iotTech

ITM-8420 User Manual

Bluetooth® LE 5.0 Wireless Module

Version 0.2

Revision History

Date	Revision Content	Revised By	Version
2024/07/29	- Initial released (Preliminary)	Issac Chen	0.1
2024/08/09	- Update measured data	Issac Chen	0.2
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	-		
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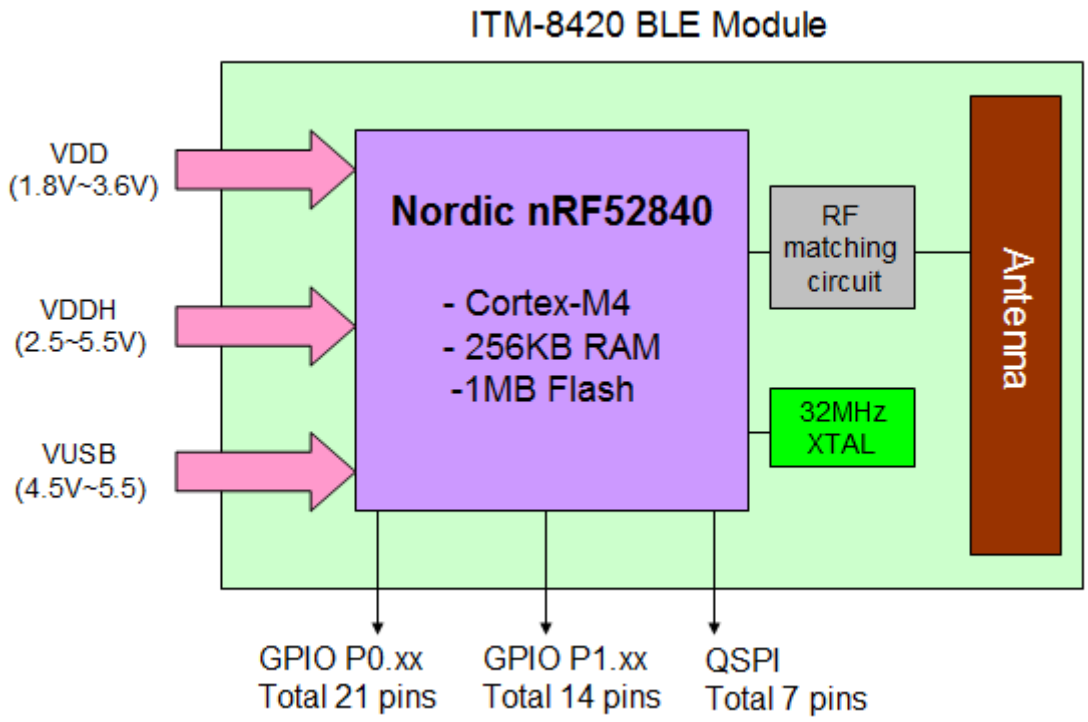
Contents

1. General Description

iTM-8420 module features a fully integrated 2.4GHz radio transceiver and baseband processor for Bluetooth 5.0 applications. It can be used as a standalone application-specific communication processor or as a wireless data link in hosted MCU systems where ultra-low power is critical. It supports flexible memory architecture for storing profiles, stacks and custom application codes, and can be updated using Over-The-Air (OTA) technology.

iTM-8420 module uses Nordic nRF52840 BLE chipset. It combines the excellent performance of a leading RF transceiver with a low-power ARM Cortex-M4 and rich powerful supporting features and peripherals. It also contains 256KB RAM, and 1MB flash memory.

1-1 Block Diagram



2. Features

- Bluetooth® 5, 2.4 GHz transceiver
  - -95 dBm sensitivity in 1 Mbps Bluetooth® low energy mode
  - -103 dBm sensitivity in 125 kbps Bluetooth® low energy mode (long range)
  - Max. 13.9 dBm TX power (peak)
  - On-air compatible with nRF52, nRF51, nRF24L, and nRF24AP Series
  - Supported data rates:
    - Bluetooth® 5 – 2 Mbps, 1 Mbps, 500 kbps, and 125 kbps
  - Single-ended antenna output (on-chip balun)
  - 128-bit AES/ECB/CCM/AAR co-processor (on-the-fly packet encryption)
  - 4.8 mA peak current in TX (0 dBm)
  - 4.6 mA peak current in RX
  - RSSI (1 dB resolution)
- ARM® Cortex®-M4 32-bit processor with FPU, 64 MHz
  - 212 EEMBC CoreMark® score running from flash memory
  - 52 µA/MHz running CoreMark from flash memory
  - Watchpoint and trace debug modules (DWT, ETM, and ITM)
  - Serial wire debug (SWD)
- Rich set of security features
  - ARM® TrustZone® Cryptocell 310 security subsystem
    - NIST SP800-90A and SP800-90B compliant random number generator
    - AES-128 – ECB, CBC, CMAC/CBC-MAC, CTR, CCM/CCM*
    - Chacha20/Poly1305 AEAD supporting 128- and 256-bit key size
    - SHA-1, SHA-2 up to 256 bits
    - Keyed-hash message authentication code (HMAC)
    - RSA up to 2048-bit key size
    - SRP up to 3072-bit key size
    - ECC support for most used curves, including P-256 (secp256r1) and Ed25519/Curve25519
    - Application key management using derived key model
- Secure boot ready

  - Flash access control list (ACL)
  - Root-of-trust (RoT)
  - Debug control and configuration
  - Access port protection (CTRL-AP)
- Secure erase
- Flexible power management
  - 1.7 V to 5.5 V supply voltage range
  - Automated peripheral power management
  - Fast wake-up using 64 MHz internal oscillator
  - 0.4 µA at 3 V in System OFF mode, no RAM retention
  - 1.5 µA at 3 V in System ON mode, no RAM retention, wake on RTC
- 1 MB flash and 256 KB RAM
- Advanced on-chip interfaces
  - USB 2.0 full speed (12 Mbps) controller
  - QSPI 32 MHz interface
  - High-speed 32 MHz SPI
  - Programmable peripheral interconnect (PPI)
  - 48 general purpose I/O pins
  - EasyDMA automated data transfer between memory and peripherals
- Nordic SoftDevice ready with support for concurrent multiprotocol
- 12-bit, 200 ksps ADC – 8 configurable channels with programmable gain
- 64 level comparator
- 15 level low-power comparator with wake-up from System OFF mode
- Temperature sensor
- 4x four channel pulse width modulator (PWM) unit with EasyDMA
- Audio peripherals – I2S, digital microphone interface (PDM)
- 5x 32-bit timer with counter mode
- Up to 4x SPI master/3x SPI slave with EasyDMA
- Up to 2x I2C compatible two-wire master/slave
- 2x UART (CTS/RTS) with EasyDMA

