

Programming RM1xx Modules with the QPK-NRF5x-01

Application Note

v2.3

INTRODUCTION

This document provides a step-by-step guide for upgrading and production cloning of Laird 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 COM port 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.

This guide and latest firmware (v300) for the QPK board has been reliably tested on Windows 7 and 10 PCs.

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 programming board
- Latest QPK-NRF5x firmware – From the Software Downloads tab of the [QPK-nRF5x page at lairdtech.com](http://www.lairdtech.com/QPK-nRF5x):

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.

- Latest MBED serial port driver from the [MBED website](http://www.mbed.org) (Windows only)
- 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>
- HEX firmware files that are applicable for your RM1xx module, available from the software downloads tab on <https://www.lairdtech.com/products/rm1xx-lora-modules>;
- 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 RM1xx modules which contain a Nordic Semiconductor nRF51 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.

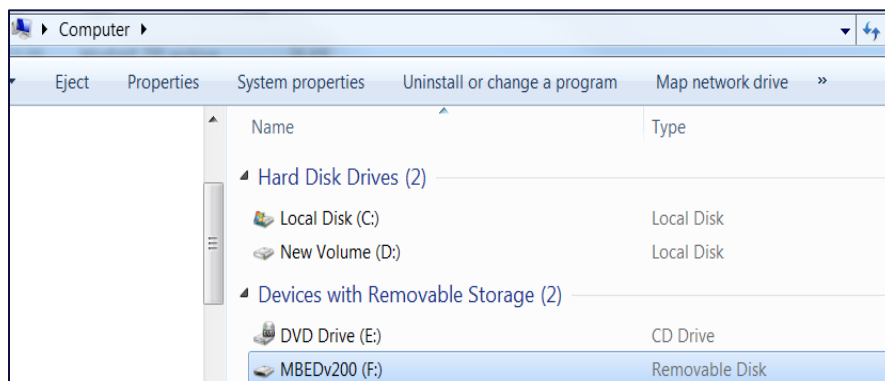


Figure 2: Programming board appears as a flash drive

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.

Installing the MBED Serial Port Driver

This step is only applicable to Windows systems and only needs to be completed once to access the full functionality of the QPK firmware. With the QPK attached to the computer, download the MBED driver from the [MBED website](#) and run the executable which should show the dialogue as shown in [Figure 3](#). Click the install button – if this button is greyed out, ensure that the QPK is connected to your computer and powered up then re-run the installer again.

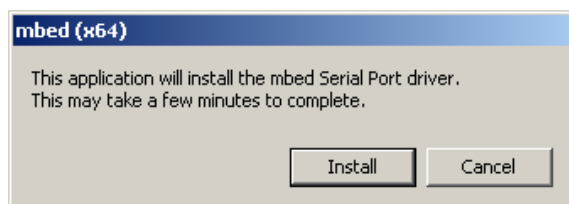


Figure 3: MBED serial port driver install

The drivers will begin to install which can take up to a few minutes as shown in [Figure 4](#).

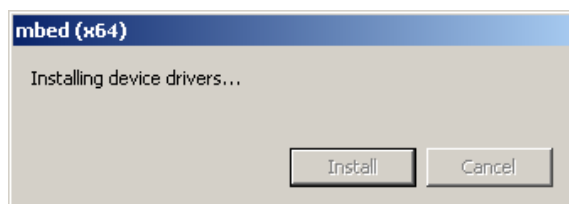


Figure 4: MBED serial port installing

To finish the installation, click the 'Finish' button as shown in [Figure 5](#).

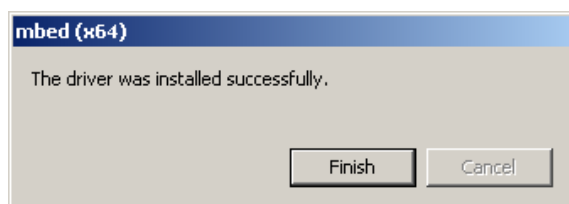


Figure 5: MBED serial port driver installation finished

Once complete, the serial port driver should be fully installed and appear in device manager/UwTerminalX.

