ISP2053
Application note AN211001

Use of Module Evaluation Boards



Introduction

Scope

This document gives details on hardware and software for using and testing Insight SiP Bluetooth Low Energy modules ISP2053-AX.

Contents

1. Recommended Documentation 3
2. Hardware Content 4
2.1. Global Description 4
2.2. ISP2053-AX Module 5
2.3. ISP130603 Interface Board – Revision F or earlier 6
2.4. ISP130603 Interface Board – Revision G or higher 7
2.5. ISP2053-AX-TB Test board – Revision B 9
2.6. ISP2053-AX-TB Test Board – Revision A 10
3. Software Installation 12
3.1. PC Software Installation 12
3.2. Smartphone Software Installation 12
4. Generic Setup 13
4.1. Hardware setup 13
4.2. Loading using an existing .hex 14
5. BLE UART Example 15
5.1. Overview 15
5.2. Setup 15
5.3. Build and load using Visual Studio Code 15
5.4. Testing 17
6. NFC Record text Example 19
6.1. Overview 19
6.2. Building and loading using West 19
6.3. Testing 19
7. Direct Test Mode 20
7.1. Overview 20
7.2. Setup 20
7.3. Building and loading using West 20
7.4. Testing 21

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Document Revision History

Revision	Date	Ref	Change Description
R0	26/10/2021	jf pg	Initial release
R1	28/06/2022	pd pg	Document layout update
R2	01/06/2023	jf pg	Add build procedure using Visual Studio Code Update procedure for nRF Connect 2.x.x
R3	23/10/2023	jf pg	New interface board

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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

- nRF5340 Development kit User Guide, hardware section should be partially ignored – Insight SiP development kit hardware replaces Nordic Semiconductor hardware.
- nRF5340 Product Specification – make sure you have the last document version updated.
- nRF Connect SDK for software development on nRF53 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*
- Find documentation about nRF Connect SDK here *https://developer.nordicsemi.com/nRF_Connect_SDK/doc/latest/nrf/index.html*
- Ask any Nordic related question and get help *https://devzone.nordicsemi.com/questions*
- For any question, you can also open a case here *https://devzone.nordicsemi.com/support/add*

Software Dev kits

- nRF Connect SDK which includes Zephyr based source code.
- nRF Connect for Desktop.
- nRF Connect application for Smartphone.
- nRF Toolbox application for Smartphone.

To access these files, go to *www.nordicsemi.com* and download the files.

Other Insight SiP documents

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

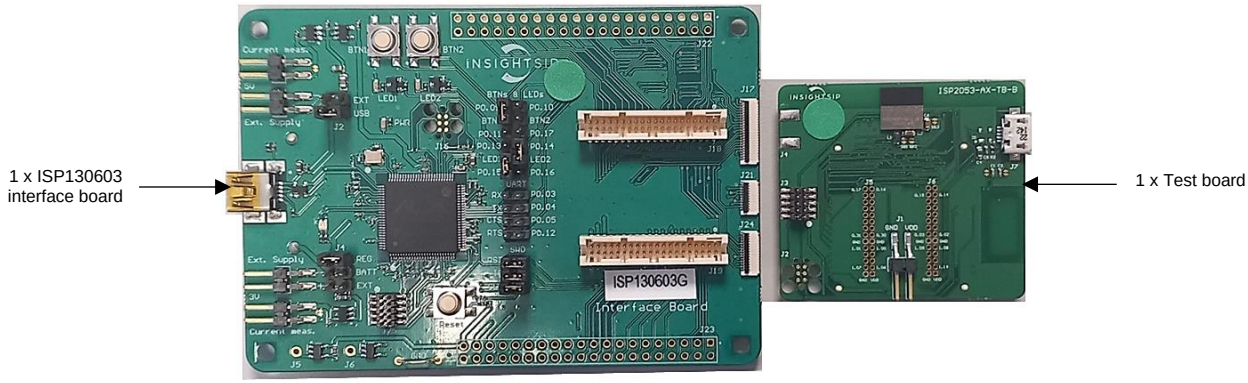
- AN211001 App Note – this document.
- ISP2053-AX module data sheet.
- ISP2053-AX Test Board schematic.
- ISP130603 Interface Board schematic.

