# BLADERF WINDOWS<sup>®</sup> INSTALL GUIDE

INSTALLING BLADERF SOFTWARE WITH MATLAB<sup>®</sup> & SIMULINK<sup>®</sup> SUPPORT

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## Revisions

Comments, feedback, improvements, and fixes may be sent to <bladeRF@nuand.com>.

Revision	Date	Summary
1	2015-01-08	Initial revision for 2016.01-rc1 installer
2	2015-06-29	Updated for 2016.06 release.

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## **Overview**

This document describes the Windows<sup>®</sup> installation procedure for pre-built bladeRF software and its associated MATLAB<sup>®</sup> & Simulink<sup>®</sup> support.

## System Requirements and Recommendations

PC system requirements, such as processor and RAM specifications, are largely dependent upon one's target SDR application. While the bladeRF can be used on a USB 2.0 port, a USB 3.0 controller is recommended in order to fully leverage the sample rate capabilities of the device.

#### Recommended minimum configuration:

- Quad-core 64-bit processor (3 GHz)
- 4 GB RAM
- USB 3.0 Controller
- Windows<sup>®</sup> 7 64-bit

Supported Windows<sup>®</sup> versions:

- XP (32-bit & 64-bit)
- Vista (32-bit & 64-bit)
- 7 (32-bit & 64-bit)
- 8.1 (32-bit & 64-bit)

Supported  $MATLAB^{\textcircled{R}}$  versions:

- 2014b
- 2015a
- 2015b
- 2016a

## **Installation Procedure**

#### Download

The latest available installer may always be found at:

https://nuand.com/windows\_installers/bladeRF-win-installer-latest.exe

Previous installer versions are located at:

https://nuand.com/installers.php

### **Execute Installer**

Ensure the bladeRF is not connected to the system. Do not connect it until after the installer completes successfully, or until instructed to do so by the firmware upgrade console.

Begin by running the installer executable. If Windows<sup>®</sup> prompts whether the program should be allowed to execute, verify that the publisher is listed as Nuand, LLC before clicking Yes.

Once started, a welcome screen will be presented, as shown below. Click Next to continue.



#### **Destination Location**

Next, the installer will prompt for an installation destination. Update this field, if desired, and click <code>Next</code>.

🊳 Setup - bladeRF	
Select Destination Location Where should bladeRF be installed?	
Setup will install bladeRF into the following folder.	
To continue, click Next. If you would like to select a different folder,	, click Browse.
C:\Program Files\bladeRF	Browse
At least 63.1 MB of free disk space is required.	
< Back Next	:> Cancel

#### **Driver Installation**

This screen presents three driver installation options. If this is the first time installing bladeRF software on a machine, a driver must be installed. Otherwise, driver installation may be skipped using the last option.

As noted on this screen, some issues have been reported when using the CyUSB3 driver for applications utilizing transmit capabilities. (RX-only applications have not been found to be affected.)

Thus, until these issues have been further investigated and resolved, it is recommended that the libusb driver be used.

This installer can always be re-run to (re)install a driver, or install a different driver. Additionally, a driver may be installed at a later time using Zadig<sup>1</sup>.

Setup - bladeRF
Driver Installation This page presents available driver options. A driver is required, if you have not previously installed one.
Use the libusb option if you are unsure which to select. You can switch drivers in the future by re-running this installer.
Issues with the using the CyUSB3 driver for TX operations have been reported and are being investigated. It is provided here as a possible alternative for RX-only applications.
<ul> <li>Install libusb (WinUSB) driver. (Recommended)</li> </ul>
Install Cypress CyUSB3 driver.
O not install a driver at this time.
< Back Next > Cancel

Click Next once the desired option is selected.

<sup>&</sup>lt;sup>1</sup>http://zadig.akeo.ie/

#### **Firmware Update**

The following page provides the option to update the bladeRF firmware during the installation process. This is generally recommended, as firmware releases include feature updates and fixes.

As noted on this installation screen, the v2.0.0 bladeRF firmware introduces a new USB VID/PID. This requires libbladeRF (bladeRF.dll) v1.16.0 or later.

However, third-party applications or other systems (e.g., live images, Linux distributions) may provide older libbladeRF versions that cannot detect a device running this newer firmware. Therefore, the v1.9.1 firmware is also provided for reverse compatibility purposes.

