BMD-300 Evaluation Kit Getting Started Guide

Contents

The BMD-300* Evaluation Kit from Rigado allows the stand-alone use of a BMD-300 module featuring the nRF52832 BLE SoC from Nordic Semiconductor.

This guide provides setup instructions for starting development.

*BMD-300, BMD301, & BMD-350 have identical operation. See BMD-300 Series Modules Datasheet for physical differences. All references to the BMD-300 throughout this guide apply to all three models noted here.

Version 1.0

Rigado LLC
3950 Fairview Industrial Dr SE, Ste 100 Salem, Oregon 97302
866-6-RIGADO ◆ modules@rigado.com ◆ www.rigado.com/modules

Contents

1 Overview

The BMD-300 is based on the advanced nRF52832 BLE SoC from Nordic Semiconductor, bringing the latest Bluetooth connectivity coupled with class leading performance. It combines a Bluetooth 4.2 compliant 2.4GHz transceiver, 64MHz ARM® Cortex™ M4F CPU, 512kB of flash memory, 64kB RAM, a suite of analog and digital peripherals, and a DC-DC converter with advanced power management into a miniaturized package. The BMD-300 enables tomorrow's most demanding IoT and wearable applications.

Figure 1. BMD-300 Modules

1.1 BMD-300 Key Features

- Complete Bluetooth 4.2 and 5.0 low energy solution with integrated antenna
- Based on the nRF52832 SoC from Nordic Semiconductor, allowing you to run your own code
- Powerful and efficient 32-bit ARM® Cortex™ M4F CPU with 512kB flash and 64kB RAM
- Highly flexible GPIO & a rich digital and analog peripheral set that can interact without the CPU
- Over-the-Air updates and Direct Test Mode enabled. Many other example applications available!
- Bluetooth Certified Component qualified, FCC and IC certified, CE compliant

1.1.1 BMD-301 Specific Key Feature

- Complete Bluetooth 4.2 and 5.0 low energy solution with U.FL for external antenna

2 Useful Tools

Below is a list of tools that aid in development with the BMD-300 Bluetooth modules.

Tool	Description
Rigado GitHub Repositories	Rigado maintains software repositories at github.com. Request access on our contact page. This guide uses the "bootloader-tools" and "programmers" repositories.
Rigado Toolbox (iPhone | Android)	The Rigado Toolbox provides a way for Rigado Module customers to configure their Rigado Beacons and other out of the box firmware features. The toolbox also provides the ability to securely update device firmware. The secure update feature is available to module customers.
nRF Connect (iPhone | Android | PC)	Nordic app that allows communication and scanning for BLE devices.
nRF Toolbox (iPhone | Android)	Nordic mobile app that demonstrates BLE profiles within Nordic SDK
Bluetooth Beacon Scanner	A mobile app of your choice to view broadcasting BLE beacons
Keil µVision IDE/Debugger	A development environment designed for microcontroller applications that enables development using the nRF52 SDK application and example files.
Segger J-Link Software	Software and documentation pack for the Segger J-Link interface
Nordic nRFgo Studio	The Nordic software suite is used to program and configure Nordic nRF devices. It supports programming of nRF52 application, bootloader, and soft device. This tool uses the on board Segger J-Link programming interface.
nRF5x Command Line Tools	Command line utility enabling programming of nRF5x devices through J-Link programmers/debuggers.
Nordic nRF5 Software Development Kit	Contains libraries, APIs and examples for software development on the nRF5x devices
PuTTY	A terminal program for using UART commands.

