

Use of ISP1907-LL Evaluation Boards

Application Note AN200401



Introduction

Scope

This document gives details on hardware and software for using and testing Insight SiP Bluetooth Low Energy module ISP1907-LL, version with 192K flash and 24K RAM memories.

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1. Recommended Documentation

The following Nordic Semiconductor documents and Software Dev Kits are required to understand the complete setup and programming methods.

Nordic Semiconductor Documents

- ✚ nRF52811 Development kit User Guide, hardware section should be partially ignored – Insight SiP development kit hardware replaces Nordic Semiconductor hardware.
- ✚ nRF52 Series Reference Manual.
- ✚ nRF52811 Product Specification V.x.x – make sure you have the last document version updated.
- ✚ S100 series SoftDevice Specification.
- ✚ nRF5 SDK for software development on nRF52 Series.

To access documentation, information, go to:

- ✚ Official Nordic Semi website <http://www.nordicsemi.com>
- ✚ The Nordic Semiconductor Infocenter is a “comprehensive library” containing technical documentation for current and legacy solutions and technologies <http://infocenter.nordicsemi.com/index.jsp>
- ✚ Ask any Nordic related question and get help <https://devzone.nordicsemi.com/questions>
- ✚ For any question, you can also open a case on the <http://www.nordicsemi.com>

Software Dev kits

- ✚ nRF Connect for Desktop and for Smartphone.
- ✚ nRF5 Software Development Kit (SDK) which includes precompiled HEX files, source code as well as SES and Keil ARM project files.
- ✚ S100 series SoftDevice, namely S112 and S132.
- ✚ Master Control Panel and/or nRF Connect application for Smartphone.

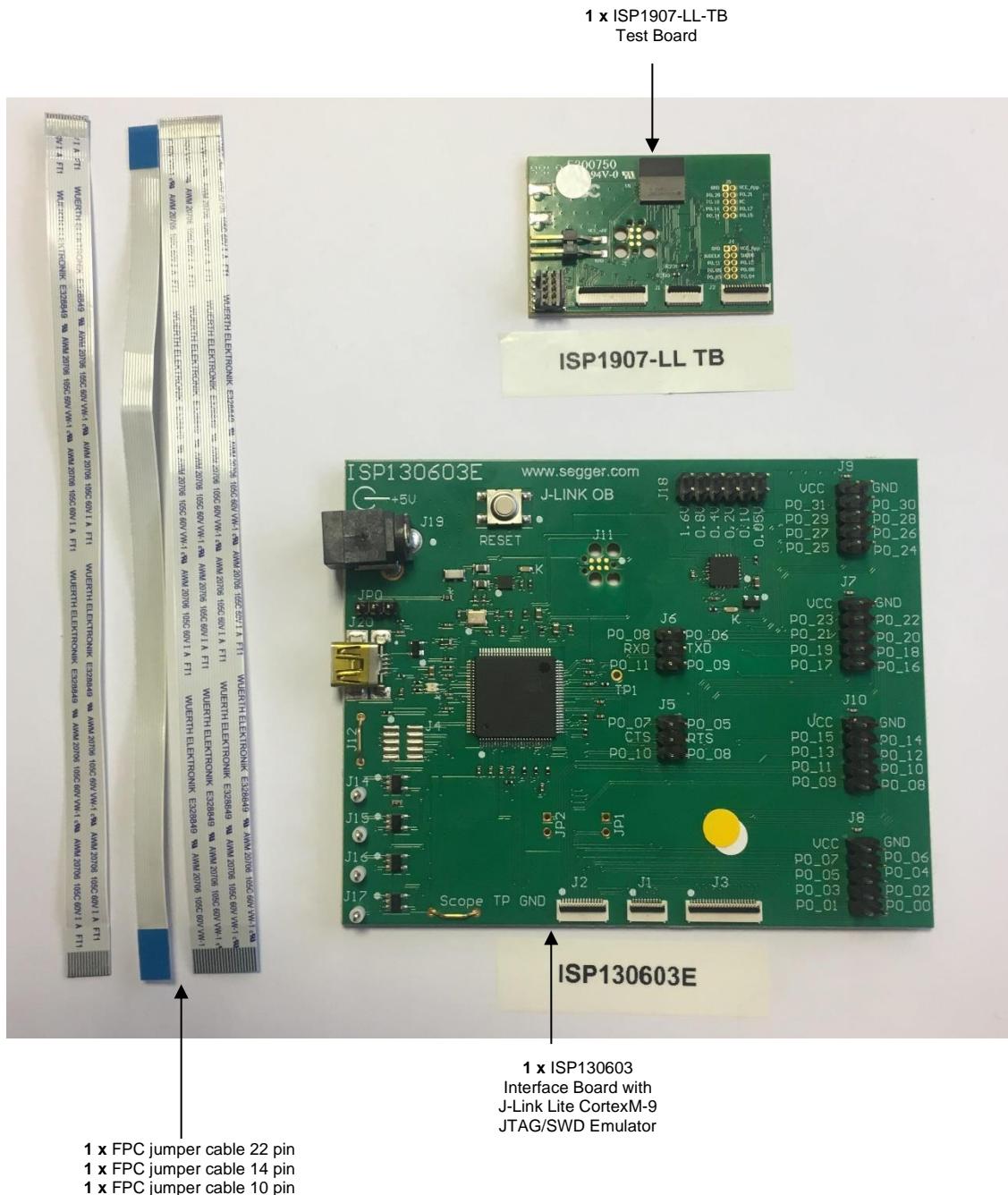
To access these files, go to www.nordicsemi.com and download the files. Instructions can be found in Section 3.

Other Insight SiP documents

To complete the above, following documents are available on Insight SiP website or/and on request:

- ✚ AN181103 App Note – this document.
- ✚ DS1907 module data sheet.
- ✚ ISP1907-LL-TB Test Board schematic.
- ✚ ISP130603 Interface Board schematic.
- ✚ ISP1880 Sensors Board schematic.

