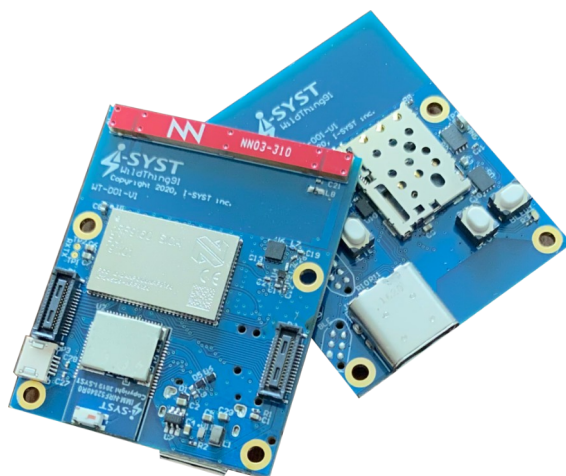# WILDTHING91

## Module

### Bluetooth® 5 / Bluetooth® Mesh
### Thread / Zigbee



Part No :

C E

FCCID:
IC:

## Revision history

| Version | Date | Note | Contributor(s) | Approver |
|---------|------|------|----------------|----------|
| 1.0 | Dec 2020 | Initial version | Nguyen Hoang Hoan | Nguyen Hoang Hoan |
| 1.1 | 2021 | | Nguyen Hoang Hoan | Nguyen Hoang Hoan |
| | | | | |
| | | | | |

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50 Rue de Lauzon, Boucherville, Quebec, Canada J4B 1E6

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### Limited Warranty

The xxxxxxxxxx module is warranted against defects in materials and workmanship for a period of 30 days from the date of purchase from I-SYST or from an authorized dealer.

### Disclaimer

I-SYST reserves the right to change this product without prior notice. Information furnished by ISYST is believed to be accurate and reliable. However, no responsibility is assumed by I-SYST for its use; nor for any infringement of patents nor other rights of third parties which may result from its use. No license is granted by implication or otherwise under the patent rights of I-SYST.

In no event shall I-SYST be liable for any direct, indirect, incidental, special, exemplary, or consequential damages (including, but not limited to, procurement of substitute goods or services; loss of use, data, or profits; or business interruption) however caused and on any theory of liability, whether in contract, strict liability, or tort (including negligence or otherwise) arising in any way out of the use of I-SYST hardware and software, even if advised of the possibility of such damage.
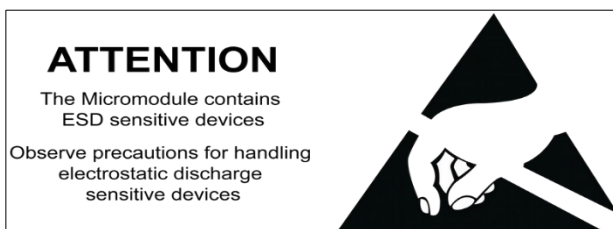
I-SYST products are not designed for use in life support appliances, devices, or systems where malfunction of these products can reasonably be expected to result in personal injury.

I-SYST customers using or selling these products for use in such applications do so at their own risk and agree to fully indemnify I-SYST for any damages resulting from such improper use or sale.

### Trademark

ARM® Cortex™ are registered trade mark of ARM

Bluetooth®  is a registered trade mark of Bluetooth SIG

**ATTENTION**

The Micromodule contains
ESD sensitive devices

Observe precautions for handling
electrostatic discharge
sensitive devices

**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 : xxxxx-xxxxxxx" 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 SAR Warning**

The device has been tested and compliance with SAR limits, users can obtain Canadian information on RF exposure and compliance.
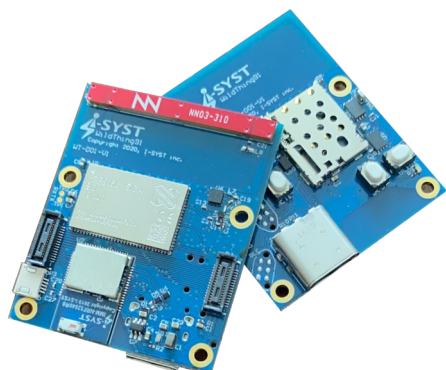
Le présent appareil est conforme Après examen de ce matériel aux conformité aux limites DAS et/ou aux limites d'intensité de champ RF, les utilisateurs peuvent sur l'exposition aux radiofréquences et la conformité and compliance d'acquérir les informations correspondantes

