N5 Starter Kit User Manual

N5DK1

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About the User Manual

- This user manual is to facilitate the evaluation and prototyping of solutions based on the N5 Starter Kit
- This user manual is for design engineers who are using the N5 Starter Kit to evaluate ANT as a wireless sensor network solution and develop applications based on ANT. The development kit is not intended as an end product or for use by individuals who do not have a professional background in data communications. Refer to the Copyright Information and Usage Notice page for detailed information and usage restrictions.

Revision History

Revision	Effective Date	Description
1.0	March 2014	First Release
1.1	March 28/2014	Updated Links
1.2	June 2014	Added Restricted Use of Development Kits and Reference Design Disclaimer notices.
1.3	July 2014	Removed EEPROM board description. Updated USB interface board driver installation. Updated N5 Starter Kit SDK description.

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1 Overview

The N5 Starter Kit is the development kit for the N5 ANT SoC module series, a turnkey, ultra low power wireless module based on the Nordic Semiconductor nRF51422 System on Chip solution.

This development kit includes a comprehensive set of hardware components and provides access to software tools to allow users to evaluate, design and prototype using the ANT Wireless Protocol. Table 1-1 below lists the hardware components included in the N5 Starter Kit.

Table 1-1. N5 Starter Kit Contents

Quantity	Part
2	N5 Modules
1	I/O Board
1	Battery Board
1	USB Interface Board
1	Segger J-link Programmer

1.1 N5 Modules

The N5 module series uses Nordic Semiconductor's nRF51422, the industry's first System on Chip (SoC) solution that supports both ANT and BLUETOOTH low energy depending on the loaded protocol stack with advantages in power, size, cost, speed and security built directly into the protocol layer. The nRF51422 integrates a 32-bit ARM® Cortex™ M0 CPU with 256KB flash, 16KB RAM, and analog and digital peripherals. Benefits will reach consumers in the form of new products with even longer battery life, expanded functionality and security, further simplified operation and overall value.

The N5 modules included in the N5 Starter Kit are the N548M5CB, which is a N548M8CB soldered onto 20mm x 20mm carrier boards. The N548M5CB includes an antenna, onboard 32k and 16M crystal clock, DC-DC converter and 13 GPIOs with 6 analogue inputs.

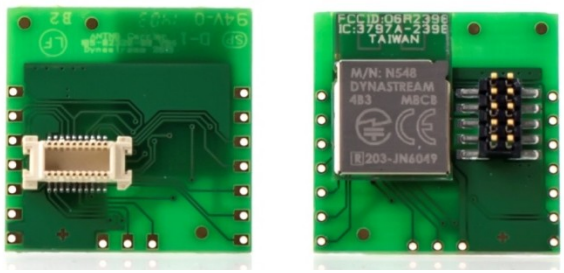


Figure 1-1. N548M5CB

When ordered separately, the N548M5CB modules are pre-programmed with the S210 SoftDevice and reference ANT network processor application code in order to function as a generic ANT RF module when connected to an application controller. Both pre-programmed images can be easily replaced via the onboard SWD interface pins using off-the-shelf ARM programmers.

1.2 Battery Board

Table 1-2 describes each of the numbered components shown on the battery board in Figure 1-2.