It is always possible to upgrade (or downgrade) firmware at a later time using the bladeRF-cli program<sup>2</sup>. The FX3 firmware images are provided in a fx3\_firmware folder within the bladeRF installation.

This installer may also be re-run to switch between the v1.9.3 and v2.0.0 firmware.

\delta Setup - bladeRF		X
<b>bladeRF firmware</b> This will update your bladeRF firmware, if the device is attached. The devican always be upgraded at a later time via the bladeRF-cli program.	ce (	
IMPORTANT: The latest firmware introduces a new USB VID/PID. Third-pa software or machines using older bladeRF.dll or driver versions may not re the device running this firmware.	irty ecognize	
Select v1.9.1 to ensure compatibility with other software and systems.		
Use v2.0.0 only if you DO NOT plan to use older bladeRF.dll or driver version	ons.	
Upgrade to v1.9.1 (Recommended for new users)		
O Upgrade to v2.0.0		
O not upgrade device firmware at this time.		
< Back Next >	Car	ncel

Use Next to advance to the next screen.

<sup>&</sup>lt;sup>2</sup>See https://github.com/Nuand/bladeRF/wiki/Upgrading-bladeRF-firmware

#### MATLAB<sup>®</sup> Search Path

If a 64-bit MATLAB<sup>®</sup> installation is detected, the following screen will be presented. It is recommended to select the default option of adding bladeRF items to the MATLAB<sup>®</sup> search path.

🥎 Setup - bladeRF	
Add bladeRF items to MATLAB path? This page allows you to make bladeRF functionality accessible to MATLAB.	
If you choose not to do this now, you will need to manually use addpath() to all MATLAB to access bladeRF libraries and scripts.	ow
O not add bladeRF scripts to MATLAB path.	
Add bladeRF scripts to MATLAB path.	
< Back Next >	Cancel

Click Next when the desire option is selected.

#### Start Menu Folder

This page provides the ability to customize the Start Menu location under which shortcuts to the bladeRF-cli and uninstall program are placed.

🊳 Setup - bladeRF	
Select Start Menu Folder Where should Setup place the program's shortcuts?	
Setup will create the program's shortcuts in the following Start	Menu folder.
To continue, click Next. If you would like to select a different folder, click	k Browse.
Nuand	Browse
< Back Next >	Cancel

Click Next to continue.

#### **Ready to Install**

Click Next be begin installing files to the system. This is the last step at which the program can be cancelled before changes are made.

🇞 Setup - bladeRF	
Ready to Install Setup is now ready to begin installing bladeRF on your computer.	
Click Install to continue with the installation, or click Back if you w change any settings.	rant to review or
Destination location: C:\Program Files\bladeRF	A
Start Menu folder: Nuand	
<	
< Back In	stall Cancel

#### **Installation Progress**

The installation will display a progress bar, as shown below.

Setup - bladeRF	
Installing Please wait while Setup installs bladeRF on your computer.	
Extracting files	
	Cancel

If a driver has been selected for installation, a dialog will appear during this stage, providing information about the driver install progress. This is shown on the following page.

If items are to be added to the MATLAB<sup>®</sup> path, a MATLAB<sup>®</sup> window will momentarily appear while this is updated.

ΣЗ C:\Windows\system32\cmd.exe . bladeRF driver installation This window will close when driver installation is complete. The installation process may take a few minutes. Ξ Installing "libusb" driver for VID=0x2cf0, PID=0x5245. Extracting driver files... Success Installing driver(s)... Success Installing "libusb" driver for legacy USB VID=0x1d50, PID=0x6066. Extracting driver files... Success Installing driver(s)... Another installation is detected pending A driver operation is still pending. Waiting 10 seconds and retrying. The pending operation may take a few minutes while Windows searches for the new driver. You may speed the process up by indicating that Windows Update should be skipped, if Windows is currently attempting to search this for a bladeRF driver. Do not be alarmed if a Windows driver installation indicates that it failed to install a bladeRF driver using the first driver. Allow this process to complete – this second stage should install required driver. Waiting for 8 seconds, press CTRL+C to quit ...