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.

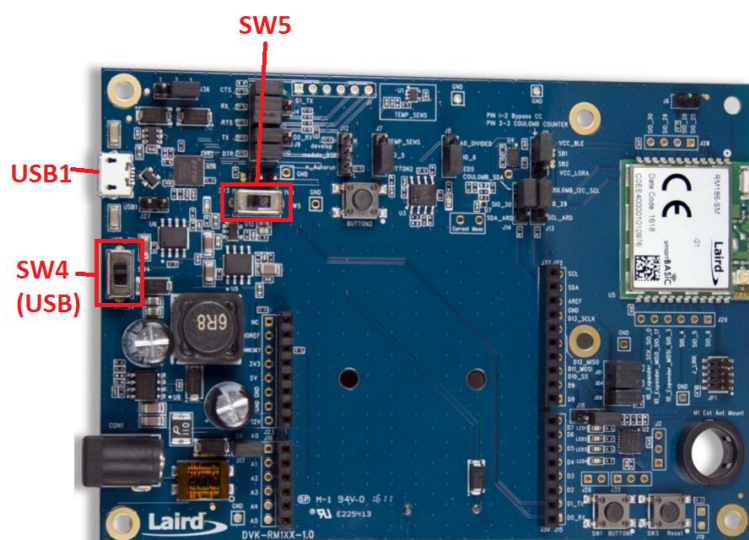


Figure 6: RM186 development board

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** and press enter to confirm you are connected to an RM186.

Type **AT+I3** and press enter to display the firmware version (Figure 7).

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.

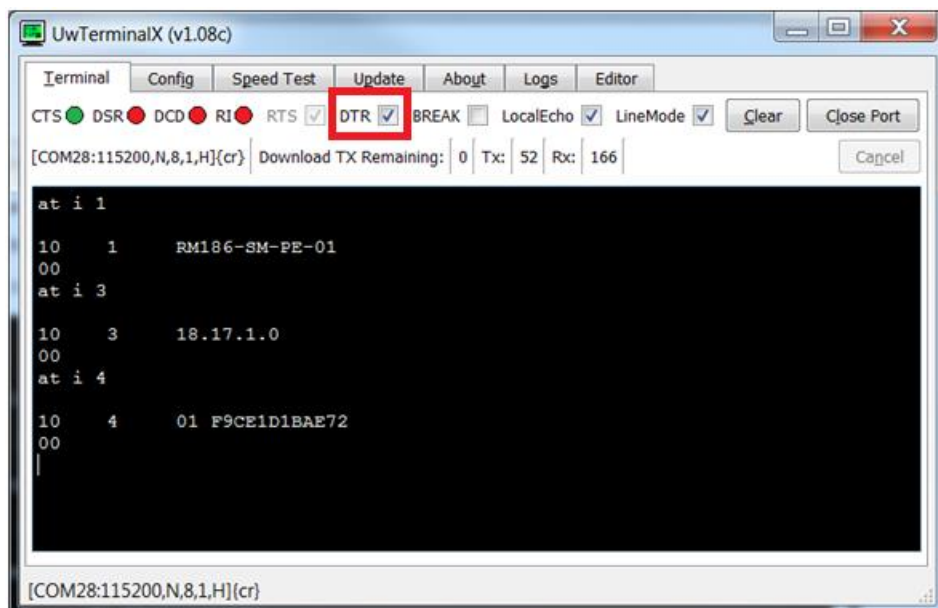


Figure 7: AT+I3 command returning the firmware version number

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

Backing up the module license

Upgrading the module might require a full erase of the module which will erase the RM1xx module license, therefore backing up the license will restore full module functionality after a firmware upgrade. Note that each module has a different unique license key which will not work with other modules.

Type **AT+I0xc0fe** and press enter to display the module's license and make a note of this (Figure 8).

