

AN140101 Use of ISP130301-DK1



Introduction

Scope

This document gives details on hardware and software for using and testing Insight SiP Bluetooth Low Energy module ISP130301.

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The following Nordic Semiconductor documents and Dev Kits (software portion) are required to understand the complete setup and programming methods:

APPLICATION NOTE

Documents:

- InRF51822 Development kit User Guide (hardware section should be partially ignored ISP development kit hardware replaces Nordic Semiconductor hardware).
- Index not series Reference Manual.
- IRF51822 PS (data sheet).
- S110 / S120 nRF51822 SoftDevice Specification.

1. Recommended Documentation

\rm hRF51 SDK.

Dev kits (software portion):

- \rm nRFgo Studio.
- nRF51 Software Development Kit (SDK):
 - Precompiled HEX files.
 - Source code.
 - Keil ARM project files.
- ↓ S110 / S120 nRF51822 SoftDevice.
- Master Control Panel.

To access these files, go to www.nordicsemi.com and log in to your Nordic My Page account, enter your product key and download the files. Instructions can be found in Chapter 3.

ISP documents that complement the above:

- **4** AN140101 App Note this document.
- **4** DS130301 module data sheet.
- ↓ ISP130601 Test Board schematic SC130602.
- ISP131001 Sensors Board schematic SC131002.
- ISP130603 Interface Board schematic SC130604.

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ISP130301-DK1



2. ISP130301-DK1 Hardware Content



1 x J-Link Lite CortexM-9

JTAG/SWD Emulator

1 x FPC jumper cable 22 pin

1 x FPC jumper cable 14 pin

1 x FPC jumper cable 10 pin

1 x 10 pin connector

1 x 2-lead patch cable

1 x 5V power supply

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3. Software Installation

This paragraph shows you the steps to follow for software installation.

- 1. Download and install Keil MDK-ARM Lite from https://www.keil.com/demo/eval/arm.htm to your hard drive.
- 2. Download and run the J-Link Software and documentation pack for Windows from http://www.segger.com/jlink-software.html. The serial number from your SEGGER J-Link hardware is needed to identify your device and can be found printed on the chip on the J-Link Lite emulator board.
- 3. Go to www.nordicsemi.com and log in to your Nordic My Page account.
- 4. Select MY KEYS from the left menu. This takes you to the My Keys page.
- 5. Enter the product key (included in this kit) into the Product Key field and click Add.
- 6. Click MY PRODUCTS in the left menu.
- 7. From the Add product dropdown, select the product name and click Add. The chosen product is now listed in the below Overview, My Products table.
- 8. In the Overview, My Products table click the Downloads link next to the product name to go directly to the relevant product page download section.
- 9. Download, install and run nRFgo Studio.
- 10. Download, install and run Master Control Panel. The software is on the CD and if you want the last version, you can find it on the Nordicsemi website. (x86 is for 32 bits windows and x64 is for 64 bits windows)
- 11. Download and run the nRF51 SDK installer. Make sure to choose the Keil MDK-ARM installer option.
- 12. Download the S110 / S120 nRF51822 SoftDevice.



4. Hardware Description

4.1 ISP130301 Module

ISP130301 is a Bluetooth Low Energy module with integrated antenna.



This module is based on Nordic Semiconductor nRF51822 2.4 GHz wireless SoC. nRF51822 integrates nRF51 series 2.4 GHz transceiver, a 32 bit ARM $Cortex^{TM}$ -M0 CPU, flash memory, and analogue and digital peripherals. nRF51822 can support Bluetooth low energy and a range of proprietary 2.4 GHz protocols. The ISP130301 module measures 8 x 11 x 1.2 mm3. The module integrates all the decoupling capacitors, the 16 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 DS130301).

4.2 ISP130601 Test Board

ISP130601 is the basic application test board that has dimensions of 18 x 30 mm².



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It encloses:

- 4 ISP130301 BLE module
- **4** 3 x FPC connectors in order to access the nRF51822 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 bottom side of the board.