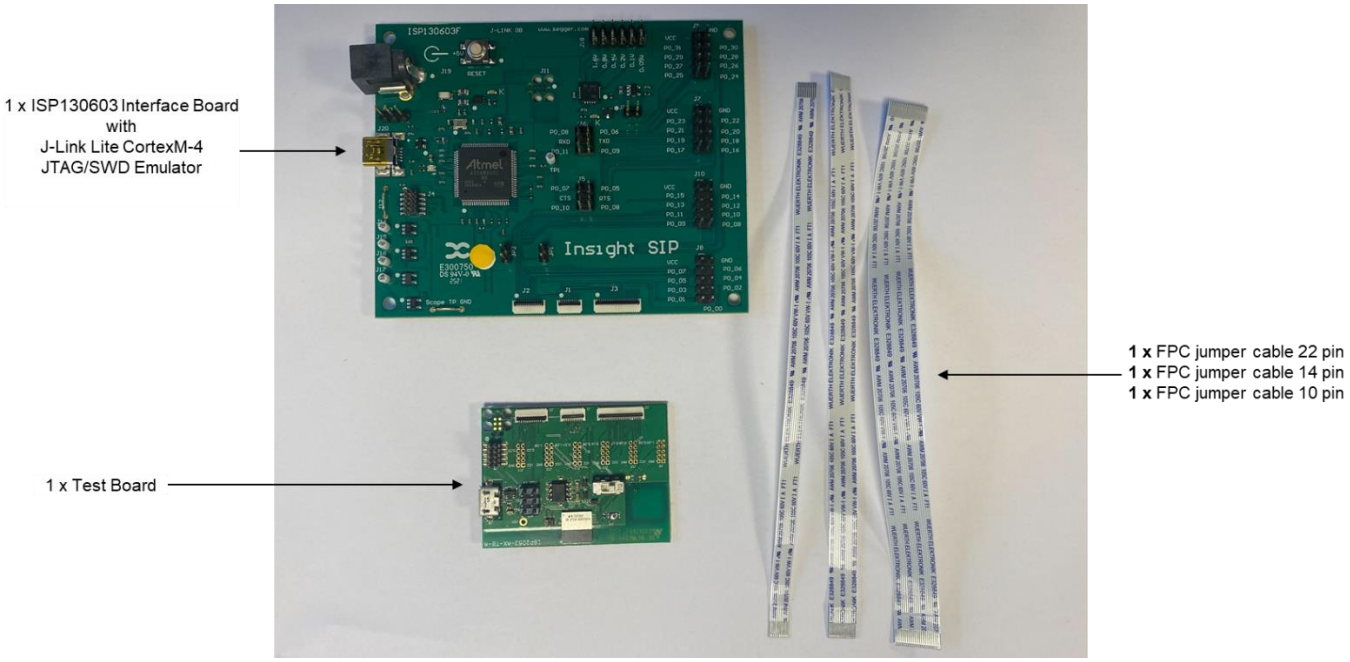
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2. Hardware Content

2.1. Global Description

The pictures below show the Evaluation Board hardware content for ISP2053-AX modules, integrating NFC functionality:

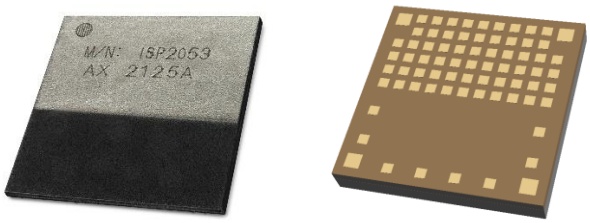




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2.2. ISP2053-AX Module

ISP2053 module series provides BT 5 connectivity with an embedded antenna.



The modules are based on Nordic Semiconductor nRF53 series 2.4 GHz wireless SoC. They integrate a 2.4 GHz transceiver, two Arm® Cortex®-M33 processors, flash memory, and analog and digital peripherals. They support Bluetooth low energy and a range of proprietary 2.4 GHz protocols, additional protocols like ANT+, Zigbee, Thread and Bluetooth Mesh.

The modules measure 8 x 8 x 1 mm. They integrate 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, please refer to related Insight SiP module data sheet.

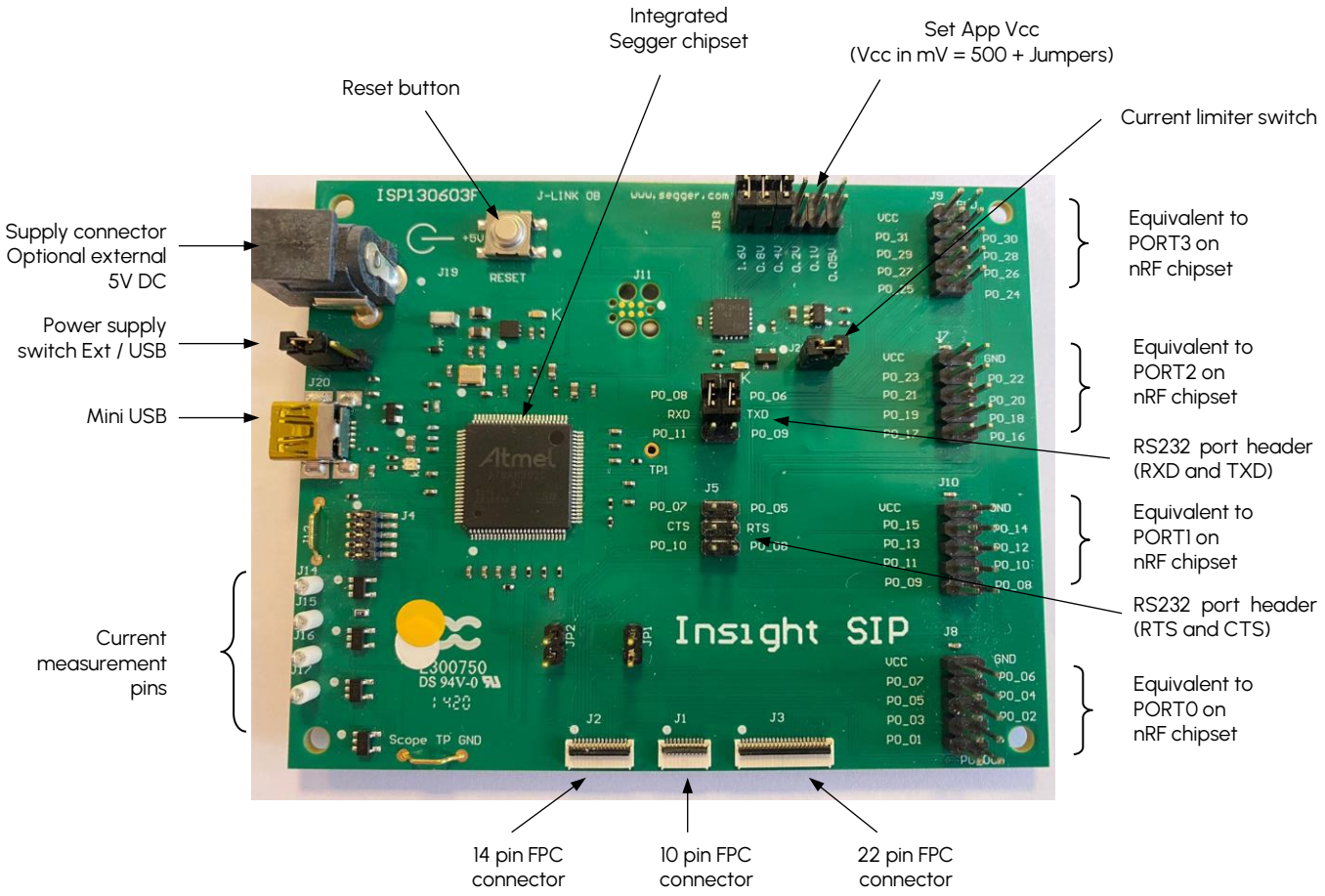
The module has the following features:

