Low Power Modes

BL5340 Module

Application Note *v2.0*

1 Introduction

The BL5340 module has three power modes:

- **Run** – The normal operation of the module when the application is running and not waiting for events.
- **System ON Idle –** The module is placed in Nordic system ON idle. The module wakes from system ON idle if any registered event is triggered.
- **System OFF** – Nordic System OFF is the lowest power mode and the module can only exit it through a system reset.

This guide demonstrates the power consumption of the two low power modes: System ON idle and System OFF using the low power application provided by Nordic.

2 Requirements

- Ezurio DVK-BL5340 (453-00052-K1 or 453-00053-K1).
- Micro USB to USB (Type-A) Cable – provided with devkit.
- PuTTY (for observing output from the running application): https://www.chiark.greenend.org.uk/~sgtatham/putty/
- Nordic low power application: https://github.com/zephyrproject-rtos/zephyr/tree/master/samples/boards/nrf/system_off This application's functional behaviour after pressing reset button (S1) is:-
  - Busy-wait for 8 seconds.
  - Busy-wait for 8 seconds with UART off.
  - Sleep 8 seconds.
  - Sleep 8 seconds with UART off. :This is Nordic System ON Idle (measured in this App Note).
  - Enter system off; press BUTTON1 to restart. :This is Nordic System OFF (measured in this App Note).

  The Nordic low power application was modified to change the "Busy-wait" and "Sleep" from 2 seconds to 8 seconds, allowing time to measure the current consumption. The application's last step, "press BUTTON1 to restart," does not work on DVK-BL5340, as the buttons on DVK-BL5340 are behind I2C Port Expander (which this Nordic application does not have code for). To restart low power application press reset button S1 on DVK-BL5340.

  This application note does not show how to modify or build and compile the application.
- Current measuring digital multimeter (DMM), that can measure down to 0.4uA.
- Programmer tool inside nRF Connect for Desktop, used to load the application over the SWD interface: https://www.nordicsemi.com/Software-and-tools/Development-Tools/nRF-Connect-for-desktop/Download#infotabs

3 Development Kit Setup

To set up the DVK-BL5340 development kit, complete the following steps:

1. Configure the board to the following settings (shown in Figure 1)
   - DC/USB power source switch (SW4) – in position USB (default)
   - Switch SW7 is in middle position for Normal Voltage mode operation (default)
   - Jumper J7 removed, cut solder bridge SB1
   - SW11 in left position
   - Open DIP switch S12, pin3 and pin4 (to disconnect Accelerometer INT1_ACC and INT2_ACC), other there will 250uA extra current when running lower power application.
2. To measure the current consumption of the module, connect the current measuring DMM to J7 on the development kit (Figure 1).

Note: After the test is complete, remember to replace the jumper on J7.