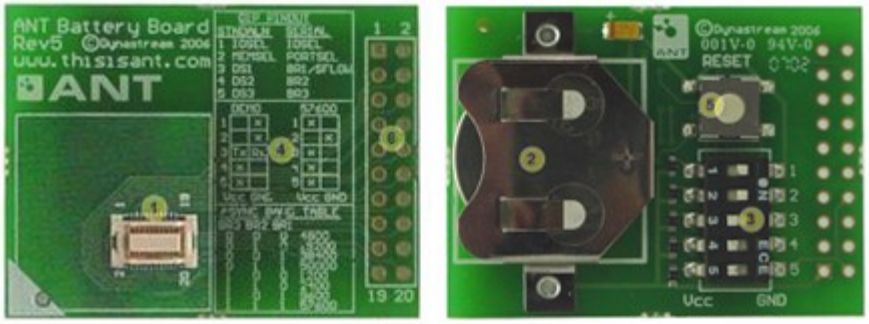


Figure 1-2. Battery Board

Table 1-2. Battery Board Description

Number	Component	Description
1	Module Socket	Used for plugging in an ANT module or an I/O interface board
2	Battery Slot	Used to power the demo mode setup (fits a 2032 coin cell)
3	Dipswitches	Used to select the state of the module's 5 configuration lines.
4	Dipswitch Instructions	Silkscreen instructions showing Dipswitch pin-out, Default Baud Rate configuration, and Baud Rate table
5	Reset Button	Resets the module
6	Interface Header	0.1" module interface header. See Table 1-4 below for the pin-out of this 20-pin header (not provided on board).

1.3 I/O Interface Board

Table 1-3 describes each of the numbered components shown on the battery board in Figure 1-3.

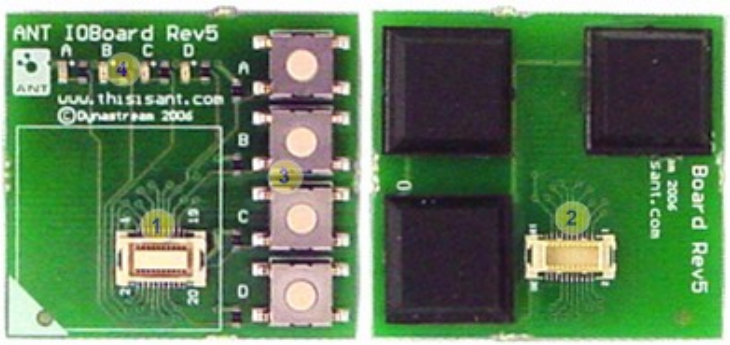


Figure 1-3. I/O Interface Board

Table 1-3. I/O Interface Board Description

Number	Component	Description
1	Module Socket	Used for plugging in an ANT module
2	Connector	Used to plug onto the battery board
3	Buttons	Used as inputs to 4 of the module's IO pins. See Table 1-4 below. When a button is released its IO line is pulled up with 1MΩ resistor. When a button is pressed its IO line is grounded.
4	LEDs	Used as outputs of 4 of the module's IO pins. See Table 1-4 below. An LED turns ON when its line is low and OFF when its line is high.

Table 1-4. N5 Starter Kit Boards Stack Pin-outs

Molex Pin #	nRF51 Pins	Battery Board Interface Header Pin #	Battery Board Input	IO Board Components	USB Interface Board Header
1	Vcc	1			1
2	P005	5	Switch 1		5
3	P012	3,11		Button C	3
4	P015	4,15		LED C	4
5	P006	18	Switch3		
6	SWDCLK	7			7
7	P024	19	Switch 4		
8	P003	14		LED B	
9	P009	20	Switch 5		
10	RST/SWDIO	6	Reset Button		6
11	P000	17	Switch 2		
12	P008	13		LED A	
13	P030	16		LED D	
14	P011	12		Button D	
15	P002	10		Button B	10
16	P021	N/C			
17	P023	9		Button A	9
18	P001	N/C			
19	GND	2,8			2,8
20	P004	N/C			

1.4 USB Interface Board

Figure 1-4. USB Interface Board

Table 1-5 describes each of the numbered components shown on the battery board in Figure 1-4.

Table 1-5. USB Interface Board Description

Number	Component	Description
1	Module Socket	Used for plugging in an ANT module
2	Interface Header	0.1" module interface header. See Table 1-4 for the pin-out of this 10-pin header (not provided on board).

1.5 Segger J-Link Lite Programmer

The Segger J-Link Lite Cortex M (cable and board) provided is used to connect the ANT module to a PC for programming as shown in Figure 1-5.