The ISED certification label of a module shall be clearly visible at all times when installed in the host product; otherwise, the host product must be labelled to display the ISED certification number for the module, preceded by the word "contains" or similar wording expressing the same meaning, as follows: Contains IC: xxxxx-xxxxxxx

# Contents

# 1. Introduction

The **WildThing91** is the tracker and gateway module.

The **WildThing91** is built around the Nordic nRF9160 System-in-Package (SiP) with built-in assisted GPS. The nRF9160 SiP offers a modern and powerful 64 MHz Arm Cortex-M33 CPU with on-chip flash and RAM exclusively for application use.

The **WildThing91** is also integrated the **BLYST840** SoM with the Nordic Semiconductor ultra low power nRF52840 32-bit ARM® Cortex™ M4F CPU with floating point unit running at 64 MHz. Read the **BLYST840 IMM-NRF52840** Datasheet for more detail.

The **WildThing91** is a 40x32x1.5 mm module with embedded ceramic antenna. It allows developers to take full advantage of the **BLYST840** SoM with nRF52840 and nRF9160 SiP by making all its I/O available via 54 SMD 0.4mm pitch pads.

## 1.1 Overview and Features

### 1.1.1 nRF9160 Features

The nRF9160 SiP is making the latest LTE technology accessible for a wide range of applications and developers. Through the high integration and pre-certification for global operation, it solves the complex wireless design challenges as well as the comprehensive set of qualifications needed to utilize cellular technology.

By integrating an application processor, multimode LTE-M/NB-IoT modem, RF front end (RFFE), GPS and power management in a 10x16x1,04 mm package, it offers the most compact solution for cellular IoT (cIoT) on the market. Targeting asset tracking applications, the nRF9160 SiP has built-in assisted GPS. It combines location data from the Cloud with GPS satellite trilateration to allow remote monitoring of the device position.

**LTE-M/NB-IoT modem**

- The nRF9160 LTE modem integrates RFFE, radio and baseband. It supports operation worldwide, enabling cIoT products without regional specific variants.

- The LTE modem supports half-duplex FDD operation and all power saving and coverage enhancement modes. A single pin antenna interface is available.

- The LTE stack layers L1-L3, IPv4/IPv6, TCP/UDP, TLS/DTLS are all part of the modem firmware. The application processor communicates with the LTE modem through a BSD secure sockets API and contains the application layer protocols such as HTTP, CoAP, MQTT or LWM2M, and the application itself.

- The nRF9160 LTE modem supports both SIM and eSIM, plug-in or soldered. It provides power to the SIM and handles all communication automatically.

**nRF9160 Key features**

- Fully integrated SiP for cellular IoT
- Dedicated application processor and memory

- Multimode LTE-M/NB-IoT modem with integrated RFFE
- Assisted GPS
- Single variant certified for global operation
- Certified LTE bands: B1, B2, B3, B4, B5, B8, B12, B13, B14, B17, B18, B19, B20, B25, B26, B28 and B66
- Mobile network operator certifications: AIS, AT&T, Bell, China Telecom, Deutsche Telekom, Telstra, Verizon and Vodafone
- Global and regulatory certifiations: GCF, PTCRB, FCC, CE, ISED, ACMA RCM, NCC, IMDA, MIC, MSIP, IFT, ICASA, NBTC
- Overview of all certifications: *nordicsemi.com/9160cert*
- 10x16x1,04 mm LGA package