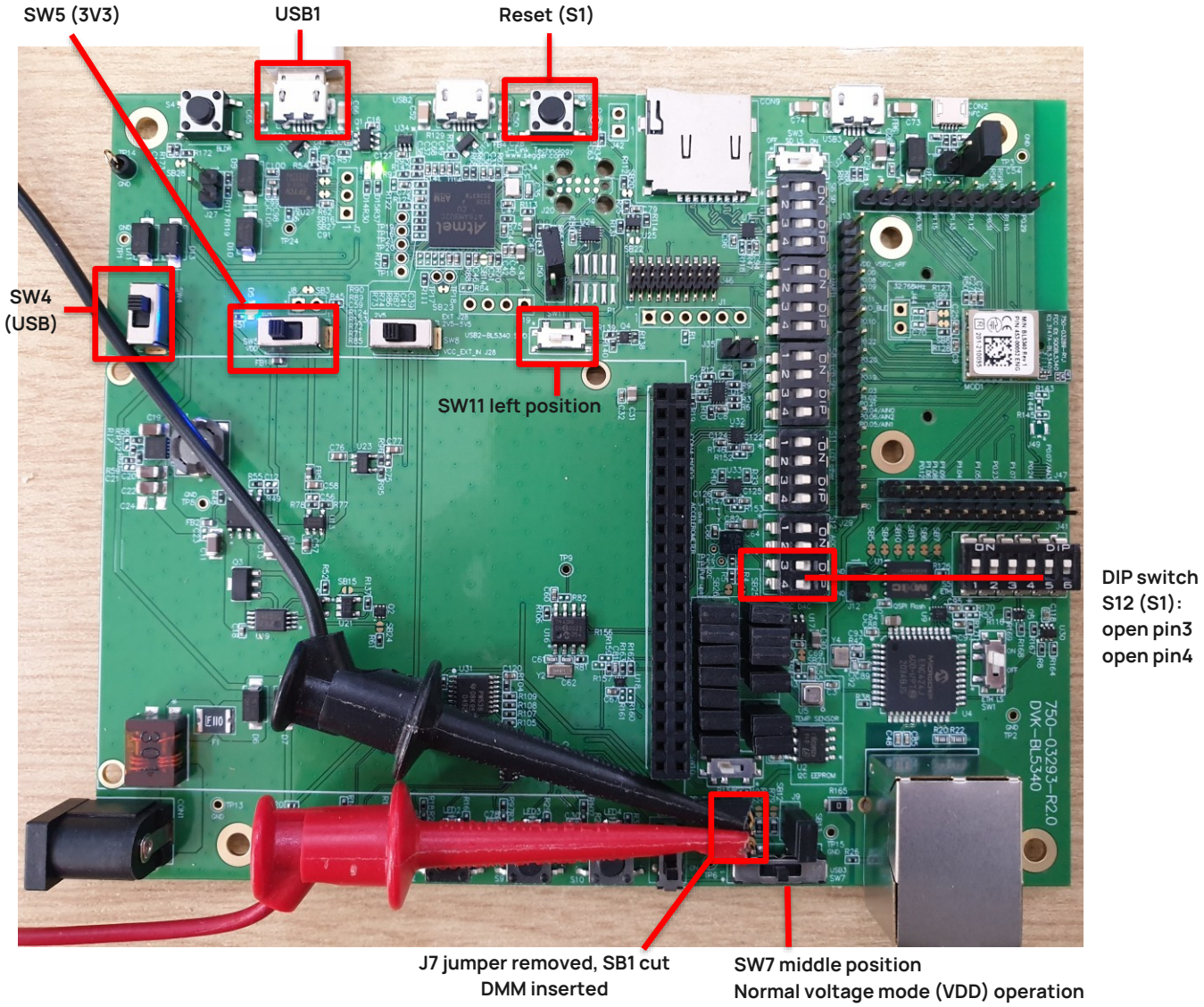

Figure 1: BL5340 development board DIP switch and switch settings

4 Loading the Low Power application using SWD interface

1. Connect the DVK-BL5340 (connector USB2) to your PC via the included USB-A to USB micro cable, to load the low power application using the onboard USB2 to SWD interface circuitry (SW11 must be in left position), as shown figure Figure 2.

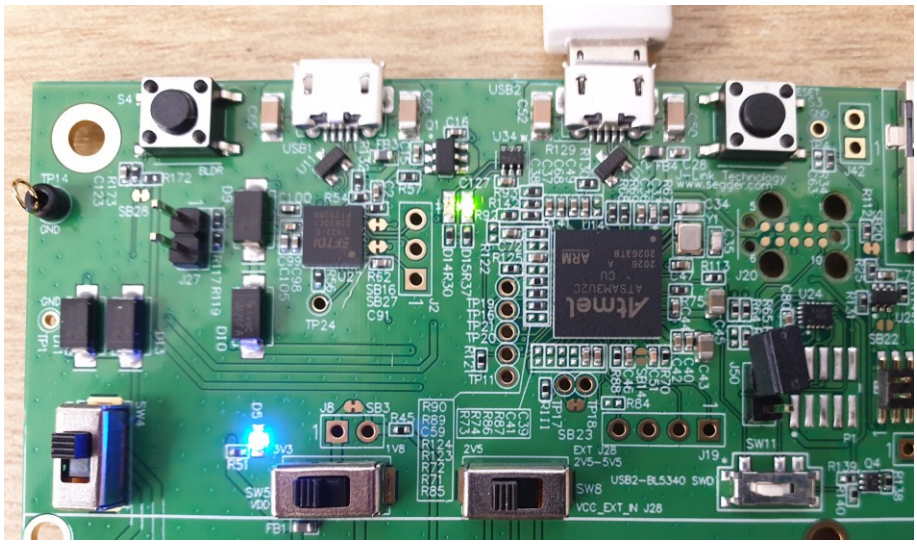

Figure 2: BL5340 development board USB2 to SWD interface for loading the application