- Application Processor ARM Cortex M33 1 MB Flash + 512 KB RAM and 8 KB Cache
- Network Processor ARM Cortex M33 256 KB Flash + 64 KB RAM and 2 KB Cache
- Security ARM TrustZone & CryptoCell 312
- Configurable 46 GPIOs including 8 ADCs
- Digital interfaces USB, QSPI, SPI, UART, I²S, PDM, PWM
- +3 dBm output power

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2.3. ISP130603 Interface Board – Revision F or earlier

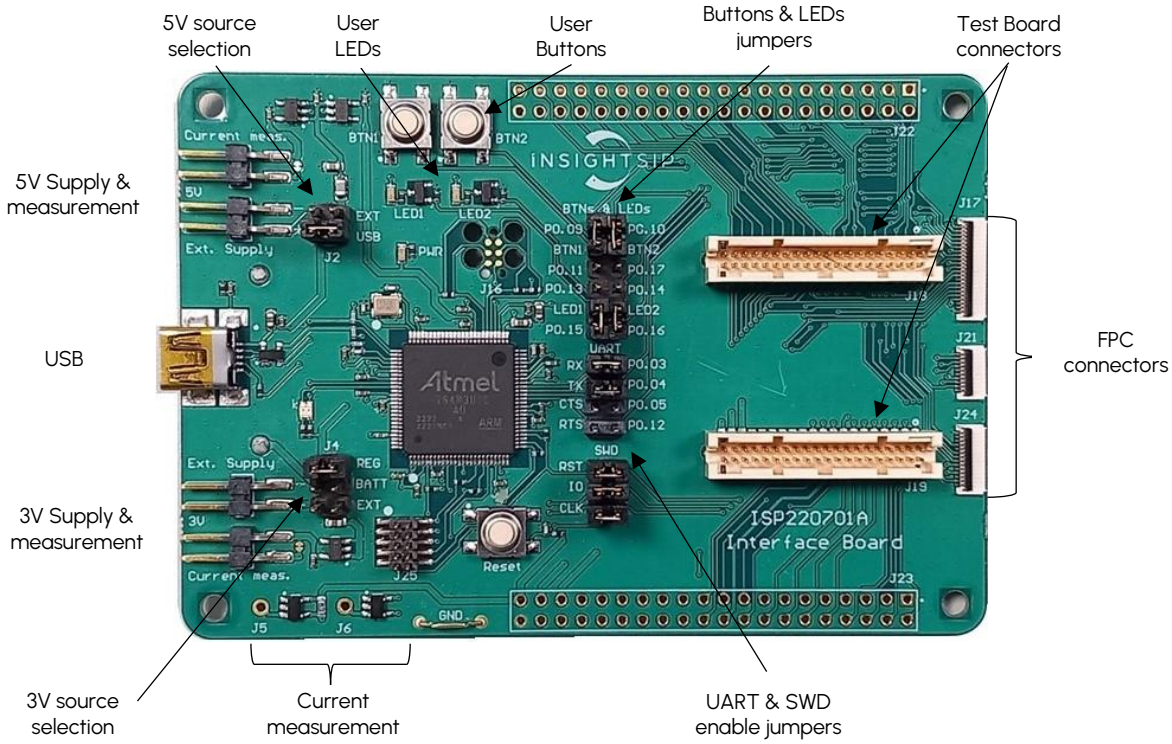
ISP130603 is an interface board that has dimensions of 100 x 80 mm. The ISP130603 electrical schematic is presented in document SC130603F.



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2.4. ISP130603 Interface Board – Revision G or higher

Board overview

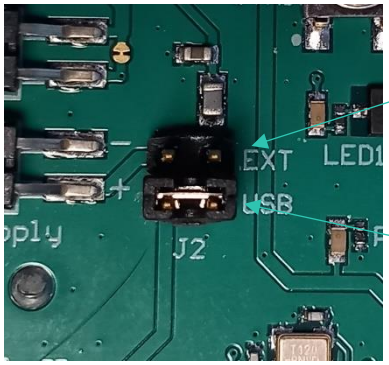




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Jumper configurations

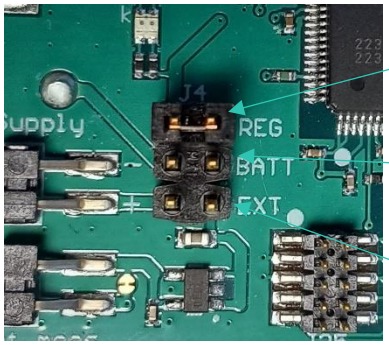
- J2 jumpers selects the 5V power supply source:



5V Supplied from external source (max 5.5V)

5V Supplied from USB

- J4 jumpers select the 3V power supply source:



3V Supplied by the embedded regulator

3V Supplied by the CRC2032 battery

3V Supplied from external source (1.7V – 3.6V)

- SWD & UART jumpers can connect or disconnect Debug and UART lines from the test board. It is recommended when powering up the board with a CRC2032 battery or external 3V. With such supply sources the debugger will not be supplied.