The ISP130601 electrical schematic is presented in document SC130602.

4.3 ISP131001 Sensors Board

ISP131001 is the sensor application board that has dimensions of 12.5 x 25 mm².



It encloses:

- ↓ ISP130301 BLE module.
- **4** ST Micro LPS331AP temperature and barometer sensor.
- **Freescale FXOS8700CQ 6-axis linear accelerometer and magnetometer sensor.**
- **4** Rohm SML-P11MTT86 mini-LED.
- Software to read/drive the sensors.
- Removable 10 pin FPC connector for software loading.

The ISP131001 electrical schematic is presented in document SC131002.

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4.4 ISP130603 Interface Board

ISP130603 is the application type interface board that has dimensions of 86 x 80 mm².



The ISP130603 electrical schematic is presented in document SC130604.

4.5 nRF51822 Development Dongle (PCA10000)

The reader should refer to the corresponding paragraph in nRF51822 Development Kit User Guide document.

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5. Basic Application using ISP130601 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 ISP130601 Test Board to the Master Emulator. In order to use Bluetooth Low Energy radio, the software is loaded in 2 parts:

- 4 S110 / S120 SoftDevice using nRFgo Studio (hex file, no source).
- Proximity Application using Keil uVision4.

Then Master Emulator is connected and Proximity Application is launched.

S110 / S120 SoftDevice loading

- 1. Connect the SEGGER J-Link board to the ISP130603 Interface Board with the 10 pin flat cable (1.27 mm pitch, provided in the Development Kit).
- 2. Connect the provided USB cable from the J-link board to your computer.
- 3. Connect the ISP130602 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)
- 4. To ensure that power supply starts correctly, disconnect Enable jumper, connect to OFF and then Enable after supplying 5V from DC power supply (provided in the Development kit).



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- Start nRFgo Studio. 5.
- Select nRF51 Programming. 6.
- 7. Click Erase all.

📢 nRFgo Studio			
File View nRF8001 Setup Help			
Features × - 2.4 GHz - Front-End Tests - TX carrier wave output - TX carrier wave output	SEGGER to use: 518004330 💙 Refresh		
- TX/RX channel sweep - TX/RX channel sweep - RX sensitivity	nRF51822 CEAADA0 (0x0047)		
- nRF8001 Configuration Dispatcher Trace Translator Direct Test Mode - nRF8002	Region 1	Program SoftDevice Program Application Program Bootloader Programming of SoftDevice on nRF51 device File to program: 51822_6.0.0_softdevice.hex Browse Lock SoftDevice from readback	
Device Manager X Motherboards RFS1 development dongles Segger 480103054 RFS1 Programming RFS1 Bootloader - RFS1 Bootloader - RF24LU1+ Bootloaders	Size: 256 kB	SoftDevice size (kB): 80	
	Addr: 0		
Log			×
(c) Nordic Semiconductor ASA 2008-2013 Erase completed			

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8. Browse to SoftDevice hex file and click Program.



🗙 nRFgo Studio		
File View nRF8001 Setup Help		
Peatures > ■ -2.4 GHz ■ Front-End Tests - TX carrier wave output - RX constant carrier/LO leakage - TX/RX channel sweep - TX/RX sensitivity	SEGGER to use: 518004330 V Refresh	
iiii Bilectooth − nRF8001 Configuration − Dispatcher − Trace Translator − Direct Test Mode − nRF8002	Region 1 Size: 176 kB Addr: 0×14000	Program SoftDevice Program Application Program Bootloader Programming of SoftDevice on nRF51 device File to program: \$1822_6.0.0_softdevice.hex Browse Lock SoftDevice from readback SoftDevice size (kB): 80
Device Manager > Motherboards InRF51 development dongles Segger 450103054 InRF51 Programming InRF51 Booloader InRF54LU1+ Bootloaders	Region 0 Size: 80 kB FW: S110_nRF51822_6.0.0 (0x0049) Erase all	Program Verify Read
Log (c) Nordic Semiconductor ASA 2008-2013 Erase completed Soltdevice D:/Pascal/projets/Nordic Semi/docu	nentation/nRF51822/nRF51822-DK/s110_nrf51822_6.0.0/s110_nrf51822_6.0.0_s0	tdevice.hex programmed successfully

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Proximity Application loading

- 1. Start Keil uVision4.
- 2. Select Project then Open Project in order to open ble_app_proximity.



