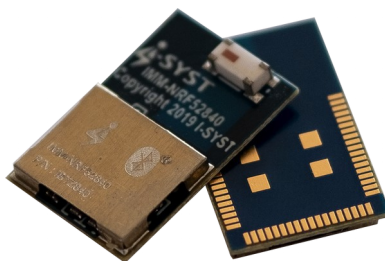


IMM-NRF52840 (BLYST840) Module

Bluetooth® 5 / Bluetooth® Mesh
Thread / Zigbee



Part No : IBTZ840



FCCID: 2ATLY- IBTZ840
IC: 25671-IBTZ840

Revision history

Version	Date	Note	Contributor(s)	Approver
1.0	12 Dec 2018	Initial version	Nguyen Hoang Hoan	Nguyen Hoang Hoan
1.1	2019		Nguyen Hoang Hoan	Nguyen Hoang Hoan
1.2	2020		Nguyen Hoang Hoan	Nguyen Hoang Hoan
1.3	2021		Nguyen Hoang Hoan	Nguyen Hoang Hoan

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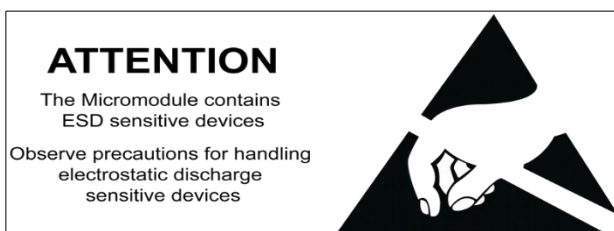
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FCC Caution

Any Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

FCC RF Radiation Exposure Statement

- I.1 This Transmitter must not be co-located or operating in conjunction with any other antenna or transmitter.
- I.2 This equipment complies with RF radiation exposure limits set forth for an uncontrolled environment.
- I.3 This equipment should be installed and operated with minimum distance 20cm between the radiator & your body.

Host product manufacturers that they need to provide a physical or e-label stating “Contains FCC ID : 2ALTY-IBTZ840B” with their finished product. **Only those antennas with same type and lesser gain filed under this FCC ID can be used with this device. The host product manufacturer is responsible for compliance to any other FCC rules that apply to the host not covered by the modular transmitter grant of certification. The final host product still requires Part 15 Subpart B compliance testing with the modular transmitter installed. The final host integrator must ensure there is no instruction provided in the user manual or customer documentation indicating how to install or remove the transmitter module except such device has implemented two-ways authentication between module and the host system. The final host manual shall include the following regulatory statement: This equipment has been tested and found to comply with the limits for a This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.**

This device complies with Industry Canada license-exempt RSS standard(s). Operation is subject to the following two conditions:

- 1 This device may not cause interference, and
- 2 This device must accept any interference, including interference that may cause undesired operation of the device.

Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes :

- 1 L'appareil ne doit pas produire de brouillage.
- 2 L'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement

IC Warning

This device complies with Industry Canada's licence-exempt RSSs. Operation is subject to the following two conditions:

- (1) This device may not cause interference; and
- (2) This device must accept any interference, including interference that may cause undesired operation of the device.

Radiation Exposure Statement

This modular complies with IC RF radiation exposure limits set forth for an uncontrolled environment. This transmitter must not be co-located or operating in conjunction with any other antenna or transmitter. This modular must be installed and operated with a minimum distance of 20 cm between the radiator and user body.

If the ISED identification number is not visible when the module is installed inside another device, then the outside of the device into which the module is installed must also display a label referring to the enclosed module. This exterior label can use wording such as the following:

"Contains Transmitter Module IC: 25671-IBTZ840B Or Contains IC: 25671-IBTZ840B"

When the module is installed inside another device, the user manual of the host must contain below warning statements;

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

The devices must be installed and used in strict accordance with the manufacturer's instructions as described in the user documentation that comes with the product.

Any company of the host device which install this modular with Single modular approval should perform the test of radiated emission and spurious emission according to RSS-247 requirement, Only if the test result comply with RSS-247 requirement then the host can be sold legally.

ÿ

Cet appareil est conforme aux CNR exemptes de licence d'Industrie Canada . Son fonctionnement est soumis aux deux conditions suivantes :

- (1) Ce dispositif ne peut causer d'interférences ; et
- (2) Ce dispositif doit accepter toute interférence , y compris les interférences qui peuvent causer un mauvais fonctionnement de l'appareil.

Déclaration d'exposition aux radiations

Ce module est conforme aux limites d'exposition aux rayonnements RF IC définies pour un environnement non contrôlé.

