

Programming and Cloning BL6xx and RM1xx Modules with the QPK-NRF5x-01

Application Note

v2.2

INTRODUCTION

This document provides a step-by-step guide for upgrading and production cloning of Laird BL6XX and RM1xx modules using the QPK-NRF5x-01 programming board using an enhanced ARM mbed drag-and-drop method.

When the QPK-NRF5x-01 is plugged into a desktop PC, it appears as an emulated flash drive labelled *MBEDv###*, where *###* are three decimal digits. Saving a file in that flash drive loads the firmware provided as a hex file into the target module. You can expedite the process by either dropping the file in a graphical user interface (such as Windows Explorer) or by using the copy command in a console window.

In versions (*###* above) 300 or newer, in addition to the emulated flash drive mentioned above, the QPK board additionally appears as a virtual comport which in Windows is installed with the name *mbed Serial Port* and a COMn driver name which exposes a SWD command processor; this now makes it possible to read and write blocks of memory using various commands. Some of the command set are described in this application note to allow manual reading and writing of memory.

This guide and latest firmware (v300) for the QPK board was reliably tested on a Window 7 and 10 PC.

Note: We do not recommend that this be done on a Linux, Mac, or other non-Windows platforms as outcomes are not reliable and no support is provided.

REQUIREMENTS

The following are required for this process:

- A PC with Windows 7 or newer
- Laird QPK-NRF5x-01 programing board
- Latest QPK-NRF5x firmware – From the Software Downloads tab of the [QPK-nRF5x page at lairdtech.com](http://lairdtech.com):

DOCUMENTATION SOFTWARE DOWNLOADS

PLEASE NOTE: Some of the software downloads below contain third party software, as indicated by 'SBT' or 'LBT' in the name. By clicking on the download link, you are accepting the terms and conditions outlined in this [License Agreement](#)


| Name | OS | Release Date |
|--|----|--------------|
|  ITSE_01053_03_QPK-NRF5X_AtmeI_APPv300_DownloadViaUsb.zip | | 24 May 2017 |

Figure 1: Software download page

The firmware is a zip file called *ITSE_01053_XX_QPK-NRF5X_AtmeI_APPvYYY_DownloadViaUsb.zip* where *YYY* is 300 or larger.

- 1X USB-A to USB-Micro cables (included with QPK-NRF5x-01)

- UwTerminalX – Available from Laird from the following URL:
<https://github.com/LairdCP/UwTerminalX/releases>
- A HEX file that is applicable for your product. You need a special HEX file that is packaged for drag-and-drop operation; for the RM1xx this can be downloaded from the QPK download page:
<https://www.lairdtech.com/products/qpk-nrf5x>; for the BL6xx see section [Locating the correct firmware for BLXX](#)
- A 10-pin flexi cable (included with QPK-NRF5x-01)

OVERVIEW

This guide uses the Laird RM186 to demonstrate the firmware upgrade process, but the same steps are applicable for programing any of the Laird BL6xx or RM1xx modules which contain a Nordic Semiconductor nRF51 or nRF52832 microcontroller.

To upgrade the module, you need a Laird DVK board or your own equivalent implementation to provide JTAG/SWD access to the module.

If you are working with your own board, please refer to [Table 1](#) for mapping JP1 on the programmer board (QPK-NRF5X) to your module pinout.

Upgrading the QPK-NRF5X Firmware

This is a one-time optional procedure if the QPK board has old firmware and needs to be updated to the latest firmware – currently v300 to ensure that new read/write functionality in the QPK is exposed. The new firmware is downloaded from a URL mentioned above.

1. Connect USB2 of the QPK programmer board to your PC via the included USB-A to USB Micro cable.

Note: There are two USB ports on the QPK board; ensure you connect to **USB2**.

The programmer board now appears as a flash drive on your PC (labeled as MBEDvXXX); **XXX** is the QPK-NRF5X firmware version number ([Figure 2](#)) and is reproduced below.