2. ISP1907-LL Dev Kit Hardware Content



3. Software Installation

This paragraph describes the steps to follow for software installation.

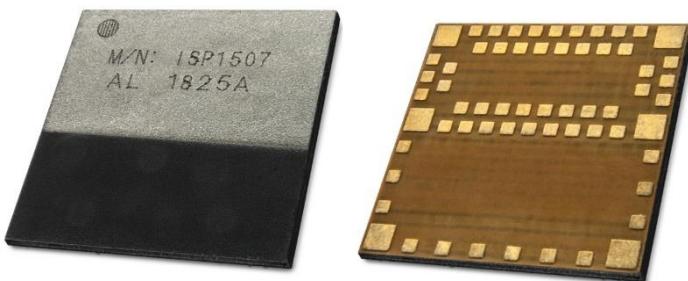
1. Download and install Segger Embedded Studio (SES) from <https://www.segger.com/downloads>. Go to <https://license.segger.com/Nordic.cgi> and fill the form. A free license key will be emailed to you, start SES, go to Tools -> License Manager and activate your license. This option allows compilation and loading of large applications.
2. Download the latest version and run the J-Link Software and documentation pack for Windows from <http://www.segger.com/jlink-software.html>.
3. Go to www.nordicsemi.com and log in to your Nordic My Page account. Go to Products and click on Bluetooth Smart/Bluetooth Energy. You will have access to the different product:
 - a. nRF52 Series: Click on nRF52811 and on the download section you have access to the documentation, SoftDevice, Master control panel, nRFgo studio, SDK, etc.
 - b. nRF52 Development Tools: You can download the last nRF5 SDK.
4. You can also download the SDK in the following link: <https://developer.nordicsemi.com/>.
5. Download and install nRF Connect for Desktop and application for Smartphone (make sure to download the last version updated). Go to <https://www.nordicsemi.com/Software-and-Tools/Development-Tools/nRF-Connect-for-desktop>.
6. Download and install Master Control Panel (x86 is for 32 bits windows and x64 is for 64 bits windows).

You can also download the Smartphone application "nRF Connect" available on the Play Store (Android version) and on the App Store (IOS version).

4. Hardware Description

4.1. Information about ISP1907-LL Module

ISP1907-LL is a Bluetooth Low Energy module with integrated antenna.



This module is based on Nordic Semiconductor nRF52811 2.4 GHz wireless SoC. nRF52811 integrates nRF52 series 2.4 GHz transceiver, a 32-bit ARM Cortex™-M4 CPU, flash memory, and analogue and digital peripherals. nRF52811 can support Bluetooth low energy and a range of proprietary 2.4 GHz protocols. The ISP1907-LL module measures 8 x 8 x 1.0 mm³. The module integrates all the decoupling capacitors, the 32 MHz and 32 kHz crystals, their load capacitors, the DC-DC converter component, the RF matching circuit and the antenna in addition to the wireless SoC. For more details, see Insight SiP module data sheet (document DS1907).

4.2. ISP1907-LL-TB Test Board

Board dimensions are 43.7 x 29 mm². It encloses:

- ✚ ISP1907-LL BLE module
- ✚ 3 x FPC connectors in order to access the nRF52810 GPIOs:
 - 1 x 10 pin FPC connector on top side of the board.
 - 1 x 14 pin FPC connector on top side of the board.
 - 1 x 22 pin FPC connector on top side of the board.
- ✚ 2 x 5 pin header for the Debug using Nordic Evaluation Board
- ✚ JTAG footprint for the programming