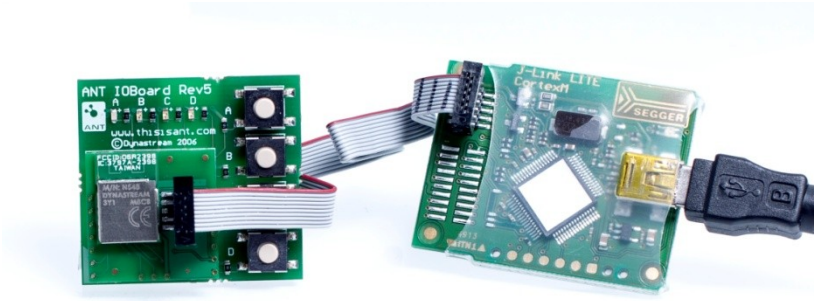


Figure 1-5. Connecting the Segger Cable

NOTE: More advanced J-Link programmers are available from Segger. Refer to section 4 for details.

1.6 Technical Resources

1.6.1 Documentation

To learn more about ANT, the following documents are available on www.thisisant.com. To access some of these documents it may be necessary to create an account.

Document	Description
N5 Module Datasheet	The technical specification of the N5 Module Series
ANT Message Protocol and Usage Document	Describes the ANT protocol and the software interface
Interfacing with ANT General Purpose Chipsets and Modules	Describes how to interface external microcontrollers to ANT
Integrated ANT-FS Interface Control Document	Describes the Integrated File System and ANT-FS feature of the CC257x and the software interface.
Integrated ANT-FS Reference Design User Manual	Describes how to use a PC based reference design for the Integrated File System and ANT-FS feature of the CC257x
ANT-FS Technical Specification	Describes the ANT-FS specification
ANT-FS User Manual	Describes how to use the ANT-FS PC Client and PC Host SW utilities.
ANTware II User Manual	Describes how to use the advanced features of ANTware.

1.6.2 Support

Technical support for the ANT wireless protocol is available via Tech FAQs and the ANT Developer Forum:

http://www.thisisant.com/developer/resources/tech-faq/

http://www.thisisant.com/forum/

Technical support for the hardware implementation (including radio performance) of ANT chips is provided by the relevant semiconductor supplier and their regional distributors. For nRF51422-specific help, please contact Nordic Semiconductor.

2 Software Setup Procedure

The following ANT, Nordic and third-party software components must be installed to begin development with the N5 Starter Kit:

Table 2-1. ANT Software Components

ANT Components		
	Component	**Source**
1.	ANT USB Interface Board Driver	http://www.dynastream.com/developer/n5starterkit (ANT USB Interface Board Driver (Windows))
	Description: Windows drivers for the ANT USB Interface Board.	
2.	ANTWareII	www.thisisant.com/developer/resources/downloads (ANTWareII)
	Description: PC Utility tool used to evaluate and debug ANT designs and applications (using the ANT USB Interface Board)	

Table 2-2. Third-Party Software Components

Third-Party Components		
	Component	**Source**
1.	Keil MDK ARM Development Kit v5 (Evaluation License sufficient for SDK reference designs)	https://www.keil.com/download/product (MDK-ARM v5)
	Description: Development environment specifically designed for microcontroller applications that lets you develop using the nRF51 SDK application and example files.	
2.	SEGGER J-Link Programmer Software	http://www.segger.com/jlink-software.html (J-Link software & documentation pack)
	Description: Software package required to use the J-Link programmer included in the development kit. (Contains drivers and files required to debug directly from the Keil Development Kit.)	

Table 2-3. Nordic Semiconductor Software Components

Nordic Semiconductor Components		
	Component	**Source**
1.	nRF51 SDK V5.2.0+	https://www.nordicsemi.com/eng/Products/ANT/nRF51422 (nRF51-SDK)
	Description: Software Development Kit that provides source code of examples and libraries forming the base of your application development. The nRF51 SDK includes: • Example code • ANT profile examples • *Bluetooth* profile examples • Drivers • Libraries • nrfjprog For more information, see the documentation packaged with the nRF51 SDK.	
2.	nRFgo Studio	https://www.nordicsemi.com/eng/Products/ANT/nRF51422-Evaluation-Kit (nRFgo Studio-Win 32/64)
	Description: Tool to program and configure devices. It supports the programming of nRF51 SoftDevices, applications, and bootloaders. The different programming modes are available on individual tabs in the nRF51 programming module. Studio is used for the following: • Setting the supply voltage • Erasing flash memory • Programming a SoftDevice • Programming an application • Programming the bootloader For more information, see the help in nRFgo Studio.	