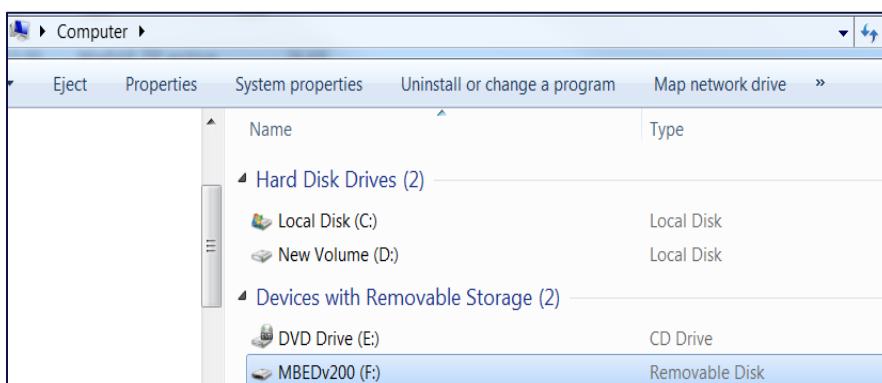


Figure 2: Programming board appears as a flash drive

2. If XXX in MBEDvXXX is 200 or older, you *must* upgrade to the latest firmware. Otherwise you may skip to the next section.

3. Unzip the file *ITSE_01053_XX_QPK-NRF5X_Atmel_APPvYYY_DownloadViaUsb.zip* to a temporary folder on your local drive. This does not work if you unzip to a Dropbox or similar cloud folder. (Ensure YYY is 300 or bigger)
4. Follow the instructions in the *_Readme_.txt* file.

Note: If it does not work at step 6, please check that the 10-way ribbon connector is correctly connected to a Laird DVK board.

5. After disconnecting both USB cables from the QPK and Laird Devkit boards (to prevent parasitic powering of the QPK board from the other DVK board) so that a power cycle happens, the QPK board reappears as *MBEDvYYY* where YYY is the new firmware.

Initial Setup Using a DVK-RM186 Development Kit

To perform the initial set-up, follow these steps:

1. Configure the RM186 development kit to the following settings:
 - DC/USB power source switch (SW4) – USB
 - VCC_1V8/VCC_3V3 switch (SW5) – VCC_3V3
2. Connect USB1 of the DVK-RM186 to your PC via the included USB-A to USB Micro cable.

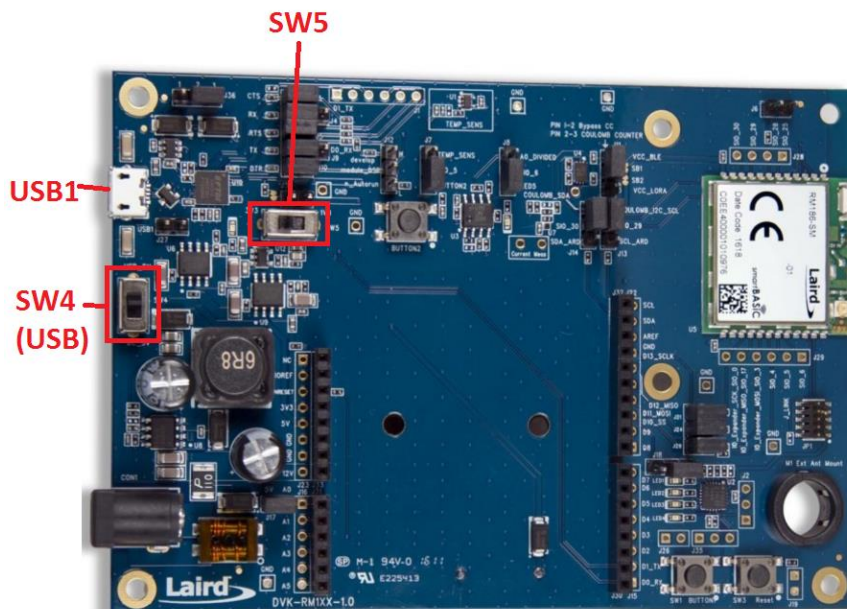


Figure 3: RM186 development board

3. Install the FTDI USB to Serial driver (<http://www.ftdichip.com/FTDrivers.htm>).
4. Ensure that the Windows Device Manager displays a new virtual COM port for the USB to Serial adapter.
5. Launch UwTerminalX (<https://github.com/LairdCP/UwTerminalX/releases>).
6. From the Update tab in UwTerminalX, click **Check for Updates** to ensure you're using the latest version of UwTerminalX with support for the RM186.
7. From the Config tab in the Device drop-down menu, select **RM186/RM191** to populate the baud, parity, stop bits, data bits, and handshaking settings.