- BTNs & LEDs jumpers gives the possibility to connect 2 buttons & 2 LEDs to the test board:

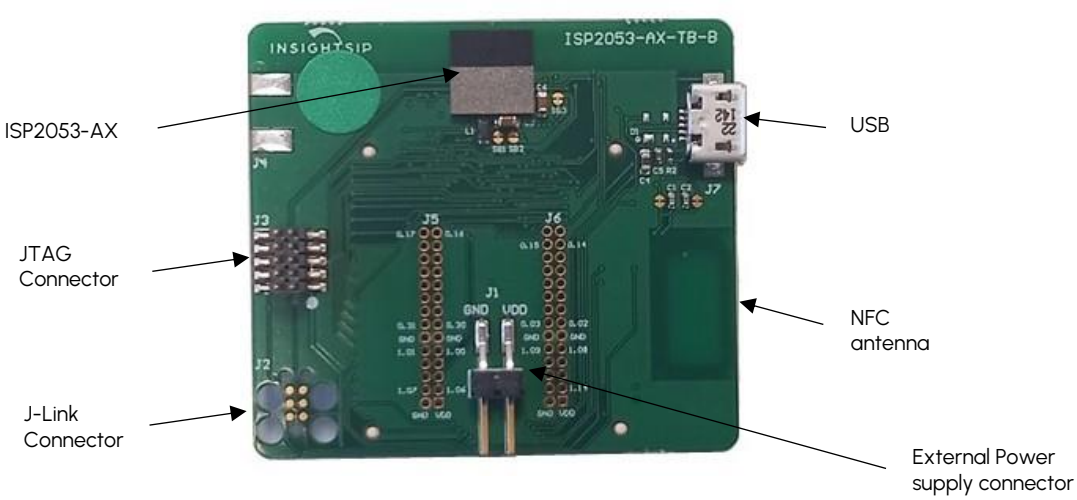
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2.5. ISP2053-AX-TB Test board – Revision B

Board dimensions are 47 x 42 mm². It includes:

- ISP2053-AX BLE module
- 2 2x20 pins connectors at the bottom for Interface Board connection
- JTAG connector for programming and debug when connected to a Segger J-Link
- USB female connector
- Printed NFC antenna
- External power supply connector

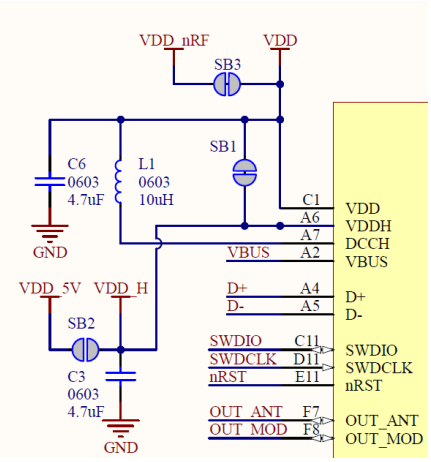
The electrical schematic is available from the website.



Power supply configuration

Normal Voltage mode (default):
SB1 closed, SB2 open, SB3 closed.
Apply Voltage (1.7V – 3.6V) on VDD_nRF.

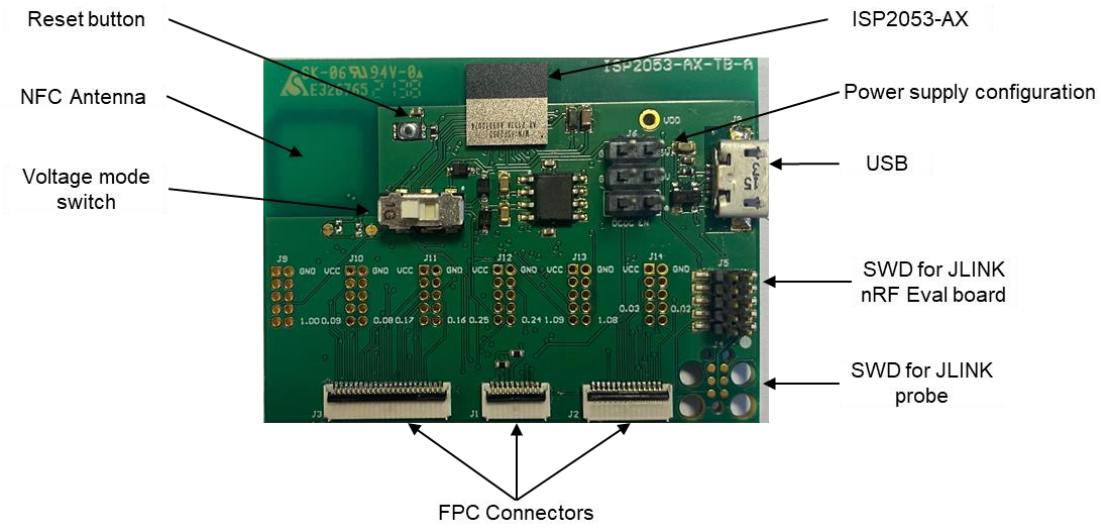
High Voltage mode:
SB1 open, SB2 closed, SB3 open.
Apply Voltage (2.5V – 5.5V) on VDD_5V.



