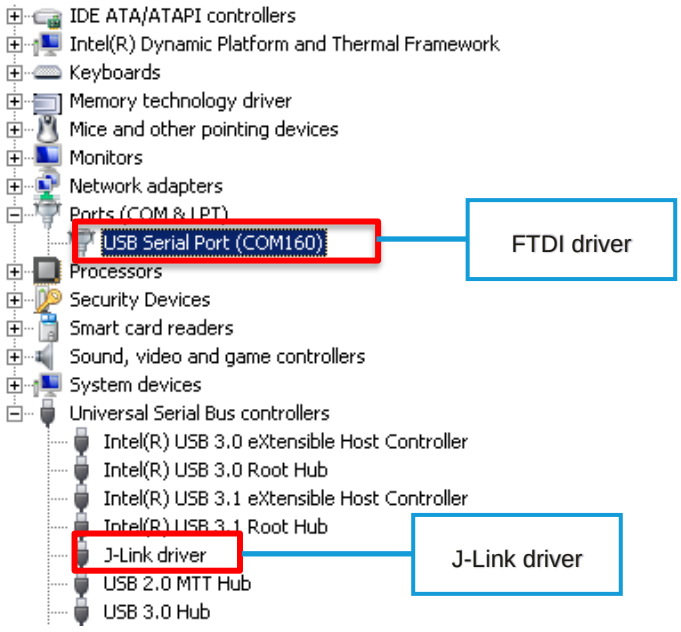

Figure 2 – Driver identifification using Device Manager

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3 SOFTWARE

3.1 FTDI UART Drivers

To download and install the FTDI UART drivers, follow these steps:

1. If UART access is required and drivers are not installed, visit the FTDI website: https://www.ftdichip.com/Drivers/VCP.htm and download the drivers for your operating system and architecture.
2. Once downloaded, run the installer. Any attached FTDI devices should be automatically detected by the installer. Once installed, the FTDI ports can be used like they were a serial port from any supported applications such as UwTerminalX, available to download from: https://github.com/LairdCP/UwTerminalX

3.2 J-Link Segger Drivers

To download and install the Segger J-Link drivers, follow these steps (**note that V6.62b or newer is mandatory/required**):

1. If Segger J-Link drivers are not installed or are outdated, visit the Segger download site: https://www.segger.com/downloads/jlink/ and download the J-Link Software and Documentation Pack for your operating system and architecture. At the time this document was written, the latest version was V6.50b.

Figure 3 – J-Link driver package

2. Once downloaded, launch the installer which installs the drivers to your system and the corresponding Segger applications to your computer.

3.3 Nordic nRF Command Line Tools

To download and install the latest Nordic nRF command line tools, follow these steps (**note that version 10.7.0 or newer is mandatory/required**):

1. Download the latest Nordic nRF command line tools from https://www.nordicsemi.com/Software-and-Tools/Development-Tools/nRF-Command-Line-Tools for your operating system and architecture. At the time this document was written, the latest version was 10.7.0.

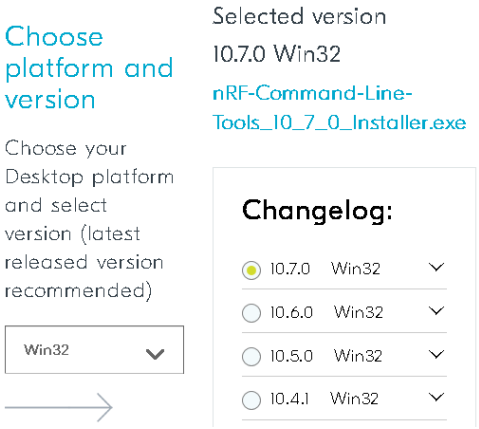

Figure 4 – Nordic nRF command line tools package

2. Once downloaded, launch the installer which installs the utilities to your system.

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3.4 UwTerminalX

UwTerminalX is a cross-platform utility for communicating with Laird Connectivity's modules via UART. To download and install the latest version, follow these steps:

1. Download the latest version from https://github.com/LairdCP/UwTerminalX/releases for your operating system and architecture.
2. If you are using Windows and have downloaded the SSL version, ensure you follow the instructions on the releases page for installing the visual studio 2015 redistributable

   If you are using Linux, ensure you follow the instructions available on the main Github project page.