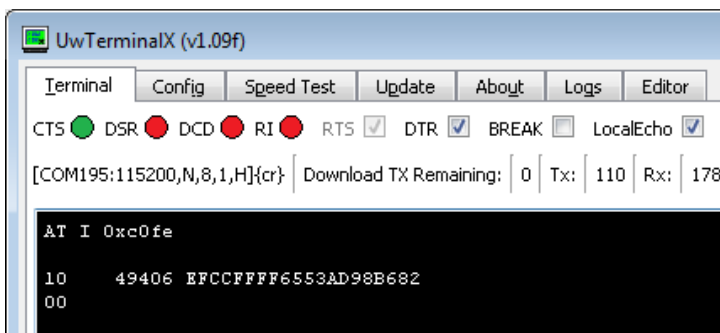


Figure 8: AT+I0xc0fe command returning the module license

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 9.

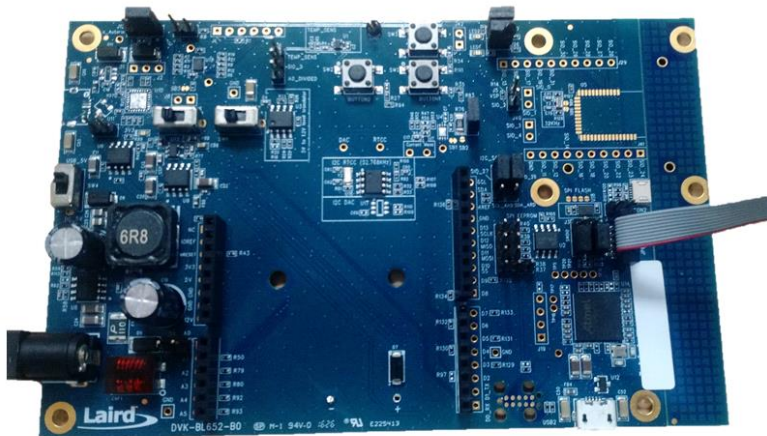


Figure 9: QPK-NRF5X programming board

2. Using the supplied ribbon cable, connect the QPK-NRF5X (the programmer board) to the DVK-RM186 development board as shown in Figure 10.

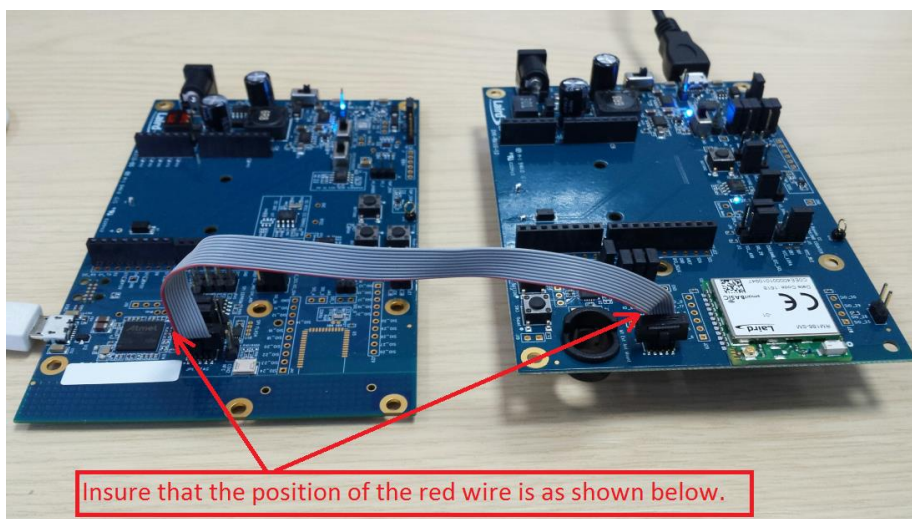


Figure 10: Connecting the programmer board to an RM186 development board

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**.

4. The programmer board now appears as a flash drive on your PC (labeled as MBEDvXXX); **XXX** is the QPK-NRF5X firmware version number (Figure 11).