Cet émetteur ne doit pas être co-localisé ou fonctionner en conjonction avec tout autre antenne ou émetteur. Ce module doit être installé et utilisé avec une distance minimale de 20 cm entre le radiateur et le corps de l'utilisateur.

OEM INTEGRATION INSTRUCTIONS:

This device is intended only for OEM integrators under the following conditions:

The module must be installed in the host equipment such that 20 cm is maintained between the antenna and users, and the transmitter module may not be co-located with any other transmitter or antenna. The module shall be only used with the internal on-board antenna that has been originally tested and certified with this module. External antennas are not supported. As long as these 3 conditions above are met, further transmitter test will not be required.

However, the OEM integrator is still responsible for testing their end-product for any additional compliance requirements required with this module installed (for example, digital device emissions, PC peripheral requirements, etc.). The end-product may need Verification testing, Declaration of Conformity testing, a Permissive Class II Change or new Certification. Please involve a FCC certification specialist in order to determine what will be exactly applicable for the end-product.

Validity of using the module certification:

In the event that these conditions cannot be met (for example certain laptop configurations or co-location with another transmitter), then the FCC/IC authorization for this module in combination with the host equipment is no longer considered valid and the FCC ID/IC of the module cannot be used on the final product. In these circumstances, the OEM integrator will be responsible for re-evaluating the end product (including the transmitter) and obtaining a separate FCC authorization. In such cases, please involve a FCC/IC certification specialist in order to determine if a Permissive Class II Change or new Certification is required.

Upgrade Firmware:

The software provided for firmware upgrade will not be capable to affect any RF parameters as certified for the FCC/IC for this module, in order to prevent compliance issues.

End product labeling:

This transmitter module is authorized only for use in device where the antenna may be installed such that 20 cm may be maintained between the antenna and users. The final end product must be labeled in a visible area with the following: "Contains FCC ID: 2ALTY-IBTZ840B, IC: 25671-IBTZ840B".

Information that must be placed in the end user manual:

The OEM integrator has to be aware not to provide information to the end user regarding how to install or remove this RF module in the user's manual of the end product which integrates this module. The end user manual shall include all required regulatory information/warning as show in this manual.

2.2 List of applicable FCC/IC rules

List the FCC/IC rules that are applicable to the modular transmitter. These are the rules that specifically establish the bands of operation, the power, spurious emissions, and operating fundamental frequencies.

DO NOT list compliance to unintentional-radiator rules (Part 15 Subpart B/ICES-003) since that is not a condition of a module grant that is extended to a host manufacturer. See also Section 2.10 below concerning the need to notify host manufacturers that further testing is required.³ Explanation: This module meets the requirements of FCC part 15C(15.247)/RSS-247.

2.3 Summarize the specific operational use conditions

Describe use conditions that are applicable to the modular transmitter, including for example any limits on antennas, etc. For example, if point-to-point antennas are used that require reduction in power or compensation for cable loss, then this information must be in the instructions. If the use condition limitations extend to professional users, then instructions must state that this information also extends to the host manufacturer's instruction manual. In addition, certain information may also be needed, such as peak gain per frequency band and minimum gain, specifically for master devices in 5 GHz DFS bands. Explanation: The EUT has a Ceramic Antenna, and the antenna use a permanently attached antenna which is not replaceable.

2.4 Limited module procedures

If a modular transmitter is approved as a "limited module," then the module manufacturer is responsible for approving the host environment that the limited module is used with. The manufacturer of a limited module must describe, both in the filing and in the installation instructions, the alternative means that the limited module manufacturer uses to verify that the host meets the necessary requirements to satisfy the module limiting conditions.

A limited module manufacturer has the flexibility to define its alternative method to address the conditions that limit the initial approval, such as: shielding, minimum signaling amplitude, buffered modulation/data inputs, or power supply regulation. The alternative method could include that the limited module manufacturer reviews detailed test data or host designs prior to giving the host manufacturer approval.

This limited module procedure is also applicable for RF exposure evaluation when it is necessary to demonstrate compliance in a specific host. The module manufacturer must state how control of the product into which the modular transmitter will be installed will be maintained such that full compliance of the product is always ensured. For additional hosts other than the specific host originally granted with a limited module, a Class II permissive change is required on the module grant to register the additional host as a specific host also approved with the module. Explanation: The Module is not a limited module.

2.5 Trace antenna designs

For a modular transmitter with trace antenna designs, see the guidance in Question 11 of KDB Publication 996369 D02 FAQ – Modules for Micro-Strip Antennas and traces. The integration information shall include for the TCB review the integration instructions for the following aspects: layout of trace design, parts list (BOM), antenna, connectors, and isolation requirements.