2. After powering the DVK-BL5340, press reset button S1.
3. Open nRFConnect **Programmer.**

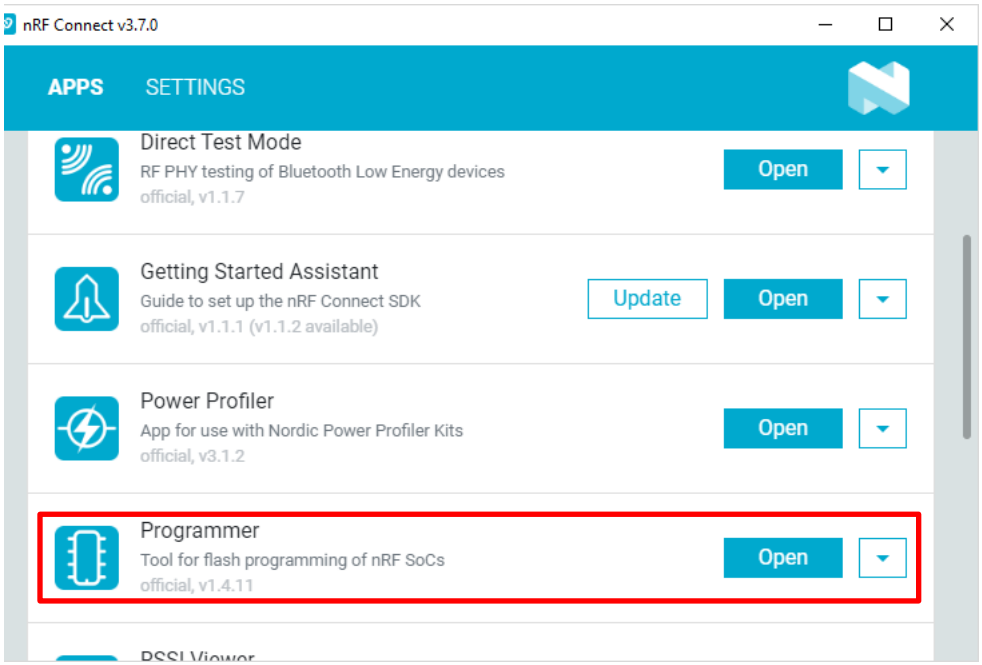

Figure 3: nRF Connect "Programmer" tool

4. Select device.

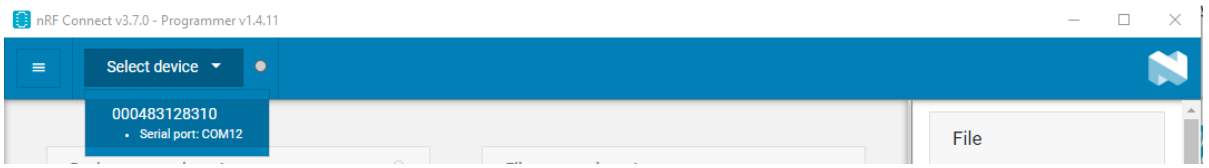

Figure 4: Select device in nRF Connect Programmer

5. Wait for boot up to complete and the "Device has been read" message to appear as shown in Figure 5.

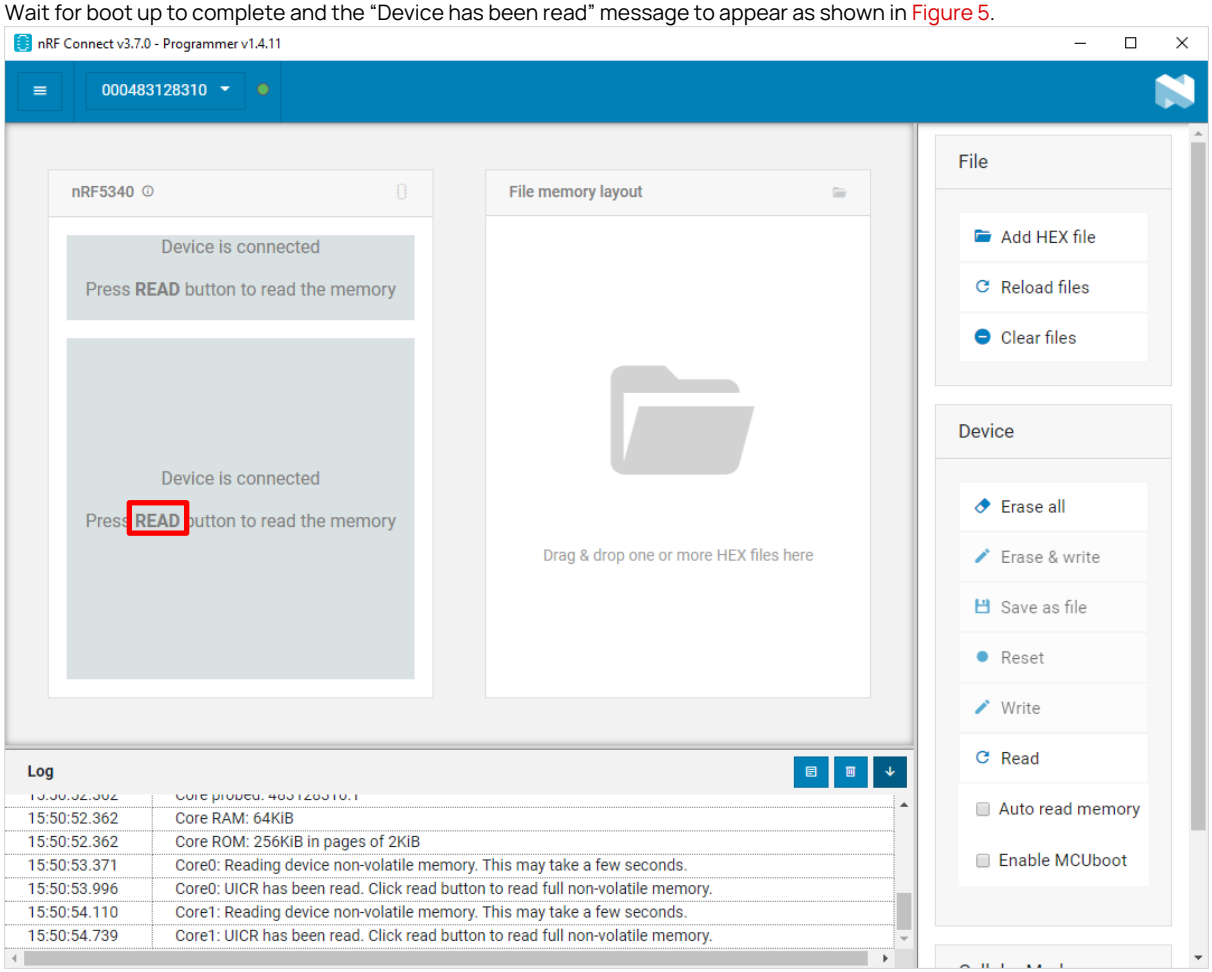