- Quadrature decoder (QDEC)
- 3x real-time counter (RTC)
- Single crystal operation

3. General Specification

Operating	Temperature: -30°C to 85°C Relative Humidity : ≤ 80%
Storage	Temperature: -40°C to 85°C Relative Humidity : ≤ 60%

3.1 Voltages

3.1.1 Absolute Maximum Ratings

Symbol	Description	Min.	Max.	Unit
VDD	VDD Supply Voltage	-0.3	3.9	V
VDDH	VDDH Supply Voltage	-0.3	5.8	V
VUSB	VUSB USB Supply Voltage	-0.3	5.8	V
VIO	I/O Pin Voltage (VDD ≤ 3.6V)	-0.3	VDD+0.3	V
	I/O Pin Voltage (VDD > 3.6V)	-0.3	3.9	V

3.1.2 Recommended Operating Ratings

Symbol	Min.	Typ.	Max.	Unit
VDD	1.75	3.0	3.6	V
VDDH	2.5	3.7	5.5	V
VUSB	4.45	5.0	5.5	V

3.2 RF Specification (RX)

Parameters	Conditions	Min.	Typ.	Max.	Unit
Frequency Range		2402		2480	MHz
RX Sensitivity < 30.8% PER	LE 1Mbps		-95		dBm
	LE 2Mbps		-92		dBm
	LE 125Kbps		-103		dBm
	LE 500Kbps		-99		dBm
Maximum Input Level			0		dBm

3.3 RF Specification (TX)

Parameters	Conditions	Min.	Typ.	Max.	Unit
Frequency Range		2402		2480	MHz
Maximum Output Power	Peak power	--	--	13.83	dBm

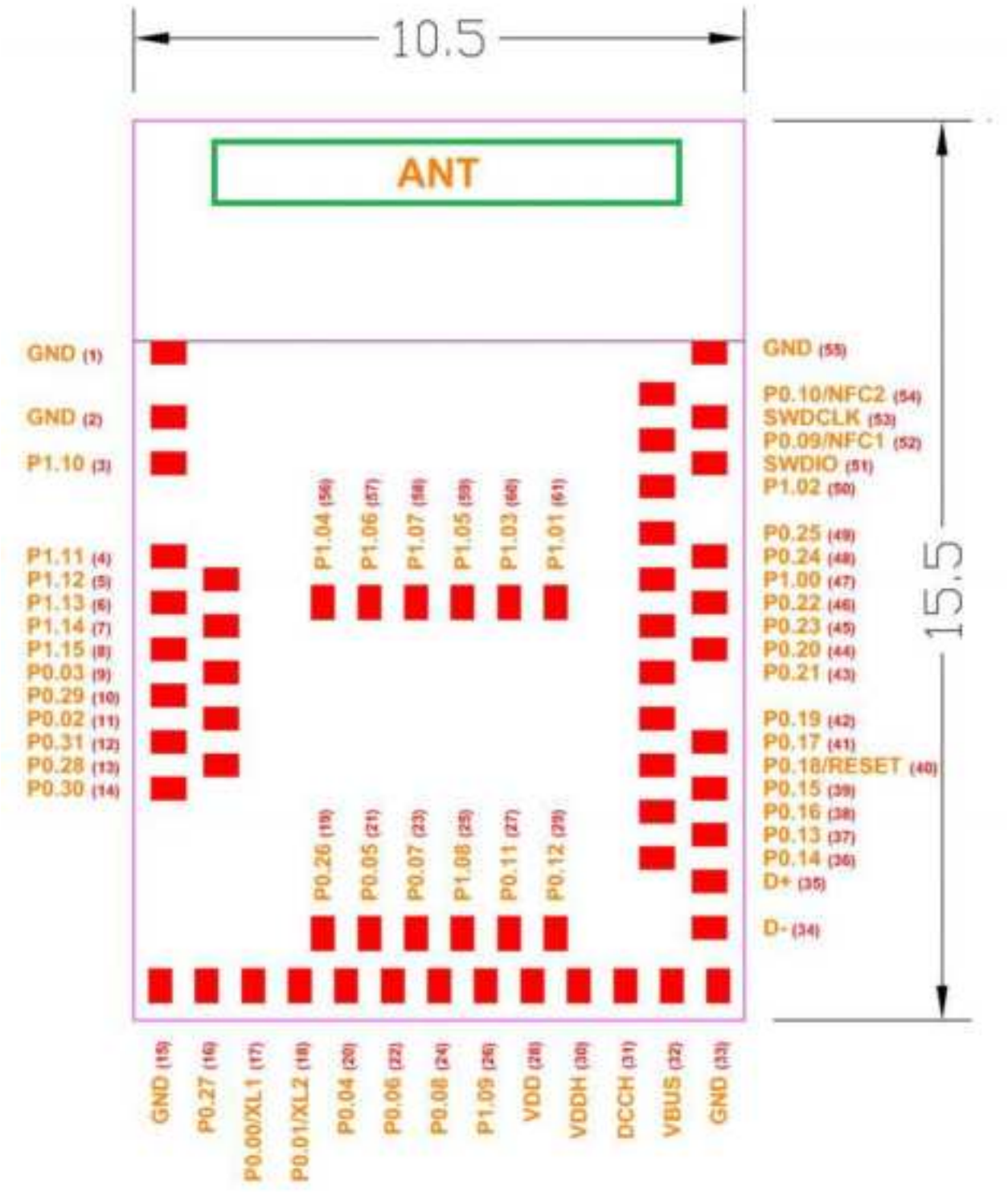
3.4 Power Consumption

Main Chip	
VDD=VDDH=3.0V; Regulator = DC-DC; Temperature=25°C	
Radio Power Consumption	
RX Mode (1Mbps)	6.3 mA (Typical)
TX Mode (0.0 dBm / 1Mbps)	6.4 mA (Typical)
TX Mode (8.0 dBm / 1Mbps)	16.4 mA (Typical)
Low Power Mode:	
Sleep (Full 256KB RAM retention; wakeup by any event)	2.35 uA (Typical)
Power Down (Wakeup by RESET)	0.40 uA (Typical)