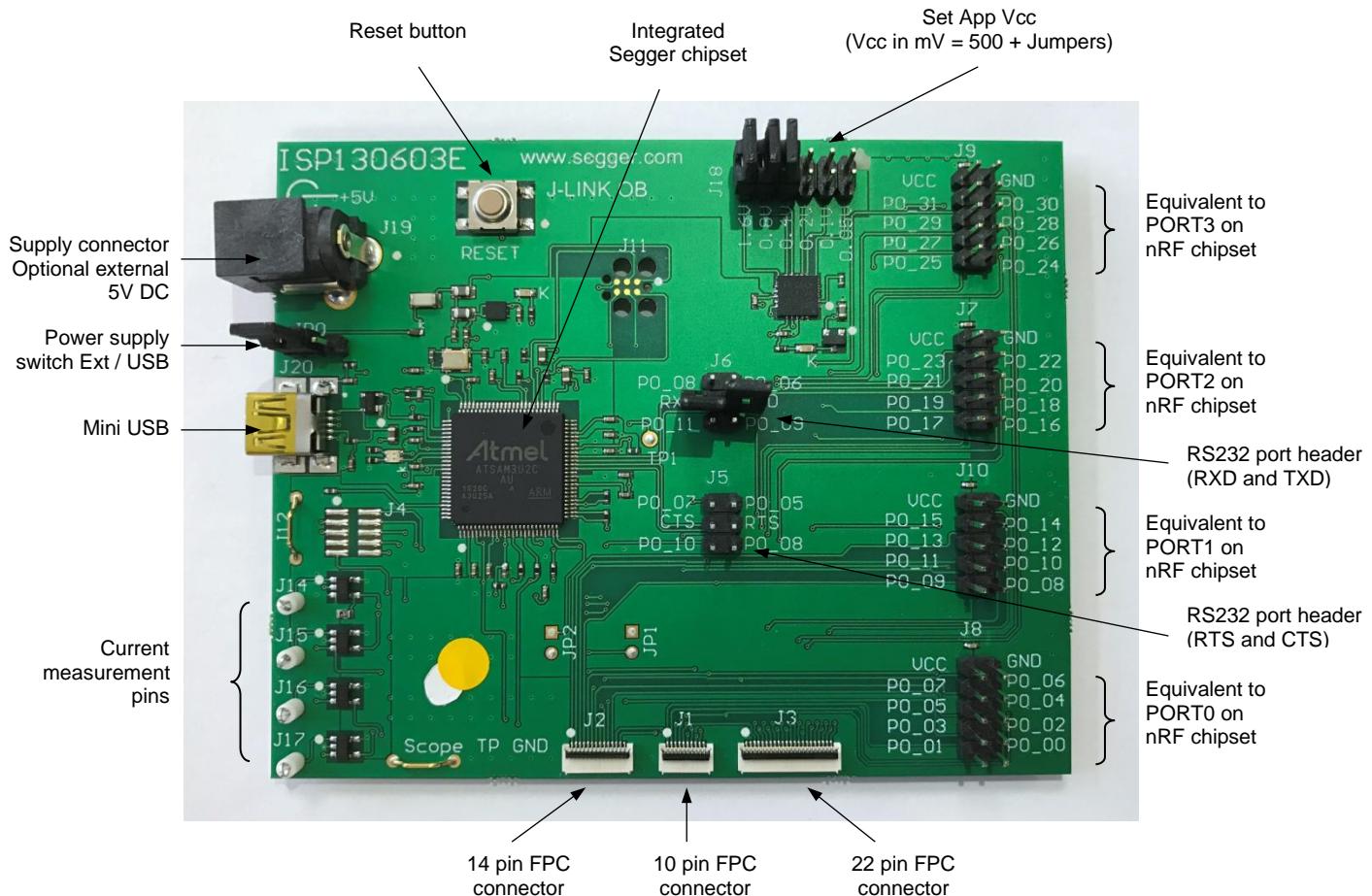


The ISP1907-LL-TB electrical schematic is presented in document Schematic_ISP1907-LL-TB.



4.3. ISP130603 Interface Board

ISP130603 is the application type interface board that has dimensions of 100 x 80 mm². The ISP130603 electrical schematic is presented in document SC130604.



4.4. nRF5 series Development Dongle

nRF5 Development Dongle is not included in the Evaluation Board and can be purchased separately. The reader should refer to the corresponding paragraph in nRF52832 Development Kit User Guide document.

Dongle/Master can also refer to your Smartphone by downloading the Smartphone application "nRF Connect" available on the Play Store (Android version) and on the App Store (IOS version).



5. Basic Application using ISP1507-AL-TB Test Board

5.1. Basic BLE Proximity Application

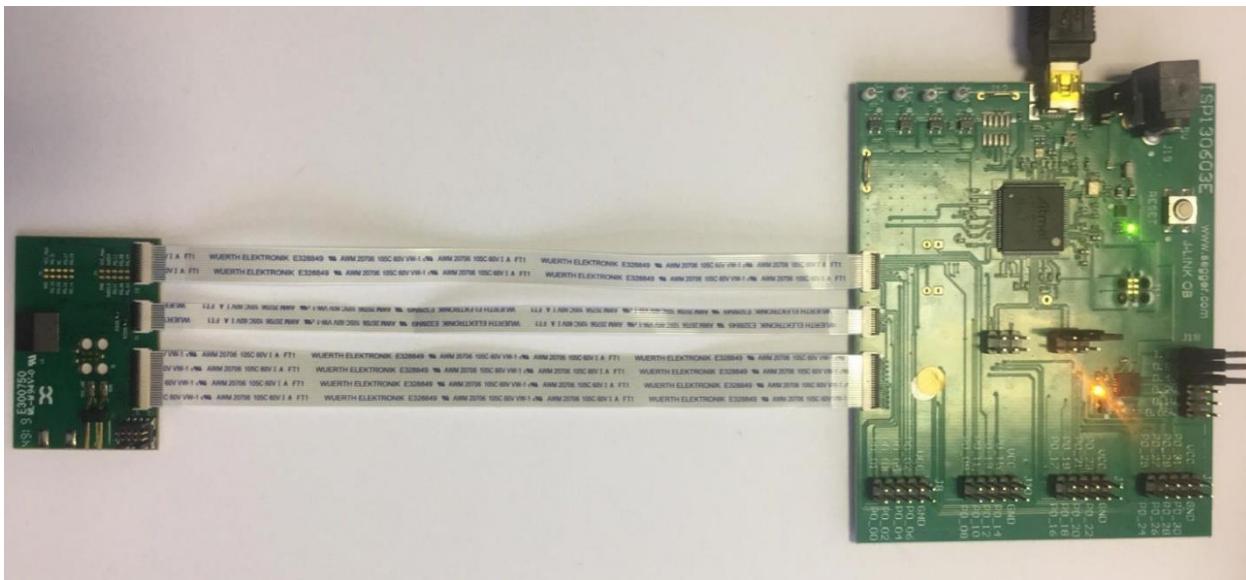
This paragraph shows you how to set up and program a BLE proximity application on top of a SoftDevice that will send data on a Bluetooth link from the ISP1907-LL-TB Test Board to the Master Emulator. In order to use Bluetooth Low Energy radio, the software is loaded in 2 parts:

- ✚ S112 SoftDevice using nRFgo Studio (hex file, no source).
- ✚ Proximity Application using SEGGER Embedded Studio.