Table 2-4. N5 Starter Kit Software Components

N5 Starter Kit Components		
	Component	**Source**
1.	N5 Starter Kit SDK Installer	http://www.dynastream.com/developer/n5starterkit (N5 Starter Kit SDK)

	Description: N5 Starter Kit patch for the nRF51 SDK. The N5 Starter Kit SDK includes:
	• Binaries for ANT Network Processor Application (S210 and S310 SoftDevices)
	• Example Code
	  ○ Basic ANT Broadcast
	  ○ ANT IO Demo (Refer to Section 3.1)
	  ○ ANT Message Types Demo (Refer to Section 3.2)
	• Header files to map nRF51422 IO pins to starter kit boards.	

2.1 Installing the Software Tools

It is recommended the supporting Software Tools are installed in the order specified below to ensure functionality.

Table 2-5. Installation Order

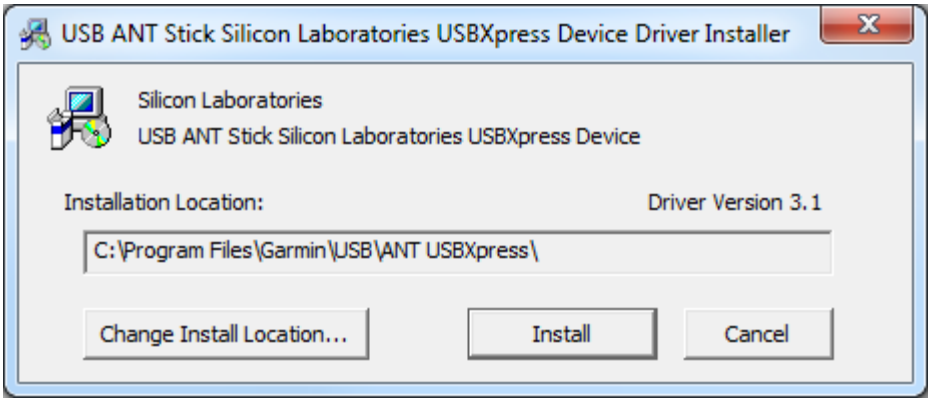
Order	Software Component
1	ANT USB Interface Board Driver
2	ANTWareII
3	Keil MDK Arm Developer Kit
4	SEGGER J-Link Programmer Software
5	nRF51 SDK
6	nRFgo Studio
7	N5 Starter Kit SDK