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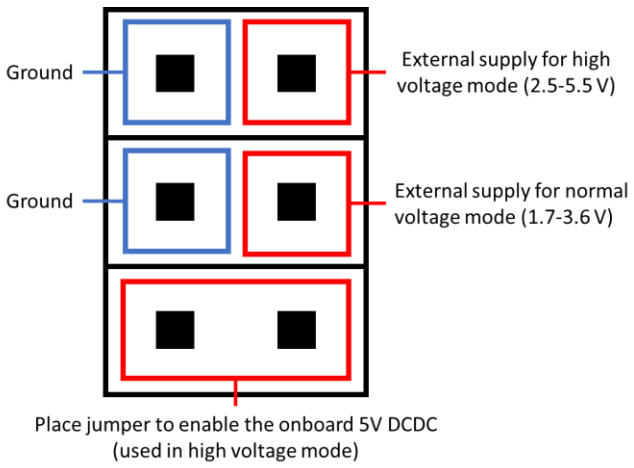
2.6. ISP2053-AX-TB Test Board – Revision A

Board dimensions are 50 x 37 mm.



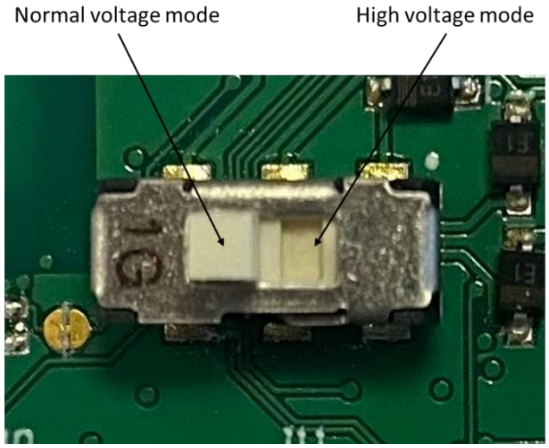
It includes:

- ISP2053-AX BLE module
- Reset button
- **J1, J2, J3**: FPC connectors to connect to the ISP300603 Interface board.
- **J4**: JTAG footprint for programming and debug when connected to a Segger J-Link Probe.
- **J5**: 2 x 5 pin header for programming and debug when connected to a Nordic Evaluation Board.
- **J6**: Header for power supply configuration.



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- **J8**: USB female connector
- **J9, J10, J11, J12, J13, J14**: 2x5 pin header footprint to access all GPIOs.
- Normal/High Voltage mode switch



About power supply configuration

In normal voltage, power can be supplied by:

- the ISP130603 Interface board through the 10 pin FPC cable.
- "3V" pin of J6 header, apply between 1.7V and 3.6V.

In high voltage mode, power can be supplier by:

- The onboard 5V DCDC converter (Place the jumper on the "DCDC EN" part of J6 header).
- "5V" pin of J6 header, apply between 2.5V and 5.5V.
- USB

The ISP2053-AX-TB electrical schematic is available from the website.

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3. Software Installation

3.1. PC Software Installation

This paragraph describes the steps to follow for software installation.

1. Download *nRF Connect for Desktop*.
2. In nRF Connect for Desktop, install the Toolchain manager.
3. In Toolchain manager install the last SDK version.
4. Download and install Realterm from *https://realterm.sourceforge.io/index.html#downloads_Download*

For more information on SDK installation go to
http://developer.nordicsemi.com/nRF_Connect_SDK/doc/latest/nrf/getting_started.html

3.2. Smartphone Software Installation

Download the smartphone application "nRF Connect" and "nRF Toolbox" available on the Play Store (Android version) and the App Store (IOS).

Note

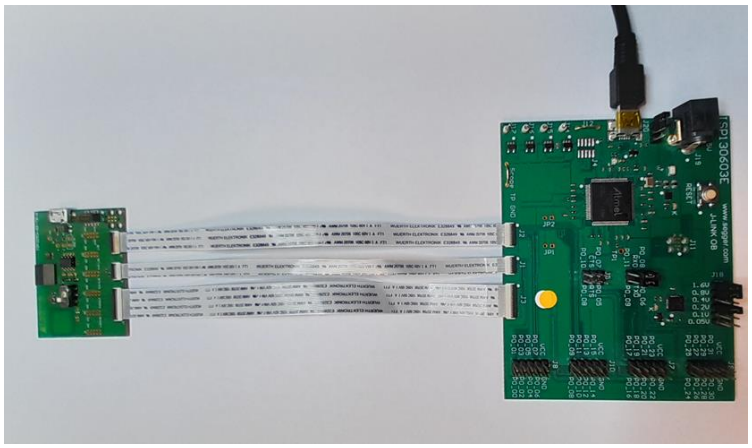
You can also use NRF5 Development Dongle by purchasing it separately from Nordic Semiconductor *https://www.nordicsemi.com/Software-and-tools/Development-Kits*, please refer to the corresponding paragraph nRF528xx Kit User Guide document.