- a) Information that includes permitted variances (e.g., trace boundary limits, thickness, length, width, shape(s), dielectric constant, and impedance as applicable for each type of antenna);
- b) Each design shall be considered a different type (e.g., antenna length in multiple(s) of frequency, the wavelength, and antenna shape (traces in phase) can affect antenna gain and must be considered);
- c) The parameters shall be provided in a manner permitting host manufacturers to design the printed circuit (PC) board layout;

- d) Appropriate parts by manufacturer and specifications;
- e) Test procedures for design verification; and
- f) Production test procedures for ensuring compliance.

The module grantee shall provide a notice that any deviation(s) from the defined parameters of the antenna trace, as described by the instructions, require that the host product manufacturer must notify the module grantee that they wish to change the antenna trace design. In this case, a Class II permissive change application is required to be filed by the grantee, or the host manufacturer can take responsibility through the change in FCC ID (new application) procedure followed by a Class II permissive change application.

Explanation: No, this module does not have a tracking antenna design. It has a permanently fixed Ceramic antenna, please refer to the user manual.

2.6 RF exposure considerations

It is essential for module grantees to clearly and explicitly state the RF exposure conditions that permit a host product manufacturer to use the module. Two types of instructions are required for RF exposure information: (1) to the host product manufacturer, to define the application conditions (mobile, portable – xx cm from a person's body); and (2) additional text needed for the host product manufacturer to provide to end users in their end-product manuals. If RF exposure statements and use conditions are not provided, then the host product manufacturer is required to take responsibility of the module through a change in FCC ID/IC (new application).

Explanation: This module complies with FCC/IC RF radiation exposure limits set forth for an uncontrolled environment, This equipment should be installed and operated with a minimum distance of 20 centimeters between the radiator and your body." This module is designed to comply with the FCC/IC statement, FCC ID: 2ALTY-IBTZ840B, IC: 25671-IBTZ840B.

2.7 Antennas

A list of antennas included in the application for certification must be provided in the instructions. For modular transmitters approved as limited modules, all applicable professional installer instructions must be included as part of the information to the host product manufacturer. The antenna list shall also identify the antenna types (monopole, PIFA, dipole, etc. (note that for example an "omni-directional antenna" is not considered to be a specific "antenna type")).

For situations where the host product manufacturer is responsible for an external connector, for example with an RF pin and antenna trace design, the integration instructions shall inform the installer that unique antenna connector must be used on the Part 15 authorized transmitters used in the host product. The module manufacturers shall provide a list of acceptable unique connectors.

Explanation: The EUT has a Ceramic Antenna, and the antenna use a permanently attached antenna which is unique.

2.8 Label and compliance information

Grantees are responsible for the continued compliance of their modules to the FCC/IC rules. This includes advising host product manufacturers that they need to provide a physical or e-label stating "Contains FCC ID" with their finished product. See Guidelines for Labeling and User Information for RF Devices – KDB Publication 784748.

Explanation: The host system using this module, should have label in a visible area indicated the following texts: "Contains FCC ID: 2ALTY-IBTZ840B, IC: 25671-IBTZ840B."

2.9 Information on test modes and additional testing requirements⁵

Additional guidance for testing host products is given in KDB Publication 996369 D04 Module Integration Guide. Test modes should take into consideration different operational conditions for a stand-alone modular transmitter in a host, as well as for multiple simultaneously transmitting modules or other transmitters in a host product.

The grantee should provide information on how to configure test modes for host product evaluation for different operational conditions for a stand-alone modular transmitter in a host, versus with multiple, simultaneously transmitting modules or other transmitters in a host.

Grantees can increase the utility of their modular transmitters by providing special means, modes, or instructions that simulates or characterizes a connection by enabling a transmitter. This can greatly simplify a host manufacturer's determination that a module as installed in a host complies with FCC/IC requirements.

Explanation: Top band can increase the utility of our modular transmitters by providing instructions that simulates or characterizes a connection by enabling a transmitter.