If **RM186/RM191** is not a selectable device because you have an older version of UwTerminalX, set the following:

- Baudrate: 115200
 - Parity: None
 - Stop Bits: 1
 - Data Bits: 8
 - Handshaking: CTS/RTS
8. In the Port drop-down menu, select the COM port associated with your DVK-RM186.
 9. At the top of the screen, click **OK**.

CHECKING RM1XX FIRMWARE VERSION

Once the module has been connected, type **AT+I0** to confirm you are connected to an RM186.

Type **AT+I3** to display the firmware version ([Figure 4](#)).

If your development board is pre-programmed with an autorun application, you must manually place the RM186 module into interactive mode. To do this, follow these steps:

1. Ensure that on J12 jumper is not fitted on pins 1-2.
2. Ensure that jumper J10 is closed.
3. Ensure that the DTR checkbox on the terminal tab is unchecked.
4. Press the reset button on the module (or on UwTerminalX, check and uncheck the BREAK checkbox which results in a reset of the module).

Your module should now be in interactive mode. You can confirm this by typing **AT** and hitting Enter. The **00** response should display.

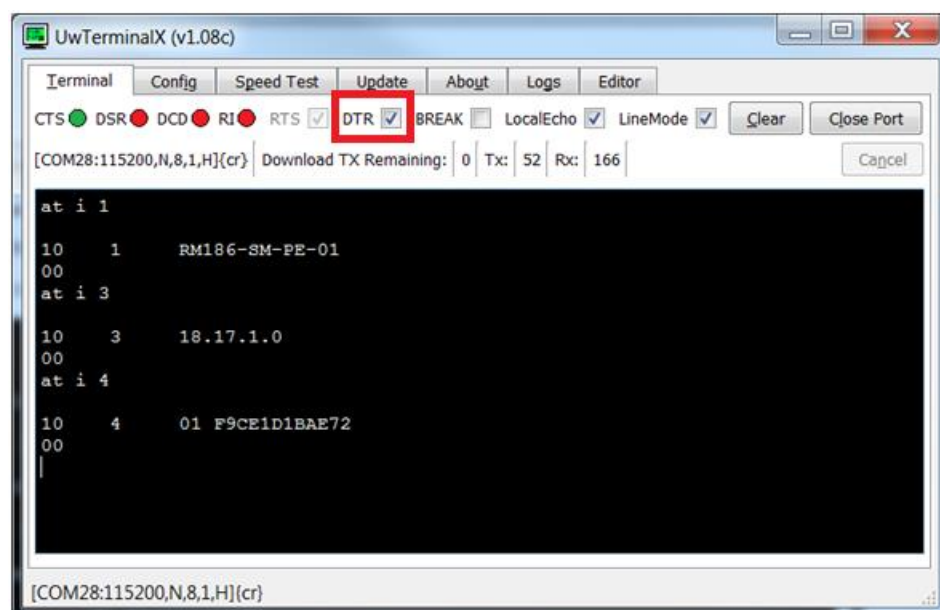


Figure 4: AT+I3 command returning the firmware version number

WARNING! Upgrading the firmware clears any programs, configuration keys, or data stored on the module.

Connecting QPK-NRF5X to DVK-RM186

To connect the QPK-NRF5X to the RM186 development kit, follow these steps:

1. Configure the QPK-NRF5X (the programmer board) as shown in Figure 5.

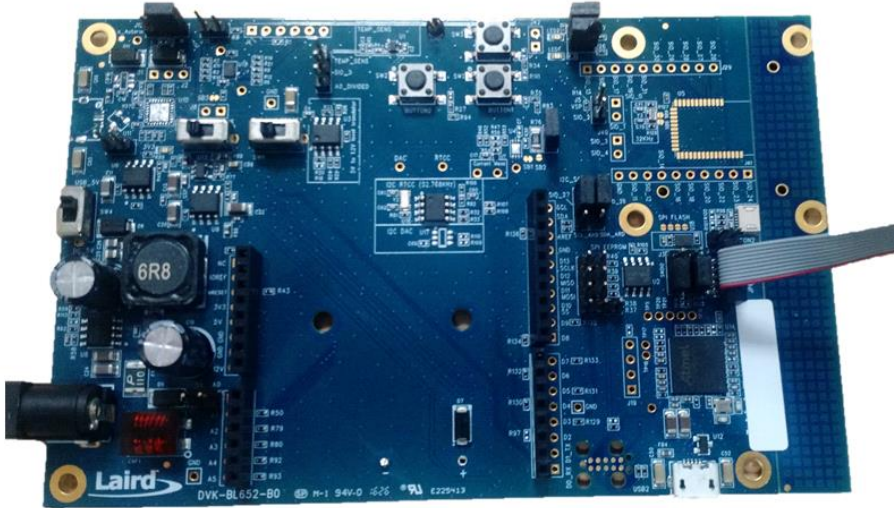


Figure 5: QPK-NRF5X programming board

2. Using the supplied ribbon cable, connect the QPK-NRF5X (the programmer board) to the DVK-RM186 development board as shown in Figure 6.

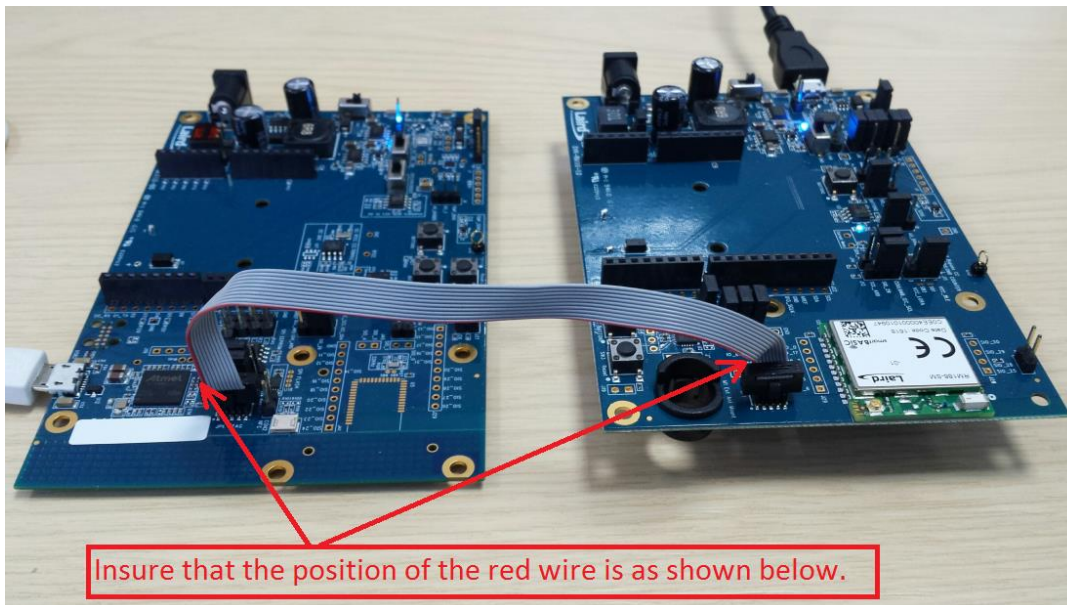


Figure 6: Connecting the programmer board to an RM186 development board

3. Connect USB2 of the QPK programmer board to your PC via the included USB-A to USB Micro cable.

Note: There are two USB ports on the QPK board; ensure you connect to **USB2**.

- The programmer board now appears as a flash drive on your PC (labeled as MBEDvXXX); **XXX** is the QPK-NRF5X firmware version number (Figure 7).

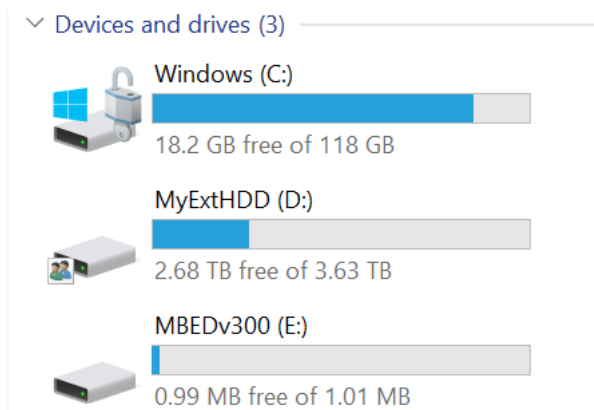


Figure 7: The programmer board displays as a flash drive

- Download the firmware from Laird website and extract it to a local drive on your PC (Figure 8).

Note: You need a special HEX file that is packaged for drag-and-drop operation. You can download a suitable hex file from the QPK Software Download tab on the [QPK Product](#) page.