**Microcontroller:**

- ARM® Cortex® -M33
    - 243 EEMBC CoreMark score running from flash memory
    - Data watchpoint and trace (DWT), embedded trace macrocell (ETM), and instrumentation trace macrocell (ITM)
    - Serial wire debug (SWD)
    - Trace port
- 1 MB flash
- 256 kB low leakage RAM
- ARM® Trustzone®
- ARM® Cryptocell 310
- Up to 4x SPI master/slave with EasyDMA
- Up to 4x I2C compatible two-wire master/slave with EasyDMA
- Up to 4x UART (CTS/RTS) with EasyDMA
- I2S with EasyDMA
- Digital microphone interface (PDM) with EasyDMA
- 4x pulse width modulator (PWM) unit with EasyDMA
- 12-bit, 200 ksps ADC with EasyDMA - eigth configurable channels with programmable gain
- 3x 32-bit timer with counter mode
- 2x real-time counter (RTC)
- Programmable peripheral interconnect (PPI)
- 32 general purpose I/O pins
- Single supply voltage: 3.0 – 5.5 V
- All necessary clock sources integrated
- Package: 10 × 16 x 1.04 mm LGA

**LTE modem:**

- Transceiver and baseband
- 3GPP LTE release 13 Cat-M1 and Cat-NB1 compliant
    - 3GPP release 13 coverage enhancement
- 3GPP LTE release 14 Cat-NB2 compliant
- GPS receiver
    - GPS L1 C/A supported
- RF transceiver for global coverage
    - Up to 23 dBm output power

- -108 dBm sensitivity (LTE-M) for low band, -107 dBm for mid band
- Single 50 Ω antenna interface
- LTE band support in hardware:
  - Cat-M1: B1, B2, B3, B4, B5, B8, B12, B13, B14, B17, B18, B19, B20, B25, B26, B28, B66
  - Cat-NB1/NB2: B1, B2, B3, B4, B5, B8, B12, B13, B17, B19, B20, B25, B26, B28, B66
- Supports SIM and eSIM with an ETSI TS 102 221 compatible UICC interface
- Power saving features: DRX, eDRX, PSM
- IP v4/v6 stack
- Secure socket (TLS/DTLS) API

**Current consumption @ 3.7 V:**

- Power saving mode (PSM) floor current: 2.7 µA
- eDRX @ 82.91s: 18 µA in Cat-M1, 37 µA in Cat-NB1 (UICC included)

## 1.1.2 Application

**Gateway**

**Geolocation:** A GPS receiver is integrated into the radio offering various modes of operation to suit a wide selection of applications that employ location-tracking functionality

**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

## 2.1 nRF9160 Specification

| LTE-M/NB-IoT modem | |
|---|---|
| Frequency range | 700-2200 MHz |
| Throughput (UL/DL) | LTE-M:   300/375 kbps<br>NB-IoT:   30/60 kbps |
| Output power | Up to 23 dBm |
| RX sensitivity | LTE-M:    -108 dBm<br>NB-IoT:  -114 dBm<br>GPS:       -155 dBm |

| Mode | HD-FDD |
|---|---|
| **Application processor** | |
| CPU | 64 MHz Arm Cortex-M33<br>Arm TrustZone |
| Flash | 1 MB |
| RAM | 256 KB |
| Peripherals | Arm Cryptocell 310<br>3 x TIMER, 2 x RTC WDT |
| Interfaces | 4 x SPI (M/S) / UARTE / TWI (M/S)<br>4 x PWM, PDM, I2S<br>12 bit/200 ksps ADC |
| **Current consumption (23 dBm TX power, 3.7 V supply)** | |
| PSM floor current | LTE-M:   2.7 uA<br>NB-IoT:  2.7 uA |
| eDRX, 655 seconds | LTE-M:   6 uA<br>NB-IoT:  9 uA |
| **Operating conditions and package** | |
| Supply voltage | 3.3-5.5 V |
| Temperature | -40-85 °C |