4. Pin Assignments

4.1 PCB Pin Outline (10.5mm x 15.5mm x 2.0mm)

< TOP VIEW >



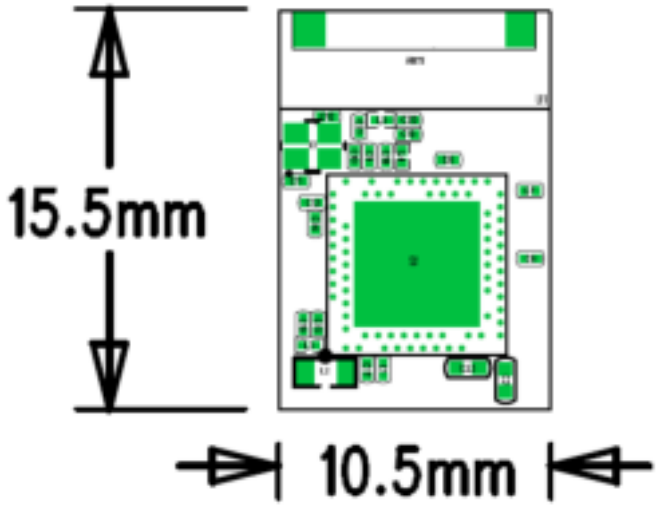
4.2 Pin Definition

Pin No.	Pin-Define	Type	Description
1	GND	G	Ground
2	GND	G	Ground
3	P1.10	DIO	GPIO P1.10 (Std. Drive/Low Freq. IO only).
4	P1.11	DIO	GPIO P1.11 (Std. Drive/Low Freq. IO only)
5	P1.12	DIO	GPIO P1.12 (Std. Drive/Low Freq. IO only)
6	P1.13	DIO	GPIO P1.13 (Std. Drive/Low Freq. IO only)
7	P1.14	DIO	GPIO P1.14 (Std. Drive/Low Freq. IO only)
8	P1.15	DIO	GPIO P1.15 (Std. Drive/Low Freq. IO only)
9	P0.03/AIN1	DIO/AI	GPIO P0.03 (Std. Drive/Low Freq. IO only) / Analog Input 1
10	P0.29/AIN5	DIO/AI	GPIO P0.29 (Std. Drive/Low Freq. IO only) / Analog Input 5
11	P0.02/AIN0	DIO/AI	GPIO P0.02 (Std. Drive/Low Freq. IO only) / Analog Input 0
12	P0.31/AIN7	DIO/AI	GPIO P0.31 (Std. Drive/Low Freq. IO only) / Analog Input 7
13	P0.28/AIN4	DIO/AI	GPIO P0.28 (Std. Drive/Low Freq. IO only) / Analog Input 4
14	P0.30/AIN6	DIO/AI	GPIO P0.30 (Std. Drive/Low Freq. IO only) / Analog Input 6
15	GND	G	Ground
16	P0.27	DIO	GPIO P0.27
17	P0.00/XL1	DIO/AI	GPIO P0.00 / 32.768kHz Crystal Input
18	P0.01/XL2	DIO/AI	GPIO P0.01 / 32.768kHz Crystal Input
19	P0.26	DIO	GPIO P0.26
20	P0.04/AIN2	DIO/AI	GPIO P0.04 / Analog Input 2
21	P0.05/AIN3	DIO/AI	GPIO P0.05 / Analog Input 3
22	P0.06	DIO	GPIO P0.06
23	P0.07/TRACECLK	DIO	GPIO P0.07 / Trace Buffer Clock
24	P0.08	DIO	GPIO P0.08
25	P1.08	DIO	GPIO P1.08
26	P1.09/TRACEDATA3	DIO	GPIO P1.09 / Trace Buffer Data[3]
27	P0.11/TRACEDATA2	DIO	GPIO P0.11 / Trace Buffer Data[2]
28	VDD	P	Power Supply

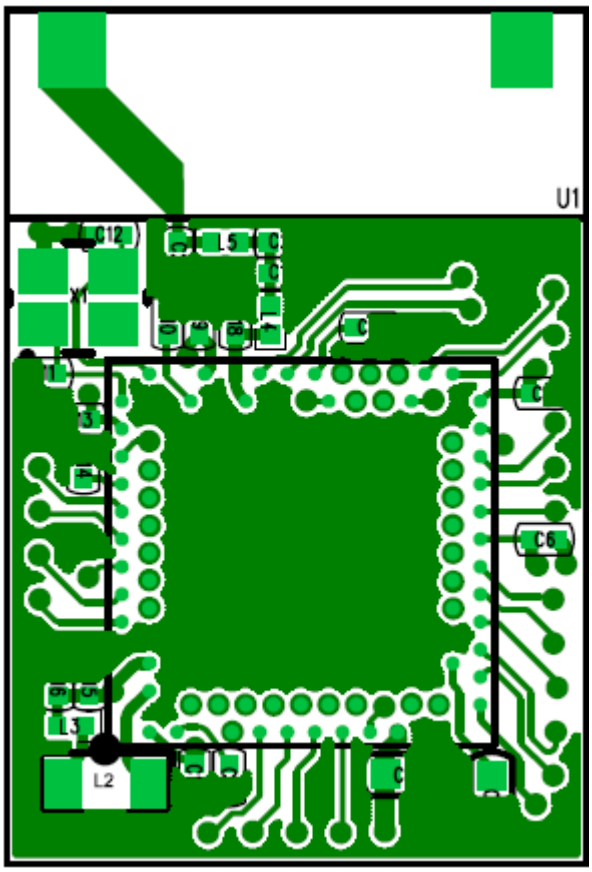
29	P0.12/TRACEDATA1	DIO	GPIO P0.12 / Trace Buffer Data[1]
30	VDDH	P	High Voltage Power Supply
31	DCCH	P	DC/DC Converter Output
32	VBUS	P	5V Input for USB 3.3V Regulator
33	GND	G	Ground
34	USB_DM	AIO	USB DM Signal
35	USB_DP	AIO	USB DP Signal
36	P0.14	DIO	GPIO P0.14
37	P0.13	DIO	GPIO P0.13
38	P0.16	DIO	GPIO P0.16
39	P0.15	DIO	GPIO P0.15
40	P0.18 / nRESET	DIO	GPIO P0.18 / Configurable as System Reset
41	P0.17	DIO	GPIO P0.17
42	P0.19	DIO	GPIO P0.19
43	P0.21	DIO	GPIO P0.21
44	P0.20	DIO	GPIO P0.20
45	P0.23	DIO	GPIO P0.23
46	P0.22	DIO	GPIO P0.22
47	P1.00/TRACEDATA0	DIO	GPIO P1.00 / Trace Buffer Data[0]
48	P0.24	DIO	GPIO P0.24
49	P0.25	DIO	GPIO P0.25
50	P1.02	DIO	GPIO P1.02 (Std. Drive/Low Freq. IO only)
51	SWDIO	DIO	Serial Wire Debug I/O
52	P0.09	DIO / AI	GPIO P0.09 (Std. Drive/Low Freq. IO only)
53	SWDCLK	DIO	Serial Wire Debug Clock
54	P0.10	DIO / AI	GPIO P0.10 (Std. Drive/Low Freq. IO only)
55	GND	G	Ground
56	P1.04	DIO	GPIO P1.04 (Std. Drive/Low Freq. IO only)
57	P1.06	DIO	GPIO P1.06 (Std. Drive/Low Freq. IO only)
58	P1.07	DIO	GPIO P1.07 (Std. Drive/Low Freq. IO only)
59	P1.05	DIO	GPIO P1.05 (Std. Drive/Low Freq. IO only)
60	P1.03	DIO	GPIO P1.03 (Std. Drive/Low Freq. IO only)
61	P1.01	DIO	GPIO P1.01 (Std. Drive/Low Freq. IO only)