3. Click Build Target and Load.

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Master Emulator and Proximity Application

- 1. Connect Development Dongle PCA10000 (Master Emulator) into a USB port on your computer.
- 2. Start Master Control Panel.
- 3. Click Start Discovery.

Master Control Panel			
File Help			
Master emulator			
СОМ6 - 480103054 🛛 👻	480103054 connected	Reset	
Scan for devices			
Stop discovery			
Discovered devices			
Nordic_Prox (0xD526D85C28	2A) (-54dBm)		
Select device			
Delete bond info			
Log			
[18:40:18.5] Loading			
[18:40:19.1] Device address: 0xF1F	4CDFF6348		
[18:40:19.1] Master emulator firmwa	re version: mefw_nrf51822_0.9.0	D.10022	
[18:40:22.0] Ready			
[18:40:22.2] SERVER: Server has a	started		
[18:40:23:2] Device discovery starts	ed		

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4. If you have an error message as indicated in the photo :



It means that the nRF51822 Development Dongle (PCA10000) is not programmed. For your information, please refer to the nRF51822 Development Kit User Guide document as indicated in our application note ISP130301-DK1 part 4.5 on page 14-7. You can find this user guide on the Nordicsemi website. The procedure to program the dongle (PCA10000) is described on page 13. I enclose a copy of the user guide for your convenience.

- 1) Open the Master Control Panel from the Start menu (Start > All Programs > Nordic Semiconductor > Master Control Panel).
- 2) Make sure the Development Dongle is detected. The Master Emulator item list should show COMnn-xxxxxxxx (nn gives the COM port number; xxxxxxxxx is the SEGGER serial number printed on the dongle). Restart the application if it doesn't appear in the item list. Before continuing, make sure you have selected the correct device by verifying the serial number in the item list with the serial number printed on the Development Dongle.
- 3) When you use the Development Dongle for the first time, you must first program it with the Master Emulator Firmware.
 - a. In the Master Control Panel menu click File and select Flash Programming.
 - b. Click Browse. This opens a browser that automatically points to the location of the
 - c. mefw_nrf51822_<version>_firmware.hex (<version> will be replaced by a number
 - d. giving the version of the actual firmware).
 - e. The Master Control Panel Firmware file is located in:
 - f. C:\Program Files (x86) \ Nordic Semiconductor \ Master Control Panel \<version>\firmware\
 - g. pca10000/MEFW_nRF51822_<version>_firmware.hex.
 - h. Select the Master Emulator Firmware file and click Open.
 - *i.* Click Program to start programming the selected device.
 - j. When the programming is finished click Exit to go back to the main window.
- 5. Click Select Device.
- 6. On the following display, click successively on Bond, Service Discovery and Enable Services.