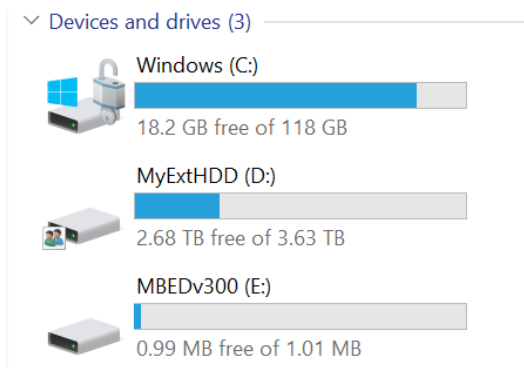


Figure 11: The programmer board displays as a flash drive

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

Note: The RM1xx firmware is available on the [RM1xx Product](#) page under the Software Downloads tab, there will be different links for central and peripheral firmware releases for each region.

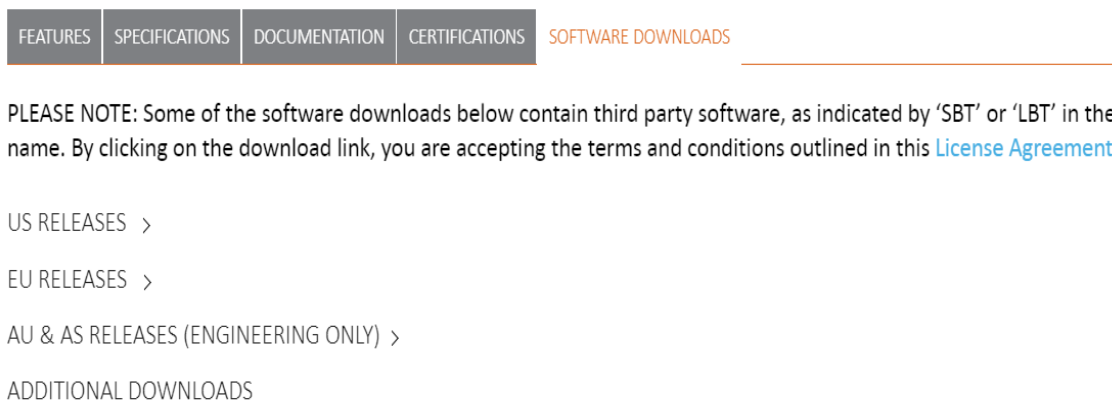


Figure 12: RM1xx software download tab

Peripheral ▶ RM191_PE_US				
Name	Date modified	Type	Size	
_LoadCombinedRM1xx_PE.bat	20/11/2017 06:03	Windows Batch File	2 KB	
nrfjprog.dll	20/11/2017 06:03	Application extens...	93 KB	
nrfjprog.exe	20/11/2017 06:03	Application	538 KB	
RM1xx-defs.h	20/11/2017 06:03	VisualStudio.h.11.0	6 KB	
RM1xxPeUartFwUpgrade.exe	20/11/2017 06:03	Application	3,159 KB	
RM191_PE_US_SDAPP_COMBINED.hex	20/11/2017 06:51	HEX File	642 KB	
RM191_PE_US_Uart.uwf	20/11/2017 06:51	UWF File	141 KB	
smartBASIC(notepad++).xml	20/11/2017 06:26	XML Document	11 KB	
XComp_RM191_PE_US_1192_05F7.exe	20/11/2017 06:26	Application	1,172 KB	

Figure 13: Download and extract the firmware on to your PC

The required .hex file is highlighted below:

Peripheral ▶ RM191_PE_US				
Name	Date modified	Type	Size	
RM191_PE_US_SDAPP_COMBINED.hex	20/11/2017 06:51	HEX File	642 KB	

Figure 14: Hex file for drag and drop upgrade

Firmware Upgrade Procedure

To upgrade the firmware, select the .hex file and drag-and-drop (or copy-and-paste) it onto the MBED flash drive.