5. Dimensions and Layout

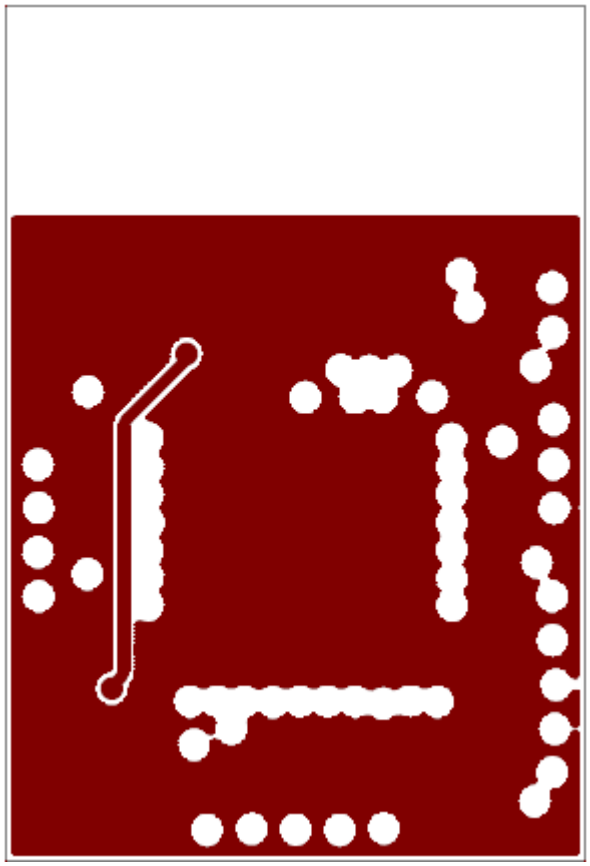
5.1 Module Dimension



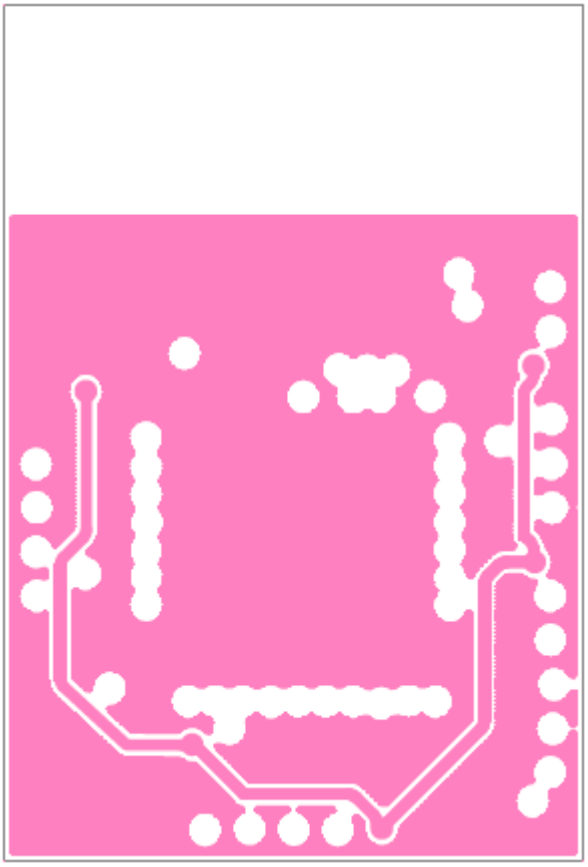
5.2 Module Layout



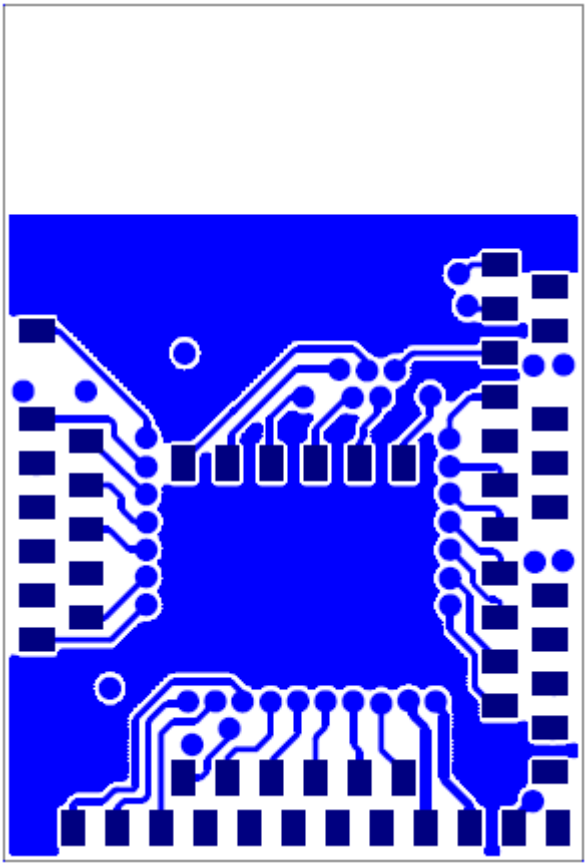
TOP Layer



Inner Layer 2



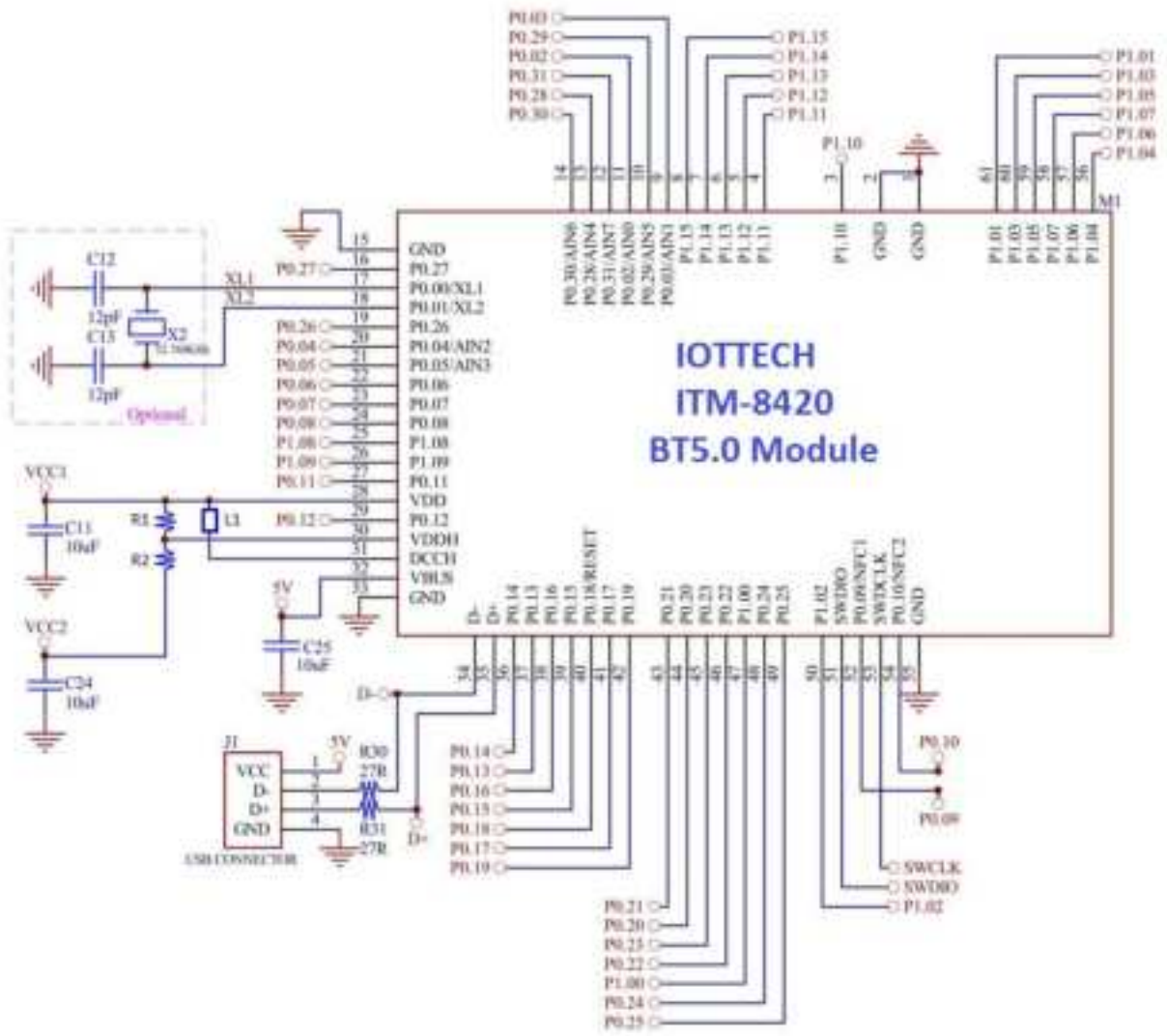
Inner Layer 3