# 3. Hardware Specification
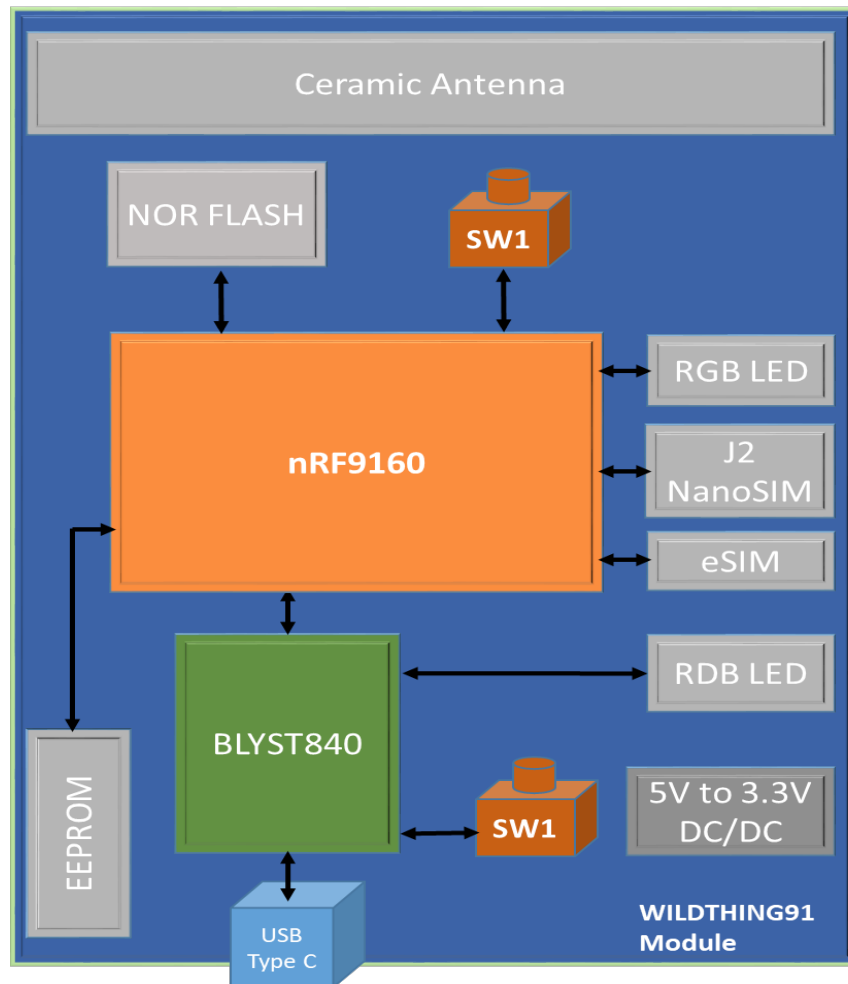
## 3.1 Module Diagram

*Figure 1: Module internal diagram*

*Figure 2: 3D Module design*

*Figure 3: 3D Module design*

## 3.2 Dimensions and I/O pins layout

### 3.2.1 IMM-NRF52840 I/O pins layout

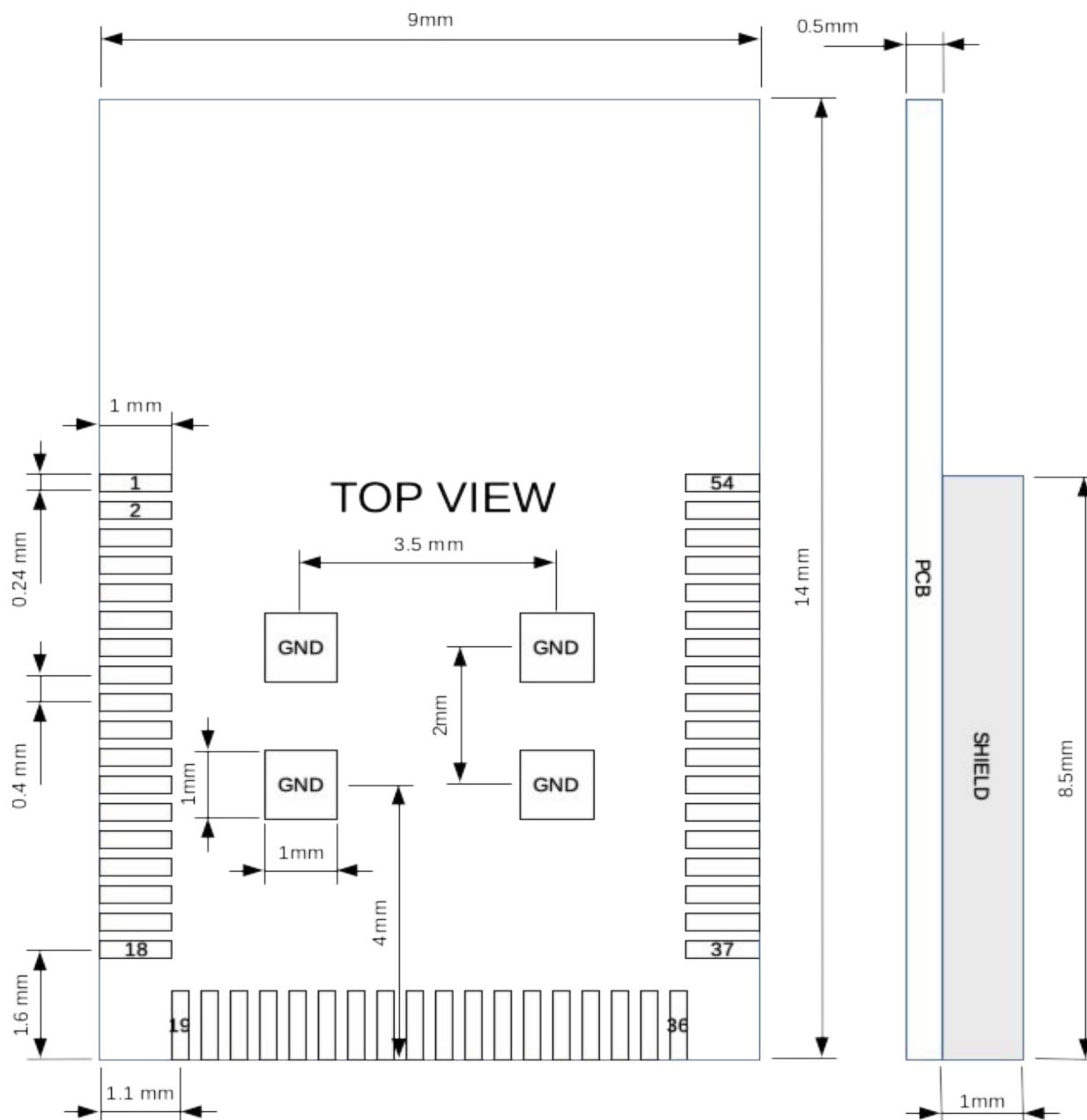Bellow is the