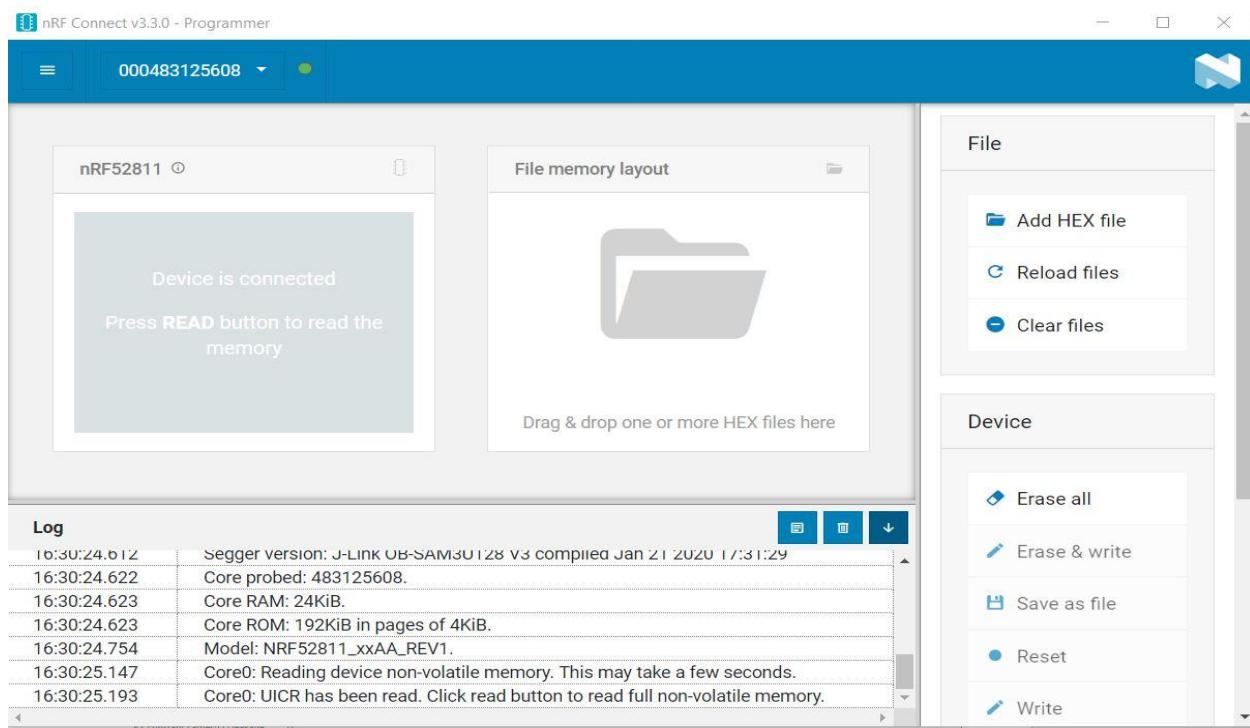
Then Master Emulator is connected, and Proximity Application is launched.

S112 SoftDevice Loading

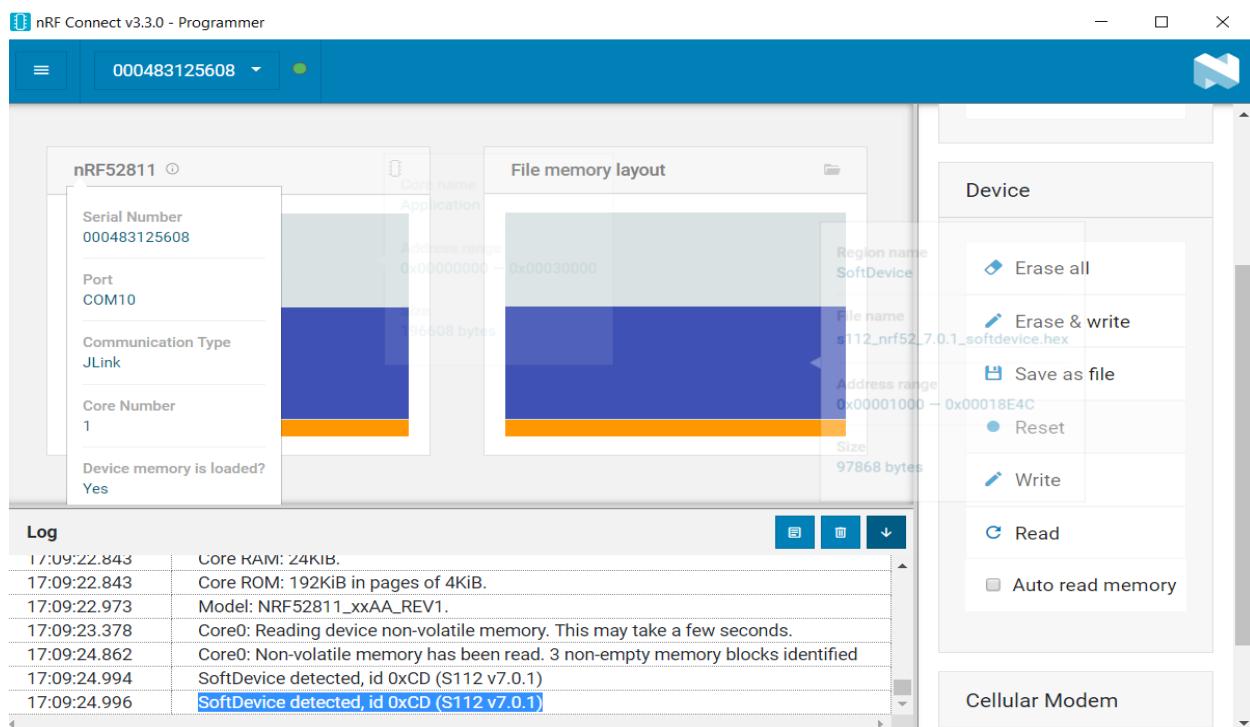
1. Connect the provided USB cable from the Interface Board ISP130603 to your computer.



2. Connect the ISP1907-LL-TB Test Board to the ISP130603 Interface Board with the 10 pin, 14 pin and 22 pin FPC jumper cables (0.5 mm pitch, provided in the Development Kit).
3. Start nRF Connect.
4. Select Programmer.
5. Click on Erase all.