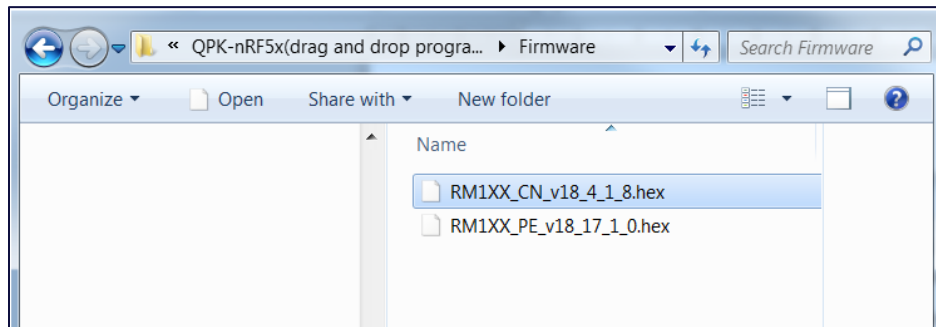


Figure 8: Download and extract the firmware on to your PC

Firmware Upgrade Procedure

To upgrade the firmware, select the **firmware .hex** file and drag-and-drop it onto the new flash drive.

Once the firmware upgrade is completed, the new firmware version can be verified in UwTerminalX by issuing the **AT I 3** command (Figure 9).

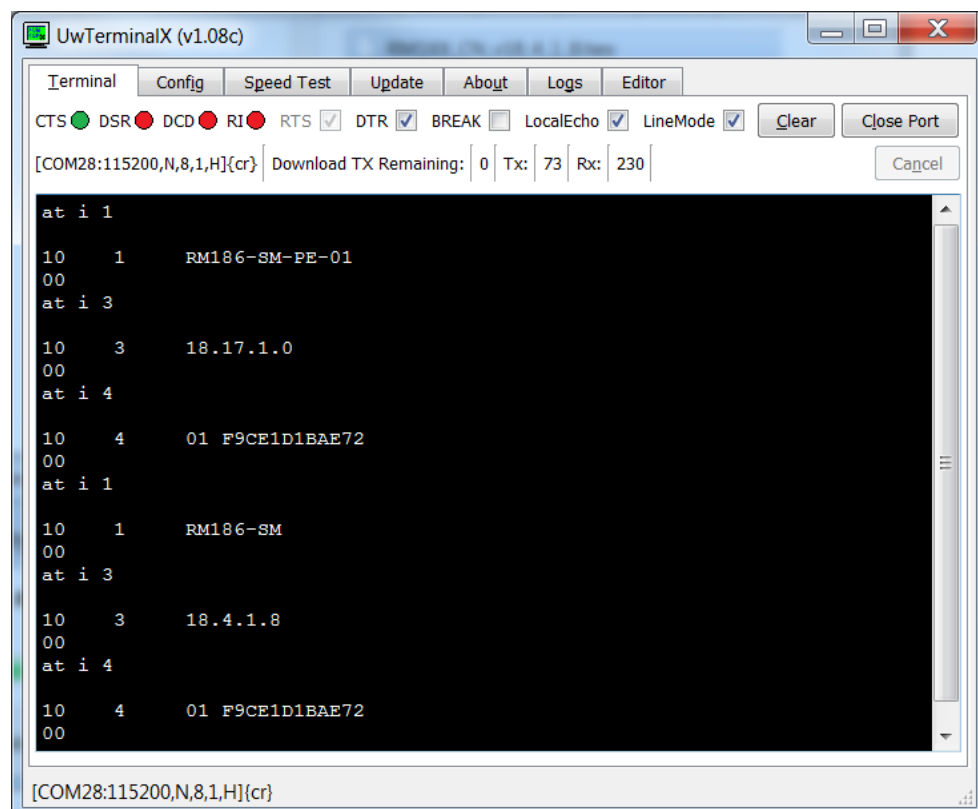


Figure 9: Verifying the new firmware version with AT I 3 command

Using the QPK-NRF5X to Program the Target Board

To upgrade the firmware of your module, you must bring out the following signals from the Laird RM1XX or BL6XX module:

- SWDCLK
- nRESET/SWDIO
- GND

Table 1 shows how to map the JP1 on the programmer board (QPK-NRF5X) to your module pinout.