Master Control Panel	
File Help	
- Master emulator	
COM6 - 480103054 v 480103054 connected Reset	
C Device info	
Device address: D526D85C2B2A Bonded: True	
Actions	
Service discovery Bond Disconnect Disable services	
Service Discovery	
PrimaryService, Generic Attribute (0x1801)	^
CharacteristicDeclaration, Properties: Indicate, Characteristic UUID: 0x2405	_
 ServiceChanged, (No values read) ClientCharacteristicConfiguration, CharacteristicConfigurationBits: Indication (0002) 	
- Cherica hardcenside of ingulation, characteristic configuration bits, indication (0002) - PrimaryService, TxPower (0x1804)	
CharacteristicDeclaration, Properties: Read, Characteristic UUID: 0x2A07	
TxPowerLevel, Value: F8	
- FrimaryService, Immediate Alert (ux1 802) - CharacteristicDeclaration, Properties: WriteWithoutResponse, Characteristic UUID: 0x2406	
AlertLevel, (No values read)	
😑 PrimaryService, Link Loss (0x1803)	
CharacteristicDeclaration, Properties: Read, Write, Characteristic UUID: 0x2A06 Mart evel Value: 00	
PrimaryService, BatteryService (0x180F)	
CharacteristicDeclaration, Properties: Read, Notify, Characteristic UUID: 0x2A19	
– Battery Level, Value: 60 Client Characteristic Configuration, Characteristic Configuration Rite: Motification (0001)	~
	>
Attribute value	
UUID (0x): Handle (0x): Bead long	Read
Value: O hex O text Send	undate
Back	
[18:43:42.2] Received a HandleValueNotification on handle 0017 with value 63	~
[18:43:44.2] Received a HandleValueNotification on handle 0017 with value 62	_
[18:43:45.5] Received Connection Parameter Update Request	
[18:43:45.5] ConnectionParameterUpdateResponse sent with ACCEPTED response	
[18:43:45.5] Connection Parameters Update sent. ConnInterval:500.0ms, SlaveLatency:0, SupervisionTimeout:4000.0ms	
[18:43:46.2] Received a HandleValueNotification on handle UUT / with value 51 [19:42:49:2] Received a HandleValueNotification on handle 0017 with value 50	_
[16:45:46:2] Neceived a HandlevalueNotification on nandle 0017 with value 60	~

7. You can note Battery voltage is sent by the ISP130601 Test Board to the Master Emulator via the Bluetooth link. The application is written to send a value that changes cyclically.

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5.2 Direct Test Mode (UART)

This paragraph shows you how to set up and program the Direct Test Mode through the UART on ISP130601 Test Board.

Direct Test Mode Set-up

- 1. Connect the SEGGER J-Link board to the ISP130603 Interface Board with the 10 pin flat cable (1.27 mm pitch, provided in the Development Kit).
- 2. Connect the USB cable from the J-link board to your computer.
- 3. Connect the ISP130601 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)
- 4. On the ISP130603 Interface Board, connect the 2-lead patch cable in order to connect RXD to P0_16 and TXD to P0_17. Make sure the RXD/TXD labels match for each wire. This matches the default setting in the SDK project ble_app_dtm (be careful: depending on the ble_app_dtm version, the ports used could be different).
- 5. Connect a USB to serial cable converter from RS232 port connector of the ISP130603 Interface Board to a USB port on your computer.
- 6. Connect the 5V DC power supply to the ISP130603 Interface Board.



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Direct Test Mode Loading

- 1. Start Keil uVision4.
- 2. Select Project then Open Project in order to open ble_app_dtm.



3. Click Build Target and Load.

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Direct Test Mode Testing

- 1. Start nRFgo Studio.
- 2. Select Direct Test Mode.

K nRFgo Studio - Direct Test Mode UART interface			
File View nRF8001 Setup Help			
Features X	Direct Test Mode Set up on Com port COM10 Mode Transmit Channel Single Channel	UART interface Program Refresh list of com ports Receive Sweep 19	
Device Manager X Motherboards nRF51 Programming nRF51 Bootboader nRF24LU1+ Bootboaders	Payload model Payload length Packets received	Constant carrier	
Log			×
(c) Nordic Semiconductor ASA 2008-2013			

3. For details on how to use the Direct Test Mode, press F1 to open the nRFgo Studio help.

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6. Basic Sensor Application with ISP131001

This paragraph shows you how to set up a Sensor application with ISP131001 Sensors Board that will send data via the Bluetooth link to the Master Emulator or to an iPhone.