2.2 ANT USB Driver Installation

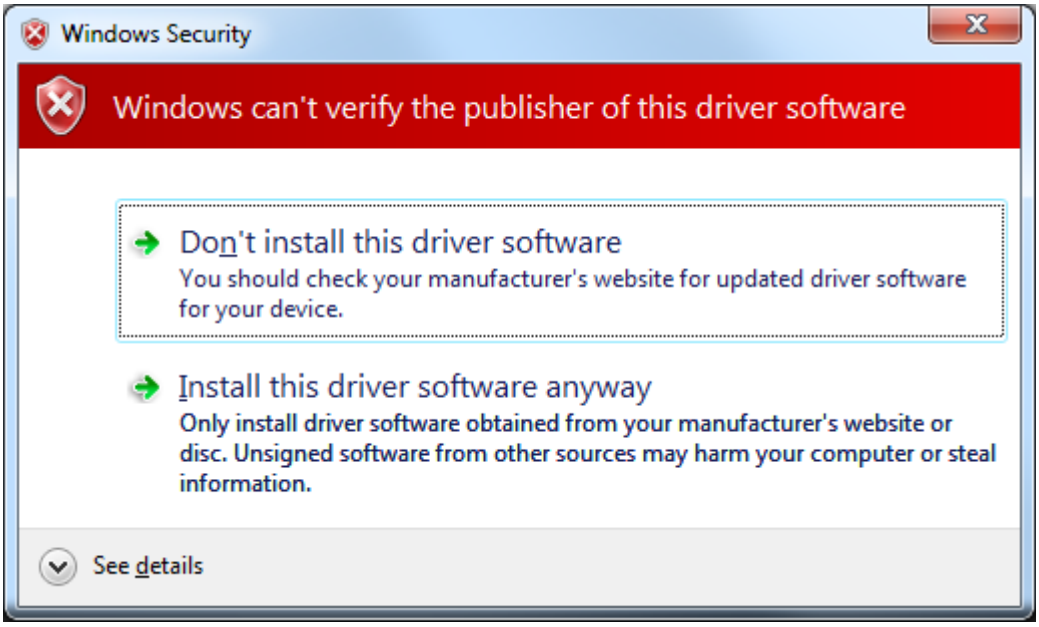
Source: http://www.dynastream.com/developer/n5starterkit **(ANT Interface Board Driver (Windows))**

Download the 'ANT USB Interface Board Driver for Windows' package from http://www.thisisant.com/developer/resources/downloads and extract the entire contents onto your hard drive. Run the USBXpressInstaller.exe file contained in the folder.

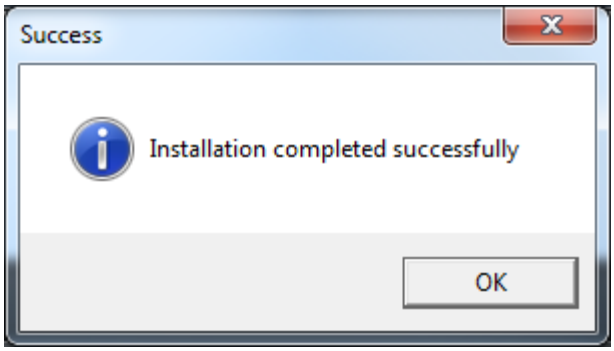
Install the drivers in your desired location.



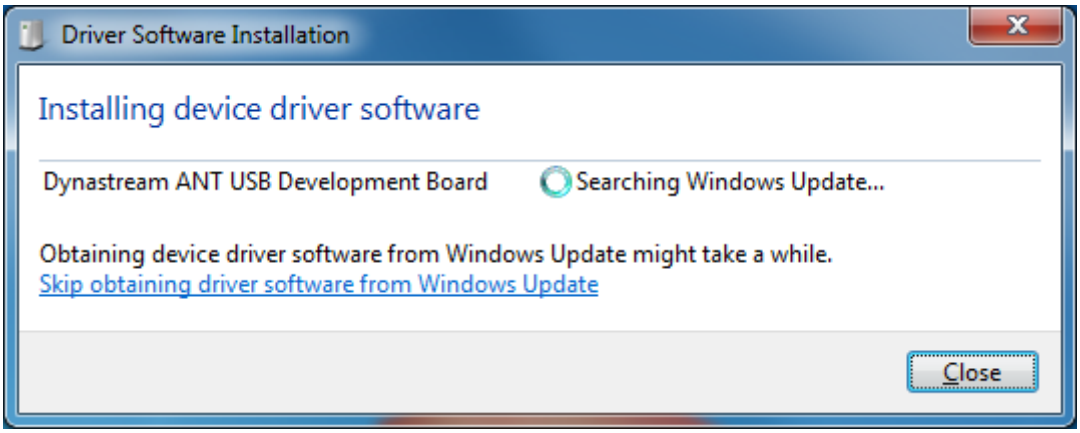
You may receive a warning message that indicates that Windows can't verify the publisher of the driver software. Click 'Install this driver software anyway' to continue.



A window will indicate if the drivers have installed correctly.