Table 1. Useful Tools for BMD-300 Series

3 Hardware Kit

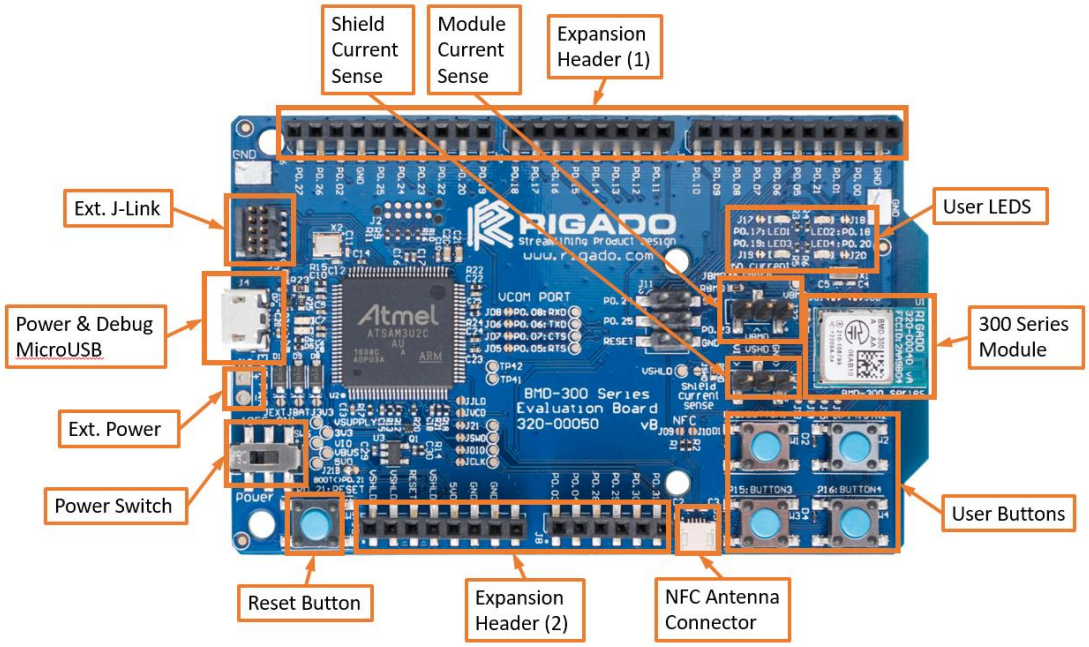

Figure 2. BMD-300 Evaluation Board Overview (top view)

3.1 BMD-300 EVAL / BMD-350-EVAL

- 1x Evaluation Board
- 1x Micro-USB Cable

3.1.1 Additional components in BMD-301-EVAL

- 2x Bluetooth Antennas – patch and tilt-whip styles
- 1x U.FL to RP-SMA jumper cable

4 Out of the Box: BMDware

At factory, Rigado loads the BMDware firmware package on BMD-300 Evaluation Boards. BMDware provides Beacon, BLE-UART bridge, GPIO and Direct Test Mode functions. This application firmware may be sufficient for your application allowing quick time-to-market.

4.1 Using the Rigado Toolbox with BMDware

1. Open the Rigado Toolbox app on a mobile device (iPhone | Android)
2. Connect to RigCom. If there are multiple devices advertising, choose the one with the correct MAC Address (see figure 6). This should also have the highest RSSI value when the mobile device is near the evaluation board.

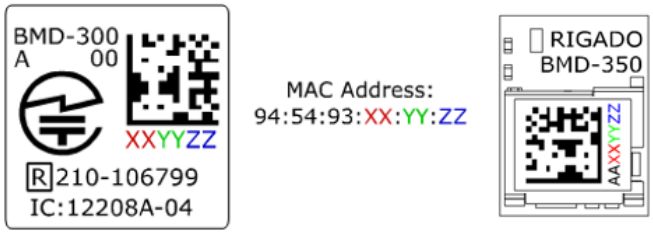

Figure 3. Where to Find MAC Address on BMD-300 Series

4.1.1 Beacon Configuration

1. Navigate to the Beacon Config tab
2. Enable Beacon:

Figure 4. Toolbox Beacon Configuration

3. Return to the scanning screen in order to save this setting.
4. Open a BLE Beacon app on your mobile device and scan. A beacon with the UUID "00112233-4455-6677-8899-aabbccddeeff" should appear

4.1.2 UART Configuration

1. Connect to RigCom again.
2. Navigate to the UART Config Tab
3. Make sure the device is connected to a computer
4. Enable UART and open the test console:

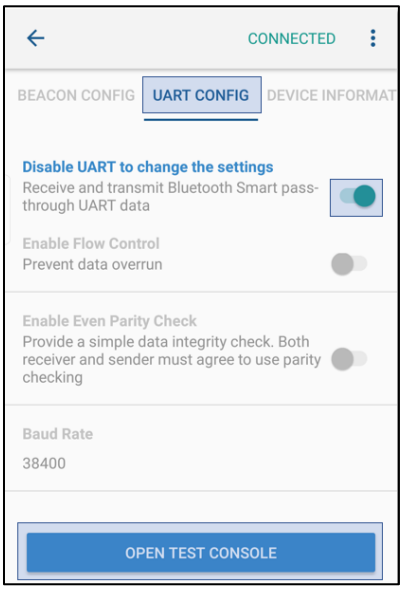

Figure 5. Toolbox UART Configuration

5. On the computer, start a terminal program
6. Check which COM port to use by opening Device Manager. The device should read "JLink CDC UART Port (COM#)"
7. Ensure the serial speed matches the baud rate set in Rigado Toolbox

8. Open the terminal
9. In the Test Console, write “Rigado is awesome!” in the send data field and hit the enter key to send the message:

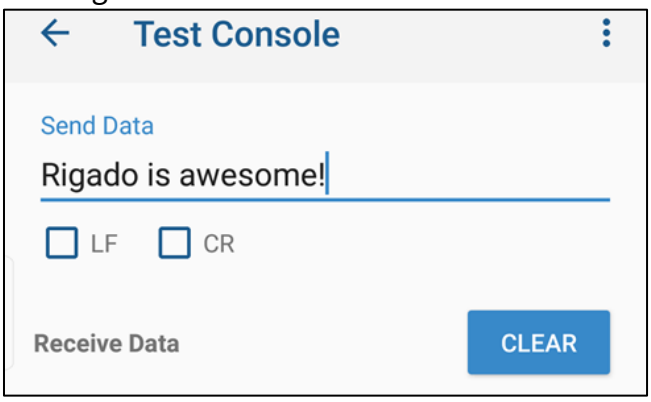

Figure 6. Toolbox Test Console "Rigado is awesome!"

10. On the computer, “Rigado is awesome” should appear in the PuTTY terminal:

Figure 7. UART Incoming Data

11. Conversely, text entered in the PC terminal will appear in the Rigado Toolbox.

4.1.3 AT Mode Beacon Example:

The AT command interface allows a device or microcontroller connected via a UART interface to configure BMDware through a physical connection rather than over the Bluetooth Low Energy interface. *Note: When AT Mode is enabled, the Pass-through UART is not available for use by default.*

1. Enable the AT Mode by holding button 2 (P0.14) while pressing reset. Continue to hold button 2 for approximately 3 seconds.
2. Open a terminal program. This example uses PuTTY
3. Under connection type, select Serial:

Figure 8. PuTTY Connection Type Serial

4. Open the terminal configuration form the category panel
5. Select “Implicit CR in every LF” to avoid a “stair step” display of text in the terminal
6. Change the local echo setting to “Force on” to see text typed into the terminal

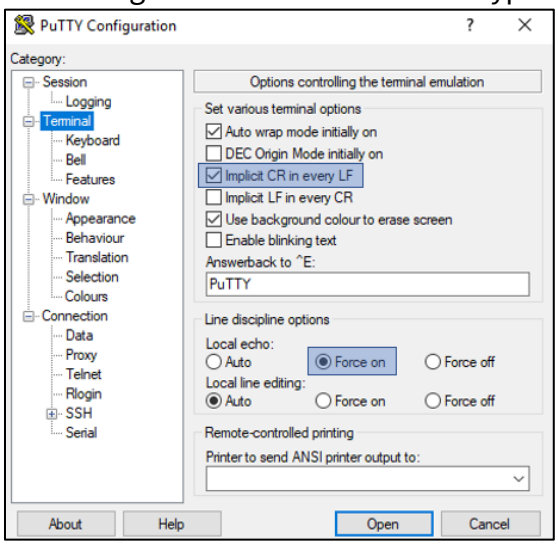

Figure 9. PuTTY Terminal Settings Configuration

7. Open the serial configuration from the category panel
8. Ensure the serial line is the correct COM port for the device (check Device Manager)
9. Correct the following:
    - Baud rate: 57600
    - Data bits: 8
    - Stop bits: 1
    - Parity: None
    - Flow Control: None