2.10 Additional testing, Part 15 Subpart B/ICES-003 disclaimer

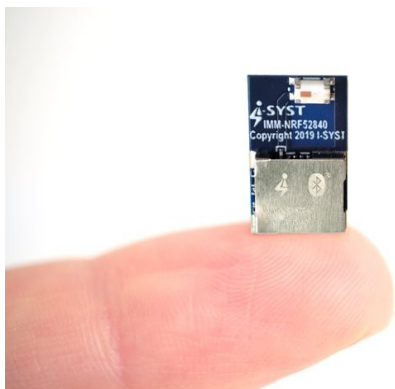
The grantee should include a statement that the modular transmitter is only FCC authorized for the specific rule parts (i.e., FCC/IC transmitter rules) listed on the grant, and that the host product manufacturer is responsible for compliance to any other FCC/IC rules that apply to the host not covered by the modular transmitter grant of certification. If the grantee markets their product as being Part 15 Subpart B/ICES-003 compliant (when it also contains unintentional-radiator digital circuitry), then the grantee shall provide a notice stating that the final host product still requires Part 15 Subpart B/ICES-003 compliance testing with the modular transmitter installed.

Explanation: The module without unintentional-radiator digital circuitry, so the module does not require an evaluation by FCC Part 15 Subpart B/ICES-003. The host should be evaluated by the FCC Subpart B/ICES-003.

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1. Introduction



The **IMM-NRF52840** SoM is built around the Nordic Semiconductor ultra low power nRF52840 32-bit ARM® Cortex™ M4F CPU with floating point unit running at 64 MHz. It integrates the nRF52 series 2.4GHz transceiver with programmable output power -20dBm to +8 dBm, USB 2.0, Flash memory, analog and digital I/O. The nRF52840 supports Bluetooth® 5, Zigbee, Threads and proprietary wireless protocols.

The IMM-NRF52840 is a 14x9x1.5 mm module with embedded ceramic antenna. It allows developers to take full advantage of the nRF52840 by making all its I/O available via 54 SMD 0.4mm pitch pads.

1.1 Overview and Features

IMM-NRF52840 modules are designed so that no extra PCB space or any external components are required on user's application board for all the functionality of the nRF52840.

- A fingertip-size ARM® Cortex™ M4F module with Bluetooth® 5.2, Thread, Zigbee and 46 I/O
- It's designed as a feature-rich but tiny and ultra-low-power SoM to make it easy to integrate into your own projects and IoT hardware.
- It has 46 fully programmable I/O, 1 MB flash, 256 kB RAM, is ready for Bluetooth® 5.2, is Thread and ZigBee capable, is NFC-enabled, has built-in security measures, and supports MicroPython.

Features

- 64MHz ARM® Cortex™ M4F
- 2.4GHz transceiver, Bluetooth® 5
- IEEE 802.15.4 radio support Zigbee, Thread
- USB 2.0 Device full speed 12Mbps
- 1MB FLASH, 256KB SRAM.
- 32 MHz Crystal 20PPM
- 32.768 KHz Crystal 20PPM
- DC/DC power mode configurations builtin
- 46 configurable I/O pins
- NFC-A Tag with wakeup on field
- ARM® CryptoCell CC310
- 8 configurable 12 bits, 200 ksps ADC
- Digital microphone interface
- 3 x 4 channels PWM
- AES hardware encryption
- Temperature sensor
- Up to 4 PWM
- Digital interfaces SPI Master/Slave, Quad SPI, 2-wire Master/Slave (I2C compatible), UART (CTS/RTS)
- Quadrature decoder
- Low power comparator
- Operating voltage : 1.7V to 5.5V
- Dimension: 14x9x1.5 mm

1.2 Application

IoT

- Smart Home products
- Industrial mesh networks
- Smart city infrastructure

Interactive entertainment devices

- Advanced remote controls
- Gaming controller

Advanced wearables

- Connected watches
- Advanced personal fitness devices
- Wearables with wireless payment
- Connected Health
- Virtual/Augmented Reality applications

2. Specification

Frequency band	2.4GHz
On-air data rate	2Mbps/1Mbps/500kbs/125kbs - Bluetooth low energy 250kbs – 802.15.4 2Mbps/1Mbps – 2.4GHz proprietary
Output power	Programmable -20dBm to +8dBm
Sensitivity	Bluetooth 5: -103dBm at 125kbs, -99dBm at 500kbs, -96dBm at 1Mbps, -92dBm at 2Mbps 802.15.4: -100dBm at 250kbs ANT: -92.5dBm at 1Mbps 2.4GHz: -92.5dBm at 1Mbps, -89dBm at 2Mbps
Radio current consumption DC-DC at 3v	4.8mA TX at 0dBm, DC/DC at 3V 14.8mA TX at +8dBm, DC/DC at 3V 9.6mA TX at +4dBm, DC/DC at 3V 4.6mA RX at 1Mbps
Microcontroller	64MHz ARM® Cortex™-M4F
Program memory	1MB Flash with cache
RAM	256kB
Oscillators	32MHz crystal oscillator, 64MHz RC oscillator, 32kHz crystal oscillator, 32kHz RC oscillator
System current consumption	0.5µA at 3V System OFF mode, no RAM retention 1.5µA System ON mode, no RAM retention 0.7µA All peripherals in IDLE mode 0.03µA per 4kB RAM retention
Hardware security	128-bit AES ECB/CCM/AAR co-processor
Cryptography	ARM CryptoCell 310
GPIO	48 configurable
Digital I/O	QSPI x 1, SPI master x 3, SPI slave x 3, 2-wire master x 2, 2-wire slave, UARTe x 2, Quadrature decoder, PDM, I ² S
Peripherals	12-bit/200ksps ADC, RNG, LP comparator, WDT, PWM x 4