Figure 5: "Device is Connected" message

6. Click **Erase all.**

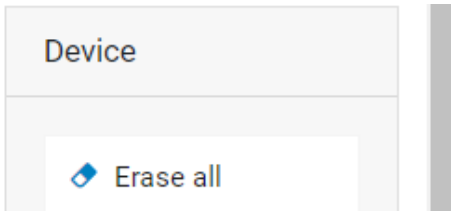

Figure 6: Erase All button

7. Wait for the "Device has been Read" message to appear again. Then click **Add HEX File**.

8. Navigate to the location of the firmware file in your file explorer, select the file and click **Open.**

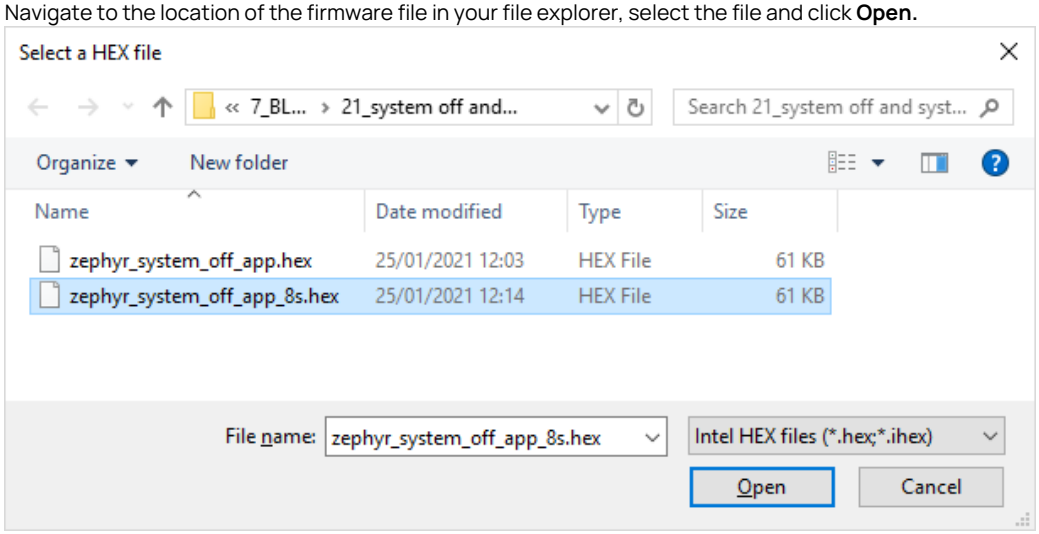

Figure 7: Firmware HEX file (for Nordic lower power application) in file explorer