Table 1: Mapping the JP1 to your module pinout

| JP1 on QPK-NRF5X | Signal Name | BL600/ BL620 | BL652 | RM186/RM191 |
|------------------|--------------|--------------|-------|-------------|
| 1 | VCC IO | NC | NC | NC |
| 2 | nRESET/SWDIO | 22 | 5 | 22 |
| 3 | GND | 28 * | 1 * | 21 * |
| 4 | SWDCLK | 23 | 6 | 23 |
| 5 | GND | NC | NC | NC |
| 6 | NC | NC | NC | NC |
| 7 | NC | NC | NC | NC |
| 8 | NC | NC | NC | NC |

| JP1 on QPK-NRF5X | Signal Name | BL600/ BL620 | BL652 | RM186/RM191 |
|------------------|-------------|--------------|-------|-------------|
| 9 | GND | NC | NC | NC |
| 10 | NC | NC | NC | NC |

* Any GDN signal on the module.

Note: We have tested the programing interface over a 15 cm cable. Try to keep the wiring of these signals at 15 cm or less.

CLONING GOLDEN UNITS FOR PRODUCTION

Assuming that you are done with prototyping and have tested your device, this section describes a process where the file system can be extracted from the golden device as a hex file. This file can then be copied into Laird modules which are in factory default state. This process can also allow you to upgrade the firmware of the Laird module to the same version as that in the golden unit (if it's different).

When cloning a file system from a golden unit to a new module, it's important that the firmware is the same as the content of the file system if customized for particular firmware revisions.

For this process, follow these steps:

1. Contact Laird to receive the following information:
 - The location of the file system for the applicable module.
You must supply the firmware version as it is possible that the location of the file system was moved for that specific version. Use the **AT I 3** command (using any terminal emulator although UwTerminalX is highly recommended) to obtain the module's firmware version.
 - One or more regions of memory which needs to be extracted as intel hex format files.
 - A start address and the block size for each region.
2. To extract the cloning data, connect the QPK programming board using the 10-way ribbon cable to your module.
If the module is in-situ on your device and you have provided access to the SWD lines using other than the 10-way connector, then you will be using a custom cable that has the 10-way header at one end and appropriate connector on the other.
3. Power up the QPK board by plugging in the USB2 to your PC and your device. Assuming you are using a Windows PC, use the device manager to determine the comport number of the *mbed Serial Port*.
4. Open UwTerminalX on that *mbed Serial Port*.
5. Ensure the following settings:
 - Handshaking – None
 - Baudrate – 115200
 - Databits – 8
 - Stop Bits – 1
 - Parity – None
6. Enter the command *ver* terminated by the enter key.

- Confirm that you see the following response:

```
MBEDvYYY
OK
```

Where YYY is a number which is at least 300.

- For each memory region provided by Laird, enter the following command:

```
rdhxc SSSSS LLLLL
```

Where SSSSS is the start address and LLLLL is the length of the block. The values can be decimal or hexadecimal in the format 0xhhhhh.

For example, if the start address is 0x3FC00 and size is 0x400, then you should have something like the following displayed in UwTerminal after it is processed.

```
rdhxc 0x3fc00 0x400
:020000040003F7
:10FC000000FFFCFCFFFFFFFFFFFFFFFF160000509F
:10FC1000FFFFFFFFF00005FFFF8F80000005030001A
:10FC20000050FFFFFFFFFFFFFFFFF02000000A5A540
:10FC30005FFFFCFC16000050FFFFFFFFFFFFFFFFF10
:10FC4000FFFFFFFFF07000200FFFFB9730BCD00723B
:10FC50005C902648FFFFFFFFFFFFFFFFFFFFFFFF56
:00000001FF
OK
```

- Highlight all lines from :020000040003F7 to (and including) :00000001FF.
- Right-click and select **Copy** item from the drop-down menu.
- Paste the clipboard into an empty document (in the text editor of your choice).
- Ensure that the last line has a line terminator to ensure you can position the cursor on a new line after the :00000001FF line.
- Save the file as *some_name_of_your_choice.hex*. Ensure that the file has the **.hex** extension.
- Repeat this process for each memory block provided by Laird.

Copying the hex file(s) to a module results in cloning of the file system from the golden unit.

We acknowledge that the drag-and-drop process is not convenient in a production environment. We also acknowledge that it is possible to automate using a batch file because it is the process of copying a hex file that triggers the download and not the drag-and-drop action.