PPI	20
USB	USB 2.0 (12Mbps)
Timers/counters	32-bit timers x 5, RTC x 3
NFC	NFC-A

3. Hardware Specification

3.1 Module Diagram

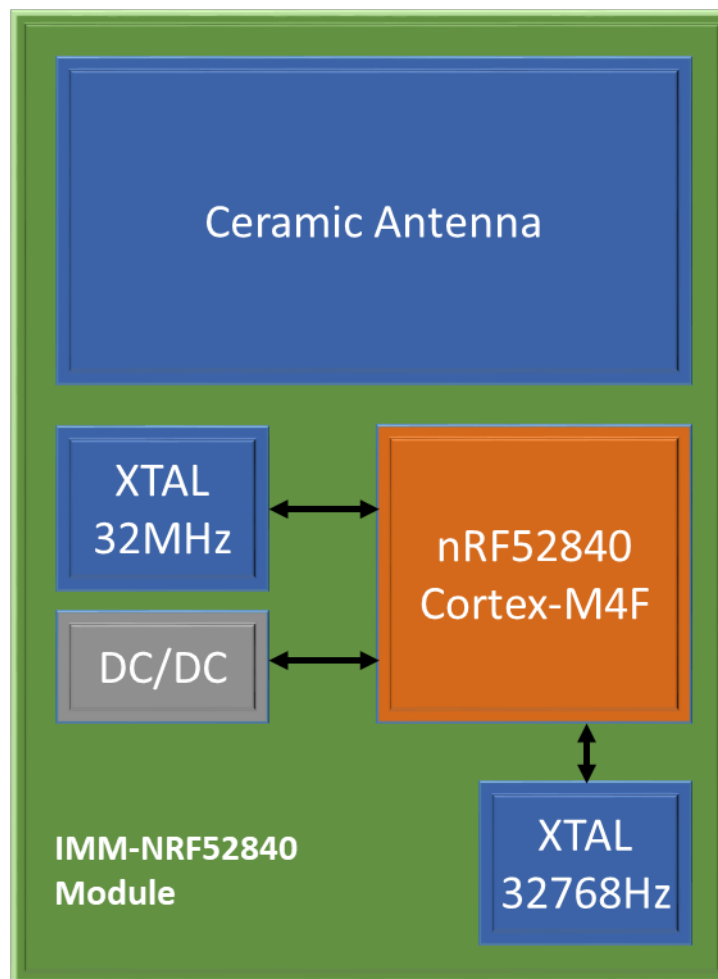
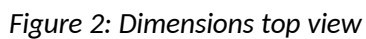


Figure 1: Module internal diagram

Bellow is the direct relationship of the module pads and the nRF52840 I/O pins.



3.1.2 Pin Description

Pin Number	Pin Name	Description
1	P1.07	GPIO port 1, pin 7
2	P1.03	GPIO port 1, pin 3
3	P1.02	GPIO port 1, pin 2
4	P1.05	GPIO port 1, pin 5
5	SWDCLK	JTAG Clock
6	P1.04	GPIO port 1, pin 4
7	P1.01	GPIO port 1, pin 1
8	SWDIO	JTAG Data
9	P0.25	GPIO port 0, pin 25
10	P0.22	GPIO port 0, pin 22
11	P0.19	GPIO port 0, pin 19
12	P1.00	GPIO port 1, pin 0
13	P0.18/nRESET	GPIO port 0, pin 18 or nRESET
14	P0.21	GPIO port 0, pin 21
15	P0.24	GPIO port 0, pin 24
16	P0.23	GPIO port 0, pin 23
17	D-	USB D-
18	D+	USB D+
19	P0.20	GPIO port 0, pin 20
20	P0.17	GPIO port 0, pin 17
21	GND	Ground
22	VDD_nRF	Core voltage 1.75V-3.6V configurable as in or out
23	VDDH	Main input voltage 1.75V-5V
24	VUSB	USB input voltage 5V
25	P0.16	GPIO port 0, pin 16
26	P0.15	GPIO port 0, pin 15
27	P0.14	GPIO port 0, pin 14
28	P0.13	GPIO port 0, pin 13
29	P0.12	GPIO port 0, pin 12
30	P0.11	GPIO port 0, pin 11
31	P1.09	GPIO port 1, pin 9
32	P1.08	GPIO port 1, pin 8
33	P0.08	GPIO port 0, pin 8
34	P0.07	GPIO port 0, pin 7