9. An orange bar appears in the memory layout panel on the right-hand side of the main window.

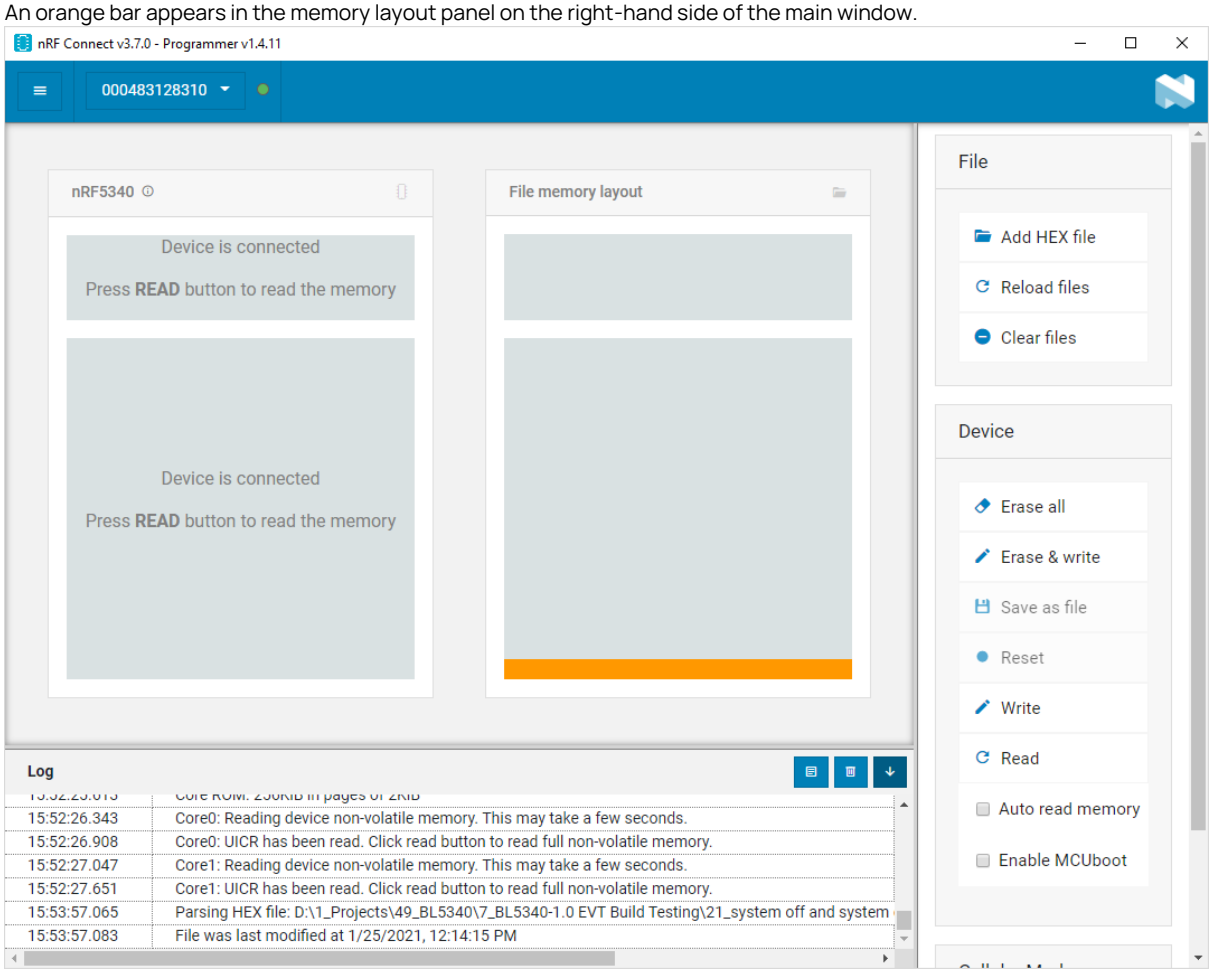

Figure 8: HEX file (Nordic lower power application) loaded in nRF Connect

10. Click **Write** and wait until write is complete.

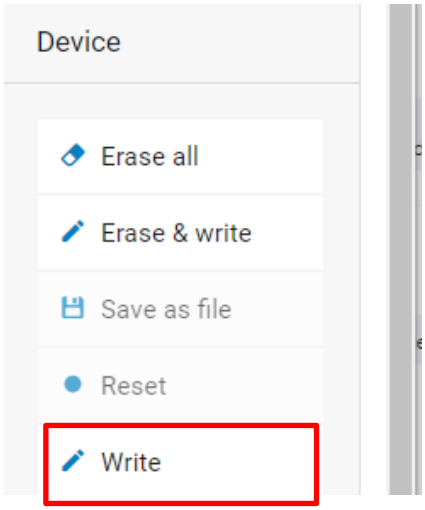

Figure 9: Write to device

11. When Write is complete, should see the screen as shown below with the "Device has been Read" message.

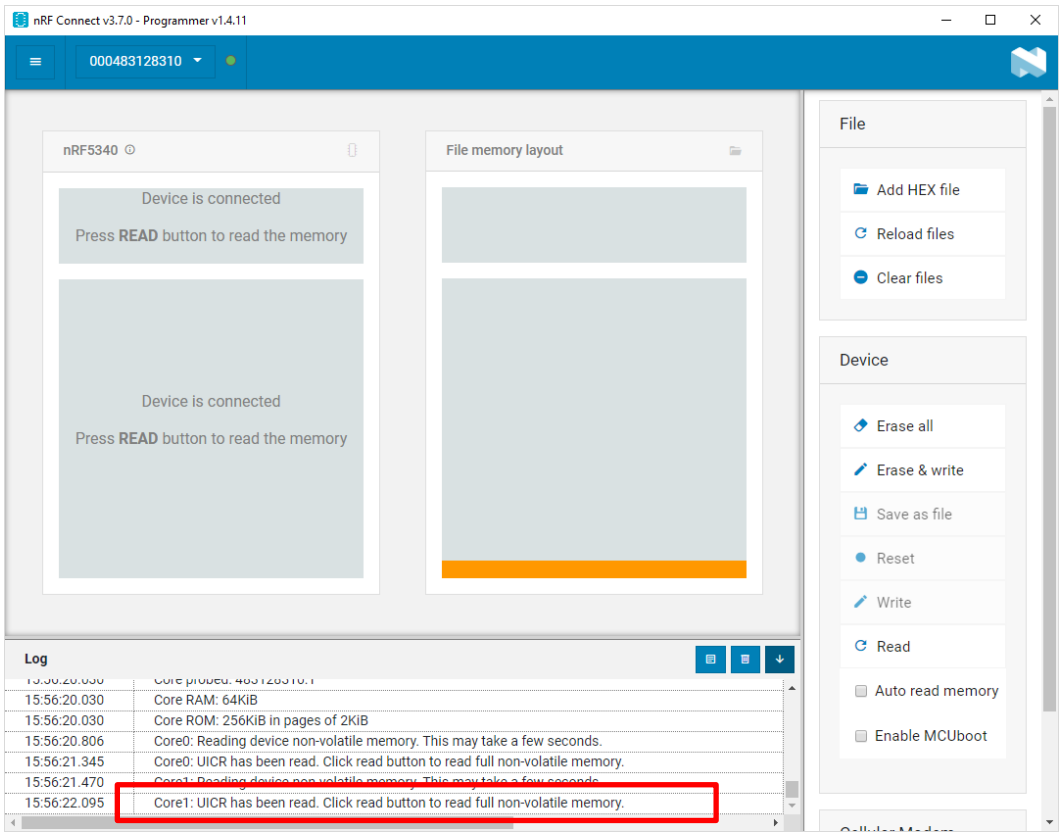

Figure 10: Write complete (for Nordic lower power application)

12. Power cycle DUT by removing USB cable from laptop to DVK-BL5340 **USB2** connector.

5 Running Low Power Application over the UART

1. Low Power Application will be run on BL5340 module and its output observed over the UART0 (which goes to USB1 connector via the FTDI chip (USB1 to UART0 convertor)).
2. Connect the DVK-BL5340 (connector **USB1**) to your PC via the included USB-A to USB micro cable.
3. Ensure that the current measuring DMM is connected to J7 before the development kit is powered up (or else the board will not be powered).
4. Follow the on-screen prompts. Windows may prompt you to install FTDI drivers (available from the following site: http://www.ftdichip.com/FTDrivers.htm).
5. Ensure that the Windows Device Manager displays a new virtual COM port for the USB to Serial adapter.
6. Launch PuTTY.
7. From the PuTTY configuration, select Serial and then for the Serial Port the COM port associated for the DUT DVK-*BL5340* (COM port shown in Windows Device Manager) and speed 115200 as shown in Figure 11.