#### **Firmware Update Progress**

If a firmware update was selected, a console similar to the one shown below will appear.

A message is displayed, indicating that the bladeRF to update should be connected to the system. Connect a bladeRF and wait for Windows<sup>®</sup> to finish installing its driver. Check Device Manager if it is unclear whether this has been done.

After pressing Enter, the firmware update will begin. Progress messages will be displayed as the on-board flash is erased and reprogrammed.



Do not disconnect the bladeRF until the console displays a message noting that this process has completed. After a firmware update, the bladeRF will need to be unplugged and reconnected for the changes to take effect.

Should one accidentally disconnect the device or encounter a failure, the device will enter a recovery bootloader mode. Information on re-flashing firmware while in this mode is available on the bladeRF wiki<sup>3</sup>.

<sup>&</sup>lt;sup>3</sup>https://github.com/Nuand/bladeRF/wiki/Upgrading-bladeRF-firmware#Upgrading\_ using\_the\_FX3\_bootloader

#### System PATH

At the end of the installation, the following screen is presented. Adding bladeRF items to %PATH% will allow bladeRF-cli to be executed from cmd.exe, and other programs to locate bladeRF.dll

Setup - bladeRF
Add bladeRF to system PATH? This page allows you to add a bladeRF entry to your system PATH variable.
Any bladeRF PATH entries from a previous installation will be removed and replaced with the option selected here. Use the default option if you are unsure.
Do not include bladeRF items in PATH.
Add 32-bit bladeRF items to PATH.
Add 64-bit bladeRF items to PATH.
Next >

#### **Installation Completed**

Upon completion of the previous steps, the final screen is displayed.

**Important**: You may need to log out and log back in order for changes to the System PATH and MATLAB<sup>®</sup> search path variables to take effect.



## **Testing Basic Device Access**

A quick means of verifying that the installation has succeeded is to view information about a bladeRF using the bladeRF-cli program.

A shortcut to bladeRF-cli may be executed from the Start Menu location selected in Section 3.2.1. Alternatively, it can be executed from cmd.exe as follows:

bladeRF-cli -i

Once in the command-line interface, information about the device may be obtained using the version, info, and print commands. Sample output is shown below.

S bladeRF CLI	X
bladeRF> version	
bladeRF-cli version: 1.4.0 libbladeRF version: 1.7.2	
Firmware version: 2.0.0 FPGA version: 0.6.0	
bladeRF> info	
Serial #: 3c6 b87 UCTCKO DAC calibration: 0x8f89 PFGA isce: 115 KLE PFGA loaded: yes USB hus: 3 USB address: 4 USB speed: SuperSpeed Backend: 11busb Instance: 0	≡
bladeRF> print	
RX Bandwidth: 28000000 Hz TX Bandwidth: 28000000 Hz	
RX Frequency: 2484000000 Hz TX Frequency: 2446999999 Hz	
GP10: 5x8969692f LMS Enable: Enabled LMS RX Enable: Enabled LMS TX Enable: Enabled TX Band: High Band (1.5GHz - 3.8GHz) RX Band: High Band (1.5GHz - 3.8GHz) RX Source: LMS6092D	
Loopback mode: none	
RX mux: BASEBAND_LMS - Baseband samples from LMS6002D	
RXLNA Gain: 6 dB RXUGA1 Gain: 30 dB RXUGA2 Gain: 3 dB TXUGA1 Gain: -14 dB TXUGA2 Gain: 0 dB	
Sampling: Internal	
RX sample rate: 1000000 0/1 TX sample rate: 1000000 0/1	
SMB Mode: Disabled	
Current UCTCXO trim: 0x8f89 Stored UCTCXO trim: 0x8f89	
UCTCX0 tamer mode: Disabled	
Expansion GPIO register: 0xffffffff Expansion GPIO direction register: 0x00000000	
bladeRF>	
	~

# MATLAB<sup>®</sup> and Simulink<sup>®</sup>

## MATLAB<sup>®</sup> Search Path

If bladeRF items were not added to the MATLAB<sup>®</sup> search path in Section 3.2.4, then the following paths must be provided to the addpath<sup>4</sup> function.

- C:\Program Files\bladeRF\x64
- C:\Program Files\bladeRF\matlab

Change C:\Program Files\bladeRF as necessitated by the installation location.