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

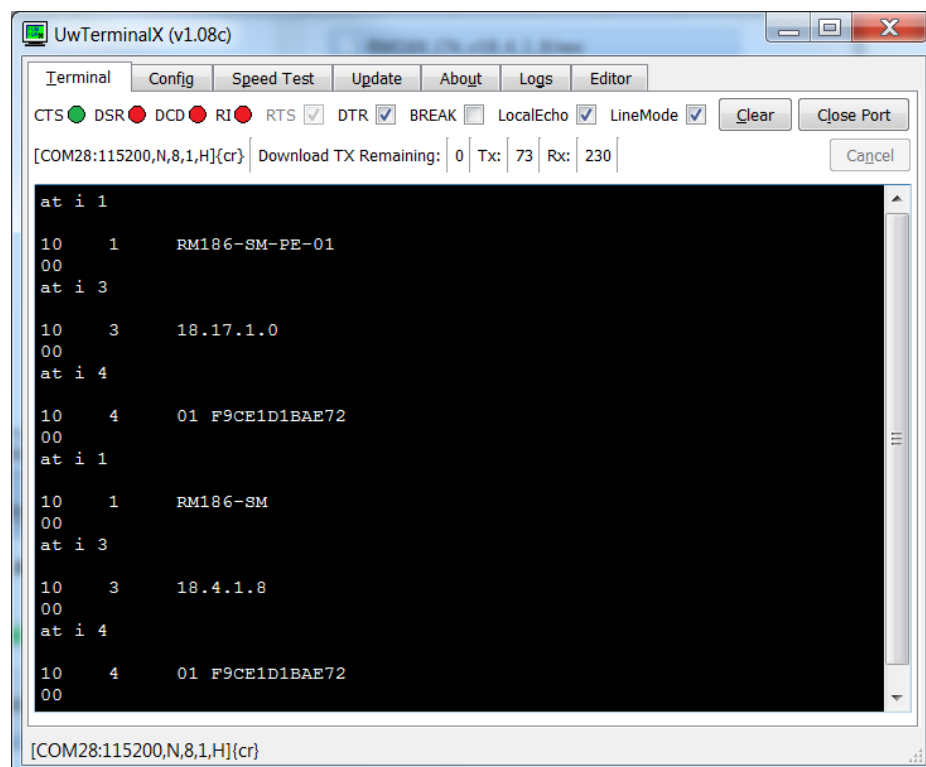


Figure 15: Verifying the new firmware version with AT I 3 command

If the module does not respond to commands or the CTS remains red after a firmware upgrade (Figure) then the firmware upgrade process has failed and the module will need to be fully erased and the firmware upgrade process repeated which is described in the next section.