Connect anN5 module to the ANT Development Kit's USB interface board and insert into a USB port on your PC. The Driver Software Installation wizard should pop up and begin a search for drivers and indicate the USB device is 'Ready to Use' when it detects the installed drivers on the PC.



Note: The ANT USB Interface Board drivers are unsigned. Systems that require signed drivers for installation are required to boot with driver signature enforcement disabled to complete the installation process.

2.3 Install ANTWareII

Download ANTWareII from the ANTWareII link on the www.thisisant.com/developer/resources/downloads page. Follow the steps in the installer to install ANTWareII on your computer. **Please note that the .NET Framework 3.5 must be installed on your PC in order for this application to run.**

2.4 Install Keil MDK Arm Developer Kit

Download the Keil MDK Arm Developer Kit from the MDK-ARM v5 link on the https://www.keil.com/download/product/ page. Follow the steps in the installer to install the Keil µVision IDE V5 on your PC.

2.5 Install SEGGER JLink Programmer Software

Download the Segger JLink Programmer from the source listed in Section 2 above. Follow the steps in the installer to install the required Segger drivers on the computer.

2.6 Install Nordic nRF51 SDK

Register a Nordic Semiconductor MyPage account on https://www.nordicsemi.com/eng/user/register/2. Once registered, add the N5 Starter Kit to your My Products page (https://www.nordicsemi.com/eng/product/myproducts) using the Nordic Product Key provided on the back of the N5 Starter Kit package sleeve. Download the Nordic nRF51 SDK from the source listed in Section 2 above. Follow the steps in the installer to install the nRF51 SDK on the computer. It is recommended that the default installation location is used to avoid having to modify paths and project component locations later.

2.7 Install nRFgo Studio

Download the nRFGo Studio tool from the source listed in Section 2 above. Follow the steps in the installer to install nRFGo Studio on the computer. (You will have to be registered on the Nordic Semiconductor website using the steps listed in Section 2.6 to have access to this tool.)

2.8 Install N5 Starter Kit SDK

Use the install file available from the source listed in Section 2 above. It is recommended that the default installation location is used to avoid having to modify paths and project locations in the reference code. The N5 Starter Kit SDK must be installed over the Nordic Semiconductor nRF51 SDK. (The installation folder for the N5 Starter Kit SDK must contain the **nrf51422** folder from the nRF51 SDK.)

3 Testing the Reference Code Demos

3.1 ANT IO Demo

The N5 Module that comes stacked on the IO and Battery Boards comes preloaded with an example IO demo to demonstrate the functionality of the LEDs and Buttons of the N5 Starter Kit using a simple ANT channel. The N5 Module that comes stacked on the ANT USB interface board is preloaded with an ANT Network Processor reference code to emulate a stand-alone ANT module to allow serial communication with external controllers.

Steps to test the preloaded IO Demo and Network Processor programs on the N5 module:

1. Insert a CR2032 coin cell battery into the battery board stacked with an IO Board and N5 module.
2. Plug in the N5 Module stacked on the ANT USB Interface board into a USB port on your PC. (The N5 Module that comes placed on the USB Interface board has the ANT Network Processor program preloaded. The ANT Network Processor built program is also available in the N5 Starter Kit SDK)
3. Open the ANTWareII tool.
4. Configure Channel 0 as a Slave.
5. Set the Channel ID 0,0,0 to wildcard channel ID.
6. Open the channel with default values for all the other channel configuration parameters to begin the search for the other N5 module.
7. Once the two modules have paired (indicated by receiving broadcasts in the ANTWare Log window), you can begin to test the Buttons and LEDs on the IO board.
8. Click on the "Simulation" tab on the right-hand side of the ANTWareII application. Modify the "Respond With" field to either of these values:

Tx Buffer Value	Description
01-00-00-00-00-00-00-FE	Turns on LED A on the IO Board
01-00-00-00-00-00-00-FD	Turns on LED B on the IO Board
01-00-00-00-00-00-00-FB	Turns on LED B on the IO Board
01-00-00-00-00-00-00-F7	Turns on LED B on the IO Board

9. Check the "Auto Send Response to Received Msgs" check box. The N5 module will now respond with a message of its own every time it receives an ANT broadcast message to control the LEDs on the IO board.
10. The buttons on the IO board will allow you to modify the contents of the broadcast messages being transmitted from the N5 module.