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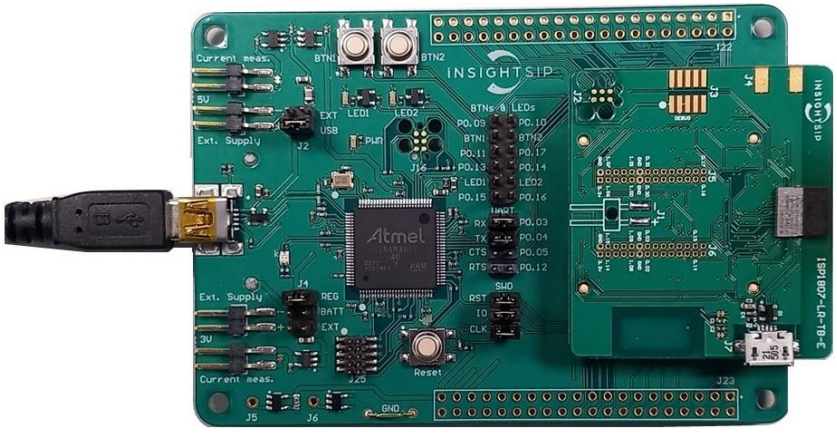
4. Generic Setup

4.1. Hardware setup

- Set the test board in "Normal voltage mode".
- Connect the USB cable from the Interface Board ISP130603 to your computer.
- If using ISP130603 Revision F, Connect the BLE Test Board to the ISP130603 Interface Board with the 10 pin, 14 pin and 22 pin FPC jumper cables.



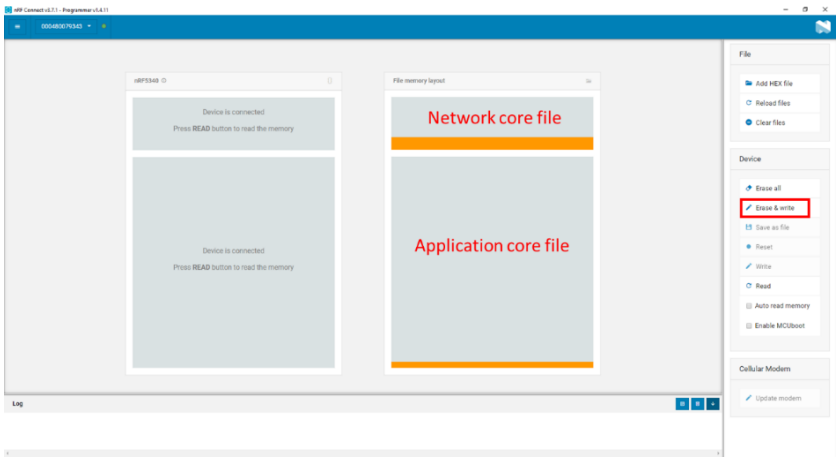
If using the ISP130603 Revision G or higher, plug the Test Board to the Interface Board using the 2x20 connectors.



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4.2. Loading using an existing .hex

- Start nRF Connect for desktop and click Programmer
- Drag and drop both application core and network core .hex files in the "Files memory layout" box. Then program by pressing "Erase & Write".

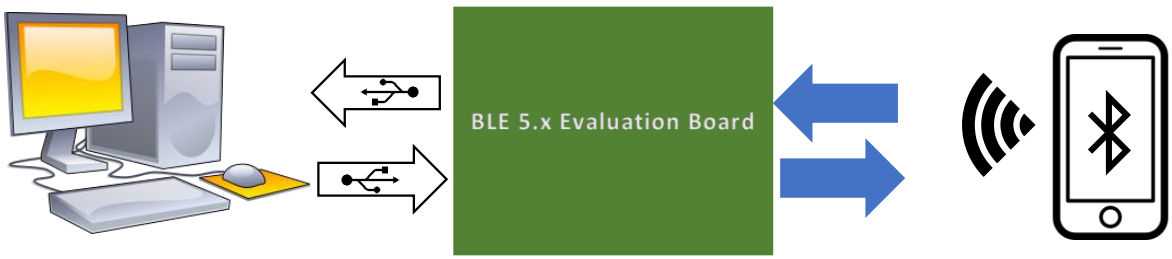


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5. BLE UART Example

5.1. Overview

This paragraph shows how to set up and program an example that emulates a serial port over BLE. In this example, the Insight SiP development boards serve as a peer to the phone application "nRF Toolbox", 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.



5.2. Setup

Connect the test board to the interface ISP130603 board using the 3 FPC cables.
On the ISP130603 Interface Board, connect with jumpers or wires provided in the kit:

- RXD to P0_08
- TXD to P0_06
- CTS to P0_07
- RTS to P0_05

5.3. Build and load using Visual Studio Code

Visual Studio Code is official IDE used to build nRF Connect projects. Follow this follow to get started with this IDE: *https://www.nordicsemi.com/Products/Development-tools/nRF-Connect-for-VS-Code*.
Once installed follow this step to configure and build the BLE UART example:

1. Create project

In nRF Connect, Toolchain manager, click on "Open VS Code".
In nRF Connect menu click on "Create a new project". Select "peripheral_uart" in "application template" and click "Create Application".
In Application menu click on "No build Configurations". Select "nrf5340dk_nrf5340_cpuapp" as Board and click "Build Configuration".

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2. Modify the uart0 configuration

By default, the configuration of the uart pins is not compatible with our interface board. Therefore, we need to modify the board configuration file.
Modify the app.overlay file by adding:

```
&pinctrl {
	uart0_default: uart0_default {
		group1 {
			psels = <NRF_PSEL(UART_TX, 0, 6)>,
				<NRF_PSEL(UART_RTS, 0, 5)>;
		};
		group2 {
			psels = <NRF_PSEL(UART_RX, 0, 8)>,
				<NRF_PSEL(UART_CTS, 0, 7)>;
			bias-pull-up;
		};
	};

	uart0_sleep: uart0_sleep {
		group1 {
			psels = <NRF_PSEL(UART_TX, 0, 6)>,
				<NRF_PSEL(UART_RX, 0, 8)>,
				<NRF_PSEL(UART_RTS, 0, 5)>,
				<NRF_PSEL(UART_CTS, 0, 7)>;
			low-power-enable;
		};
	};
};
```

3. Build and flash the project

Click "Build"
Both application core and network core are now generated. They are in the following directories:

- <YOUR_DIR>\peripheral_uart\build\zephyr for the application core file.
- <YOUR_DIR>\peripheral_uart\build\hci_rpmsg\zephyr for the network core file.