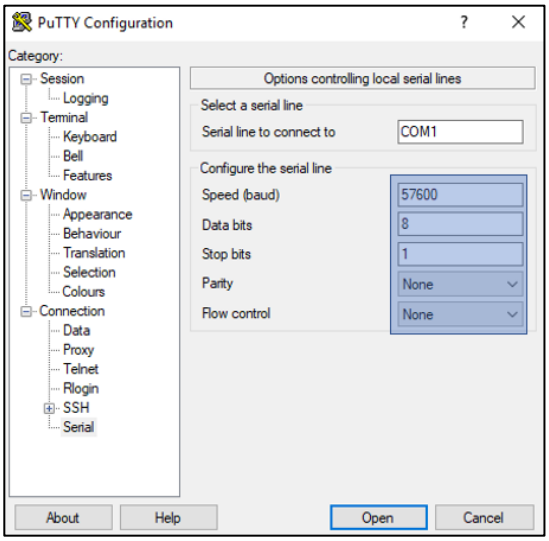

Figure 10. PuTTY Serial Configuration

10. Click Open
11. Test the connection by entering “at” and hitting enter

12. The BMD-300 will send the response “OK”, displayed in the terminal:

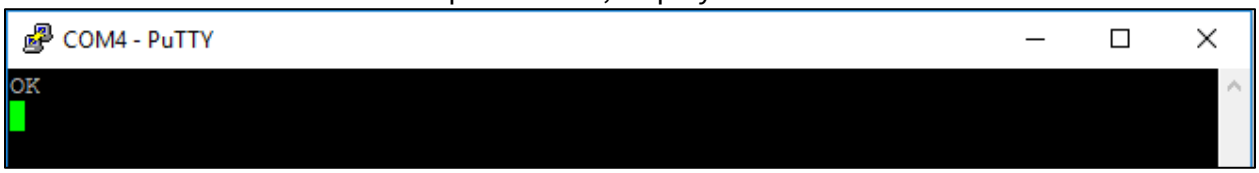

Figure 11. AT Command Expected Response Terminal

4. Change the beacon UUID by typing: at$buuid ffeeddccbbaa00112233445566778899 <enter>
5. Enable the beacon by typing: at$ben 01 <enter>
6. Check that the beacon is visible through the BLE Beacon app used in section 4.1.1
7. Notice the beacon UUID matches the UUID input previously
8. Disable the beacon by typing (note: the beacon must be disable to change beacon parameters): at$ben 00 <enter>
9. Check that the beacon is no longer visible through the BLE Beacon app

4.2 BMDware Version

BMDware AD is programmed to BMD-300 modules at factory. If necessary, BMDware can be updated through a Windows programming utility or OTA. See the Factory Firmware Migration Help Center article for the latest information on updating BMDware.

5 Custom Application Firmware Development

For applications that require custom functions, before firmware can be developed and loaded onto the BMD-300, a few tools need to be installed.

5.1 Set-up SDK Directory

The Nordic Semiconductor Software Development Kit (SDK) contains the necessary libraries, APIs, support files and code examples for software development on the nRF52 Series MCUs used in the Rigado BMD-300. Rigado’s RigDFU bootloader supports SDK v11.0.0 and v12.x.x. This guide will use v12.x.x, although the BMD-300 is compatible with any version which targets the Nordic nRF52832.

1. Navigate to http://developer.nordicsemi.com/nRF5_SDK/
2. Download the most recent nRF5_SDK_v12.x.x zip file
3. Extract the zip file to a location off the C drive such as “C:\Rigado”

5.2 Set-up Keil µVision

Keil µVision is a development environment designed for microcontroller applications that enables development using the nRF52 SDK application and example files.

1. Navigate to http://www.keil.com/download/product/
2. Click “MDK-ARM”
3. Complete the contact form
4. Download and run the EXE file
5. Complete the installation with default settings
6. Wait for the install to complete
7. If the Keil Pack Installer does not open, click the (pack installer) button

8. Click the  (update) button in the left corner
9. If you receive an error "*Cannot install Pack NordicSemiconductor.nRF_DeviceFamilyPack.8.3.1*", download and install the most current device pack from here: https://www.nordicsemi.com/eng/nordic/Products/nRF51822/nRF5x-MDK-Pack/48803
10. The pack installer should now contain the Nordic Semiconductor packs:

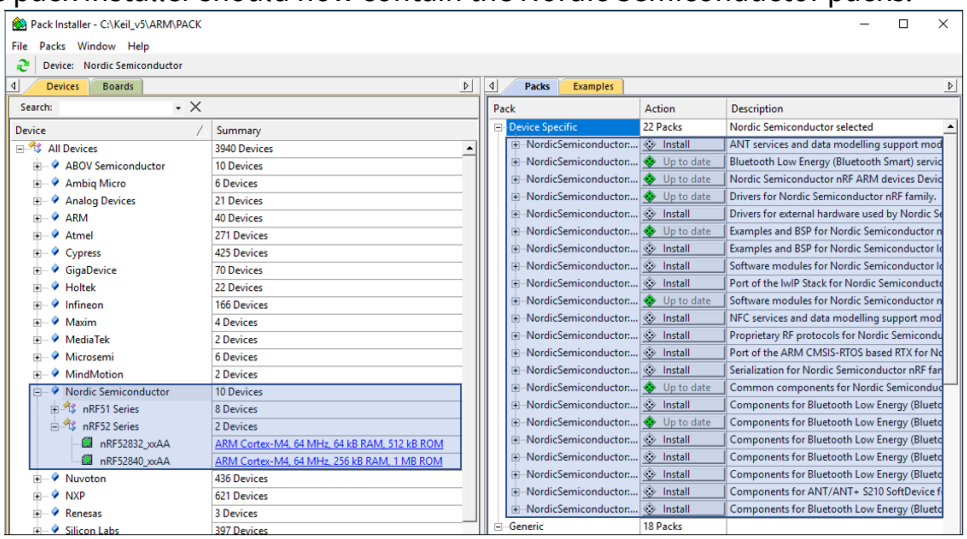

Figure 12. Keil Pack Installer Showing nRF Device Familiy Pack

11. Close the Pack Installer once the update is complete

5.3 Set-up Segger J-Link Utilities

The Segger J-link utilities are a software and documentation pack for the Segger J-Link interface.

1. Navigate to www.segger.com/downloads/jlink
2. Click "Click for downloads" under "J-Link Software and Documentation Pack"
3. Download the appropriate package for your OS
4. Accept the License Agreement
5. Run the installation program with default configurations
6. Ensure Keil µVision is selected. (It's usually a good idea to associate all displayed IDEs with the new J-Link version)

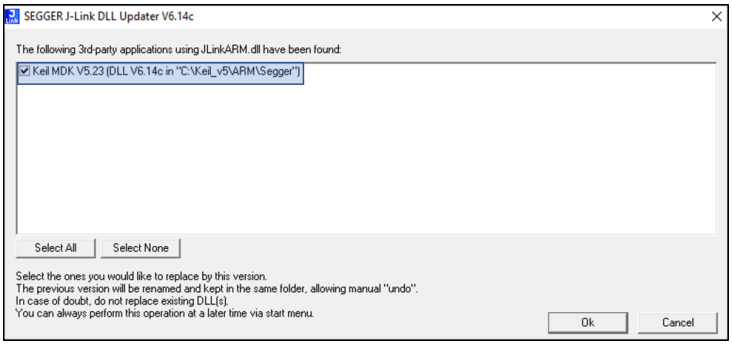

Figure 13. Segger J-link DLL Updater

5.4 Set-up nRFgo Studio (Windows and Linux only)

The Nordic software suite is used to program and configure the Rigado modules containing Nordic nRF devices. It supports programming of nRF52 application, bootloader, and soft device. This tool uses the Segger J-Link-OB programming interface on the BMD-300-EVAL. The Nordic Command Line Utilities are usually installed along with nRFgo Studio, though they may be obtained separately.

1. Navigate to https://www.nordicsemi.com/eng/node_176/2.4GHz-RF/nRFgo-Studio#Downloads
2. Download and run the appropriate version for your operating system

Note: Guides are available for installing nRFgo Studio on OSX and Linux.

6 Erase Prior to Application Development

While RigDFU provides means of sending UART and OTA updates, using the SWD debug port during development is useful. Modules with version AB factory firmware are configured with read-back protection and require a full chip erase prior to using any debugger tools. Modules with AD firmware do not have read-back protection enabled, yet an erase gives a fresh development starting point.