3.2 ANT Message Types Demo

The ANT Message Types reference demo demonstrates the three different ANT message types: Broadcast, Acknowledged, and Burst. The prebuilt image can be preloaded onto the N5 module using the nRFGo Studio tool used with the Segger JLink Programmer. The LEDs of the IO Board in this demo will give a visual presentation of the CPU sleep time and ANT active time using different ANT messages.

Steps to program a pre-built application onto an N5 Module:

1. Stack on the N5 module to be programmed onto the IO and Battery Boards. As shown in the figure below.

Figure 3-1. N5 Module stacked on IO and Battery Boards.

2. Insert CR2032 Coin Cell battery into the Battery Board.
3. Attach the JLink Segger Ribbon Cable to the programming header on the N5 module as shown in the figure below.

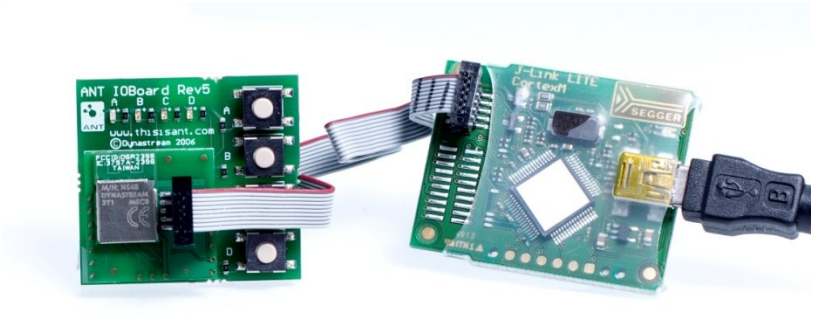
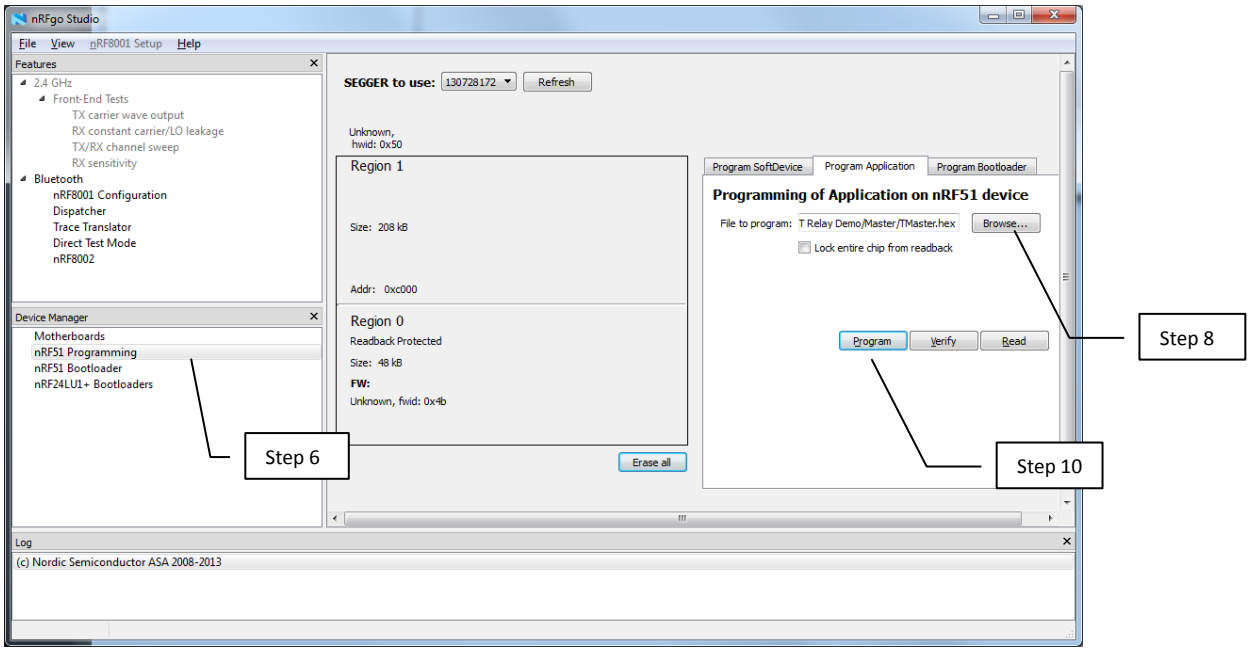