6. Browse to SoftDevice hex file and click Write. The SoftDevice is available on the Nordic Website or on the SDK folder by installing the nRF5-SDK and go to for example:
`\nRF5_SDK_16.0.0\components\softdevice\s112\hex\s112_nrf52_7.0.1_softdevice.hex`



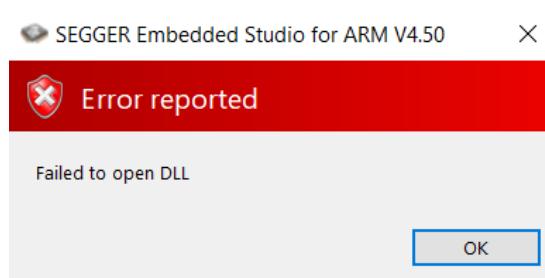
Proximity Application Loading

You can directly load the program application (hex file) through nRF Connect. Nordic have already compiled file and it is available on the followed path, for example:

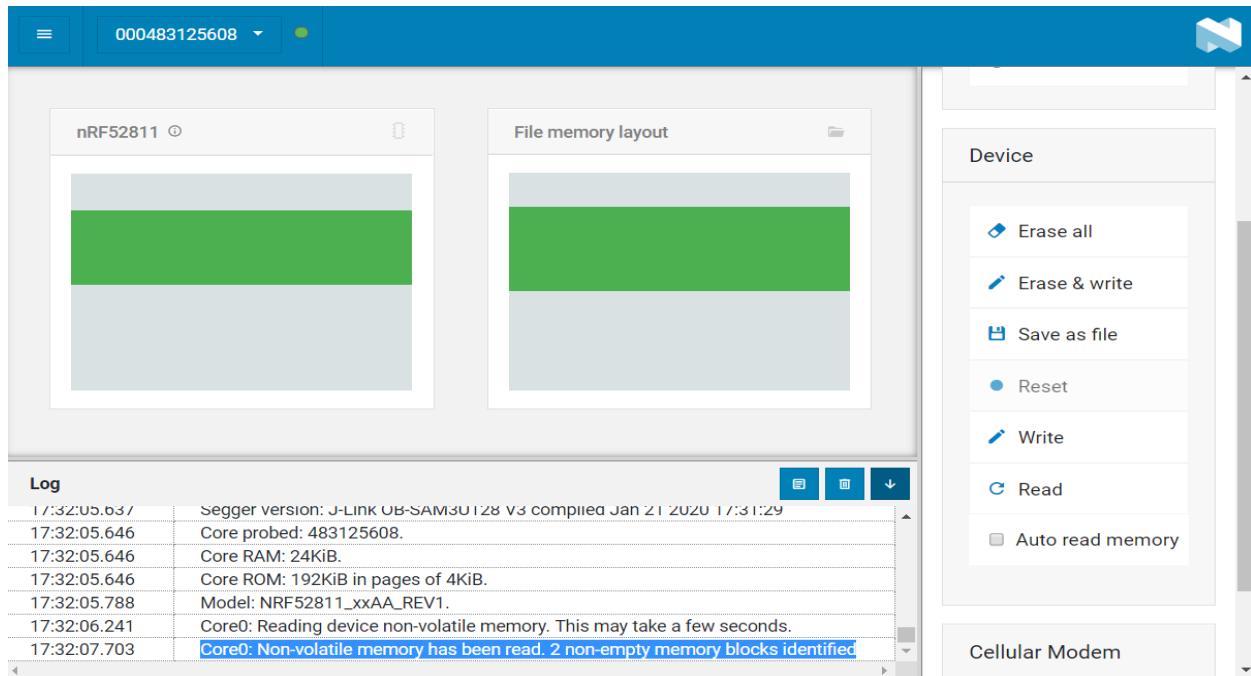
...\\nRF5_SDK_16.0.0\\examples\\ble_peripheral\\ble_app_proximity\\hex\\ble_app_proximity_pca10040e_s112.hex

If you want to modify the application software example, you can use Keil uVision and follow recommendation below:

1. Start SEGGER Embedded Studio.
2. Select File then Click on “Open Solution” . Select Make sure it is the right file project. The project is locked, it is read only, if you want to modify it, you have to change the right in the file App directory properties, for example:
...\\nRF5_SDK_16.0.0\\examples\\ble_peripheral\\ble_app_proximity\\pca10040e\\s112\\ses\\ble_app_proximity_pca10040e_s112.emProject.
3. Click Build Target and Download. If you have this message after click Download, it means that the power is not enough, and you have to increase the voltage by adding jumpers on the interface board.



You can also load the hex file (generated after building target with SEGGER Embedded Studio) by nRF Connect in the programmer application.



The file project is located for example:

`\nRF5_SDK_16.0.0\examples\ble_peripheral\ble_app_proximity\pca10040e\s112\ses\Output\Release\Exe\ble_app_proximity_pca10040e_s112.hex`

5.2. Direct Test Mode (UART)

This paragraph shows you how to set up and program the Direct Test Mode through the UART on ISP1907-LL-TB Test Board.

Direct Test Mode Set-up

1. Connect the USB cable from the Interface Board ISP130603 to your computer.
2. Connect the ISP1907-LL-TB Test Board to the ISP130603 Interface Board with the 10 pin, 14 pin and 22 pin FPC jumper cables (0.5 mm pitch, provided in the Development Kit)
3. On the ISP130603 Interface Board, connect the 2-lead patch cable in order to connect:
 - RXD to P0_08 (by default on the source code)
 - TXD to P0_11 // P0_06 by default (could be defined/changed on the main source code. For the ISP1907-LL, P0_06 does not exist and we have replaced by P0_11)