Click on "Flash". Visual Studio Code will automatically program both cores.
Reset the board.

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Test example

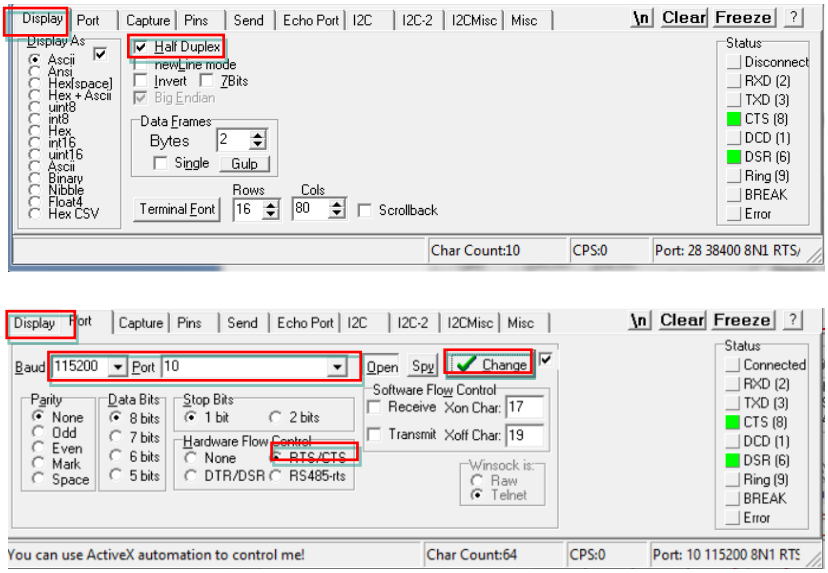
1. Setup the smartphone

In the nRF Toolbox application:

- Click the UART button
- Click the connect button
- Select the device: Nordic_UART_Service.
- Slide the screen from left to right to display the log menu.

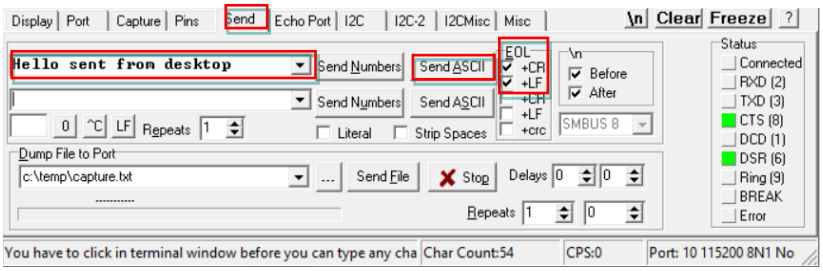
2. Setup Computer

Run "RealTerm" on your desktop,configure the baudrate 115200 and choosethe COM port ...