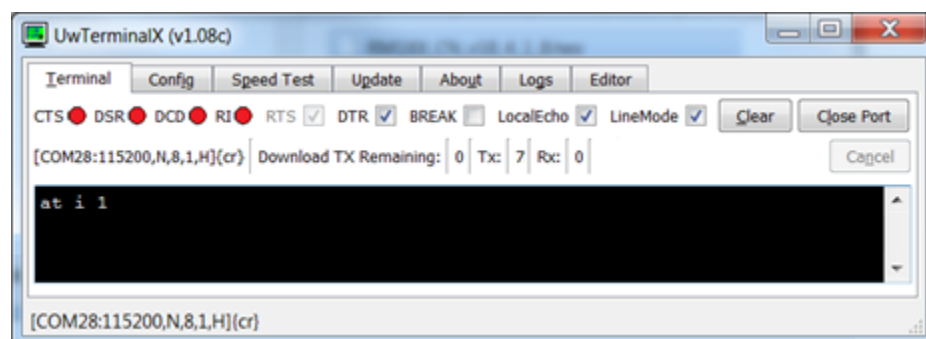
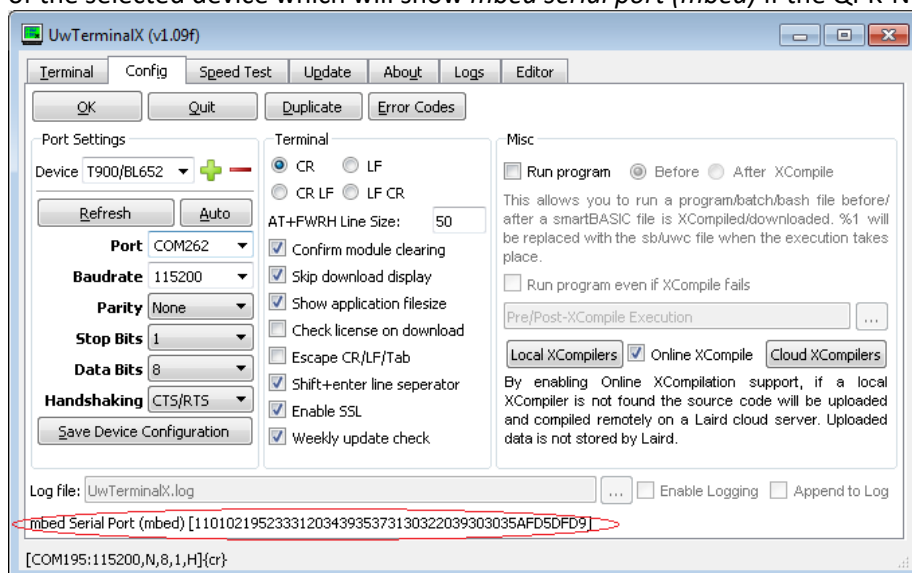


Figure 16: Module fails to respond after firmware upgrade

Recovering a module using the QPK-NRF5X

This section guides you through recovering a module whereby a firmware upgrade has failed or the module has stopped working and requires an erase before being re-flashed with the firmware. You will need the module connected to the QPK as described in the previous sections before following these steps.

1. Launch UwTerminalX.
2. From the Config tab, set the following options:
 - Baudrate: 115200
 - Parity: None
 - Stop Bits: 1
 - Data Bits: 8
 - Handshaking: None
3. In the Port drop-down menu, select the COM port associated with the QPK-NRF5X. To help in identifying the correct port, when a selection is made the bottom of the UwTerminalX window will show a description of the selected device which will show *mbed serial port (mbed)* if the QPK-NRF5X has been selected.



4. At the top of the screen, click **OK**.
5. A 54-byte string should be printed at the top of the terminal, type the command **erasechip** and press enter

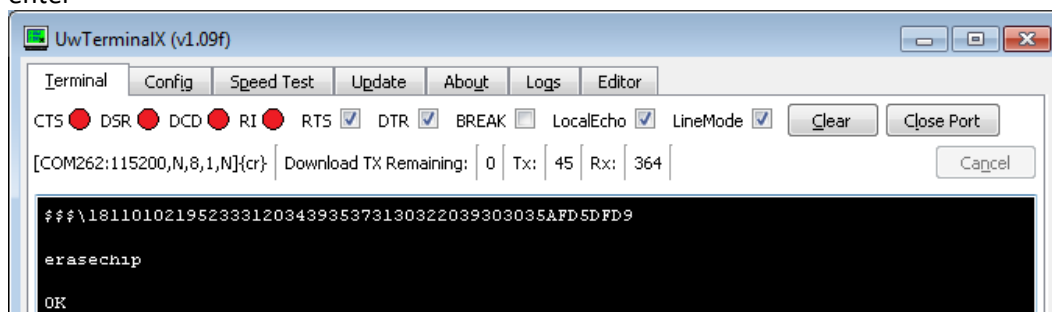


Figure 13: Module successfully erased

6. If successful then the QPK will return OK, if it returns an error code or fails to respond, ensure that the cables are correctly connected and that the QPK and target device are both powered then try issuing the command again. If this still fails, close the port in UwTerminalX, remove the QPK USB cable, wait a few seconds and plug it back in, then re-run the erasechip command.