6.1 Erase

The Rigado “Erase and Recovery” utility from the GitHub “programmers” repository may be used to perform the full chip erase:

1. Clone the “programmers” GitHub repository to a convenient location on your system.
2. Navigate to where the programmers repository is stored > programmers > BMD-300 Erase & Recovery
3. Run BMD300 Erase.exe
4. Click Program:

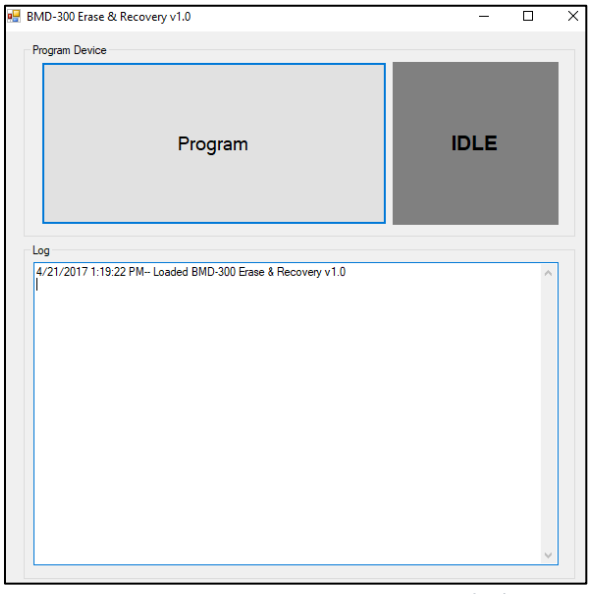

Figure 14. BMD-300 Erase & Recovery Default

5. Wait for the operation to complete. The grey idle square should read success and turn green when done:

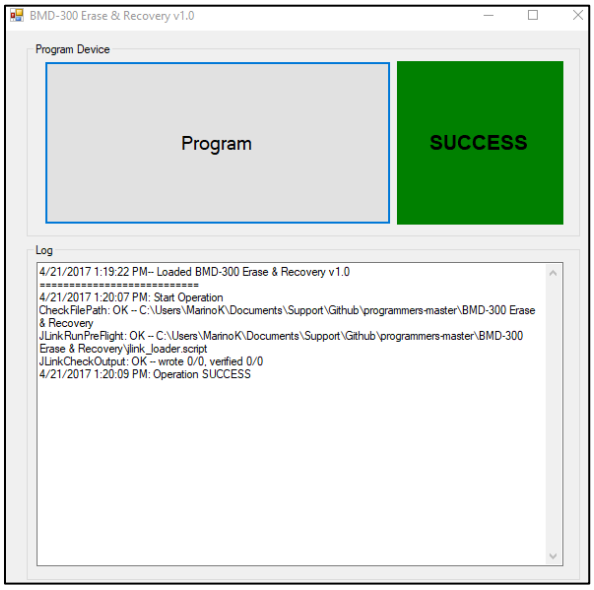

Figure 15. BMD-300 Erase & Recovery Complete

7 Example Project: Create a Beacon

This is an example of how to program a BMD-300 Evaluation Board using various methods. After each method, the device should be visible on a beacon scanner mobile app.

7.1 Using a HEX File

This is a quick check with the Nordic supplied HEX file to see how the program should behave.

1. Navigate to C:\Nordic\nRF5_SDK_12.2.0_f012efa\examples\ble_peripheral\ble_app_beacon\hex
2. Copy the ble_app_beacon_pca10040_s132.hex file. This contains both the beacon application and the S132 SoftDevice merged into a single hex file
3. Navigate to the JLINK drive and paste the hex file
4. Once the device is programmed, a red LED should start blinking

7.2 Using Keil µVision

1. Navigate to C:\Nordic\nRF5_SDK_12.2.0_f012efa\examples\ble_peripheral\ble_app_beacon\pca10040\s132\arm5_no_packs
2. Open the .uvprojx file
3. Click the (build) button and wait for the build to complete
4. Close the pack installer and return to µVision
5. Click the (program) button
6. Once the device is programmed, a red LED should start blinking and the device will be visible in the nRF Toolbox