3.5 UwFlashX

To download the latest version of UwFlashX, follow these steps:

1. Visit the UwFlashX github page at https://github.com/LairdCP/UwFlashX.
2. Click the Releases tab.
3. Under the latest release, select the package for your operating system. Builds are provided for the following:
   - Windows (32-bit build, supports 32 and 64-bit versions of Windows 7 onwards)
   - Linux x86 (static build, requires 32-bit libUSB and libFTDI installed on your system)
   - Linux x86_64 (static build, requires 64-bit libUSB and libFTDI installed on your system)
   - Linux ARM (Raspberry Pi) (static build, requires libUSB and libFTDI installed on your system)
   - Mac (**Note:** Does not support automatic bootloader entrance functionality. You must manually enter the bootloader if a user-application is loaded to the Pinnacle 100 module.)
4. Download and open the file for your target operating system and move it to a location from which you want to run it.
5. For Linux users, please ensure you follow the instructions for enabling non-root users access to USB serial devices as described on https://github.com/LairdCP/UwTerminalX/wiki/Granting-non-root-USB-device-access-(Linux).
6. Open UwFlashX by running the executable file.

4 Restoring Factory Defaults

If a signed firmware is loaded to the Pinnacle 100 module or configuration options are set, then the module might need to be restored to factory defaults before the AT interface firmware is programmed. Only follow the below steps if this is the case. If this is not the case, then move on to the following section, *Obtaining the Latest Firmware*.

4.1 Restoring to Factory Defaults (via UART)

Once a Pinnacle 100 module is programmed with settings like a user application and public key, this information cannot be changed by programming another key, but the module can be restored to factory default. This restoration erases all data on the module except the license key, allowing it to be re-used if a wrong key was programmed or if the programmed application is not valid.

Note: If the full-erase block is enabled as described in the *Pinnacle 100 Programming Guide*, then issuing the full-erase command does not work and an error is returned. The only way to erase the module in this instance is to perform an erase using SWD as described in the Full-Chip Erase/Recovery (via SWD) section.

Note: Restoring to factory defaults does not erase or reset the readback protection security option or the CPU debug protection. The only way to remove this protection is to perform a recovery operation via SWD, which is detailed in the Full-Chip Erase/Recovery (via SWD) section.

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Returning a unit to factory default settings can take up to approximately three minutes but is usually quicker. This depends on the age and utilization of the device. Follow these steps to perform a restore process:

1. Enter bootloader mode on the Pinnacle 100 by doing the following:
   Hold P0.31 (pin 16 on the M.2 connector) low and reboot the module or power it up (on the development board, hold down SW1 and press the reset button).
2. Open a serial utility such as UwTerminalX and select the correct serial port connected to the Pinnacle 100 module, with hardware flow control enabled, baud rate set to 115200, 1 stop bit, and no parity.

   The CTS status should be green to indicate that the module is ready to accept commands.
3. Send a new-line character (by pressing Enter on the terminal) to confirm that it is in bootloader mode. The response should be *f* and a hex character – which in UwTerminalX take the form of a slash (\) followed by two numbers.
4. Right-click on the UwTerminalX window and select the automation option.
5. Check the *Un-Escape Strings* box.
6. In the top field, add the following data: **p\0f\51\2a\51**
7. In the second field, add the following data: **\7f\7f**
8. If the automation window is in the way of the terminal window, move it so that both are visible.
9. Click **Send** next to the top field to unlock the bootloader. The module should respond with an *a*. If it does not, there is an issue with your setup or configuration, or you are using a different module which is incompatible.
10. Click **Send** next to the second field to begin the restore process. No response should be emitted from the module for some time. Once complete, the module should output *a*. If it emits an *f*, then an error occurred during the erase process.

    The module is now restored to factory defaults, excluding resetting any security bits, and can be used or programmed as desired.

4.2 Full-Chip Erase/Recovery (via SWD)

Performing a full-chip erase via SWD erases all data on the Pinnacle 100 module – bootloader, settings, and update images (including security bits which include readback protection and CPU debug protection).

Note: A full-chip erase does not erase modem settings or firmware.

To perform a full-chip erase, follow these steps:

1. Connect the Pinnacle 100 module to your PC with the Segger J-Link.
2. Open a terminal or command prompt window and issue the following command: **`nrfjprog -f NRF52 --recover`**
3. Once complete, issue the following command: **`nrfjprog -f NRF52 –qspieraseall`**
   Note that this command may take up to 3 minutes to complete.
4. The Pinnacle 100 is now blank and not running any software.

   If you wish to reprogram the bootloader, follow the remaining steps.
5. Download the latest version of the bootloader from the Laird Connectivity Pinnacle 100 product page in the downloads section.
6. Program the bootloader to the module using the following command (replace the filename with the filename from the firmware package):
   `nrfjprog -f NRF52 --program Pinnacle_100_Bootloader.hex --reset`
7. Once the programming is complete, open a serial utility such as UwTerminalX. Select the correct serial port connected to the Pinnacle 100 module, with hardware flow control enabled, baud rate set to 115200, 1 stop bit, and no parity.