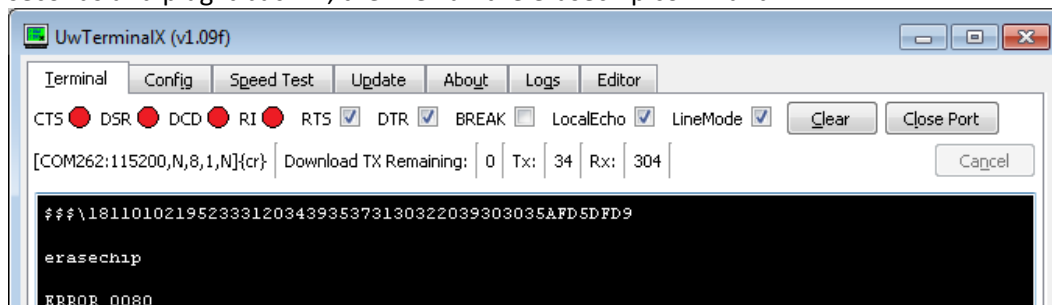


Figure 18: Module erase failure

7. Follow the previous steps to [upgrade the firmware](#).
8. Once finished, restore the license to the module which was [backed up](#) earlier:
 - a. The module response to the **AT I 0xc0fe** command is: **10 49406 <license key>** which for the example earlier gave a license key of **EFCCFFFF6553AD98B682**.
 - b. Use the **AT+LIC "<license key>"** command to save the license to the module which for the earlier example would be **AT+LIC "EFCCFFFF6553AD98B682"** and press enter.
 - c. The module will reboot and display **00** to confirm it has been saved – if you get an error code this likely means that there is a license key already present.
 - d. Confirm that the license key was successfully saved by sending **AT I 4** and pressing enter then checking the response which should contain the Bluetooth address of the module, if you see **0016A4C0FFEE** then you have restored the wrong license to the module and the module will need to be erased and have the correct license restored.

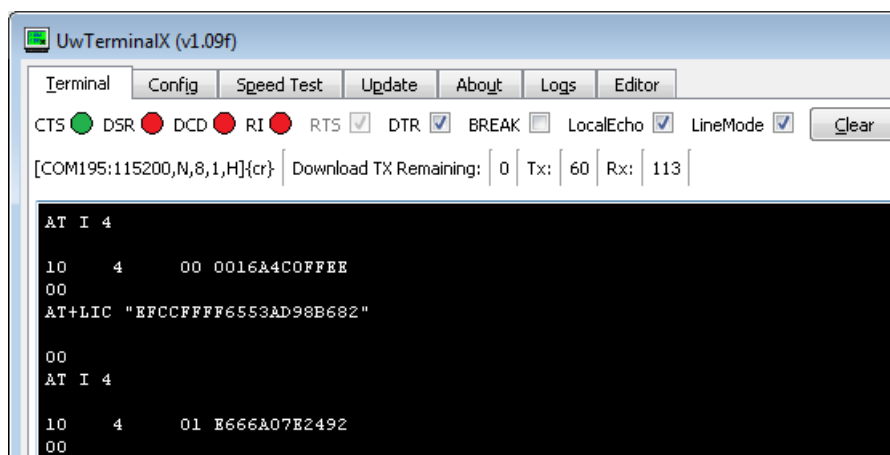


Figure 19: Module license successfully restored

9. The module has now been successfully upgraded to the desired firmware and can be used as needed.

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 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	RM186/RM191
1	VCC_IO	NC
2	nRESET/SWDIO	22
3	GND	21 *
4	SWDCLK	23
5	GND	NC
6	NC	NC
7	NC	NC
8	NC	NC
9	GND	NC
10	NC	NC

* Any GND signal on the module.

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

FURTHER INFORMATION

Further information relating to the RM1xx modules that are supported by the QPK-NRF5xx programming board are available from the Laird website product page on <https://www.lairdtech.com/products/rm1xx-lora-modules>

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
2.3	13 Nov 2017	Split RM1xx parts out into separate document	Jonathan Kaye

Mouser Electronics

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[QPK-NRF5X-01](#)