7.2.1 Create Hex File in Keil µVision

1. Select project > Options for Target 'project'...
2. Navigate to the "Output" tab

3. Optionally, change the name of the HEX file in the “Name of Executable” field
4. Ensure "Create HEX File" is selected:

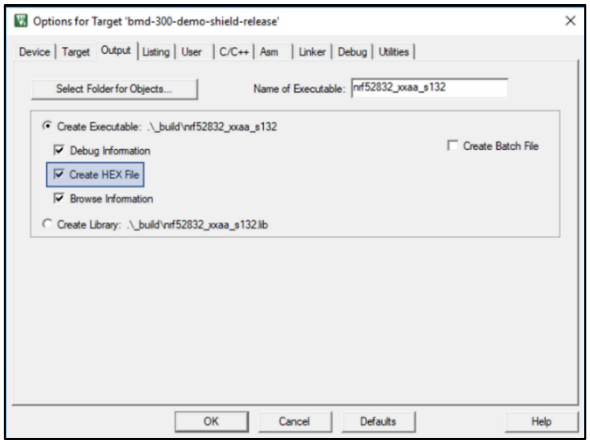

Figure 16. Keil µVision Configuration for HEX FIle

5. Click OK
6. Click the (build) button and wait for the build to complete
7. The HEX file should now be available in the project’s “_build” folder

8 Factory Restore

It may also be desirable to restore the entire factory-loaded image. This can also be done with the programmers repository using a SWD connection.

8.1 Erase and Restore

1. Navigate to where the programmers repository is stored > programmers > Factory Images > BMD-300 > BMD-300_AD_wMAC (or the newest version)
2. Run the BMD300 Programmer.exe
3. Enter the last 6 digits of the MAC address as seen in Figure 5
4. Click Program:

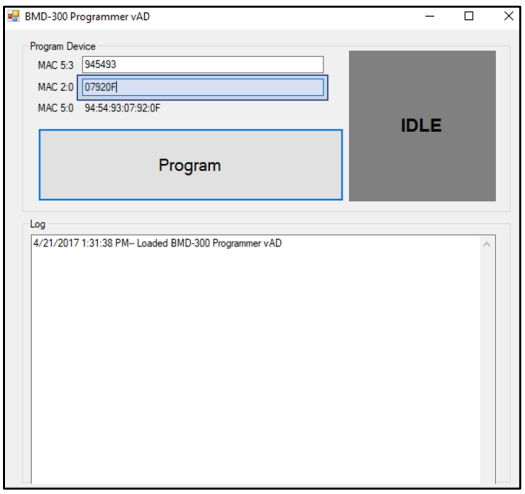

Figure 17. BMD-300 Programmer Default

5. Wait for the operation to complete. The grey idle square should read success and turn green when done:

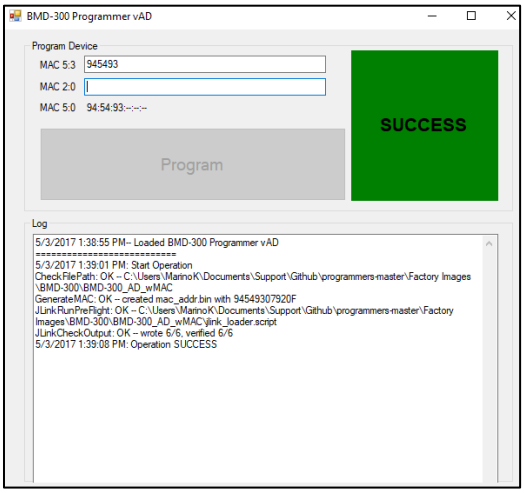

Figure 18. BMD-300 Programmer Complete

9 Using Rigado's Bootloader Tools

Rigado's "bootloader-tools" repository on GitHub contains tools for programming via J-Link or generating custom firmware update images to update OTA ("Over-The-Air") with a mobile app such as Rigado's Toolbox app, a Mac or Linux PC, or by UART. Download the RigDFU Datasheet from our downloads page for full details.

9.1 Preparing for OTA Update

An application HEX file must be prepared to perform an OTA Update with RigDFU.