Bottom Layer

6. Hardware Design Guidelines

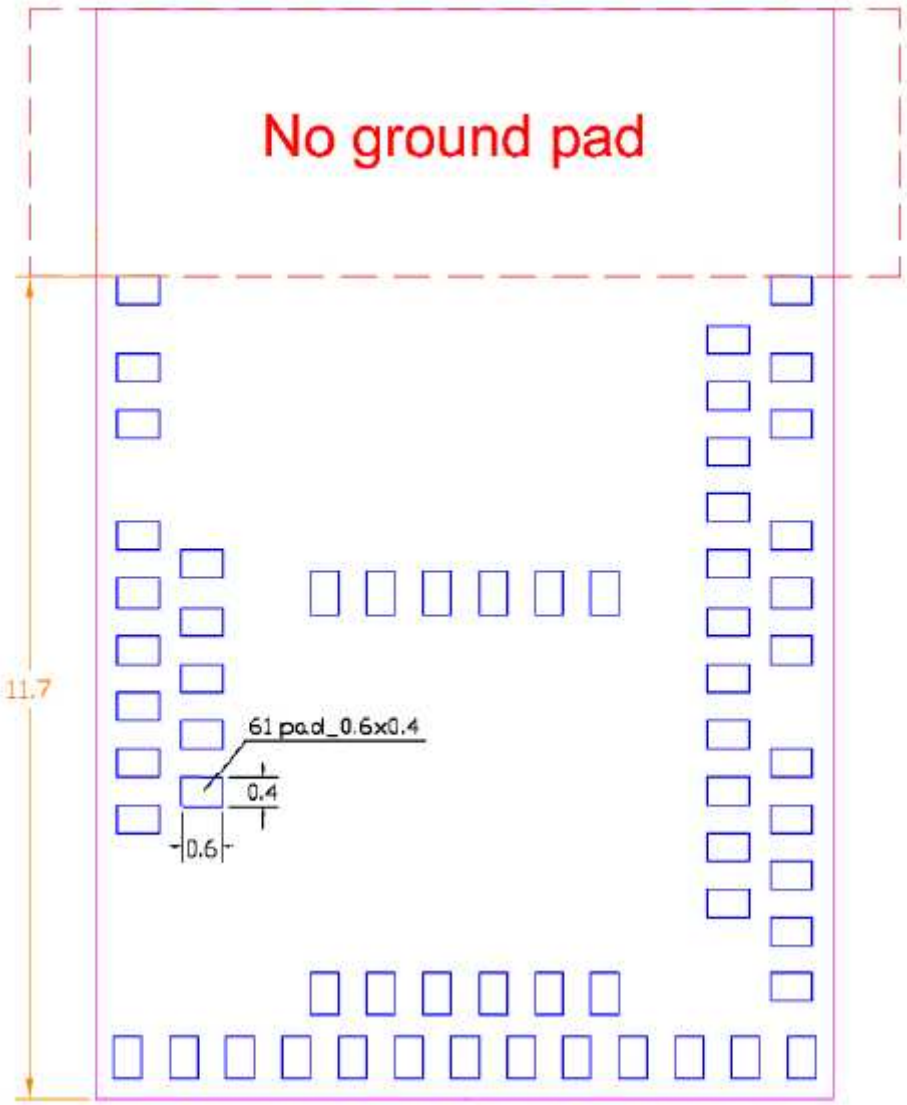
6-1 Reference Design

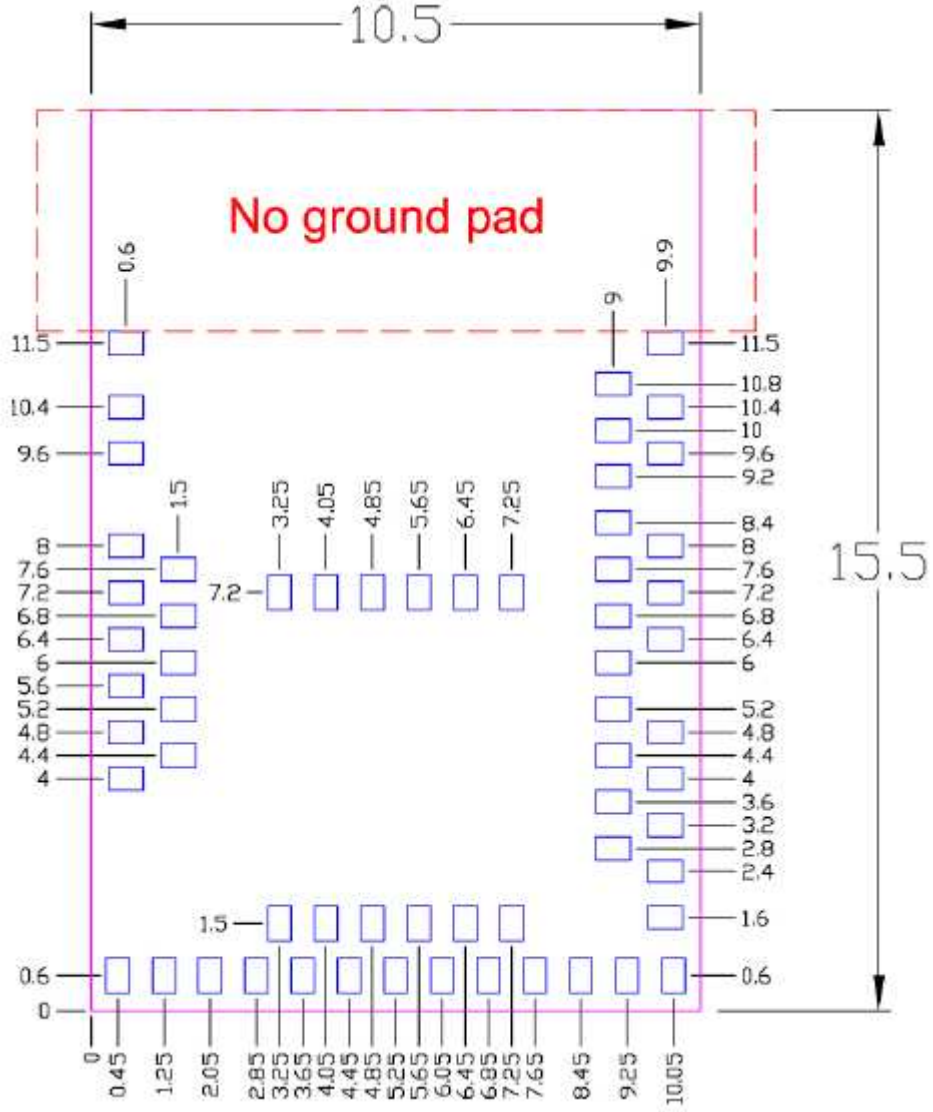


6.2 Layout Recommendation

(Unit: mm)

< TOP VIEW >



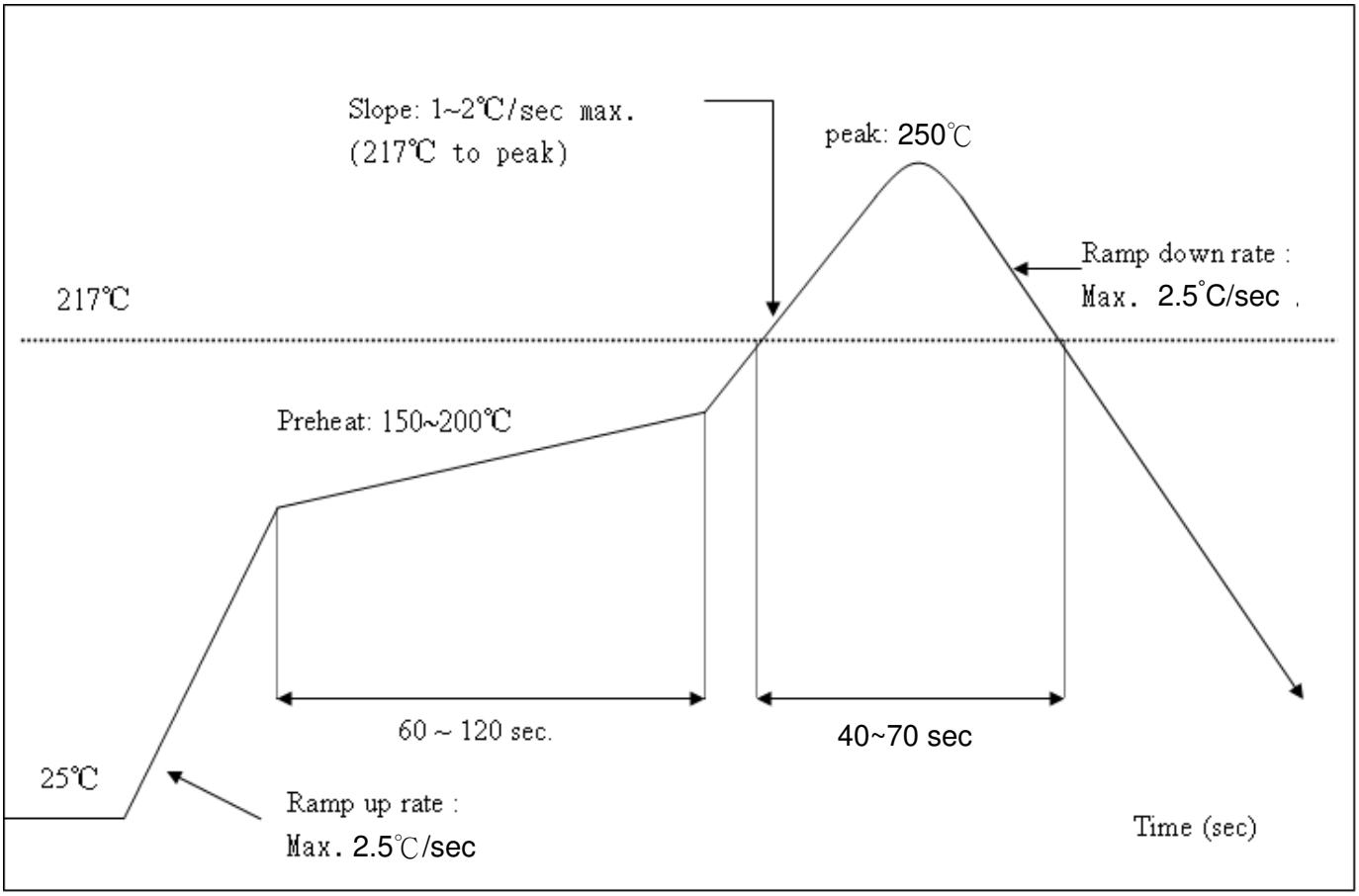

10.5
No ground pad
15.5
0.6
9
9.9
11.5
10.4
9.6
1.5
3.25
4.05
4.85
5.65
6.45
7.25
8
7.6
7.2
6.8
6.4
6
5.6
5.2
4.8
4.4
4
10.8
10
9.2
8.4
3.6
3.2
2.8
2.4
1.6
0.6
0
0.45
1.25
2.05
2.85
3.65
4.45
5.25
6.05
6.85
7.65
8.45
9.25
10.05

6-3 Recommended Reflow Profile

Referred to IPC/JEDEC standard.