Supposing you have three hex files named as follows and the mbed flash drive appears as drive letter **M:** in your production system:

```
some_name_of_your_choice_1.hex
some_name_of_your_choice_2.hex
some_name_of_your_choice_3.hex
```

Then you can create a Windows batch file as follows:

```
@echo off
set dr=M:
del %dr%\*.hex
```

```
set fn=some_name_of_your_choice_1.hex
echo Downloading %fn%
copy %fn% %dr%\
del %dr%\*.hex

set fn=some_name_of_your_choice_2.hex
echo Downloading %fn%
copy %fn% %dr%\
del %dr%\*.hex

set fn=some_name_of_your_choice_3.hex
echo Downloading %fn%
copy %fn% %dr%\
del %dr%\*.hex

echo Done
```

LOCATING THE CORRECT FIRMWARE FOR BLXX

To locate the correct firmware for a drag-and-drop upgrade, follow these steps:

1. Go to the [product page](#) on our website.
2. Under the Software Downloads tab, select the applicable firmware version.



Figure 10: Software Download tab

3. Extract the .zip file in to a folder.
4. Locate the .hex file. This is the file you need to drag and drop.

| Name | Size | Packed | Type | Modified | CRC32 |
|--|----------------|----------------|-----------------|-------------------------|-----------------|
| .. | | | File folder | | |
| __READ_ME_FOR_SAMPLE_APP.txt | 236 | 177 | Text Document | 11/08/2016 11:22 | 8FDC1D30 |
| __READ_ME_TO_CLONE_FILESYSTEM___.txt | 3,162 | 1,277 | Text Document | 10/08/2016 13:51 | 88879B47 |
| __READ_ME_TO_UPGRADE___.txt | 1,389 | 602 | Text Document | 10/08/2016 13:51 | 96A97CB5 |
| __Change_Log.txt | 169 | 96 | Text Document | 11/08/2016 10:03 | 1FA1A22C |
| _CaptureAndGenFFDS.bat | 2,291 | 525 | Windows Batc... | 11/08/2016 10:31 | AFFE49E0 |
| _DownloadFirmwareJlinkbat | 3,282 | 770 | Windows Batc... | 10/08/2016 13:51 | 524301F5 |
| _DownloadFirmwareUart.bat | 517 | 168 | Windows Batc... | 10/08/2016 13:51 | 48AAEEE6 |
| _DownloadxFfdfsJlinkbat | 320 | 171 | Windows Batc... | 10/08/2016 13:51 | F5817E9B |
| _DownloadxFfdfsUart.bat | 56 | 55 | Windows Batc... | 11/08/2016 11:36 | ED0C650F |
| BL65xUartFwUpgrade.exe | 3,233,792 | 785,720 | Application | 10/08/2016 13:51 | A977A32B |
| BL652 GitHub repo.htm | 257 | 173 | HTML Docume... | 10/08/2016 13:51 | 5C010AF4 |
| BL652_FFDS.ums | 456 | 275 | UMS File | 03/08/2016 11:57 | 6A2F768F |
| BL652_MBR_SD_APP_magic_BLR_UICR.hex | 772,964 | 308,549 | HEX File | 10/08/2016 13:54 | 43E48A21 |
| BL652_SD_APP_magic.uwf | 270,834 | 183,629 | UWF File | 10/08/2016 13:54 | 7C40BD87 |

Figure 11: BL652 firmware release pack with the required HEX file highlighted

FURTHER INFORMATION

Further information relating to the BL6xx or RM1xx modules that are supported by the QPK-NRF5xx programming board are available from the Laird website product pages:

<https://www.lairdtech.com/products/rm1xx-lora-modules>

<https://www.lairdtech.com/products/bl600-series>

<https://www.lairdtech.com/products/bl652-ble-module>

REVISION HISTORY

| Version | Date | Notes | Approver |
|---------|--------------|--|-----------------|
| 1.0 | 27 Mar 2017 | Initial Release | Jonathan Kaye |
| 2.0 | 15 May 2017 | Added section on updating QPK-NRF5x Firmware | Jonathan Kaye |
| 2.1 | 18 May 2017 | Updates to the Introduction and Requirements sections due further testing on non-windows PCs | Mahendra Tailor |
| 2.2 | 11 July 2017 | Clarifications on required FW files for drag-and-drop functionality | Jonathan Kaye |

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