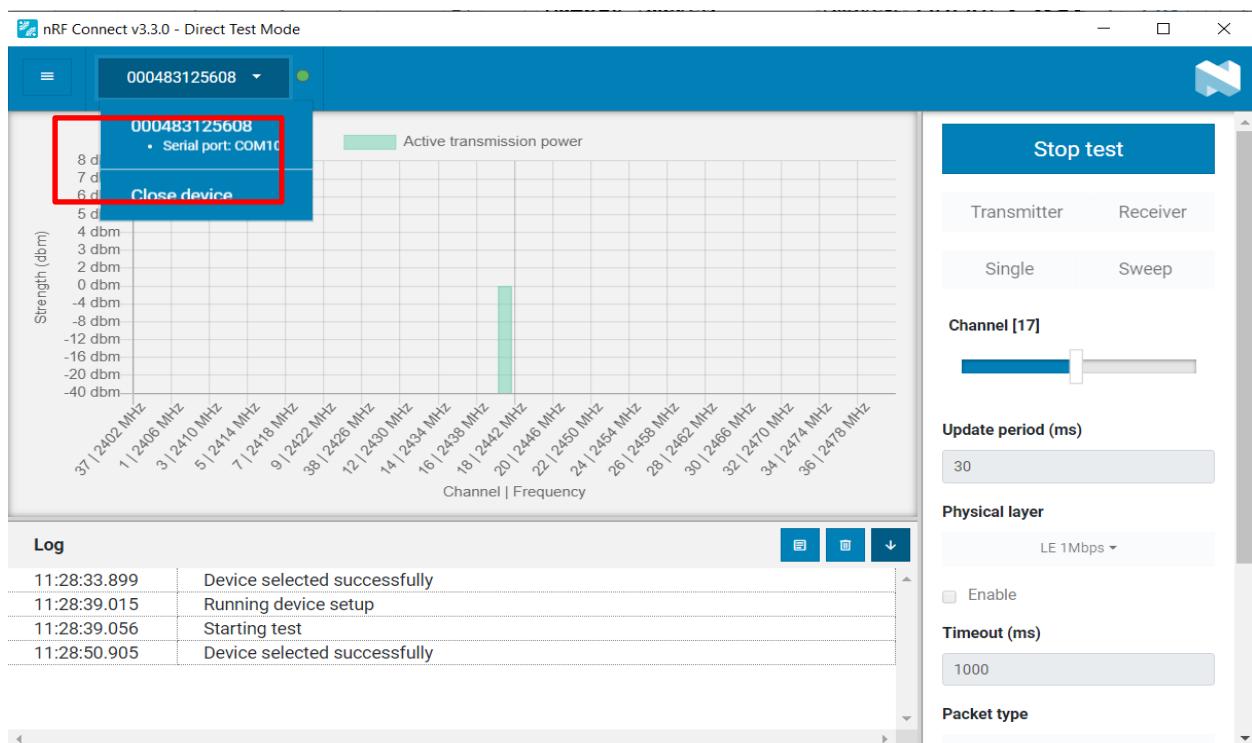
Make sure the RXD/TXD labels match for each wire. This matches the default setting if you are using the Nordic Board PCA10040 in the SDK project (be careful: depending on the Nordic Board version you are using, the ports used could be different, see next part: Direct Test Mode loading).

Direct Test Mode Loading

1. Start SEGGER Embedded Studio.
2. Select File then Open Solution in order to open Direct Test Mode application: ...\\nRF5_SDK_16.0.0\\examples\\dtm\\direct_test_mode\\pca10040e\\blank\\ses\\direct_test_mode\\pca10040e.emProject.
3. Build, Target and Download the direct test mode program.

Direct Test Mode Testing

1. Start nRF Connect
2. Select Direct Test Mode.
3. Select device. If an error while setting up the device has occurred, reboot the interface board.
4. Select the device and start test.



5.3. UART Mode Example

This paragraph shows you how to set up and program a communication by sending some characters through the UART interface on ISP1907-LL-TB Test Board. This example just echoes input characters from the PC terminal.

UART Mode Set-up

1. Connect the USB cable from the Interface Board ISP130603 to your computer.
2. Connect the ISP1907-LL-TB Test Board to the ISP130603 Interface Board with the 10 pin, 14 pin and 22 pin FPC jumper cables (0.5 mm pitch, provided in the Development Kit)
3. On the ISP130603 Interface Board, connect the 2-lead patch cable in order to connect:
 - RXD to P0_08 (by default on the source code)
 - TXD to P0_11 // P0_06 by default (could be defined/changed on the main source code. For the ISP1907-LL, P0_06 does not exist and we have replaced by P0_11)
 - CTS to P0_14 // P0_07 by default (could be defined/changed on the main source code. For the ISP1907-LL, P0_07 does not exist and we have replaced by P0_14)
 - RTS to P0_15 // P0_05 by default (could be defined/changed on the main source code. For the ISP1907-LL, P0_05 does not exist and we have replaced by P0_15)

Make sure the RXD/TXD and CTS/RTS labels match for each wire. This matches the default setting if you are using the Nordic Board pca10040 in the SDK project (be careful: depending on the Nordic Board version you are using, the ports used could be different, see next part: UART Mode loading).

CTS and RTS are needed because in the UART process when the TX is ready to send (RTS), the RX needs to allow the TX send data (CTS) and vice versa.

UART Mode Loading

1. Start SEGGER Embedded Studio.
2. Select File then Open Solution in order to open UART_example application:
...\\nRF5_SDK_16.0.0\\examples\\peripheral\\uart\\pca10040e\\ses\\uart_pca10040e.emProject
3. Click Build Target and Download.

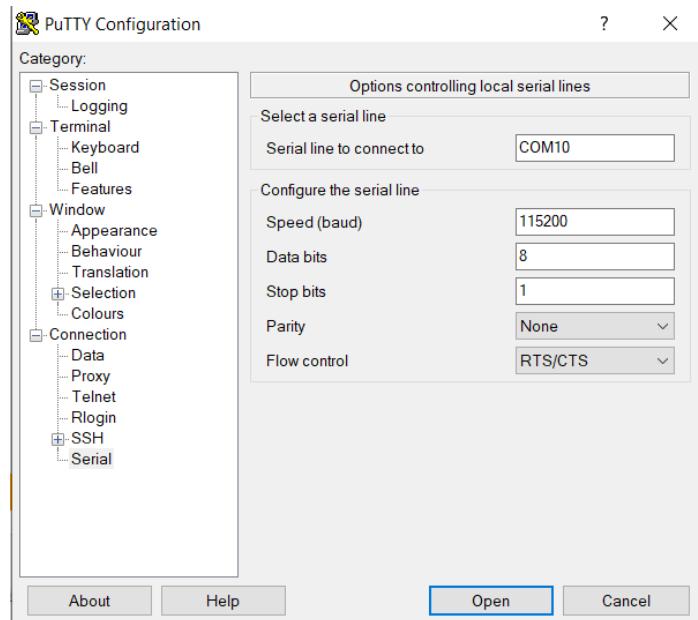
Note

Nordic have already generated the hex file “uart_pca10040e.hex” available on the SDK folder, for example: ...\\nRF5_SDK_16.0.0\\examples\\peripheral\\uart\\hex\\uart_pca10040e.hex