Peak Temperature : <250°C

Number of Times : ≤2 times



7. Software Introduction

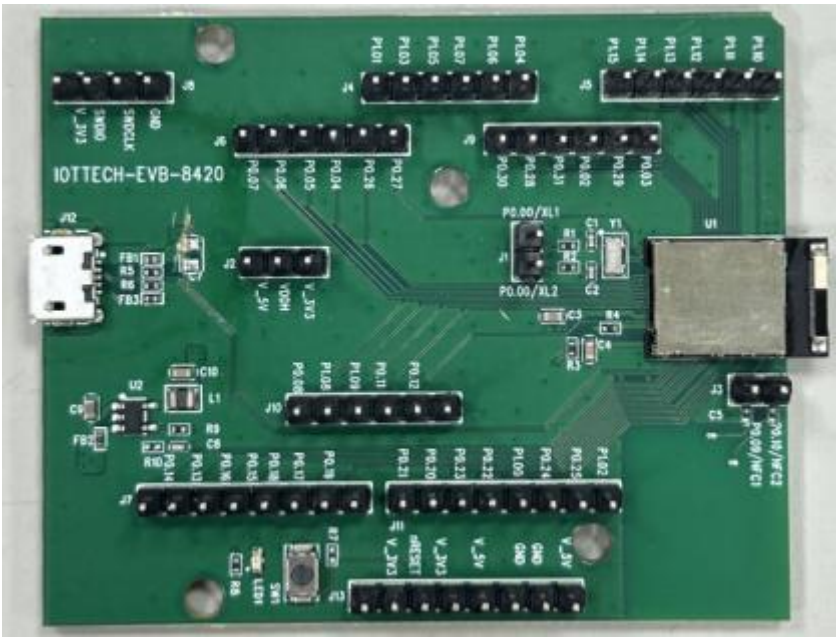
7-1 Getting Started

Hardware Requirements

- ITM-8420 Development Kit
- Micro-USB 2.0 cable
- Personal computer (PC)
- External debugger (J-link)
- External *UART* to *Universal Serial Bus (USB)* bridge

Software Requirements

- Windows 8 or Windows 10
- Linux
- MacOS



ITM-8420 Development Kit

Runing a First Test

Before you start developing, program and run a precompiled application on your development kit to ensure that the kit functions as expected and the communication between your computer and development kit works.

- Power up the development kit
  - Connect one end of a micro-USB 2.0 cable to the Universal Serial Bus (USB) connector on the kit and the other end to a USB power adapter.
- Download your application from PC via external debugger (J-link)
  - Connect external debugger (J-link) to your development kit for download

7-2 Setting Up Tool Chain

Before you can start developing, you must install the required software. This software includes tools to connect to your development kit, an Integrated Development Environment (IDE) for developing your application, and the nRF Connect SDK that provides libraries and example applications.

Installing the nRF Connect SDK

The nRF Connect SDK includes the libraries and samples that you need to build an application. It also contains the required development tools, including nRF Connect for Visual Studio Code.

The recommended way to install the nRF Connect SDK is through an app in nRF Connect for Desktop.

nRF Connect for Desktop provides different apps to simplify installing the nRF Connect SDK, depending on the operating system that you are using.

Complete the following steps to install the nRF Connect SDK using an nRF Connect for Desktop app:

- Download and install nRF Connect for Desktop.
- Install and run one of the following apps:
  - On Windows or macOS, use the Toolchain manager. This app installs the full sandboxed toolchain that you need, including nRF Connect for Visual Studio Code and the nRF Connect SDK source code.
  - On Linux, use nRF Connect for Visual Studio Code. This app assists you in setting up the toolchain and the nRF Connect SDK source code.

  See nRF Connect for Desktop for information about how to install and open apps.
- Follow the instructions in the app to install the nRF Connect SDK.
- Make sure that you have the correct version of the nRF Connect SDK source code. Unless instructed otherwise, you should work with the last tagged release of the nRF Connect SDK.
  - If you used the Toolchain manager app, you installed a specific version and no further action is required.
  - If you used nRF Connect for Visual Studio Code, make sure that you checked out the correct version and ran west update.

  If you want to switch to a different tagged release or to the latest version on the main branch, see Updating the repositories for instructions.

7-3 Communicating with the Kit

If your application outputs logging information or needs console input, you should connect the kit to your computer to interact with a console. You can use *Universal Asynchronous Receiver/Transmitter (UART)* for communicating with the kit.
Connecting via *UART* is quick and power-efficient, but it requires dedicated use of the *UART* peripheral for logging. Alternatively, you can use an external *UART* to *Universal Serial Bus (USB)* bridge.