35	P0.06	GPIO port 0, pin 6
36	P0.05/AIN3	GPIO port 0, port 5 or Analog Input 3
37	P0.04/AIN2	GPIO port 0, pin 4 or Analog Input 2
38	P0.27	GPIO port 0, pin 27
39	P0.26	GPIO port 0, pin 26
40	P0.31/AIN7	GPIO port 0, pin 31 or Analog Input 7
41	P0.30/AIN6	GPIO port 0, pin 30 or Analog Input 6
42	P0.29/AIN5	GPIO port 0, pin 29 or Analog Input 5
43	P0.28/AIN4	GPIO port 0, pin 28 or Analog Input 4
44	P0.03/AIN1	GPIO port 0, pin 3 or Analog Input 1
45	P0.02/AIN0	GPIO port 0, pin 2 or Analog Input 0
46	P1.15	GPIO port 1, 15
47	P1.14	GPIO port 1, pin 14
48	P1.13	GPIO port 1, pin 13
49	P1.12	GPIO port 1, pin 12
50	P1.11	GPIO port 1, pin 11
51	P1.10	GPIO port 1, pin 10
52	P1.06	GPIO port 1, pin 6
53	P0.10/NFC2	GPIO port 0, pin 10 or NFC2
54	P0.9/NFC1	GPIO port 0, pin 9 or NFC1

3.1.3 Power configuration

The modules supports 2 power modes as shown bellow.

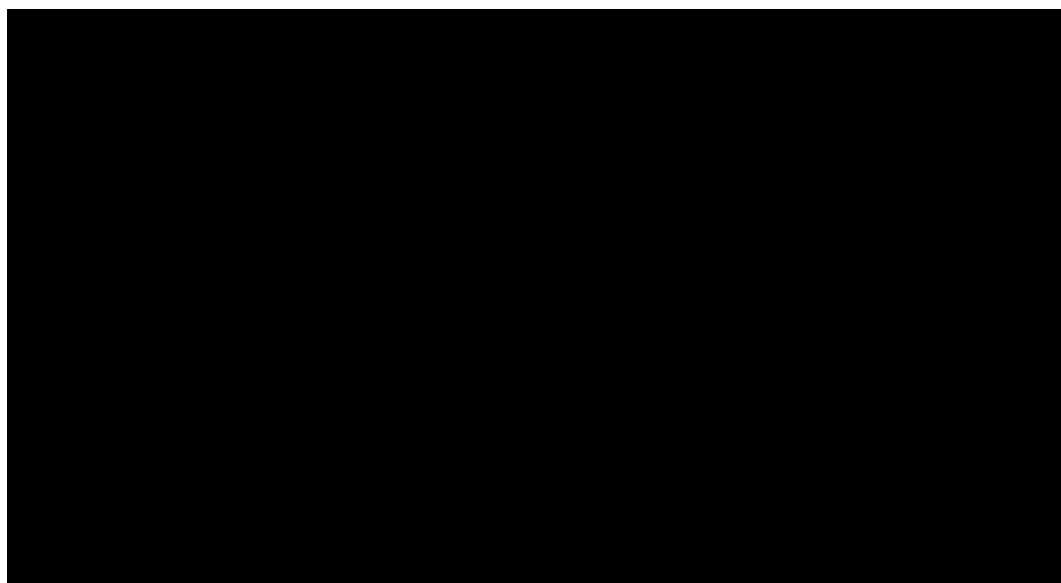


Figure 3: Power Configuration

3.1.4 SMD Footprint

Note: Do not route any traces or planes under the indicated antenna area.