Two types of demonstration are presented. The first one is directly executable with hardware and software provided in the Development Kit using Master Control Panel application. The second demonstration requires the use of an iPhone (4S or higher). The iphone application is available on demand only as an App that can be installed for development purposes via the Apple developer program. The procedure to obtain the App from Insight SiP and demonstration of the Sensor application with iPhone are described hereafter.

6.1 On Master Control Panel

- 1. Place the CR2032 lithium battery into the battery holder.
- 2. Connect the battery holder to the Sensors Board ISP131001.
- 3. Connect Development Dongle PCA10000 (Master Emulator) into a USB port on your computer.
- 4. Start Master Control Panel.
- 5. Click Start Discovery.

Master Control Panel	
File Help	
COM6 - 480103054	Reset
Scan for devices	
Stop discovery	
Discovered devices	
Select device	
Delete bond info	
Log	
[17:26:19.6] Loading [17:26:20.1] Device address: 0xF1F4CDFF6348 [17:26:20.1] Master emulator firmware version: mefw_nrf51822_0.9.0.10022 [17:26:23.0] Ready [17:26:23.2] SERVER: Server has started	
[17:26:25.7] Device discovery started	
	.::

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- 6. Click Select Device.
- 7. On the following display, click successively on Bond, Service Discovery and Enable Services.

Master Control Panel	Master Control Panel
File Help	File Help
Master emulator	Master emulator
COM6 - 480103054 🖌 480103054 connected Reset	COM6 - 480103054 V 480103054 connected Reset
Device address: DE9F51144D7E Bonded: True	Device info Device address: DE9F51144D7E Bonded: True
Actions	Actions
Service discovery Bond Disconnect Disable services	Service discovery Bond Disconnect Disable services
 Service Discovery 	- Service Discovery
 PrimayService, Grenic Access (bit 800) Characteristic Access (bit 800) Characteristic Declaration, Properties: Read, Write, Characteristic UUID: 0x2400 DeviceName, DeviceName, InsightSIP_C0010 Characteristic Declaration, Properties: Read, Characteristic UUID: 0x2401 Appearance, Appearance, Read, Characteristic UUID: 0x2401 StareFrieteredCorrectorParameters, MinCorninterval, 0x0008, MaxCorninterval, 0x010A, SlaveLatency: 0x0 PrimayService, Grenic Attribute (0x1001) Characteristic Declaration, Properties: Read, Characteristic UUID: 0x2404 Generateristic Declaration, Properties: Read, Characteristic UUID: 0x2405 Generateristic Declaration, Properties: Read, Notify, Characteristic UUID: 0x2404 Characteristic Declaration, Properties: Read, Notify, Characteristic UUID: 0x2404 Characteristic Declaration, Properties: Read, Notify, Characteristic UUID: 0x2404 Characteristic Declaration, Properties: Read, Notify, Characteristic UUID: 0x24A4 Characteristic Declaration, Properties: Read, Notify, Characteristic UUID: 0x24A5 Characteristic Declaration, Properties: Read, Notify, Characteristic UUID: 0x24A8 Characteristic Declaration, Characteristic Configuration Bits: Notification (0001) PrimayService, 0x1837 Characteristic Declaration, Characteristic UUID: 0x24A8 UUID: 2A48, Value: Declaration, Characteristic UUID: 0x24A8 UUID: 2A40, Value: UVID: 0x24A4 UUID: 2A40, Value: UVID: 0x24A4 UUID: 2A40, Value: UVID: 0x24A4 UUID: 2A40, Value: UVI	Primatybertroc, Benetic Access (UK1800) Primatybertroc, Benetic Access (UK1800) DeviceName, DeviceName, InsightSIP_C0010 DeviceName,
Attribute under	
Utility (nut) Display as UTF8 Read long Read	Display as UTF8 Reading Read
Value: hex bext Send update	Value: hex text Send update
Back	Back
Log	Log
[17:29:50.9] Received a HandleValueNotification on handle 0012 with value E4E6F10151EA3D00	[17:30:44.4] Received a HandleValueNotification on handle 0012 with value 55E8F60197EB3D00
[17:29:50.9] Received a HandleValueNotification on handle 000E with value 040018FBF020E0019201E700	[17:30:44.4] Received a HandleValueNotification on handle 000E with value F4FF1CFBF020E8018C01F500
[17:29:51.0] Received a HandleValueNotification on handle 000E with value E4FF1CFBFC20E4018001FD00	[17:30:44.4] Received a HandleValueNotification on handle 000E with value F8FF18FBF420EE018201F800
[17:29:51.0] Received a HandleValueNotification on handle 000E with value E8FF04FBF420E3017401D800	[17:30:44.5] Received a HandleValueNotification on handle 000E with value 040014FB0821ED017D01EF00
[17:29:51.0] Received a HandleValueNotification on handle 0012 with value E2E6E301B3E93D00	[17:30:44.5] Received a HandleValueNotification on handle 0012 with value 45E8ED012AEA3D00
[17:29:51.1] Received a HandleValueNotification on handle 000E with value F8FF28FBFC20E2017401EE00	[17:30:44.5] Received a HandleValueNotification on handle 000E with value 000024FBE420F0018701FC00
[17:29:51.1] Received a HandleValueNotification on handle 000E with value F0FF14FBEC20DB017701D600	[17:30:44.5] Received a HandleValueNotification on handle 000E with value F8FF24FBEC20EC018501FB00
[17:29:51.1] Received a HandleValueNotification on handle 000E with value 000014FBDC20ED017901EE00	[17:30:44.6] Received a HandleValueNotification on handle 000E with value 080018FB0021F3018701DF00
[17:29:51.1] Received a HandleValueNotification on handle 0012 with value DEE6ED01BBE93D00	[17:30:44.6] Received a HandleValueNotification on handle 0012 with value 44E8F30148E93D00
[17:29:51:1] Received a HandleValueNotification on handle 000E with value 04001CFB0821D1018E01F900	[17:30:44.6] Received a HandleValueNotification on handle 000E with value 000010FBF820EC018A01F100