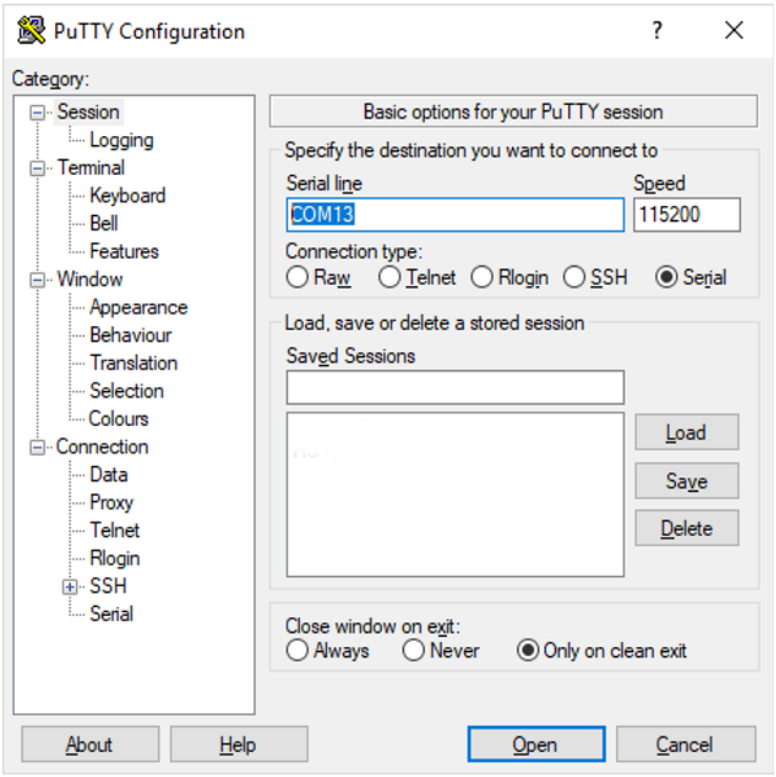

Figure 11: PuTTY setting connection parameters

8. At the top of the screen, click **OK.**
9. PuTTY opens as shown in Figure 12.

Figure 12: PuTTY opens

11. Press **reset button (S1)**, to start and run the lower power application. The following messages appear:

"Sleep 8 s with UART off" :is System ON Idle

"Entering system off; press BUTTON1 to restart" :is System OFF

In this application note we record the measured current consumption for System OFF and System ON Idle.

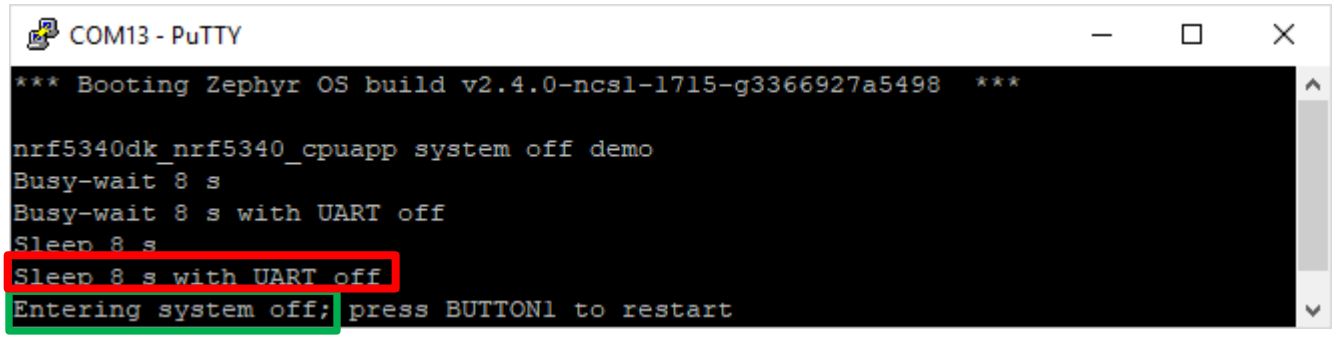

Figure 13: Low Power Application running to System ON Idle and then System OFF mode

In this application note we record the measured current consumption for System OFF and System ON Idle.

10. Press **reset button (S1)**, to run the lower power application again,

5.1 Measured System OFF current consumption

To measure the System OFF mode current, complete the following steps:

1. Run the low power application by pressing the **reset button S1**, Figure 14 shows low power application running to System OFF.

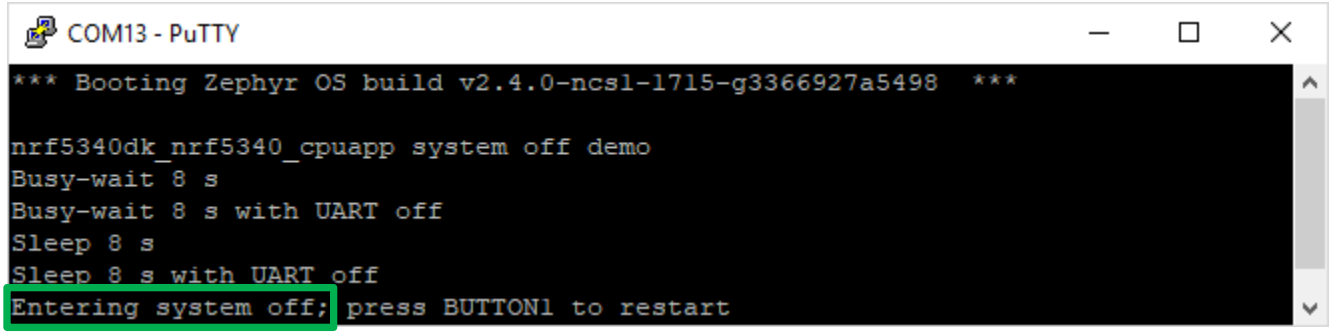

Figure 14: Low Power Application running to System OFF mode

2. Through the current measuring DMM, the current should fall to about 0.9 uA at 25°C temperature (Figure 15).

Note: In Nordic System OFF and Nordic System ON idle, the regulator uses refresh mode – the regulator charges up a capacitor, then turns off and turn on again when the voltage on the capacitor is below a certain value. This means that the current flows into the chip in short bursts. In Nordic System OFF, the distance between the current spikes is about 250 milliseconds. So, if the multimeter is not able to average over a long enough time, you will likely see that the value varies.