- P0.06: ITM8420 UART TXD
- P0.08. ITM8420 UART RXD
- P0.07: ITM8420 UART CTS
- P0.05 ITM8420 UART RTS

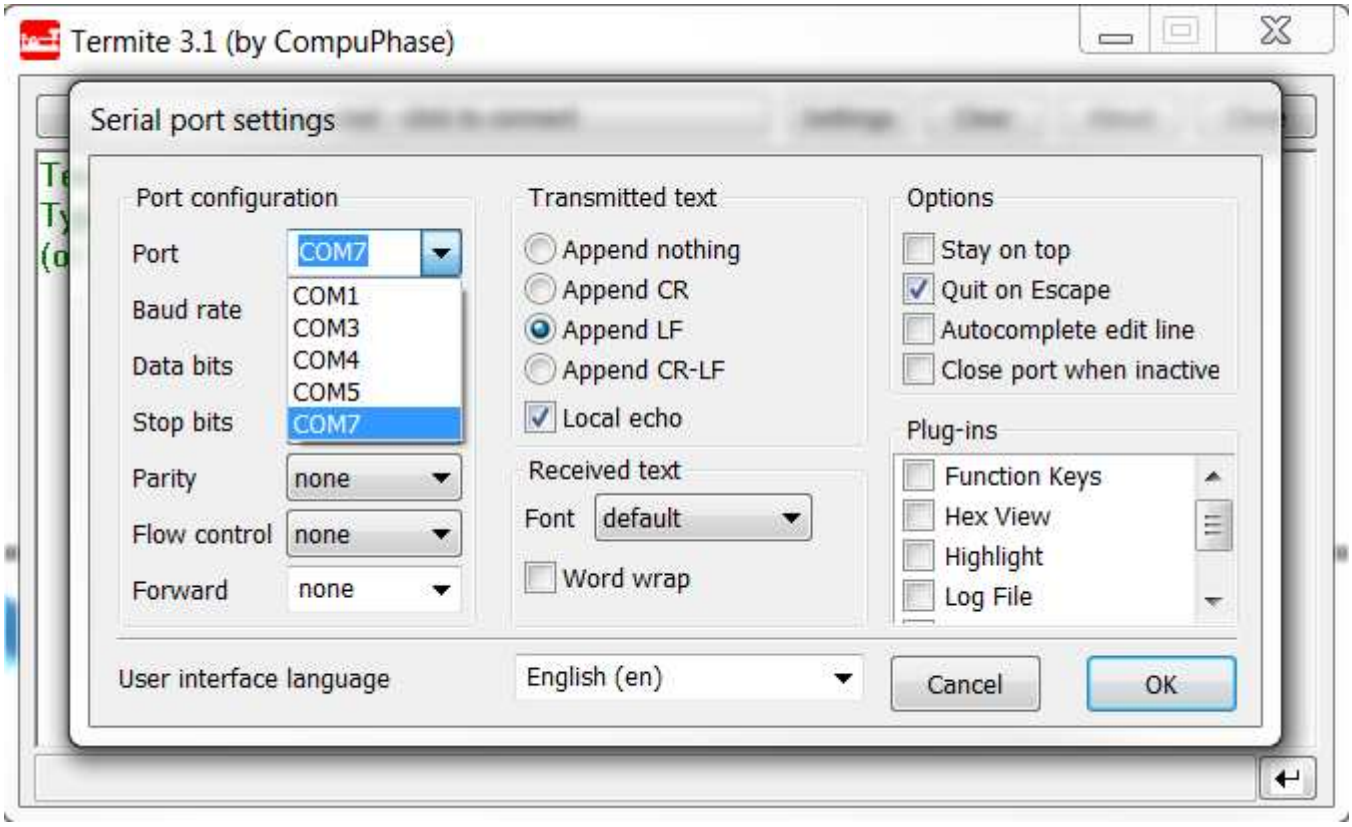
Connecting via USB-UART

To connect via USB-UART, start a terminal emulator and connect to the used COM port.
There is a wide variety of terminal emulators that you can use, for example, Termite (GUI-based, Windows only) or PuTTY (GUI-based, available for multiple operating systems).
When configuring the connection, use the following *Universal Asynchronous Receiver/Transmitter (UART)* settings:

- Baud rate: 115200 (default baud rate for most samples in the nRF Connect SDK)
- 8 data bits
- 1 stop bit
- No parity
- HW flow control: RTS/CTS

The following instructions show how to configure Termite on Windows. Other GUI-based terminal emulators can be set up in a similar way.

- Download and install the latest version of Termite.
- Connect the development kit to your computer.
- Open Termite and click Settings.
  Depending on what devices you have connected to your computer, you might have several choices, as shown in the following figure:



- Select the correct COM port to connect to the kit.
  To find the correct port, follow these steps:
  - Go to the start menu in Windows and type devmgmt.msc to open the Device Manager.
  - Scroll down and expand Ports (COM & LPT).
  - Find the port of your external *UART* to *Universal Serial Bus (USB)* bridge and note down the number in parentheses.
  - If you have more than one UART to USB bridge port, unplug the one that you want to use, plug it back in, and observe which one appeared last.
- Configure the baud rate and the flow control. Use the default values for the rest of the settings (8 data bits, 1 stop bit, no parity).
- By default, the SDK uses a baud rate of 115200 and RTS/CTS flow control.
- Make sure that Append LF is selected.
  This option appends a newline character to any text that is sent.
- Configure the terminal to send an RTS (Ready To Send) signal to the development kit:
  - Go to Settings > Plug Ins.
  - Enable Status LEDs and click OK.
  - Click on the dark green rectangle above RTS to set this signal high.
    The text Start... is displayed in Termite.

8. FCC Statement

Compliance with

2.2 List of applicable FCC rules

CFR 47 FCC PART 15 SUBPART C has been investigated. It is applicable to the modular transmitter

2.3 Specific operational use conditions

This module is stand-alone modular. If the end product will involve the Multiple simultaneously transmitting condition or different operational conditions (example, uses another antenna) for a stand-alone modular transmitter in a host, host manufacturer have to consult with module manufacturer for the installation method in end system.

2.4 Limited module procedures

This module is single modular.

Not applicable.

2.5 Trace antenna designs

Not applicable.

2.6 RF exposure considerations

This modular transmitter should be used in the mobile conditions and 20cm from a person's body, the host product manufacture should be put those information in the end-product manual to the end users. If RF exposure statement and use conditions are not provided, then the host product manufacture is required to take responsibility of the module through a change in FCC ID(new application)

2.7 Antennas

This radio transmitter FCC ID : 2AWP5WM8420 and has been approved by Federal Communications Commission to operate with the antenna types listed below, with the maximum permissible gain indicated. Antenna types not included in this list that have a gain greater than the maximum gain indicated for any type listed are strictly prohibited for use with this device.

Manufacturer	Part No.	Antenna Type	Maximum antenna gain
USD Corp.	WCA1-ZZ-0601	Chip Antenna	3.53 dBi for 2.4GHz

2.8 Label and compliance information

The final end product must be labeled in a visible area with the following" Contains FCC ID: 2AWP5WM8420.

2.9 Information on test modes and additional testing requirements

Host manufacturer which install this modular with limit modular approval should perform the test of radiated emission and spurious emission according to FCC part 15 :15.212 requirement, only if the test result comply with FCC part 15.212 requirement, then the host can be sold legally.When testing host product, the host manufacture should follow FCC KDB Publication 996369 D01 Module Integration Guide for testing the host products. The host manufacturer may operate their product during the measurements.

2.10 Additional testing, Part 15 Subpart B disclaimer

Host manufacturer is responsible for compliance of the host system with module installed with all other applicable requirements for the system such as Part 15 B.

Federal Communication Commission Interference Statement

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

FCC Caution:

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

IMPORTANT NOTE:

In the event that these conditions can not be met (for example certain laptop configurations or co-location with another transmitter), then the FCC authorization is no longer considered valid and the FCC ID can not 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.

End Product Labeling:

The final end product must be labelled in a visible area with the following:

【Contains FCC ID: 2AWP5WM8420】

Manual Information to the End User

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.