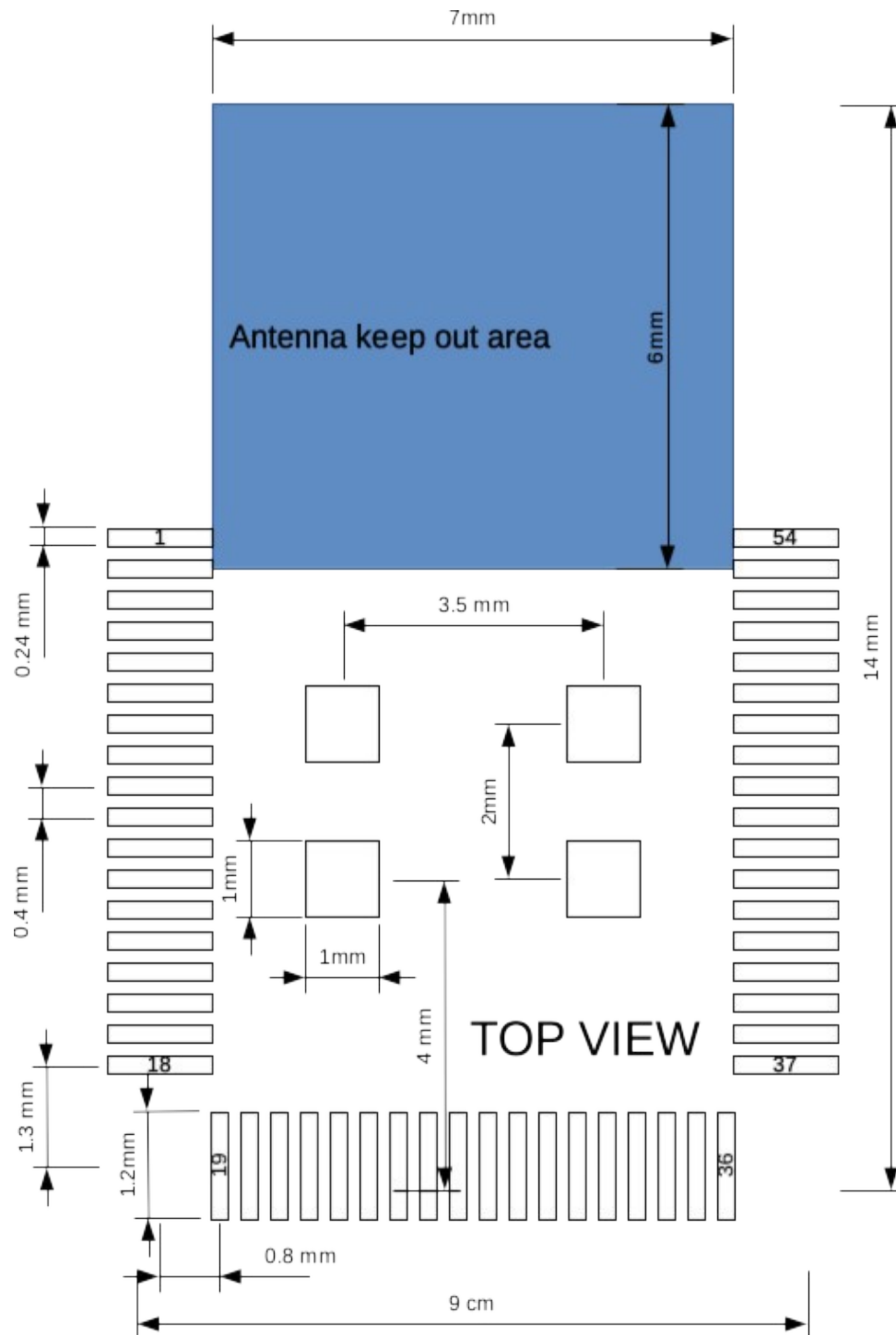


Figure 4: SMD footprint top view

4. Quick Start

4.1 Requirements

The follows are required for software development

- Debug J-Tag : IDAP-Link, Segger J-Link, or any ARM compatible J-Tag.
- Nordic SDK & Softdevice BLE stack (<https://developer.nordicsemi.com/>)
- C/C++ embedded software development environment : Eclipse, Keil, CrossWorks, ...

4.2 Flashing firmware

The Nordic Softdevice is required to use ANT, BLE, Zigbee, Thread application. There are many methods to flash it in the module. The official method from Nordic is to use nrfjprog with J-Link.

This program is available on Nordic website

<https://www.nordicsemi.com/Software-and-Tools/Development-Tools/Test-and-Evaluation-Software>.

The other method is to use IDAP-Link with IDAPnRFProg for OSX, Linux & Windows. More details available on blog page <http://embeddedsoftdev.blogspot.ca/p/ehal-nrf51.html>.