direct relationship of the module pads and the nRF52840 I/O pins.



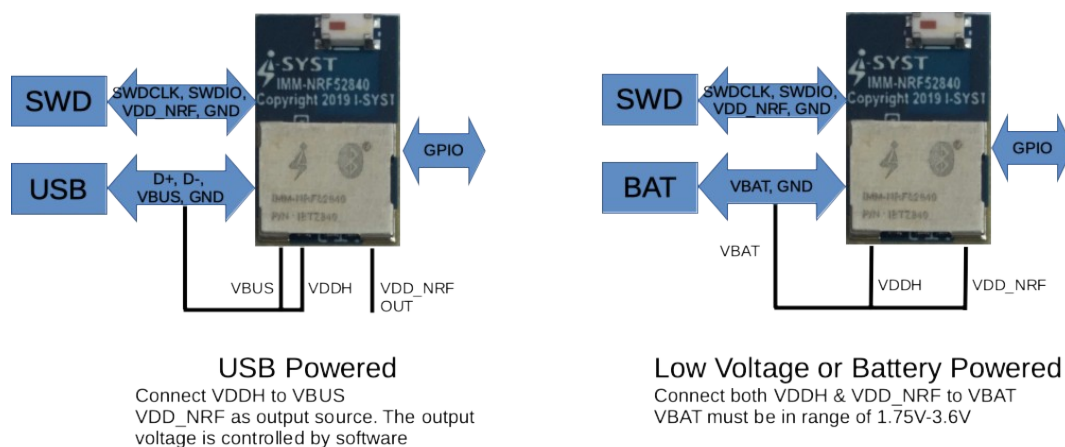*Figure 4: nRF52840 Dimensions top view*

### 3.2.2 NRF52840 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 |

## 3.2.3 BLYST840 Power configuration

The modules supports 2 power modes as shown bellow.