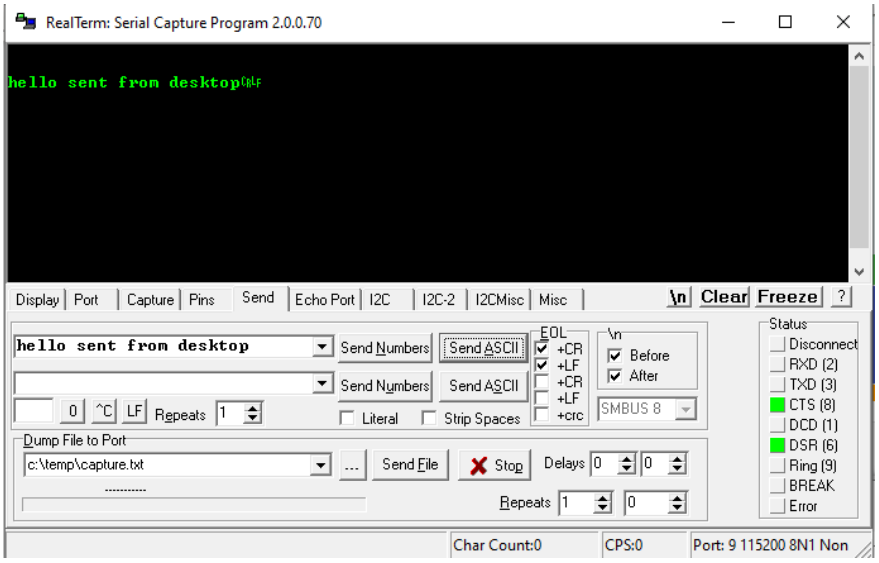


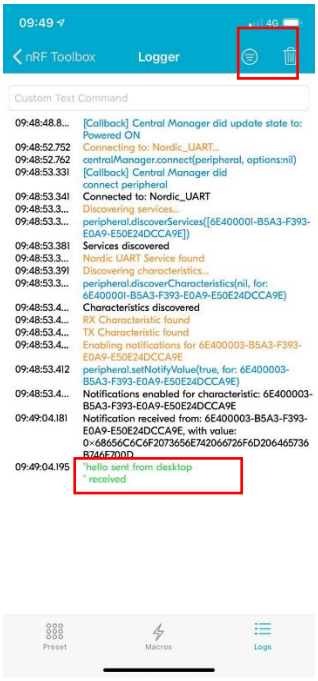
5.4. Testing

1. Write some characters and click on "Send ASCII".

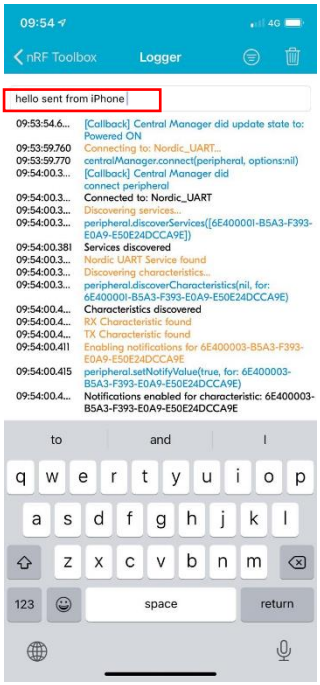


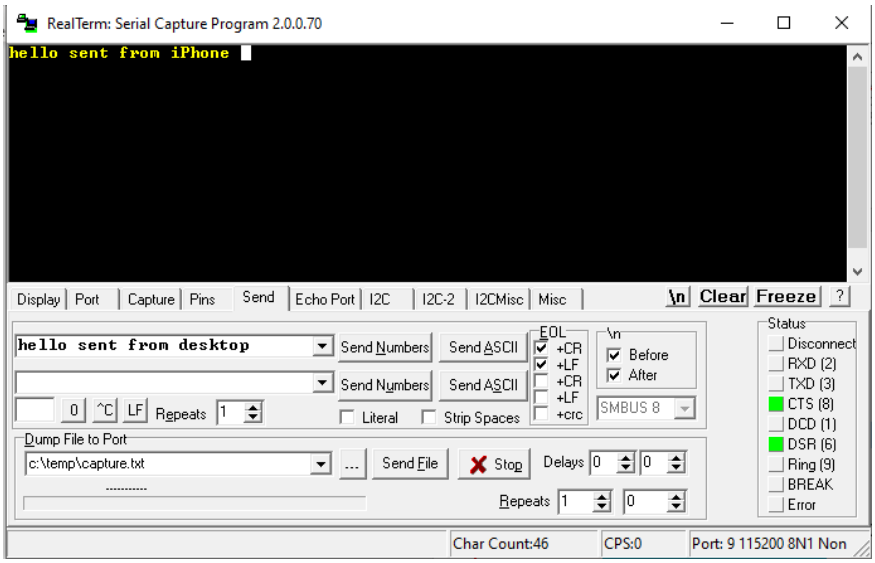
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2. Write some characters on your smartphone and click on send.





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

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6. NFC Record text Example

6.1. Overview

The Launch App Example shows how to use the NFC tag. It will display a "hello world" on a device that supports NFC.

6.2. Building and loading using West

1. Build and flash the sample

Open nRF Connect, open Toolchain manager and then Open bash
In the Bash windows, enter the followings commands:

```
cd nrf/samples/nfc/record_text
west build -b nrf5340dk_nrf5340_cpuapp
west flash
```

If the flashing failed, the module might be locked. You may recover using this command:

```
west flash –recover
```

Note: This sample is running exclusively on the application core. No firmware needs to be flashed on the network core.

2. Press the reset button (or power cycle the board)

6.3. Testing

Approach your smartphone to the NFC antenna and a observe a "hello world" display on the screen.

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7. Direct Test Mode

7.1. Overview

The Direct Test Mode is used during certification and test, Output power and receive sensitivity can be measured using this mode. This paragraph shows you how to set up and program the Direct Test Mode sample on a test board.

7.2. Setup

Connect the test board to the interface ISP130603 board using the 3 FPC cables.
On the ISP130603 Interface Board, connect with jumpers or wires provided in the kit:

- RXD to P0_08
- TXD to P0_06

7.3. Building and loading using West

1. Modify uart0 pin configuration

Using a text editor open the app.overlay file located in
<SDK>\ncs\v2.x.x\nrf\samples\bluetooth\direct_test_mode.
Modify the uart0 configuration, it should look like this:

```
&pinctrl {
        uart0_default: uart0_default {
                group1 {
                        psels = <NRF_PSEL(UART_TX, 0, 6)>,
                                <NRF_PSEL(UART_RTS, 0, 5)>;
                };
                group2 {
                        psels = <NRF_PSEL(UART_RX, 0, 8)>,
                                <NRF_PSEL(UART_CTS, 0, 7)>;
                        bias-pull-up;
                };
        };

        uart0_sleep: uart0_sleep {
                group1 {
                        psels = <NRF_PSEL(UART_TX, 0, 6)>,
                                <NRF_PSEL(UART_RX, 0, 8)>,
                                <NRF_PSEL(UART_RTS, 0, 5)>,
                                <NRF_PSEL(UART_CTS, 0, 7)>;
                        low-power-enable;
                };
        };
};
```


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2. Build and flash the sample

Open nRF Connect, open Toolchain manager and then Open bash
In the Bash windows, enter the followings commands:

```
cd nrf/samples/bluetooth/direct_test_mode
west build -b nrf5340dk_nrf5340_cpunet
west flash
```

Note: The direct test mode is running exclusively on the network core. The tool "west" will automatically build "empty_app_core" and flash it to the application core. The "empty_app_core" sample is necessary for the network core to boot up.

3. Press the reset button (or power cycle the board)

7.4. Testing

1. Open Direct Test Mode in nRF Connect.
2. Select device and start Test.

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