The IDAPnRFProg can program Softdevice, DFU and Firmware app without requiring mergehex. It can parallel program multiple nRF5x series boards at once when multiple IDAP-Link are connected to same PC

4.3 Breakout board

For quick development and prototyping, a breakout board, IBK-NRF52840, is available with all I/O pins routed out to standard DIP48, 2.54mm pitch header pin, onboard LED indicator, buttons and USB. Ready to be mounted on a breadboard. The SWD connector pins are also routed out for debug probe. Connect it to the IDAP-Link for OpenOCD debugging.

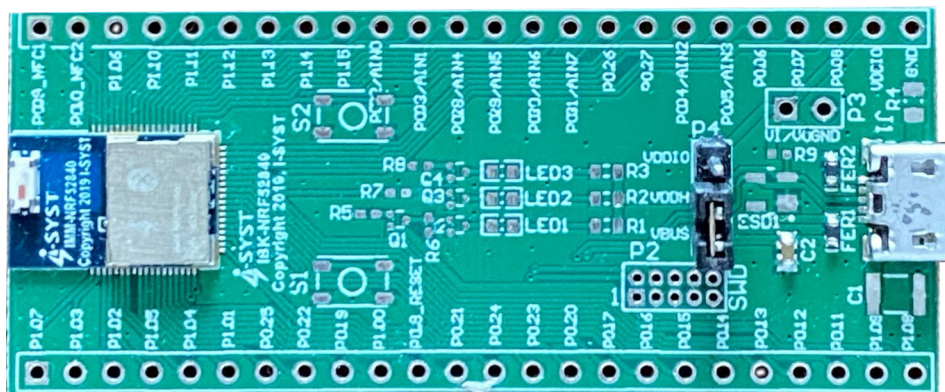


Figure 5: IBK-NRF52840 Breakout Board.

4.4 J-Tag wiring

The IMM-NRF52840 module has exposed the SWD (Serial Wire Debug) pins SWDIO & SWCLK, see I/O layout section. The module can be directly connected to a J-Tag tool for development by wiring the 2 SWD and the optional Reset pins to the appropriate pins on the J-Tag connector. The

VIN must be wire to the VCC pin on the J-Tag. GND pad is also require to be connected to GND on J-Tag.

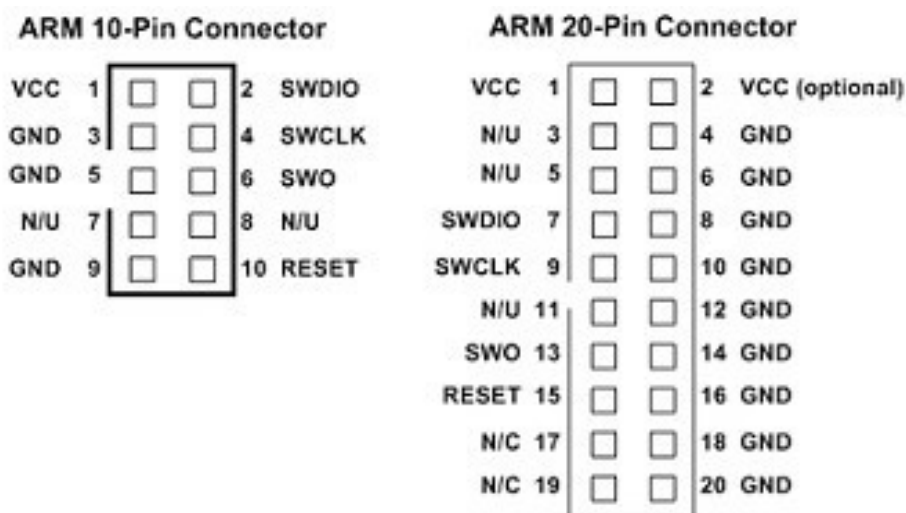


Figure 6: ARM JTAGE Connector

4.5 Nordic Software

The Nordic SDK and software tools can be download from <http://developer.nordicsemi.com> and <http://www.nordicsemi.com>. Community support forum at <https://devzone.nordicsemi.com>.

4.6 Firmware development with Eclipse IDE

Eclipse with GCC is the most cost effective software development environment. It is 100% free. The drawback is that it requires a bit of gymnastics to setup. Fortunately many Blog posts are available on the Internet showing step by step. Follow this blog to setup the Eclipse IDE & GCC compiler:

<http://embeddedsoftdev.blogspot.ca/p/eclipse.html>.

There are samples code in the Nordic SDK itself. Other Eclipse based example code are available from this Blog page <http://embeddedsoftdev.blogspot.ca/p/ehal-nrf51.html>