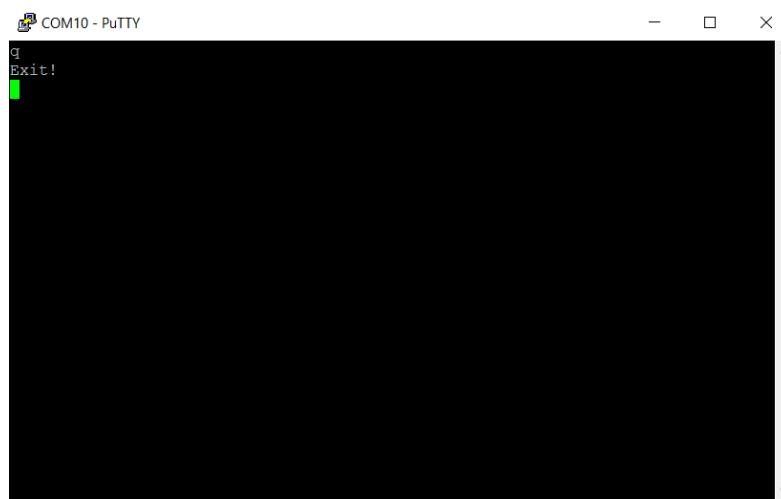
Insight SiP can provide also the Hex files on demand at contact@insightsip.com

UART Mode Testing

1. Download and install the program “Putty.exe” (or equivalent like TTERM for example) in order to configure the baud rate, the port COM, etc.



2. Click to Open.
3. You can write and/or delete some characters. Sometimes you have to reset the ISP130603 Interface Board in case if it is not working.



4. Press 'q' to exit

5.4. BLE UART Mode Example

This paragraph shows you how to set up and program an example that emulates a serial port over BLE. In the example, Nordic Semiconductor's development board serves as a peer to the phone application "nRF UART", which is available for iOS from Apple Store and for Android from Play Store. In addition, the example demonstrates how to use a proprietary (vendor-specific) service and characteristics with the SoftDevice. In order to use Bluetooth Low Energy and UART interface, the software is loaded in 2 parts:

- The SoftDevice: **S112 (or S132)**
- ble_app_uart using SEGGER Embedded Studio.

UART Mode Set-up

1. Connect the USB cable from the Interface Board ISP130603 to your computer.
2. Connect the ISP1907-LL-TB Test Board to the ISP130603 Interface Board with the 10 pin, 14 pin and 22 pin FPC jumper cables (0.5 mm pitch, provided in the Development Kit)
3. On the ISP130603 Interface Board, connect the 2-lead patch cable in order to connect:
 - RXD to P0_08 (by default on the source code)
 - TXD to P0_11 // P0_06 by default (could be defined/changed on the main source code. For the ISP1907-LL, P0_06 does not exist and we have replaced by P0_11)
 - CTS to P0_14 // P0_07 by default (could be defined/changed on the main source code. For the ISP1907-LL, P0_07 does not exist and we have replaced by P0_14)
 - RTS to P0_15 // P0_05 by default (could be defined/changed on the main source code. For the ISP1907-LL, P0_05 does not exist and we have replaced by P0_15)

Make sure the RXD/TXD and CTS/RTS labels match for each wire (be careful: depending on the Nordic Board version you are using, the ports used could be different, see next part: UART Mode loading).

CTS and RTS are needed because in the UART process when the TX is ready to send (RTS), the RX needs to allow the TX send data (CTS) and vice versa.

S112 SoftDevice Loading

1. Start nRF Connect
2. Select Programmer.
3. Click Erase all.
4. Browse to SoftDevice hex file and click Erase & write. The SoftDevice is available on the Nordic Website or on the SDK folder by installing the nRF5-SDK and go to, for example:
`\nRF5_SDK_16.0.0\components\softdevice\s112\hex\s112_nrf52_7.0.1_softdevice.hex`

UART Mode Loading

1. Start SEGGER Embedded Studio.
2. Select File then Open Solution in order to open ble_app_uart application:
`...\\nRF5_SDK_16.0.0\\examples\\ble_peripheral\\ble_app_uart\\pca10040e\\s112\\ses\\ble_app_uart_pc\\a10040e_s112.emProject`
3. Click Build Target and Download.

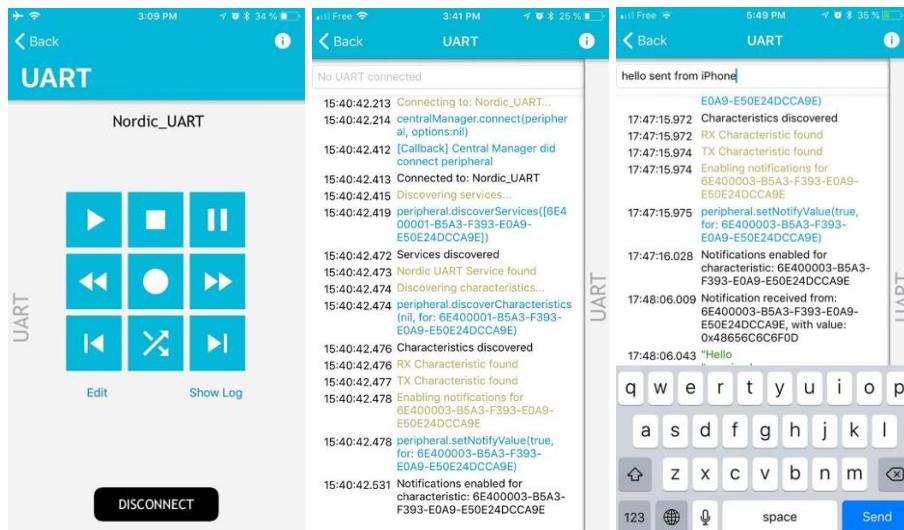
Note

You can directly load the program application (hex file) through nRF Connect. Nordic have already generated the hex file "ble_app_uart_pca10040e_s112.hex" available on the SDK folder, for example:
`...\\nRF5_SDK_16.0.0\\examples\\ble_peripheral\\ble_app_uart\\hex\\ble_app_uart_pca10040e_s112.hex`

Insight SiP can provide also the Hex files on demand at contact@insightsip.com

BLE Mode Testing

1. Download and install "nRF Toolbox" on your iOS or Android device, which is available for iOS from App Store and for Android from Play Store.
2. Run the App, choose UART and click to Connect and select the device: Nordic_UART.