**USB Powered**
Connect VDDH to VBUS
VDD_NRF as output source. The output
voltage is controlled by software

**Low Voltage or Battery Powered**
Connect both VDDH & VDD_NRF to VBAT
VBAT must be in range of 1.75V-3.6V

32.768KHz and all DC coils are builtin, no extra components require to work.
Just wire the power configuration of 3 power pins VUSB, VDDH and VDD_NRF
and the SWD debug Jtag.

*Figure 3: Power Configuration*

## 3.2.4 BLYST840 SMD Footprint

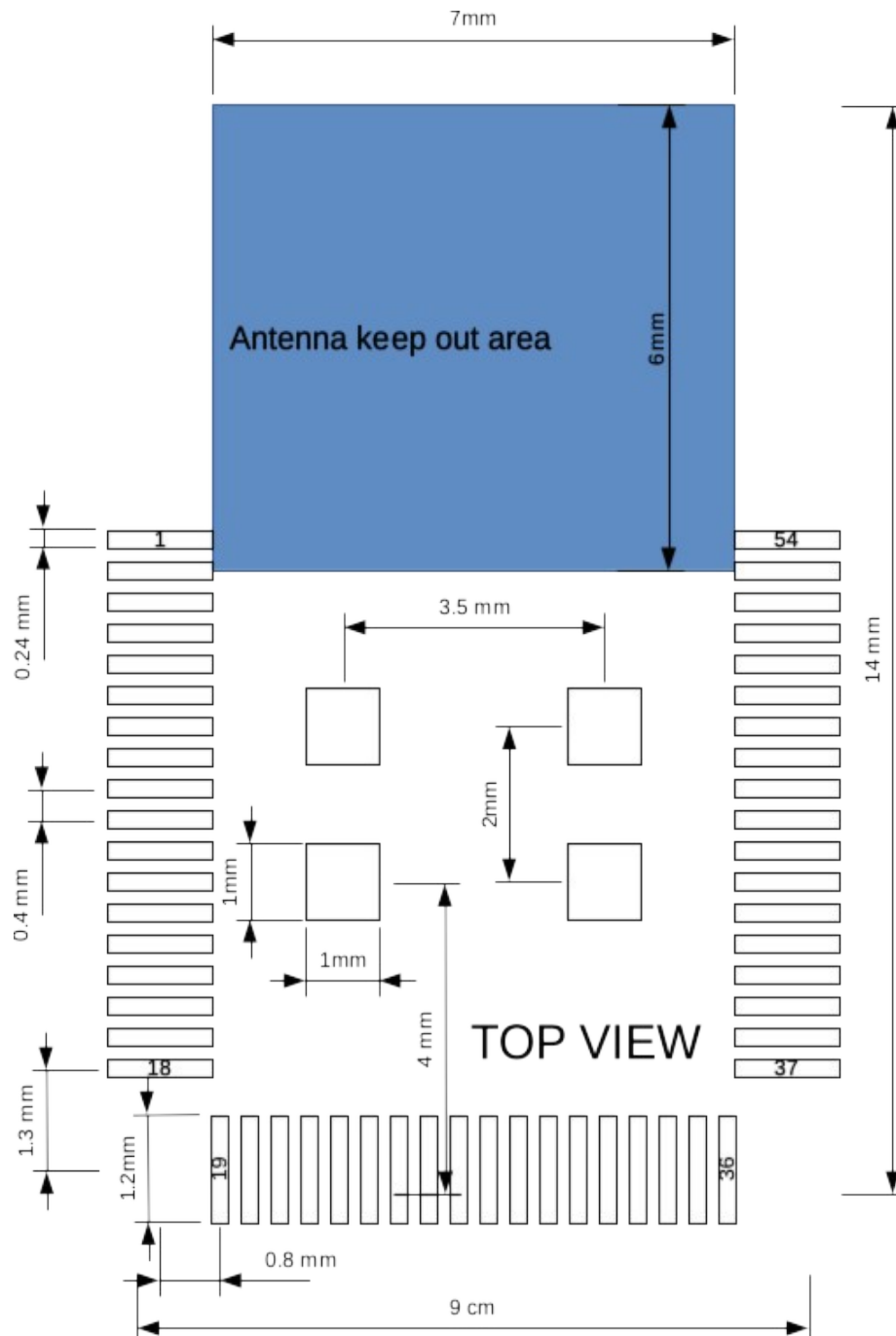**Note**: Do not route any traces or planes under the indicated antenna area.