Figure 15: The current falls to about 0.9uA (900nA) at 25°C temperature when placed in System OFF mode

Note: The only way to exit System OFF mode is through a hardware reset (press reset button S1). This returns the BL5340 into running the application.

5.2 Measured System ON Idle current consumption

To measure the System ON idle mode current, complete the following steps:

1. Run the low power application by pressing the **reset button S1**, Figure 16 shows low power application running to System ON Idle

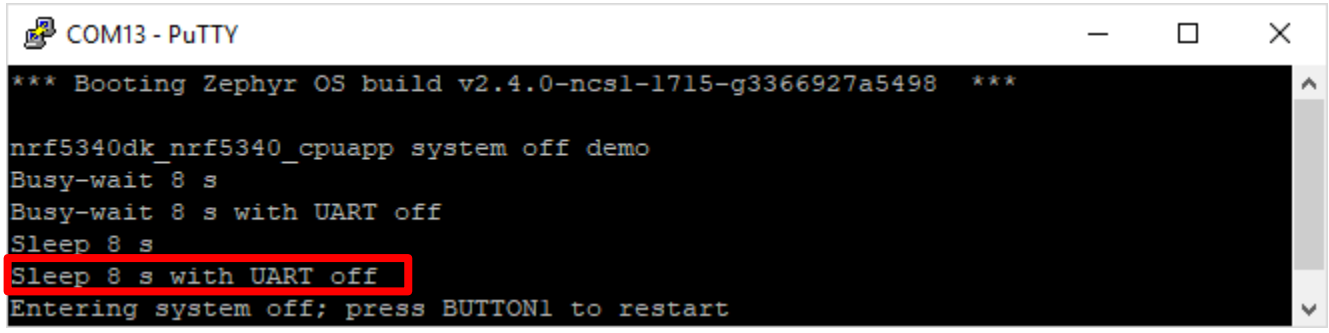

Figure 16: Placing module into System ON Idle mode

2. Through the current measuring DMM, the current should fall to about 3.3 uA at 25°C temperature (Figure 17). Note, the lower power application will only stay in System ON idle for 8 seconds. So to measure again, restart lower power application by pressing reset button S1 in development board.

Note: Once you're done with the current measurement, place the jumper back on J7. Otherwise, the BL5340 is not powered through the USB port; it is powered parasitically instead.

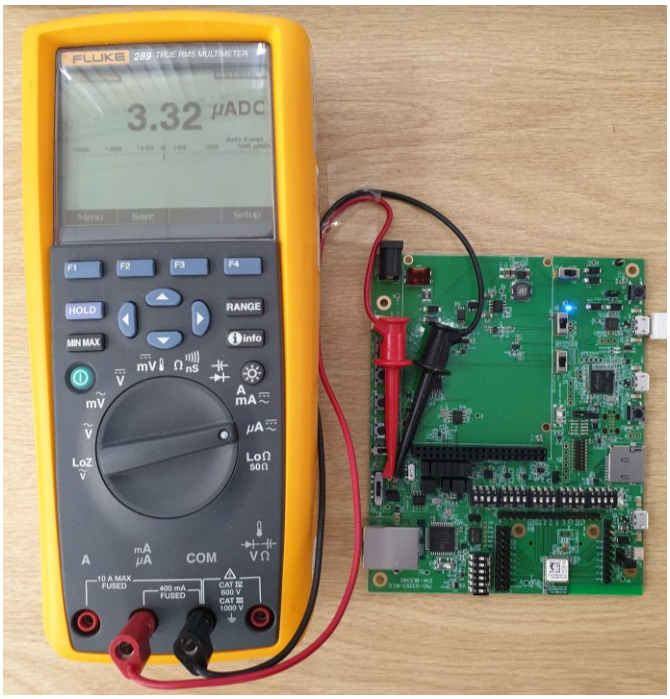

Figure 17: The current falls to about 3.3uA at 25°C temperature when placed in System ON idle mode

Note: In Nordic System OFF and Nordic System ON idle the regulator uses refresh mode, which means that the regulator charges up a capacitor, then turns off, and turn on again when the voltage on the capacitor is below a certain value. This means that the current flows into the BLE chip in short bursts. In Nordic System OFF the distance between the current spikes is about 250 ms. So, if the multimeter is not able to average over a long enough time you will probably see that the value is varying.

6 Further Information

Additional documents are also accessible from the Documentation tab in the BL5340 product page.

7 Revision History

Version	Date	Notes	Contributor(s)	Approver
1.0	29 June 2021	Initial Release	Raj Khatri	Jonathan Kaye
2.0	10 Apr 2025	Ezurio rebranding	Sue White	Dave Drogowski

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