- 8. You can note data that transit between the ISP131001 Sensors Board and the Master Emulator via the Bluetooth link:
 - Data of the accelerometer/magnetometer on the above left figure
 - Data of the temperature/pressure on the above right figure

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To switch off ISP131001 Sensors Board, disconnect battery holder as seen in the figure below. 9.



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6.2 On iPhone Device (4S or higher)

The Sensor application is available on demand from Insight SiP. The iPhone App is a demonstration App that is provided "as is" in order to demonstrate the Smart Bluetooth sensor node. Only one iPhone is allowed per development kit.

The installation procedure for the Sensor application is described hereafter:

1. Contact Insight SiP at contact@insightsip.com and communicate the UDID of your iPhone device (4S or higher). The UDID is available when connecting your iPhone to you computer and starting iTunes on your computer.

- 2. Once you receive reply from Insight SiP, open Safari web browser on your iPhone device.
- 3. Open the URL link provided by Insight SiP.
- 4. The InsightSiPDemo application is downloaded and installed. You should see the following screen on your iPhone device.

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Then you will be able to set up the application demonstration as follows:

- 1. Place the CR2032 lithium battery into the battery holder.
- 2. Connect the battery holder to the Sensors Board ISP131001.
- 3. Start InsightSiPDemo application on your iPhone, click Connect and select your Sensors Board (name is InsightSiP_xxxxx).

	Insight SIP Demo Connect	Back Connect
sightSIP	Accelerometer	InsightSIP_COCCO
	Temperature	
	LED	
•••		

4. Click Accelerometer. A Calibration phase invites you to rotate the ISP131001 Sensors Board. Then, a starship on your iPhone screen follows the Sensors board movement.

5. Click Back and Temperature to start temperature and pressure demonstration.

6. Click Back and LED. A prompt will invite you to pair the Sensors Board with the iPhone. Click Pair. The LED lights up.

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To switch off ISP131001 Sensors Board, disconnect battery holder as seen in the figure below. 7.

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