Figure 3-2. Stacked N5 Module with Segger JLink Programmer Ribbon Cable

4. Connect the JLink Programmer Segger to the computer using a USB to mini-USB cable.
5. Launch nRFgo studio.
6. Click on the "nRF51 Programming" option in the "Device Manager" panel on the left-hand side of the application.



7. Click on the "Program Application" tab on the right-hand side of the application.
8. Click the "Browse…" button and navigate to the directory where the built hex file should be stored:
9. (if the default nRF51 SDK and N5 Starter Kit SDK installation locations were used: \Keil_v5\ARM\Device\Nordic\nrf51422\Board\n5_series\s210\ant_message_types\message_types_master\arm_build)
10. Open the message_types_master.hex file.
11. Click the "Program" button in the "Program Application" tab to program the N5 Module.
12. The Log window at the bottom of the screen should read: "Application […]/message_types_master.hex programmed successfully".

Now that the N5 module has been programmed, we can test the different ANT message types using the ANTWareII tool.

1. Plug in the N5 Module stacked on the ANT USB Interface board into the computer (The N5 Module that comes placed on the USB Interface board has the ANT Network Processor program preloaded. The ANT Network Processor built program is also available in the N5 Starter Kit SDK.)
2. Open the ANTWareII tool.
3. Configure Channel 0 as a Slave.
4. Set the Channel ID 0,0,0 to wildcard channel ID.
5. Open the channel with default values for all the other channel configuration parameters to begin the search for the other N5 module.

6. Once the two modules have paired. The buttons on the N5 module with the IO board will allow you to switch between broadcasting, acknowledgement and burst messaging. Button A will switch the N5 module to broadcasting mode, Button B will switch it to acknowledgement mode and Button C will switch it to bursting mode. LED A will indicate when the CPU is sleeping, while LEDs B, C and D will indicate when a broadcast, acknowledgement, or a burst is being transmitted via ANT.

4 Appendix 1 – A Note from Segger

A SEGGER J-Link Lite Cortex-M is included in this kit. The J-Link Lite is a very small form factor debug probe which is software compatible to the widely acknowledged J-Link line. This device has a JTAG clock of up to 2 MHz. It supports SWD and -SWO. The J-Link Lite is only delivered and supported as part of a starter kit, which includes an evaluation board. It is not sold separately. It may only be used with the evaluation board it came with. The SEGGER public forum is available at: http://forum.segger.com/.

When you have completed your use of the J-Link Lite while working with this starter kit and are ready to move to a full debug probe and/or production flash programmer, we are confident you will find one of the following SEGGER solutions a perfect fit.

J-Link PRO

Debug Probe with USB and Ethernet interface
Includes all software enhancement modules

J-Link ULTRA+

Ultra Fast Debug Probe
Includes all software enhancement modules

J-Link PLUS

Debug Probe
Includes all software enhancement modules

J-Link BASE

Debug Probe

J-Link EDU

Educational Use Debug Probe

SEGGER also offers a full featured RTOS and middleware offering (File System, USB Stack, TCP/IP Stack, and Graphics Package).

Additional information may be found at:
www.segger.com and:
www.segger.com/debug-probes.html

Flasher ARM

Production Flash Programmer

Flasher Portable

Portable Flash Programmer