*Figure 4: BLYST840 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 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:

Eclipse IDE in firmware development with IOsonata | I-SYST's Site (i-syst.com)

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

# 5. CE conformity

SHENZHEN HUATONGWEI INTERNATIONAL INSPECTION Co., Ltd.

## Test Verification of Conformity

**Issued date: Dec.09, 2019**    **Certificate verification:**

In accordance with the following applicable Directives:

**Radio Equipment Directive (RED) 2014/53/EU**

**Certificate number:**    SHT1907094305EW

**Certificate Holder:**    I-SYST Inc.

**Address:**    6245 rue Berthier, Brossard, QC., Canada J4Z 2K4

**EUT Name:**    Bluetooth Module

**Trade Mark:**    -

**Model number:**    IMM-NRF52840

**Listed Model(s):**    -

**Test Laboratory:**    Shenzhen Huatongwei International Inspection Co., Ltd.

Hongfa Hi-tech Industrial Park, Genyu Road, Tianliao, Gongming, Shenzhen, China

Tel: 86-755-26748078   Fax: 86-755-26748089

Http: //www.szhtw.com.cn   E-mail: cs@szhtw.com.cn

The radio equipment meets the following essential requirements

| Essential Requirement | | Applied Standards | Test Report No. | Result |
|---|---|---|---|---|
| Art. 3.1a | Health | EN 62311:2008 | CHTEW19120011 | Conform |
| | Safety | EN 62368-1:2014+A11:2017 | CHTSE19110119 | Conform |
| Art. 3.1b | EMC | ETSI EN 301 489-1 V2.2.3 (2019-11) <br> Draft ETSI EN 301 489-17 V3.2.0 (2017-03) | CHTEW19120010 | Conform |
| Art. 3.2 | Radio | ETSI EN 300 328 V2.1.1: 2016-11 | CHTEW19120009 | Conform |

The verification is only valid for the equipment and configuration described ,in conjunction with the test data detailed above

The CE mark as shown beside can be used ,under the responsibility of the manufacturer, after completion of an EU

Directive of Conformity and compliance with all relevant EU Directive.

Authorized by:    **Jeffrey Lu**

Position:    General Manager

## CCIC (SHENZHEN) ENVIRONMENTAL SERVICE CO.,LTD.

# Test Verification of Conformity

**Certificate No.:**CTC19110210

**Issued Date:** Nov 29, 2019

The sample, as described herewith, was tested pursuant to the testing standard :

**IEC 62321-3-1-2013, IEC 62321-6-2015, IEC 62321-8-2017**

and all the test results comply with the requirements of :

**RoHS Directive 2011/65/EU, (EU) 2015/863**

**Restriction of the use of certain Hazardous Substance
in electrical and electronic equipment**

**Applicant:**     I-SYST Inc.

6245 rue Berthier, Brossard, QC., Canada J4Z 2K4

**Manufacturer:**   I-SYST Inc.

6245 rue Berthier, Brossard, QC., Canada J4Z 2K4

**Sample Name:**   **Bluetooth Module**

**Sample Model(s):IMM-NRF52840**

**Laboratory:**    **CCIC (Shenzhen) Environmental Service Co., Ltd.**
Floor 2, Minlida Industrial Park, Honghualing Industrial Zone, Nanshan District, Shenzhen, Guangdong, China
Tel: 86-755-86632632     Fax: 86-755-86632632
Http: // www.ccicshenzhen.com.cn     E-mail: zjjc@sz.ccic.com

**RoHS**

**Note:**
The certification is only valid for the submitted sample(s), in conjunction with the test data detailed in our test report

No. :   QHJ19110210/EN

**For and on behalf of
CCIC (Shenzhen) Environmental Service Co., Ltd.**

**Authorized by:**   *Renjou. Yang*