<sup>&</sup>lt;sup>4</sup>http://www.mathworks.com/help/matlab/ref/addpath.html?requestedDomain=www. mathworks.com

#### **RX GUI Demo**

A receive-only demo program implemented entirely in  $MATLAB^{(R)}$  may be executed via the command:  $bladeRF_rx_gui$ 

As shown below, this program allows various parameters to be manipulated while viewing FFT plots and sample values in real time.





#### **Viewing Documentation**

For information about available device properties and functions, run doc bladeRF.

Because the bladeRF MATLAB<sup>®</sup> support is implemented as a thin layer atop of bladeRF.dll, the libbladeRF API documentation<sup>5</sup> may also be referenced for more detailed information.

<sup>&</sup>lt;sup>5</sup>https://nuand.com/bladeRF-doc/libbladeRF

#### Adding a bladeRF block to a Simulink<sup>®</sup> Model

Simulink<sup>®</sup> support is implemented via a System Object<sup>6</sup>. To add a bladeRF block to a model, select the MATLAB System block from the Library Brower:



Once placed, double click the System block to specify that it should implement a bladeRF\_Simulink object.



<sup>&</sup>lt;sup>6</sup>http://www.mathworks.com/help/vision/system-objects.html

A bladeRF block will default to being receive-only, as denoted by only having an RX Samples output. Double-click the block to open up the block parameters. An input for the transmit path may be enabled in the TX Configuration tab.

bladeRF   This block provides access to a Nuand bladeRF device via libbladeRF MATLAB bindings.   Source code     Device   RX Configuration   TX Configuration   Miscellaneous   Device specification string:   Active loopback mode:   None   Interpreted execution Interpreted execution    OK Cancel Help Apply	Source Bl	Source Block Parameters: MATLAB System					
This block provides access to a Nuand bladeRF device via libbladeRF MATLAB bindings. Source code  Device RX Configuration TX Configuration Miscellaneous Device specification string: Active loopback mode: None   Enable use of XB-200 (must be attached) Simulate using: Interpreted execution  OK Cancel Help Apply	bladeRF	bladeRF					
Source code  Device RX Configuration TX Configuration Miscellaneous Device specification string: Active loopback mode: None   Enable use of XB-200 (must be attached) Simulate using: Interpreted execution  OK Cancel Help Apply	This block	This block provides access to a Nuand bladeRF device via libbladeRF MATLAB bindings.					
Device RX Configuration TX Configuration Miscellaneous Device specification string: Active loopback mode: None Enable use of XB-200 (must be attached) Simulate using: Interpreted execution  OK Cancel Help Apply	Source coo	Source code					
Device specification string: Active loopback mode: None   Enable use of XB-200 (must be attached) Simulate using: Interpreted execution  OK Cancel Help Apply	Device	RX Configuration	TX Configuration	Miscellaneous			
Active loopback mode: None   Enable use of XB-200 (must be attached) Simulate using: Interpreted execution  OK Cancel Help Apply	Device spe	cification string:					
Correl Help Apply	Active loop	back mode:	lone			-	
Simulate using: Interpreted execution	Enable u	use of XB-200 (mu	st be attached)				
	Simulate u	sing: Interpreted	execution			-	
on concer help Apply			ОК	Cancel	Help Apply	,	

As shown below, the block may be configured for a full-duplex configuration, with both RX and TX ports.



Before running a simulation, the following settings **must** be applied:

- Select Simulate using: Interpreted Execution in the block parameters Devices tab
- Configure the model's Solver Options for Fixed-Step, with a discrete (no continuous state) Solver.

😵 Configuration Parameters: untitled/Configuration (Active)		
Select:	Simulation time	
Solver Data Import/Export	Start time: 0.0	Stop time: 10.0
Data Import/Export • Optimization • Diagnostics Hardware Implementation Model Referencing • Simulation Target	Solver options Type: Fixed-step Fixed-step size (fundamental sample time): Tasking and sample time options Periodic sample time constraint: Tasking mode for periodic sample times: Automatically handle rate transition for data transfer Higher priority value indicates higher task priority	Solver: discrete (no continuous states)  auto Unconstrained Auto
Ø		OK Cancel Help Apply