

WILDTHING91 Module

Bluetooth[®] 5 / Bluetooth[®] Mesh Thread / Zigbee







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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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-xxxxxx" 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



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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 cloT 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

ΙοΤ

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



Mode	HD-FDD	
Application processor		
CPU	64 MHz Arm Cortex-M33 Arm TrustZone	
Flash	1 MB	
RAM	256 КВ	
Peripherals	Arm Cryptocell 310 3 x TIMER, 2 x RTC WDT	
Interfaces	4 x SPI (M/S) / UARTE / TWI (M/S) 4 x PWM, PDM, I2S 12 bit/200 ksps ADC	
Current consumption (23 dBm TX power, 3.7 V supply)		
PSM floor current	LTE-M: 2.7 uA NB-IoT: 2.7 uA	
eDRX, 655 seconds	LTE-M: 6 uA 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 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



Pin Number	Pin Name	Description
1		GPIO port 1 pip 7
	P1 03	GPIO port 1, pin 3
	P1 02	GPIO port 1, pin 2
	P1.02	GPIO port 1, pin 5
	SWDCLV	ITAC Clock
<u>5</u>	DI 04	CDIO mort 1 min 4
	P1.04	CPIO port 1, pin 4
/ 	P1.01	
8	SWDIO	JIAG Data
<u> </u>	P0.25	GPIO port 0, pin 25
10	P0.22	GPIO port 0, pin 22
	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

3.2.2 NRF52840 Pin Description



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.



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



3.3 WildThing91 Schematic



Figure 5: WildThing91 schematic





Figure 6: WildThing91 schematic



Figure 7: WildThing91 dimention

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 (<u>https://developer.nordicsemi.com/</u>)
- 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 <u>http://embeddedsoftdev.blogspot.ca/p/ehal-nrf51.html</u>.

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:

<u>Eclipse IDE in firmware development with IOsonata | I-SYST's Site (i-syst.com)</u> There are samples code in the Nordic SDK itself. Other Eclipse based example code are available from this Blog page <u>http://embeddedsoftdev.blogspot.ca/p/ehal-nrf51.html</u>



5. CE conformity

Certificate Certificate	ice with the	Padia Equipment Directives:	136459.56	
Certificate Certificate		Radio Equipment Directive (RED) 201	4/53/EU	
Certificate	number:	SHT1907094305EW	Reportivo: CHTCW131	0003
Certificate Holder:		I-SYST Inc.		
Address:		6245 rue Berthier, Brossard, QC., Canada J4Z 2K4		
EUT Name:		Bluetooth Module		
Trade Mark				
Model num	ber:	IMM-NRF52840		
Listed Mod	lel(s):			
Test Labor	atory:	Shenzhen Huatongwei International Inspection	Co., Ltd.	
The redie e				
Esse	quipment r ntial	neets the following essential requirements Applied Standards	Test Report No.	Result
Esser Require	quipment r ntial ement	Applied Standards	Test Report No.	Result
Require Art. 3.1a	quipment r ntial ement Health	Applied Standards	Test Report No.	Result Conform
Require Art. 3.1a	quipment r ntial ement Health Safety	Applied Standards EN 62311:2008 EN 62368-1:2014+A11:2017	Test Report No. CHTEW19120011 CHTSE19110119	Result Conform Conform
Art. 3.1a	quipment r ntial ement Health Safety EMC	Applied Standards EN 62311:2008 EN 62368-1:2014+A11:2017 ETSI EN 301 489-1 V2.2.3 (2019-11) Draft ETSI EN 301 489-17 V3.2.0 (2017-03)	Test Report No. CHTEW19120011 CHTSE19110119 CHTEW19120010	Result Conform Conform Conform
Art. 3.1a Art. 3.1b Art. 3.2	quipment r ntial ement Health Safety EMC Radio	Applied Standards EN 62311:2008 EN 62368-1:2014+A11:2017 ETSI EN 301 489-1 V2.2.3 (2019-11) Draft ETSI EN 301 489-17 V3.2.0 (2017-03) ETSI EN 300 328 V2.1.1: 2016-11	Test Report No. CHTEW19120011 CHTSE19110119 CHTEW19120010 CHTEW19120009	Result Conform Conform Conform Conform



CCIC	(SHENZHEN) ENVIRONMENTAL SERVICE CO., LTD.			
	Test Verification of Conformity Certificate No.:CTC19110210 Issued Date: Nov 29, 2019			
The sample, as o	lescribed 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 re	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.			
Manufacturer:	6245 rue Berthier, Brossard, QC., Canada J4Z 2K4 6245 rue Berthier, Brossard, QC., Canada J4Z 2K4			
Sample Name:	Bluetooth Module			
Sample Model(s	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			
CE	No. : QHJ19110210/EN			
Authorized by:	For and on behalf of CCIC (Shenzhen) Environmental Service Co., Ltd. Renford. Yang			