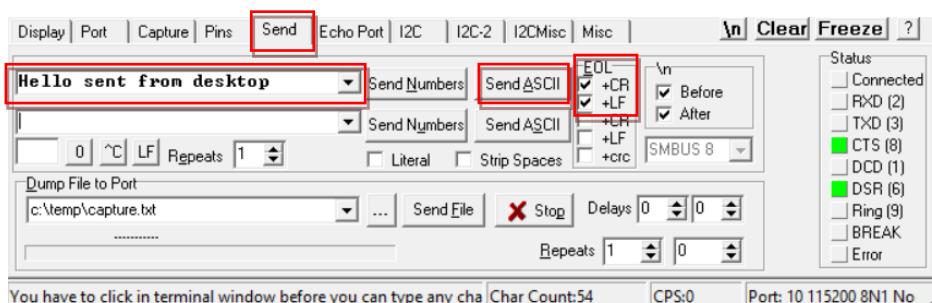
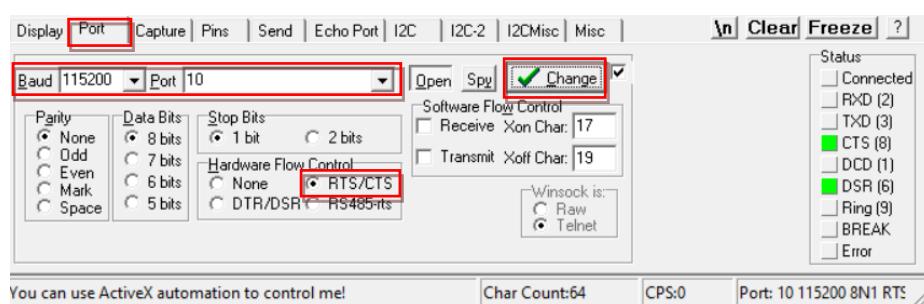
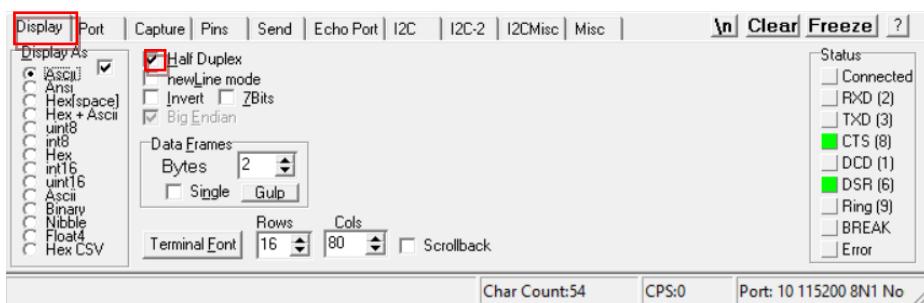


3. You are now able to send and receive data through the BLE. Next step is to establish the communication with the UART interface.



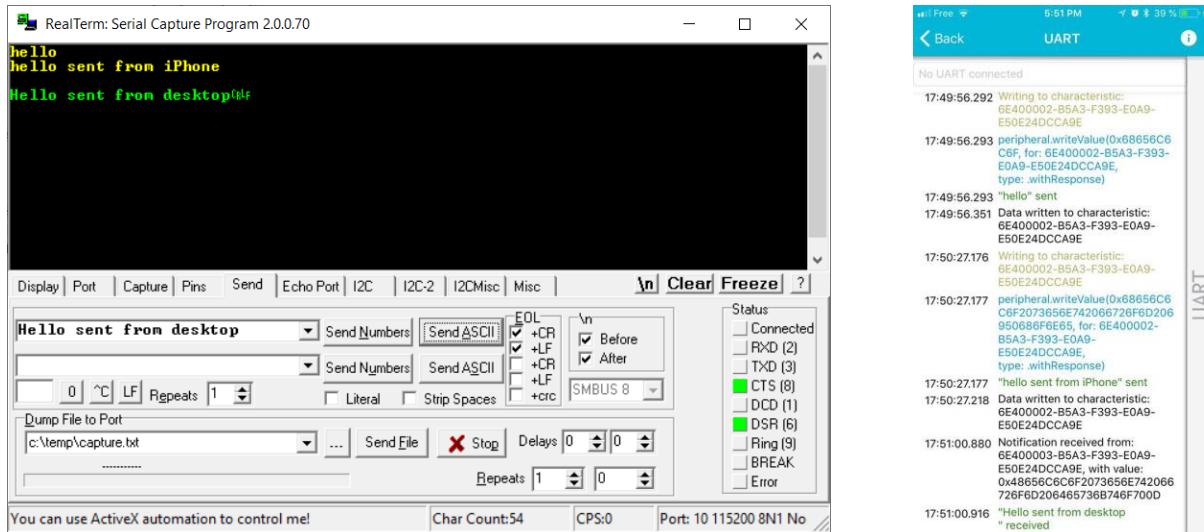
UART Mode Testing

1. Download and install the program “RealTerm” (or equivalent like Putty, TTERM for example) in order to configure the baud rate, the port COM, etc.





2. Click to Send, write some characters and click to "Send ASCII".



3. The communication is established, you are now able to emulate a serial port over BLE.