1. Navigate to C:\Nordic\nRF5_SDK_12.2.0_89a8197\examples\ble_peripheral\ble_app_beacon\pca10040\s132\arm5_no_packs_build
2. Note the full path, or copy the hex file to where the “bootloader-tools” repository was stored, then bootloader-tools-master\image-tools\genimage
3. Open a command prompt in this location
4. To generate an unsigned OTA BIN file, run:

```
python genimage.py --hexfile nrf52832_xxaa_s132.hex -o beacon_example_OTA.hex -f config\nrf52832
-sd132v3.x.0.cfg
```

Note: RigDFU supports the Nordic SoftDefice S132 v2.0.0 and v3.x.0. Be sure to select the config file that matches the S132 version.
Note: If required, an encrypted update file may be generated by using the signimage utility on the output of genimage. See the RigDFU datasheet for details.

9.2 OTA Update

The OTA Update can be completed while running BMDware or directly from RigDFU. Make sure the mobile device does not go into sleep mode during the update. This will cause Rigado Toolbox to disconnect and the original firmware to restart.

9.2.1 Update from BMDware

1. Place the OTA .bin file somewhere easy to navigate to on your mobile device (for iOS, email the file to an account accessible on the iPhone or iPad).

iOS – Update from BMDware

2. Open the BIN file with Rigado Toolbox
3. Connect to RigCom
4. Tap on the first "Unknown" characteristic
5. Tap on "Firmware" (top right corner)
6. At the next screen under "Command to Start", enter: 03563057, then tap "Start" in the upper right. This will start the update process and display a progress bar on the app

Android – Update from BMDware

2. Open Rigado Toolbox
3. Connect to RigCom
4. Tap "Firmware Update"
5. Tap "Firmware Image File", select the BIN file
6. Tap "Activation Characteristic", select 2413B33F-707F90BD-2045-2AB880757187
7. Select “Unknown Characteristic”
8. Tap "Activation Command", enter 03563057
9. Tap Begin Update. This will start the update process and display a progress bar on the app

When complete, stop and restart the Bluetooth on the mobile device to clear any cached advertised names.

9.2.2 Update from RigDFU

1. Email the OTA BIN file to an account associated with on the mobile device.
2. Download and open the BIN file with Rigado Toolbox
3. Connect to RigDFU(i.e. highest RSSI when the device is nearby). *If the device disconnects, tap "attempt reconnect" and power cycle the device at the same time*

iOS – Update from RigDFU

4. Tap on the first "Unknown" characteristic
5. Tap on "Firmware" in the upper right corner of the app.
6. At the next screen under "Command to Start", enter: 00, then tap "Start" in the upper right. This will start the update process and display a progress bar on the app

Android – Update from RigDFU

4. Select the first "Activation Characteristic"
5. Select the first "Unknown Characteristic"
6. Enter "00" for the "Activation Command", then tap "Send Command". This will start the update process and display a progress bar on the app

When all complete, stop and restart the Bluetooth on the mobile device to clear any cached names. *Note: RigDFU only runs for 2 seconds then passes control to the application firmware. If no firmware or a "bad" image is present, then RigDFU will run for 3 minutes. RigDFU can be told to run for 3 minutes by selecting Unknown Characteristic and using the command 96dff40b. See the RigDFU datasheet for example application firmware code.*

10 Contact Information

Headquarters
Rigado LLC
3950 Fairview Industrial Dr SE, Ste 100
Salem, Oregon 97302
866-6-RIGADO • modules@rigado.com

Portland Branch
Rigado LLC
1001 SW Water Ave, Ste 290
Portland, OR 97214
866-6-RIGADO • modules@rigado.com

Sales Network
Please visit the Partners page of our Rigado Website for the contact details of our distributor(s) and sales representative(s) in your region.

Appendix A – References

Item	Description / Link
Rigado Documents	http://rigado.com/support
Nordic Semiconductor Infocenter	http://infocenter.nordicsemi.com/index.jsp

Table 2. References

Appendix B – Tables

Appendix C – Figures

Appendix D – Revision History

Revision	Changes	Date
1.0	Initial Release	2017-05-05

Table 3. Revision History

Mouser Electronics

Authorized Distributor

Click to View Pricing, Inventory, Delivery & Lifecycle Information:

Rigado:

BMD-301-EVAL BMD-350-EVAL BMD-300-EVAL