   The CTS status should be green to indicate that the module is ready to accept commands.
8. Send a new-line character (by pressing enter on the terminal) to confirm that it is in bootloader mode. The response should be *f* and a hex character, which in UwTerminalX is a slash (\) followed by two numbers.

   The module is now fully restored to factory default settings, including removing any security bit settings, and can be used/programmed as desired.

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5 Obtaining the Latest Firmware

The latest AT interface firmware for the Pinnacle 100 can be found on the Laird Connectivity Pinnacle 100 product page in the downloads section.

It is distributed in a zip file which includes hex files (used for SWD programming) and ubu files (used for UwFlashX programming).

Download the firmware zip file and extract onto your system so that it can be used to program the module in the following steps.

6 Firmware Selection

The firmware zip file contains the AT interface firmware with differing levels of security (described in Table 2). We recommend that you use the high security firmware file. However, it is important to note that, once a high security image is programmed to the module, nrfjprog access to the module no longer works. Future AT interface firmware updates can only be performed using UwFlashX over the UART.

Table 2: Comparison of firmware security

	*-no-security	*-mid-security	*-high-security
Description	Firmware with no security Can be freely used for testing and can be easily reused for custom application development. We do not recommend using this image in production	Mid-level security image Enables some, but not all, security features If the end application is likely to change (e.g. to a custom Zephyr application), this allows loading the replacement firmware to the module and does not block access to the CPU debug functionality	High security firmware which is recommended for production. The UART command for performing a full erase is blocked. The only feature not activated is the bootloader unlock key. For details of this feature and for how to enable it, see the Pinnacle 100 *Programming Guide*
Readback protection	x	x	✔
CPU debug protection	x	x	✔
Laird Connectivity AT interface public key set	✔	✔	✔
Block UART bootloader verification	x	✔	✔
Block UART bootloader readback	x	✔	✔
UART full erase command blocked	x	x	✔
Bootloader unlock code set	x	x	x
Boot verification	x	½	✔
Solo action prevention	x	x	✔
Erase sections blocked	x	x	✔

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7 Programming the Firmware

7.1 UwFlashX

To flash the AT interface firmware using UwFlashX, follow these steps:

1. Open UwFlashX.
2. Change the Port drop-down option to the serial port to which the Pinnacle 100 module is connected.
3. Change the *Bootloader Entrance Method* to *FTDI reset (Pinnacle 100)*.

   For Mac users, this option is unavailable. Instead, hold down the SW1 button on the development board and press the reset button. Wait three seconds then let go of the SW1 button.
4. Click **…** and select the *ubu* file from the previously extracted firmware zip file.
5. If you have set a bootloader unlock key, click the Bootloader Unlock Key tab and enter your unlock key into the Bootloader Unlock Key field.
6. Click **Begin Update**.

   The firmware file is now uploaded to the module. Once complete, the module automatically resets, and the bootloader performs the requested firmware update. This may take up to two minutes but is typically much faster. The green LED on the Pinnacle 100 development board (LED4) will blink to indicate that the firmware upgrade is in progress.

Note: If a HL7800 firmware update image is enclosed, the update process may take in excess of 15 minutes.

The process is now complete. You should be able to send AT commands to the module via the UART.

7.2 SWD

To flash the AT interface firmware using nrfjprog, follow these steps:

1. Open a terminal or console in the directory in which the firmware hex file resides.
2. Ensure that the Nordic nRF command line tools are in your path. If they are not, add them.
3. Flash the hex file to the module and begin execution using the following command:
   `nrfjprog -f NRF52 --program <file.hex> --sectorerase --qspisectorerase --reset`

   The application outputs the progress of downloading the application to the module and resets the Pinnacle 100 after it is programmed.
4. The module automatically resets and the bootloader performs the requested firmware update. This may take up to two minutes but is typically much faster. The green LED on the Pinnacle 100 development board (LED4) will blink to indicate that the firmware upgrade is in progress.

Note: If a HL7800 firmware update image is enclosed, the update process may take in excess of 15 minutes.

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5. The process is complete, and you should be able to send AT commands to the module via the UART.

8 Using the AT Interface Application

For details of functionality and how to use the AT interface application on the Pinnacle 100, please consult the dedicated user guide on the downloads section of the Laird Connectivity Pinnacle 100 website https://www.lairdconnect.com/wireless-modules/cellular-solutions/pinnacle-100-modem

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9 License Information

The bootloader on the Pinnacle 100 and the PC utilities used for generating firmware or flashing firmware to Pinnacle 100 modules utilises code from other software authors whose licenses are as follows:

9.1 b64.c

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9.9 fontconfig

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9.11 bz2

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Julian Seward, jseward@bzip.org
bzip2/libbzip2 version 1.0.6 of 6 September 2010

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